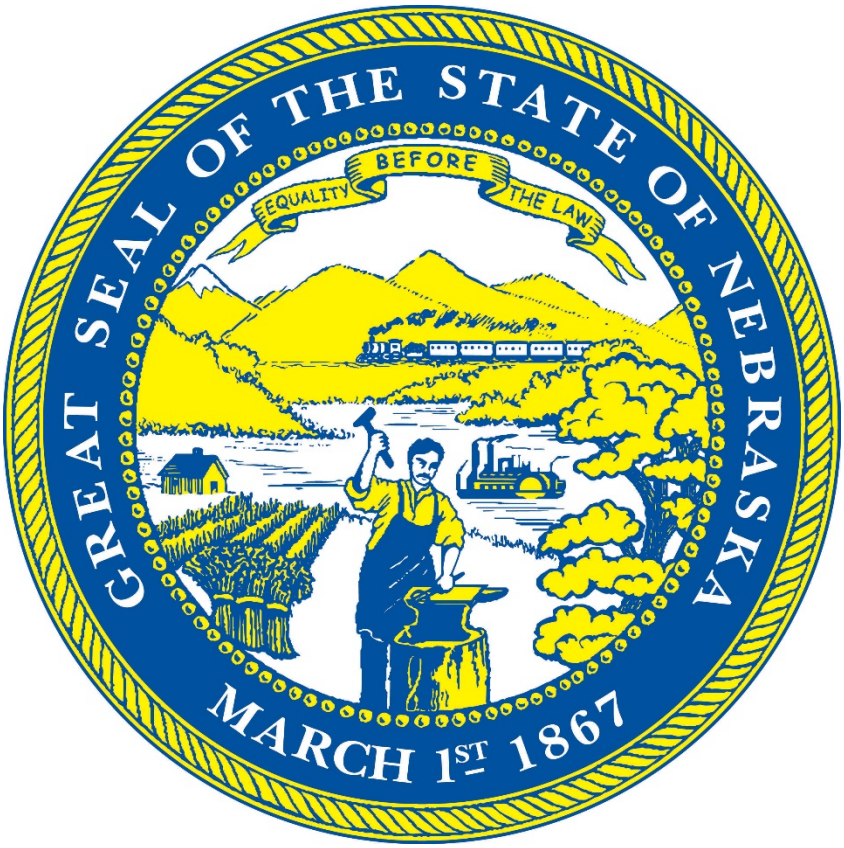
Roadway Design Manual



Nebraska Department of Transportation

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The information contained in the Introduction, dated July 2006, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this chapter.

Introduction

1. PURPOSE OF MANUAL

This manual has been developed to provide guidance and assistance to the roadway designer and other **Nebraska Department of Transportation (NDOT)** personnel in the practices and procedures for the detailed design of roadways and the preparation of contract plans. The manual has been developed to meet the following principal objectives:

- Document **NDOT** guidelines with regard to design criteria and practices for the development of plans
- Define design criteria to guide judgments and decisions made by **Roadway Design Division** personnel
- Describe the coordination necessary to develop plans in a timely and cost effective manner
- Describe the most current and effective design techniques and practices and to present charts, tables and other information useful to designers.

2. HOW TO USE THE MANUAL

This manual has been written to provide information for both the new designer and for the more experienced designer. General guidelines and design practices are described. For more detailed explanation of the topics, references are provided for the reader.

It should be noted that the **NDOT** design criteria presented in this book generally conforms to the guidelines of the **American Association of State Highway and Transportation Officials (AASHTO)** in publications such as **AASHTO's** A Policy on Geometric Design of Highways and Streets. In some instances, where nationwide guidelines do not fit Nebraska conditions, **NDOT** design practice differs from **AASHTO** guidelines. For those situations **NDOT** guidelines take precedence over **AASHTO's** guidelines. However, if the **NDOT** design criteria cannot be attained the designer should follow **AASHTO's** guidelines.

NDOT and the **Board of Public Roads Classifications and Standards** have developed the Nebraska Minimum Design Standards. These standards represent minimum design values. Higher values may be used if it is environmentally friendly and economically feasible. The designer should contact his/her supervisor if **NDOT** standards cannot be met because a design exception approval may be required (See Chapter One: Design Standards, Section 6).

Throughout the manual, the words "shall", "should", and "may" are used to describe the appropriate application of various design techniques. The following definitions describe the proper application of these terms:

- "Shall" is a mandatory condition; the designer will make every practical effort to follow the criteria. If it is impractical to follow the "shall" criteria, the designer needs to obtain **Assistant Design Engineer** approval and document the decision made, or obtain authorization for a design exception (See Chapter One: Design Standards, Section 6).
- "Should" is an advisory condition; the designer is recommended, not mandated, to follow the criteria. For situations where it is impractical to follow the "should" criteria, the designer needs to obtain **Assistant Design Engineer** approval and document the decision made (See Chapter One: Design Standards, Section 6.D).
- "May" is a permissive condition; it is recommended that the designer make reasonable efforts to follow the design criteria. For situations where it is impractical to follow the "may" criteria, the designer does not need authorization for design variances.

Several formatting conventions have been used in the manual to aid the designer in locating information. When Exhibits are discussed in the text, the titles are highlighted, e.g., EXHIBIT 2.1. Individuals, sections, divisions, and other organizations with which interaction may be required appear in bold lettering, e.g., **Roadway Design Division Engineer.** References to material in other chapters of this manual are shown as: Chapter Two: Roadway Design Process, for example, with pertinent sections noted as appropriate.

3. MANUAL UPDATES

This manual may be found on the internet at:
http://www.roads.nebraska.gov/business-center/design-consultant/rd-manuals/

This site should be accessed periodically for changes in design guidance and for errata.

4. SOURCES OF INFORMATION

This manual is a principal source of information providing general guidance on design guidelines and practices. Other sources of information are listed in the REFERENCES section found at the back of each Chapter. Suppliers of construction materials also may be used as sources of information for special design problems such as special culverts, retaining walls, impact attenuators, etc.

Where possible, Internet connections have been given for reference materials cited in this manual. This connection will follow the first citation of a document in a chapter and will also appear in the REFERENCES section found at the back of the Chapter.

The information contained in Chapter One: Design Standards, dated July 2006, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this chapter.

Chapter One
Design Standards

1. DESIGN STANDARDS

Design standards have been developed to provide a systematic means of achieving quality roadway design in a uniform manner. They incorporate basic design considerations and design controls, described in later sections, for the various functional classes of roadway and types of improvements to be made.

This manual and the Nebraska Minimum Design Standards, (Reference 1.1), are the primary sources of roadway design standards for **NDOT.** These state standards are based on guidelines from **AASHTO,** the **Federal Highway Administration (FHWA)**, the **Occupational Safety and Health Administration (OSHA)**, the **Access Board**, and others. On projects in municipal areas, designers may also need to comply with local codes and street standards. For additional information, the following sources may be consulted:

NDOT Publications

The following is a partial listing of pertinent **NDOT** publications:

- Nebraska Department of Transportation Bridge Office Policies and Procedures, (BOPP Manual) (http://www.roads.nebraska.gov/media/2912/bopp-manual.pdf)
- Access Control Policy to the State Highway System (http://www.roads.nebraska.gov/media/3460/access-control-policy.pdf)
- Standard/Special Plans Book (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/)
- State of Nebraska Department of Transportation Standard Specifications for Highway Construction (http://roads.nebraska.gov/media/6897/specbook-2007.pdf)
- Nebraska Deparment of Roads Standard Item List (http://www.roads.nebraska.gov/business-center/business-opp/hwy-bridge-lp/item-history/)
- Nebraska Department of Transportation Construction Manual (http://roads.nebraska.gov/business-center/contractor/contruction-manual/)

AASHTO Publications

The following is a partial listing of applicable **AASHTO** publications:

- A Policy on Geometric Design of Highways and Streets (latest edition)
- Roadside Design Guide
- A Policy on the Accommodation of Utilities Within Highway Right-of-Way
- A Policy on the Accommodation of Utilities Within Freeway Right-of-Way
- Guide for the Development of Bicycle Facilities
- Guide for Erecting Mailboxes on Highway

Federal Highway Administration (FHWA) Publications

(http://www.fhwa.dot.gov/index.html)

The **Federal Highway Administration (FHWA)** sets forth specific policies and procedures for projects on the National Highway System (NHS), (See Section 5.A). **FHWA** manuals, bulletins, notices and technical advisories are available for guidance. Examples of some of their publications are:

- A User's Guide to Positive Guidance, FHWA-TO-81-1
- Federal Aid Policy Guide (http://www.fhwa.dot.gov/legsregs/directives/fapg/cfr0470a.htm)
- New Methods for Determining Requirements for Truck Climbing Lanes, FHWA-IP-89-022
- Manual on Uniform Traffic Control Devices (http://mutcd.fhwa.dot.gov/kno_2009r1r2.htm)
- Traffic Control Devices Handbook

The Access Board

(http://www.access-board.gov)

The **Access Board** is an independent Federal agency devoted to accessibility for people with disabilities. Guidelines developed under the Americans with Disabilities Act (ADA), which covers access to a wide range of facilities in the public and private sectors and under the Architectural Barriers Act (ABA), which requires access to certain federally funded facilities may be found at: (http://www.access-board.gov/guidelines-and-standards)

2. NEBRASKA MINIMUM DESIGN STANDARDS

(http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/)

The Nebraska Minimum Design Standards, (Reference 1.1) are developed by the **Board of Public Roads Classifications and Standards**. Included are design standards for rural and municipal state highways, municipal streets and rural roads. These standards generally represent minimum values; higher values should be used within reasonable economic and environmental limits. To ensure uniform practice on a statewide basis, designs not meeting the minimum design standards may not be used without a design relaxation (See Appendix H, "Application of Standards"). Deviations from minimum design standards to save established slopes, trees, wetlands or right-of-way items (e.g., wells, windmills, towers, cemeteries, etc.) will require design relaxation approval.

The designer should follow these steps to use the Nebraska Minimum Design Standards (Reference 1.1):

1. Review the engineering review statement and recommendations from the **Project Development Division**.
2. Request projected traffic data from the **Traffic Analysis Section** in the **intermodal Planning Division**.
3. Determine the roadway segment's national functional classification, (See Section 5.B).
4. Determine if the project roadway is on the priority commercial system, (See Section 5.B).
5. Determine whether the terrain is level or rolling, (See Section 6.D).
6. Enter the Nebraska Minimum Design Standards (Reference 1.1) to determine the design number and other design information.
7. Compare the minimum design standards requirements with the recommendations from the engineering review statement. If there is a discrepancy, the designer should discuss it with his/her **Roadway Design Unit Head** to determine if changes can be made. If changes cannot be made, follow the design relaxation procedures (See Appendix H, "Application of Design Standards").

2.A New and Reconstructed Projects

New and reconstructed projects generally consist of: construction of a new road, relocating an existing route on new alignment, major widening (adding lanes) on an existing road, or reconstruction of an existing route on old alignment. New and reconstructed projects also include projects in which the principal activity is building a new bridge or rehabilitation consisting of bridge widening. New and reconstructed projects shall be considered when:

- Significant existing geometric deficiencies are to be corrected.
- Significant grading is to be done that requires major right-of-way to be acquired and/or major utility relocations.

3. MAINTENANCE PROJECTS

The **Board of Public Roads Classifications and Standards** has also established minimum maintenance standards for each functional classification roadway ("Procedures for Classifications and Standards", Reference 1.4). Maintenance projects are programmed for bringing the roadway surfacing back to its' original condition.

3.A Maintenance Project Policy Guidelines

Design guidelines for projects to be designed under "Maintenance Projects" are as follows:

1. "Maintenance Projects" shall consist of resurfacing work and shoulder work only. If there are deficiencies, other than surfacing, a future project should be programmed to correct them.
2. Maintenance projects are for 24 ft. (7.3 m) or less in width only, except:
    A. For roadways with existing surfaced shoulders, resurfacing of the existing surfaced shoulders will be allowed if the **Materials and Research Division** determines that a grade raise of more than ½ in. (13 mm) at the edge of the pavement is needed.
    B. 28 ft. (8.5 m) widths will be allowed on roadways with an existing 28 ft. (8.5 m) top.
3. No surface widening work will be allowed, except:

    When the **Materials and Research Division** has determined that the surfacing strategy will be an in-place recycle of the existing asphalt surface to a certain depth, then a lowering of the grade to a lesser depth will be accomplished by trench widening up to 2 ft. (0.6 m) in width on each side. A resurfacing of the entire surfaced roadway width will then be made with up to a 2 ½ in. (63 mm) overlay. The total existing roadway width, outside edge of shoulder to outside edge of shoulder, does not change. This surface widening is a direct result of this type of maintenance strategy rather than the result of a planned surface widening to meet 3R Minimum Design Standards, thus the **NDOT**, in its sole discretion, has determined that any maintenance project with this type of strategy may remain classified as a maintenance project.

4. A grade raise of up to 2 ½ in. (63 mm) is acceptable; a grade raise of more than 2 ½ in. (63 mm) at the edge of the pavement will be the exception and will require justification by the **Materials and Research Division** documented to the project file. Up to a ½ in. (13 mm) grade raise at the edge of the pavement will require NO shoulder or guardrail work. A grade raise of more than ½ in. (13 mm) at the edge of the pavement will require an investigation for the need of guardrail work.
5. Surfacing will be feathered out at intersections and driveways.
6. Surfacing will be milled out at bridge approaches so that there is no grade raise at bridges.
7. If more than a 2 in. (50 mm) depth is placed at the centerline a city agreement may be required.
8. If the grade is raised and the contractor does the shoulder work, the **District Engineer** will determine if suitable earthwork material is available within the right-of-way.
9. The "10 ft. straightedge, 1/8 in. variation limit, in the longitudinal direction, and at the discretion of the Engineer" version of a smoothness specification will be used on all maintenance projects.
10. No guardrail, new mailbox turnout, or superelevation correction work will be allowed.
    A. If guardrail work is required the project will be reclassified to a 3R project.
11. Curb ramps will be built where needed when surfacing overlays of 2 in. (50 mm) or more are placed (2 in. (50 mm) total lift even if the surface is milled first). A city agreement may be required.

4. OTHER TYPES OF PROJECTS

4.A Safety Improvement Projects

Safety improvement projects are projects that are usually located at specific high accident sites. The **Highway Safety Division** identifies the high accident locations and the **Safety Committee** then evaluates individual projects on a case-by-case basis. **District Engineers** may also request study of individual locations. Usually safety improvement projects are designed with 10-year traffic forecasts. These projects may include intersection projects, adding left turn lanes, minor radii improvements, sight distance improvements, etc.

4.B Enhancement Projects

The Federal-Aid Highway Program specifies that 10% of the STP funds will be available for transportation enhancement projects. The Nebraska Transportation Enhancement Program provides funding to local, regional and state governmental entities to construct and restore transportation infrastructure that is not eligible to be funded through other programs. Examples of transportation infrastructure projects that would be eligible under this program include trails, development of scenic byways, restoration of historic transportation facilities, and other projects directly related to the historic, current or future transportation infrastructure.

Interested governmental entities may submit proposals to **NDOT** for enhancement projects. Three categories have been established for project eligibility:

- Historic preservation: easement or property acquisition, historic highways, historic transportation facilities, archaeological planning.
- Trails: facilities for bicycles and pedestrians, easement or property acquisition, railway corridors.
- Scenic byways: easement acquisition, scenic highways, landscaping, runoff mitigation.

4.C Off-System Urban Projects

The federal STP provides funds on an annual basis for all cities of the first class in Nebraska. The funding split is 80% federal and 20% city. Eligible projects under this program include:

- Construction, reconstruction, resurfacing, restoration and rehabilitation and operational improvements for highways and bridges on any public road rated higher than a minor collector, including work to accommodate other transportation modes.
- Capital costs for transit projects and publicly owned bus terminals and facilities.
- Carpool projects, parking facilities and non-recreational bicycle and pedestrian facilities.
- Highway and transit safety improvement programs, rail-highway grade crossings and projects to mitigate hazards due to wildlife.
- Capital and operating costs for traffic monitoring, management and control facilities.
- Transportation control measures listed in Section 108 of the Clean Air Act, (Reference 1.5) (http://www.ehso.com/ehshome/caa2.php)
- Wetlands mitigation efforts.

4.D Secondary Roads - Off-System Rural Projects

The **Local Projects Section** of the **Materials & Research Division** deals with all off-system rural roads for which local road standards have been developed. For further information see Part Two of the Nebraska Minimum Design Standards, (Reference 1.1).

5. HIGHWAY SYSTEM CLASSIFICATION

The roadway system has been classified for identification, prioritization and funding purposes for planning, design, traffic operations, and administration of the highway program. Classification relates to network, function, roadway location, access, traffic volume, trip purposes and length. In turn, classification designation dictates the standards that should be used for roadway design.

5.A Federal Classification

The National Highway System (NHS) is an interconnected system of principal arterial routes that serves major population centers, international border crossings, ports, airports, public transportation facilities, other intermodal transportation facilities and other major travel destinations. NHS highways also meet national defense requirements and serve interstate and interregional travel (Reference 1.7).

The Surface Transportation Program (STP) is a funding program that includes public roads not functionally classified as minor rural collectors, local roads, or streets. It includes some collector routes that were not previously on the federal-aid system. In addition to being a funding source for these routes, the STP specifies some set aside funds for obstacle elimination projects and for transportation enhancement activities (See Section 4.C).

5.B Nebraska National Functional Classification
(http://www.roads.nebraska.gov/travel/map-library/func-by-county/)

Functional classification is the grouping of highways by the character of service they provide. It basically considers the level of access and mobility the roadway is to provide. The Nebraska National Highway Functional Classification (NNFC) Map identifies four roadway classes:

1. Interstates and freeways.
2. Principal arterials.
3. Minor arterials.
4. Major collectors.

These classes are based on **American Association of State Highway and Transportation Officials' (AASHTO)** functional classes found in A Policy on Geometric Design of Highways and Streets (Reference 1.9).

The intended purpose of a roadway determines its design. Functional classification is a means of identifying the travel purposes to be served. The Nebraska National Highway Functional Roadway Classes on the map are:

- Interstate: a national defense highway system established to connect most cities of 50,000 or more population in the U.S., with complete access control and a minimum of two 12 ft. (3.6 m) lanes in each direction, divided in most instances by wide medians.
- Principal Arterials: corridor movement with trip length and density compatible with significant statewide or interstate travel. There is usually a high operating speed and level of service with some degree of access control through limiting intersection spacing and direct property access.
- Minor Arterials: routes to provide linkage of cities, towns and other traffic generators, integrating interstate and intercounty service, usually at relatively high speed and minimum interference to through movement.
- Major Collectors: serve a dual function of property access and feeding arterials, generally for shorter trip lengths. They will have lower speeds and levels of service than arterials. In urban areas, collectors are usually designed to discourage through traffic in residential areas by following indirect and discontinuous alignment.

All other roadways are local roads and streets.

5.C Nebraska State Functional Classification
(http://www.roads.nebraska.gov/travel/map-library/func-by-county/)

By act of the **Nebraska Legislature,** the **Board of Public Roads Classifications and Standards** has established a state functional classification. The state functional classification is defined for rural and municipal areas. EXHIBITS 1.1 AND 1.2 identify characteristics of roadway types in rural and municipal settings, respectively. Rural highways consist of all public highways and roads outside the limits of any incorporated municipality. Municipal streets are all public streets within the limits of any incorporated municipality. Municipal areas are further subdivided by population size: over 50,000 (urban areas), 5,001-49,999 (small urban areas), and 1-5,000 (villages and cities of the second class) (See “Procedures for Classifications and Standards”, Reference 1.4). Municipalities of 5,001 and over population are cities of the first class.

Functional Classification	General Characteristics
Interstate	- The Federally designated National System of Interstate and Defense Highways.
Expressway	- A group of highways following major traffic desires in Nebraska which rank next in importance to the National System of Interstate and Defense Highways. The expressway system is one that ultimately should be developed to multilane divided highway standards.
Major Arterial	- The balance of routes that serve major statewide interests for highway transportation. This system is characterized by high-speed, relatively long-distance travel patterns.
Scenic-Recreation	- Highways or roads located within or which provide access to or through state parks, recreation or wilderness areas, other areas of geographical, historical, geological, recreational, biological, or archaeological significance, or areas of scenic beauty.
Other Arterial	- Highways of less importance as through-travel routes that serve places of smaller population and smaller recreation areas not served by higher systems.
Collector	- Highways that pick up traffic from many local or land-service roads and carry it to community centers or to the arterial systems. They are the main school bus routes, mail routes, and farm-to-market routes.
Local	- All remaining rural roads except minimum maintenance roads.
Minimum Maintenance	- (a) Roads used occasionally by a limited number of people as alternative access roads for areas served primarily by local, collector, or arterial roads, or (b) roads which are the principal access roads to agricultural lands for farm machinery and which are not primarily used by passenger or commercial vehicles.

Exhibit 1.1 Nebraska State Rural Highway Functional Classifications (Source: Reference 1.8)

Functional Classification	General Characteristics
Interstate	- The Federally designated National System of Interstate and Defense Highways.
Expressway	- (a) Extensions of rural expressways within some urban areas and (b) some additional routes serving very high volumes of local traffic within urban areas.
Major Arterial	- Extensions of rural major arterials that provide continuous service through municipalities for long-distance rural travel. They are the arterial streets used to transport products into and out of municipalities.
Other Arterial	- (a) Municipal extensions of rural other arterials and (b) arterial movements peculiar to a municipality's own complex, that is streets which interconnect major areas of activity within a municipality, such as shopping centers, the central business district, manufacturing centers, and industrial parks.
Collector	- A group of streets which collect traffic from residential streets and move it to smaller commercial centers or to higher arterial systems.
Local	- The balance of streets in each municipality, principally residential access service streets and local business streets. They are characterized by very short trip lengths, almost exclusively limited to vehicles desiring to go to or from adjacent property.

Exhibit 1.2 Nebraska State Municipal Streets Functional Classification (Source: Reference 1.8)

5.D Priority Commercial and Expressway Systems

5.D.1 Priority Commercial System

The Priority Commercial System, initiated in 1988, provides a continuous network of routes that are designed to carry higher traffic volumes, especially larger volumes of commercial vehicles.

This system, which includes the rural expressway system, was established at 3,303 miles. As with all state systems, there may be variances in exact mileage from year-to-year as highway alignments change and as municipal boundaries are altered. It directly serves all of the first class (5,001 – 100,000 population) and larger cities, directly serves 80 of the 115 second class cities (800 – 5,000 population), and comes within 10 miles of another 18 second class cities.

The non-expressway portion of this system is being constructed with two 12 ft. (3.6 m) driving lanes and 10 ft. (3 m) shoulders, 8 ft. (2.4 m) of which is to be paved. In addition to the system as established, any route which has a design year traffic volume (the volume at the initial year of construction plus 20 years) of 3,000 ADT or greater will be developed with 8 ft. (2.4 m) paved shoulders. Bridges are to be widened to shoulder width.

5.D.2 Expressway System

As part of the 1988 Needs Study, Department engineers reviewed Nebraska socioeconomic data. This data included population and demographic trends, general economic activity as reflected in sales tax revenue, agricultural production, employment data, and other information relative to economic trends. The initial review precipitated the development of an expanded Expressway System of approximately 600 miles.

Factors included in the development of the system were: 1) to connect urban centers of 15,000 population or greater to the Interstate System, 2) to add those routes which have an average daily traffic of 500 or more heavy commercial vehicles, and 3) to add additional segments for continuity.

The Expressway System is being constructed as multi-lane divided highways. Interchanges may be built where an Expressway intersects with high volume highways. Access other than at public roads will be limited. Whether the system will directly serve developed areas, or whether bypass routes will be constructed, will be decided on a case-by-case basis. The Expressway System currently consists of some two-lane highways that will ultimately be constructed to multilane divided highway standards.

6. DESIGN CONTROLS

Once the type of roadway improvement is determined and the functional classification of the roadway known, several basic factors serve as design controls. They are determinants for other geometric design standards. See the Nebraska Minimum Design Standards, (Reference 1.1) and A Policy on Geometric Design of Highways and Streets, (Reference 1.9).

6.A Design Year Forecast Traffic

The ADT for the design year, the year twenty years after the initial construction of the project, is used as a target in design for New and Reconstructed projects. See Chapter Seventeen for the design year for 3R projects. For additional information, see the Nebraska Minimum Design Standards, Reference 1.1.

Traffic projections on individual project segments must be compared to the priority commercial system map for design standard compliance.

6.B Design Speed

The desirable design speed for a roadway project is 5 mph greater than the anticipated posted speed limit for the roadway. The minimum design speed is the design speed from the Nebraska Minimum Design Standards, (Reference 1.1). An exception to the above would be in the instance where the design speed from the Nebraska Minimum Design Standards is greater than the anticipated posted speed; in this case the minimum design speed from the standards will be used. For example, if the design speed from the Nebraska Minimum Design Standards is 60 mph and the anticipated posted speed of the roadway is 50 mph, a design speed of 60 mph will be used.

Rural roadway projects should be designed to *one* design speed. If a rural project has a posted speed of 65 mph, the desirable design speed is 70 mph; but if one section of the roadway can only be designed to 65 mph, the *entire* project should be designed to 65 mph in order to meet driver expectations.

Deviation from the established design speed will require **Assistant Design Engineer** approval while **Board of Public Roads and Classifications** approval will be required to design to less than the statutory design speed from the Nebraska Minimum Design Standards, (Reference 1.1).

6.C Sight Distance

Sight distance is the length of roadway that is visible to the driver in various situations including stopping sight distance, passing sight distance, and intersection sight distance. For further discussion of sight distance see Chapter Three: Roadway Alignment, Section 1.

6.D Terrain

Terrain is a design control affecting alignment. Two basic types of terrain are found in Nebraska:

- Level: the condition where highway sight distances, as governed by both horizontal and vertical restrictions, are generally long or could be made to be so without construction difficulty or major expense.
- Rolling: the condition where the natural slopes rise above and fall below the road or street grade and where occasional steep slopes offer some restriction to normal horizontal and vertical roadway alignment.

6.E Access Control

Access control effectively increases roadway capacity by restricting the number and location of access points along the highway. This provides a safer environment for the roadway user, increases the efficient movement of through traffic, and reduces roadway accidents by minimizing the number of conflict points located along the highway (See Chapter Fifteen: Right-of-Way, Section 3).

6.F Lateral Obstacle Clearance

Lateral obstacle clearance is the roadside area starting at the edge of the travel lane available for the safe use of errant vehicles. It may consist of the shoulder, a recoverable slope, a non-recoverable slope and/or a clear runout area. The required lateral obstacle clearance will vary depending upon the design roadway standard (DR) (See Nebraska Minimum Design Standards, Reference 1.1). Chapter Six: The Typical Roadway Cross-Section, Section 9, discusses this further.

6.G Urban/Rural

Separate design standards have been developed for rural areas and urban (municipal) areas. In addition, typical cross-sections differ depending upon rural/urban location. In general, urban design standards reflect lower design speeds and restricted rights-of-way for the higher traffic volumes more common in urban areas while rural design standards reflect higher design speeds and the more flexible right-of-way opportunities possible in rural areas.

7. DESIGN ANALYSIS AND EVALUATION

7.A Capacity Analysis

NDOT's goal is to provide a transportation system to meet the needs of the forecast design year traffic. Providing unlimited capacity to handle any amount of traffic is not fiscally responsible. Good design must provide sufficient roadway capacity, providing acceptable levels of service to motorists without undue burden on the resources of the state. The principal objective of capacity analysis is to estimate the maximum amount of traffic that can be accommodated by a given facility while maintaining predetermined operational quality, or level of service.

Capacity analysis provides the necessary information to evaluate improvement alternatives. The designer should work with the **Traffic Engineering Division** to ensure that the design typical section and alignment contained in the project file would provide the intended capacity and level of service for the project roadway.

7.B Economic Analysis

In general, the designer should follow the design standards unless the estimated cost of doing so is exorbitant. When a design relaxation is to be requested, the designer needs to substantiate the specific estimated costs associated with following versus deviating from the minimum design standards The **Construction Division Cost Estimating Unit** provides assistance as requested by the designer for determining cost estimates of different design alternatives (See Chapter Twelve: Cost Estimating & Funding, Section 1.A.3).

7.C Accident Analysis

Project improvements typically are evaluated on the basis of accident analyses. High accident location analyses are performed to prioritize projects and also to evaluate project alternatives. The **Traffic Engineering Division** performs accident analyses.

8. REFERENCES

1.1 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards, Current Edition. (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/)

1.2 Nebraska Department of Transportation, State Highway Inventory Report.

1.3 American Association of State Highway and Transportation Officials, Roadside Design Guide, Washington, D.C., 2011.

1.4 The Board of Public Roads Classifications and Standards, "Procedures for Classifications and Standards," Current Edition.

1.5 The Clean Air Act: 23 U.S.C. 109(1) as amended, 42 U.S.C. 7401-7428 (http://www.ehso.com/ehshome/caa2.php)

1.6 23 Congressional Federal Register 625 (http://www.access.gpo.gov/nara/cfr/waisidx_02/23cfrv1_02.html)

1.7 "Intermodal Surface Transportation Efficiency Act: The National Highway System, The Backbone of America's Intermodal Transportation Network," U.S. Department of Transportation, Federal Highway Administration, Washington, D.C., December, 1993. (http://ntl.bts.gov/DOCS/ste.html)

1.8 Nebraska. Laws, Statutes, Etc., Nebraska Highway and Bridge Law; Consisting Of Chapter 39, Highways and Bridges; Sections 49-801 And 49-802, Definitions And Rules Of Construction; Article 6 Of Chapter 60, Nebraska Rules Of The Road. Revised Reissued Statutes Of Nebraska, Current Edition

1.9 American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, D.C., 2011.

Nebraska Department of Roads

Roadway Design Division - Policy Letter

Policy Number: **DES 09–01** **Page 1 of 1**

Approval Date: 04/17/09 Approved By:

Approval Date: 04/17/09 Approved By:

Roadway Design Manual chapter affected by this policy letter:

Chapter One: Design Standards
Section 8. Design Controls/ 8.A: Design Year Traffic

Chapter Two: Design Process
Section 5 Preliminary Roadway Design/ 8.D.: Request Information from Other Divisions

Effective Date: Immediately for all 3R projects that have not completed functional design. Projects in final design may continue with the traffic furnished.

Subject: Design Year Traffic Determination

The 2008 Minimum Design Standards (MDS) for Resurfacing, Restoration, and Rehabilitation (3R) projects, allow the use of the life of the pavement for the determination of the design year and subsequently the design year traffic.

Note (1) on page 7 of the MDS, referring to design year traffic, states "(1) "Design Year" shall be the year of initial construction plus the expected life of the surfacing up to 20 years."

The NDOR has established an average life of ten years for 3R projects constructed with hot-mixed asphalt pavement and twenty years for 3R projects constructed from Portland Cement Concrete pavement.

The Planning and Project Development Division is responsible for providing traffic projections for all projects as necessary.

When requesting the traffic volumes, include in your request the year of initial construction and the ending year of the expected life of the surfacing.

Sent to: NDOR Roadway Design, NDOR "Distribution B", and selected consultants.

Nebraska Department of Roads

Roadway Design Division – Policy Letter

Policy Number: **DES 15–01**

Approval Date: 8/13/15 By: _____ Roadway Design Engineer

Approval Date: 8/17/15 By: _____ Construction Engineer

Approval Date: 8/21/15 By: _____ Materials & Research Engineer

Approval Date: 8/25/15 By: _____ FHWA Division Administrator

VALUE ENGINEERING

Purpose

Federal Regulations require that State Transportation Agencies (STAs) develop a policy for governing a Value Engineering (VE) Program. The purpose of this document is to create the required policy establishing the Nebraska Department of Roads' (NDOR) Value Engineering Program. This policy provides guidance for conducting a VE analysis on applicable Federal-aid highway projects.

NDOR establishes this policy along with procedures, functions, and guidance to monitor, assess, and report on the performance of the VE program. The NDOR shall ensure that its sub-recipients conduct VE analyses as indicated in this policy.

Definitions

Bridge project: A bridge project shall include any project where the primary purpose is to construct, reconstruct, rehabilitate, resurface, or restore a bridge.

Final design. Any design activities following preliminary design and expressly includes the preparation of final construction plans and detailed specifications for the performance of construction work.

Major Project. Based on the *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU),* signed into law on August 10, 2005, a Major Project is defined as "a project with a total estimated cost of $500 million or more that is receiving financial assistance." The FHWA also has the discretion to designate a project with a total cost of less than $500 million as a Major Project. The FHWA may choose to do so in situations where the projects require a substantial portion of the STA's program resources; have a high level of public or congressional interest; are unusually complex; have extraordinary implications for the national transportation system; or are likely to exceed $500 million in total cost.

Project. The term "project" means any undertaking eligible for assistance under Title 23 of the United States Code. The limits of a project are defined as the logical termini in the

Sent to: NDOR Roadway Design, NDOR "Distribution B", and selected consultants.

environmental document and may consist of several contracts, or phases of a project or contract, which may be implemented over several years.

Total project costs. The estimated costs of all work to be conducted on a project, including the environment, design, right-of-way, utilities and construction phases.

Value Engineering (VE) analysis. The systematic process of reviewing and assessing a project by a multidisciplinary team not directly involved in the planning and development phases of a specific project that follows the VE Job Plan and is conducted to provide recommendations for:

- Providing the needed functions, considering community and environmental commitments, safety, reliability, efficiency, and overall lifecycle cost;
- Optimizing the value and quality of the project; and
- Reducing the time to develop and deliver the project.

Value Engineering (VE) Job Plan. A systematic and structured action plan for conducting and documenting the results of the VE analysis. While each VE analysis shall address each phase in the VE Job Plan, the level of analysis conducted and effort expended for each phase may be scaled to meet the needs of each individual project.

Value Engineering Program

The NDOR hereby establishes, and through this policy, sustains a VE program under which VE analyses are identified conducted and approved VE recommendations implemented on applicable projects. NDOR has designated the Roadway Design Engineer in general and the Roadway Design Standards Engineer in particular as NDOR's VE Program Coordinator to coordinate VE program activities and functions. The VE Coordinator's responsibilities include establishing and maintaining the NDOR's VE policies and procedures; facilitating VE training; ensuring VE analyses are conducted on applicable projects; monitoring, assessing, and reporting on the VE analyses conducted and VE program; participating in periodic VE program and project reviews; submitting the required annual VE report to the FHWA; and supporting the other elements of the VE program.

Applicable Projects

A VE analysis shall be conducted prior to the completion of final design on each applicable project that utilizes Federal-aid highway funding. The applicable Assistant Roadway Design Engineer (ADE) shall notify the Roadway Design Standards Engineer when an applicable project has been identified.

Applicable projects requiring a VE analysis include the following:

- Each project located on the National Highway System (NHS) with an estimated total project cost of $50 million or more that utilizes Federal-aid highway funding;
- Each bridge project located on the NHS with an estimated total project cost of $40 million or more that utilizes Federal-aid highway funding;
- Any major project, located on or off of the NHS, that utilizes Federal-aid highway funding in any contract or phase comprising the major project;
- Any project where a VE analysis has not been conducted and a change is made to the project's scope or design between the final design and the construction letting which

results in an increase in the project's total cost exceeding the thresholds identified in this section; or

- Any other project FHWA determines to be appropriate that utilizes Federal-aid highway program funding.

An additional VE analysis is not required if, after conducting a VE analysis required under this part, the project is subsequently split into smaller projects in the design phase or the project is programmed to be completed by the letting of multiple construction projects. However, the NDOR may not avoid the requirement to conduct a VE analysis on an applicable project by splitting the project into smaller projects, or programming multiple design or construction projects.

NDOR may recommend a VE analyses to be conducted for projects falling below the required thresholds identified in this section where there is a high potential for the project to benefit from a VE analysis. Applicable projects may include the following:

- Complex projects on or off the NHS that have a total project cost of $25 million or more;
- Complex Bridge Projects on or off the NHS with an estimated total project cost of $20 million or more;
- Any other complex, difficult, or high cost project as determined by NDOR.

The ADE shall review projects where a delay occurs between when the final plans are completed and the project advances to a letting for construction to determine if a change has occurred to the project's scope, design, or estimate where a VE analysis would be required to be conducted.

Conducting the VE analysis

A VE analysis should be conducted as early as practicable in the planning or development of a project, preferably before or during the Plan-In-Hand field review. The VE analysis should be closely coordinated with other project development activities to minimize the impact approved recommendations might have on previous agency, community, or environmental commitments; the project's scope or schedule; and the use of innovative technologies, materials, methods, plans or construction provisions. At a minimum, the VE analysis shall be conducted prior to completing Final Design.

The ADE, in coordination with the VE Coordinator and the NDOR Divisions and Districts, shall put together a multidisciplinary VE team not directly involved in the planning or design of the project, with at least one individual who has training and experience with leading VE analyses. NDOR or local public agencies may employ qualified consultants to conduct a VE analysis. The consultant shall possess training and experience with leading VE analyses. A consulting firm or individual shall not be used to conduct or support a VE analysis if they have a conflict of interest. VE team members would generally include members from Roadway Design, Traffic Engineering, Environmental (PPD), Pavement Design (M&R), Central Office Construction Division, District Construction Office, Bridge Division, Federal Highway Administration (FHWA), and potentially Bridge or Roadway Design Hydraulics. VE Team members shall be selected

based on their ability to add value to the analysis. Typically, the VE Team will consist of Section heads, and other individuals with the experience and knowledge to discern practicable cost effective proposals.

The VE Analysis will result in a formal written report. The report will consist of at least the following:

- A summary of necessary project information which includes the purpose and need for the project, a project description, location map, and overview of the geographic features of the area
- Identification of the VE analysis team including members of the VE team, contributing individuals, the Standards Engineer, and the other project stakeholders.
- Background and supporting documentation, such as information obtained from other analyses conducted on the project (e.g., environmental, safety, traffic operations, and constructability); these documents may include project time allowance, accident report, pavement condition report, DR-73 Scoping Report, and project estimates.
- Document the stages of the VE Job Plan including life-cycle cost analysis, if appropriate, that were analyzed which includes and documents seven phases:

1. *Information Phase:* The VE Team will gather project information including project commitments and constraints. This may also include a site visit, orientation meeting, and/or a presentation of the current state of design. This meeting is held prior to the start of the VE Study to acquaint the team members with the project.

2. *Function Analysis Phase:* The VE Team will analyze the project to understand the required functions for the project. Required functions could vary based on the project, but may include the designated purpose and need for the project, NDOR goals, and project based goals.

3. *Creative Phase:* The VE Team will generate ideas on ways to accomplish the required functions which improve the project's performance, enhance its quality, and lower project costs. Ideas generated from this phase may not qualify for future evaluation, but may provide additional insight or project enhancements to consider prior to final design.

4. *Evaluation Phase:* The VE team will evaluate ideas from the Creative Phase and select feasible alternatives for development based on their apparent advantages and disadvantages.

5. *Development Phase:* The VE Team will develop the feasible alternatives into fully supported proposals. These proposals are developed through technical analysis. This can be performed by functional areas of the VE team (Roadway, Earthwork, Environmental, etc.), and supported through cost-effectiveness analysis.

6. *Presentation Phase:* The VE Team will present VE proposals to the project stakeholders. Project Stakeholders would typically include the Director, Deputy Director – Engineering, Deputy Director – Operations, District Engineer,

Roadway Design Engineer, Construction Engineer, and those Divisions or Sections affected by the VE Proposal or delivery of the project.

7. *Resolution Phase:* The project stakeholders shall evaluate all presented proposals for acceptance, rejection, or require further study by the VE Team. For proposals requiring further study, the VE Team, or other subject matter experts, shall further evaluate until the Project Stakeholders can either, approve or reject the proposal. A second VE presentation for review and to vote at the VE Final Recommendation meeting is recommended to occur at least one week after the Presentation Phase.

- Summary of the analysis conducted;
- Document the proposed recommendations and approvals received at the time the report is finalized; and

For bridge projects, in addition to the requirements above, the VE analyses shall:

- Include bridge substructure and superstructure requirements that consider alternative construction materials; and
- Be conducted based on:
  1. An engineering and economic assessment, taking into consideration acceptable designs for bridges; and
  2. An analysis of life-cycle costs and duration of project construction.

The final report will be provided to the Design Standards Engineer and the appropriate ADE, and placed in the NDOR document management database to be retained for at least three years after the project has been completed.

The ADE shall coordinate the VE analysis for applicable projects and ensure that approved practicable recommendations be included in the project's plans, specifications and estimates prior to FHWA authorizing the project for construction. Since the VE recommendations and analysis are reviewed at a cursory level during the VE study, additional study and review of the assumptions and practicability during final design may show that the approved recommendation is not practicable or prudent. If it becomes apparent that the recommendation cannot be incorporated into the project, a decision document stating the reasons why it cannot be incorporate shall be attached to the final VE study report for the subject project.

VE Change Proposal (VECP)

A VECP is a construction contract change proposal submitted by the construction contractor based on a VECP provision in the contract. These proposals may improve the project's performance, value and/or quality, lower construction costs, or shorten the delivery time, while considering their impacts on the project's overall lifecycle cost and other applicable factors.

NDOR's Standard Specifications for Highway Construction provide for the contractor to consider changes reduce the project's overall costs without adversely affecting the long term performance of the project. The basis for NDOR or a local public agency to consider a VECP is the analysis and documentation supporting the proposed benefits that would result from implementing the proposed change in the project's contract or project plans.

Proposals to accelerate construction after the award of the contract will not be considered a VECP and will not be eligible for Federal-aid highway program funding participation. Where it is necessary to accelerate construction, NDOR and local public agencies are encouraged to use the appropriate incentive or disincentive clauses so that all proposers will take this into account when preparing their bids or price proposals.

The Construction Division shall provide the Standards Engineer with the VECP's and the net savings between NDOR and the contractor.

VE for Local Public Agencies

The Local Projects Section of the Materials & Research Division shall ensure that a VE analysis has been performed on each applicable project administered by sub-recipients, and shall ensure approved recommendations are implemented into the project's plans, specifications, and estimates prior to the project being authorized for construction. The final report and VE recommendations shall be placed in the NDOR document management database sent to the Design Standards Engineer. The report shall be retained for at least three years following final completion of the project.

VE Program Reporting

The Design Standards Engineer shall monitor and assess NDOR's VE Program, and provide an annual report to the FHWA consisting of a summary of all approved recommendations implemented on applicable projects requiring a VE analysis, the accepted VECPs, and VE program functions and activities;

The Design Standards Engineer shall facilitate training for NDOR's VE program as the need arise.

References include the following

- Title 23, United States Code (U.S.C), Section 106(e)
- Moving Ahead for Progress in the 21st Century (MAP-21, Section1503 (a)(3)
- Title 23, Code of Federal Regulations (CFR), Part 627
- Title 23 U.S.C., Section 101(a)(23)
- The Office of Management and Budget's (OMB) Value Engineering Circular A-131
- 2007 NDOR Standard Specifications for Highway Construction, Section 104.03

Sent to: NDOR Roadway Design, NDOR "Distribution B", and selected consultants.

Nebraska Department of Roads

Roadway Design, Bridge & Construction Division – Policy Letter

Policy Number: **DES 17–02**

Approval Date: 6-5-17 By: _____ Roadway Design Engineer

Approval Date: 6-12-2017 By: _____ FHWA – Nebraska Division

This policy affects Roadway Design Manual: Chapter; One: Design Standards

Nominal Shoulder Width for Lateral Offset to Obstruction

Purpose

This policy provides clarification and guidance for the Lateral Offset to Obstruction criterion, which was included in State Highway minimum design standards for the first time in 2016. Nominal shoulder width and nominal paved shoulder width terms need clarification. Guidance for low-volume roads (i.e. less than an ADT of 400 VPD), per Section 4.4.2 of the Green Book, is included for information.

Policy

Low-Volume Highways (ADT < 400 VPD)

Roadside barriers may be placed at the outer edge of the shoulder; however, it is desirable to provide a minimum clearance of 4 ft. from the edge of traveled way to the barrier. No approval is necessary for the design decision.

Clarification of "Nominal Shoulder Width"

The nominal shoulder width is the shoulder width:

a) on a paved or a turf only shoulder, the nominal shoulder width is the shoulder width(ex. New & Reconstructed(N&R) Interstate 4'Lt. 12'Rt. is the nominal shoulder width and the lateral offset to obstruction Or N&R Major Arterial 1500 VPD 6' is the nominal shoulder width and the lateral offset to obstruction);
b) on a shoulder with a paved portion & turf, the nominal shoulder width is the total shoulder width(ex. N&R Major Arterial 8' total 2' Paved; 8' is the nominal shoulder width and the lateral offset to obstruction);

Sent to: NDOR Roadway Design, NDOR "Distribution B", and selected consultants.

NEW AND RECONSTRUCTED RURAL – STATE HIGHWAY SYSTEM

State Functional Classification	National Functional Classification	Lateral Offset to Obstruction
Interstate	Interstate	The paved shoulder width
Expressway (Access Only at Interchanges)	Other Freeways and Expressways	The paved shoulder width
Expressway	Other Freeways and Expressways	Left = 4 ft. / Right = 8 ft.
Major Arterial	Other Principal Arterials or Minor Arterial	ADT ≥ 2,000 VPD: 8 ft. ADT 400 – 1,999 VPD: 6 ft. ADT < 400 VPD: 4 ft.
Major Arterial	Major Collector, Minor Collector or Local	ADT ≥ 2,000 VPD: 8 ft. ADT 400 – 1,999 VPD: 6 ft. ADT < 400 VPD: 4 ft.
Scenic Recreation – Major Arterial	Other Principal Arterials, Minor Arterial, Major Collector or Minor Collector	Design Speed ≥ 50 mph: 6 ft. Design Speed < 50 mph: 4 ft. desirable 2 ft. minimum

NEW AND RECONSTRUCTED MUNICIPAL – STATE HIGHWAY SYSTEM

State Functional Classification	National Functional Classification	Lateral Offset to Obstruction
Interstate	Interstate	The paved shoulder width
Expressway (Access Only at Interchanges)	Other Freeways and Expressways	The paved shoulder width
Expressway	Other Freeways and Expressways	Curbed: 1.5 ft. from the face of the curb Non-Curbed: Left = 4 ft. / Right = 8 ft.
Major Arterial	Other Principal Arterials or Minor Arterial	Curbed: 1.5 ft. from the face of the curb Non-Curbed: ADT ≥ 2,000 VPD: 8 ft. ADT 400 – 1,999 VPD: 6 ft. ADT < 400 VPD: 4 ft.
Major Arterial	Major Collector or Minor Collector	Curbed: 1.5 ft. from the face of the curb Non-Curbed: ADT ≥ 2,000 VPD: 8 ft. ADT 400 – 1,999 VPD: 6 ft. ADT < 400 VPD: 4 ft. desirable 2 ft. minimum

RESURFACING, RESTORATION AND REHABILITATION (3R) RURAL – STATE HIGHWAY SYSTEM

Sent to: NDOR Roadway Design, NDOR "Distribution B", and selected consultants.

State Functional Classification	National Functional Classification	Lateral Offset to Obstruction
Interstate	Interstate	The paved shoulder width
Expressway	Other Freeways and Expressways	The paved shoulder width
Major Arterial	Other Principal Arterials or Minor Arterial	ADT ≥ 2,000 VPD: 6 ft. ADT < 2,000 VPD: 4 ft. desirable 2 ft. minimum
Major Arterial	Major Collector, Minor Collector or Local	ADT ≥ 2,000 VPD: 6 ft. ADT < 2,000 VPD: 4 ft. desirable 2 ft. minimum
Scenic Recreation – Major Arterial	Other Principal Arterials, Minor Arterial, Major Collector or Minor Collector	4 ft. desirable 2 ft. minimum

RESURFACING, RESTORATION AND REHABILITATION (3R) MUNICIPAL – STATE HIGHWAY SYSTEM

State Functional Classification	National Functional Classification	Lateral Offset to Obstruction
Interstate	Interstate	The paved shoulder width
Expressway	Other Freeways and Expressways	Curbed: 1.5 ft. from the face of the curb Non-Curbed: 8 ft.
Major Arterial	Other Principal Arterials or Minor Arterial	Curbed: 1.5 ft. from the face of the curb Non-Curbed: ADT ≥ 4,000 VPD: 8 ft. ADT 2,000 – 3,999 VPD: 5 ft. ADT < 2,000 VPD: 4 ft. desirable 2 ft. minimum
Major Arterial	Major Collector or Minor Collector	Curbed: 1.5 ft. from the face of the curb Non-Curbed: ADT ≥ 4,000 VPD: 8 ft. ADT 2,000 – 3,999 VPD: 5 ft. ADT < 2,000 VPD: 4 ft. desirable 2 ft. minimum

Sent to: NDOR Roadway Design, NDOR "Distribution B", and selected consultants.

The information contained in Chapter Two: Roadway Design Process, dated July 2006, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this chapter.

The designer should refer to the Design Process Outline for the current design process, activity order and activity numbers.

Chapter Two
Roadway Design Process

1. DESIGN PROCESS OUTLINE

(http://www.roads.nebraska.gov/business-center/design-consultant/)

The Design Process Outline (DPO), (Reference 2.1), summarizes the major activities to be completed during the course of project design. A copy of the current DPO, (Reference 2.1), shall be used to track activities performed for each project. Activities in the DPO, (Reference 2.1), are major work categories. Activities consist of groups of tasks. Tasks are steps to take to accomplish an activity. Upon completion of the tasks associated with a given activity, a major project benchmark is reached.

Not all activities will be required for all projects. All applicable tasks within each activity should be completed. Some tasks may occur simultaneously. The order in which tasks are completed does not necessarily have to follow the order in which they appear in the outline; however some critical path tasks will need to be completed before proceeding on to the next activity. The designer should look at the activities and tasks before starting a project (or an activity) and decide which tasks are appropriate for the project and the priority they have for completion.

These design process activities are included in Clarity. Each activity number corresponds to an activity in Clarity. Clarity includes average times for completion of each activity associated with a project for project scheduling. The **Project Scheduling and Program Management Division** tracks the progress of all projects in Clarity, maintains this information and then updates the actual project schedule as activity completion dates are supplied. Estimated letting dates, based on the activity completion dates, are provided to other decision makers for prioritization and funding.

Completion dates should be recorded on the DPO, (Reference 2.1), beside each applicable activity as activities are completed. The last task listed under each activity signifies the official completion of that activity. The dates of completion for each activity should be entered in Clarity.

Many of the activities in the DPO, (Reference 2.1), seem to duplicate earlier tasks. This reflects the need to check and recheck information. This is especially true for projects that may extend over lengthy time periods. It is important to carefully check to be sure all items are included and nothing has been overlooked.

SEE THE DPO

While not part of Clarity, the same activity numbers are also used on time sheets for employee timekeeping and payroll purposes. Time sheets should reflect the activity worked on in two-hour increments. Work on an activity in shorter time increments should be lumped together at the end of the week.

2. ENGINEERING REVIEW (ACTIVITY 5202)

The **Project Development Division** or the **Roadway Design Division** prepares an engineering review and scope determination for New and Reconstructed projects and for major 3R projects, (See **EXHIBIT 'O'** of the DPO, Reference 2.1). For smaller safety projects and other projects of smaller scope, the **Roadway Design Division** may do the initial project review and setup under Activity 5308. See Chapter Thirteen: Planning and Project Development, Section 3, for additional discussion of the engineering review.

3. INITIAL PROJECT REVIEW AND SETUP (ACTIVITY 5308)

(For projects without an Engineering Review)

On safety projects, the **District** usually will request safety improvements for a specific location. The **Roadway Design Division** will obtain the as-built plans, scope the project, develop a cost estimate and forward this information to the **Highway Safety Office** for a benefit/cost analysis. The **Safety Committee** will review the project to see if it meets the criteria for a safety project. If the appropriate criteria for a safety project are met, the **Safety Committee** reviews the request, may suggest recommendations, and approves the request. The **District Engineer** and others (e.g., **City**, **County**, etc.) must then approve the request. After approval, the **District Engineer** prepares the Highway Improvement Planning Request (DR form 73) and forwards it to the **Deputy Director-Engineering** for approval.

The last action in Activity 5308 occurs when the designer submits the initial project review to the **Project Scheduling and Program Management Division** for incorporation into Clarity.

SEE THE DPO

Roadway Design Division

Date: .....

Initial Project Scoping Data Sheet

By: .....

1. Highway _____ Control No. _____
   Ref. Post _____ Project No. _____
   Length _____ Project Name _____

2. 20-Year Forecast Traffic Range _____ Trucks _____ Dr. Std. _____
   Expressway _____ Priority Commercial _____ Sandhills Area _____

3. Typical Section Existing Proposed Standards
   Driving lanes
   Shoulders
   Bridges

4. R.P. L x W S.R. Proposed Work sq ft Cost (m^2 Cost)

5. Needs Study Deficiencies
   Pavement Width _____ Shoulder Width _____ Sight Distance _____
   Vertical Curves _____

6. Photolog Notes:

7. District Engineer Comments:

8. Proposed Work:

9. Estimated Cost
   _____ Miles (Kilometers) X $_____ / mile (km) = _____
   Bridges _____ X 1.18 (estimate increase) = _____
   Miscellaneous _____ = _____
   Add P.E. _____% Utilities _____ E & C _____% = _____
   ROW _____ = _____
   Total Estimated Cost = _____

SEE THE DPO

Exhibit 2.1 Initial Project Scoping Data Sheet

4. PRELIMINARY ALIGNMENT DESIGN FOR BRIDGE HYDRAULICS (ACTIVITY 5306/5312)

Activity 5306/5312 consists of the preliminary design of the horizontal and vertical alignments, through any bridge areas on a project, for submittal to the **Bridge Division** for use in hydraulic analysis. This activity only applies to projects with bridge structures.

5. PRELIMINARY ROADWAY DESIGN (ACTIVITY 5307/5309)

Activity 5307/5309 consists of data collection, data analysis and preliminary design tasks. For some projects, the first four tasks of this activity may be completed prior to a designer being assigned to the projects.

5.A Obtain Preliminary Data

During Activity 5307/5309, survey information is processed by the **CADD Applications Unit** and sent to the appropriate **Roadway Design Unit Head**. A designer will be assigned to review the survey and the project data sheet and to identify missing topographic items by viewing the photolog.

If additional survey work is required, request a survey through the **Highway Geodetic and Preliminary Survey Supervisor.** If the survey information is sufficient, the survey is returned to the **CADD Applications Unit** for loading existing centerline(s) and cross-sections on the computer. If there is no surveyed alignment, the **Roadway Design Unit Head** sends as-built plans to the **CADD Applications Unit**. Terrain is only loaded on the workstation during the preliminary process if the project requires plan and profile sheets. The project is sent to the **Roadway Design Plans Development Unit** and the **Roadway Design Unit Head** so that the **Roadway Design Plans Development Unit** can create the base plans. Once the base plans are complete, the designer will then receive and review the plotted plans and/or electronic files from the **Roadway Design Plans Development Unit**.

The **Roadway Design Unit Head** will conduct a start-up meeting with the **Roadway Design Plans Development Unit, Right-of-Way**, and the designer to assign responsibilities for the development of preliminary plans. Either the designer or the design technician will be responsible for plan production and places the initial design in the file. Preliminary files are also made available, in electronic form, to the **Right-of-Way Division** so that they can begin Ownership right-of-way plans.

The roadway designer will create a project file, including information obtained from the **Project Development Division**. The designer will maintain the file until the project is constructed.

The designer should review the correspondence, the as-built plans and the engineering review or Highway Improvement Planning Request, (DR form 73). Read the engineering review and/or the Initial Project Data Form (DR form 333), and check to see if any environmental documentation will be required (See Chapter Thirteen: Planning and Project Development, Section 4). The most current photolog should be examined looking for safety hazards, utility discrepancies, posted speeds, school or pedestrian crossings, differences from the preliminary plans, etc.

SEE THE DRC

If conditions have changed in the field or the project scope has been changed from an overlay to a reconstructed section, a new survey will be needed. The request for new or expanded project surveys, right-of-way surveys, and utility surveys should be coordinated with the **Survey Coordinator**. At this time the designer should also determine the appropriate design standard and typical section for the project (See Chapter One: Design Standards, Section 2). He/she should also contact the **District Engineer** to obtain the balance factor.

5.B Project Scope Review and Scoping Changes

The designer should review the project scope and alignment with the **Roadway Design Unit Head, Assistant Design Engineer**, and, if necessary, the **Roadway Design Division Engineer** and the **District Engineer**. If considerable time has passed since the project was originally programmed there may have been changes in design guidance or roadway conditions which will impact the scope of the project.

An updated cost estimate *must* be requested whenever a change in project scope occurs, (See Chapter Twelve: Cost Estimating & Funding, Section 3). Because a change in project cost affects a **District's** budget, the **District Engineer** shall be involved in the decision making process regarding project scope changes.

Any changes in project scope which are initiated by the roadway designer or **Roadway Design Unit Head**, which are not included in the Engineering Review, (See Section 2), and/or the Plan-in-Hand Report, (See Section 8), require approval at different **NDOT** administrative levels depending upon the magnitude of the change in terms of funding required, length of project, etc. (changes from the Engineering Review that affect alignment or add temporary roads should be coordinated with the **Project Development Division**). Major scope changes, including changes to the project termini, will require a revised DR Form 73, “Highway Improvement Program Request”, (See Chapter Twelve: Cost Estimating & Funding, Section 5.C for additional information).

Copies of the approved changes in scope of the project which occur after the Engineering Review, (See Section 2), but before the Plan-In-Hand field inspection, (See Section 7.C), shall be furnished to the **Deputy Director-Engineering, Division Head**, **District Engineer,** the **Utilities Unit** of **Roadway Design**, the **Environmental Permits Units** of the **Project Development Division**, and the **Project Scheduling and Program Management Engineer**. All additional **Divisions/Sections/Units** involved with the project shall be advised of the change in project scope.

Any change in the scope of the project occurring after the routing of the Plan-In-Hand Report, (See Section 8), which would have been included in the P.I.H. Report, (e.g., a change in project length or alignment), should be handled as a supplement to the report. At the initiation of the scope change the roadway designer should inform the recipients of the Plan-In-Hand Report (See **EXHIBIT ‘I’** of the Design Process Outline (DPO), Reference 2.1), that a supplement to the Plan-In-Hand Report is being prepared, listing the basics of the change. When the scope change is approved, the supplement to the Plan-In-Hand Report should be sent directly to each of the recipients of the P.I.H. Report (the supplement does not need to be routed through the list).

SEE THE DPO

Assistant Design Engineer approval is required for any scope changes that result in:

1. Increases or decreases in project cost of approximately $100,000 or less.
2. Increases or decreases in project length of 0.2 mi. (0.32 km) or less.

Division Head or **District Engineer** approval is required for any scope changes that result in:

1. Increases or decreases in project cost of $100,000 to $500,000.
2. Increases or decreases in project length of 0.2 mi. (0.32 km) to 0.5 mi. (0.8 km).
3. Change from or to a resurfacing project from a full construction project.
4. Change from bridge widening to new bridge.

Deputy Director-Engineering approval is required for any scope changes that result in:

1. Increases or decreases in project cost of more than $500,000.
2. Increases or decreases in project length of more than 0.8 km (0.5 mi).
3. Changes in type of surfacing, such as from asphalt to concrete.

5.C Begin Preliminary Design

The preliminary vertical and horizontal alignment is developed during Activity 5307/5309 including preliminary intersection and frontage road design, if applicable. The designer should discuss the alignment with the **Traffic Engineering Division** to coordinate lane configuration, signing, etc. Earthwork computations should be made after the horizontal and vertical alignment has been developed and surveys and balance factors have been obtained. If the **Project Development Division** has not prepared a location map, one should be drawn for public hearings and agreements.

5.D Request Information from Other Divisions

An accident records report for the project for the previous three years should be requested from the **Highway Safety Division**. This will include such information as an accident rate analysis, collision diagram, spot map, etc., as appropriate. This information is for **NDOT** use *only* and shall not be shared with the general public.

Obtain the load ratings for all bridges that are to remain in place from the **Bridge Division**. The **Bridge Division** will also provide structural analyses of bridge-size culverts (i.e., 20 ft (6 m) in width measured along the roadway centerline) and a bridge data sheet. On reconstruction projects where the fill over an existing culvert (pipe or box) is to increase, the **Bridge Division** will provide, upon request, an analysis of structural capacity. Also, receive and review preliminary type, size and location (TS&L) sheets from the **Bridge Division**.

Wetland delineation plans (2-W sheets) should be obtained from the **Environmental Permits Unit** (See Chapter Thirteen: Planning and Project Development, Section 4.B).

The **Materials and Research Division** will provide a preliminary pavement determination.

Activity 5307/5309 also includes the task to request additional survey(s) as needed. This is a reminder to check for missing or incorrect information such as pivots, water lines, sewers, utilities, right-of-way, new drives, culvert size, shelter belts, etc., and for extending cross-sections, pavement shots, wetlands, etc. Check construction books for culvert sizes.

Depending upon the type of project, the **Traffic Engineering Division** will provide special studies and recommendations for traffic engineering items. See Chapter Fourteen: Traffic, Section 1, for additional information.

Ordinarily, the **Utilities Unit** of **Roadway Design** keeps track of utility locations and will check surveys they receive from the **Roadway Design Division**. Occasionally, a designer may want to do this independently. For example, a utility may be noted during the plan-in-hand inspection that was not on the preliminary survey and the designer can then check on it.

To check the permits for utilities that are in the right-of-way, query the CICS1 program on IBM as follows:

1. Enter CICS1 by entering C1 and your DR# and password (the same process as accessing your time sheets.
2. Enter 8 to select Integrated Highway Inventory System.
3. Enter 22 to select Use and Occupancy Permits.
4. Enter 2 to Select Query.
5. Enter 3 to select Use and Occupancy Permit by Hwy/Cnty/Type/Status Query.
6. Enter the highway # and a reference post range – county, type and status may be left blank.

This shows a list of permits in the area selected.

Check for any recently issued utility permits and also check to see that all of the utilities are accounted for on the utility survey. Note that the desired utility location shown on the permit may not be the actual location of the utility. The **Utilities Unit** makes a final check of the locations of all utilities. Contact the **Permit Section** of the **Right-of-Way Division** and the **Utilities Unit** for assistance with details about permits.

SEE THE DPO

5.E Drainage

The Drainage Design and Erosion Control Manual, Chapter One: Drainage, (Reference 2.2), describes drainage design procedures. This activity will begin with determining if the project is in the floodplain and what types of control and what the allowable headwater is. Draw a drainage map and compute the drainage areas. Determine the Q values and size drainage structures. Contact the **Bridge Hydraulics Section** or the **Roadway Design Hydraulics Engineer** to discuss bridge sizes and other structure issues. Begin the following designs:

- Culverts and storm sewers.
- Special ditches.
- Median drains.
- Erosion and sedimentation control measures (preliminary).

5.F Initiate Special Investigations

Some projects may require special investigations. Special investigations should be initiated during Activity 5307/5309. The following topics may require special investigation:

- Drainage structures and box culverts requiring special design or special plans from the **Bridge Division**.
- Railroad agreement information from **Railroad Liaison Engineer**.
- Detours/temporary roads (e.g., road shifts, temporary road construction, phasing, etc.).
- Retaining walls.
- Soils investigation by the **Materials and Research Division** for compaction requirements, etc.
- Traffic signals and signing from the **Traffic Engineering Division**.
- Lighting from the **Roadway Design Lighting Unit**.
- Erosion control from the **Roadside Development Unit** of **Project Development**.
- Hazardous materials, electric substations, underground storage tanks, etc. from the **Project Development Division**.

Assemble the special provisions related to the above topics as they apply to the project.

5.F.1 Additional Survey

At any time throughout the design activities, additional survey work may be needed. For example, a special drainage structure may require additional survey information because right-of-way is affected. Request additional survey work through the **Highway Geodetic and Preliminary Survey Supervisor**.

5.F.2 Traffic Engineering Review

Coordinate roadway design with the **Traffic Engineering Division**. They will review the plans for compatibility of geometrics with traffic requirements.

SEE THE DPO

5.G Aerial Photo (2-A) Sheet Preparation

Consider the time since the previous aerial photo (2-A) sheets were developed prior to public hearings. If the aerial photos, from which the public hearing displays are made, are less than 18 months old, they may be used for the public hearing. If project stations run the same, 2-W sheets from the **Environmental Permits Unit** may be used.

The following information should be shown on the 2-A sheets:

- Alignment.
- Stationing.
- Shifted alignment, if any.

As a general rule, existing wetlands need to be shown on air photo plans, (2W Sheets). See Chapter Thirteen: Planning and Project Development, Section 4.B, for information regarding wetlands.

5.H Utilities on Urban Projects

Cities are not required to have permits to occupy the right-of-way. Thus, it is important to determine any city-owned utility locations and possible conflicts by meeting with utility owners and the **Utility Coordinators**.

5.I Preliminary Access Control Determination

Determine preliminary access control during Activity 5307/5309 by:

- Obtaining relevant information from the **District Engineer** and others.
- Reviewing the zoning, existing and future land use.
- Conducting a field examination.
- Considering intersection sight distance, natural barriers, property lines, and the development of future frontage roads.

See Chapter Fifteen: Right-of-Way, Section 3, and the Access Control Policy to the State Highway System, (Reference 2.3), (http://www.roads.nebraska.gov/media/3460/access-control-policy.pdf)

5.J Review Design Checklist

The last step in Activity 5307/5309 is to review the design checklist (See **EXHIBIT 'B'** of the DPO, Reference 2.1). Go through the checklist and mark off the completed or required tasks, note of the tasks that will continue into the next activity, and be certain that all applicable tasks have been completed. Once the checklist has been reviewed, Activity 5307 ends. Note the completion date on the DPO, (Reference 2.1), for the project and enter the date in Clarity. When the design checklist has been reviewed for this activity, stop charging time to Activity 5307/5309.

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6. COST UPDATE 1 - STATUS 30 (ACTIVITY 5403)

The cost estimate checklist (**EXHIBIT 'C'** of the DPO, Reference 2.1) should be checked to be certain that all applicable items for the project are incorporated into the cost estimate. Funding splits should be verified with the **Roadway Design Unit Heads** for projects within city limits and/or within railroad rights-of-way. The Project Information Sheet, (DR form 342) should be updated and quantities should be submitted to the **Cost Estimating Unit** on Project Quantity Sheets, (DR form 343). Submit the completed project information sheet and cost estimate forms to the **Roadway Design Unit Head** for his/her review. See Chapter Twelve: Cost Estimating & Funding, Section 2, for further details. Activity 5403 ends with the completion of the **Roadway Design Unit Head** review. Enter the date of completion in Clarity. Please note that Activity 5403 should not be used for annual cost updates in Clarity. Clarity does not schedule annual cost updates.

7. DESIGN PLAN-IN-HAND (PIH) (ACTIVITY 5315)

Activity 5315 is always an **NDOT** activity. If a **consultant** is responsible for design, this activity is a joint **Consultant**/**NDOT** activity. During Activity 5315, obtain right-of-way Ownership Plans from the **Right-of-Way Division.** See Chapter Fifteen: Right-of-Way, Section 2.B, for further information.

7.A Plan-in-Hand Plans

The plan-in-hand plans are prepared consisting of the:

- Location map.
- Typical section.
- Traffic data (on the typical section sheet).
- Wetland delineation plans (2-W) sheets from the **Environmental Permits Unit**.
- 2-A sheets (if the project does not include wetlands).
- Plan and profile sheets.
- 2-L sheets.

See Chapter Eleven: Highway Plans Assembly, Section 4 for an explanation of the various plan sheets.

The plans should include the following preliminary details:

- Earthwork balance points, quantities and balance factor.
- Line shifts (new geometrics).
- Limits of construction.
- Detailed limits of construction for urban areas.
- New grade line with vertical curve data and grades.
- Intersection designs, frontage roads, county road alignments, major commercial driveways.
- Begin and end project stations.
- Proposed culvert sizes (include Drainage Area, Design Q, and Headwater).
- Channel changes, if any.
- Preliminary storm sewer design in urban areas.
- Edge of pavement, drives and walks in urban areas.
- Project centerline and surveyed baseline on a 2-A sheet.

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- Areas of impacted wetlands.
- All available aerial and underground utility facility locations (electrical, telephone, pipelines, gas, cable TV, etc.).

Plans submitted to the **Utilities Coordinator** will require the most up-to-date details on the items listed in **EXHIBIT 'G'** of the DPO, (Reference 2.1).

Contact the **Utilities Unit** to coordinate activities related to any utility conflicts.

7.B Plan-in-Hand Plan Distribution

The plan-in-hand plans including location map and typical section, stamped preliminary and dated, should be distributed to the entities shown in **EXHIBIT 'F'** of the DPO, (Reference 2.1), at least two weeks prior to the inspection date. Use the Design Plans Transmittal form, (DR form 135), and the Letter of Transmittal form, (DR form 480), for submittal and notification of plan availability. DR form 135 should be used for transmittals within **NDOT**, and DR form 480 should be used for other agency transmittals, e.g., cities, counties, consultants, other state agencies, etc.

7.C Conduct the Plan-in-Hand Inspection

The plan-in-hand inspection is a field inspection of the proposed project by the **District Engineer, FHWA** (if they have oversight, see Appendix H, "Application of Design Standards"), **City/County Representatives, Utilities Coordinator, Roadway Design Unit Head, Assistant Design Engineer** and the designer. Use the checklist shown in **EXHIBIT 'H'** of the DPO, (Reference 2.1), as a reference to note any items that need to be addressed during the plan-in-hand inspection or may be noted during the inspection. The following items should be taken to the plan-in-hand inspection:

- Camera, 100 ft (100 m) tape, hand level.
- Safety vest, cap/hard hat, strobe light.
- One set of half-size cross-sections.
- One set Stage II right-of-way plans.
- Four sets of half-size plans.
- Plan-in-hand checklist.
- Correspondence file(s).
- Contact aerial photos.
- Drainage maps/worksheets.
- Erosion control checklist.

If there are changes to the project resulting from the plan-in-hand inspection, the designer will meet with the **Environmental Program Manager** to review the changes and to determine if changes to the pre-permit application consultation process will be necessary.

Following the plan-in-hand inspection, consolidate all sets of comments into one set of plans, label the set as official plan-in-hand plans and place them on file. These plans are then a milestone document for the project. This activity is the end of Activity 5315. Enter the completion date in Clarity.

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8. PIH REPORT (ACTIVITY 5318/5338)

This activity consists of the preparation and review of the plan-in-hand report. An optional meeting may be held with the **Assistant Design Engineer** and **Division Head** to discuss the plan-in-hand prior to the completion of the plan-in-hand report. The plan-in-hand report, location map, accident report, engineering review statement and other miscellaneous attachments, as appropriate, are routed to the appropriate individuals for review and approval as listed in **EXHIBIT 'I'** of the DPO, (Reference 2.1).

Please note the plan-in-hand report may go back and forth several times before the final report is approved. The **Roadway Design Office Manager** incorporates all the approved changes and then submits them for signatures.

The plan-in-hand report outline should be followed (See **EXHIBIT 'I'** of the DPO, Reference 2.1). An abbreviated report format may be used for off-system projects. Note that starred topics must have comments attached for all projects. A list of possible safety enhancements is shown in **EXHIBIT 'I'** of the DPO, (Reference 2.1).

On resurfacing projects, or projects not requiring additional right-of-way, add the following statement to the plan-in-hand report:

> A special provision will be written to remove those trees that are inside the lateral obstacle clearance zone, but not beyond the limits of existing right-of-way.

Once the appropriate parties approve the plan-in-hand report, copies are released for additional distribution. Copies of the plan-in-hand report with location maps and any miscellaneous attachments are distributed to the individuals or agencies listed in **EXHIBIT 'I'** of the DPO, (Ref. 2.1). This marks the end of Activity 5318/5338. Enter the completion date in Clarity.

9. ROADWAY FUNCTIONAL DESIGN (ACTIVITY 5316/5326)

Roadway functional design (activity 5316/5326), incorporating comments from the plan-in-hand field inspection and the Public Information Meeting, (if held), may begin while the plan-in-hand report is being circulated for approval. The designer may need to revise the plans based on comments from the Public Information Meeting and from the final plan-in-hand report. One of **NDOT's** goals is to have as much of the final design accomplished as possible at the functional design stage (Activity 5316). The only changes to the project design after the functional design stage should be as a result of the design public hearing, unanticipated utility problems or changes as a result of right-of-way negotiations.

The designer should conduct a post-plan-in-hand meeting (Meeting "B") with the **Roadway Design Plans Development Unit** and **Roadway Design Unit Head** to coordinate making the necessary changes (See **EXHIBIT 'A'** of the DPO, Reference 2.1). Design details to be considered may also include locations of borrow and/or waste pit sites, guardrail locations, etc. Erosion control design should also be coordinated with the **Roadside Design Section**.

The functional design plans should then be sent to the **Environmental Permits Unit** with the preliminary design showing impacted wetlands, possible mitigation sites, any proposed channel change locations including typicals and justification for both impacted wetland and channel changes, i.e., why avoidance was not possible. Plans for public hearing meetings should show existing wetland sites. The decision will be made at the dry run whether to show potential

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mitigation sites. The designer should search potential mitigation sites for the most appropriate site and make a recommendation at the dry run. Coordination with the **Environmental Permits Unit** is essential in determining the number of acres (hectares) impacted and the most appropriate mitigation site. See Chapter Thirteen: Planning and Project Development, Section 4.B, for further discussion of wetlands procedures.

Special investigations may also be updated as needed during Activity 5316/5326 for such items as drainage structures, railroad agreement information, detour/shoofly, retaining walls, stairs (from the **Bridge Division**), soils investigation, phasing, traffic, lighting, signing, erosion control. Again, additional surveys may be required for mitigation sites, borrow/waste pits, etc. The **Traffic Engineering Division** may also need to review the updated plans.

9.A Special Provisions

Activity 5316/5326 also includes the initial writing of any special provisions that may be needed for the project. This information accompanies the computations for the Plans, Specifications and Estimates (PS&E) package.

9.B Initiate Agreements

The **Roadway Design Division** initiates agreements by completing the Request for Agreement form (DR-form 65). The request form is forwarded to the appropriate division for processing. The designer should keep track of the agreement progress and provide any necessary display information. Agreements go to the **District Engineer** to obtain signatures from other parties to the agreements. See DOT-OI 45-5, "Agreements" (Appendix B, "Selected NDOT Operating Instructions") for further information regarding agreements.

9.B.1 City Agreements

All projects within city/municipal limits that are designed to 3R standards or higher will require a city agreement. The **Project Development Division** prepares city agreements based on information obtained from the **Roadway Design Division.** City agreements may be developed for such things as maintenance and operation of roadway lighting including poles beyond city limits. See Chapter Thirteen: Planning and Project Development, Section 5.A, for further information.

On all city agreements city limits should be described by stationing or reference post, either prior to Section 1 of the agreement or on the cost estimate sheet. Also note if the city limits encompass the entire highway right-of-way or one side only. The transmittal letter for the agreement should be sent from the **Roadway Design Unit Head** through the **Assistant Design Engineer** to the **District Engineer**.

City agreements will not be required, with the **District Engineer's** approval, on Maintenance Resurfacing Projects.

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9.B.2 Irrigation Agreements

The **Project Development Division** works with the appropriate **Water Districts** regarding irrigation agreements.

9.B.3 Railroad Agreements

The **Highway Liaison Manager** in the **Intermodal Planning Division** is responsible for all agreements, easement documents, and railroad special provisions. The designer should realize that some agreement and easement documents take considerable time to be executed. Early coordination is essential.

When there is railroad involvement but an agreement and/or easement are not needed, the **Railroad Liaison** group will draft railroad special provisions to add to the letting package. See Chapter Thirteen: Planning and Project Development, Section 5.G, for further information.

9.C Design Access Control

Once the roadway designer is prepared to make recommendations regarding access control, he/she should contact the **Highway Right-of-Way Associate** in the **Property Management Section** of the **Right-of-Way Division** and request to be on the agenda for the next access control meeting. The designer presents his/her recommendations to the **Control Access and Permit Review Committee** with the necessary supporting documentation. Access control is required on all interstate, expressway and four-lane divided highways. The department will consider acquiring access rights on all other highways when:

1. The 20 year forecast traffic (ADT) is 3001 or greater, as shown on the department's current 20 Year Forecast Traffic Map: or
2. The route is within the present or projected two mile zoning limits of first class cities (population 5,000 to 99,999) and within the present or projected three mile zoning limits of primary (population 100,000 to 299,999) and metropolitan class cities (population more than 300,000); or
3. There are three miles or less between the interstate and the connecting or parallel highway.
4. At other locations deemed appropriate.

The designer should provide an aerial photo with property lines and locations of access sites that meet the policy for the committee's review and approval. The designer may need to take the project to several access control meetings throughout the design process.

EXHIBIT 'K' of the DPO, (Reference 2.1), lists the necessary documentation needed for access control meetings at various project stages. See Chapter Fifteen: Right-of-Way, Section 3, for additional discussion of access control. Document the results of the access control meetings in the project file and route the information through the **Roadway Design Engineer, Project Development Engineer, Right-of-Way Manager** and the **Highway Right-of-Way Associate**.

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9.D Receive Additional Documentation

If the project has a Class I or Class III environmental classification, a draft environmental impact statement (DEIS) or draft environmental assessment (DEA), as appropriate, will be submitted to the **Roadway Design Division** from the **Project Development Division.** See Chapter Thirteen: Planning and Project Development, Section 4.A, for additional discussion.

The **Materials and Research Division** will also submit an approved pavement determination to the designer, see Chapter Eight: Surfacing, Section 1.B, for additional information. This is an indicator that a cost update will be due.

9.E Notifications

Notify the **Public Hearings Officer** of the availability of plans for projects that will not have public hearings. Plans will be available to the public in the **District Engineer's** office. See Section 12 for further information regarding public notification and public hearings.

9.F Design Relaxations

If a design relaxation is necessary, the request for relaxation should be submitted to the **Director-State Engineer,** the **Nebraska Board of Public Roads Classifications and Standards,** and/or the **Federal Highway Administration,** as appropriate. Appendix H, "Application of Standards", discusses the design relaxation process in further detail.

9.G Submit Functional Plans

Functional plans, also known as hearing plans, should be submitted to the individuals and agencies shown in **EXHIBIT 'F'** of the DPO, (Reference 2.1). If a public hearing is to be held, these plans shall be submitted to the appropriate entities five weeks prior to the public hearing. Functional plans should be stamped preliminary plans and dated. This is the end of Activity 5316/5326. Enter the completion date in Clarity.

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10. COVENANT RELINQUISHMENT AGREEMENT

A covenant relinquishment agreement (CRA) is a signed agreement between **NDOT** and a **City/County** in which **NDOT** maintains ownership of the right-of-way for utility easement purposes but relinquishes responsibility for the maintenance and operation of the roadway facility to the **City/County**. In a CRA, **NDOT** agrees to bring the roadway surfacing up to an acceptable serviceability value. The designer will need to get a determination from the **District Engineer** and/or the **Project Scheduling and Program Management Division** on whether the surfacing of the relinquishment should be added to the project or if a separate project should be programmed, unless the relinquishment is part or an expressway project, in which case the cost to improve the relinquishment will be a project cost. The scope of work on the segment to be relinquished must be justified and be approved on a scoping document, such as the plan-in-hand report or a revised DR-73 form ("Highway Improvement Programming Request").

The designer should review any CRAs that may have been developed to determine if new or revised CRAs are needed. If a new CRA is required or revisions are needed, the designer shall provide the necessary information for the documents. The approximate location should be identified and a location map exhibit should be prepared by the **Roadway Design Plans Development Unit**. Submit the information for the CRA to the **Materials and Research Division**. Review the draft CRA and exchange comments. A signed agreement must be received prior to scheduling a dry run for a public hearing, (See Section 12, for further information regarding public hearings). For further information on relinquishments see Section 21; Chapter Fifteen: Right-of-Way, Section 7.E; and The Department of Transportation Operating Instruction 60-13, "Relinquishment of Roads from the Highway System" (Appendix B, "Selected NDOT Operating Instructions").

11. COST UPDATE 2 -STATUS 40 (ACTIVITY 5406)

Review the cost estimate checklist (**EXHIBIT 'C'** of the DPO, Reference 2.1) for the project. Check for funding splits on the Initial Project Data form, (DR form 333), or the Project Data Revision form, (DR form 334) and/or on CICS1/CICS3. Quantities should be submitted to the **Cost Estimating Unit** on Project Quantity Sheets, (DR form 343), and the Project Information Sheet, (DR form 342), should be updated. Submit the completed project information sheet and cost estimate forms to the **Roadway Design Unit Head** for his/her review. The last task in Activity 5406 is the completion of the **Roadway Design Unit Head's** review. Enter the completion date in Clarity. Do not sign off on Activity 5406 in Clarity when completing an annual cost update. See Chapter Twelve: Cost Estimating & Funding, Section 2, for further details.

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12. DESIGN PREPARATION FOR PUBLIC HEARINGS (ACTIVITY 5323/5324)

12.A Public Hearings

A public hearing is an advertised formal meeting, presided over by a **Highway Commissioner**, to present the proposed project to the public and to obtain public input. Design functional plans (Activity 5316) and R.O.W. ownership plans are needed for this meeting. Before scheduling the public hearing the designer will need to obtain a signed city covenant agreement (if applicable), a signed covenant relinquishment agreement (if needed) and a signed draft environmental document and noise study, if a noise study was conducted. These documents are required *before* a public hearing may be scheduled. Hearing guidelines must be followed for proper public notice of the hearing, for information that must be presented, and for the hearing procedures. A transcript is made of the verbal and written testimony. Location public hearings and design public hearings may be held separately or they may be combined into one hearing. See "Guidelines for Public Hearing", **EXHIBIT 'M'** of the Design Process Outline, (Reference 2.1), for further information

The following items should be collected and/or prepared for the public hearing:

- Comments from Public Information Meeting, if applicable.
- Design year traffic information (i.e., design year is 20 years after the year of construction completion).
- Typical section display.
- Aerial photo display (less than 18 months old).
- Hearing plans (See **EXHIBIT 'F'** of the DPO, Reference 2.1).
- Engineering statement (take 5-10 extra copies to the hearing for the **Highway Commissioner** to give to the media).

A dry run should be held six weeks prior to a proposed public hearing. **EXHIBIT 'L'** of the DPO, (Reference 2.1) lists people who should be invited to a dry run. Contact the **Design Standards Engineer** for a current list of people who should be invited. Be sure that the **Director-State Engineer**, the **Deputy-Director Engineering** and the **Roadway Design Division Engineer** are available to attend. Others may be invited when appropriate. The **District Engineer** should also be contacted and asked if he/she would like to attend the dry run. The dry run should simulate an actual public hearing. It provides the opportunity to practice and refine the presentations prior to an actual public hearing. The public hearing checklist (**EXHIBIT 'M'** of the DPO, Reference 2.1) should be used to gather information and tools for the dry run and the public hearing.

A "Public Hearing Notice Worksheet", (EXHIBIT 2.2), a "Fact Sheet" (**EXHIBIT 'S'** of the Design Process Outline, Reference 2.1), a detour map (if applicable) and a current location map is to be submitted to the **Public Information Office** in the **Communications Division** prior to the dry run. After the dry run is completed, the designer provides the **Secretary of the Highway Commission** and the **Public Hearings Officer** with a copy of the engineering statement. The **Public Hearings Officer** will provide the designer with a copy of the presentation including exhibits that will be used during the hearing. The **Public Hearings Officer** advertises the hearing in the official county newspaper and in general circulation newspapers in the project area at five and at two weeks prior to the hearing date.

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The designer is responsible for providing the **District** and **City** (if applicable) with a set of design functional plans at the same time as the advertising information is submitted to the **Public Hearings Officer**. After the hearing, the designer will submit a copy of the engineering statement to the **Secretary of the Highway Commission**.

Public hearings will be held for all environmental Class I projects, (those requiring an environmental impact statement), and environmental Class III projects, (those having an environmental assessment) (See Chapter Thirteen: Planning and Project Development, Section 4). All environmental Class II projects, (categorical exclusions), are reviewed on an individual basis to determine if a hearing will be held. The plan-in-hand report will note the decision made. All environmental Class I and III projects will require **State Highway Commission** recommendation and the **Governor's** approval, as will any Class II project for which a public hearing is held. Public Hearing Statements should include some environmental statements, such as:

- Thoughtful design and construction techniques are used to minimize the impacts to the environment, wetland areas will be avoided when possible and replaced when eliminated.
- Temporary erosion and sediment control measures will be used to reduce soil erosion.
- Trees will be saved where consistent with good design.
- On this project some trees are located within the proposed construction limits and will be removed.
- After construction, disturbed areas will be seeded with grasses and wildflowers chosen based upon the soil type and compatibility with the surrounding vegetation.

After the hearing is over, the designer reviews and consolidates comments that were made, and compiles the plans, displays and hearing statement for the permanent file as hearing plans. Comments from the afternoon informal session are put in one set of plans and stamped as public hearing documents.

The completion date for Activity 5323 occurs at this point for solely roadway design tasks. Enter the completion date in Clarity at this time. Other divisions share responsibility for the rest of the tasks in Activity 5323. Designer time associated with public hearing tasks should be charged to Activity 5323 even after the completion date has been entered in Clarity.

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12.B Highway Commission Statement

After the public hearing has been held, the designer or **Roadway Design Unit Head** shall prepare a Highway Commission statement, (forms may be obtained from the Roadway Design vault). The statement will be presented to the **Highway Commission**. The **Assistant Design Engineer** reads the statement into the **Highway Commission** proceedings, summarizes the comments received at the public hearing, and answers questions. A copy of the statement goes to the **Highway Commission Secretary**. Upon receipt of approval from the **Highway Commission** and the **Governor**, the project proceeds. Receipt of approval marks the end of Activity 5323 for time sheets.

12.C Public Meetings

Communication between **NDOT** and the public is an important ongoing activity coordinated by the **Public Hearings Officer** in the **Communications Division**. Depending on the nature of the project, several types of contact may be made during the course of a project. The **Public Hearings Officer** publishes notices for hearings in general circulation newspapers in project areas to provide information about the proposed projects to the public. Types of public meetings that are held are:

- Public Information Meetings.
- City and/or County Officials Meetings.
- Property Owners Pre-Hearing Meetings.
- Pre-hearing Information Meetings.
- Location Public Hearings.
- Design Public Hearings.

For guidance on which type(s) of public meeting(s) should be held for a project see the "Public Meeting Checklist", **EXHIBIT 'R'** of the Design Process Outline (Reference 2.1). Plan and agreement requirements for the various types of public meetings may be found in EXHIBIT 2.2.

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Meeting Type	Design Plans (Activity #)	Environmental Permits Unit Plans	R.O.W. Plans	Signed Agreements (As Necessitated by the Project)
"Preliminary/Input From Public" Information Open House	Preliminary Plans (#5315)	Wetlands Impacts and Potential Mitigation Sites	Ownership	
"In Lieu Of A Hearing" Information Open House	Functional Plans (#5316)	Wetlands Impacts and Preferred Mitigation Site(s)	Ownership	City Covenant Agreement Covenant Relinquishment Agreement Draft Environmental Document(s) * or a FONSI **
"Pre-Design Hearing" Information Open House	Functional Plans (#5316)	Wetlands Impacts and Preferred Mitigation Site(s)	Ownership	City Covenant Agreement Covenant Relinquishment Agreement Draft Environmental Document(s) * or a FONSI **
Property Owners Pre-Hearing Meeting	Functional Plans (#5316)	Wetlands Impacts and Preferred Mitigation Site(s)	Ownership	City Covenant Agreement Covenant Relinquishment Agreement Draft Environmental Document(s) * or a FONSI **
Corridor Hearing	Functional Plans (#5316)	Wetlands Impacts and Potential Mitigation Sites	Ownership	Covenant Relinquishment Agreement
Public Hearing	Functional Plans (#5316)	Wetlands Impacts and Preferred Mitigation Site(s)	Ownership	City Covenant Agreement Covenant Relinquishment Agreement Draft Environmental Document(s) * or a FONSI **
City and/or County Officials Meeting	Functional Plans (#5316)	Wetlands Impacts and Preferred Mitigation Site(s	Ownership	City Covenant Agreement Covenant Relinquishment Agreement Draft Environmental Document(s) * or a FONSI **
"Project Update" Information Open House	Functional Plans (#5316) or Better (if available)***	Wetlands Impacts and Preferred Mitigation Site(s)	Ownership or Better (if available)***	City Covenant Agreement Covenant Relinquishment Agreement Draft Environmental Document(s) * or a FONSI **
"L.O.C./Phasing" Information Open House	L.O.C. Plans (#5335)	Wetlands Impacts and Preferred Mitigation Site(s)	Appraisal***	City Covenant Agreement Covenant Relinquishment Agreement Draft Environmental Document(s) * or a FONSI **
Information Meeting Prior to Appraisal and Acquisition	L.O.C. Plans (#5335)	Wetlands Impacts and Preferred Mitigation Site(s)	Appraisal***	City Covenant Agreement Covenant Relinquishment Agreement Draft Environmental Document(s) * or a FONSI **

* Includes a Noise Study, if one was conducted.
** An Environmental Assessment with a **F**inding **O**f **N**o **S**ignificant **I**mpact
*** All required final environmental documents must be signed be before R.O.W. Appraisal and Final Design Activities (#5355) can begin.

For further information see Sections 9 and 16, Chapter Thirteen: Planning and Project Development, (Section 4), and Chapter Fifteen: Right-of-Way, Sections 3.F & 4.

Exhibit 2.2 Plan and Agreement Requirements for Public Meetings

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12.C.1 Public Information Meetings

Public information meetings are advertised meetings held to inform the public of the proposed project location and/or design, to obtain public input and to answer questions through one-on-one conversations with the public. These are not recorded meetings but citizen Comment Sheets are made available.

The required plans and agreements for these meetings may be found in EXHIBIT 2.2. Items that should be taken to a public information meeting may be found on the "Public Meeting Checklist" in **EXHIBIT 'M'** of the Design Process Outline (Reference 2.1). Items 5 through 9 and 11 through 26 are usually sufficient for a public information meeting, but items 2 through 4 may be added if a mosaic is available. The designer should create a "Project Fact Sheet", **EXHIBIT 'M'** of the Design Process Outline (Reference 2.1), for distribution at the public information meeting.

Public information meetings are scheduled in coordination with the **District Engineer** and/or the **Project Development Division** and the **Communication Division**. Meetings usually are held for major relocations and location studies, right-of-way appraisal, design and scope changes, wetlands impacts, projects in villages and cities, and sometimes for an engineering review. There are various types of public information meetings:

- A **"Preliminary/Input from the Public" Information Meeting"** is often scheduled to solicit public input prior to putting proposed design features on a map. This meeting may be held in concert with the plan-in-hand.
- An **"In Lieu of a Hearing" Information Meeting"** is held when the public has indicated there is significant interest in the project but no public hearing is planned. This may also be used in the case of a Class II environmental classification project (See Chapter Thirteen: Planning and Project Development, Section 4).
- An **"Information Open House"** meeting is always held in the afternoon of a design hearing.
- A **"Project Update" Information Meeting** is held when 18 months or more have elapsed since a design hearing was held or when there has been a change in the scope of the project.
- A **"Limits of Construction/Phasing of Construction" Information Meeting** is held to inform adjacent property owners of the possible impacts to their property. In metropolitan areas, these meetings are often held only with homeowner groups that are affected by the project. If there are fewer than four affected properties, and no public information meeting is held, LOC Design Plans (Activity 5335) will be sent to the **District Engineer** who will be asked to contact the property owners, showing them our proposed design and explaining its impact to their property.
- An **Information Meeting Prior to Appraisal and Acquisition** is held to answer questions regarding the project and the **Department of Transportation** property acquisition process. Landowners impacted by the project are particularly encouraged to attend. The preliminary R.O.W. plans must have been completed before this meeting. This is a meeting held by the **Roadway Design Division**, which may be attended by appraisers from the **R.O.W. Division**. Factors considered in selecting a Pre-Appraisal Information Open House include: a decision by the **Assistant Design Engineer**, a request from the **District Engineer** or **DOT Administration**, elapsed time since a previous meeting with the public, etc.

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The designer should submit a "Public Hearing Notice Worksheet", (EXHIBIT 2.3), a "Fact Sheet" (**EXHIBIT 'S**' of the Design Process Outline, Reference 2.1), a detour map (if applicable) and a current location map to the **Public Hearings Officer** five weeks prior to a proposed information open house so that the required meeting advertising and official notifications may be produced. The first publication occurs three weeks prior to the meeting and the final publication will be one week prior to the meeting. The designer is responsible for providing the **District** and (if applicable) the **City/Village** office with a set of plans at the same time that the advertising information is sent to the **Public Hearings Officer**. See Section 12.A for additional information.

After each meeting all notes from the various plans and note pads shall be consolidated onto one set of plans and/or one set of minutes. The minutes will become part of the project file and the plans shall be properly tagged as "Information Meeting" or "Public Hearing" plans and will be kept until the project has been built. It is the responsibility of the designer to ensure that all promises for studies, phasing, and/or plan changes are honored and that any information received that affects other divisions is shared.

12.C.2 City and/or County Officials Meeting

The **Assistant Design Engineer** will determine when a **City and/or County** officials meeting is to be held. While it is not necessary that the **Roadway Design Division** conduct all of the meetings and coordination, such as in utilities conflicts, they are responsible for seeing that it is accomplished. The plan and agreement requirements for this meeting may be found in EXHIBIT 2.2.

12.C.3 Property Owners Pre-Hearing

Pre-hearing meetings may be held with impacted property owners on projects entailing major changes in access, parking, drop off lanes, right-of-way, driveways, relocation (especially of occupied residences), etc. The **Assistant Design Engineer** will determine when a property owner pre-hearing will be held. See EXHIBIT 2.2 for the required plans and agreements for this meeting.

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Public Hearing Notice Worksheet

Please return to the Public Information Office in the Communication Division prior to your hearing dry run or scheduling of your open house.

Your Name:	Division, Section, Unit:
Phone No.: / Fax No.:	Type of Hearing: *(Check one)* ☐ Notice of highway corridor hearing ☐ Notice of highway design hearing ☐ Notice of information open house ☐ Pre-appraisal meeting ☐ Other *(please specify)*
Date of Hearing:	
Time of Hearing or Information Meeting: Starting:_____ Ending:_____ *(if appropriate)*	Time of Preceding Information Discussions, if any: Starting ___ Ending ____
Hearing Location: *(Building, Address, and City)*	Division(s) and/or District(s) Providing Personnel for Informal Discussions: ☐ Roadway Design ☐ Project Development ☐ Right-of-Way ☐ District
Project No(s). and "Known As" Descriptions:	Control No.: *(For internal referencing only)*
Briefly Describe Location and Type of Proposed Improvement: *(Major Elements)*	
Total Lanes in the Completed Project:	Project to be Constructed Under Traffic? ☐ Yes ☐ No
Highway Access Control Information:	

SEE THE DRO

DR Form 356, May 05/ *(Continued)*

Exhibit 2.3 Public Hearing Notice Worksheet

Detour Information:		
Shoo-fly Information:		
Right of Way Information:		
Roadway Removal, Relinquishment:		
Acquisition of Business, Residence or Other Structures:		
Environmental Areas, including Wetlands to be Affected by the Project:		
Location and Address Where Preliminary Plans may be Inspected:	Contact Person for News Release:	
	Phone No.: *(Include Area Code)*	
	Have you attached the most current map detailing the location of the proposed improvement? ☐ Yes ☐ No	
Is the project politically sensitive? *(Explain – for background purposes only)*		
Section/Unit Manager Reviewing & Approving Hearing Notice Materials:	Phone No.:	Fax No.:

SEE THE DPO

Exhibit 2.3 Public Hearing Notice Worksheet (Continued)

13. ROADWAY DESIGN (ACTIVITY 5325/5327)

Activity 5325/5327 begins with a review of the hearing plans and the public hearing transcript. Typical cross-sections should be updated as necessary. The **Materials and Research Division** will provide the final typical pavement cross-sections.

Design of geometrics and grades for driveways, intersections, frontage roads and cross-sections should be completed during this activity. Compute impacted wetlands and submit them to the **Environmental Permits Unit** for recommendations regarding elevations and mitigation.

Finalize any special investigations such as drainage structures, box culverts, railroad agreement information, detours/temporary roads, construction phasing, retaining walls, soils investigations, traffic signals, lighting, signing, marking, wetlands mitigation plans, erosion and sedimentation control measures (both temporary and permanent). Review the design checklist (**EXHIBIT 'B'** of the DPO, Reference 2.1). Order additional surveys, if necessary. Have the **Traffic Engineering Division** review any pertinent changes.

Submit plans to the **Roadway Design Plans Development Unit** for final plan preparation upon completion of the special investigations. The end of Activity 5325 coincides with the scheduling of the **Roadway Design Division** review meeting (See Activity 5335). Enter the completion date in Clarity.

14. ROADWAY DESIGN REVIEW/ LIMITS OF CONSTRUCTION PLANS (ACTIVITY 5335/5336)

The **Roadway Design Division** review meeting with the **Roadway Design Unit Head** is the first task in Activity 5335/5336 and is held to check the plans using the design checklist (**EXHIBIT 'B'** of the DPO, Reference 2.1), the plan-in-hand plans, and the hearing plans.

14.A Limits of Construction Plans

The limits of construction plans should show the final limits of construction including all culverts, driveways, intersections, dikes, etc. and taking into account the needs of **Lighting**, **Utilities**, **Roadside Development**, **Wetlands**, and **Traffic**. Distribute the limits of construction plans with location maps and typical sections to the entities shown in **EXHIBIT 'F'** of the DPO, (Reference 2.1). The plans should be stamped preliminary and dated.

After L.O.C. plans have distributed, notice should be given when changes are made to the L.O.C. plans that may affect **R.O.W. Design**, **Utilities**, **Bridge**, **Traffic,** the **Wetlands Unit** or other divisions. Some examples of changes:

- Construction Limits.
- Special Ditches (even if within the planned R.O.W., it may affect utilities).
- Vertical Profile.
- Intersection/ Drive Locations.
- Temporary Roadways, etc.
- Impacts to Wetlands areas.

SET THE DPO

R.O.W. Design, **Utilities** and any other affected sections/units shall be notified when work is beginning on a change. Send an E-mail to:

- **R.O.W. Design Engineer**.
- **ROW Designer**.
- **Utilities Unit ADE**.
- **Utility Coordinator**.
- **Wetlands Unit**.
- Other affected sections.

The notification shall include the following information:

- Project Name & Number.
- Control Number.
- Tract Numbers affected.
- A brief description of the changes.
- An approximate completion date.

14.B Other Tasks in Activity 5335

A meeting with the **Traffic Engineering Division** may be held to review any unusual situations related to traffic concerns, e.g., intersection, pavement marking plans, etc. Typically, the **Traffic Engineering Division** is simply notified that the limits of construction plans are available (See **EXHIBIT 'F'** of the DPO, Reference 2.1). In addition, the **Lighting Unit** should be given a set of base plans if there is lighting involved.

Any covenant city agreements should be completed and sent to the **District Engineer** to obtain signatures. The final task in Activity 5335 is a meeting of **Right-of-Way,** the **Roadway Design Plans Development Unit, Roadway Design Unit Heads, Assistant Design Engineers** and the **Utilities Coordinator**. Enter the completion date in Clarity.

15. COST UPDATE 3 - STATUS 45 (ACTIVITY 5408)

Review the cost estimate checklist (**EXHIBIT 'C'** of the DPO, Reference 2.1) for the project to be certain all items are included. Recheck the funding splits on the Initial Project Data form, (DR form 333), the Project Data Revision form, (DR form 334), and/or on CICS1/CICS3. The Project Information Sheet, (DR form 342) should be updated and updated quantities should be submitted to the **Cost Estimating Unit** on Project Quantity Sheets, (DR form 343). Submit the completed project information sheet and cost estimate forms to the **Roadway Design Unit Head** for his/her review. See Chapter Twelve: Cost Estimating & Funding, Section 2, for further details. The last task in Activity 5408 is completion of the **Roadway Design Unit Head** review. Do not use Activity 5408 to record annual cost updates in Clarity.

OFF THE DPO

16. DESIGN REVIEW SUPPORT PROCESSES (ACTIVITY 5340)

The designer should review the scheduled letting date, the anticipated time to construct the project, etc. in Clarity to be certain the schedule is still on track. Review the schedule, keeping the following (and other similar) activities and concerns in mind:

- **Agreements:** city, county, irrigation, and railroad. Recognize that some city/county councils may only meet once a month. Also be aware that irrigation modifications can only be done during that part of the year when there is no water in the systems. Railroad owners may be out of state, and agreements require extended lead-time.
- **Final Relinquishment Agreement:** agreements must be executed prior to submittal of the plans package to **PS&E** (See Section 21).
- **Wetlands:** permitting requires input from multiple agencies; mitigation should be done in winter months, if possible.
- **Utilities:** seasons are also critical for utility relocation.
- **Right-of-way:** acquisition is a lengthy process (See Chapter Fifteen: Right-of-Way, Section 5).
- **Soils:** surcharge and settlement may need to be programmed into the construction schedule.
- **Phasing:** coordinate bridge and roadway construction phasing, etc.
- **Promises:** be aware of promises made, e.g., construction completed before football season.
- **Logo signs:** tourist-oriented directional (TOD) signs should be moved during the off- peak tourist season, if possible.
- **Miscellaneous:** nesting seasons of birds that nest on bridges, trout migration, etc.

The estimated working days for construction should also be reviewed and the letting date should be confirmed. Lettings usually occur once a month. This is the end of Activity 5340. Enter the completion date in Clarity.

17. PRELIMINARY RIGHT-OF-WAY PLAN REVIEW (ACTIVITY 5345)

At this stage, right-of-way design is on the critical path. In Activity 5345, the designer should review the Preliminary Right-of-Way plans (See Chapter Fifteen: Right-of-Way, Section 2.C). Once the roadway designer has received and reviewed the plans, the roadway designer holds a Preliminary R.O.W. plan review meeting and invites those shown in **EXHIBIT 'Q'** of the DPO, (Reference 2.1) to discuss design of the preliminary right-of-way. **Right-of-Way Design** provides a copy of the Preliminary Right-of-Way plans to the **Roadway Design Division.** Receipt of these plans marks the end of Activity 5345. Enter the completion date in Clarity.

17.A Removal Items and Notes

Items which are to be removed from a tract, such as a well or a sign base, should be noted on either the plan-in-hand field inspection or during the appraisal process. Removal notes for these items will be added to the final design plans up to the time of the project turn-in to **PS&E** (approximately three months prior to the project letting). The removal should be handled as a contract item, with a special provision addressing the removal. The **Right-of-Way Design Section** should provide the roadway designer with a list of the removal items that will appear on the Right-of-Way Certificate during the Review Appraisal Process. There should be no plan changes or revisions for removal items discovered after the submittal of the final plans package; these items should be handled by the **District** with a change order and should be recorded on the as-built plans, if necessary.

SEE THE DPO

18. DESIGN PLANS TO UTILITIES UNIT (ACTIVITY 5600)

At this stage of the project, the design is complete except for any changes from right-of-way negotiations and any unforeseen utility changes. **Right-of-Way Design** will send Appraisal Right-of-Way plans to the **Roadway Design Division** for review. The designer should transmit a set of the most recent reproducible plans to the **Utilities Unit** for them to distribute the plans to affected utilities. Contact the **Utilities Coordinator** to discuss the project further and to check for any other utility conflicts. Enter the completion date in Clarity.

19. INFORMATION MEETING PRIOR TO APPRAISAL AND ACQUISITION (ACTIVITY 5314)

If information meetings prior to appraisal and acquisition are held, the designer should attend along with the **Roadway Design Unit Head,** the **District Engineer,** and sometimes the **Construction Project Manager** and **Appraisers** from the **R.O.W. Division.** These meetings will use Appraisal Right-of-Way plans, (See Chapter Fifteen: Right-of-Way, Section 2.D). The **Roadway Design Division** handles the arrangements for these information meetings, (See Section 12.C, for further information).

Make any required changes as a result of the appraisal and negotiations. Be sure that all parties, such as the **Utility Coordinator,** are notified of changes.

20. CHANGES TO FINAL DESIGN (ACTIVITY 5355/5357)

The final design (Activity 5355/5357) begins with a review of the design checklist (**EXHIBIT 'B'** of the DPO, Reference 2.1) for any uncompleted tasks. This is the beginning of the final compilation of all of the information for the PS&E package. It also includes pre-appraisal meetings, if the **Chief Appraiser**, with input from the roadway designer, deems them necessary.

20.A Check on Other Agreements

The designer must also check on the status of all required permits and agreements so that all necessary documentation will be completed. Waterway permits, railroad agreements, status of utilities forms (that document all utilities negotiations have been settled and plans for relocation prior to construction are complete), county agreements, **Natural Resource District (NRD)** agreements, Irrigation District negotiations, etc. should all be obtained.

The city utility conflicts cost estimates and plans (if required) should be obtained. The cost estimates are required for the financial portion of the covenant agreement and should include the percentage of betterment/non-betterment work. As long as the work is non-betterment, **NDOT** pays the cost of relocation.

Ordinarily, the city will provide its own plans for utility relocation, especially for sanitary sewers. The city utility rehabilitation plans may or may not be included in the **NDOT** project. In some cases, the city work is completed prior to **NDOT** construction. In other cases, particularly in smaller cities, the utility rehabilitation may be incorporated into **NDOT** plans. A meeting should be held during this stage between the designer and city-owned utilities to discuss relocation/rehabilitation. Items to be discussed include such things as scheduling so the city can phase its work, betterment/non-betterment, etc. Enter the completion date in Clarity.

SEE THE DPO

21. FINAL RELINQUISHMENT AGREEMENT (FRA)

The **Materials and Research Division** provides the covenant relinquishment agreements (CRA) for the final relinquishment agreement (FRA). The designer should review the CRA prior to preparing information for the FRA. The exact limits of the relinquished segment are included in the FRA along with a location map exhibit from the **Roadway Design Plans Development Unit**, and a resolution and petition form (See EXHIBIT 2.4).

The designer should review the completed FRA location map exhibit with his/her supervisor, and then send all the information to the **Materials and Research Division**. The designer should review the draft FRA and then return it to the **Materials and Research Division** for processing. For further information on relinquishments see Section 10; Chapter Fifteen: Right-of-Way, Section 7.E; and The Department of Transportation Operating Instruction 60-13, "Relinquishment of Roads from the Highway System" (Appendix B, "Selected NDOT Operating Instructions").

SEE THE DPO

Resolution and Petition

WHEREAS, the Nebraska Department of Transportation of the State of Nebraska, has notified the City of _____, Nebraska, of its intention to relinquish a portion of State Highway No. _____.

NOW THEREFORE, BE IT RESOLVED by the City of _____, Nebraska that said City herewith petitions for relinquishment of said portion of said State Highway No. _____ located within the Corporate Limits of said City, and which the Department of Transportation intends to relinquish pursuant to Statute Nos. 39-1314-15 of Revised Statutes of Nebraska (1988).

AND BE IT FURTHER RESOLVED, that the Department of Transportation be notified of the desire of said City of _____ to maintain said portions of State Highway No. _____, by transmitting a copy of this Resolution to said Department.

Passed and approved this _____ day of _____, 20___.

By _____

Title _____

ATTEST:

_____
City Clerk

SEE THE DPO

Exhibit 2.4 Resolution and Petition Form

22. PREPARATION OF FINAL PLANS PACKAGE / FINAL PLAN REVIEW FOR PS&E (ACTIVITY 5369/5368)

This activity essentially is the assembly of the final plans package. Plans submitted to **PS&E** shall have all plan corrections completed by the **Roadway Design Plans Development Unit** prior to submission. The designer should complete any outstanding miscellaneous design plans, (i.e., guardrail). The design checklist (**EXHIBIT 'B'** of the DPO, Reference 2.1) should once again be checked.

Computations should be received from the **Materials and Research Division** and typical sections should be finalized. The computation sheets for each pay item should be completed, checked and rechecked, preferably by someone other than the one who did the original computations. Design details should be completed.

For further information, see Chapter Eleven: Highway Plans Assembly, Section 4.

22.A Assemble Project Data

The designer should accumulate all project data including but not limited to the following:

- Right-of-way certificate, (See Chapter Fifteen: Right-of-Way, Section 6).
- Status of utilities.
- Seeding and erosion control special provisions and special plans.
- Agreements with city, county, Irrigation District, utilities, railroads, NRD, sanitary improvement districts (in urban areas), (See Section 10 and Chapter Thirteen: Planning and Project Development, Section 5.A).
- Final Relinquishment Agreement, (See Section 21).
- Waterway permits, e.g., 404 permit, nationwide permit (NWP), channel relocation, floodplain certification, etc., (See Chapter Thirteen: Planning and Project Development, Section 4).

The total design package including graphical presentation of plans, complete notes and details should be reviewed so that nothing has been forgotten. Again, use the design checklist (**EXHIBIT 'B'** of the DPO, Reference 2.1). Any special provisions that have been compiled should be elaborated on and/or finalized. The soils report should be reviewed and checked for the need for special provisions such as a compaction requirement (2K) sheet.

Receive plans from:

- **Bridge Division**.
- **Traffic Engineering Division**.
- **Lighting Unit**.
- **Materials and Research Division**.
- **Right-of-Way Design** (Ownership plans).
- Others , e.g., **City, County, Utilities, NRD**, etc.

Computer books for the **District Engineer** should be prepared including slope stake book, blue top book and paving grades.

SEE THE DPO

22.B Check Earthwork and Notes

Use the earthwork checklist (**EXHIBIT 'N'** of the DPO, Reference 2.1) to review earthwork information. Verify that a utility note is included that shows the contractor is responsible for notifying utilities prior to digging.

Note that in some cases shoulder construction notes specify separate pay items by station. Check for:

- Earthwork balance points and quantities.
- Covercrop seeding note: on expressway projects where traffic remains on the existing roadway and then switches to new travel lanes, some areas may need seeding more than once.
- Shoulder construction notes.
- Superelevation notes.
- Scale stamp on cross-sections: horizontal and vertical scales will differ.
- Grade alignment at project ends and crossings for detours and temporary roads.
- Special provisions, e.g., surcharge over winter.
- Sketches for construction items, e.g., typicals for dikes, guardrail, driveways on 2-S sheets, etc.

Be sure that project stationing is shown on plans, typical sheets and project length sheet.

The final task of activity 5369 is the completion of a PS&E Required Sheet (DR form 280). This form is a legal size sheet that should be completed to accompany the PS&E package. Enter the completion date in Clarity.

22.C Checking Plans for Conflicts

The designer is responsible for checking plans generated by other divisions for conflicts with the Roadway Design plans. For example: Have light poles or overhead traffic signs been installed in front of the guardrail? Are there conflicts with existing or proposed utilities and the storm sewer design?

SEE THE DPO

22.D Final Plan Review For PS&E

Activity 5369/5368 includes the final check of all construction notes with the computation sheets and includes a review of the PS&E plans with the **Roadway Design Unit Head**. The design checklist (**EXHIBIT 'B'** of the DPO, Reference 2.1) should be used.

The city financial agreement should be prepared and sent to the **District Engineer** to obtain signatures. See DOT-OI 45-5, "Agreements", (Appendix B, "Selected NDOT Operating Instructions") for further information regarding agreements.

The final task for this activity is the submittal of PS&E plans to the **PS&E Section** in the **Construction Division.** Enter the completion date in Clarity when the project is given to **PS&E**.

PS&E checks the plans and quantities and informs the designer of any required plan changes. When the corrected plans are returned to **PS&E**, the CADD files are locked to prevent unauthorized changes to the contract plans. The roadway designer shall contact the **Roadway Design Plans Manager** to unlock the CADD files prior to making plan revisions, (See Section 23.A and Chapter Eleven: Highway Plans Assembly, Section 7, for further information).

During the period after a project has been advertised for letting until it has been let to contract, all questions from outside the **Nebraska Department of Transportation** (i.e. contractors or suppliers) regarding the project and plans shall be referred to the **Highway Construction Scheduling Manager** in the **Construction Division**.

23. POST LETTING SUPPORT AND PLAN REVISION (ACTIVITY 5375/5376)

Activity 5375/5376 covers all post letting Design functions including the Pre-Construction Conference, construction review of any type, Plan Revisions, and the Post-Construction Conference. The project is not complete until construction is finished and **NDOT** has accepted the finished product.

23.A Changes to the Design Plans

Any changes to the design plans which occur after the project has been let to contract will necessitate either a plan revision or a change order. Any changes which require engineering should be handled as plan revisions. Any changes which are adjustments to the existing plans (such as changing the culvert placement within the same drainage way) can be handled as change-orders and should be shown on the as-built plan set.

SEE THE DPO

23.A.1 Plan Revisions

The **Roadway Design Division** may be involved in plan revisions at any time during the construction of a project. If the plans for a project are to be changed after the project has been submitted to **PS&E** but before it is advertised for letting, **PS&E** will send the plans back to the **Roadway Design Division** for the changes to be made. The changes are not considered to be a plan revision at this stage of the project. If, however, the project has been advertised and changes are necessary, the plan revision procedures should be used as outlined in Chapter Eleven: Highway Plans Assembly, Section 7.

Notice should be given when plan revisions are anticipated. Any division that is involved in a project needs to be made aware of any changes or revisions that another division may make to the plans. For example, if a roadway project requires a bridge revision, the **Bridge Division** must inform the **Roadway Design Division**, **Right-of-Way**, **Traffic**, and any other involved divisions that they are initiating a revision to the plans.

For plan revisions initiated in the **Roadway Design Division**, the roadway designer should send a notification, (which can be an e-mail), detailing the proposed revision to the **Assistant Design Engineer** and the **Roadway Design Unit Head**. The notification should include the following information:

- Project Name & Number.
- Control Number.
- Revision Number.
- Tract Numbers affected.
- A brief description of the changes.
- An approximate completion date.

If the **Assistant Design Engineer** approves of the proposed revision, the **Roadway Design Unit Head** will forward the notification to the following:

- **District Engineer**
- **District Construction Engineer**
- **Roadway Design Plans Manager** (responsible for unlocking CADD files)
- **Construction Engineer**
- **District Project Manager**
- **Bridge** (if applicable)
- **Traffic**
- **ROW Design Engineer**
- **ADE** for the **Utilities Unit**
- **CADD Applications Engineer**
- **FHWA** (on federal oversight projects only)
- Any other affected Divisions/Sections

*Plans will not be revised without written authorization from the **Assistant Design Engineer**.* All federal oversight projects shall have **FHWA** approval to proceed **before** the plan revisions are made, (the **Design Unit Head** is responsible for informing the **Roadway Design Plans Manager** when **FHWA** approval has been received).

SEE THE DPC

All plan revisions *must* be signed and sealed by a P.E., (See Chapter Eleven: Highway Plans Assembly, Section 8). The **Roadway Design Unit Head** and **Assistant Design Engineer** must be kept informed of all changes to the plans, regardless of whether the changes are made in the **Roadway Design Division** or in the **District**; it is the **Assistant Design Engineer's** decision whether a plan change can be handled with a change order or is a plan revision requiring a signed and sealed document. If the **District Engineer** or the **District Construction Engineer** is willing to seal and sign plan revisions in the field that is acceptable, as long as the **Roadway Design Unit Head** and **Assistant Design Engineer** are consulted about the design of the proposed revisions before they are finalized. If the **Roadway Design Division** authorizes or transmits a plan revision to the **District** via fax, phone, or e-mail, the responsible **Roadway Design Division Engineer's** seal and signature will be affixed to the transmittal, which will then be scanned and sent to the **District**.

24. ARCHIVING THE PROJECT FILE

After the project is completed, the designer is responsible for archiving the project file in the vault. Archive instructions (transmitted by the vault to the designer) should be used to properly prepare the file for archives. This usually occurs two years after final computations are completed.

SEE THE DRO

25. REFERENCES

2.1 Nebraska Department of Transportation, Design Process Outline, Current Edition (http://www.roads.nebraska.gov/business-center/design-consultant/)

2.2 Nebraska Department of Transportation, Drainage Design and Erosion Control Manual, Current Edition

2.3 Nebraska Department of Transportation, Access Control Policy to the State Highway System, Current Edition. (http://www.roads.nebraska.gov/media/3460/access-control-policy.pdf)

SEE THE DPO

Nebraska Department of Roads

Roadway Design Division - Policy Letter

Policy Number: **DES 09–01** **Page 1 of 1**

Approval Date: 04/17/09 Approved By:

Approval Date: 04/17/09 Approved By:

Roadway Design Manual chapter affected by this policy letter:

Chapter One: Design Standards
Section 8. Design Controls/ 8.A: Design Year Traffic

Chapter Two: Design Process
Section 5 Preliminary Roadway Design/ 8.D.: Request Information from Other Divisions

Effective Date: Immediately for all 3R projects that have not completed functional design. Projects in final design may continue with the traffic furnished.

Subject: Design Year Traffic Determination

The 2008 Minimum Design Standards (MDS) for Resurfacing, Restoration, and Rehabilitation (3R) projects, allow the use of the life of the pavement for the determination of the design year and subsequently the design year traffic.

Note (1) on page 7 of the MDS, referring to design year traffic, states "(1) "Design Year" shall be the year of initial construction plus the expected life of the surfacing up to 20 years."

The NDOR has established an average life of ten years for 3R projects constructed with hot-mixed asphalt pavement and twenty years for 3R projects constructed from Portland Cement Concrete pavement.

The Planning and Project Development Division is responsible for providing traffic projections for all projects as necessary.

When requesting the traffic volumes, include in your request the year of initial construction and the ending year of the expected life of the surfacing.

Sent to: NDOR Roadway Design, NDOR "Distribution B", and selected consultants.

FED HWY ADMIN

MAY 12 2009

NEBRASKA

Nebraska Department of Roads

Roadway Design Division - Policy Letter

Policy Number: **DES 09–03**

Approval Date: 05/05/2009 NDOR Approved By:

Approval Date: 05/05/2009 FHWA Approved By: 05/12/09

Roadway Design Manual Chapter affected by this policy letter:

Chapter Two: Design Process
Section 9: Design Analysis and Evaluation
New sub-section: Documentation of Scope Change

Effective Letting Date: Immediately

Subject: Documentation of Scope Change

Changes in the scope of a project must be properly documented and communicated.

When a scope change is necessary, the latest project scope document is modified to describe in detail the change. The documents are as follows:

- DR-73
- Engineering Review
- Plan-In-Hand Report

If the scope change occurs after the DR-73 and prior to the completion of the engineering review: The DR-73 will be revised, signed by the District Engineer, and routed again for approval.

If the scope change occurs after the engineering review is completed and before the plan-in-hand inspection, the engineering review report will be revised by Project Development or a supplement to the engineering review prepared Roadway Design and routed for approval.

If the scope change occurs after the plan-in-hand report has been completed and prior to the design hearing: The plan-in-hand report will be revised and routed for information and approval as shown in the Roadway Design Manual.

Changes in scope that occur following the design public hearing must be evaluated for their consequence to the public participation process. If the scope change is considered to have an effect on what was presented at the hearing, it may be necessary to conduct another hearing or information meeting.

Changes that occur after the design public hearing, or following functional design in the event there is no hearing, will be recorded in a design decision document and forwarded for approval and information using the same distribution as that for the plan-in-hand report.

Sent to: NDOR Roadway Design, NDOR "Distribution B", and selected consultants.

As a minimum the documentation for the scope change shall contain the following:

1. A detailed description of the change in scope.
2. Documentation of the need for the change
3. The estimated change in cost to the project, including
    a. PE,
    b. Utilities,
    c. Right-of-way
    d. Construction and CE
4. The impact of the change upon the schedule of the project, taking into account all activities that will have to be performed again, due to the change.
    Reminders:
    a. Wetlands/ Environmental
    b. ROW
    c. Traffic
    d. Bridge
    e. Timing of Construction or Letting
    f. Utilities
5. A description of the additional coordination or public participation that will need to take place due to the change.

Sent to: NDOR Roadway Design, NDOR "Distribution B", and selected consultants.

The information contained in Chapter Three: Roadway Alignment, dated April 2011, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this chapter.

This chapter replaces Chapter Three: Roadway Alignment, dated July 2006. This chapter was approved by the Nebraska Division of the FHWA for use on the National Highway System and other federal projects on June 17, 2011.

Chapter Three
Roadway Alignment

This chapter presents the **Nebraska Department of Transportation** (**NDOT**) policies and criteria for the design of roadway horizontal and vertical alignments, generally based on passenger car performance unless otherwise stated. The **American Association of State Highway and Transportation Officials** (**AASHTO's**) A Policy on Geometric Design of Highways and Streets (the *Green Book*) (Ref. 3.1) provides a more comprehensive description of the alignment considerations presented in this chapter and should be referred to for further details.

1. SIGHT DISTANCE

A driver must be able to see an object on the roadway ahead with sufficient time and distance to select and complete the appropriate action (avoid the object or stop). This is referred to as sight distance. The different types of sight distance include:

- Decision sight distance
- Stopping sight distance
- Passing sight distance
- Sight distance on horizontal curves
- Intersection sight distance

For additional information see Chapters 3 and 9 of the *Green Book* (Ref. 3.1).

2. HORIZONTAL ALIGNMENT DESIGN

Major considerations in horizontal alignment include:

- Design speed
- Topography
- The environment
- Economics

The **Project Development Division** (**PDD**) will usually recommend an approximate horizontal alignment for the project during the engineering review. It is the responsibility of the roadway designer to check the alignment and to verify that it is in compliance with the **NDOT's** design guidance (See Chapter One: Design Criteria).

Environmental considerations and impacts are a vital component of the design process; the roadway designer shall coordinate with the **Environmental Section** in **PDD** in the development of, and in any subsequent alteration to, the horizontal alignment. The horizontal alignment should not be changed during the Final Design Phase (Activity 5500).

2.A Horizontal Curvature

The **NDOT** designs and designates horizontal curves based on the radius of the curve (for conversion from/to degree of curvature see Appendix G, "Degree of Curvature"). The use of the minimum horizontal curve radius should be avoided unless economically or environmentally necessary. As a general guide, any change in direction with a deflection angle of 1° or greater will require a horizontal curve. For small deflection angles, curves should be long enough to avoid the appearance of kinks. For further information see Chapter Three of the *Green Book* (Ref. 3.1), "General Controls for Horizontal Alignment".

2.A.1 Simple Curves

The **NDOT** uses arc definition for curve computation. Usually the PI station, the intersection angle (I), and the circular curve radius (R) are established; the remaining curve data must be computed (See EXHIBIT 3.1).

2.A.2 Reverse Curves

A reverse curve consists of two curves on opposite sides of a common tangent with a relatively short tangent length between the curves. The tangent length between the curves is usually dictated by superelevation requirements for each curve (See Section 2.B).

2.A.3 Compound Curves

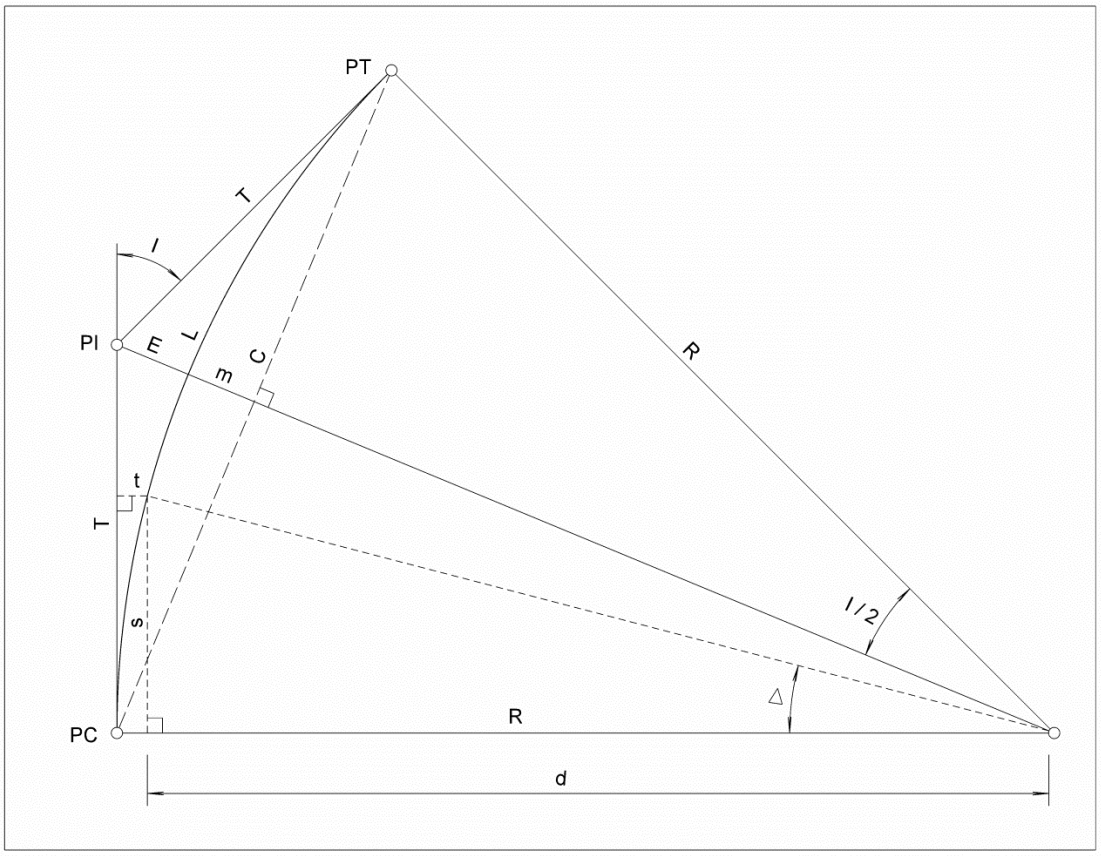
A compound curve consists of two consecutive curves of differing radii deflecting in the same direction with no tangent length between the curves. When field conditions dictate that a compound curve be utilized (e.g. for locations where an obstruction cannot be mitigated otherwise) the ratio of the flatter radius to the sharper radius should not exceed 1.5:1.

2.A.4 Broken Back Curves

A broken back curve consists of two consecutive curves deflecting in the same direction joined by a short tangent section.

2.A.5 Spiral Transition Curves

A spiral curve provides a transition between a tangent roadway section and a circular curve. The degree of curvature on a spiral gradually varies from zero at the tangent end to the degree of circular arc at the curve end. While the **NDOT** sees only marginal benefits in the design of spiraled transition curves for new roadway alignments in general, spiral transition circular curves are preferred on Interstate ramps due to the higher percentage of truck traffic. For additional information see Chapter Three of the *Green Book* (Ref. 3.1), "Spiral Curve Transitions".



Curve Symbols and Abbreviations	**Curve Formulas**
I Intersection angle of the curve C Length of long chord from PC to PT D Degree of curve E External distance (PI to mid-point of curve) L Length of curve from PC to PT m Middle ordinate (distance from the mid-point of the curve to the mid-point of the long chord) PC Point of curvature (beginning of curve) PI Point of intersection of tangents PT Point of tangency (end of curve) R Radius of curve T Tangent distance (distance from PC to PI, distance from PI to PT) s Distance along the tangent to any point on curve t Offset from the tangent to any point on curve Δ Intersection angle to any point on curve	$I = 2 \sin^{-1}(L/2R) = (L/R) \times (180/\pi)$ $C = 2R \sin (I/2)$ (I in degrees) $D = 5729.57795/R$ $E = [\sqrt{(R^2 + T^2)}]-R$ $L = RI$ (I in radians) $= 2\pi R (I / 360)$ (I in degrees) $m = R(1 - \cos(I/2))$ (I in degrees) $R = 5729.57795/D$ $= (4m^2 + C^2)/8$ $s = R \sin\Delta$ $d = R \cos\Delta$ $t = R - d$ $\pi = 3.141592653$ PC Sta. = PI Sta. – T PT Sta. = PC Sta. + L

Exhibit 3.1 Elements of a Simple Curve

2.B Superelevation

The minimum horizontal curve radius is determined by the design speed of the facility (V) and by the maximum allowable superelevation rate (e_{max}). Selection of a maximum superelevation rate depends on several factors, including:

- Design speed
- Location
- Climatic conditions
- Roadside conditions
- Future or ultimate development
- Roadway characteristics
- Facility type
- Driver expectations

EXHIBIT 3.2 summarizes the superelevation rates used in Nebraska.

For rural highways and for bridge structures a desirable maximum superelevation rate of 6% (EXHIBIT 3.3c) should be used unless design constraints dictate the use of the 8% maximum superelevation rate. Bridge structures should not be constructed in the transition zones of superelevated horizontal curves. Due to prevailing snow and ice conditions, the maximum superelevation rate shall not exceed 8%. The use of the maximum superelevation rate of 8% requires **Assistant Design Engineer** (**ADE**) approval and a decision letter to the project file (See Appendix H, "Application of Design Standards"). An 8% superelevation rate should be designed in accordance with Chapter Three of the *Green Book* (Ref. 3.1), "Horizontal Alignment".

Location	Max. Allowable Superelevation	Desirable Max. Superelevation
Rural Roadways	8%* (See Ref. 3.1, Chapter 3)	6% (EXHIBITS 3.3c, 3.4c & 3.5c)
Bridges	8%* (See Ref. 3.1, Chapter 3)	6% (EXHIBITS 3.3c, 3.4c & 3.5c)
High-Speed Urban Roadways V ≥ 50 mph	6% (EXHIBIT 3.3c)	6% (EXHIBIT 3.3c)
Desirable Design, Low-Speed Urban Roadways V ≤ 45 mph	4% (EXHIBIT 3.3d)	4% (EXHIBITS 3.3d & 3.6c)
Minimum Design, Low-Speed Urban Roadways V ≤ 45 mph	4% (Ref. 3.1, **TABLE 3-13b****)	4% (Ref. 3.1, **TABLE 3-13b** **)

* Requires **ADE** approval and a decision letter to the project file.
** The use of **TABLE 3-13b** (Ref. 3.1) requires **ADE** approval and a decision letter to the project file (See Appendix H, "Application of Design Standards").

Exhibit 3.2 Superelevation Rates

2.B.1 Transition Lengths

- **Tangent Runout** - The distance required to transition the roadway from a normal crown section to a section with the adverse crown removed, or vice versa.
- **Superelevation Runoff Length** (L_r) - The distance required to transition the roadway from a section with the adverse crown removed to a fully superelevated section, or vice versa.
- **Superelevation Transition Length** - The sum of the tangent runout and the superelevation runoff (L_r).

EXHIBITS 3.3b, 3.4b, 3.5b, and 3.6b illustrate the relationship between superelevation transition, tangent runout, and superelevation runoff length for two-lane roadways, for dual lane highways with crowned surface, for dual lane highways with tangent surface, and for dual lane highways with raised medians.

The minimum superelevation runoff lengths shown in EXHIBITS 3.3c AND 3.3d were calculated for two-lane and four-lane undivided roadways, see **TABLE 3-16** of the *Green Book* (Ref. 3.1) to determine the minimum superelevation runoff lengths for multilane undivided roadways.

For simple curves 60 to 90% of the superelevation runoff length (L_r) should be placed on the tangent prior to the curve. This percentage will vary based on the design speed and the number of lanes being rotated. To determine the appropriate percentage see **TABLE 3-18** of the *Green Book* (Ref. 3.1).

To facilitate pavement drainage, a minimum profile grade of 1.5% shall be maintained through the area where the adverse crown has been removed. A flatter profile grade, down to and including a grade of 0.5%, may be used with **Unit Head** approval.

2.B.2 Axis of Rotation

The axis of rotation is the point on the roadway cross-section about which the roadway is rotated to attain the desired superelevation through the horizontal curve. EXHIBITS 3.3a, 3.4a, 3.5a, and 3.6a illustrate the **NDOT** standard procedures for the application of the axis of rotation in superelevation development for two-lane highway sections and for four-lane divided highway sections. See “Transition Design Controls” in Chapter 3 of the *Green Book* (Ref. 3.1) for methods of attaining superelevation where the **NDOT** procedures do not apply.

For two-lane roadways the superelevation should be rotated about the highway centerline, which is normally the profile grade line (See EXHIBIT 3.3a). This method minimizes the elevation differential between the pavement edges and their normal profiles. Rotation about the inside or outside axis of the roadway is acceptable when required to satisfy field conditions, such as surface drainage on a curbed facility.

For multi-lane facilities with crowned surfaces and depressed medians of 40 feet or less in width the profile grade point should be about the inside (median) edge of the 12 foot inside lane of each roadway (See EXHIBIT 3.4a). The axis of rotation for the outer roadway should be located at the centerline of the lanes until the superelevation transition attains reverse crown, at which point the axis of rotation will shift to the inside edge of the 12 foot inside lane. The axis of rotation for the inner roadway should be located at the inside edge of the 12 foot inside lane of the roadway, the same location as the profile grade point. This method results in the maintenance of approximately

a 2 foot median ditch depth. When the median width is greater than 40 feet the axis of rotation and the profile grade point may be the centerline of the individual lanes.

For multi-lane facilities with tangent surfaces and depressed medians of 40 feet or less in width the axis of rotation should be about the profile grade line, which is the inside (median) edge of the 12 foot inside lane of each roadway. This method maintains the median in a horizontal plane throughout the curve (See EXHIBIT 3.5a). When the median width is greater than 40 feet the axis of rotation and the profile grade point may be the centerline of the individual lanes.

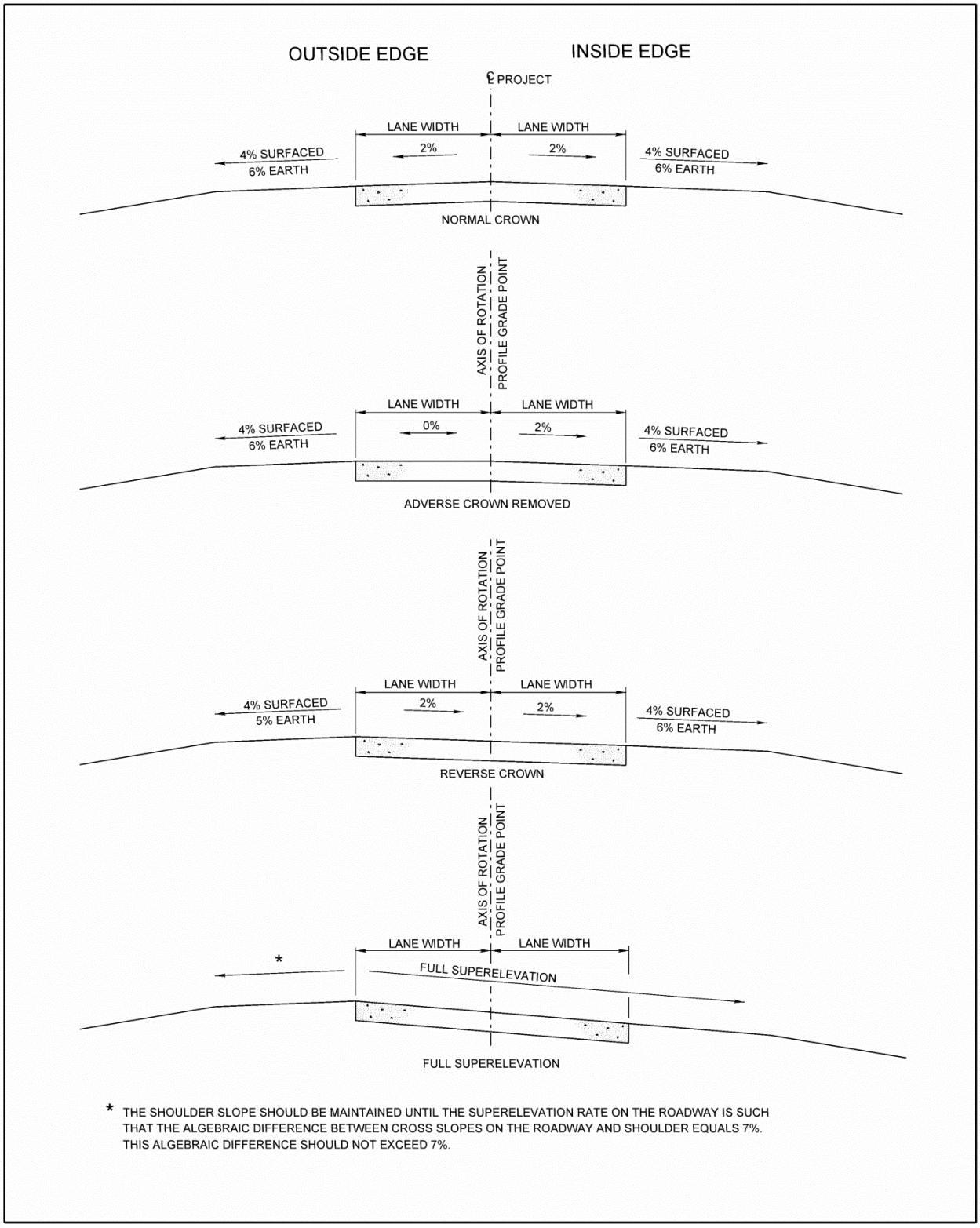
For multi-lane facilities with raised medians, the axis of rotation and the profile grade point should be located at the inside edge of the 12 foot inside lane (See EXHIBIT 3.6a).

2.B.3 Smoothing of Pavement Edge Profile

Angular breaks in the vertical profile of the pavement edge through the superelevation transition length should be rounded in the final design. For general appearance, the **NDOT** softens these sharp angular breaks by the insertion of short vertical curves along the pavement edge. As an approximate guide, the minimum vertical curve length in feet can be set as numerically equal to the design speed in miles per hour; greater lengths should be used where practical.

2.C Pavement Widening on Curves (Off-tracking)

Pavement widening may be warranted if a vehicle or truck occupies a greater width due to the rear wheels tracking inside of the front wheels while rounding curves. For additional information see “Traveled-Way Widening on Horizontal Curves” in Chapter 3 of the *Green Book* (Ref. 3.1).



* THE SHOULDER SLOPE SHOULD BE MAINTAINED UNTIL THE SUPERELEVATION RATE ON THE ROADWAY IS SUCH THAT THE ALGEBRAIC DIFFERENCE BETWEEN CROSS SLOPES ON THE ROADWAY AND SHOULDER EQUALS 7%. THIS ALGEBRAIC DIFFERENCE SHOULD NOT EXCEED 7%.

Exhibit 3.3a Superelevation Data for Crowned Highways
Typical Sections

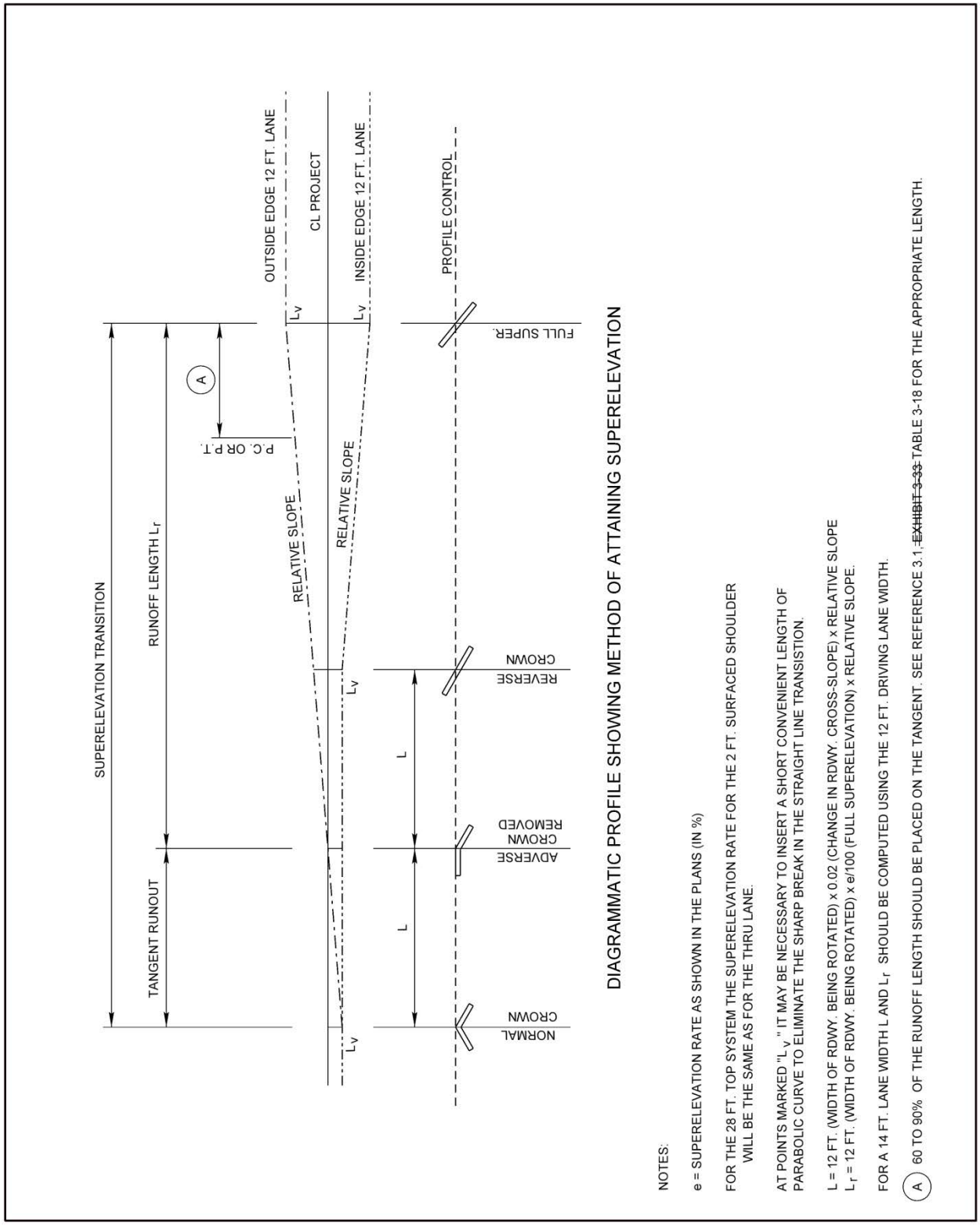


Exhibit 3.3b Superelevation Data for Crowned Highways
Diagrammatic Profile

Radius of Curve (ft.)	V=50 mph			V=55 mph			V=60 mph			V=65 mph			V=70 mph			V=75 mph			V=80 mph		
	e (%)	Maximum Relative Slope 200:1		e (%)	Maximum Relative Slope 213:1		e (%)	Maximum Relative Slope 222:1		e (%)	Maximum Relative Slope 233:1		e (%)	Maximum Relative Slope 250:1		e (%)	Maximum Relative Slope 263:1		e (%)	Maximum Relative Slope 286:1	
		L (ft.)	L_r(ft.)		L (ft.)	L_r(ft.)		L (ft.)	L_r(ft.)		L (ft.)	L_r(ft.)		L (ft.)	L_r(ft.)		L (ft.)	L_r(ft.)		L (ft.)	L_r(ft.)
23000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0
20000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0
17000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0
14000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	2.0	63	63	2.0	69	69
12000	NC	0	0	NC	0	0	NC	0	0	2.0	56	56	2.0	60	60	2.0	63	63	2.1	69	72
10000	NC	0	0	NC	0	0	2.0	53	53	2.0	56	56	2.1	60	63	2.3	63	73	2.5	69	86
8000	NC	0	0	2.0	51	51	2.0	53	53	2.3	56	64	2.5	60	75	2.8	63	88	3.1	69	106
6000	2.0	48	48	2.2	51	56	2.6	53	69	2.9	56	81	3.2	60	96	3.5	63	110	4.0	69	137
5000	2.2	48	53	2.6	51	66	3.0	53	80	3.3	56	92	3.7	60	111	4.1	63	129	4.6	69	158
4000	2.7	48	65	3.1	51	79	3.6	53	96	4.0	56	112	4.4	60	132	4.9	63	155	5.5	69	189
3500	3.0	48	72	3.5	51	89	3.9	53	104	4.4	56	123	4.9	60	147	5.3	63	167	5.9	69	202
3000	3.4	48	82	3.8	51	97	4.3	53	115	4.8	56	134	5.4	60	162	5.7	63	180	Rmin = 3050		
2500	3.8	48	91	4.3	51	110	4.8	53	128	5.3	56	148	5.8	60	174	6.0	63	189			
2000	4.3	48	103	4.9	51	125	5.4	53	144	5.8	56	162	Rmin = 2040			Rmin = 2500					
1800	4.6	48	110	5.1	51	130	5.6	53	149	6.0	56	167									
1600	4.9	48	118	5.4	51	138	5.8	53	155	Rmin = 1660											
1400	5.2	48	125	5.7	51	146	6.0	53	160												
1200	5.5	48	132	5.9	51	151	Rmin = 1330														
1000	5.9	48	142	Rmin = 1060																	
900	6.0	48	144																		
	Rmin = 833																				

$e_{max} = 6\%$

Source: Adapted from "A Policy on Geometric Design of Highways and Streets", (Reference 3.1), Eq. 3-12 thru 3-24.
For additional information see Reference 3.1, EXHIBIT 3-26.

KEY:
V = Assumed design speed
e = Rate of superelevation
L = Tangent runout based on a 12 ft. lane
Lr = Minimum length of superelevation runoff based on a 12 ft. lane
NC = Normal crown section

Exhibit 3.3c Superelevation Data for Crowned Highways
Values for Design Elements Related to Design Speed and Horizontal Curvature
(e_{max}=6%)

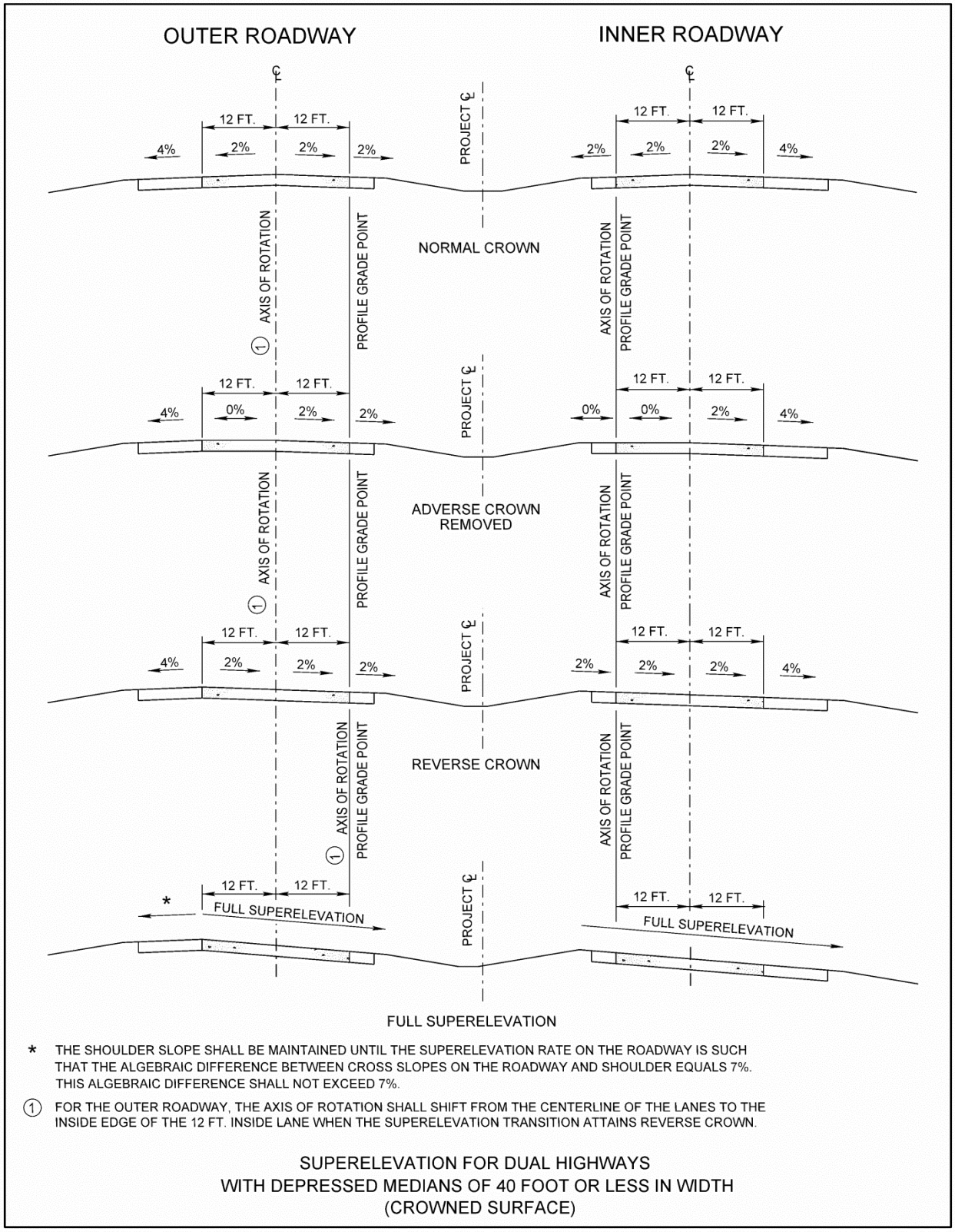
Radius of Curve (ft.)	V=25 mph			V=30 mph			V=35 mph			V=40 mph			V=45 mph			V=50 mph		
	e (%)	Maximum Relative Slope 143:1		e (%)	Maximum Relative Slope 152:1		e (%)	Maximum Relative Slope 161:1		e (%)	Maximum Relative Slope 172:1		e (%)	Maximum Relative Slope 185:1		e (%)	Maximum Relative Slope 200:1	
		L (ft.)	L_r (ft.)		L (ft.)	L_r (ft.)		L (ft.)	L_r (ft.)		L (ft.)	L_r (ft.)		L (ft.)	L_r (ft.)		L (ft.)	L_r (ft.)
8000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0
6000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	2.0	48	48
5000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	2.0	44	44	2.0	48	48
4000	NC	0	0	NC	0	0	NC	0	0	2.0	41	41	2.0	44	44	2.3	48	55
3500	NC	0	0	NC	0	0	2.0	39	39	2.0	41	41	2.2	44	49	2.5	48	60
3000	NC	0	0	NC	0	0	2.0	39	39	2.1	41	43	2.4	44	53	2.7	48	65
2500	NC	0	0	2.0	36	36	2.0	39	39	2.3	41	47	2.6	44	58	2.9	48	70
2000	2.0	34	34	2.0	36	36	2.3	39	45	2.6	41	54	2.8	44	62	3.2	48	77
1800	2.0	34	34	2.0	36	36	2.4	39	46	2.7	41	56	3.0	44	67	3.3	48	79
1600	2.0	34	34	2.2	36	40	2.5	39	48	2.8	41	58	3.2	44	71	3.5	48	84
1400	2.0	34	34	2.3	36	42	2.6	39	50	3.0	41	62	3.3	44	73	3.7	48	89
1200	2.1	34	36	2.4	36	44	2.8	39	54	3.2	41	66	3.6	44	80	3.9	48	94
1000	2.3	34	39	2.6	36	47	3.0	39	58	3.4	41	70	3.8	44	84	4.0	48	96
900	2.4	34	41	2.7	36	49	3.1	39	60	3.6	41	74	3.9	44	87	Rmin = 926		
800	2.4	34	41	2.8	36	51	3.3	39	64	3.7	41	76	4.0	44	89			
700	2.5	34	43	3.0	36	55	3.4	39	66	3.9	41	80	Rmin = 711					
600	2.7	34	46	3.2	36	58	3.6	39	70	4.0	41	83						
500	2.8	34	48	3.4	36	62	3.9	39	75	Rmin = 533								
450	2.9	34	50	3.5	36	64	4.0	39	77									
400	3.1	34	53	3.6	36	65	4.0	39	77									
350	3.2	34	55	3.8	36	69	Rmin = 371											
300	3.4	34	58	3.9	36	71												
250	3.6	34	62	4.0	36	73	Rmin = 250											
200	3.8	34	65															
Rmin = 154																		

$e_{max} = 4\%$

Source: Adapted from "A Policy on Geometric Design of Highways and Streets", (Reference 3.1), Eq. 3-12 thru 3-24. For additional information see Reference 3.1, EXHIBIT 3-25.

KEY:
V = Assumed design speed
e = Rate of superelevation
L = Tangent runout based on a 12 ft. lane
Lr = Minimum length of superelevation runoff based on a 12 ft. lane
NC = Normal crown section

Exhibit 3.3d Superelevation Data for Crowned Highways
Values for Design Elements Related to Design Speed and Horizontal Curvature
(e_{max}=4%)



* THE SHOULDER SLOPE SHALL BE MAINTAINED UNTIL THE SUPERELEVATION RATE ON THE ROADWAY IS SUCH THAT THE ALGEBRAIC DIFFERENCE BETWEEN CROSS SLOPES ON THE ROADWAY AND SHOULDER EQUALS 7%. THIS ALGEBRAIC DIFFERENCE SHALL NOT EXCEED 7%.

① FOR THE OUTER ROADWAY, THE AXIS OF ROTATION SHALL SHIFT FROM THE CENTERLINE OF THE LANES TO THE INSIDE EDGE OF THE 12 FT. INSIDE LANE WHEN THE SUPERELEVATION TRANSITION ATTAINS REVERSE CROWN.

SUPERELEVATION FOR DUAL HIGHWAYS
WITH DEPRESSED MEDIANS OF 40 FOOT OR LESS IN WIDTH
(CROWNED SURFACE)

Exhibit 3.4a Superelevation Data for Dual Highways (Crowned Surface)
Depressed Median Width = 40 Foot or Less
Typical Sections

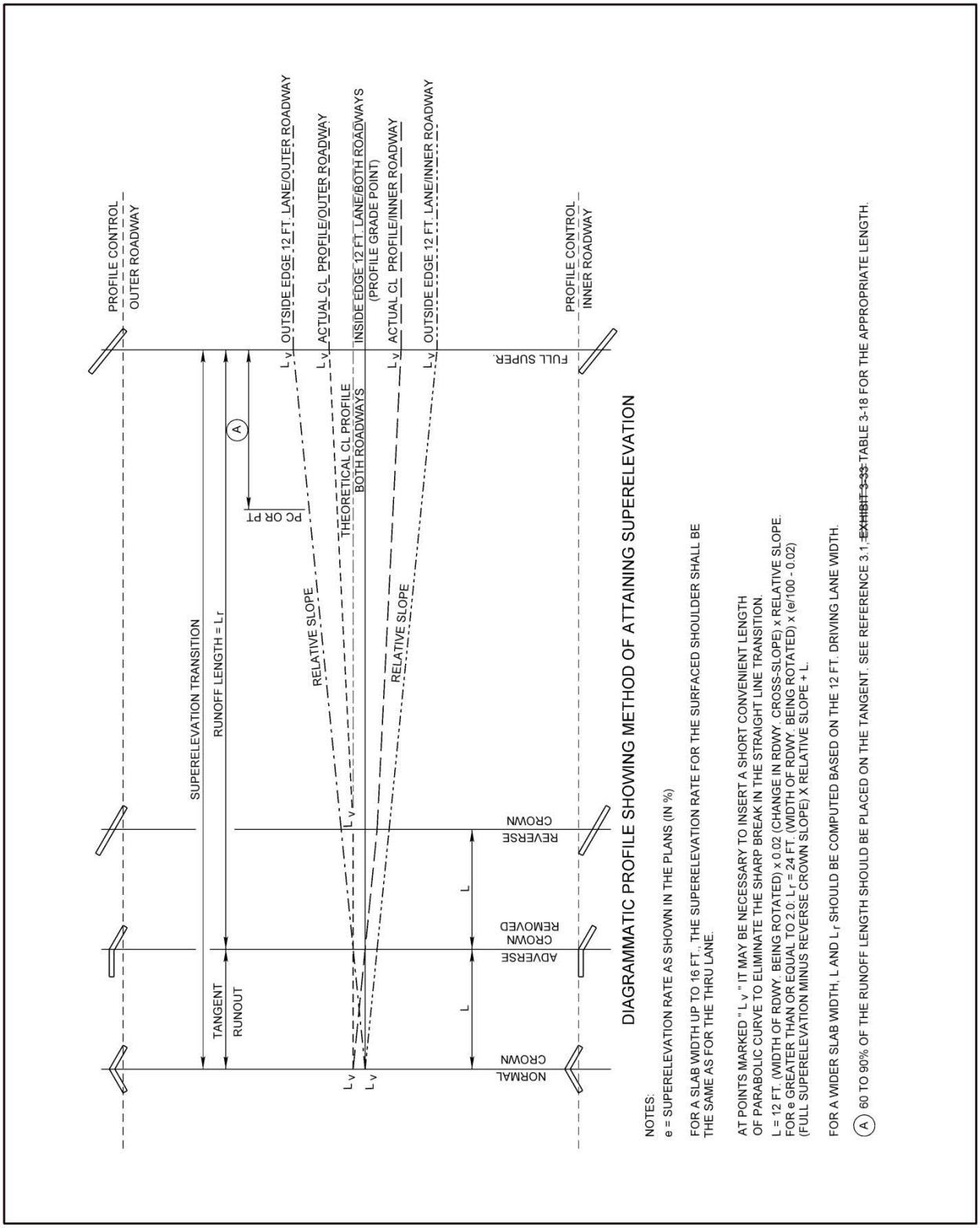


Exhibit 3.4b Superelevation Data for Dual Highways (Crowned Surface)
Depressed Median Width = 40 Foot or Less
Diagrammatic Profile

Radius of Curve (ft.)	V=50 mph			V=55 mph			V=60 mph			V=65 mph			V=70 mph			V=75 mph			V=80 mph		
	e (%)	Maximum Relative Slope 200:1		e (%)	Maximum Relative Slope 213:1		e (%)	Maximum Relative Slope 222:1		e (%)	Maximum Relative Slope 233:1		e (%)	Maximum Relative Slope 250:1		e (%)	Maximum Relative Slope 263:1		e (%)	Maximum Relative Slope 286:1	
		L (ft.)	L_r(ft.)		L (ft.)	L_r(ft.)		L (ft.)	L_r(ft.)		L (ft.)	L_r(ft.)		L (ft.)	L_r(ft.)		L (ft.)	L_r(ft.)		L (ft.)	L_r(ft.)
23000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0
20000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0
17000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0
14000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	2.0	63	63	2.0	69	69
12000	NC	0	0	NC	0	0	NC	0	0	2.0	56	56	2.0	60	60	2.0	63	63	2.1	69	76
10000	NC	0	0	NC	0	0	2.0	53	53	2.0	56	56	2.1	60	66	2.3	63	82	2.5	69	103
8000	NC	0	0	2.0	51	51	2.0	53	53	2.3	56	73	2.5	60	90	2.8	63	113	3.1	69	144
6000	2.0	48	48	2.2	51	61	2.6	53	85	2.9	56	106	3.2	60	132	3.5	63	158	4.0	69	206
5000	2.2	48	58	2.6	51	82	3.0	53	106	3.3	56	129	3.7	60	162	4.1	63	196	4.6	69	247
4000	2.7	48	82	3.1	51	107	3.6	53	138	4.0	56	168	4.4	60	204	4.9	63	246	5.5	69	309
3500	3.0	48	96	3.5	51	128	3.9	53	154	4.4	56	190	4.9	60	234	5.3	63	271	5.9	69	337
3000	3.4	48	115	3.8	51	143	4.3	53	176	4.8	56	212	5.4	60	264	5.7	63	297	Rmin = 3050		
2500	3.8	48	134	4.3	51	168	4.8	53	202	5.3	56	240	5.8	60	288	6.0	63	315			
2000	4.3	48	158	4.9	51	199	5.4	53	234	5.8	56	268	Rmin = 2040			Rmin = 2500					
1800	4.6	48	173	5.1	51	209	5.6	53	245	6.0	56	280									
1600	4.9	48	187	5.4	51	225	5.8	53	255	Rmin = 1660											
1400	5.2	48	202	5.7	51	240	6.0	53	266												
1200	5.5	48	216	5.9	51	250	Rmin = 1330														
1000	5.9	48	235	Rmin = 1060																	
900	6.0	48	240																		

Rmin = 833

e_{max} = 6%

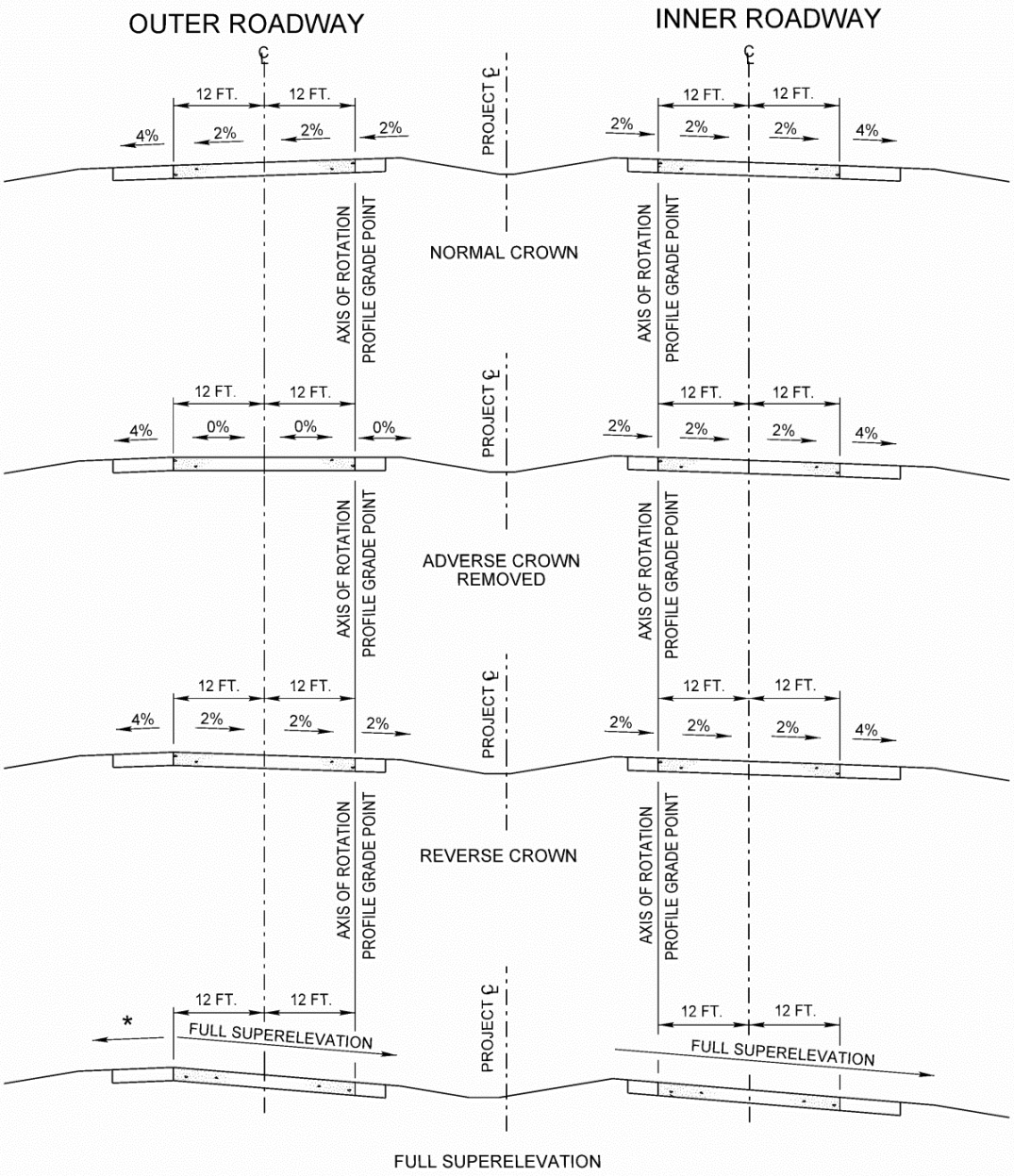
Source: Adapted from "A Policy on Geometric Design of Highways and Streets", (Reference 3.1), Eq. 3-12 thru 3-24. For additional information see Reference 3.1, EXHIBIT 3-26.

KEY:

V = Assumed design speed
e = Rate of superelevation
L = Tangent runout based on a 12 ft. lane
Lr = Minimum length of superelevation runoff based on a 24 ft. roadway
NC = Normal crown section

Notes: For 4 lane divided roadways with medians greater than 40 ft. in width, use the relative gradient given for the 2 lane roadway in Exhibit 3.3

Exhibit 3.4c Superelevation Data for Dual Highways (Crowned Surface)
Depressed Median Width = 40 Foot or Less
Values for Design Elements Related to Design Speed and Horizontal Curvature
(e_{max}=6%)



* THE SHOULDER SLOPE SHALL BE MAINTAINED UNTIL THE SUPERELEVATION RATE ON THE ROADWAY IS SUCH THAT THE ALGEBRAIC DIFFERENCE BETWEEN CROSS SLOPES ON THE ROADWAY AND SHOULDER EQUALS 7%. THIS ALGEBRAIC DIFFERENCE SHALL NOT EXCEED 7%.

SUPERELEVATION FOR DUAL HIGHWAYS
WITH DEPRESSED MEDIANS OF 40 FOOT OR LESS IN WIDTH
(TANGENT SURFACE)

Exhibit 3.5a Superelevation Data for Dual Highways (Tangent Surface)
Depressed Median Width = 40 Foot or Less
Typical Sections

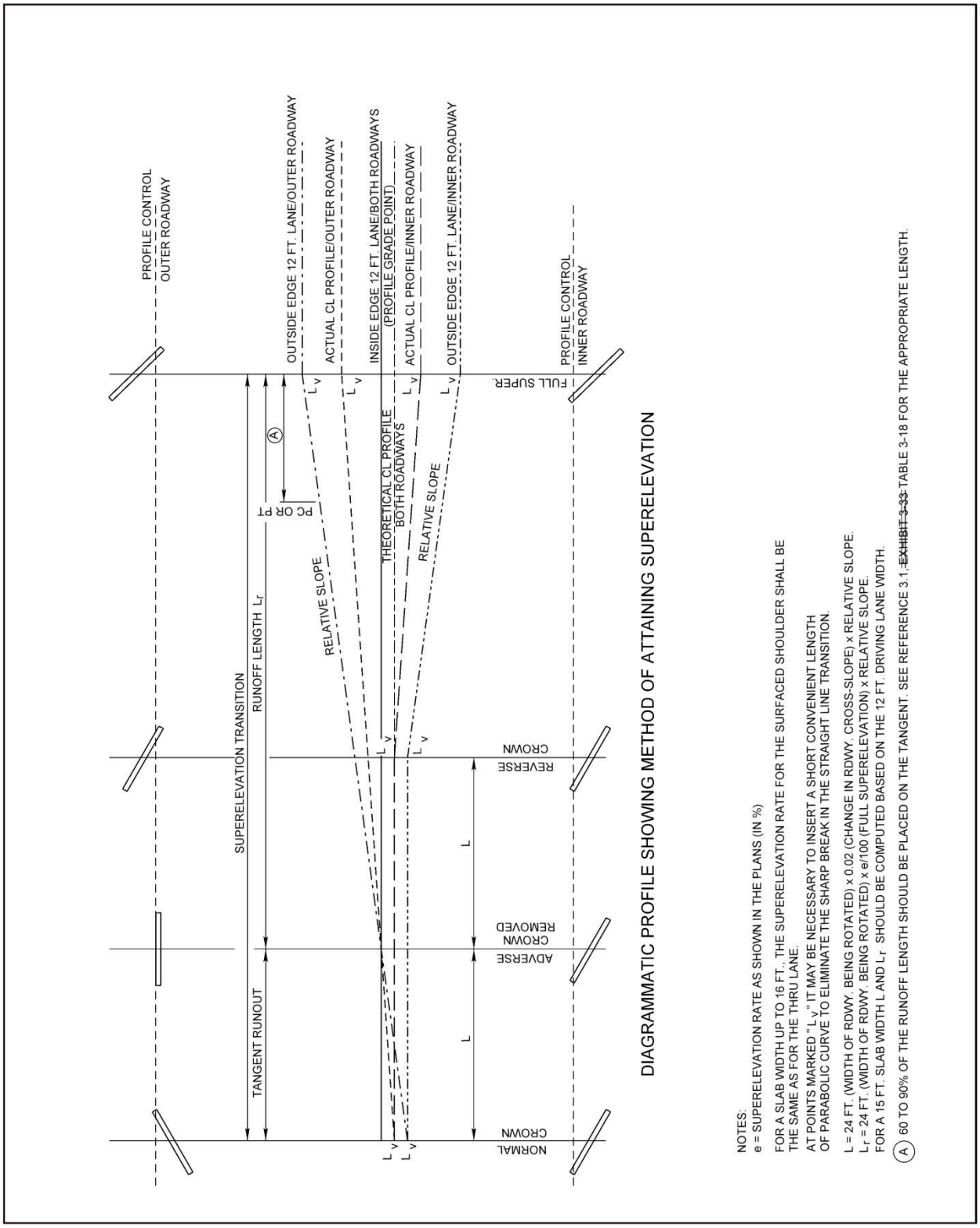
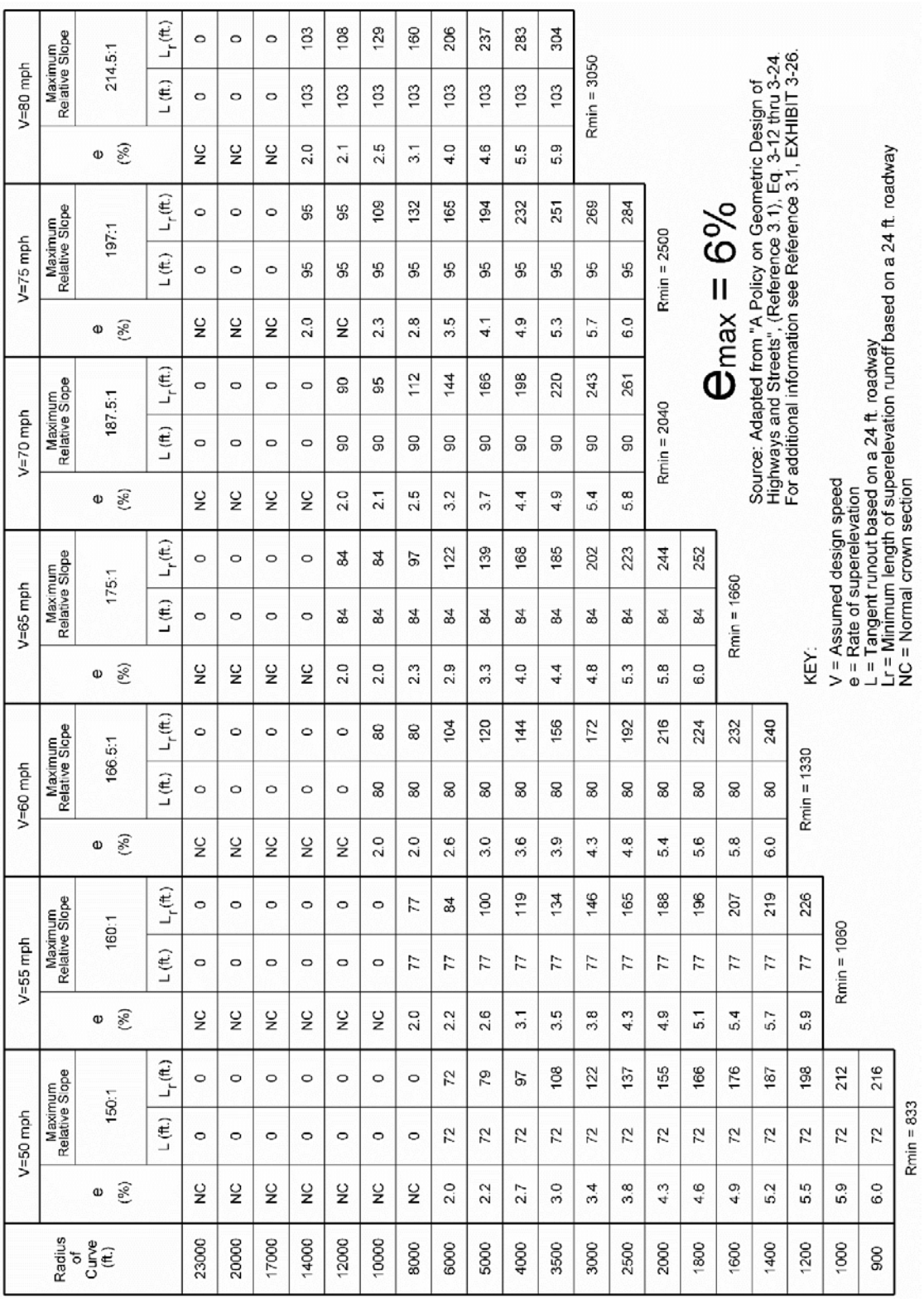


Exhibit 3.5b Superelevation Data for Dual Highways (Tangent Surface)
Depressed Median Width = 40 Foot or Less
Diagrammatic Profile



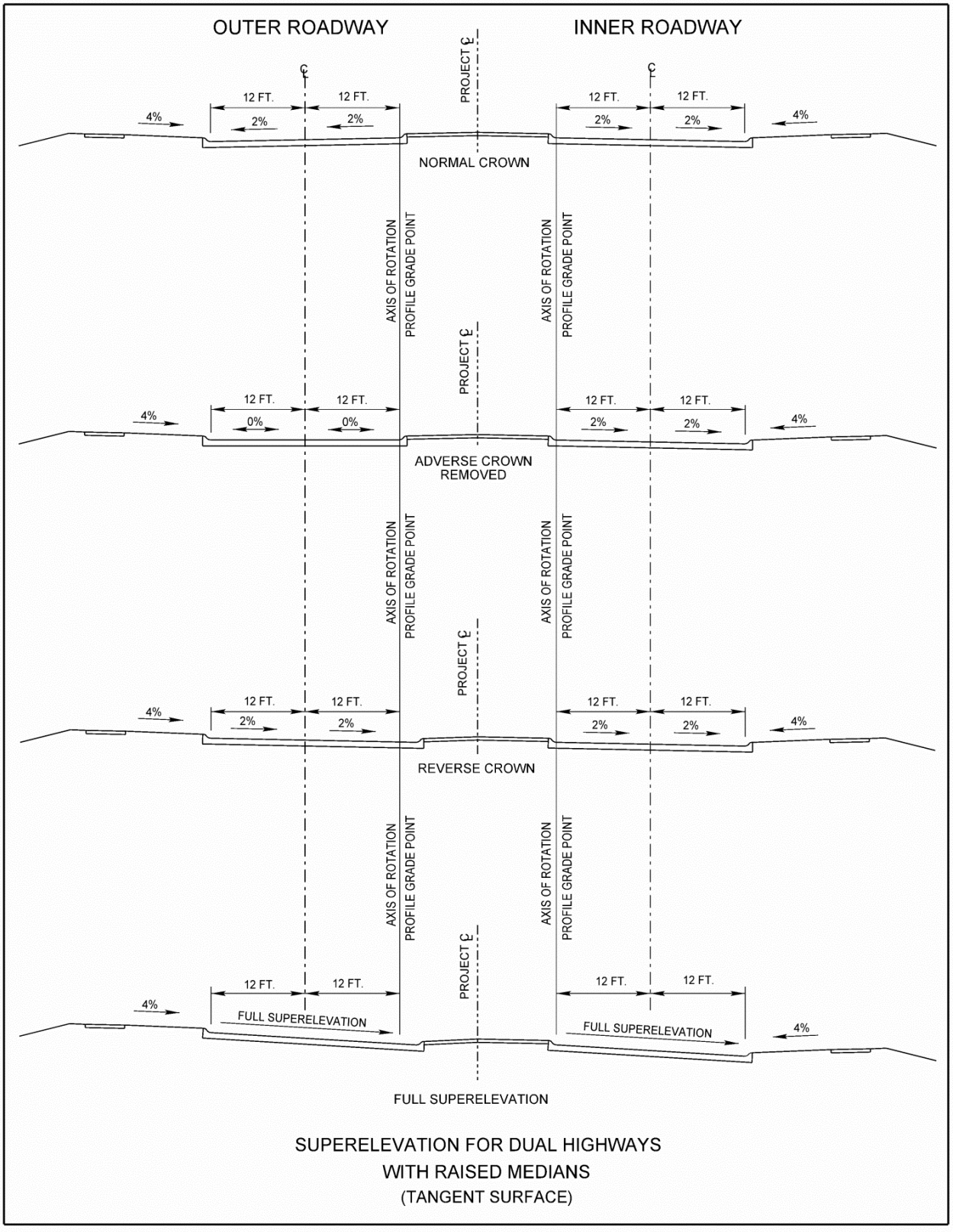
Radius of Curve (ft.)	V=50 mph			V=55 mph			V=60 mph			V=65 mph			V=70 mph			V=75 mph			V=80 mph		
	e (%)	Maximum Relative Slope 150:1		e (%)	Maximum Relative Slope 160:1		e (%)	Maximum Relative Slope 166.5:1		e (%)	Maximum Relative Slope 175:1		e (%)	Maximum Relative Slope 187.5:1		e (%)	Maximum Relative Slope 197:1		e (%)	Maximum Relative Slope 214.5:1	
		L (ft.)	L_r (ft.)		L (ft.)	L_r (ft.)		L (ft.)	L_r (ft.)		L (ft.)	L_r (ft.)		L (ft.)	L_r (ft.)		L (ft.)	L_r (ft.)		L (ft.)	L_r (ft.)
23000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0
20000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0
17000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0
14000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	2.0	95	95	2.0	103	103
12000	NC	0	0	NC	0	0	NC	0	0	2.0	84	84	2.0	90	90	NC	95	95	2.1	103	108
10000	NC	0	0	NC	0	0	2.0	80	80	2.0	84	84	2.1	90	95	2.3	95	109	2.5	103	129
8000	NC	0	0	2.0	77	77	2.0	80	80	2.3	84	97	2.5	90	112	2.8	95	132	3.1	103	160
6000	2.0	72	72	2.2	77	84	2.6	80	104	2.9	84	122	3.2	90	144	3.5	95	165	4.0	103	206
5000	2.2	72	79	2.6	77	100	3.0	80	120	3.3	84	139	3.7	90	166	4.1	95	194	4.6	103	237
4000	2.7	72	97	3.1	77	119	3.6	80	144	4.0	84	168	4.4	90	198	4.9	95	232	5.5	103	283
3500	3.0	72	108	3.5	77	134	3.9	80	156	4.4	84	185	4.9	90	220	5.3	95	251	5.9	103	304
3000	3.4	72	122	3.8	77	146	4.3	80	172	4.8	84	202	5.4	90	243	5.7	95	269	Rmin = 3050		
2500	3.8	72	137	4.3	77	165	4.8	80	192	5.3	84	223	5.8	90	261	6.0	95	284			
2000	4.3	72	155	4.9	77	188	5.4	80	216	5.8	84	244	Rmin = 2040			Rmin = 2500					
1800	4.6	72	166	5.1	77	196	5.6	80	224	6.0	84	252									
1600	4.9	72	176	5.4	77	207	5.8	80	232	Rmin = 1660											
1400	5.2	72	187	5.7	77	219	6.0	80	240												
1200	5.5	72	198	5.9	77	226	Rmin = 1330														
1000	5.9	72	212	Rmin = 1080																	
900	6.0	72	216																		
	Rmin = 833																				

$e_{max} = 6\%$

Source: Adapted from "A Policy on Geometric Design of Highways and Streets", (Reference 3.1), Eq. 3-12 thru 3-24. For additional information see Reference 3.1, EXHIBIT 3-26.

KEY:
V = Assumed design speed
e = Rate of superelevation
L = Tangent runout based on a 24 ft. roadway
Lr = Minimum length of superelevation runoff based on a 24 ft. roadway
NC = Normal crown section

Exhibit 3.5c Superelevation Data for Dual Highways (Tangent Surface)
Depressed Median Width = 40 Foot or Less
Values for Design Elements Related to Design Speed and Horizontal Curvature
(e_{max}=6%)



SUPERELEVATION FOR DUAL HIGHWAYS
WITH RAISED MEDIANS
(TANGENT SURFACE)

Exhibit 3.6a Superelevation Data for Dual Highways w/Raised Median Typical Sections

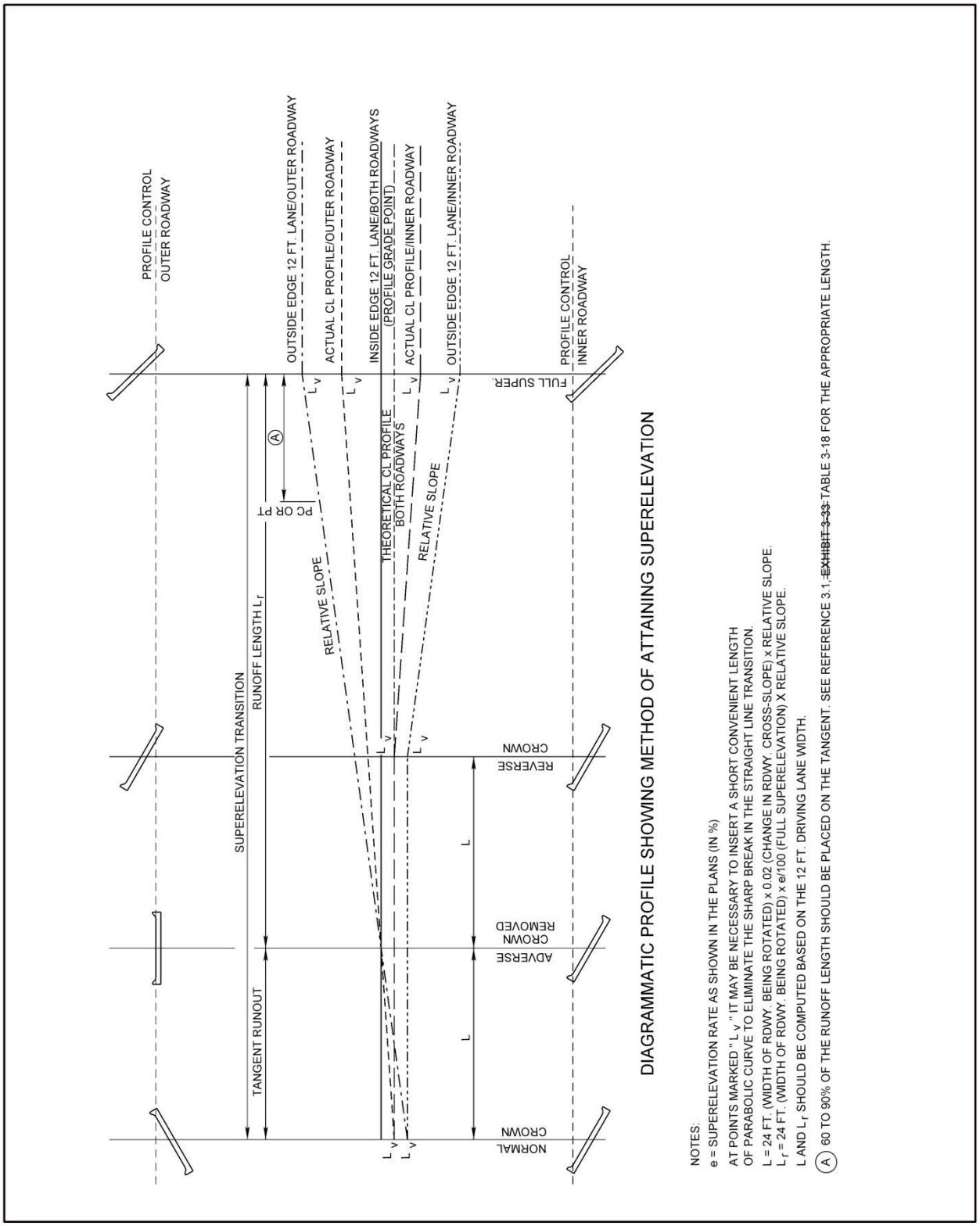


Exhibit 3.6b Superelevation Data for Dual Highways w/Raised Median Diagrammatic Profile

Radius of Curve (ft.)	V=25 mph			V=30 mph			V=35 mph			V=40 mph			V=45 mph		
	e (%)	Maximum Relative Slope 107.25:1		e (%)	Maximum Relative Slope 114:1		e (%)	Maximum Relative Slope 120.75:1		e (%)	Maximum Relative Slope 129:1		e (%)	Maximum Relative Slope 138.75:1	
		L (ft.)	L_r (ft.)		L (ft.)	L_r (ft.)		L (ft.)	L_r (ft.)		L (ft.)	L_r (ft.)		L (ft.)	L_r (ft.)
8000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0
6000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0
5000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	2.0	67	67
4000	NC	0	0	NC	0	0	NC	0	0	2.0	62	62	2.0	67	67
3500	NC	0	0	NC	0	0	2.0	58	58	2.0	62	62	2.2	67	73
3000	NC	0	0	NC	0	0	2.0	58	58	2.1	62	65	2.4	67	80
2500	NC	0	0	2.0	55	55	2.0	58	58	2.3	62	71	2.6	67	87
2000	2.0	51	51	2.0	55	55	2.3	58	67	2.6	62	80	2.8	67	93
1800	2.0	51	51	2.0	55	55	2.4	58	70	2.7	62	84	3.0	67	100
1600	2.0	51	51	2.2	55	60	2.5	58	72	2.8	62	87	3.2	67	107
1400	2.0	51	51	2.3	55	63	2.6	58	75	3.0	62	93	3.3	67	110
1200	2.1	51	54	2.4	55	66	2.8	58	81	3.2	62	99	3.6	67	120
1000	2.3	51	59	2.6	55	71	3.0	58	87	3.4	62	105	3.8	67	127
900	2.4	51	62	2.7	55	74	3.1	58	90	3.6	62	111	3.9	67	130
800	2.4	51	62	2.8	55	77	3.3	58	96	3.7	62	115	4.0	67	133
700	2.5	51	64	3.0	55	82	3.4	58	99	3.9	62	121			
600	2.7	51	69	3.2	55	88	3.6	58	104	4.0	62	124			
500	2.8	51	72	3.4	55	93	3.9	58	113						
450	2.9	51	75	3.5	55	96	4.0	58	116						
400	3.1	51	80	3.6	55	98	4.0	58	116						
350	3.2	51	82	3.8	55	104									
300	3.4	51	88	3.9	55	107									
250	3.6	51	93	4.0	55	109									
200	3.8	51	98												

Rmin = 154

Rmin = 250

Rmin = 371

Rmin = 533

Rmin = 711

$e_{max} = 4\%$

Source: Adapted from "A Policy on Geometric Design of Highways and Streets", (Reference 3.1), Eq. 3-12 thru 3-24. For additional information see Reference 3.1, EXHIBIT 3-25.

KEY:

V = Assumed design speed
e = Rate of superelevation
L = Tangent runout based on a 24 ft. roadway
Lr = Minimum length of superelevation runoff based on a 24 ft. roadway
NC = Normal crown section

Note: For values for a high-speed roadway (> 45 mph), see Exhibit 3.5c.

Exhibit 3.6c Superelevation Data for Dual Highways w/Raised Median
Values for Design Elements Related to Design Speed and Horizontal Curvature
(e_{max}=4%)

3. VERTICAL ALIGNMENT DESIGN

The vertical alignment (profile grade line) is a reference line which establishes the elevation of the pavement and other features of the highway. Vertical alignment is influenced by such factors as:

- Design speed
- Design year traffic volumes
- Environmental concerns
- Location (e.g. in a Flood Plain)
- Topography
- Earthwork
- Horizontal alignment
- Functional classification of the roadway
- Type of improvement
- Vertical clearances
- Geology
- Drainage control
- Construction costs
- Appearance considerations
- Vehicle operating characteristics (trucks)

The performance of heavy vehicles on grades is a significant factor in the development of the vertical alignment.

A practical vertical alignment design will be economically sound and minimize impacts to environmentally sensitive areas while meeting sight distance and other design requirements for the design classification of the highway. Environmental considerations and impacts are a vital component of the design process; the roadway designer shall coordinate with the **Environmental Section** in **PDD** in the development of, and in any subsequent alteration to, the vertical alignment. The vertical alignment should not be changed during the Final Design Phase (Activity 5500).

Projects should be designed to produce balanced earthwork whenever practicable. Adjustments to the vertical alignment are usually preferred to ditch widening. For additional discussion see Chapter Seven: Earthwork, Section 1.

There should be a smooth transition between the proposed profile grade line and the existing grade line of an adjacent highway section. Connections with previously constructed projects should be compatible with the design speed of the proposed project. A connecting profile grade line should be established which satisfactorily joins to the existing alignment. Existing grade lines should be considered for a distance of 2000 feet or more, if practical, to address the sight distance beyond the proposed project limits.

For additional information see “Vertical Alignment” in Chapter Three of the *Green Book* (Ref. 3.1).

3.A Grades

3.A.1 Maximum Grades

A Policy on Design Standards Interstate System (Ref. 3.8) and the *Green Book* (Ref. 3.1) establish the applicable maximum grades for use on the National Highway System (NHS). The **Board of Public Roads Classifications and Standards** establishes the maximum allowable grades for State highways in the Nebraska Minimum Design Standards (*MDS*) (Ref. 3.2) (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/). Grades steeper than those given shall only be used with an approved design exception from the **Federal Highway Administration** (**FHWA**) and/or an approved design relaxation from the **Board of Public Roads Classifications and Standards** (See Appendix H, "Application of Design Standards"). Grades which are less than the maximum should be used whenever practical.

3.A.2 Minimum Grades For Drainage

1. Rural Curbed Roadways and Bridges: A minimum grade of 0.50% is acceptable. Flatter grades may cause stormwater runoff to spread across the traveled way.
2. Urban Curbed Roadways: A minimum grade of 0.35% is acceptable. Flatter grades, down to and including 0.20%, may be used with **Unit Head** approval. As an alternative to a grade flatter than 0.35%, rolling the gutterline and warping the centerline grade line at a minimum slope of 0.35% may be considered.
3. Non-curbed Roadways: Level longitudinal gradients are acceptable where the pavement is crowned 2% or more, provided that consideration is given to the need for special ditches.
4. Superelevation Runout: To facilitate pavement drainage, a minimum grade of 1.5% shall be maintained through the area where the adverse crown has been removed. A flatter grade, down to and including 0.5%, may be used with **Unit Head** approval.

3.A.3 Critical Length of Grade

Critical length of grade is the maximum length of a designated upgrade on which a loaded truck can operate without an unreasonable reduction in speed. For normal design purposes, a maximum speed reduction of 10 mph is acceptable. If this speed reduction is exceeded, the designer should consider shortening the length of grade, flattening the grade, or adding a climbing lane.

3.A.4 Climbing Lanes

The **Traffic Engineering Division** (**Traffic Engineering**) analyzes the need for climbing lanes based on capacity and operations characteristics. The type of roadway facility is usually taken into consideration in the climbing lane analysis. Climbing lanes may be provided on arterial highways based on speed differential and capacity analysis. Climbing lanes may be provided on collector two-lane highways based on speed reduction only. Climbing lanes should be used to provide uniformity of operation rather than to avoid extreme congestion and disruption. Climbing lanes are applicable on multilane highways where extreme grade conditions reduce the level of service below that provided in adjacent roadway sections. Climbing lanes on multilane facilities may not be warranted until several years after construction; for this condition there may be an economic advantage in designing and grading for, but deferring the pavement construction of, climbing lanes on multilane facilities. EXHIBIT 3.7 summarizes the **NDOT** standards for the design of climbing lanes. See "Climbing Lanes" in Chapter 3 of the *Green Book* (Ref. 3.1) for additional information.

Design Element	Desirable	Minimum
Lane Width	Same as approach roadway.	Same as approach roadway.
Shoulder Width	Same as approach roadway. For turf shoulders, same as minimum requirement.	Expressway: Same as approach roadway. Other: 4 feet paved plus 2 feet turf. (4)
Cross Slope on Tangent	Same as adjacent travel lane.	Same as adjacent travel lane.
Superelevation	(1)	(1)
Beginning of Full-Width Lane	Near the Vertical Point of Tangency (VPT) of the grade.	Where the truck speed is 10 mph below highway design speed or is at 45 mph, whichever is less. (2)
End of Full-Width Lane (3)	Where the truck has reached highway design speed.	Where the truck has reached 10 mph below highway design speed. (2)
Entering Taper	1:25	300 feet
Exiting Taper	1:50	600 feet
Minimum Full-Width Length (3)	N/A	1000 feet

1. For horizontal curves on climbing lanes, determine the proper superelevation of the climbing lane on the high side by reading the applicable superelevation table for V = 40 mph or the design speed, whichever is less (See Section 2.B). This reflects the slower operating speeds of the climbing lane. The maximum allowable difference in cross slope between the travel lane and the climbing lane is 4%.
2. See Chapter 3 of A Policy on Geometric Design of Highways and Streets (Ref. 3.1), **FIGURE 3-28**, to determine truck deceleration and acceleration rates.
3. The designer will provide sufficient decision sight distance and length of auxiliary lane past the crest of a vertical curve to allow for the completion of the merger maneuver. The designer should coordinate the design of the auxiliary lane with **Traffic Engineering**.
4. If there is a mailbox located within the climbing lane, the surfaced mailbox turnout width will be 10 feet, 8 feet of which will be surfaced. See the Standard/Special Plans Book (*Standard Plans*) (Ref. 3.3).

Exhibit 3.7 Standards for Climbing Lanes

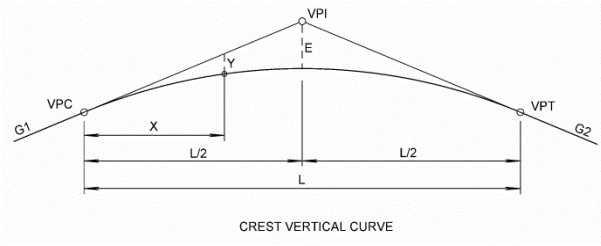
3.B Vertical Curves

Vertical curves join two intersecting tangents to provide a smooth transition between changes in grade. Vertical curves are not required on low-speed roadways (≤ 45 mph) where the algebraic difference in grades is less than 1%; high-speed roadways (≥ 50 mph) will generally require a vertical curve when the change in grade is greater than 0.5%. Curves must be long enough to provide desirable stopping sight distance but should not be flattened to such an extent as to make drainage a problem. A series of angular breaks in lieu of a vertical curve is not an acceptable design. For additional information see NCHRP Synthesis 299, Recent Geometric Design Research for Improved Safety and Operations (Ref. 3.7).

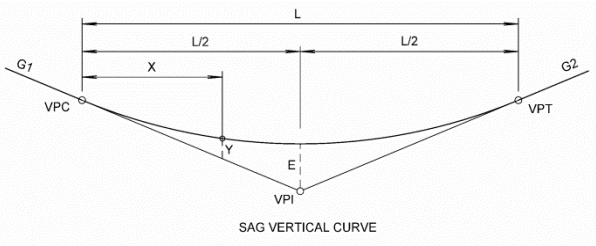
3.B.1 Vertical Curve Computations

The **NDOT** uses the symmetrical parabolic curve. Symmetrical curves are those with equal tangent lengths at the point where the curve is divided by the vertical point of intersection (VPI) of the two tangents. Asymmetrical vertical curves (curves with unequal tangent lengths) are sometimes used in unique situations, such as to provide vertical clearance at a bridge structure where a symmetrical curve will not work. Equations for asymmetric curves may be found in many engineering manuals. Compound curves designed in the vertical plane may also be used in these situations.

Dimensions and equations for use in symmetrical vertical curve computations are shown in EXHIBIT 3.8. The symbols, abbreviations, and formulas apply to both crest and sag vertical curves. It is **NDOT** practice to design vertical curves so that the vertical PC and PT fall on even stationing.



CREST VERTICAL CURVE



SAG VERTICAL CURVE

Vertical Curve Symbols and Abbreviations		**Vertical Curve Formulas**
VPC	Vertical point of curvature (beginning of curve)	$V = E_O + [L/2 \times G1]$
VPI	Vertical point of intersection of grades	$E_T = V - [L/2 \times G2]$
VPT	Vertical point of tangency (end of curve)	$R = (G2 - G1)/L$
G1	Grade at beginning of curve, ft/ft	$E_X = E_O + G1X + {}^1/_2RX^2$
G2	Grade at end of curve, ft/ft	$E_S = E_O - [G1^2 \div 2R]$
E	External distance from VPI to curve	$X_S = -G1/R$ (if X_S is negative or if $X_S > L$, the curve doesn't have a high point or a low point)
L	Horizontal length of curve	$A = G1 - G2$
R	Rate of change of grade, ft/ft	$E = AL/800$
E_O	Elevation of VPC	$Y = (X \div L/2)^2 \times E$
V	Elevation of VPI	
E_T	Elevation of VPT	
X	Distance of any point on the curve from the VPC	
Y	Tangent offset to curve at X distance from the VPC	
E_X	Elevation of any point X distance from the VPC	
X_S	Distance from the VPC to lowest point of a sag curve or highest point of a crest curve	
E_S	Elevation of lowest point on a sag curve or highest point on a crest curve	
A	Algebraic difference of grades, %	

Exhibit 3.8 Elements and Formulas for Symmetrical Parabolic Vertical Curves

3.B.2 Design

The primary design control for the minimum length of a vertical curve is stopping sight distance. The minimum vertical curve length in feet should be approximately three times the design speed of the roadway when the length of curve is less than the desirable stopping sight distance.

The relationship of the curve length (L) and the algebraic difference in percent of grades (A) or L/A, is termed the K value. The K value is a measure of curvature, defined as the horizontal distance in feet required to effect a 1% change in grade. K values for roadways on new alignment, with minimum and desirable stopping sight distance for crest and sag vertical curves, are shown in EXHIBITS 3.9 & 3.14 for a range of design speeds and intersection configurations.

The desirable K values shown in EXHIBITS 3.9 & 3.14 should be used for all new and reconstructed projects. The desirable K values provide intersection stopping sight distance for passenger cars for various intersection conditions. If the desirable K values cannot be met, the vertical curve may be designed to any length down to and including stopping sight distance with **Unit Head** approval and a decision letter to the project file (See Appendix H, "Application of Design Standards"). For intersection conditions other than listed in the exhibits, intersections and driveways (except for field entrances) will be evaluated for intersection sight distance according to the procedures presented in Chapter 9 of the *Green Book* (Ref. 3.1), "Intersection Sight Distance".

The minimum K values shown in EXHIBITS 3.9 & 3.14 are from the *Green Book* (Ref. 3.1) and are for stopping sight distance **only** and do not include intersection sight distance. When the minimum K values are used for new and reconstructed projects, intersections and driveways (except for field entrances) will be evaluated for intersection sight distance according to the procedures presented in Chapter 9 of the *Green Book* (Ref. 3.1), "Intersection Sight Distance". The use of the minimum K values will require **Unit Head** approval and a decision letter to the project file (See Appendix H, "Application of Design Standards").

The use of K values below the minimum values given in EXHIBITS 3.9 & 3.14 for a new and reconstructed project will require **Roadway Design Engineer** approval, a design exception from the **FHWA** for projects on the NHS, and/or a relaxation of the *MDS* (Ref. 3.2) (See Appendix H, "Application of Design Standards").

The use of an intersection sight distance less than that given in Chapter 9 of the *Green Book* (Ref. 3.1) will require **Unit Head** approval and a decision letter to the project file (See Appendix H, "Application of Design Standards").

Special attention to pavement drainage must be exercised where a K value in excess of 143 is used, a minimum roadway cross-slope of 1.5% should be maintained. For additional information see Chapter Three of the *Green Book* (Ref. 3.1), "Design Controls – Stopping Sight Distance".

U.S. Customary

Crest Vertical Curve

Design Speed (mph)	Minimum Stopping Sight Distance ①		Desirable Stopping Sight Distance (2-Lane, Left-Turn Condition and 2-Lane w/TWTL **, Left-Turn Condition) ②		Desirable Stopping Sight Distance (5-Lane and 4-Lane Divided w/18' Median, Left-Turn Condition) ③		Desirable Stopping Sight Distance (4-Lane Divided w/40' Median, Left-Turn Condition) (Crowned Lanes @) ④	
	Length (ft)	Rate of Vertical Curvature K*	Length (ft)	Rate of Vertical Curvature K*	Length (ft)	Rate of Vertical Curvature K*	Length (ft)	Rate of Vertical Curvature K*
35	250	29	453	93	500	128	540	125
40	305	44	517	121	570	167	617	163
45	360	61	582	153	642	212	695	207
50	425	84	647	189	713	262	772	255
55	495	114	711	228	784	316	849	308
60	570	151	776	272	855	376	926	367
65	645	193	841	319	927	442	1003	430
70	730	247	906	370	998	512	1080	499

* K is the length of curve per percent algebraic difference in grades (A). K=L/A.

* * TWTL = Two -Way Left-Turn Lane, See Chapter Four, Section 5.C.

@ Check Intersection Sight Distance if Building Tangent Lanes.

① Based on a 3.5' eye height and an object height of 2.0', (See "A Policy on Geometric Design of Highways and Streets", Reference 3.1, EXHIBIT 3-72). These values do not meet intersection sight distance requirements. All intersections and driveways, except for field entrances, shall be evaluated for intersection sight distance according to the proceedures outlined in Chapter 9 of Reference 3.1. Minimum K values may be used on New and Reconstructed projects with Design Unit Head approval.

② Includes Intersection Sight Distance for the given Conditions, (for other intersection conditions see Chapter Four and Reference 3.1, Chapter 9). Based on an 8.8 second gap in traffic, a 2.33 ' eye height and an object height of 3.25'. See Exhibit 3.10a for the derivation of the eye and object heights. The use of K values for less than the desirable stopping sight distance requires Design Unit Head approval.

③ Includes Intersection Sight Distance for the given Conditions, (for other intersection conditions see Chapter Four and Reference 3.1, Chapter 9). Based on a 9.7 second gap in traffic, a 2.0 ' eye height and an object height of 2.9'. See Exhibit 3.10b for the derivation of the eye and object heights. The use of K values for less than the desirable stopping sight distance requires Design Unit Head approval.

④ Includes Intersection Sight Distance for the given Conditions, (for other intersection conditions see Chapter Four and Reference 3.1, Chapter 9). Based on a 10.5 second gap in traffic, a 2.50 ' eye height and an object height of 3.38'. See Exhibit 3.10c for the derivation of the eye and object heights. The use of K values for less than the desirable stopping sight distance requires Design Unit Head approval.

Note: The NDOT time gap is arrived at by adding an initial time gap of 7.5 sec. (left turn from "A Policy on Geometric Design of Highways and Streets", Reference 3.1, Chapter 9) plus 0.8 sec. (1.2 sec. x 4 for a driveway/intersection approach at a 4% grade) plus 0.5 sec. for each additional 12 ft. lane (or for each 12 ft. width of median).

Exhibit 3.9 Design Controls for Crest Vertical Curves

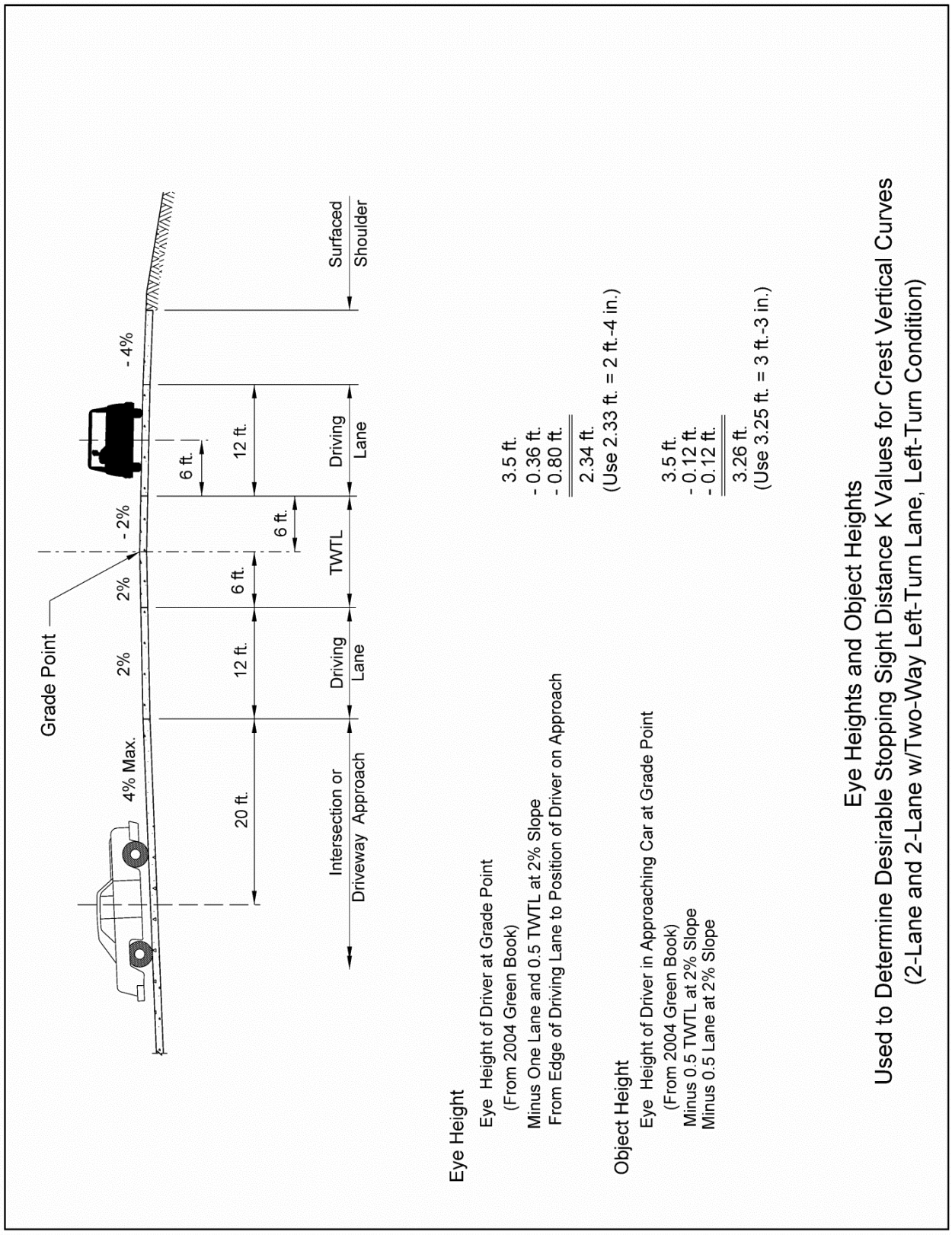


Exhibit 3.10a Eye and Object Heights used to Determine Desirable K Values (Crest Vertical Curves)

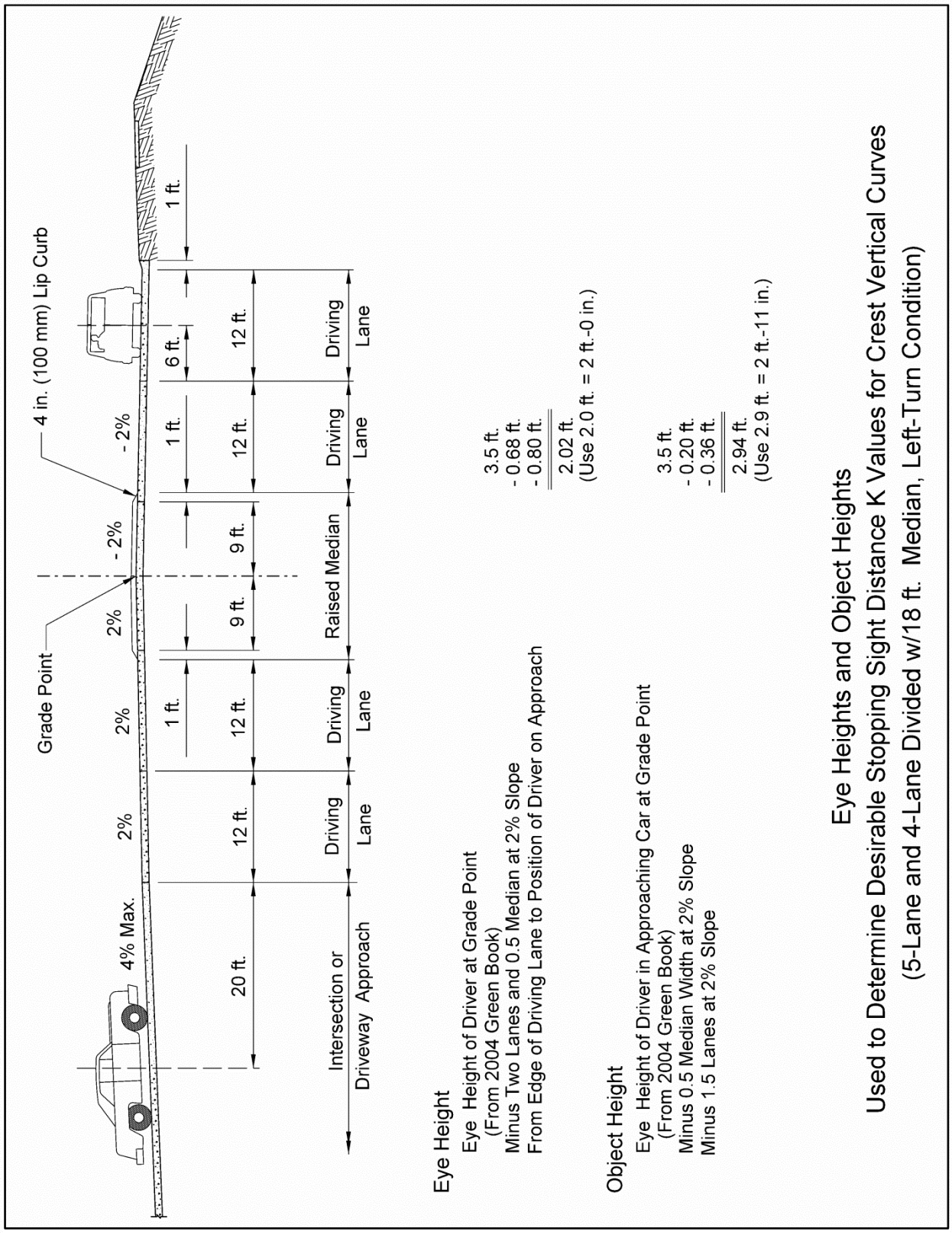


Exhibit 3.10b Eye and Object Heights used to Determine Desirable K Values (Crest Vertical Curves)

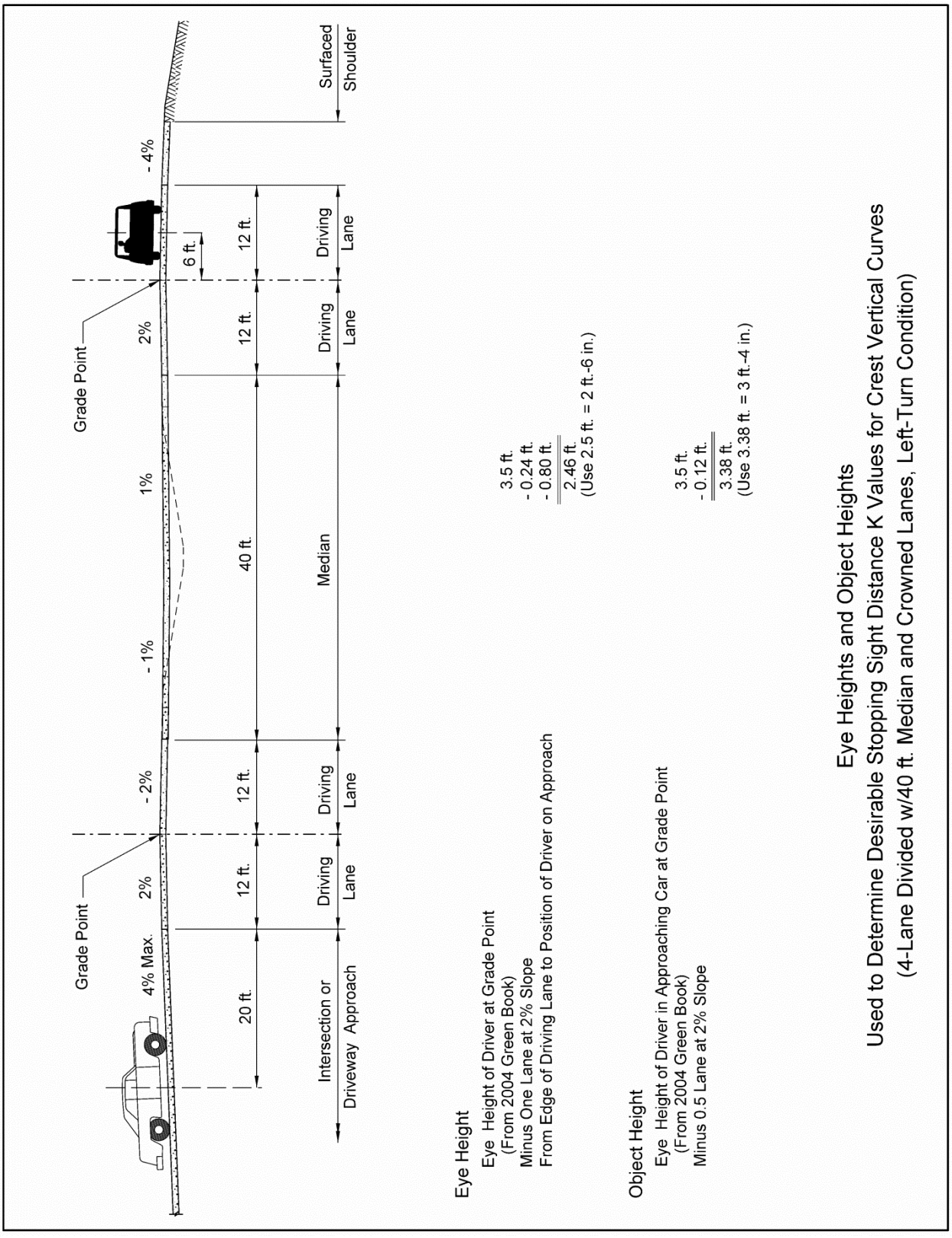


Exhibit 3.10c Eye and Object Heights used to Determine Desirable K Values (Crest Vertical Curves)

3.C Crest Vertical Curves

3.C.1 Stopping Sight Distance

EXHIBIT 3.11 depicts the stopping sight distance height of eye and height of object assumptions for crest vertical curves. The equation given below may be used to determine the length of crest vertical curve which provides the **NDOT desirable** stopping sight distance at each design speed (desirable stopping sight distance includes intersection sight distance).

S_d = 1.47 x speed (mph) x time (sec)

Where:

S_d = stopping sight distance = intersection sight distance in feet.

Time = acceptable time gap in traffic (in seconds) based on intersection conditions (See Chapter Four: Intersections, Driveways and Channelization and Chapter 3 of the *Green Book*, Ref. 3.1). The **NDOT** uses a time gap of 8.8 sec. for the two-lane left-turn condition (the **NDOT** time gap is arrived at by adding an initial time gap of 7.5 sec. (left-turn condition from Chapter 9 of the *Green Book*, Ref. 3.1) plus 0.8 sec. (1.2 sec. x 4 for a driveway/intersection approach at a 4% grade) plus 0.5 sec. for each additional 12 foot lane (or for each 12 feet of median width).

Equations 3-43 & 3-44 of the *Green Book* (Ref. 3.1) may be used to determine the stopping sight distance for crest vertical curves.

When designing a crest vertical curve the designer should refer to EXHIBIT 3.9 in choosing an appropriate K value. Multiply K by A (algebraic difference in grade) to obtain the desirable length of vertical curve (L).

When the desirable sight distance cannot be attained, the vertical curve may be designed to any length down to and including the stopping sight distance shown in EXHIBIT 3.9 with **Unit Head** approval and a decision letter to the project file (See Appendix H, "Application of Design Standards").

The minimum K values shown in EXHIBIT 3.9 are from the *Green Book* (Ref. 3.1) and are for stopping sight distance **only** and do not include intersection sight distance. For intersection conditions other than listed in the exhibit, intersections and driveways on new and reconstructed projects (except for field entrances) will be evaluated for intersection sight distance according to the procedures presented in Chapter 9 of the *Green Book* (Ref. 3.1), "Intersection Sight Distance". The use of an intersection sight distance less than that given in Chapter 9 of the *Green Book* (Ref. 3.1) will require **Unit Head** approval and a decision letter to the project file (See Appendix H, "Application of Design Standards").

The use of K values below the stopping sight distance values given in EXHIBIT 3.9 for a new and reconstructed project will require **Roadway Design Engineer** approval, a design exception from the **FHWA** for projects on the NHS, and/or a relaxation of the *MDS* (Ref. 3.2) (See Appendix H, "Application of Design Standards").

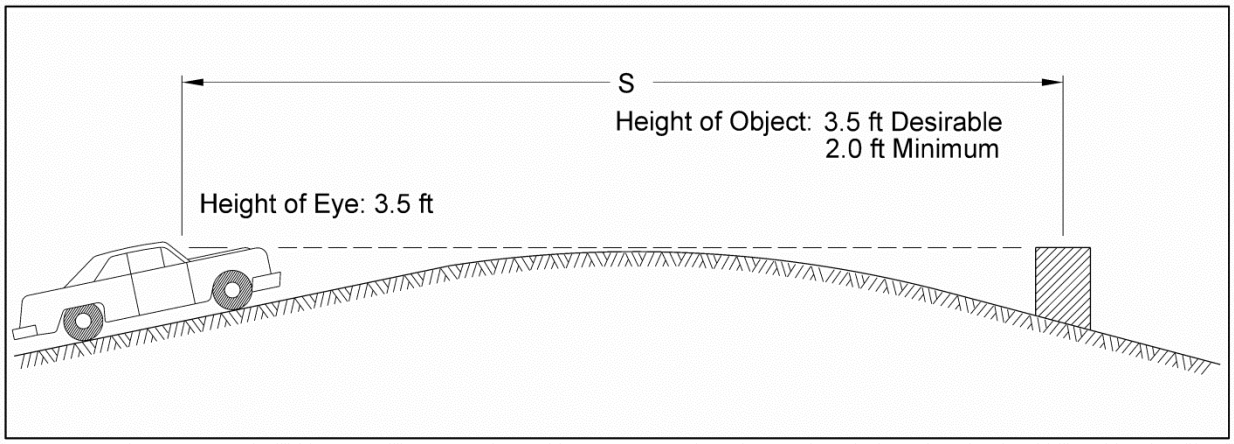


Exhibit 3.11 Crest Vertical Curve Design Elements

3.C.2 Two-Lane, Two-Way Roadways - Passing Sight Distance

Passing sight distance is not one of the thirteen principal controlling design criteria (See Appendix H, "Application of Design Standards"). It is not practical to design crest vertical curves to provide for passing sight distance. For evaluation, **TABLE 3-34** and Equations 3-45 & 3-46 of the Green Book (Ref. 3.1) may be used to determine the minimum length of vertical curve for passing sight distance. For additional information see Chapter 3 of the Green Book (Ref. 3.1), "Passing Sight Distance for Two-Lane Highways".

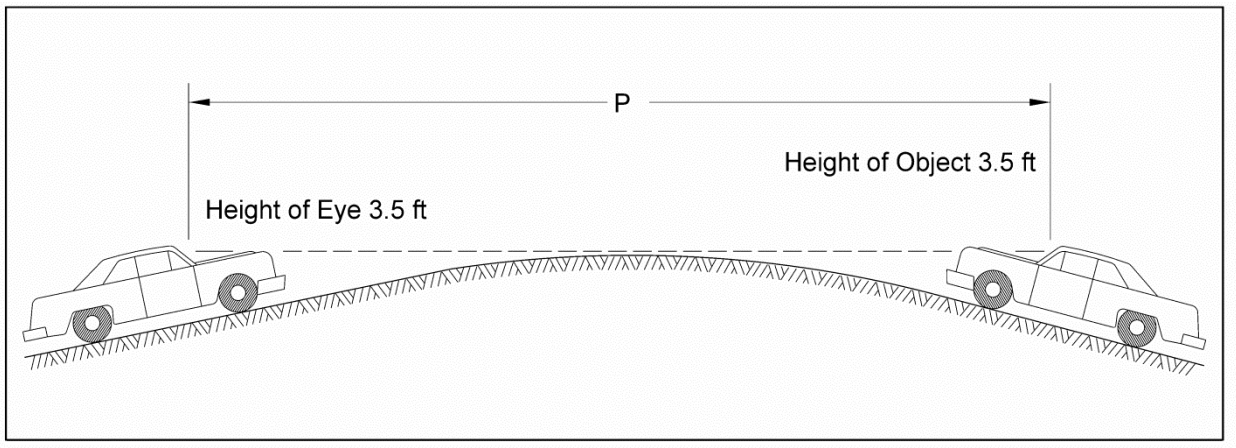


Exhibit 3.12 Passing Sight Distance Design Considerations

3.D Sag Vertical Curves

3.D.1 Stopping Sight Distance

The minimum length of a sag vertical curve depends mainly on headlight distance at night except in areas where roadway lighting is present (See EXHIBIT 3.13). For overall safety on highways, it is desirable that the stopping sight distance be nearly the same as the headlight beam distance.

The equation given below may be used to calculate the length of sag vertical curve which provides the **NDOT desirable** stopping sight distance at each design speed (desirable stopping sight distance includes intersection sight distance).

S = 1.47 x speed (mph) x time (sec)

Where:

S = headlight beam distance = stopping sight distance in feet.

Time = acceptable time gap in traffic (in seconds) based on intersection conditions (See Chapter 3 of the *Green Book*, Ref. 3.1). The **NDOT** uses a time gap of 8.8 sec. for the two-lane, left-turn condition.

Equations 3-48 & 3-50 of the *Green Book* (Ref. 3.1) may be used to determine the stopping sight distance for sag vertical curves.

EXHIBIT 3.14 lists the desirable sight distances and the stopping sight distances for various design speeds. When the desirable sight distance cannot be attained, the vertical curve may be designed down to and including the stopping sight distance with **Unit Head** approval and a decision letter to the project file (See Appendix H, "Application of Design Standards").

The minimum K values shown in EXHIBIT 3.14 are for stopping sight distance **only** and do not include intersection sight distance. For intersection conditions other than those listed in the exhibit, intersections and driveways on new and reconstructed projects (except for field entrances) will be evaluated for intersection sight distance according to the procedures presented in Chapter 9 of the *Green Book* (Ref. 3.1), "Intersection Sight Distance". The use of an intersection sight distance less than that given in the *Green Book* (Ref. 3.1) will require **Unit Head** approval and a decision letter to the project file (See Appendix H, "Application of Design Standards").

The use of K values below the stopping sight distance values given in EXHIBIT 3.14 for a new and reconstructed project will require **Roadway Design Engineer** approval, a design exception from the **FHWA** for projects on the NHS, and/or a relaxation of the *MDS* (Ref. 3.2) (See Appendix H, "Application of Design Standards").

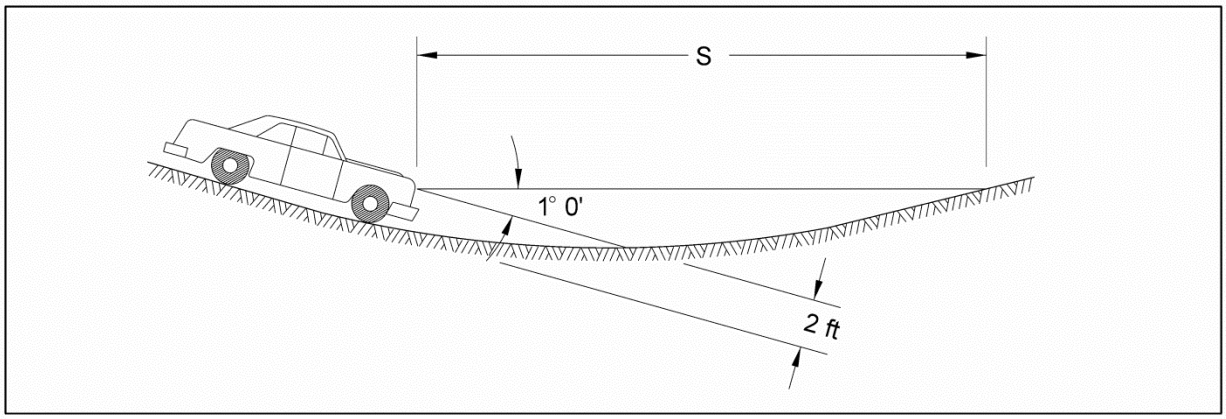


Exhibit 3.13 Sag Vertical Curve Design Elements

U.S. Customary

Sag Vertical Curve

Design Speed (mph)	Minimum Stopping Sight Distance ①		Desirable Stopping Sight Distance (2-Lane, Left-Turn Condition and 2-Lane w/TWTL **, Left-Turn Condition) ②		Desirable Stopping Sight Distance (5-Lane and 4-Lane Divided w/18' Median, Left-Turn Condition) ③		Desirable Stopping Sight Distance (4-Lane Divided w/40' Median, Left-Turn Condition) ④	
	Length (ft)	Rate of Vertical Curvature K*	Length (ft)	Rate of Vertical Curvature K*	Length (ft)	Rate of Vertical Curvature K*	Length (ft)	Rate of Vertical Curvature K*
35	250	49	453	103	500	116	540	127
40	305	64	517	121	570	136	617	149
45	360	79	582	139	642	156	695	170
50	425	96	647	157	713	176	772	192
55	495	115	711	175	784	196	849	214
60	570	136	776	193	855	215	926	236
65	645	157	841	212	927	236	1003	257
70	730	181	906	230	998	256	1080	279

* K is the length of curve per percent algebraic difference in grades (A). K=L/A.

** TWTL = Two -Way Left-Turn Lane, See Chapter Four, Section 5.C.

① Based on a 3.5' eye height, a 2.0' headlight height and a 1 degree upward divergence of the light beam, (See "A Policy on Geometric Design of Highways and Streets", Reference 3.1, EXHIBIT 3-75). These values do not meet intersection sight distance requirements. All intersections and driveways, except for field entrances, shall be evlauated for intersection sight distance according to the proceedures outlined in Chapter 9 of Reference 3.1. Minimum K values may be used on New and Reconstructed projects with Design Unit Head approval.

② Includes Intersection Sight Distance for the given Conditions, (for other intersection conditions see Chapter Four and Reference 3.1, Chapter 9). Based on an 8.8 second gap in traffic, a 3.5' eye height, a headlight height of 2.0' and a 1 degree upward divergence of the light beam, (See Reference 3.1, Chapter 3). The light beam distance has been set to the intersection sight distance. The use of K values for less that the desirable stopping sight distance requires Design Unit Head approval.

③ Includes Intersection Sight Distance for the given Conditions, (for other intersection conditions see Chapter Four and Reference 3.1, Chapter 9). Based on a 9.7 second gap in traffic, a 3.5' eye height, a headlight height of 2.0' and a 1 degree upward divergence of the light beam, (See Reference 3.1, Chapter 3). The light beam distance has been set to the intersection sight distance. The use of K values for less that the desirable stopping sight distance requires Design Unit Head approval.

④ Includes Intersection Sight Distance for the given Conditions, (for other intersection conditions see Chapter Four and Reference 3.1, Chapter 9). Based on a 10.5 second gap in traffic, a 3.5' eye height, a headlight height of 2.0' and a 1 degree upward divergence of the light beam, (See Reference 3.1, Chapter 3). The light beam distance has been set to the intersection sight distance. The use of K values for less that the desirable stopping sight distance requires Design Unit Head approval.

Note: The NDOT time gap is arrived at by adding an initial time gap of 7.5 sec. (left turn from "A Policy on Geometric Design of Highways and Streets", Reference 3.1, Chapter 9) plus 0.8 sec. (1.2 sec. x 4 for a driveway/intersection approach at a 4% grade) plus 0.5 sec. for each additional 12 ft. lane (or for each 12 ft. width of median).

Exhibit 3.14 Design Controls for Sag Vertical Curves

3.D.2 Comfort Criteria

Driver/passenger comfort is affected more by the change in vertical direction on sag vertical curves than on crest vertical curves. This is because the gravitational and centripetal forces are combining rather than opposing. The length of a sag vertical curve required to meet the comfort criteria is approximately 50% of that required to satisfy the stopping sight distance requirement (headlight distance). The minimum length of a sag vertical curve based on comfort criteria may be calculated using Equation 3-51 of the *Green Book* (Ref. 3.1).

3.D.3 Underpass Sight Distance

The designer should verify that, when sag vertical curves are used on underpasses, the overhead structure does not obstruct driver visibility. Equations 3-52 & 3-53 of the *Green Book* (Ref. 3.1) should be used to calculate the appropriate overhead clearance to provide the stopping sight distance.

Underpasses become a design control when the minimum length of sag vertical curve required for unobstructed sight distance exceeds the minimum length of curve required for stopping sight distance (headlight sight distance). The longer of the two lengths will control design.

3.D.4 Vertical Curve with Obstructions

The required minimum vertical clearance over or under an existing or future obstruction of known elevation often dictates that the vertical profile must pass through a specific point to satisfy minimum clearance criteria. The minimum vertical clearance will be measured from the high point of the roadway, including the shoulders. If the minimum vertical clearance point on the profile is located on a vertical curve, the curve length will be dependent upon the required elevation of the given point. “Sight Distance at Undercrossings” in Chapter 3 of the *Green Book* (Ref. 3.1) presents a procedure for calculating the length of vertical curve required to pass the curve through a specific point.

3.D.4.a Minimum Vertical Clearances for Overhead Facilities

The roadway designer should always check the overhead clearance based on the high point of the roadway (including the turf shoulders), which may or may not be at the profile grade point, and should allow sufficient clearance for a future 6 inch overlay, if possible.

1. Utilities: Vertical clearances for overhead utility facilities shall comply with all applicable state and national electrical codes. Utilities over the roadway shall never be less than 18 feet above the high point of the roadway, including the turf shoulders. For additional discussion see Chapter Thirteen: Planning and Project Development, Section 6.
2. Signs or Signal Structures: Vertical clearances for overhead signs or signal structures shall comply with the Manual on Uniform Traffic Control Devices for Streets and Highways (Ref. 3.5) (http://www.roads.nebraska.gov/business-center/contractor/mutcd/).
3. Bridges: For information on allowable vertical clearances for bridge structures, see Chapter Ten: Miscellaneous Design Issues, Section 2.
4. Airfields: For information on allowable airspace at airfields, see **EXHIBIT ‘R’** of the Design Process Outline (Ref. 3.9) (http://www.roads.nebraska.gov/business-center/design-consultant/).

3.E Roller-Coaster Profile

"Roller-coaster" or "hidden-dip" profiles (See EXHIBIT 3.15) generally occur on relatively straight horizontal alignments where the roadway profile closely follows a rolling natural ground line. This type of profile should be avoided on new and reconstructed projects.

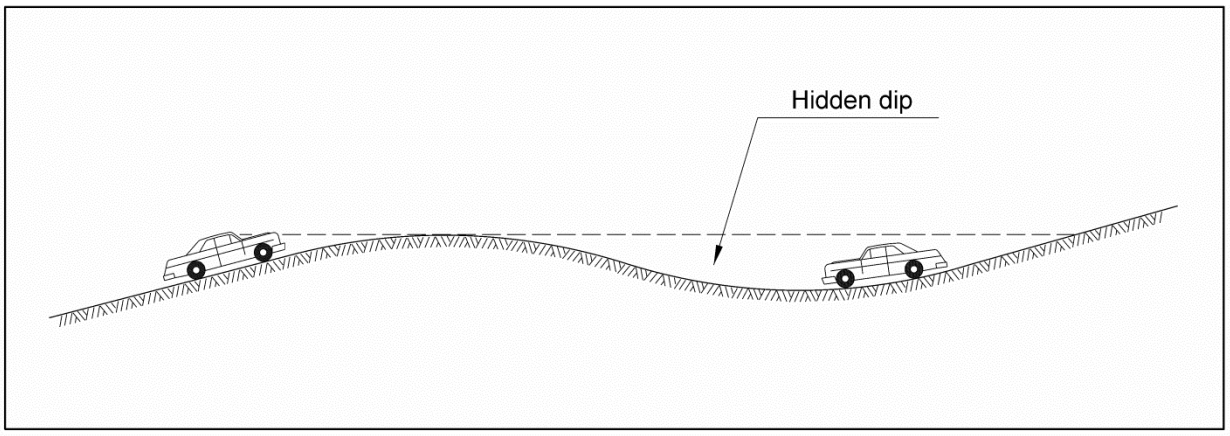


Exhibit 3.15 Roller Coaster Profile

4. COMBINATION OF HORIZONTAL AND VERTICAL ALIGNMENT

The design of horizontal and vertical roadway alignments must be carefully coordinated. See the *Green Book* (Ref. 3.1), Chapter 3, "Combinations of Horizontal and Vertical Alignment", for guidance.

5. ALIGNMENT DESIGN VALUES

A summary of the basic alignment design values used by the **NDOT** is presented below. Chapter Eleven: Highway Plans Assembly, Section 4, discusses the format and content of the sheets that make up a typical set of roadway design plans.

5.A Horizontal Alignment

The common horizontal alignment design values and the degree of accuracy to be shown on the plans include:

- Stationing - to the nearest 0.01 foot
- Radius of curvature - to the nearest foot
- Superelevation runoff lengths - rounded to the next appropriate 5 feet
- All other curve data - to the nearest 0.01 foot, or to the nearest 0.01 second, whichever is applicable

Computations for the design of horizontal alignment assume a horizontal plane.

5.A.1 Station Equations

Station equations may be utilized to avoid revising the stationing throughout the length of a project when changes are made from the original surveyed line in the field. The station equation links two station numbers, one that is correct when measuring on the line back of the equation and one that is correct when measuring on the line ahead of the equation.

5.B Vertical Alignment

The common vertical profile design values and the degree of accuracy to be shown on the plans include:

- Grades - expressed in percent rise (+) or fall (-) to the fourth decimal place
- Profile elevations - to the nearest 0.01 foot
- Vertical curve lengths - usually defined to even 100 feet

6. REFERENCES

3.1 American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets (the *Green Book*), 2011.

3.2 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards (*MDS*), Current Edition. (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/)

3.3 Nebraska Department of Transportation, Standard/Special Plan Book (*Standard Plans*), Current Edition. (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/)

3.4 American Association of State Highway and Transportation Officials, Roadside Design Guide, Washington, DC, 2011.

3.5 United States Department of Transportation Federal Highway Administration, Manual on Uniform Traffic Control Devices for Streets and Highways, Washington, D.C., 2009. (http://www.roads.nebraska.gov/business-center/contractor/mutcd/)

3.6 Transportation Research Board, Highway Geometric Design and Operational Effects Issues, National Cooperative Highway Research Program (NCHRP) Report 1658, Washington, DC. 1999.

3.7 Transportation Research Board, Recent Geometric Design Research for Improved Safety and Operations, National Cooperative Highway Research Program (NCHRP) Synthesis 299, Washington, DC. 2001.

3.8 American Association of State Highway and Transportation Officials, A Policy on Design Standards Interstate System, Washington, D.C., 2005.

3.9 Nebraska Department of Transportation, Design Process Outline, Current Edition (http://www.roads.nebraska.gov/business-center/design-consultant/)

The information contained in Chapter Four: Intersections, Driveways and Channelization, dated April 2012, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this chapter.

This chapter replaces Chapter Four: Intersections, Driveways and Channelization, dated July 2006. This chapter also supersedes Nebraska Department of Transportation Policy Letters DES 06-01: "Left Turn Lanes on Rural Divided Roadways" dated July 21, 2006 and DES 06-02: "Median Width of Freeways" dated July 21, 2006. This chapter was approved by the Nebraska Division of the FHWA for use on the National Highway System and other federal projects on April 19, 2012.

Chapter Four
Intersections, Driveways and Channelization

1. INTERSECTIONS

Intersections are locations where two or more roadways or entrances cross and/or meet each other at the same elevation. The design of an intersection will affect the operation and capacity of the approach roadways.

Intersection design should consider driver expectancy, vehicle operating characteristics, and the intersection environment. Intersection design elements should be standardized as much as possible to avoid presenting unexpected or confusing situations to roadway users. The intent of intersection design should be the efficient movement of vehicles through intersections by the proper use and placement of design elements.

The environment of an intersection includes:

- The surrounding land use and zoning
- Traffic composition
- Traffic flows
- Non-motorized usage
- Traffic control
- Provisions for parking
- Public transit
- Signing
- Utilities
- Lighting
- Traffic barriers
- Roadway surface conditions

For a detailed discussion of intersection/driveway design see Chapter 9 of A Policy on Geometric Design of Highways and Streets (the *Green Book*) (Ref. 4.1), the **Federal Highway Administration's** (**FHWA's**) Manual on Uniform Traffic Control Devices (*MUTCD*) (Ref. 4.2)

(http://www.roads.nebraska.gov/business-center/contractor/mutcd/), the State of Nebraska Supplement to the Manual on Uniform Traffic Control Devices (*NE-MUTCD*) (Ref. 4.3) (http://www.roads.nebraska.gov/business-center/contractor/mutcd/), and NCHRP Report 420, Impacts of Access Management Techniques (Ref. 4.5).

1.A Types Of Intersections

Intersections are usually either a three-leg or a four-leg design (See the *Green Book*, Ref. 4.1, **FIGURES 9-3** through **9-9**). Both three-leg and four-leg intersections may vary in size, shape, and channelization.

Intersections having five or more legs should be avoided. Measures to reduce vehicle collisions and improve the efficiency at these intersections include:

- Realignment of one or more of the intersecting legs
- Combining some of the traffic movements at adjacent intersections
- Making some legs one-way with the traffic direction away from the intersection
- Construct a roundabout

Many factors enter into the selection of intersection type, but the principal controls are:

- Design vehicle
- Design hour traffic volumes (DHV)
- Composition of traffic
- Design speed
- Type of traffic control
- Proximity of accesses

See Section 1.E of this chapter for additional information.

1.A.1 Unchannelized Intersections

The most common type of intersection is the unchannelized, consisting of the crossing of two roadways at the same elevation connected by radius returns to accommodate the wheel paths of turning vehicles. Typical characteristics of unchannelized intersections are low turning movements and low overall traffic volumes.

1.A.2 Channelized Intersections

Channelized intersections separate conflicting traffic movements into definite paths of travel by the use of pavement markings and/or curbs. A primary purpose of channelization is to provide reference points to enable a driver to predict the path of intersecting vehicles. Channelization also serves to segregate, store, and protect turning and crossing vehicles. Median and island channelization also provides a location for the installation of traffic control devices. See Section 5 of this chapter for further discussion of channelization.

1.A.3 Roundabouts

Roundabouts are circular intersections in which the traffic flows around a central island. Entry and exit to/from a roundabout is accomplished through a low speed right turn, yielding to the traffic already in the roundabout, which substantially reduces the number, type, and severity of traffic accidents in the intersection (See EXHIBIT 4.1 and **FIGURES 9-12**, **9-13** and **9-70** of the *Green Book*, Ref. 4.1).

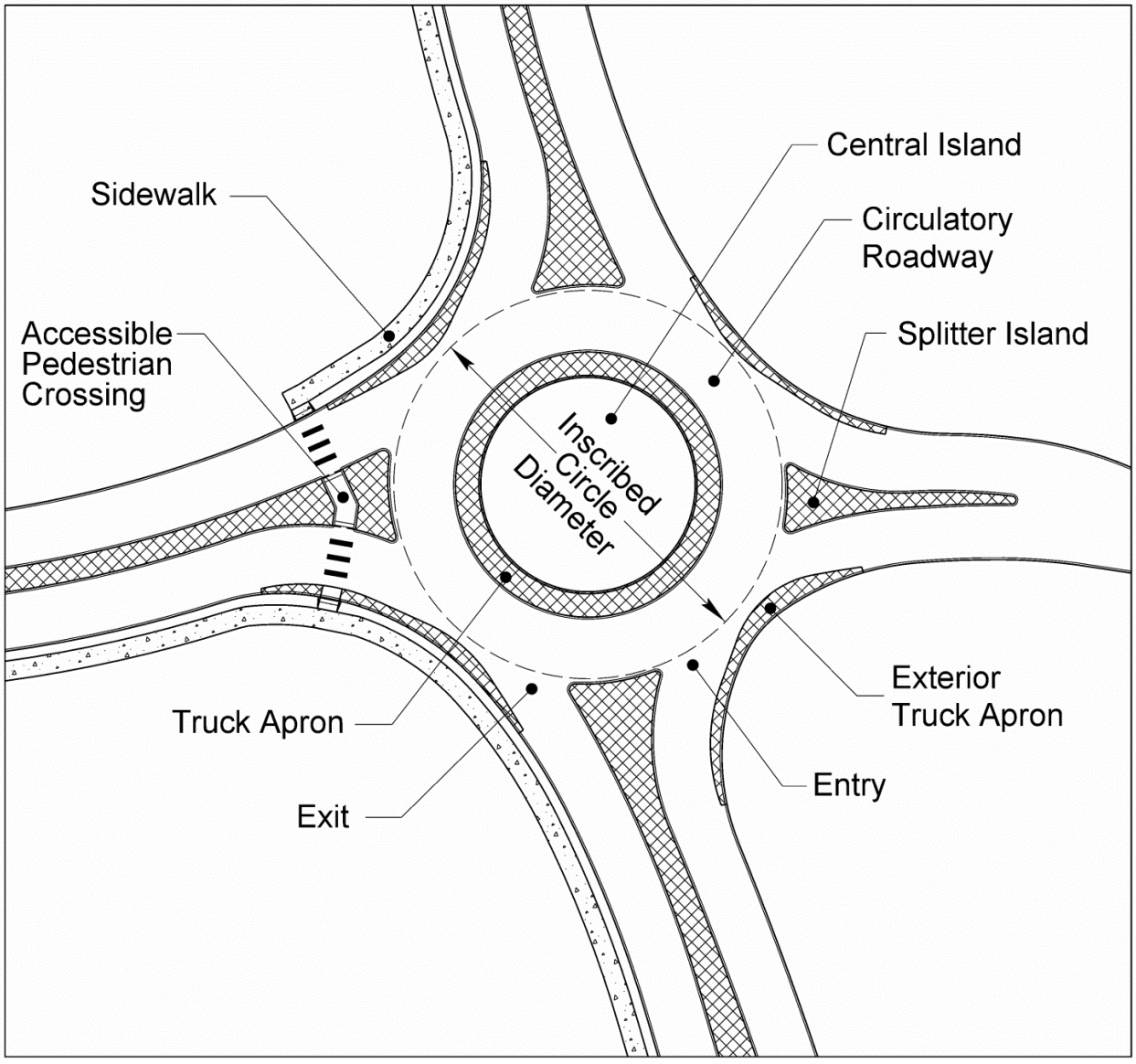
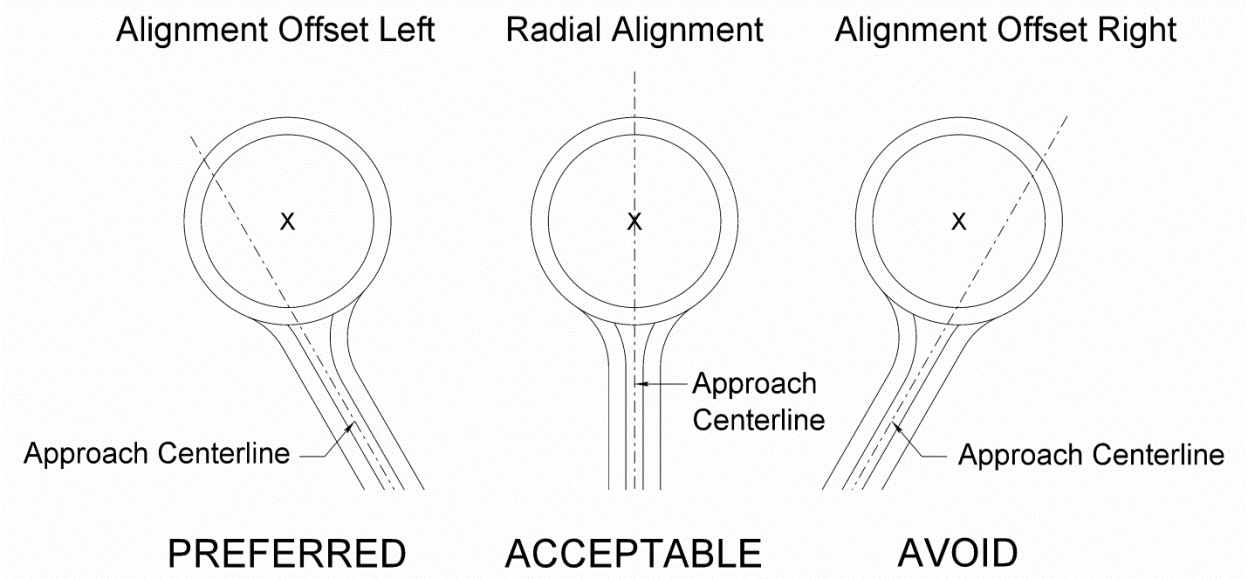


Exhibit 4.1 Typical Elements of a Roundabout Intersection

The **Nebraska Department of Transportation** (**NDOT**) will use the roundabout design guidance found in Chapter 6 of NCHRP Report 672, "Roundabouts: An Informational Guide", Second Edition (Ref. 4.18) (http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_672.pdf). Additional **NDOT** guidance includes:

- **Design Vehicle:**
  1. The design vehicle for the intersection of all State Highways, rural and urban, will be the WB-67
  2. The design vehicle for urban roundabouts which do not involve a state highway will be based on the traffic composition
- **Assumed Running Speed within 400 feet of the Intersection:** 45 mph (See "Appropriate Design Speed for Horizontal Curves Approaching a Stop", Ref. 4.4)
- **Lanes:** The **Traffic Engineering Division** (**Traffic Engineering**) will recommend the number of lanes for the roundabout, including any auxiliary or by-pass lanes.
- **Alignment:**



- **Vertical Approach Grade:** +2% entering the roundabout (at the edge of the inscribed circular roadway) and for approximately ½ the length of the entry radius
- **Splitter Island:**
  1. **Splitter Island Length:** 200 feet minimum for rural high-speed roadways, 50 feet minimum for urban roadways
  2. **Roadway Taper Rate Approaching the Splitter Island:** 50:1 for rural high-speed roadways (design speed ≥ 50 mph); the taper rate should equal the posted speed limit (at a minimum) for low-speed (design speed ≤ 45 mph) roadways
  3. **Approach Roadway Width at the Splitter Island:** 16 feet to 18 feet back-of-curb to back-of curb
- **Splitter Island and Truck Apron:** Both the splitter island and the truck apron shall be textured and a different color than the pavement; exterior truck aprons will be flush with the adjacent lane

- **Curbs:**
    1. Beyond 400 feet of the inscribed circle, a 4 inch sloping curb will be used for the outer curb and for any medians
    2. Within 400 feet of the inscribed circle, a 6 inch integral curb will be used for the outer curb and for the splitter island (splitter islands on roundabouts **must** be raised)
    3. A 3 inch sloping truck apron curb will be used for the outer radius of the center island truck apron (See EXHIBIT 4.2)
    4. When required (the central island slopes towards the truck apron) a 4 inch sloping curb will be used for the inner radius of the center island truck apron (See EXHIBIT 4.2)
- **Curb Clearance:** A 3 foot minimum clear distance will be maintained between the outside tire edge of the design vehicle wheel path and the back of the outer curb
- **Curb Inlet Location:** Avoid placing in the right-turn path of a truck
- **Drives:** In rare instances when a driveway must have direct access onto or near the roundabout it will look like a driveway (e.g. appropriate drive radius, use of a 2 inch slope curb). All access, both on and near the roundabout, will be coordinated with **Traffic Engineering**
- **Lighting:** Lighting will be required on roundabouts

For additional information see "Roundabouts" in Chapter 9 of the *Green Book* (Ref. 4.1), NCHRP Report 672 (Ref. 4.18), and Chapter Ten: Miscellaneous Design Issues, Section 3.B.

1.B Intersection Locations

1.B.1 The Intersection of Two State Highways

The design of an intersection of two state highways requires coordination and input from the roadway designer, **District**, and **Traffic Engineering**. This team will address aspects of the intersection as they relate to each other, including but not limited to:

- The crash history
- The horizontal and vertical alignments
- Intersection drainage
- Signage
- Driver expectation
- Driver perception
- Approach visibility
- Proximity of access

The designer will alert **Traffic Engineering** of any changes to the intersection environment (the existing conditions and/or any changes throughout the design process). EXHIBIT 4.3 shows design guidance for the intersection geometry.

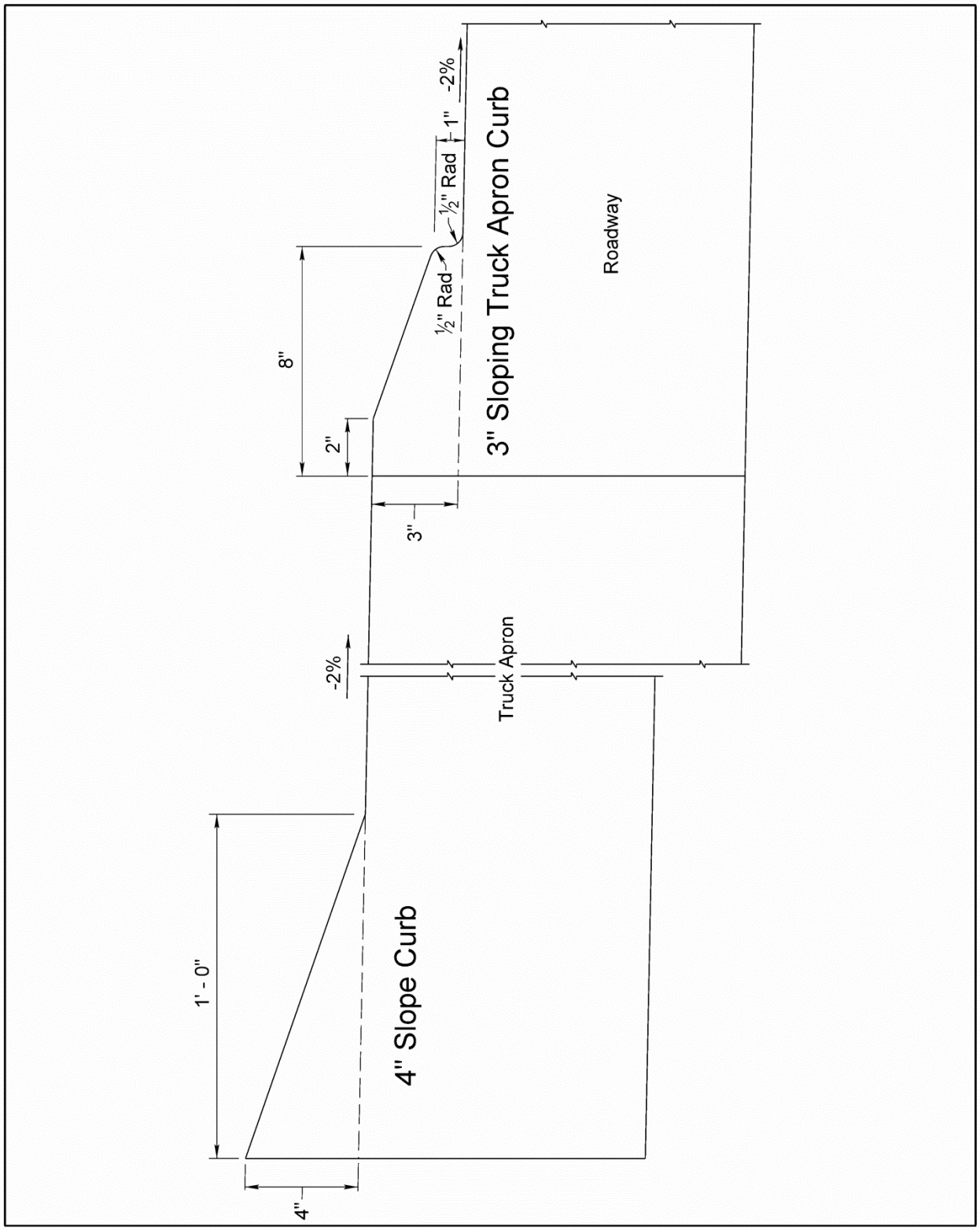


Exhibit 4.2 Roundabout Intersection – Typical Truck Apron Curb Arrangement

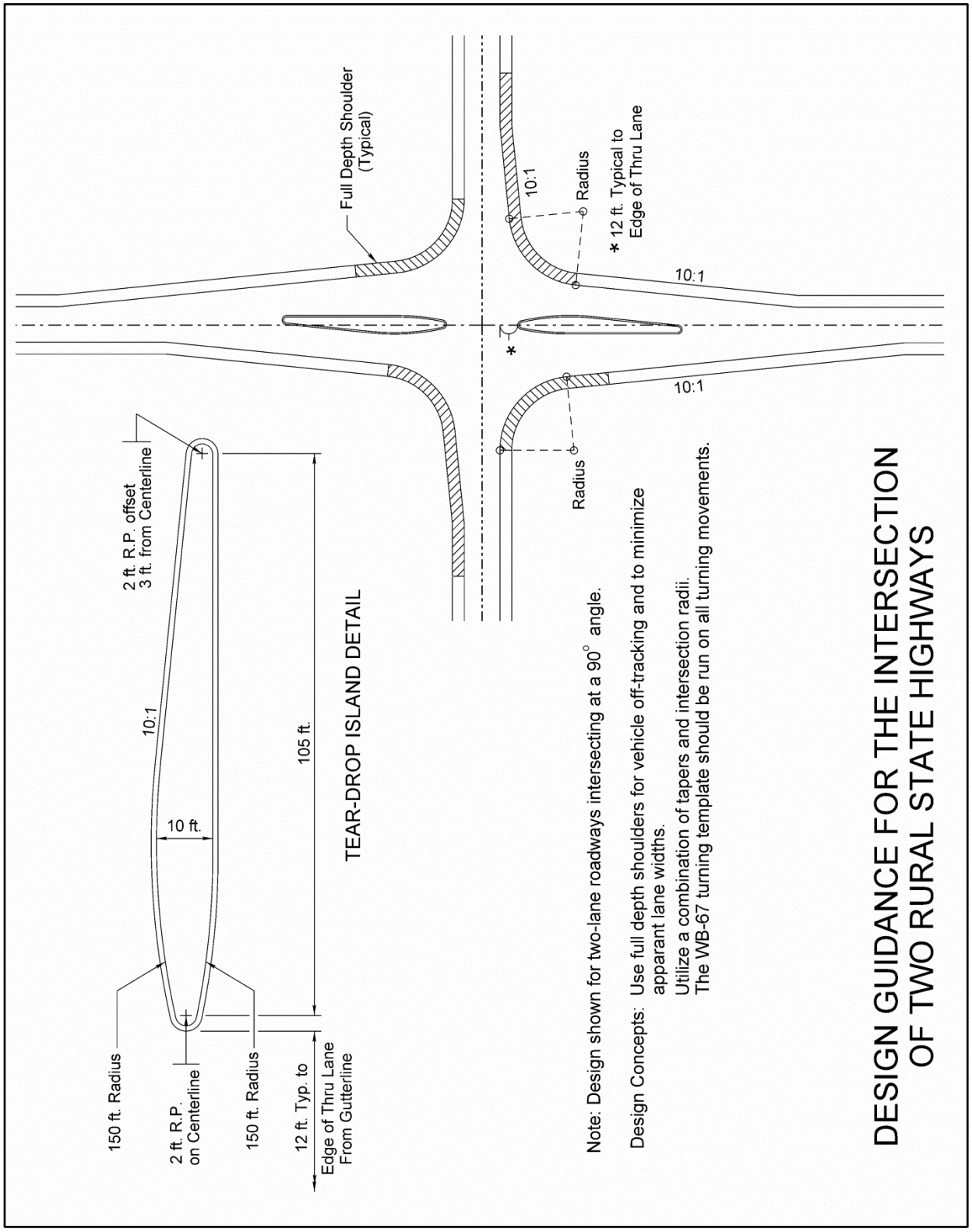


Exhibit 4.3 Design Guidance for the Intersection of Two Rural State Highways

1.B.2 Rural Intersections

A rural intersection often consists of the crossing of a low volume roadway with a higher type roadway. The low volume roadway may carry agricultural equipment or other slow-moving, heavily laden vehicles across or onto the main roadway.

Topography plays a major role in the design of a rural intersection. The placement of an intersection within a length of roadway where the driver's sight distance is impaired should be avoided. If indicated by the crash history, the vertical and/or horizontal alignment should be investigated for the potential of increasing the intersection sight distance (See Section 1.C.2). When the location of an intersection is on a horizontal or vertical curve, **Traffic Engineering** may be consulted regarding the need to add auxiliary lanes to separate the through traffic from the turning traffic.

1.B.3 Urban Intersections

Due to existing development, there is limited opportunity for new intersection locations in urban areas; therefore the design of most urban intersections must be coordinated with and tied to the geometry of the existing roadway system. Grades, lane widths, and intersection return radii should match those already present when no other options are available.

Urban intersection operation may be affected by:

- Traffic composition
- Significant directional traffic flow during peak periods
- Intersection spacing
- Adjacent intersection operation
- Mid-block traffic generators
- Pedestrian and/or bicycle traffic
- On-street parking

Sight distance at urban intersections may be obstructed by:

- The vehicle stop-line setback for pedestrian crosswalks
- Trees
- Fencing
- Signing
- Traffic signal control boxes
- Other development

The design of urban intersection improvements should include field surveys to ascertain whether the desired intersection sight distance either currently exists or can be achieved (See Section 1.C.2).

1.B.4 Frontage Roads

The use of frontage roads allows the traffic capacity on the main roadway to remain at a higher level of service by combining driveway and/or minor roadway access locations into one intersection with the main roadway. In areas experiencing a transition from rural to urban character or from agricultural to commercial use, designers should anticipate possible future congestion and consider the addition of frontage roads.

Frontage roads can be designed to accommodate parking, transit services, and bicycle traffic for a developed corridor. The flow chart in EXHIBIT 4.4 should be used to determine the roadway widths of frontage and access roads. EXHIBIT 4.5 shows a typical frontage road connection off of a major roadway.

If the frontage road intersects with a crossroad, the edge of the pavement of the frontage road should be a minimum distance of 220 feet from the edge of the through driving lane of the main roadway to provide sufficient distance for the development of left-turn lanes and for signing (See EXHIBIT 4.6). **Traffic Engineering** should be consulted to determine the actual distance required and to determine if traffic signals are warranted at the frontage road intersection based on the traffic volumes.

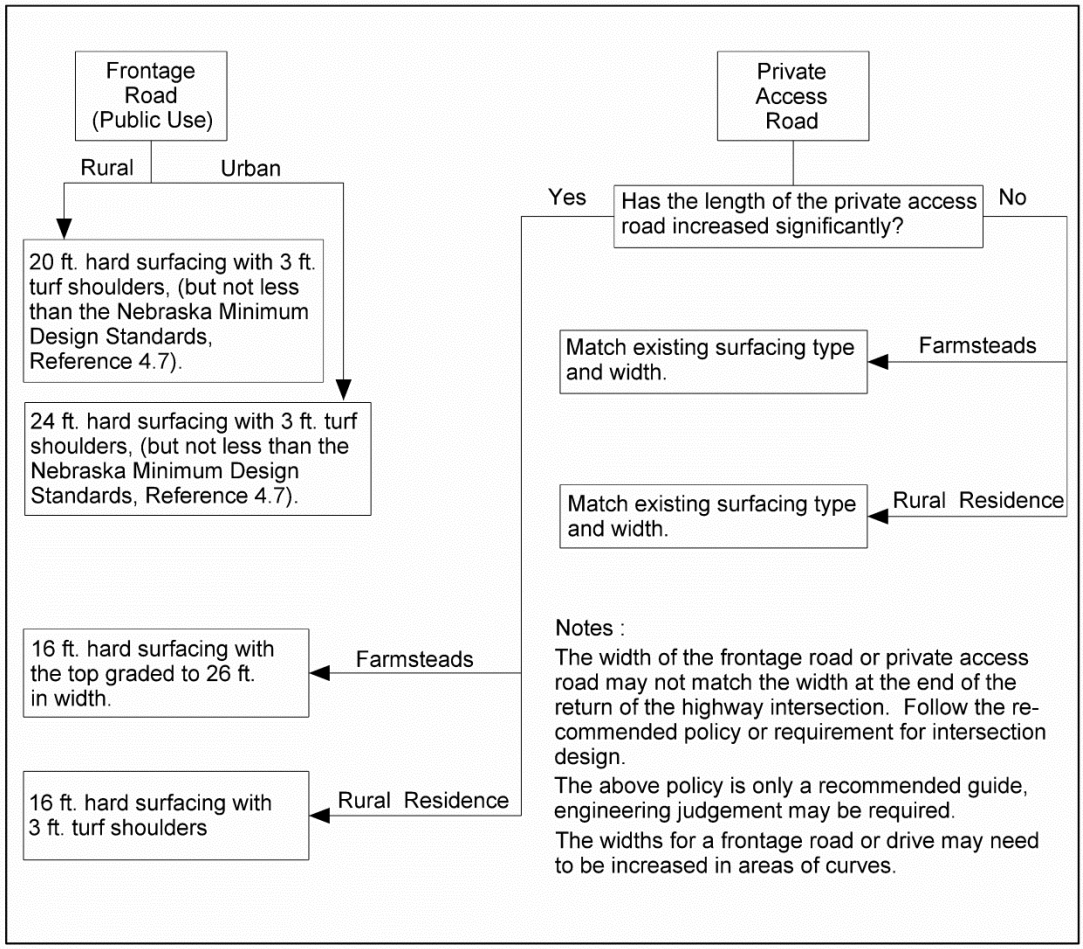


Exhibit 4.4 Flow Chart for Roadway Widths of Frontage Roads and Access Roads

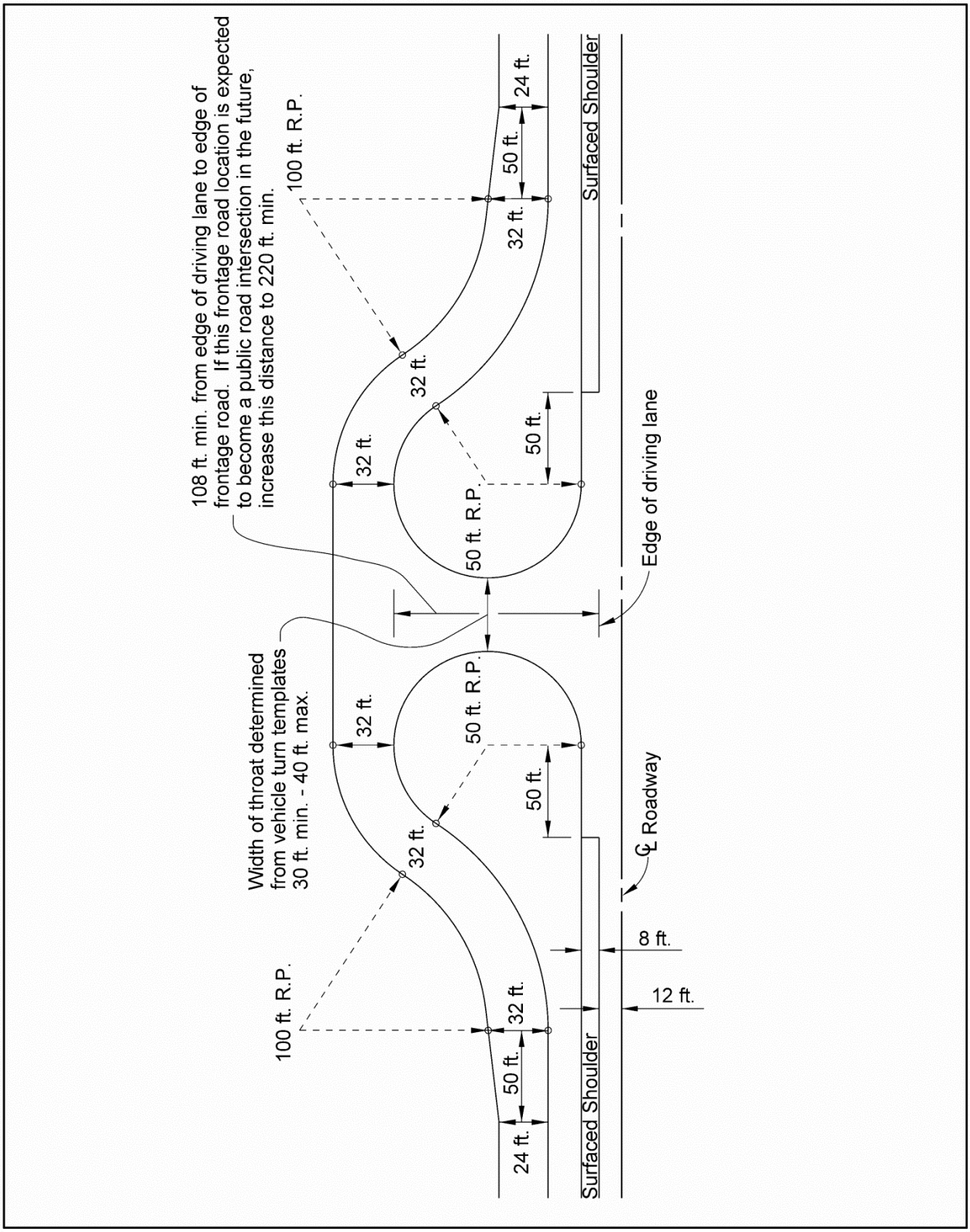


Exhibit 4.5 Typical Frontage Road Connection off of a Main Roadway

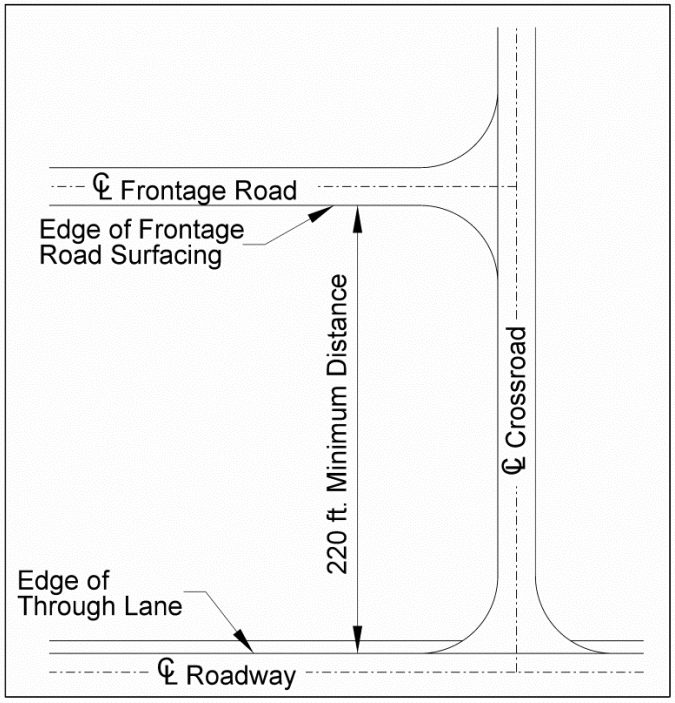


Exhibit 4.6 Typical Frontage Road Connection off of a Crossroad

1.C Intersection Design Considerations

1.C.1 Capacity and Level of Service

The capacity of an intersection and the performance of the traffic flow passing through it vary considerably depending on the traffic controls used. Capacity analysis and the design of the intersection geometry should go hand-in-hand. **Traffic Engineering** performs capacity analysis with input from **Roadway Design**; **Roadway Design** in turn utilizes the capacity analysis results for the design of the intersection geometry.

1.C.2 Intersection Sight Distance

Intersection sight distance consists of the provision of sight triangles along each leg of an intersection which are free of visual obstacles, giving a driver sufficient time and distance to avoid conflicts at the intersection (See **FIGURE 9-15** of the *Green Book*, Ref. 4.1). For new and reconstructed projects the minimum stopping sight distance shall be provided on each leg of an intersection consistent with its design speed; intersection sight distance should be provided at unsignalized intersections (See Chapter Three: Roadway Alignment, EXHIBITS 3.9 & 3.14 for stopping sight distances).

The location of each intersection should be reviewed to identify sight restrictions. Intersections on new and reconstructed projects should be designed for intersection sight distance for left-turns from a major roadway based on a passenger car (Case F from "Intersection Control" in Chapter 9 of the *Green Book*, Ref. 4.1); **Assistant Design Engineer** (**ADE**) approval is required if this condition cannot be met. For additional information see So You Want Access to the Highway? (Ref. 4.17) (http://www.roads.nebraska.gov/media/3462/access-hwy.pdf).

1.C.3 Horizontal Alignment

Desirably, all legs of an intersection will be on a tangent alignment; when roadways intersect on a horizontal curve, the design of the intersection geometry becomes significantly more complicated. Horizontal alignment at intersections requires special consideration of intersection sight distance, crash history, superelevation development, and other related factors. See Chapter Three: Roadway Alignment, Section 2, for additional information.

1.C.3.a Intersection Skew w/Stop Control on Minor Roadway

Roadways should intersect at approximately 90°. A right angle intersection provides a driver with the best conditions for judging the lane orientation and speed of vehicles on other approaches, provides a minimum distance for vehicles crossing through the intersection, and equalizes the turning maneuvers in all four quadrants.

The intersection skew angle is defined as the degree of deviation from 90° (EXHIBIT 4.7). When designing new and reconstructed projects, a skew of 15° or less is preferred. Use of a skew angle greater than 15° requires **Unit Head** approval, with input from **Traffic Engineering**. The allowable skew for 3R projects will be based on the recommendations from **Traffic Engineering** and on the crash history of the intersection.

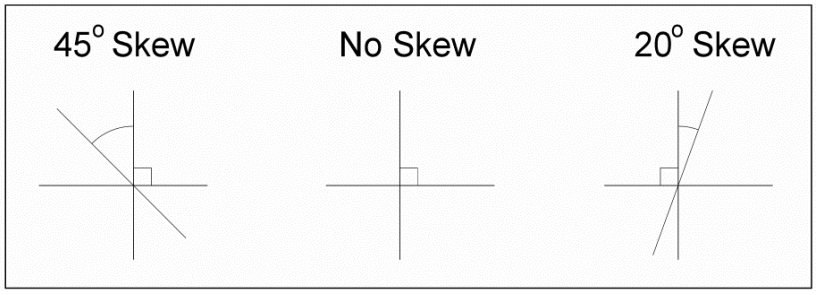
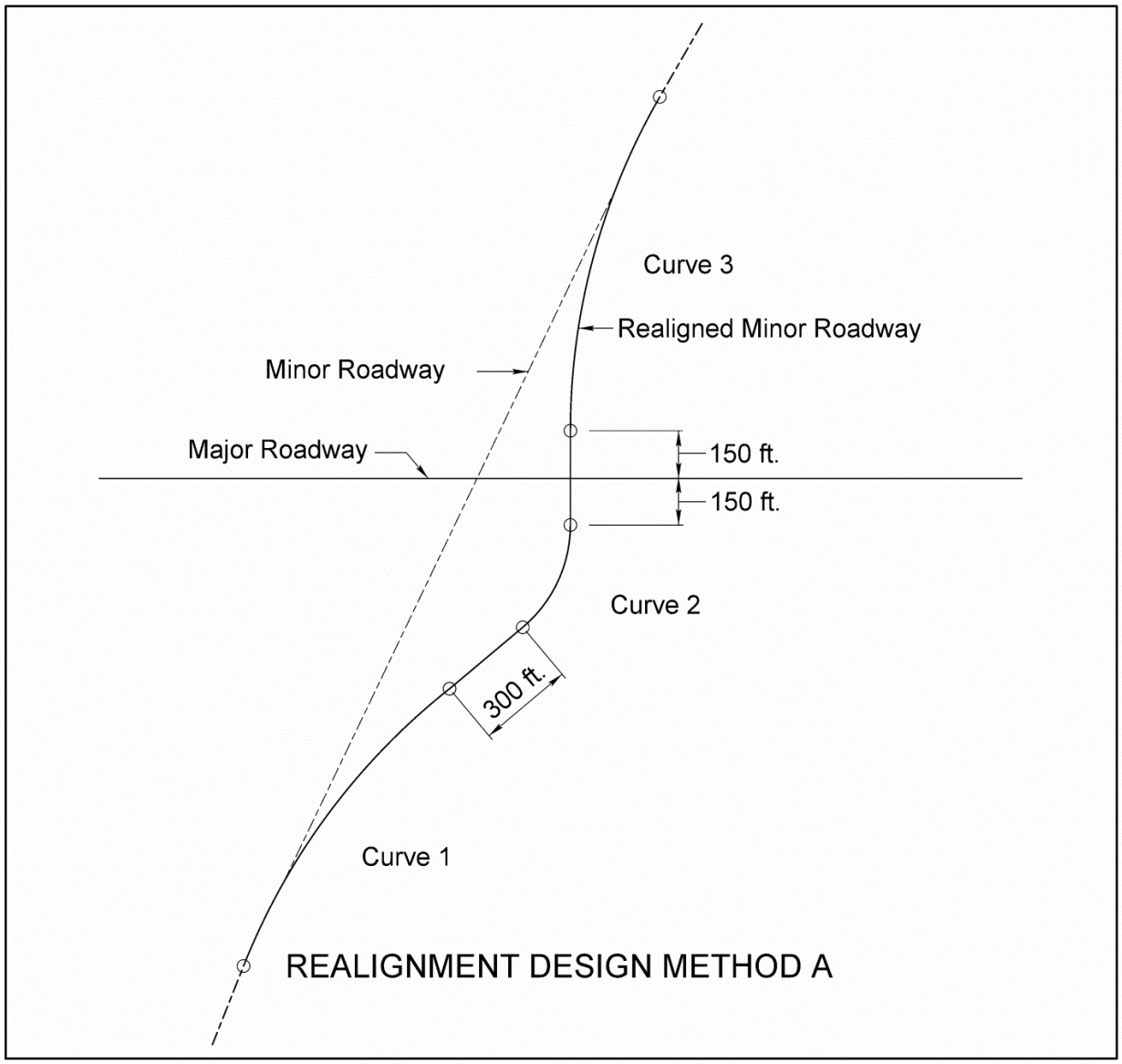


Exhibit 4.7 Skew Angle Definition

Method A (See EXHIBIT 4.8) is used when there are excessive impacts on one side of the roadway (e.g. wetlands, buildings, grain elevators); Method B is the preferred intersection realignment; Methods C and D should only be used under very low volume conditions or, if in urban areas, where a minimum distance is provided between the offset intersections (**Traffic Engineering** may analyze the intersection configuration for left turn conflicts, etc. and will determine the minimum required distance). The dimensions and curve values given in EXHIBIT 4.8 are suggested design values only. The final design of the realignment requires **Roadway Design Unit Head** (**Unit Head**) approval.

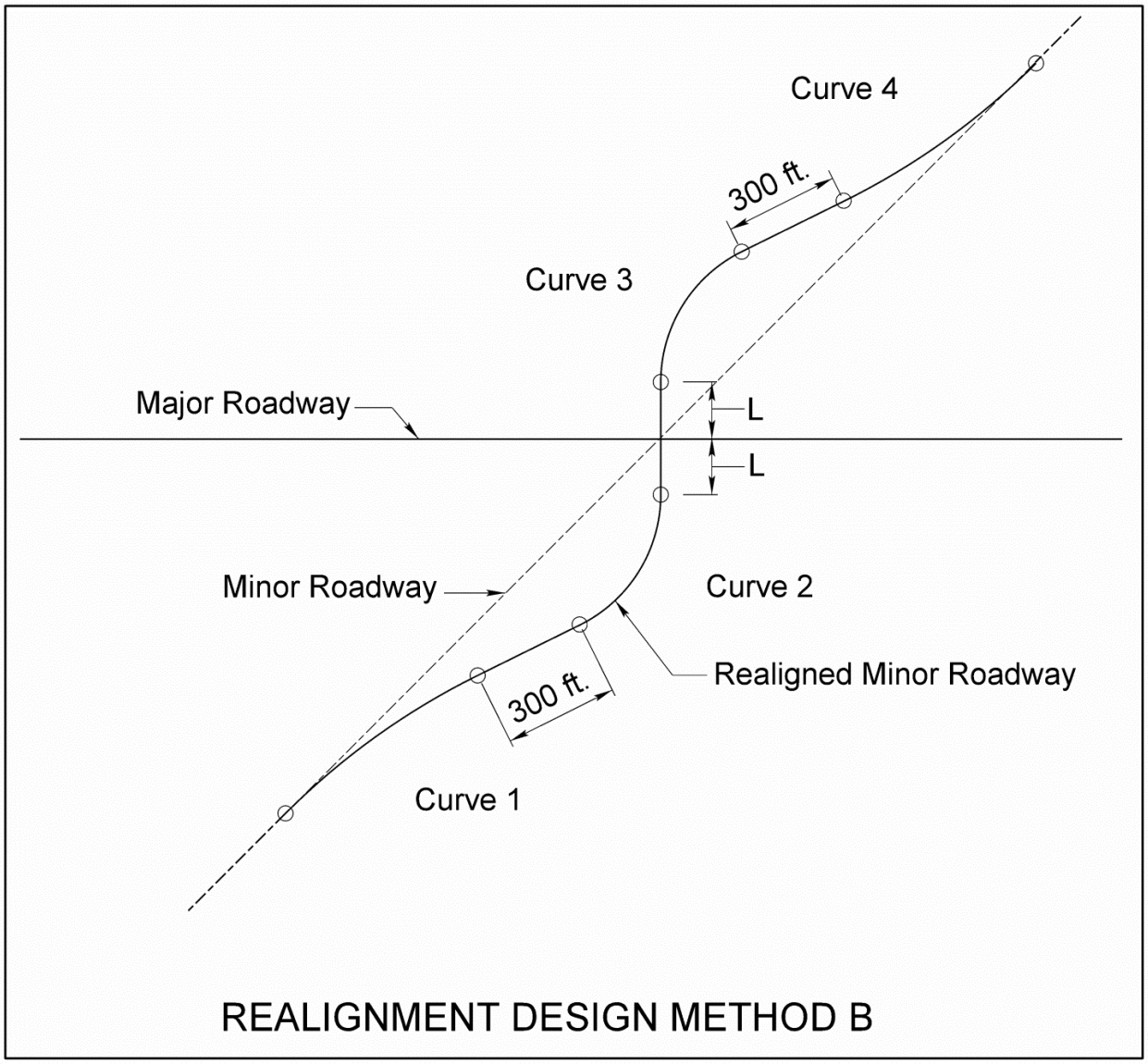
At intersection locations where the topography or where right-of-way impacts constrain intersection realignment, the designer should investigate the feasibility of realigning the intersection to the extent practicable.



Intersection Skew Angle	Curve 1			Curve 2			Curve 3		
	Radius Feet	Deflection Angle Δ	Curve Length Feet	Radius Feet	Deflection Angle Δ	Curve Length Feet	Radius Feet	Deflection Angle Δ	Curve Length Feet
20º	1910	20º	667	382	40º	267	1910	20º	667
30º	1910	30º	1000	382	60º	400	1910	30º	1000
45º	1910	45º	1500	382	90º	600	1910	45º	1500

Note: Dimensions and curve values shown above are suggested design values. The final design of the realignment requires **Unit Head** approval.

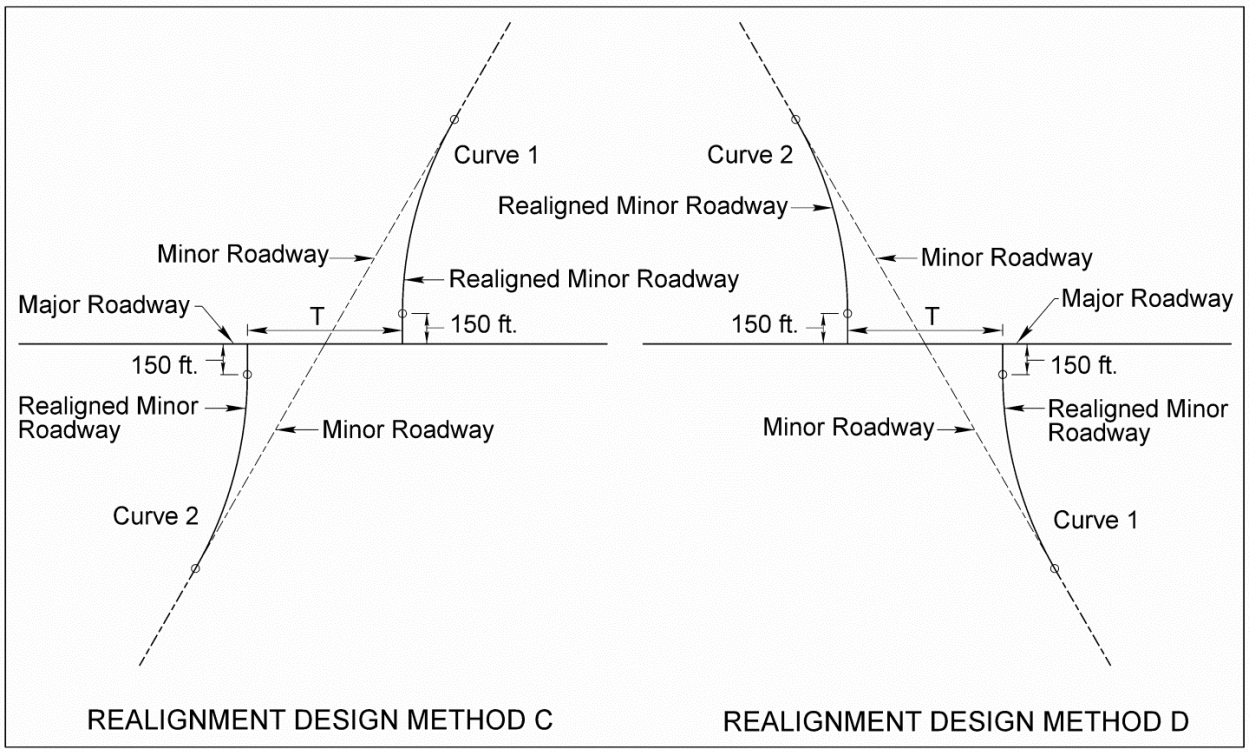
Exhibit 4.8a Intersection Realignment Design Method A



Intersection Skew Angle	L Feet	Curves 1 and 4			Curves 2 and 3		
		Radius Feet	Deflection Angle Δ	Curve Length Feet	Radius Feet	Deflection Angle Δ	Curve Length Feet
20º	150	1910	9º	300	382	29º	193
30º	150	1910	13º	433	382	43º	287
45º	150	1910	18.75º	625	382	63.75º	425
60º	155	1910	24.25º	808	382	84.25º	562

Note: Dimensions and curve values shown above are suggested design values. The final design of the realignment requires **Unit Head** approval.

Exhibit 4.8b Intersection Realignment Design Method B



Intersection Skew Angle	T Feet	Curve 1			Curve 2		
		Radius Feet	Deflection Angle Δ	Curve Length Feet	Radius Feet	Deflection Angle Δ	Curve Length Feet
20º	354	1910	20º	667	1910	20º	667
30º	764	1910	30º	1000	1910	30º	1000
45º	1882	1910	45º	1500	1910	45º	1500
60º	4339	1910	60º	2000	1910	60º	2000

Note: Dimensions and curve values shown above are suggested design values. The final design of the realignment requires **Unit Head** approval.

Exhibit 4.8c Intersection Realignment Design Methods C and D

1.C.3.b Intersections on Curved Alignments

When a minor roadway intersects a mainline roadway which is on a horizontal curve, the minor roadway should be realigned to provide as close to a 90° intersection to the local tangent of the mainline curve as possible. Intersection sight distance may be investigated if the curve of the roadway may cause an unacceptable line of sight or cause the driver to have to look too far back over his/her shoulder (especially the right shoulder) to see oncoming traffic.

An intersection on a curved roadway alignment requires additional design consideration. The superelevation rate for state highways at intersections with other public roads is desirably 4% or less.

Research by the University of Nebraska, "Appropriate Design Speed for Horizontal Curves Approaching a Stop" (Ref. 4.4), shows that the running speed on a curve approaching a stop sign decreases to 45 mph at approximately 400 feet from the stop sign. The superelevation of stop-controlled approaches on curved alignments within this distance should be transitioned from the full superelevation at the PC to the superelevation at the PT (based on the appropriate speed and curve radius) throughout the remainder of the curve to allow vehicles to retain control during slowing and stopping. A short tangent section should be provided on the approach to the intersection. For further information regarding horizontal alignment, see Chapter Three: Roadway Alignment, Section 2. For further discussion of intersection realignment, see the "Guidelines for Realignment of Skewed Intersections" (Ref. 4.8).

1.C.4 Profile

The profile gradient through an intersection must reflect the practicalities of matching the basic profiles of the intersecting roadways. The gradients of intersecting highways should be as flat as possible, with a consistent gradient through the intersection to facilitate traffic turning movements and to minimize the chance of stopping vehicles from sliding onto the mainline roadway when the pavement is wet or icy.

Appreciable changes in the design roadway elevation at intersections with existing cross roads and driveways should take into consideration the extent of reconstruction that will be required along the cross road or driveway to match the elevation of the new alignment profile. A profile that results in excessive grades for side roads and driveways is not a desirable design. Adjustment to the profile of an existing cross road will meet either the published standards of the appropriate city/county or the Nebraska Minimum Design Standards (*MDS)* (Ref. 4.7) (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/), whichever is more stringent.

Consideration should be given to the placement of intersections and driveways with respect to vertical curves. When an intersection or a driveway must be placed on a crest vertical curve, it should be placed as near to the crest as possible. When an intersection or driveway is located slightly past the crest, inadequate sight distance may be a problem for both the motorist approaching on the minor roadway or driveway who cannot see oncoming mainline traffic and for motorists on the major roadway who cannot see the intersection or driveway. Where practicable, the PI's of crest vertical curves for urban streets should be located at or near the intersection of the roadway centerlines. Chapter Three: Roadway Alignment, Section 3.C, discusses design controls for crest vertical curves.

1.C.5 Design Vehicle

A design vehicle is defined by the **Institute of Transportation Engineers** as "the vehicle that must regularly be accommodated on a thoroughfare without encroachment into other travel lanes". The dimensions and operating characteristics of the design vehicle are used to establish highway design controls, such as the intersection or driveway radius. Selection of a design vehicle is influenced by the roadway type and the traffic composition. In selecting the appropriate design vehicle the designer should keep in mind periodic usage of the intersection or driveway, such as the prevalence of large trucks at a grain elevator during harvest. EXHIBIT 4.9 gives the **NDOT** minimum design vehicle to be used under various intersection conditions. For additional information see the *Green Book* (Ref. 4.1), "Design Vehicles" in Chapter 2 and "Minimum Edge-of-Traveled-Way Designs" in Chapter 9. Examples of minimum path turning templates are shown in **FIGURES 2-1** through **2-23** and **9-23** through **9-30** of the *Green Book* (Ref. 4.1).

INTERSECTING HIGHWAY OR ROADWAY	MINIMUM DESIGN VEHICLE *
INTERSTATE / RAMP TERMINALS	WB-67
EXPRESSWAY / MAJOR ARTERIALS	WB-67
LOCAL ROADS / COUNTY ROADS / FRONTAGE ROADS	S-BUS 36
RESIDENTIAL / LOCAL STREETS	SU OR P
COMMERCIAL DRIVE / FARM EQUIPMENT DRIVE	SU
PRIVATE ROAD / FARM DRIVE / RESIDENTIAL DRIVE	P

* Use for design of intersection/drive geometry only, not to be used in the calculation of intersection sight distance. The use of a design vehicle smaller than the minimum listed in the table requires **Unit Head** approval.

Exhibit 4.9 Guidelines for the Selection of Intersection / Driveway Design Vehicles

1.C.6 Intersection Radius

- Urban intersections should have a minimum radius of 30 feet for 90° intersections.
- Rural intersections should have a minimum radius of 50 feet for 90° intersections.

The design of an intersection radius should be based on turning path templates of the selected design vehicle. These templates indicate wheel paths under ideal conditions; allowances should be made to provide a margin of error on the part of the driver.

A computer turning template program, such as *AutoTURN*®, may be used to determine the intersection geometry. A graphical procedure may also be used to determine the minimum intersection radius by placing the selected vehicle turning template on the intersection plan. To fit the WB-62 or WB-67 turning template, a combination of circular arc and short tapers may be the best solution (See EXHIBIT 4.3).

The minimum allowable distance between the edge of the full depth pavement and the outside edge of the tires of the turning design vehicle is 2 feet; the desirable distance is 3 feet.

1.C.6.a Left Turn Radii

A typical at-grade intersection does not have a continuous edge of pavement delineating the left turning path; the motorist has a guide at the beginning and at the end of the left turn movement provided by pavement markings or channelization. In some instances, pavement markings are provided to guide turns through wider intersections.

The design values for left turn radii are a function of the:

- Design vehicle
- Angle of intersection
- Number of lanes
- Median width

Left turn radii should be larger than required by the minimum design vehicle since the turning radius is based on a 10 mph operating speed and this speed can often be exceeded in actual operations. For roadways intersecting at right angles, left turn radii that range between 60 feet and 75 feet will normally satisfy all of the controlling factors. For dual turning movements a minimum radius of 90 feet should be applied to retain a satisfactory capacity in the outer lane.

1.C.7 On-Street Parking

On-street parking in the immediate vicinity of an intersection may obstruct the driver's line of sight, impede traffic flow, and contribute to the crash potential. Parking should not be placed within 20 feet of the intersection crosswalk of any unsignalized intersection (See **Figure 3B-21** of the *MUTCD*, Ref. 4.2); parking near signalized intersections will be controlled by the requirements for dedicated turn lanes. See Chapter Ten: Miscellaneous Design Issues, Section 11, for additional information.

1.C.8 Transit Services

Urban intersections which are on bus routes should be designed to coordinate the operation of bus turnouts with the movement of through traffic. The designer will consult with **Traffic Engineering** regarding the location and length of the bus turnout, which may be placed on the near side or far side of the intersection. The **NDOT** prefers the far side for signalized intersections. In either case, bus service may interfere with the intended operation of an intersection. Bus turnouts, merging tapers, and/or passenger loading space of sufficient length to accommodate the maximum number of buses anticipated at any given time should be provided, if practical, to minimize interference with intersection operation.

1.C.9 Signs

The placement of signs at or near an intersection shall be in accordance with the *MUTCD* (Ref. 4.2) and with the *NE-MUTCD* (Ref. 4.3). The designer will coordinate the design of the typical section and the geometry of the approach roadway with **Traffic Engineering** to allow for proper sign placement. The designer should also verify that intersection sight distance is not compromised either by the nature or the number of signs to be installed (or already in place).

1.C.10 Pedestrian Crosswalks

Curb ramps shall be constructed or reconstructed to meet the guidance found in the 2011 Draft Public Rights-of-Way Accessibility Guidelines (*PROWAG*) (Ref. 4.9) (http://www.access-board.gov/prowac/) on all projects, as required. For further information see Chapter Sixteen: Pedestrian and Bicycle Facilities, Section 7; Chapter Seventeen: Resurfacing, Restoration and Rehabilitation (3R) Projects, Section 2; and Chapter Fourteen: Traffic, Sections 1.H and 4.A. For pedestrian design at roundabouts, see Chapter 6 of NCHRP Report 672, "Roundabouts: An Informational Guide", Second Edition (Ref. 4.18).

1.C.11 Bike Lane - Highway Intersections

Bike lane design at intersections should allow both motorists and bicyclists to operate following normal rules of the road with a minimum of confusion. Intersections without bike lanes but with significant bicycle traffic may require additional traffic control study. Refer to Chapter Sixteen: Pedestrian and Bicycle Facilities, Section 4, and the Guide for Development of Bicycle Facilities (Ref. 4.10), (http://safety.fhwa.dot.gov/ped_bike/docs/b_aashtobik.pdf) for additional information. For bike lane design at roundabout intersections, see Chapter 6 of NCHRP Report 672, "Roundabouts: An Informational Guide", Second Edition (Ref. 4.18).

1.C.12 Railroad Crossings

Railroad crossing design must consider approach grades, sight distance, drainage, highway traffic volumes, and the frequency of train movements. See Section 3.A of this chapter and Chapter Ten: Miscellaneous Design Issues, Section 1, for information regarding railroad-highway grade crossings.

1.D Turn Lanes

When **Traffic Engineering** has determined that specific turning movements should be separated from through movements they will recommend that a turn lane be added to the project. While the use of a turn lane may increase the capacity of an intersection, roadway widening for turn lanes may require additional right-of-way and could impact adjacent properties, drainage patterns, and driveway operations in the vicinity of the intersection.

Traffic Engineering may recommend right turn lanes, offset right turn lanes, free flow right turn lanes, or left turn lanes as warranted (See EXHIBITS 4.10 & 4.12). The *Green Book* (Ref. 4.1) provides guidelines for turn lane design.

A right turn lane may be recommended for the following reasons:

1. To serve right turn vehicles which are required to slow for the turn movement, alleviating delays to arterial traffic and reducing the potential for rear-end crashes.
2. To move the stop bar position back on the minor approach, widening the throat entry for left turning vehicles from the arterial roadway. This serves to provide better visual "targeting" for the driver, aid larger vehicles to avoid edge drop-off, and reduce turning time which reduces the through lane clearance time requirements.

Shoulders adjacent to 12 feet wide right turn lanes should be 6 feet in width when surfaced (4 feet surfaced, 2 feet turf) and 2 feet in width when turf.

Left turn lanes should be provided on the mainline at signalized intersections, if warranted. The following situations may necessitate the addition of an exclusive left turn lane:

- Where fully protected left turn signal phasing is to be provided
- Where left turn volumes exceed 100 vph and space is available
- Where left turn volumes exceed 300 vph, dual left turn lanes should be considered

Left turn lanes may be necessary on two-lane highways where traffic volumes are high.

Left turn lanes should be provided on divided arterial routes at intersections and at other median breaks where left turn volumes and/or vehicle speeds are high. To reduce the obstruction of the line of sight by opposing traffic, the left turn lanes in 18 feet raised medians should be designed with a 1 foot offset. Wide striping on the right side of the left turn lane should be used to encourage traffic to move closer to the median (See EXHIBIT 4.11).

Two-way left turn lanes (TWLTL) have been constructed in urban areas in lieu of raised medians. **Traffic Engineering** will determine when TWLTL treatment is appropriate. TWLTL treatments provide the advantages of:

- Reduced travel time
- Improved capacity
- Ability to use the TWLTL as a travel lane during closure of a through lane
- Wide acceptance from abutting property owners

Providing a TWLTL may be preferable to having vehicles make U-turns at intersections or traveling around the block to reach a destination. Median widths of 12 feet to 16 feet wide are most adaptable to TWLTL conversion.

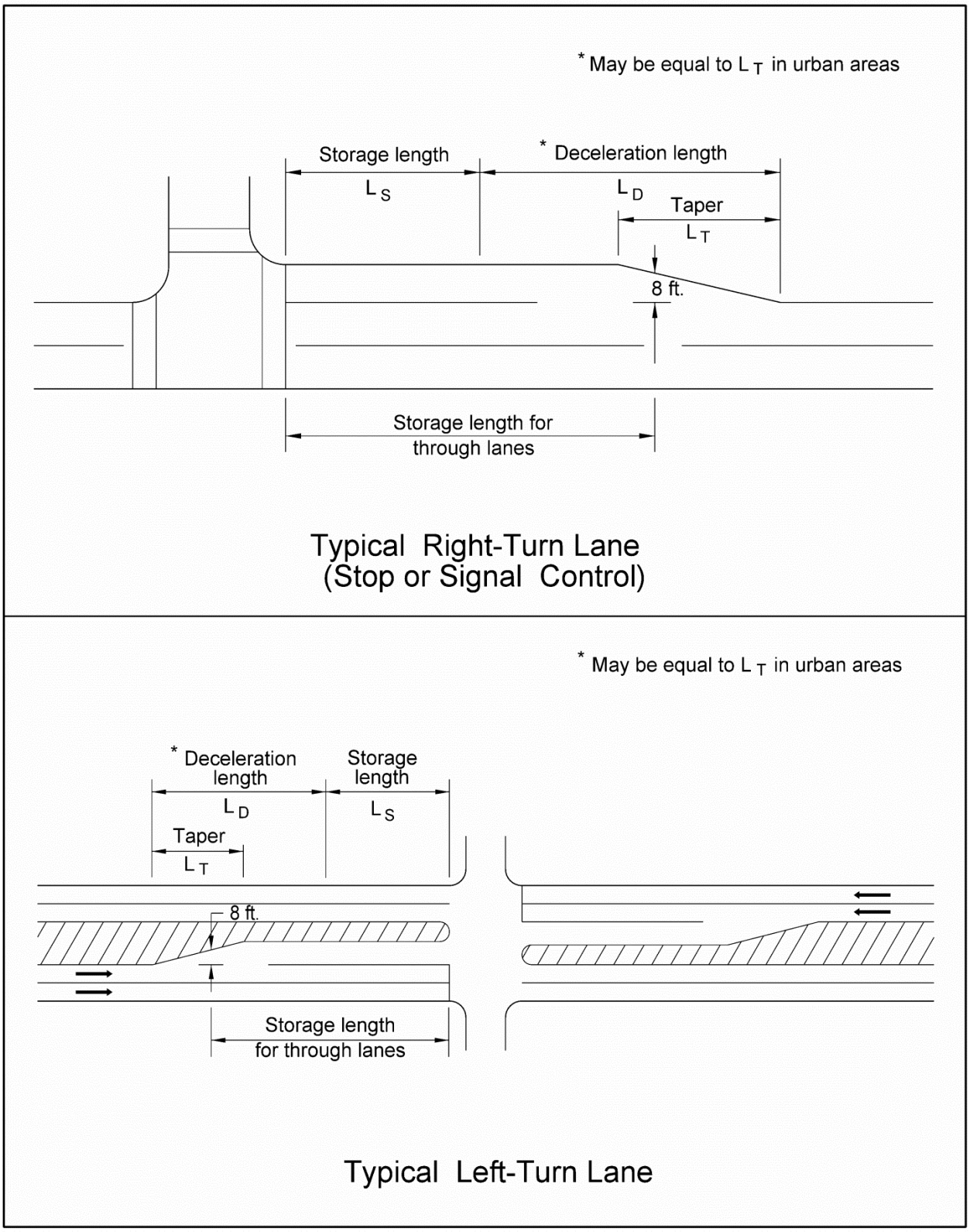


Exhibit 4.10 Typical Auxiliary Lanes

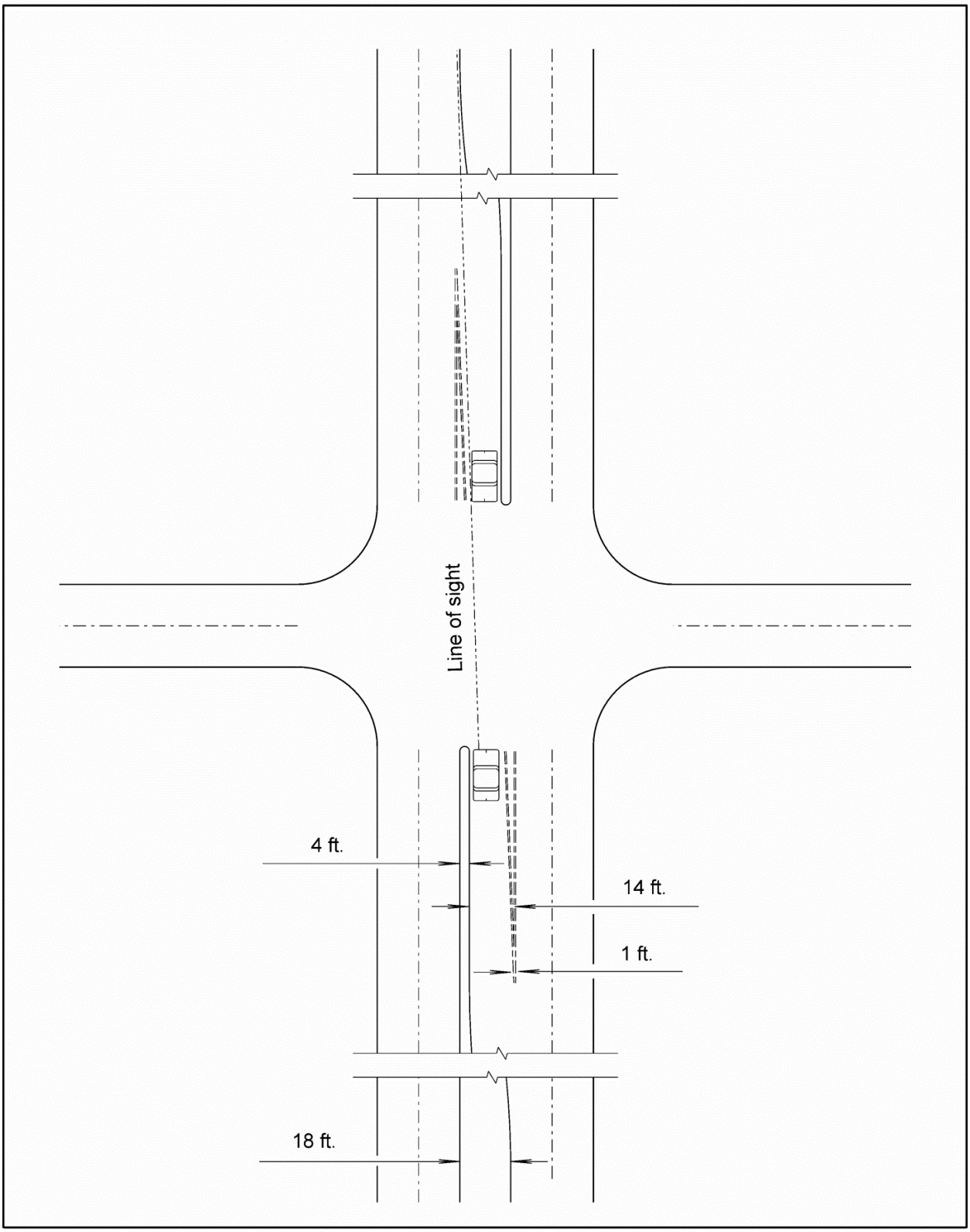


Exhibit 4.11 18 Foot Median, Left-Turn Lane

1.D.1 Turn Lane Length

Turn lane length is a function of the:

- Through traffic volumes
- Turning traffic volume
- Required storage length
- Approach design speed
- Length required to decelerate from the approach design speed to a stop
  And
- Type of intersection control

Turn lane length has three components:

- Entering taper
- Deceleration length
- Storage length

Sufficient deceleration length should be provided to allow motorists to slow from the highway design speed to a comfortable stop, based on a comfortable deceleration rate of 11.2 ft/sec^2. In urban areas with lower design speeds and more closely spaced intersections, it may not be feasible to provide the entire deceleration length. In these locations some deceleration may occur prior to entering the auxiliary lane.

The storage length should provide sufficient space so that neither turning nor through traffic blocks the other. A minimum length of 50 feet (storage space for two passenger cars) should be provided. If truck traffic exceeds 10%, storage length for at least one car and one truck should be provided (25 feet for each car and 75 feet for each truck). The roadway designer will consult with **Traffic Engineering** to determine the recommended storage length at an intersection.

1.D.2 Turn Lane Bay Taper Rate

The entering turn lane bay taper rate should be 15:1 for rural high-speed roadways (design speed ≥ 50 mph) (See EXHIBITS 4.9, 4.10, AND 4.24 THROUGH 4.28); the turn lane bay taper length should equal the posted speed limit (at a minimum) for low-speed roadways (design speed ≤ 45 mph).

1.D.3 Offset Right-Turn Lanes

An offset right-turn lane is intended to provide an unobstructed sight triangle for the driver stopped on the minor road by providing a raised or painted island between the mainline roadway and the right-turn lane. An offset right-turn lane is generally used when recommended by **Traffic Engineering** or at the discretion of the **ADE**.

The **NDOT** prefers the use of the tapered offset right-turn lane (See EXHIBIT 4.12). A parallel type offset should be used when spillback off of the cross road is anticipated (e.g. a train track runs parallel to the mainline, a congested driveway is downstream of the intersection on the cross road). **ADE** approval is required to design a parallel offset right-turn lane. The design guidance for an offset right-turn lane (2-lane and 4-lane roadways) includes:

1. The median island on the minor road should be 10 feet from the edge of the through lane (face of curb to the edge of the traveled way), regardless of shoulder width.
2. Assume that the driver's eye is 21 feet from the edge of the nearest through lane.
    a. Per the *Green Book* (Ref. 4.1), the 7.5 second t(g) is for the driver's eye at 14.5 feet from the edge of the nearest through lane.
    b. Add 0.27 sec to t(g) to adjust for the additional 6.5 feet of travel.
3. Design the Intersection Sight Distance (ISD) for 5 mph over the posted or anticipated speed limit.
4. Design the intersection sight line to the left for the vehicle crossing the nearest lane, including 4-lane roadways. On 4-lane roadways double check that a vehicle in the near lane at the required ISD does not block a vehicle in the second lane over (far lane) at the required ISD.
    a. The near lane ISD = 1.47 x V mph x 7.77 sec.
    b. Far lane ISD = 1.47 x V mph x 8.27 sec.
5. Assume that the sight line from the driver's eye to the middle of the nearest lane at the required ISD.
6. Place the outside of the tapered right-turn lane 12 feet outside of and parallel to this line.
7. Design a 2 foot lugout from where the outside edge of the right-turn lane is 2 feet from the edge of the nearest driving lane.

For further information see "Offset Right-Turn Lanes for Improved Intersection Sight Distance" (Ref. 4.19) and "Intersection Control" in Chapter 9 of the *Green Book* (Ref. 4.1).

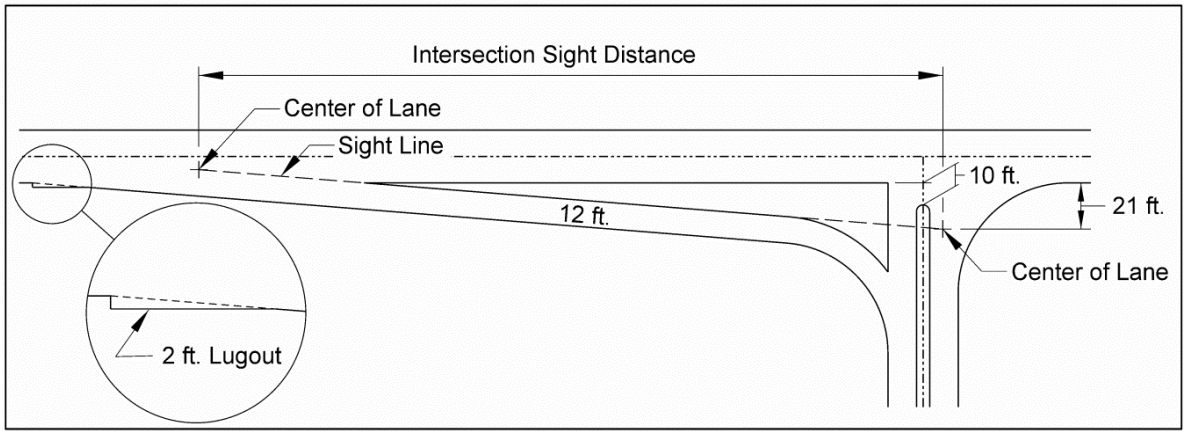


Exhibit 4.12 Tapered Offset Right-Turn Lane

1.D.4 Turning Roadways at Intersections (Free-Flow Right Turn Lanes)

Based on the traffic counts and composition, **Traffic Engineering** may recommend the design of a turning roadway. Turning roadways are channelized right-turn lanes at intersections, providing free flow turn movements. The design of a turning roadway usually consists of a deceleration lane leading to a horizontal curve, providing a gradual speed reduction and a more natural turning path for the driver. For additional information see the *Green Book* (Ref. 4.1), Chapter 3, "Widths for Turning Roadways at Intersections", and Chapter 9, "Free-flow Turning Roadways at Intersections".

1.E Traffic Control

The purpose of traffic control is to regulate, warn, and guide traffic efficiently through intersections. Traffic control design is governed by warrants discussed in *MUTCD* (Ref. 4.2) and the *NE-MUTCD* (Ref. 4.3). Traffic control is the responsibility of **Traffic Engineering**.

There are four types of traffic control:

1. No control, where motorists must be able to see and evaluate the intersection and traffic situation in sufficient time to stop.
2. Yield control, where vehicles on the minor approach yield to vehicles on the major route; all vehicles yield to vehicles in a roundabout.
3. Stop control, where vehicles on either the minor or all approaches must stop prior to entering the intersection.
4. Signal control, where the approach legs of the intersection are controlled by a traffic signal.

Traffic Engineering conducts an engineering study to evaluate the operation of an intersection and to determine the appropriate traffic control to be provided. It is essential that the roadway designer coordinate with **Traffic Engineering** regarding roadway geometry, intersection capacity, and traffic operations (See Chapter Fourteen: Traffic).

Coordination with the **Intermodal Planning Division** is required where highway intersection signals are interconnected with rail-highway crossing signals (See Chapter Thirteen: Planning and Project Development, Section 5.G).

See "Traffic Control Devices" in Chapter 9 of the *Green Book* (Ref. 4.1), Part IV of the *MUTCD* (Ref. 4.2), and the *NE-MUTCD* (Ref. 4.3) for further discussion.

1.E.1 Unsignalized Intersections

The simplest form of installed traffic control at an intersection is the use of a yield sign for the roadway having the lower traffic volume. As the traffic volume increases the minor street can be controlled by a stop sign. All roadway approaches at an intersection may be controlled with a four-way stop.

An unsignalized intersection does not normally require auxiliary lanes. The time required for each vehicle to accelerate and pass through an average intersection, after stopping or slowing to yield, is typically 3-4 seconds. When this delay increases (e.g. when truck traffic has limited opportunity to clear the intersection), as queues become commonplace for the minor roadway, and/or when a crash history is established as drivers take more risks to enter perceived gaps in traffic, the level

of service of the intersection degrades. In these situations **Traffic Engineering** may recommend the addition of auxiliary lanes to the intersection.

1.E.2 Signalized Intersections

Traffic signals usually provide more efficient traffic operation where large volumes of traffic must be accommodated by allocating time to specific traffic movements. Essentially, signalization moves vehicles in groupings or "platoons" in order to reduce delays caused by the starting and stopping of individual vehicles.

In urban areas with multiple signalized intersections, the designer must consider the progressive nature of traffic signal system coordination, where it is desirable to move vehicle platoons from one intersection to the next. Each succeeding intersection must be configured to handle the approach volumes and to store or channelize the required turning movements. The designer must coordinate with **Traffic Engineering** to verify that the proposed approach lanes and intersection design is capable of accommodating the design year traffic volumes.

2. DRIVEWAYS

Access will be provided to all properties but it may be from joint access locations, from side roads, or from frontage roads. When access locations are consolidated in rural areas, driveways on one side of the highway should be located opposite driveways on the other side of the highway. Access will conform to the Access Control Policy to the State Highway System (Ref. 4.12) (http://www.roads.nebraska.gov/media/3460/access-control-policy.pdf).

The designer should avoid an excessive number of entrances. Keep in mind that:

- Approaches are expensive
- Some existing field entrances may no longer be required
- Each driveway presents a potential conflict with highway traffic
- Each driveway could represent an obstruction in the recovery area

Recommendations for access locations should be made during the plan-in-hand inspection. If there is any question about the need for access, the situation should be investigated during the plan-in-hand or other field inspection.

Any proposed change of a field entrance or driveway location in a rural area will be coordinated with the **Right-of-Way Division** (**ROW**) and with the **Utilities Unit** in **Roadway Design** (**Utilities**) to verify that there are no utility conflicts. Location changes of urban driveways will be coordinated with **ROW**, **Utilities**, the **Lighting Unit**, and **Traffic Engineering**. Driveway locations should not change after the final design plans have been submitted.

For additional information see An Informational Guide for Preparing Private Driveway Regulations for Major Highways (Ref. 4.13), the Access Control Policy to the State Highway System (Ref. 4.12), and Chapter Fifteen: Right-of-Way, Section 3.

2.A Rural Driveways

The following guidelines should be referred to when designing field entrances and driveways in rural locations:

1. Check the project file and/or consult with the **Unit Head** for the requirements regarding access control on the project prior to locating or designing driveways.
2. To discourage wrong-way movement, rural access openings and driveways should not be located within 300 feet of a median opening unless the access opening or driveway is directly opposite the median opening.
3. Joint access to adjoining properties should be provided where practicable, the access opening should be centered on the property line. Joint access will usually require the purchase of permanent right-of-way easements.
4. Driveways should be located at or near the crest of vertical curves. Driveways located past the crest of a vertical curve may not be visible to approaching traffic.
5. The maximum desirable grade for rural access openings is ± 8%. In a high cut or deep fill situation, a maximum grade of ± 15% is allowable.
6. The grade of the shoulder slope or flatter should be continued along the driveway for a minimum of 20 feet beyond the edge of the shoulder before breaking to a steeper slope.
7. On a project where the earthwork is measured in embankment, the earthwork required for the construction of the driveways and field entrances must be included in the earthwork totals (See Chapter Seven: Earthwork, Section 4.B.1).
8. The provision of adequate driveway length to allow agricultural equipment to pull completely off of the roadway should be considered.

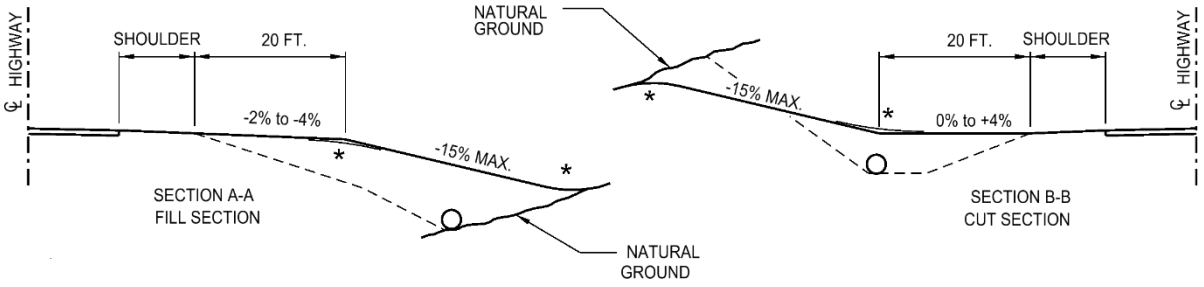
Depending on the traffic volume and composition, driveways in rural locations may be considered to be minor intersections and may include provisions for deceleration, turning movements, and acceleration.

EXHIBITS 4.14 & 4.15 show typical rural driveway designs. See EXHIBIT 4.13 for rural driveway design criteria. For additional information see Chapter Ten: Miscellaneous Design Issues, Section 9, “Mailbox Turnouts and Supports”.

Driveway Type	Rural Driveway Width *		
	Residential Drive	**Commercial Drive**	**Field Entrances**
Single	Grade 26 feet Surface 24 feet R = 25 feet	Grade 42 feet Surface 40 feet R = 40 feet	Grade 26 feet R = 25 feet
Joint Use (Driveway on property line)	Grade 26 feet Surface 24 feet R = 25 feet	Grade 42 feet Surface 40 feet R = 40 feet	Grade 42 feet R = 25 feet

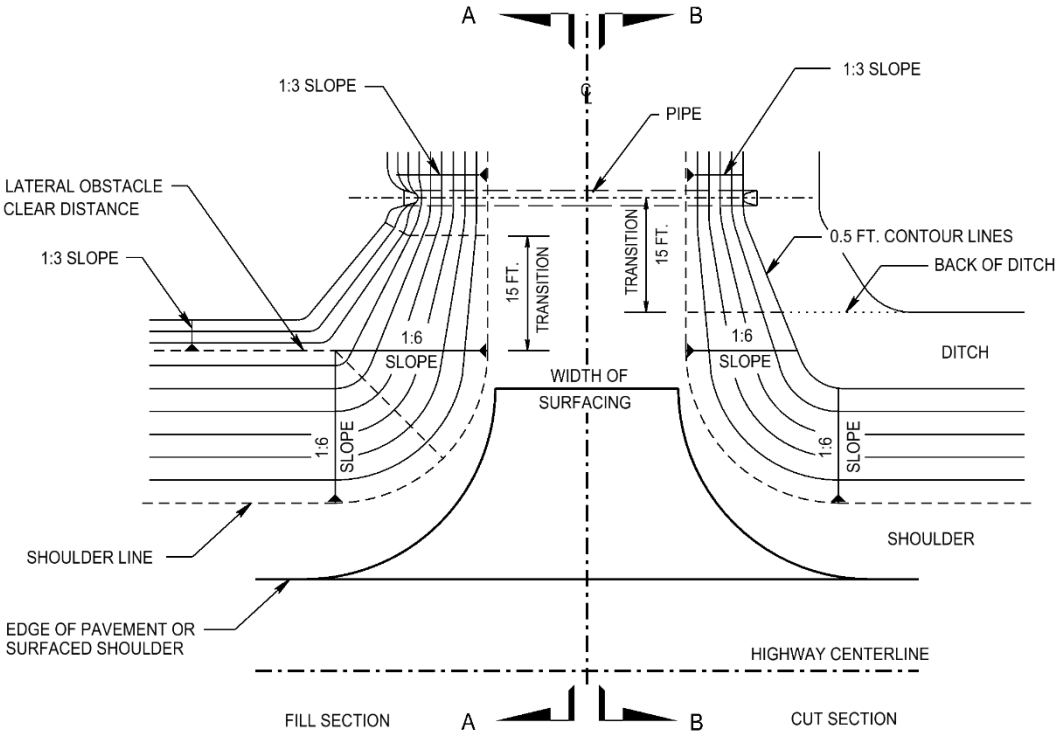
Notes: The width of the surfaced shoulder will not be subtracted from the driveway radius.
* Measured at the throat of the driveway

Exhibit 4.13 Rural Driveway Width Criteria



RURAL DRIVEWAY PROFILES
FOR GRADES EXCEEDING 8%

* 10 FT. MIN. ROUNDING IS REQUIRED FOR THE FOLLOWING GRADE CHANGES.
- FOR SAGS WITH A CHANGE IN GRADE GREATER THAN 6% USE AN 80 FT. MIN. RADIUS.
- FOR CRESTS WITH A CHANGE IN GRADE GREATER THAN 10% USE A 50 FT. MIN. RADIUS.
(SPECIFY GRADES ON SURFACED DRIVES, IF NECESSARY).



RURAL DRIVEWAY WITHOUT SPECIAL DITCH

Exhibit 4.14 Rural Driveway Without a Special Ditch

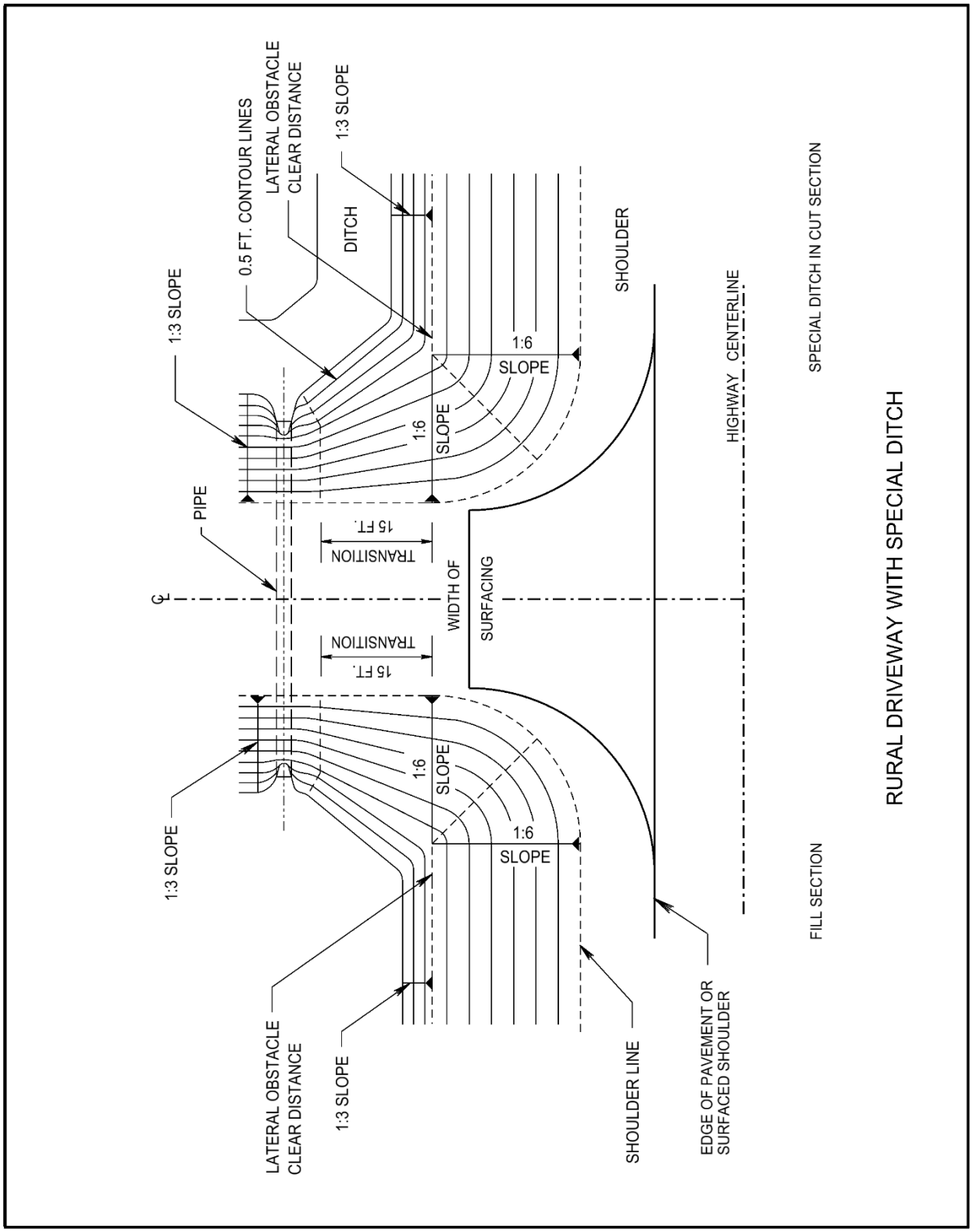
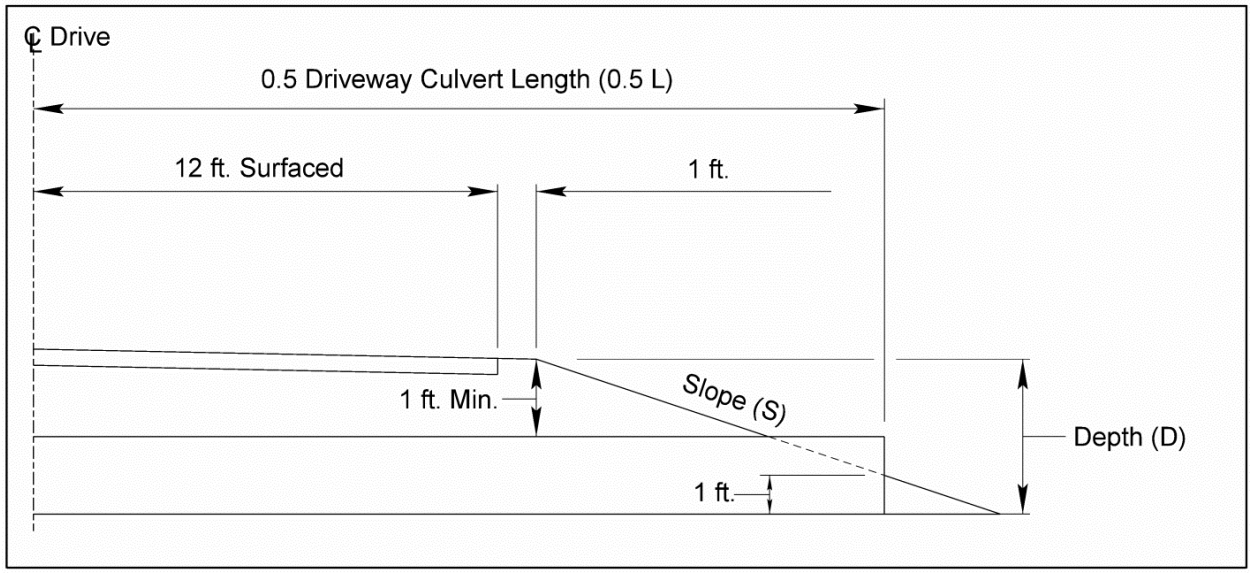


Exhibit 4.15 Rural Driveway With a Special Ditch

2.A.1 Rural Driveway Culvert Pipes

Driveway culvert pipes will be provided, where required, as a grading item. The following items should be considered in the design of rural driveway culvert pipes:

1. Driveway culvert pipe locations should be noted on the plan-in-hand field inspection.
2. The preferred location for a driveway culvert pipe is at the back of the ditch bottom, outside of the lateral clear zone (See EXHIBITS 4.14 & 4.15).
3. A minimum of 1 foot of cover should be provided over the culvert at the driveway shoulder break point (See EXHIBIT 4.16).
4. The minimum driveway culvert pipe diameter is 18 inches (24 inch diameter pipes are normally used). Larger culvert pipe diameters may be required based on the ditch hydraulics (See the Drainage Design and Erosion Control Manual (*Drainage Manual*), Chapter One: Drainage, Sections 6, 7 & 8 (Ref. 4.15) (http://www.roads.nebraska.gov/business-center/design-consultant/rd-manuals/).
5. Driveway culvert pipes will meet the requirements of the pipe material policy (See Appendix C, "Pipe Material Policy", of the *Drainage Manual*, Ref. 4.15) and Section 721 of the Standard Specifications for Highway Construction (*Spec Book*) (Ref. 4.16) (http://roads.nebraska.gov/media/6897/specbook-2007.pdf).



26 FOOT WIDE DRIVEWAY *				
DEPTH (D)	SIDE SLOPE (S)			
	1:3 [1]	1:4 [2]	1:6 [3]	1:10 [4]
3 feet (Min. D for a 24 inch Culv.)	38 feet	42 feet	50 feet	66 feet
3.5 feet (Min. D for a 30 inch Culv.)	41 feet	46 feet	56 feet	76 feet
4 feet (Min. D for a 36 inch Culv.)	44 feet	50 feet	62 feet	86 feet
4.5 feet (Min. D for a 42 inch Culv.)	47 feet	54 feet	68 feet	96 feet
5 feet (Min. D for a 48 inch Culv.)	50 feet	58 feet	74 feet	106 feet
5.5 feet (Min. D for a 54 inch Culv.)	53 feet	62 feet	80 feet	116 feet
6 feet	56 feet	66 feet	86 feet	126 feet
6.5 feet	59 feet	70 feet	92 feet	136 feet
7 feet	62 feet	74 feet	98 feet	146 feet
7.5 feet	65 feet	78 feet	104 feet	156 feet
8 feet	68 feet	82 feet	110 feet	166 feet
	MINIMUM DRIVEWAY CULVERT PIPE LENGTH (L)			

* To determine the driveway culvert length for the maximum driveway width of 42 feet, add 16 feet to L.

For ditch depths other than those given:

1. Add 6 feet to L for each additional 1 foot of depth.
2. Add 8 feet to L for each additional 1 foot of depth.
3. Add 12 feet to L for each additional 1 foot of depth.
4. Add 20 feet to L for each additional 1 foot of depth.

Exhibit 4.16 Minimum Rural Driveway Culvert Pipe Lengths

2.B Urban Driveways

The number of urban driveways should be minimized to reduce the potential for accidents and to maintain highway capacity. Joint use driveways are desirable in urban locations to limit conflict points. Access control will be acquired for any urban tract where an existing driveway is closed (See Chapter Fifteen: Right-of-Way, Section 3). Driveway access should be located outside of the storage length at signalized intersections in order to avoid conflicting movements and false signal actuations. Driveway design with signal controls requires a traffic analysis by **Traffic Engineering** to coordinate signal design and the roadway/intersection geometry.

The majority of driveway design in urban areas involves improvements to existing locations. Factors to be considered include:

- Traffic composition
- Right-of-way
- Accommodation of existing access
- Development of property being served
- Development of adjacent properties
- Access control regulations and requirements
- Location of curb inlets

All new urban driveway design will be in accordance with the criteria shown in EXHIBIT 4.17; see EXHIBIT 4.18 for a typical urban driveway design. Curb cut locations are governed by the Access Control Policy to the State Highway System (Ref. 4.12) and local ordinances. The geometry of the driveway will be referenced to the project centerline. Major driveways that are signalized should be designed as intersections. Driveway design involving shopping centers, truck stops, schools, plants with large parking lots, etc. require a special traffic analysis by **Traffic Engineering** to coordinate the number of lanes, traffic controls, and required storage lengths.

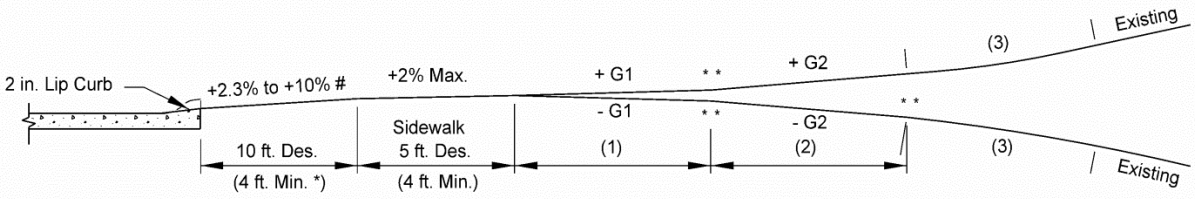
The allowable driveway grade between the 2 inch slope curb and the sidewalk, not including sidewalks located directly behind the curb, will be between +2.3% and +10%, with a maximum allowable grade of +15% with **ADE** approval.

Driveway Type	Urban Driveway Width *	
	Residential Drive	**Commercial Drive**
Single	12 feet minimum	40 feet maximum
Double	24 feet maximum, in existing locations only. Use single in new locations.	---
Joint Use (Driveway on property line)	24 feet desirable	40 feet maximum

Notes: The minimum urban driveway radius is 10 feet with 15 feet desirable and 25 feet maximum for commercial driveways.

* Measured at the throat of the driveway.

Exhibit 4.17 Urban Driveway Width Criteria



PROFILE URBAN DRIVEWAY WITH SIDEWALK OR FUTURE SIDEWALK
(MAXIMUM ALLOWABLE PERCENT OF GRADE)

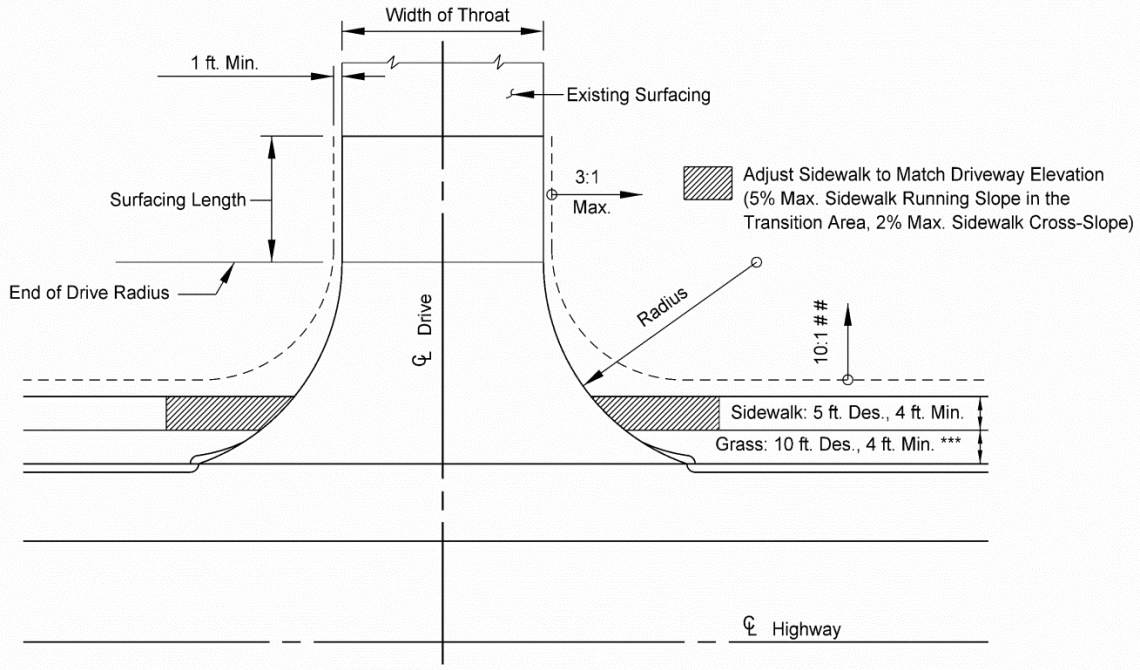
1. 10 ft. min. is required when the existing grade is greater than 8%.
2. 10 ft. min. is required when the existing grade is greater than 15%.
3. 10 ft. min. rounding is required when the existing grade is greater than 22%.

* 0 ft. is allowed in urban business districts with sidewalks of 6 ft.min. width.

** 10 ft. min. rounding desirable for the following grade changes:
- For sags with a change in grade greater than 7% use an 80 ft. min. radius.
- For crests with a change in grade greater than 10% use a 50 ft. min. radius.

A rise of 2 in. or less between the back of curb and the sidewalk will require an edge drain.

DRIVEWAY TYPE	G1 (MAX.)	G2 (MAX.)
COMMERCIAL, INDUSTRIAL	+/- 5%	+/- 8%
DWELLINGS (RESIDENTIAL)	+/- 8%	+/- 15%



10:1 des., 6:1 min. within lateral obstacle clearance distance, then transition to 3:1 in 15 ft.

*** 0 ft. allowed in urban business districts with sidewalks of 6 ft. min. width.

URBAN DRIVEWAYS

Exhibit 4.18 Urban Driveway

3. SURFACING

The determination of surfacing type for intersections and driveways is site specific; there are no absolute rules governing this topic. Surfacing type for intersections and drives should be addressed in the pavement determination and discussed at the plan-in-hand meetings, utilizing the **District's** local experience.

3.A Intersection Surfacing Guidelines

See EXHIBIT 4.19. Where parallel railroad tracks run within 200 feet of the edge of the pavement, the crossroad should be surfaced to the railroad right-of-way and may be surfaced to the tracks with **District Engineer** (**DE**) approval. Any work on railroad right-of-way requires the approval of the **DE** and a special provision prepared by **Railroad Liaison**.

3.B Driveway Surfacing Guidelines

In most cases the limit of surfacing will be either to the end of the driveway radius or to the existing driveway surface, the choice will depend on which is the least distance from the edge of the pavement, allows for a suitable driveway grade, and matches into the remaining portion of the driveway. Check with the **DE** at the plan-in-hand for verification. See EXHIBITS 4.18 & 4.20 for examples.

Field entrances will not be surfaced except in the Sandhills Region; millings should be used to surface field entrances whenever possible (verify with the **DE** at the plan-in-hand field inspection).

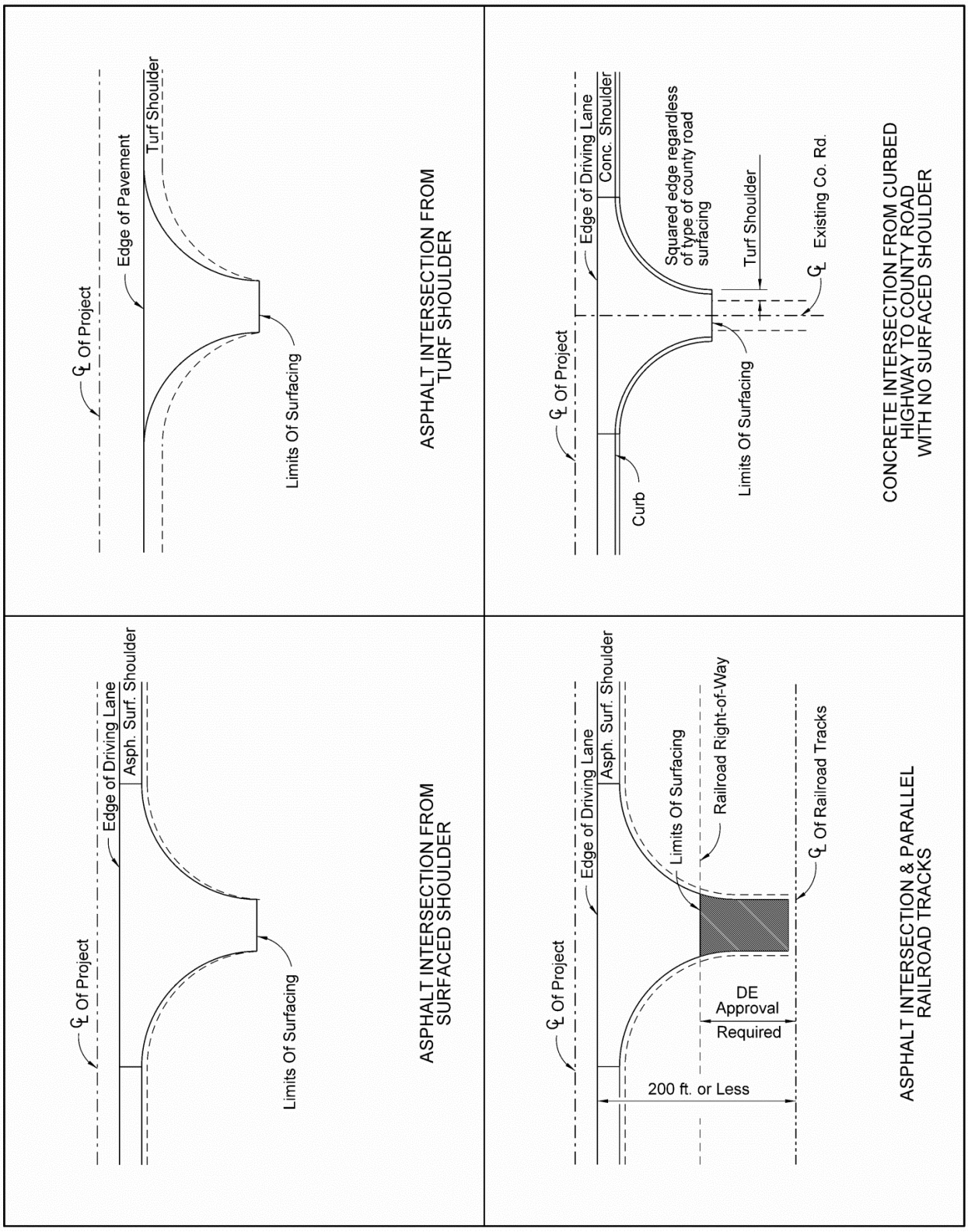


Exhibit 4.19 Limits of Surfacing at Co. Road Intersections and Other Public Roads

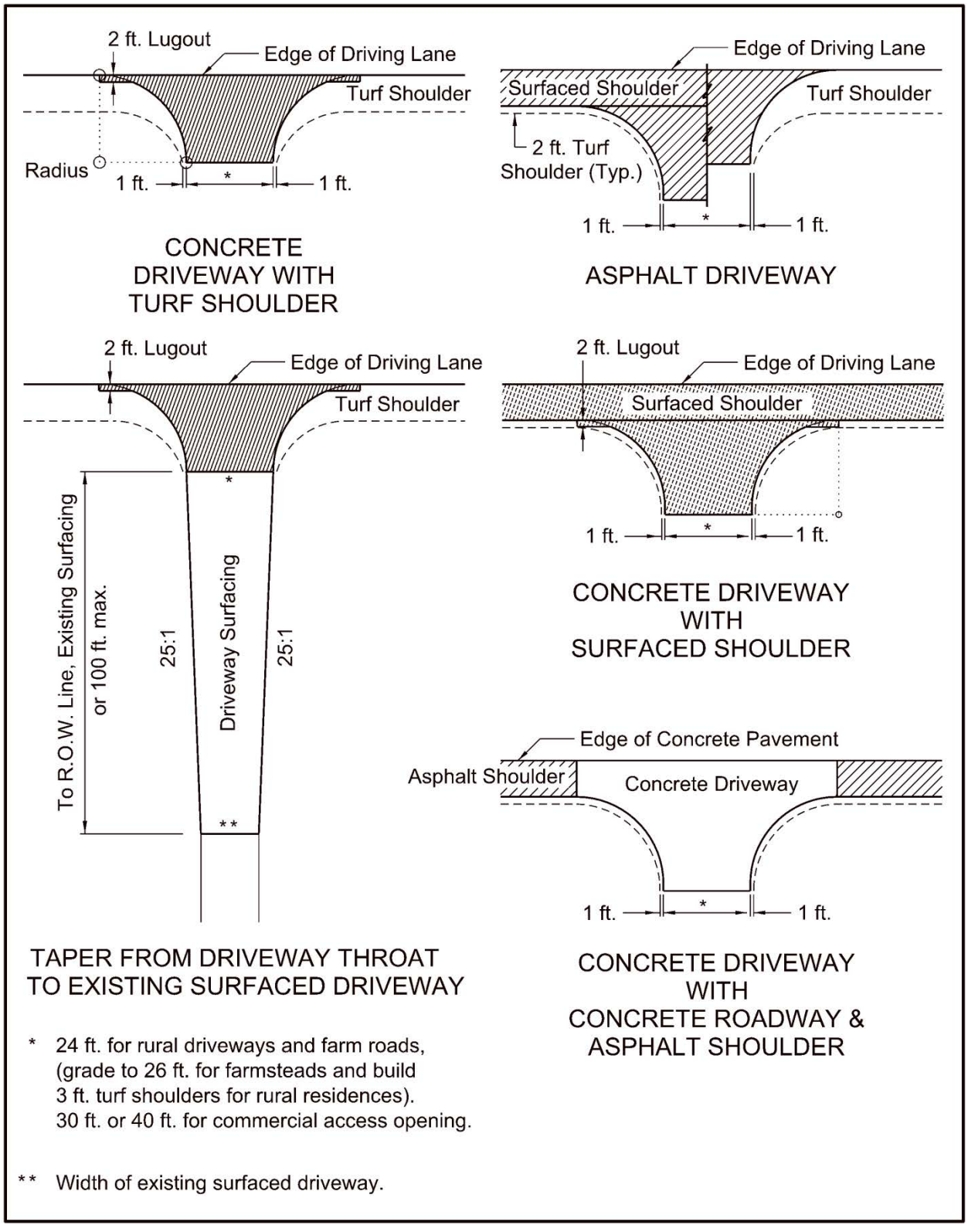


Exhibit 4.20 Surfacing Criteria for Rural Driveways

4. BUILD NOTES FOR INTERSECTIONS AND DRIVEWAYS

The following guidelines have been established for build notes for intersections and driveways:

1. Use “BUILD” in the note for driveways and intersections if any of the following conditions are present:
    - A new driveway or intersection is being constructed or an existing driveway or intersection is being relocated
    - The top width of the intersection or driveway is being changed
    - A new driveway pipe is being laid or an existing pipe is being re-laid
    - A new culvert pipe is being constructed within the radii of an existing surfaced intersection
2. Use “SURFACE” in the note for driveways and intersections if none of the above conditions are present. On resurfacing projects without surfaced shoulders, new roadway grading which is contoured around an existing intersection will not be considered as a change in the top width.
3. If a “BUILD” note is used for an intersection note, the words "and surface" will not be in the note.
4. If a “BUILD” note is used for a driveway note and the driveway is also to be surfaced, the words "and surface" will be included in the note.

5. CHANNELIZATION

Islands and medians may be used to divide and direct traffic. The degree of channelization required for a roadway is influenced by the patterns and volume of both vehicular and pedestrian traffic during peak periods. A traffic analysis, identifying the relative importance of conflicting movements, is performed by **Traffic Engineering** to establish the type of channelization to be used. Examples of channelized intersection designs are shown in EXHIBITS 4.21 & 4.22. The designer should coordinate with **Traffic Engineering** throughout intersection design regarding channelization and other issues.

The following guidelines should be considered when designing a channelized intersection:

1. Motorists should be confronted with no more than one decision at a time.
2. Turns greater than 90° and sudden sharp reverse curves should be avoided.
3. Areas of vehicle conflict should be reduced as much as possible.
4. Points of crossing or conflict should be evaluated for other possible treatments such as separation or consolidation with appropriate control devices.
5. Storage areas for turning vehicles should be provided clear of the through traffic lane.
6. Approach road designs based on refuge for vehicles in medians, to either turn left or to pass straight through, will not be considered.
7. Prohibited turns should be blocked wherever possible.
8. The location of traffic control devices should be established as a part of the channelization design.
9. Channelization may be desirable to separate various traffic movements where multiple phase signals are used.
10. All turning movements should be checked with the appropriate design vehicle (See EXHIBIT 4.9).
11. Lighting warrants should be checked when raised channelization is introduced at an intersection.

For additional information about channelization see Chapter 9 of the *Green Book* (Ref. 4.1).

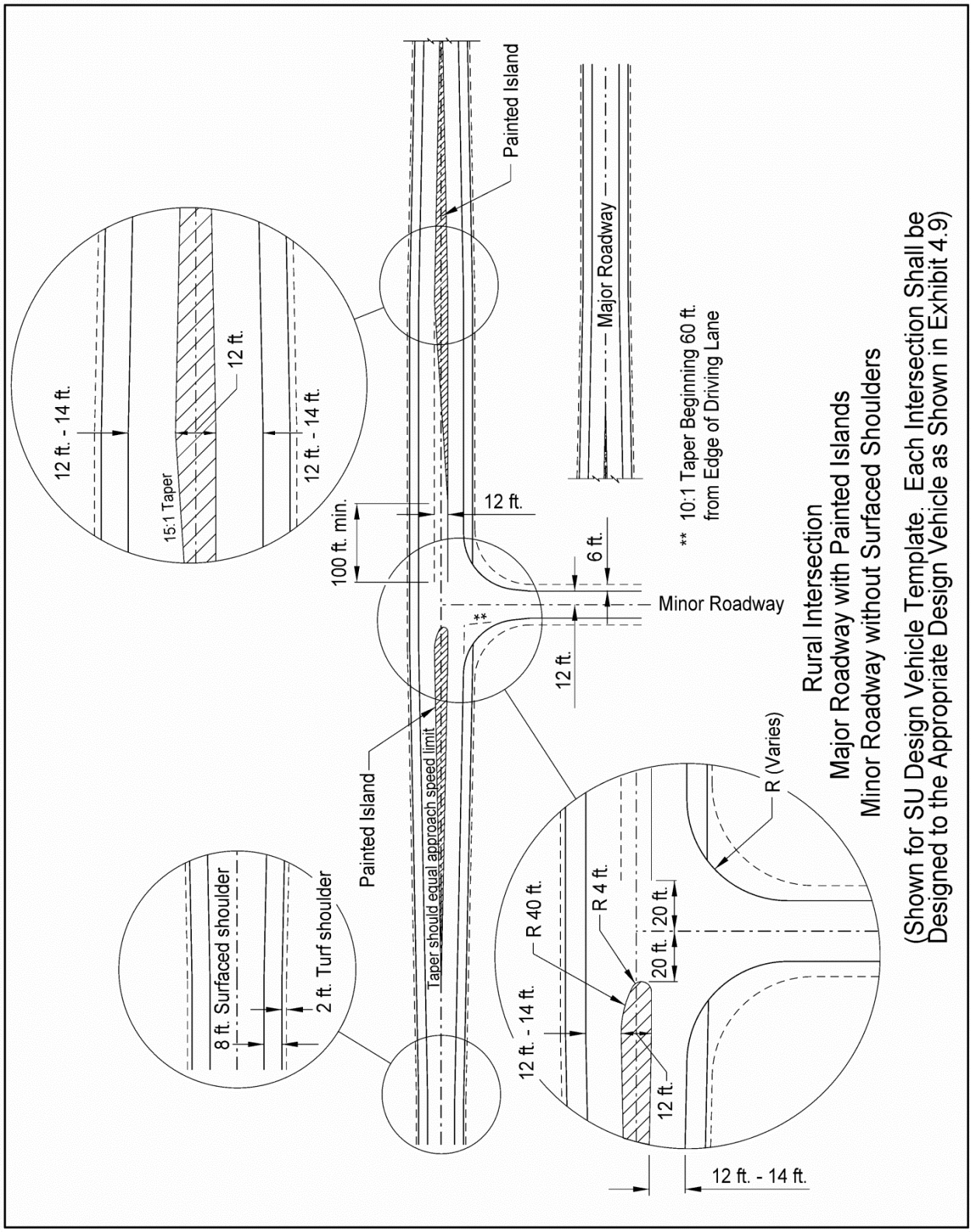


Exhibit 4.21 Example of Rural Three-Leg Intersection with Minor Roadway Without Surfaced Shoulder

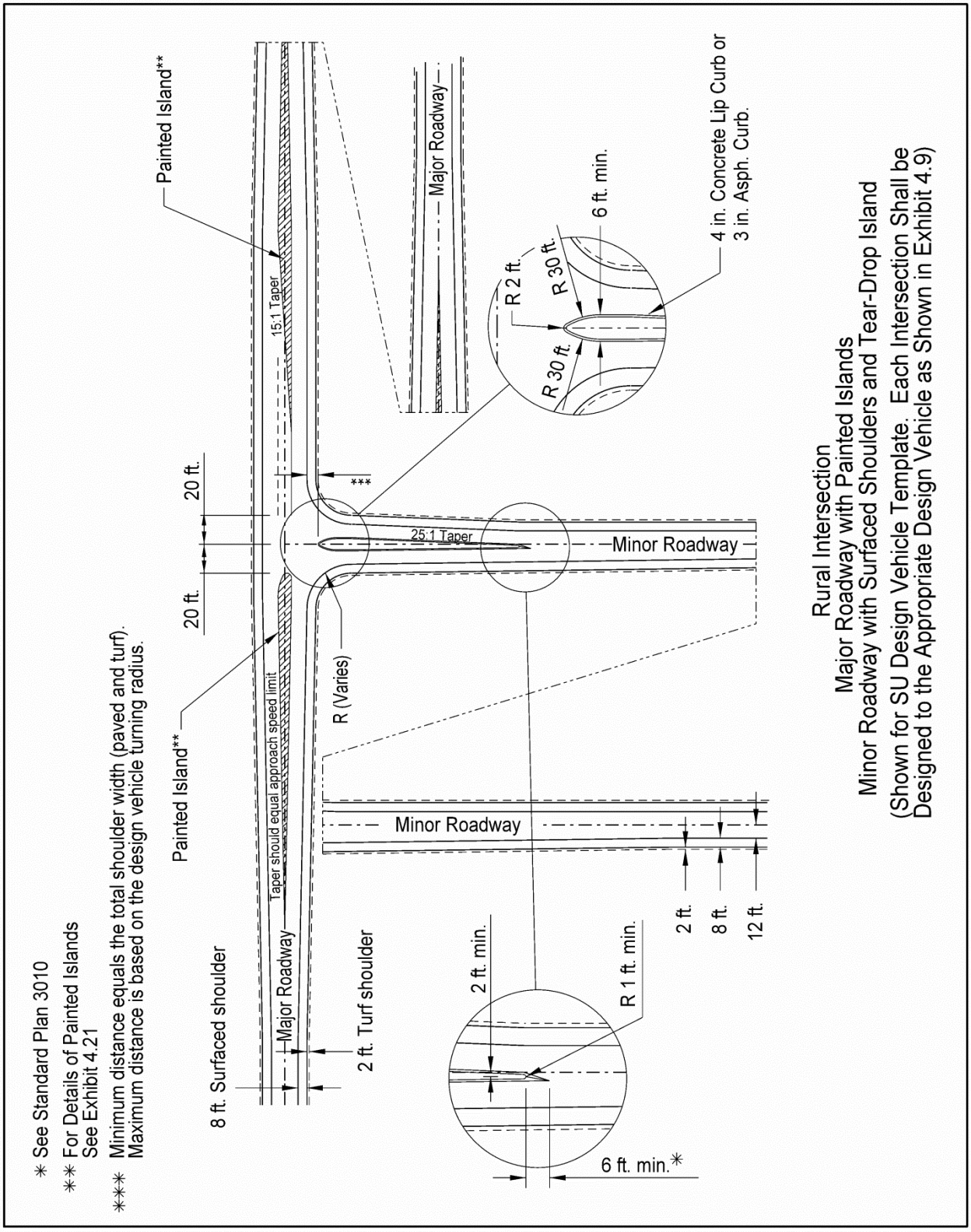


Exhibit 4.22 Example of a Rural Three-Leg Intersection with Minor Roadway With Surfaced Shoulder

5.A Islands

Islands should be designed to define the driving path. Islands may be flush or raised and may be delineated by surfacing materials or pavement markings.

For non-developed suburban crossroads, the following guidelines apply:

1. If the intersection warrants signalization within five years of the programmed construction the project may include signals, based on a recommendation from **Traffic Engineering**. A raised or flush median (determined on a project-by-project basis) and a left turn lane may be constructed. If access control is purchased on along the mainline roadway it should extend up the cross road (See Chapter Fifteen: Right-of-Way, EXHIBITS 15.3, 15.4, & 15.5).
2. If signals are not warranted within five years from construction but may be warranted at sometime within 20 years of construction, the grading may be accomplished for future islands and turn lanes but the paving will be constructed to two-lane, stop-control geometrics.

For urban and developed suburban crossroads, the following guidelines apply:

1. If signals are warranted within five years of construction, the project may include signals. An island and a left turn lane may be built.
2. If signals are not warranted within five years of construction, a standard two-lane intersection will be constructed. When signals are installed, the intersection will be reconstructed as required.

5.A.1 Raised Islands

Raised islands provide the most positive delineation and may be used to control undesirable turning movements.

The use of a raised island for pedestrian refuge should be considered if a crosswalk passes through the channelization. Raised islands may also be used for the placement of traffic signals. For concrete island and curb ramp details see the Standard/Special Plan Book (*Standard Plans*) (Ref. 4.14) (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/). See Chapter Sixteen: Pedestrian and Bicycle Facilities, Section 7, for information regarding pedestrian crosswalks.

The allowable curb height on raised islands is a function of the design speed. The following **NDOT** curb policy applies:

- On high-speed facilities (design speed ≥ 50 mph), 3 inch and 4 inch concrete slope curb and 3 inch asphaltic concrete curb are permitted in both urban and rural settings (See EXHIBIT 6.16).
- On low-speed facilities (design speed ≤ 45 mph), 6 inch integral concrete curbs are permitted (See EXHIBIT 6.16).

Lighting warrants should be checked when raised islands are used.

Teardrop raised islands on the minor roadway approach are acceptable at state highway intersections with high-volume roads (See EXHIBITS 4.3 & 4.22). These islands should be installed for placement of the stop sign when the intersection return must be widened to accommodate turning trucks. The designer should design the island and the intersection geometry so that it does not conflict with the design vehicle's turning movements.

5.B Medians

A median is defined as the portion of a divided highway which separates the opposing traffic lanes.

5.B.1 Median Uses

Medians on multilane highways and roadways may provide the following benefits:

- Separate opposing traffic movements
- Provide a recovery area for errant vehicles
- Facilitate the drainage on crowned multilane sections
- Prevent undesirable turning movements
- Provide space for deceleration lanes and storage for left turning vehicles
- Provide width for future lanes

The *MDS* (Ref. 4.7) indicates the facility classifications for which medians are required.

5.B.2 Median Types

1. Flush Medians - Flush medians are typically used on urban highways and streets. These medians are often used as two-way left-turn lanes in urban areas.
2. Raised Medians - Raised medians are typically used on urban and suburban highways and streets to control access and left turns (the *Standard Plans*, Ref. 4.14, shows a typical detail of a raised concrete median). The decision of whether to surface a raised median, and surfacing type, should be made on the plan-in-hand field inspection. Mow strips (a 2 foot surfaced section between the curb and the turf) may also be considered.
3. Depressed Medians - Depressed medians are typically used on freeways, where practicable, and on other divided arterials. Depressed medians have better drainage characteristics than raised medians.

EXHIBIT 4.23 illustrates the different median types.

5.B.3 Median Width

The width of the median is the distance between the inside edges of the through travel lanes (See EXHIBIT 4.23). The median width depends on the type of facility, costs, existing and future development, and right-of-way limitations. The desirable depressed median width for an Interstate is 64 feet, the desirable depressed median width for a 4-lane freeway is 54 feet, and the desirable depressed median width for an expressway is 50 feet. Variations in median widths should be considered on a case-by-case basis at the plan-in-hand inspection. Roadway designers should check the width and placement of any piers in the median and, if necessary, adjust the roadway design accordingly. The width of the pier cap will also be checked to verify that the minimum allowable vertical clearance is being maintained (See Chapter Ten: Miscellaneous Design Issues, Section 2.E).

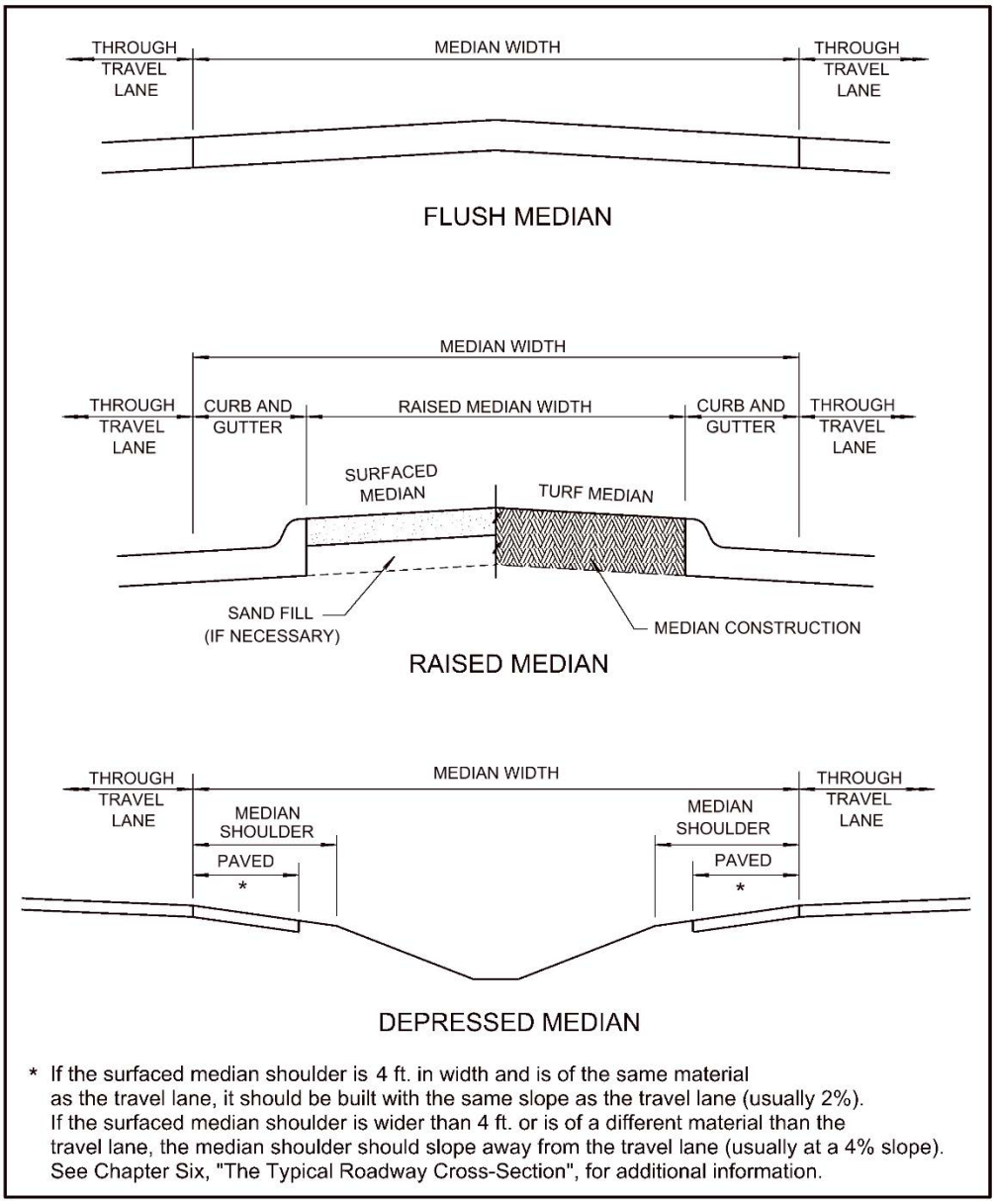


Exhibit 4.23 Median Types

5.B.4 Median Breaks

Median breaks may be provided to allow access to driveways and crossroads. The turning template for the appropriate design vehicle and the intersection/driveway environment will be used to determine the median opening width and intersection/driveway geometry. The designer should also check the effects of median channelization on neighboring intersections and driveways. Median openings are typically graded so that this pavement area drains away from the driving lanes.

Four types of median breaks may be used on divided roadways.

5.B.4.a Type A Median Breaks

Type A median breaks (EXHIBITS 4.24, 4.25, 4.27 & 4.30) may be used at intersections of the mainline with roadways having a classification of "Other Arterial" or higher and at intersections with paved public roads where there is high probability of turning vehicles blocking the opposing turning driver's line of sight (the left turn lanes of a Type A median break are offset so that the driver's line of sight will not be obstructed). At other locations a special traffic study by **Traffic Engineering** will be required to justify the use of a Type A median break. Roadway designers will consult with their **ADE** when proposing the use of Type A median breaks. The length of a Type A median break consists of:

1. 120 feet of 15:1 taper to shift the turning traffic 8 feet from the through lane,
2. A deceleration lane to slow the traffic to a full stop (it is assumed that turning traffic will slow by 10 mph prior to entering the median break),
   And
3. A storage length provided by **Traffic Engineering**. The minimum storage length will be 50 feet, providing storage for two cars at 25 feet per car, or 100 feet if the percentage of trucks exceeds 10%, which provides storage for one car at 25 feet and one truck at 75 feet.

5.B.4.b Type B Median Breaks

Type B median breaks (EXHIBITS 4.24, 4.26, 4.28 & 4.31) are appropriate for use at mainline intersections with gravel county roads, with housing development intersections, and with rural commercial driveways. The length of a Type B median break consists of:

1. 120 feet of 15:1 taper to shift the turning traffic 8 feet from the through lane,
2. A deceleration lane to slow the traffic to a full stop (it is assumed that turning traffic will slow by 10 mph prior to entering the median break),
   And
3. Storage length. The minimum storage length will be 50 feet, providing storage for two cars at 25 feet per car, or 100 feet if the percentage of trucks exceeds 10%, which provides storage for one car at 25 feet and one truck at 75 feet.

Traffic Engineering should be consulted for the appropriate storage length if the mainline traffic volume is over 9000 ADT, if the opposing peak hour traffic volume is over 500, if the peak hour turning traffic volume is 100 VPH or greater, and for rural commercial driveways.

5.B.4.c Type C Median Breaks

Type C median breaks (EXHIBITS 4.24, 4.26, 4.29, 4.32 & 4.33) are appropriate for use at mainline intersections with farmstead/rural residence driveways. The length of a Type C median break consists of a 15:1 taper to shift the turning traffic to the left of the through lane.

5.B.4.d Type D Median Breaks

Type D median breaks (EXHIBITS 4.29 & 4.34) are used at an intersection with a field entrance.

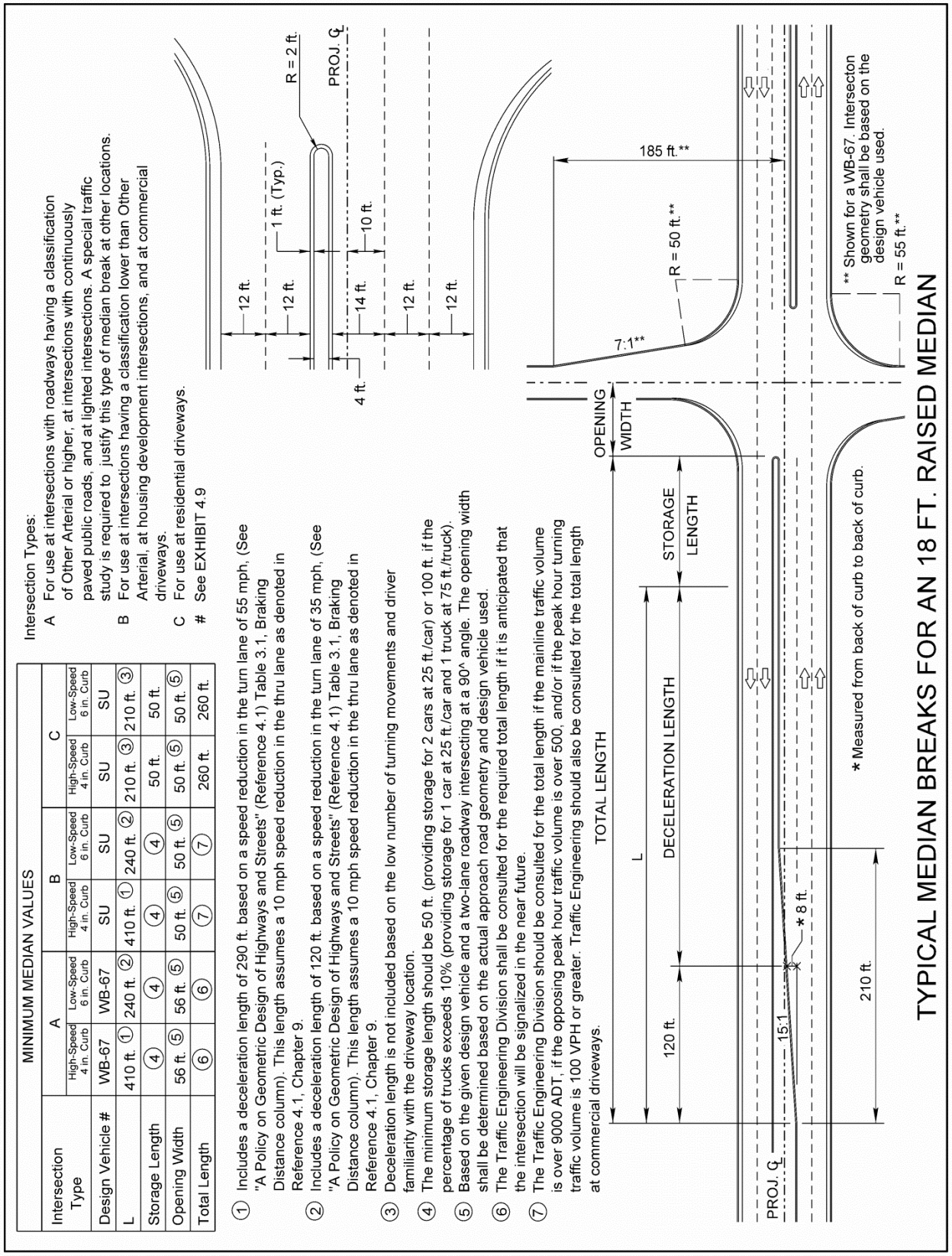


Exhibit 4.24 Typical Median Breaks (18 Ft. Raised Medians)

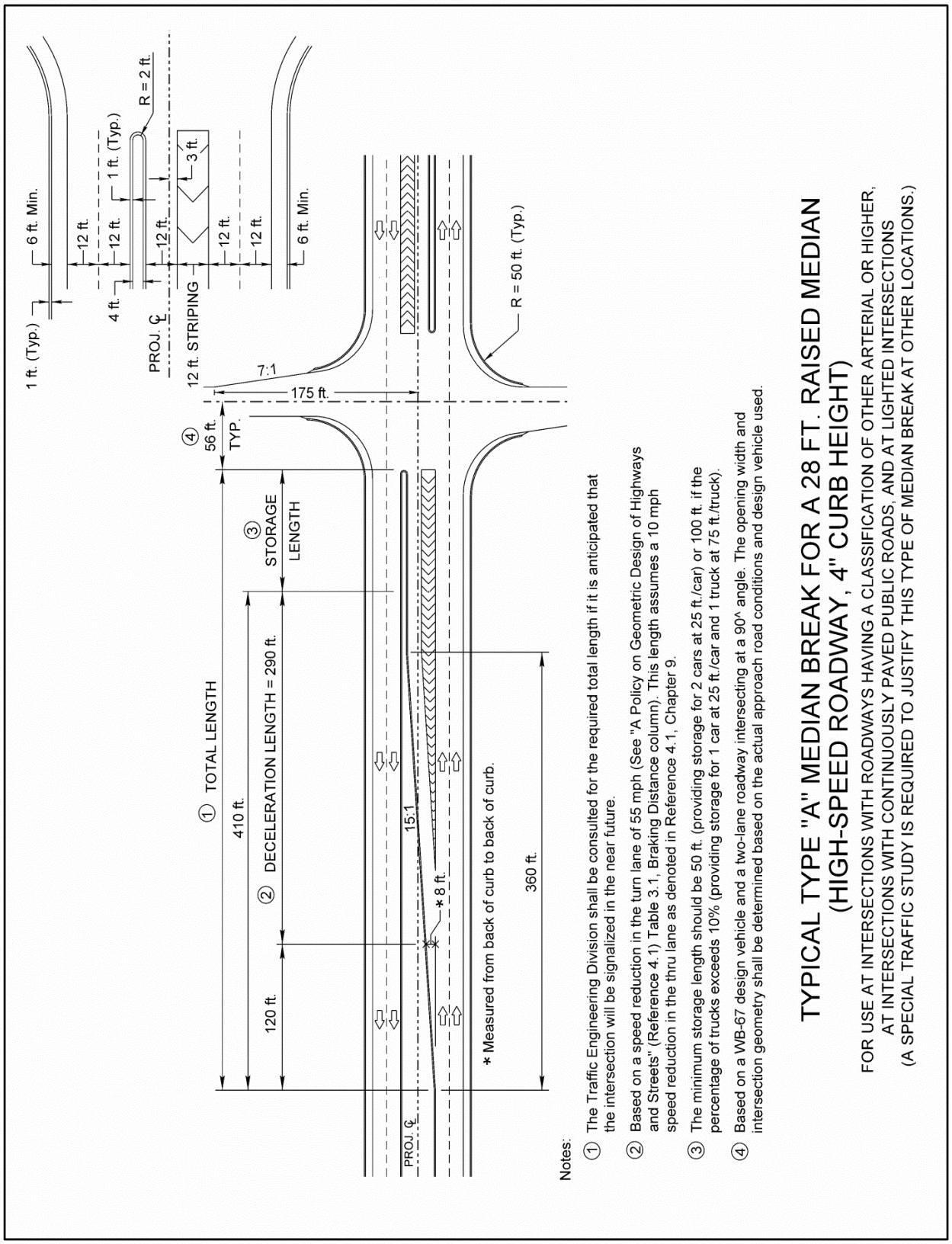
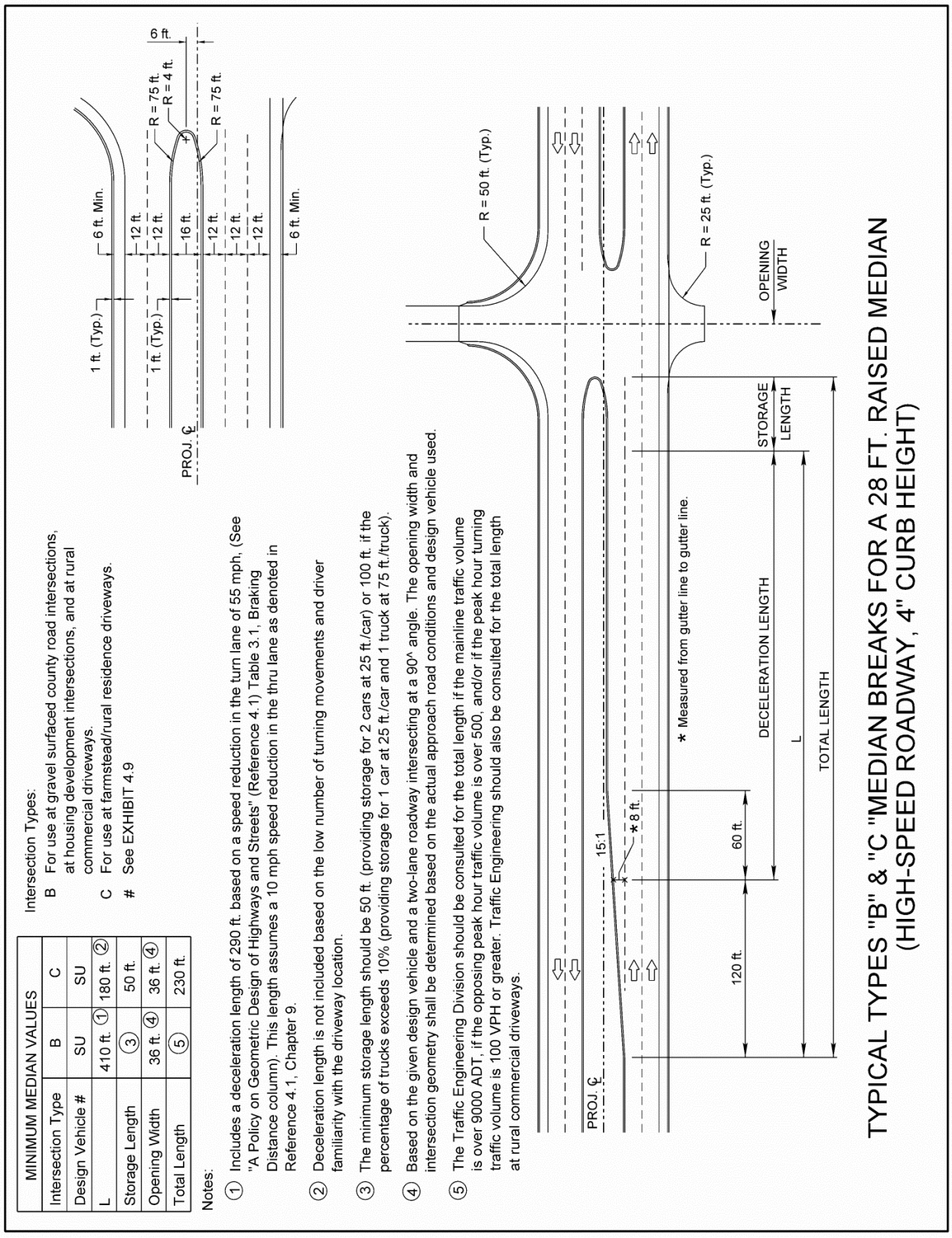


Exhibit 4.25 Typical Type A Median Break (28 Ft. Raised Median)



MINIMUM MEDIAN VALUES		
Intersection Type	B	C
Design Vehicle #	SU	SU
L	410 ft. ①	180 ft. ②
Storage Length	③	50 ft.
Opening Width	36 ft. ④	36 ft. ④
Total Length	⑤	230 ft.

Intersection Types:

B For use at gravel surfaced county road intersections, at housing development intersections, and at rural commercial driveways.

C For use at farmstead/rural residence driveways.

See EXHIBIT 4.9

Notes:

① Includes a deceleration length of 290 ft. based on a speed reduction in the turn lane of 55 mph, (See "A Policy on Geometric Design of Highways and Streets" (Reference 4.1) Table 3.1, Braking Distance column). This length assumes a 10 mph speed reduction in the thru lane as denoted in Reference 4.1, Chapter 9.

② Deceleration length is not included based on the low number of turning movements and driver familiarity with the driveway location.

③ The minimum storage length should be 50 ft. (providing storage for 2 cars at 25 ft./car) or 100 ft. if the percentage of trucks exceeds 10% (providing storage for 1 car at 25 ft./car and 1 truck at 75 ft./truck).

④ Based on the given design vehicle and a two-lane roadway intersecting at a 90^ angle. The opening width and intersection geometry shall be determined based on the actual approach road conditions and design vehicle used.

⑤ The Traffic Engineering Division should be consulted for the total length if the mainline traffic volume is over 9000 ADT, if the opposing peak hour traffic volume is over 500, and/or if the peak hour turning traffic volume is 100 VPH or greater. Traffic Engineering should also be consulted for the total length at rural commercial driveways.

Exhibit 4.26 Typical Types B and C Median Breaks (28 Ft. Raised Medians)

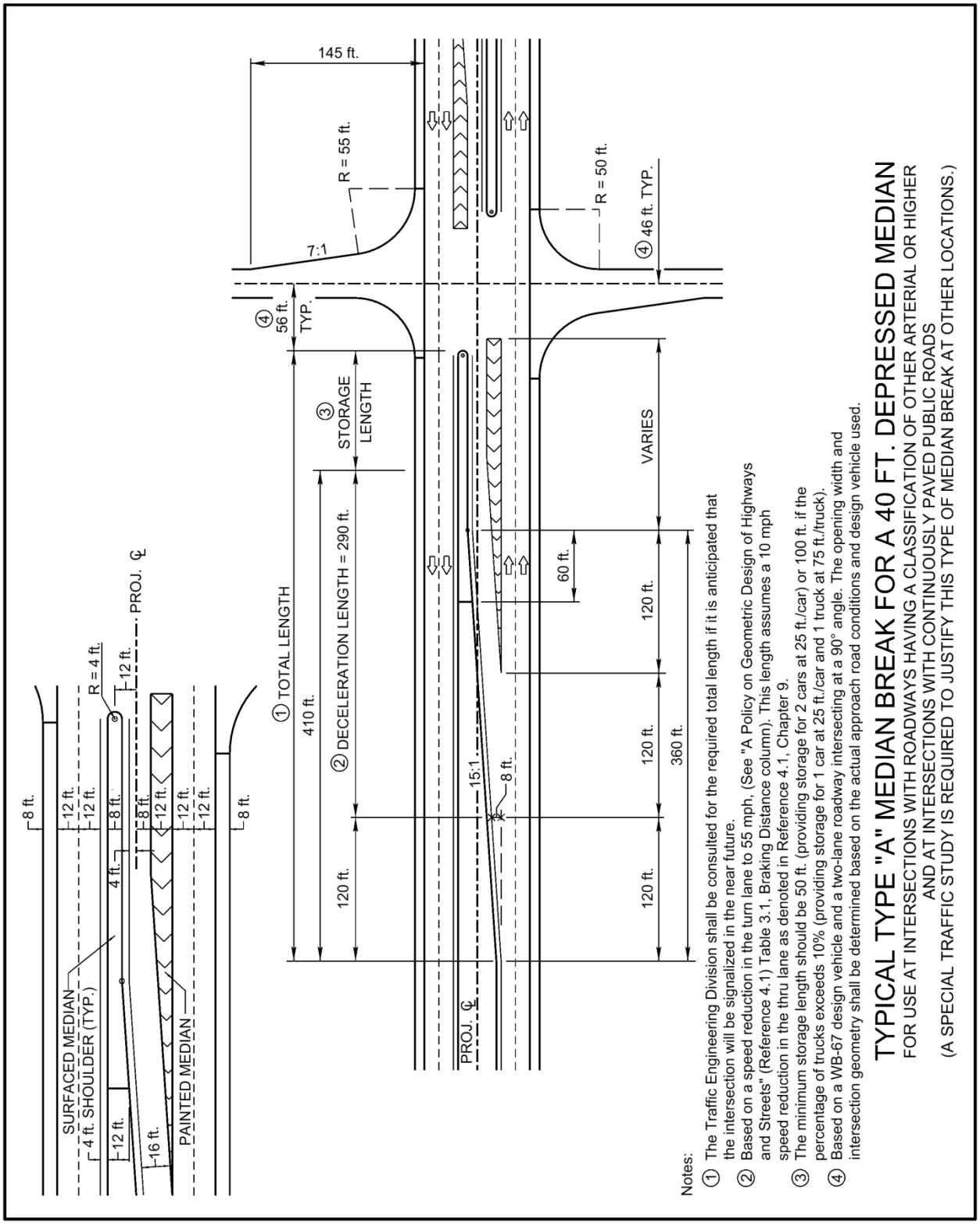


Exhibit 4.27 Typical Type A Median Break (40 Ft. Depressed Median)

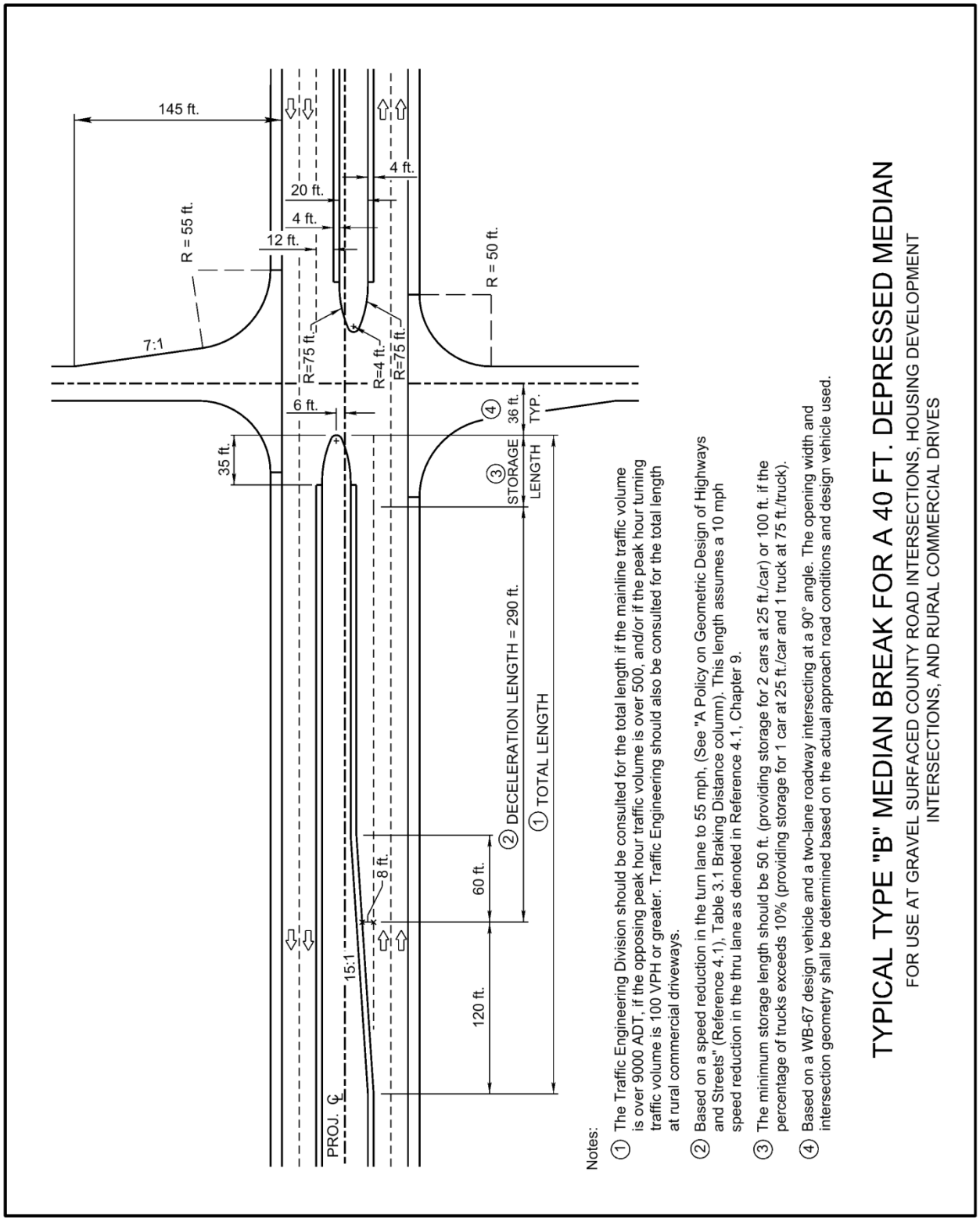


Exhibit 4.28 Typical Type B Median Break (40 Ft. Depressed Median)

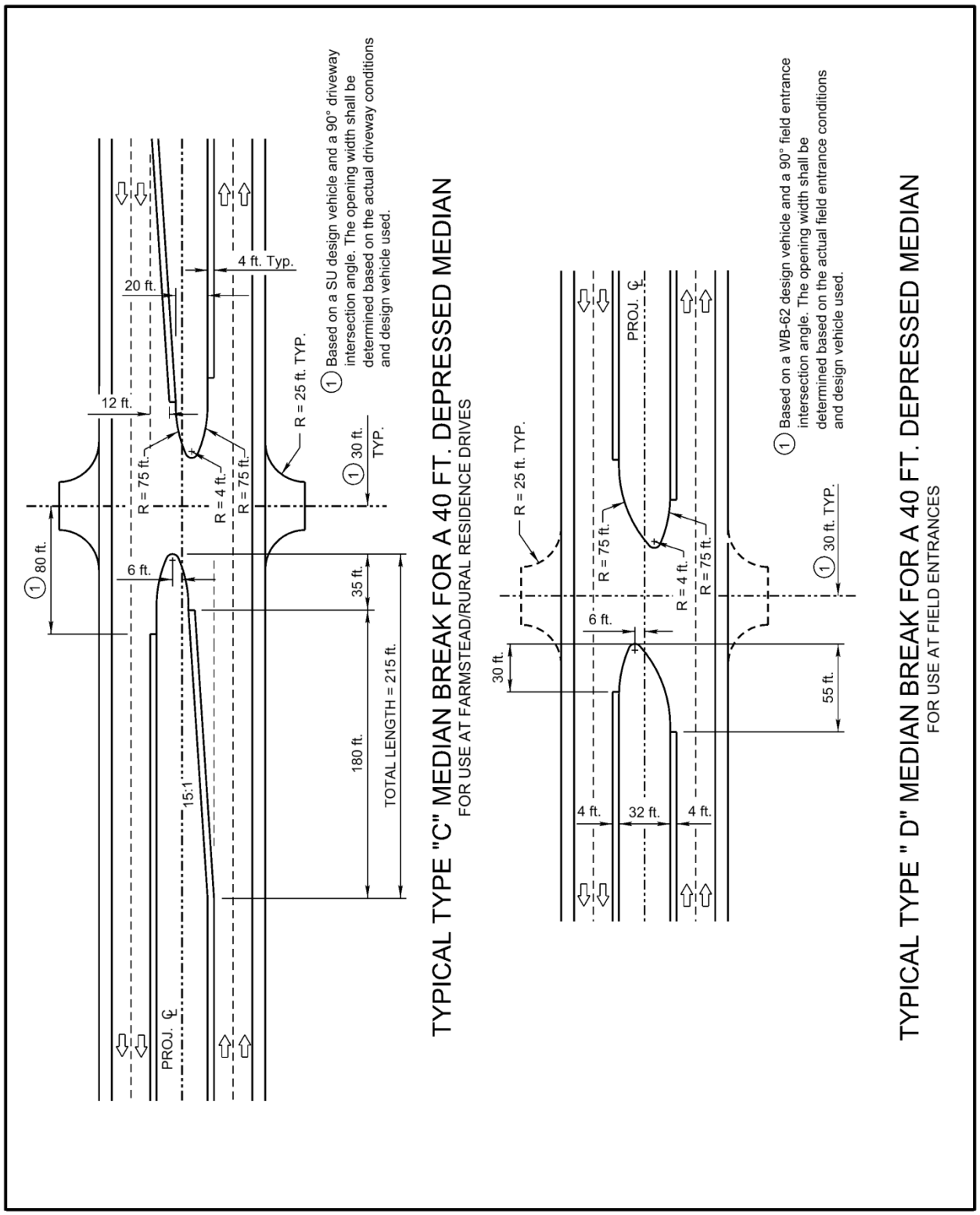


Exhibit 4.29 Typical Types C and D Median Breaks (40 Ft. Depressed Median)

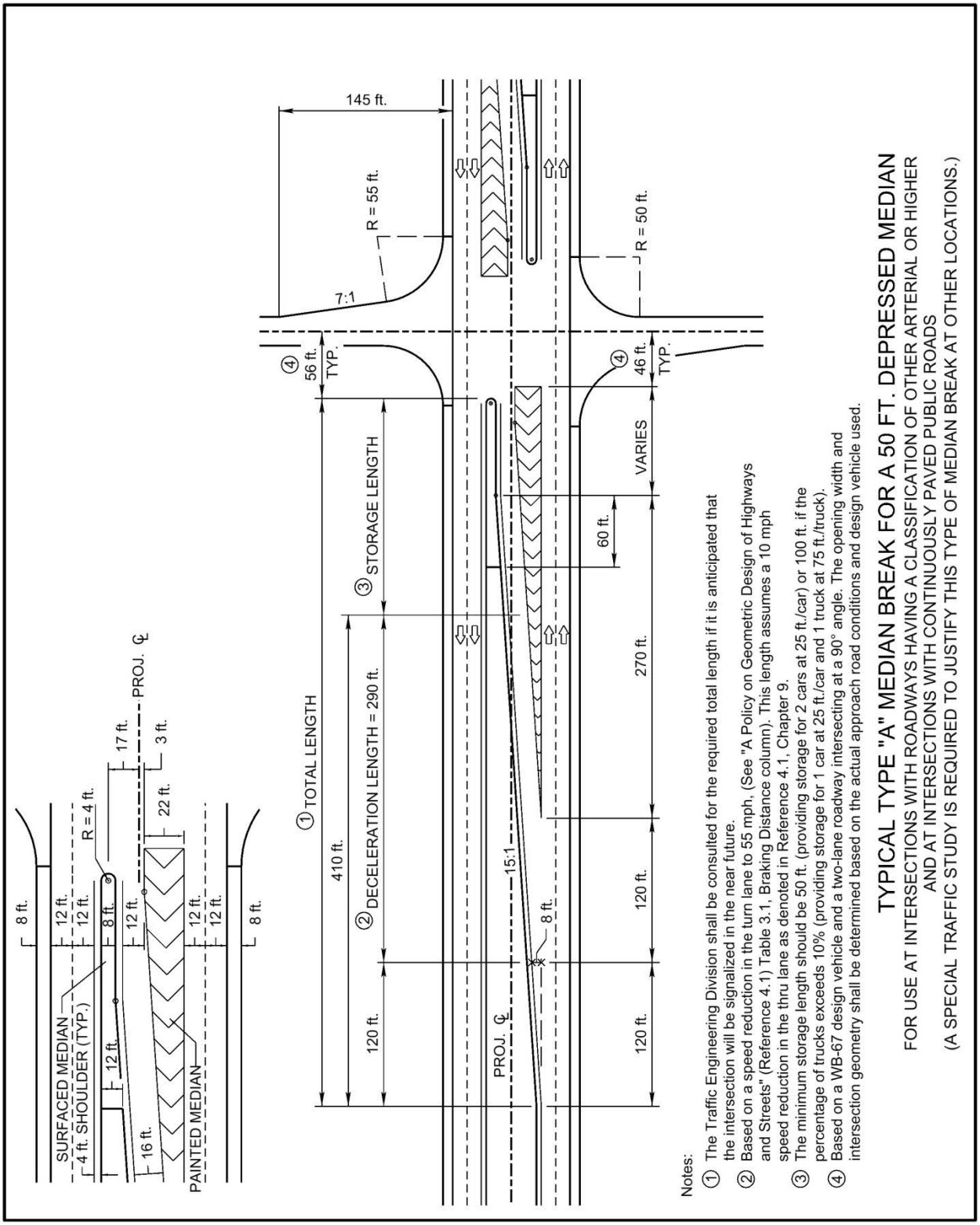


Exhibit 4.30 Typical Type A Median Break (50 Ft. Depressed Median)

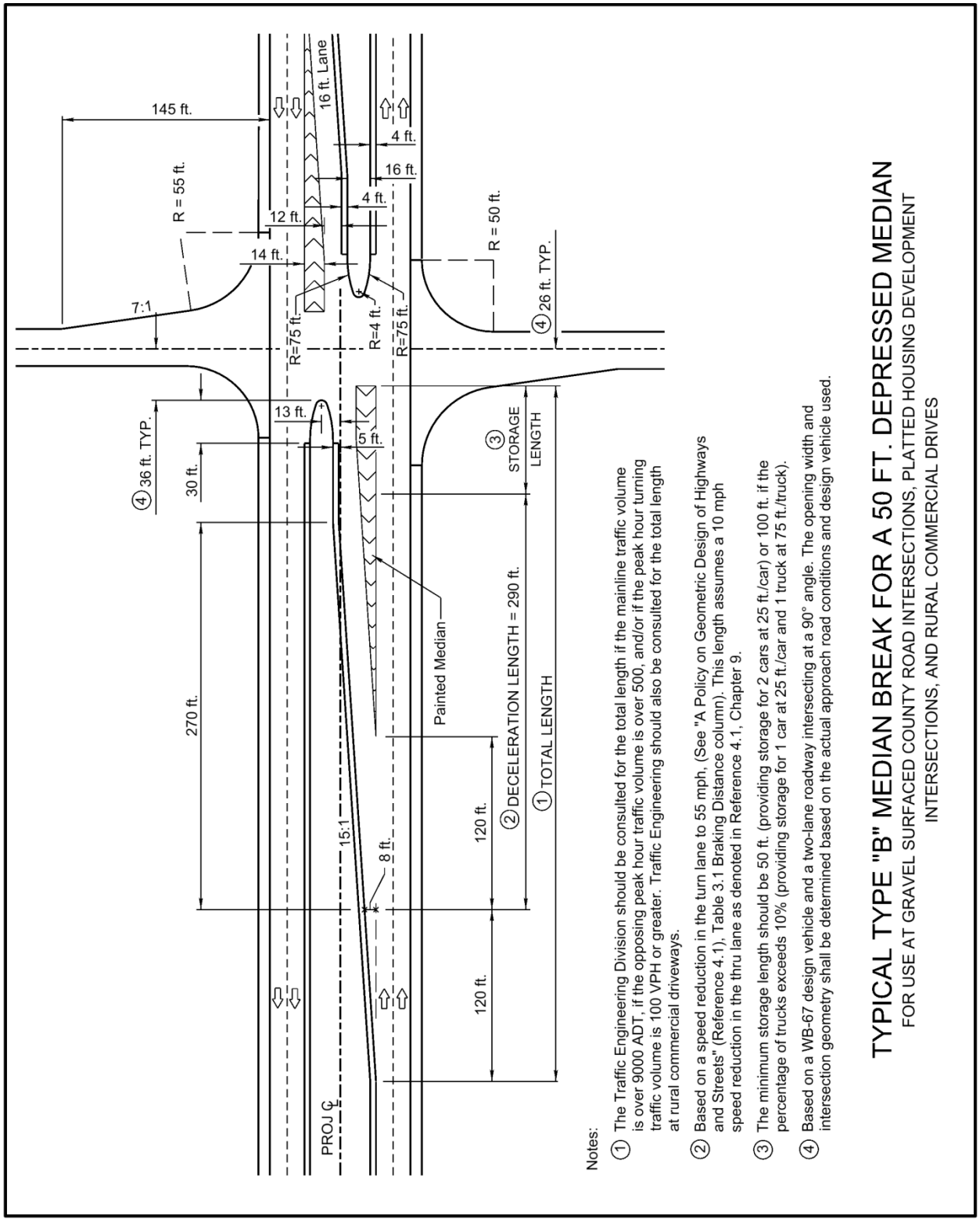


Exhibit 4.31 Typical Type B Median Break (50 Ft. Depressed Median)

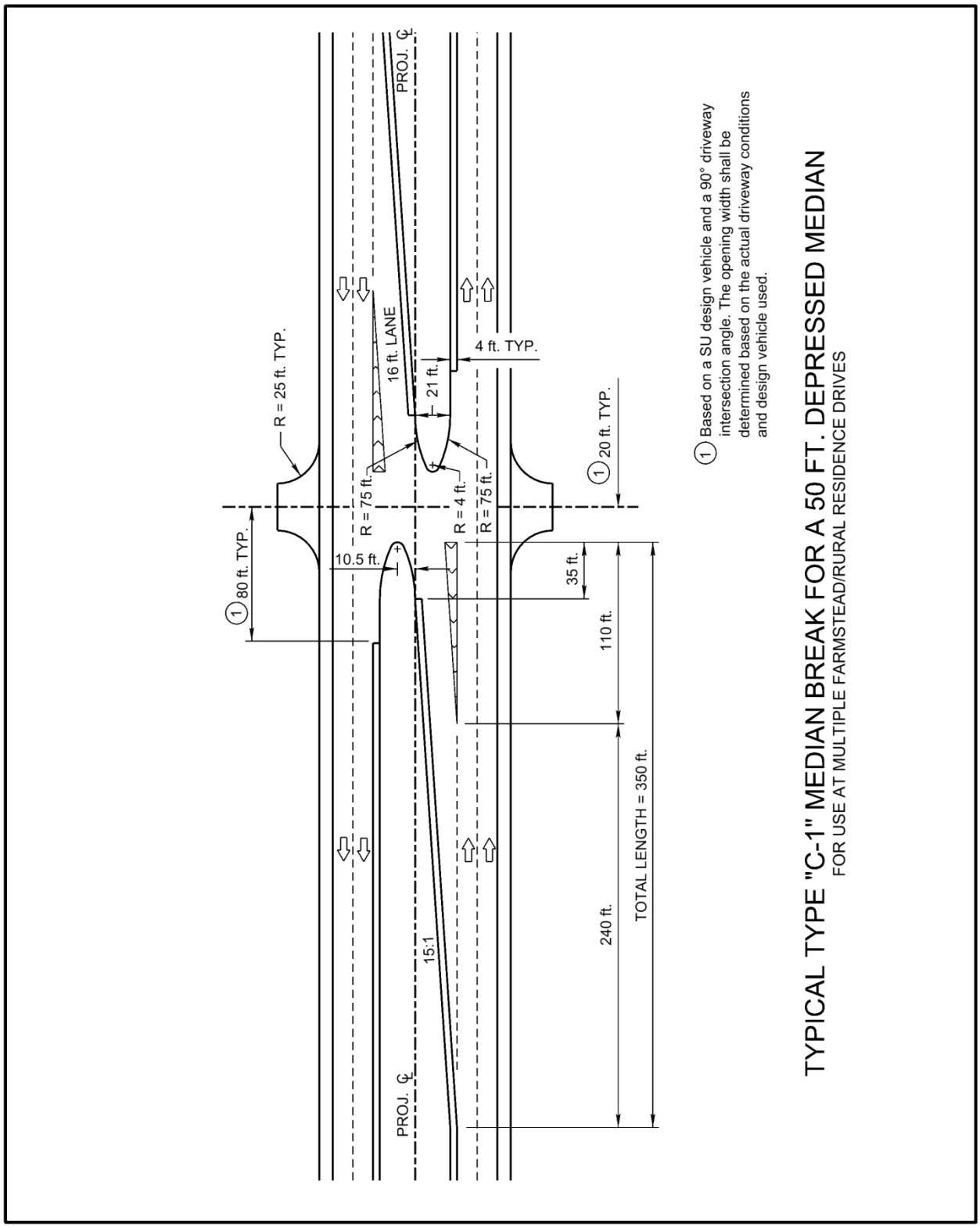


Exhibit 4.32 Typical Type C-1 Median Break (50 Ft. Depressed Median)

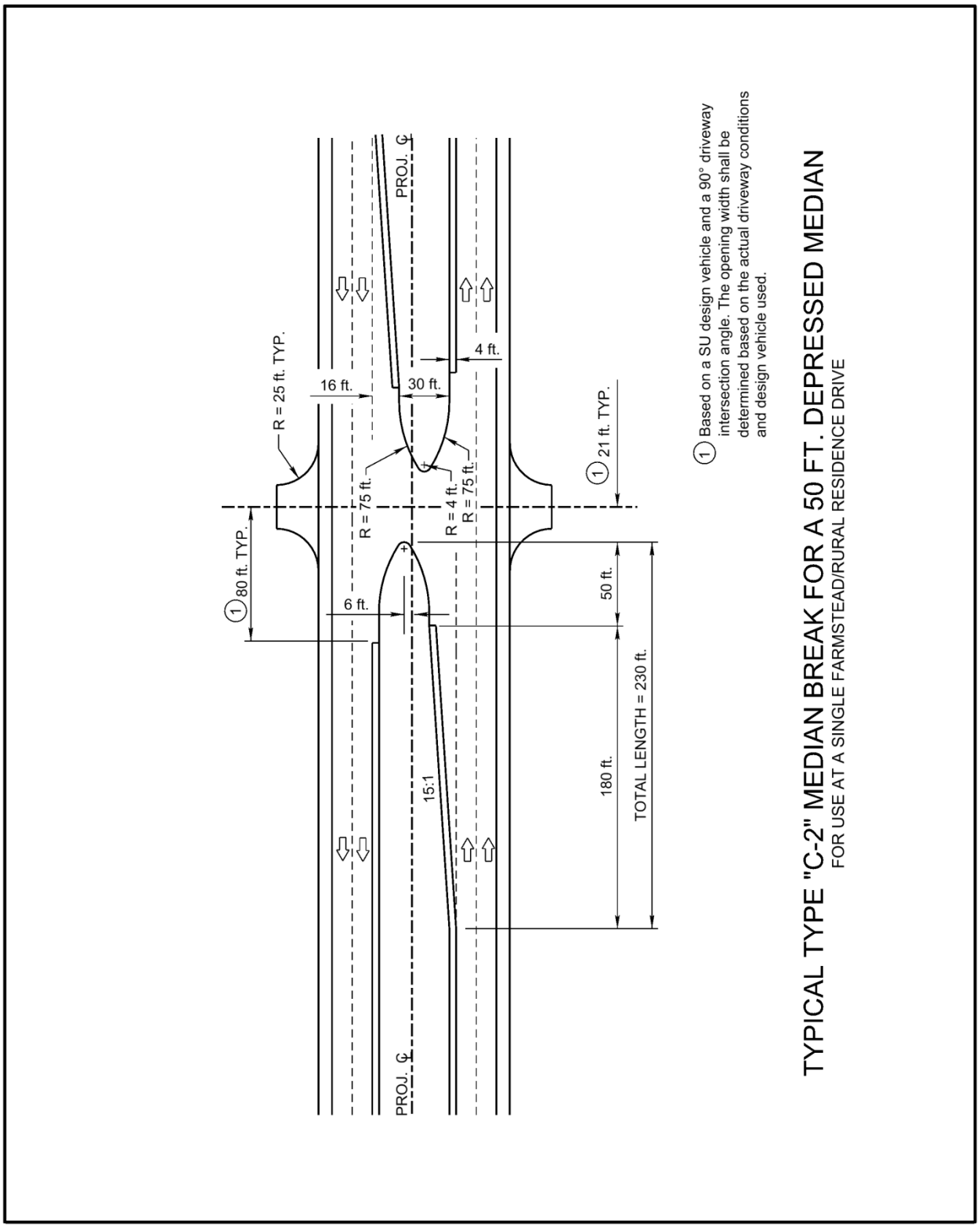


Exhibit 4.33 Typical Type C-2 Median Break (50 Ft. Depressed Median)

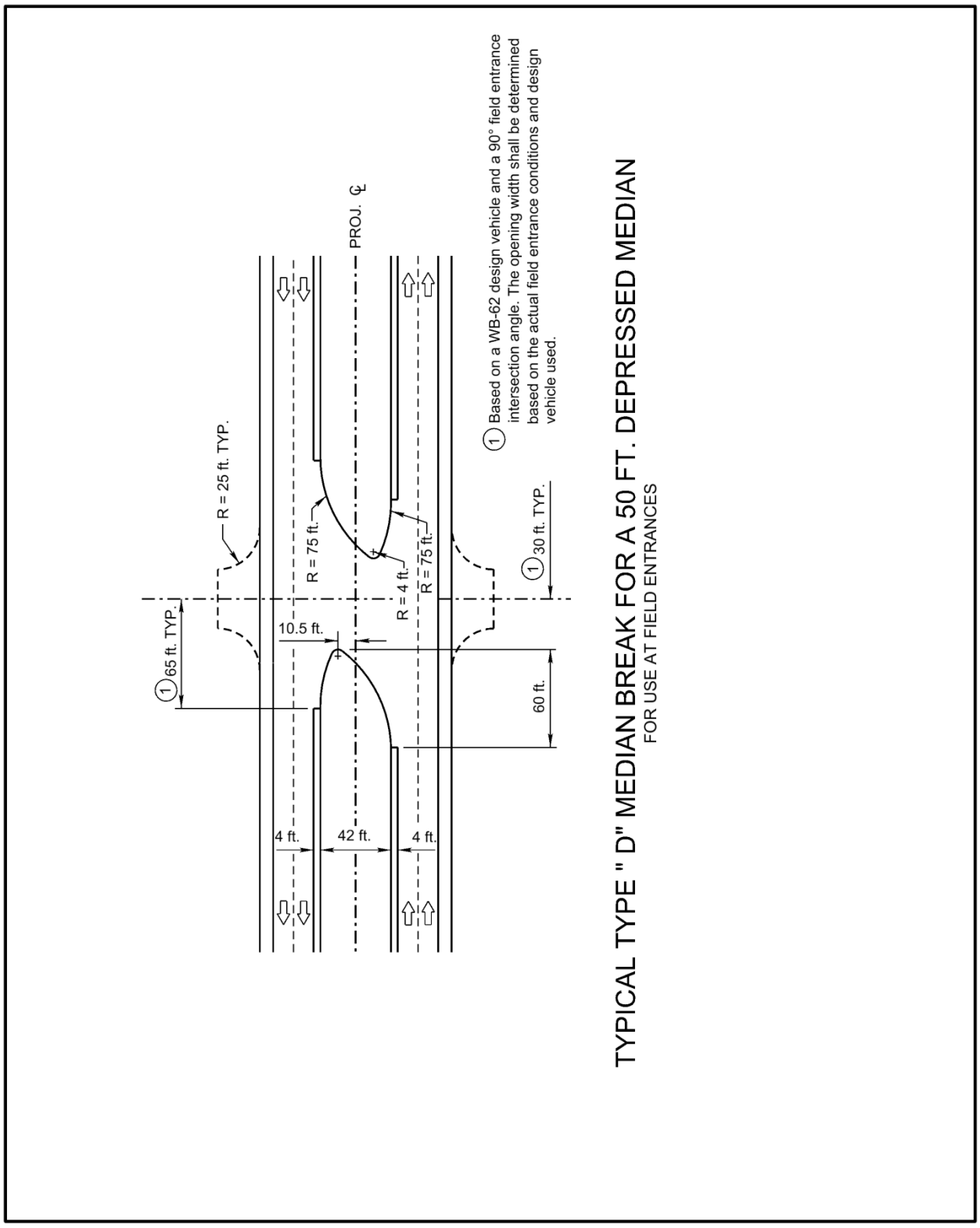


Exhibit 4.34 Typical Type D Median Break (50 Ft. Depressed Median)

6. REFERENCES

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CHAPTER UNDER CONSTRUCTION

The information contained in Chapter Six: The Typical Roadway Cross-Section, dated February 2016, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this chapter.

Chapter Six presents guidance for the design of new and reconstructed projects; design guidance for 3R projects is provided in Chapter Seventeen. This chapter replaces Chapter Six: The Typical Roadway Cross-Section, dated July 2006. This chapter also supersedes Nebraska Department of Transportation Policy Letter DES 09-02: "Curb Location at Edge of Shoulder" dated May 20, 2009 and incorporates the Nebraska Department of Transportation Policy Letter DES 13-01 R1: "Policy for the Installation of the Beveled Edge" dated June 19, 2014. This chapter was approved by the Nebraska Division of the FHWA for use on the National Highway System and other federal projects on February 18, 2016.

Chapter Six
The Typical Roadway Cross-Section

The **Nebraska Department of Transportation** (**NDOT**) typical roadway cross-sections are presented in EXHIBITS 6.1 THROUGH 6.10 and EXHIBITS 6.12 THROUGH 6.14. Variations from these typical sections must be documented by the designer and submitted to the **Assistant Design Engineer** (**ADE**) for approval and to the **Traffic Engineering Division** (**Traffic Engineering**) for concurrence.

For additional information regarding roadway cross-section elements, see Chapter 4 of A Policy on Geometric Design of Highways and Streets (the *Green Book*) (Ref. 6.1).

1. THE TRAVELED WAY

1.A Travel Lane Widths

Lane width is determined by the roadway functional classification, traffic volumes, and design speed. The minimum lane widths are provided in the Nebraska Minimum Design Standards (*MDS*) (Ref. 6.2) (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/) and in Appendix H, "Application of Design Standards"; the typical through lane width is 12 feet for rural and high-speed municipal roadways; low-speed municipal roadways are typically 11 feet in width.

1.B Travel Lane Cross Slopes

A crowned roadway cross-section "breaks" at the high point of the roadway, sloping to both shoulders, typically at a 2% cross slope (See EXHIBITS 6.1, 6.3, 6.5, 6.7 THROUGH 6.10, 6.12 AND 6.13). The high point of a non-superelevated crowned cross-section is usually located at the centerline of the roadway (for two-lane roadways) and at the centerline of the directional travel lanes (for multi-lane highways). Crowned cross-sections are preferred for two-lane roadways and for multi-lane divided roadways with depressed medians. The crowned cross-section allows for drainage to both sides of the roadway surface.

The tangent typical cross-section usually has the high point of the pavement on the inside (median) edge of the inner travel lane and slopes continuously across the travel lanes, typically at a 2% cross slope (See EXHIBITS 6.2, 6.6 AND 6.14). Tangent cross-sections are typically used for multi-lane divided roadways where there is a raised or flush median or where future lanes are to be added to the median (See EXHIBIT 6.11).

2. SHOULDERS

2.A Shoulder Width and Type

Shoulder width and type is based upon the roadway functional classification, traffic volumes, and design speed. Minimum shoulder widths are provided in the *MDS* (Ref. 6.2) and in Appendix H, "Application of Design Standards".

When turf shoulders are built adjacent to concrete lanes or shoulders, the **NDOT** prefers that an additional two feet of turf shoulder width be provided beyond the typical turf shoulder width given in EXHIBITS 6.1 THROUGH 6.10. This added width will allow a two foot minimum turf shoulder to be maintained after future overlay surfacing.

2.B Shoulder Cross Slopes

The cross slope of the shoulder is based upon the functional classification of the roadway and the type of shoulder construction (paved or turf). Typically, shoulder cross slopes for rural roadways are 4% for surfaced shoulders and 6% for turf shoulders.

Surfaced median shoulders which are four feet wide and are of the same surfacing material as the traffic lanes should be at the same cross slope as the adjacent traffic lane. Wider shoulders and shoulders of a different surfacing material than the traffic lanes should slope away from the traffic lanes for drainage, typically at a 4% cross slope.

See EXHIBITS 6.1 THROUGH 6.10 for typical shoulder cross slopes.

2.C Beveled Edge

A beveled edge may allow a smoother return to the roadway when a vehicle has departed the surfacing. The beveled edge will be installed on rural high-speed (V ≥ 50 mph) highways in the following conditions:

1. The project includes surfacing placement of two inches or greater.
2. Surfaced shoulders are less than six feet in width, not including segments of erosion control curbed shoulders.
3. On the inside (median) shoulders of Interstates, freeways and expressways with depressed medians.
4. The roadway is not curbed.
5. In other locations as determined by **Traffic Engineering**.

The type of beveled edge to be used is based upon the project type and surfacing recommendation. See Appendix I, "Installation of the Beveled Edge", for additional information and beveled edge details.

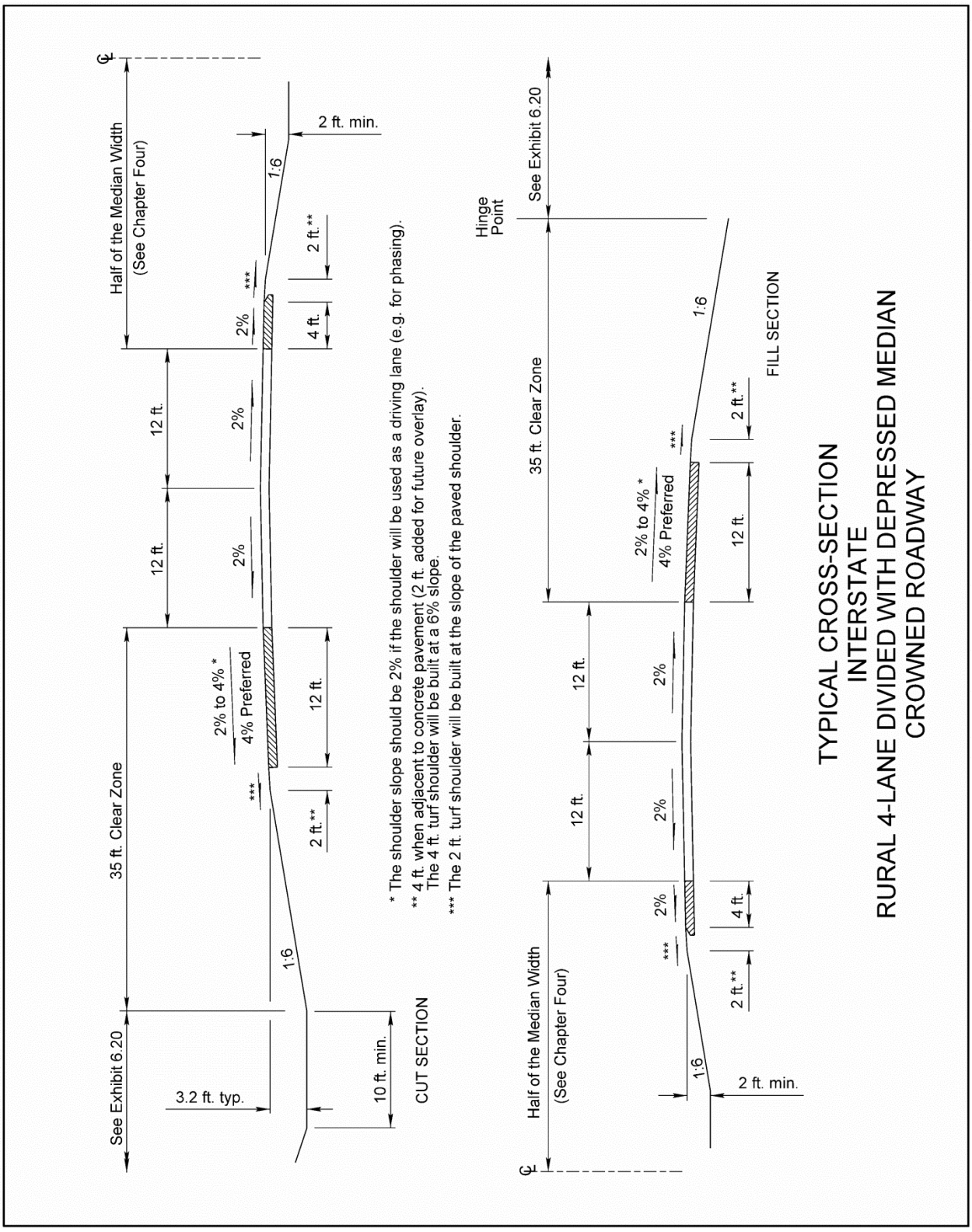


Exhibit 6.1 Typical Section - Rural Four-Lane Divided Interstate with Depressed Median (Crowned Roadway)

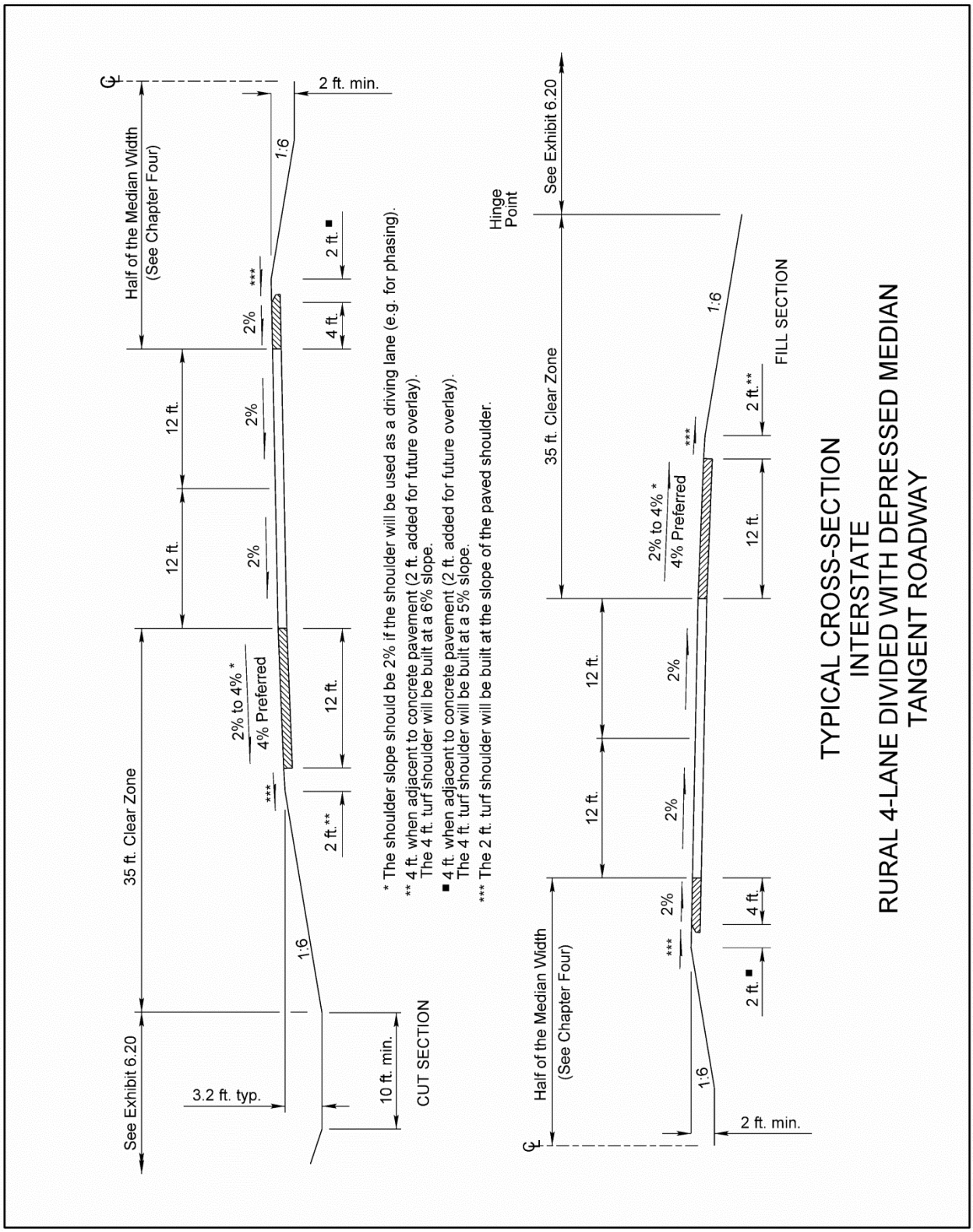


Exhibit 6.2 Typical Section - Rural Four-Lane Divided Interstate with Depressed Median (Tangent Roadway)

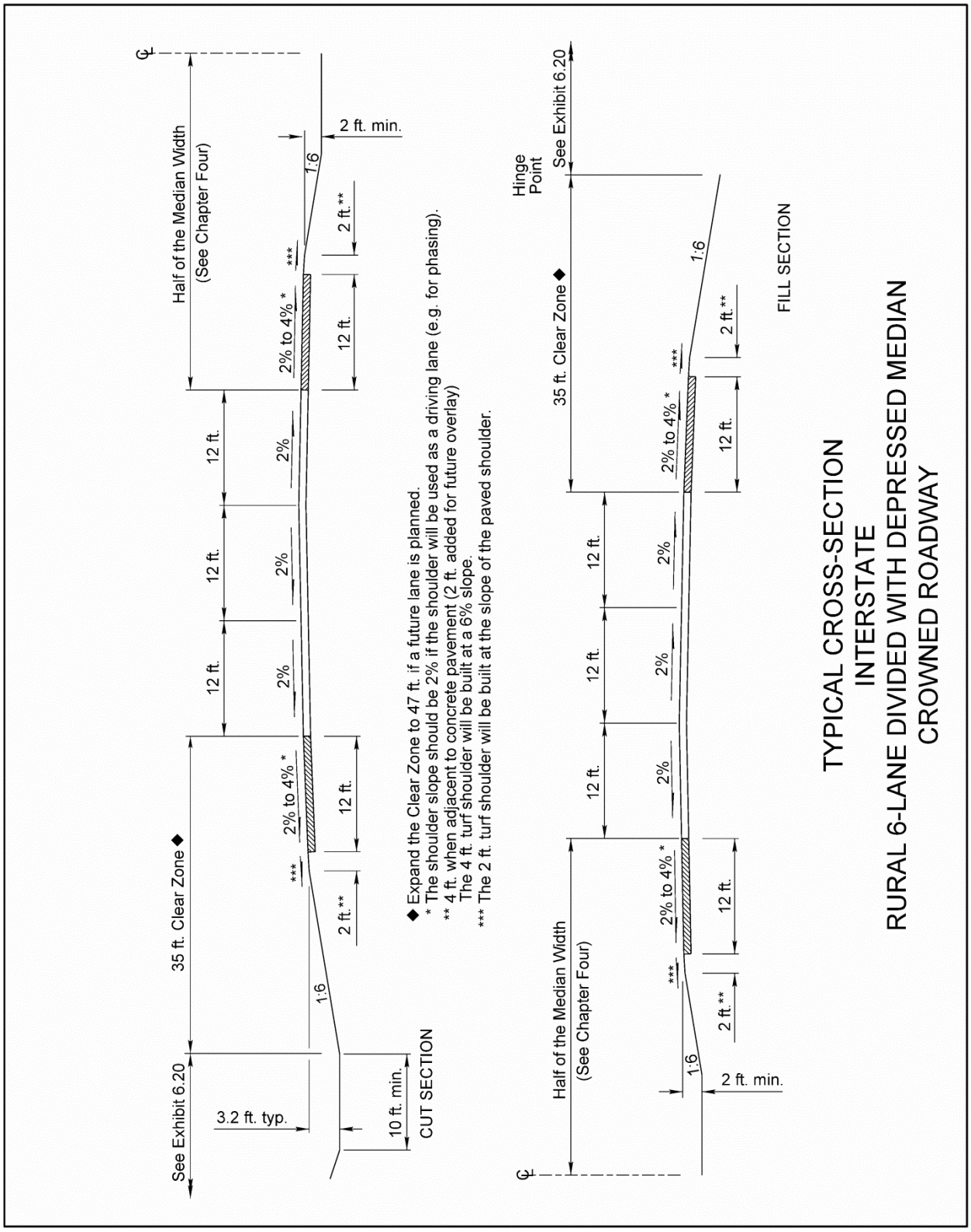


Exhibit 6.3 Typical Section - Rural Six-Lane Divided Interstate with Depressed Median (Crowned Roadway)

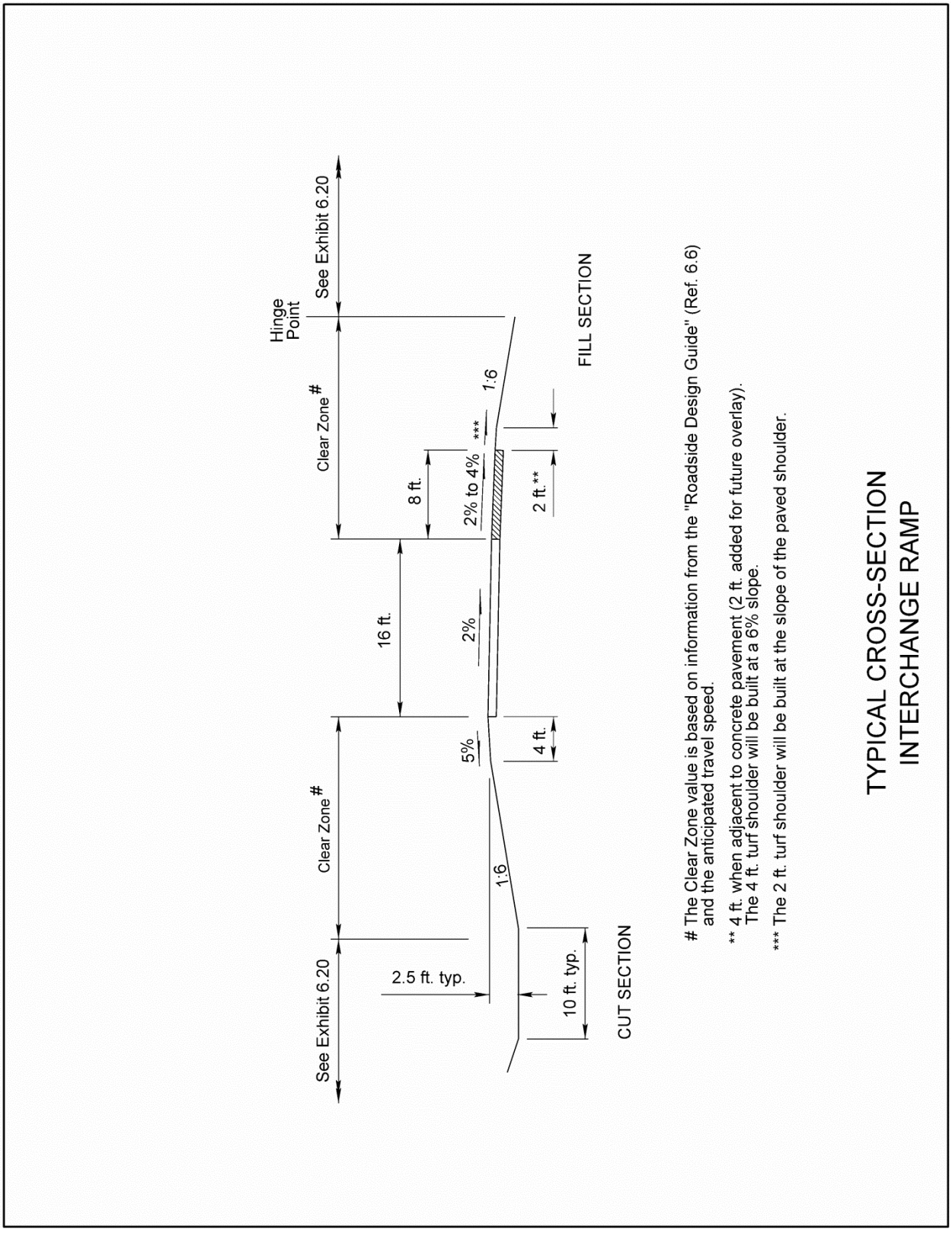


Exhibit 6.4 Typical Section of an Interchange Ramp

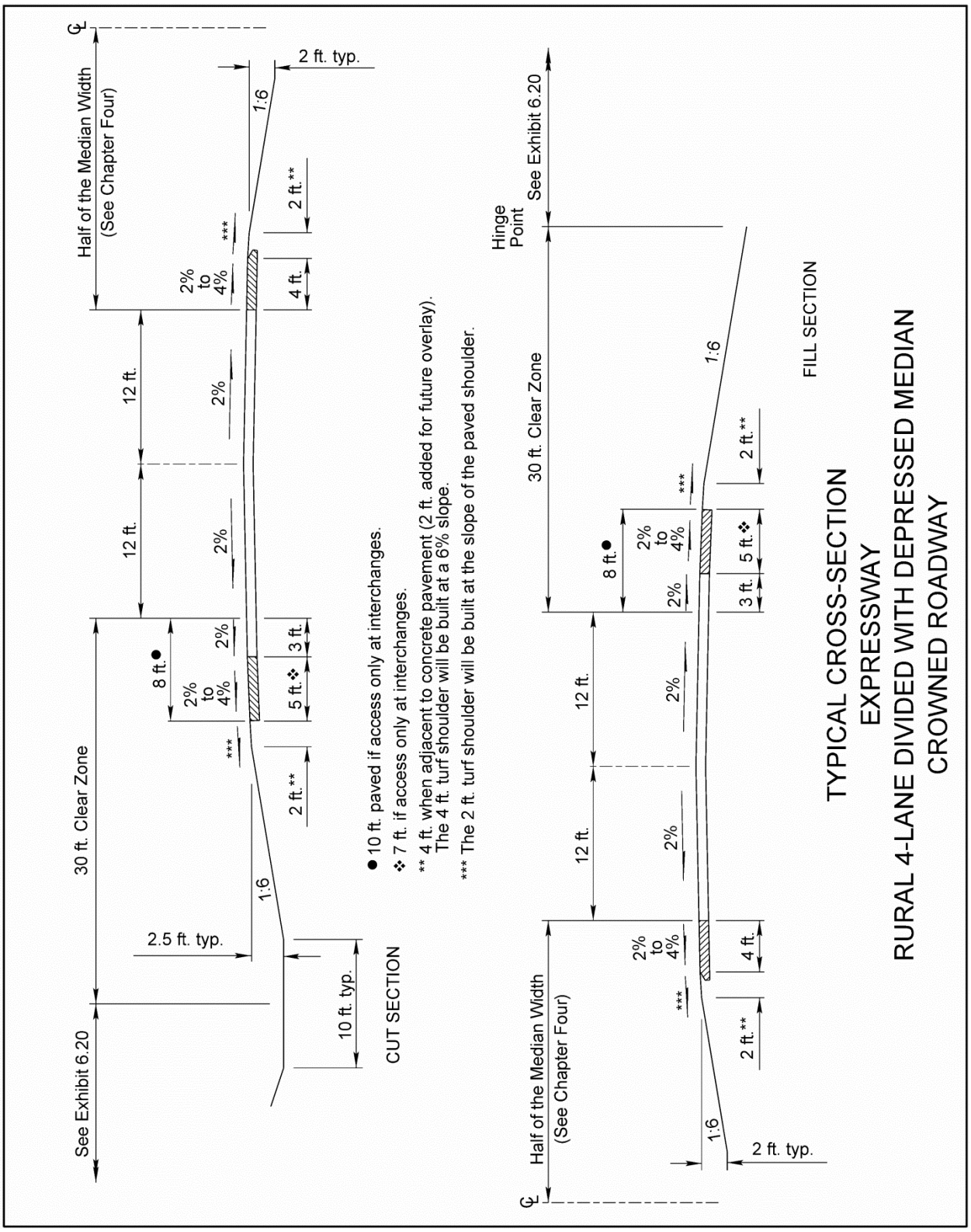


Exhibit 6.5 Typical Section - Rural Four-Lane Divided Expressway with Depressed Median (Crowned Roadway)

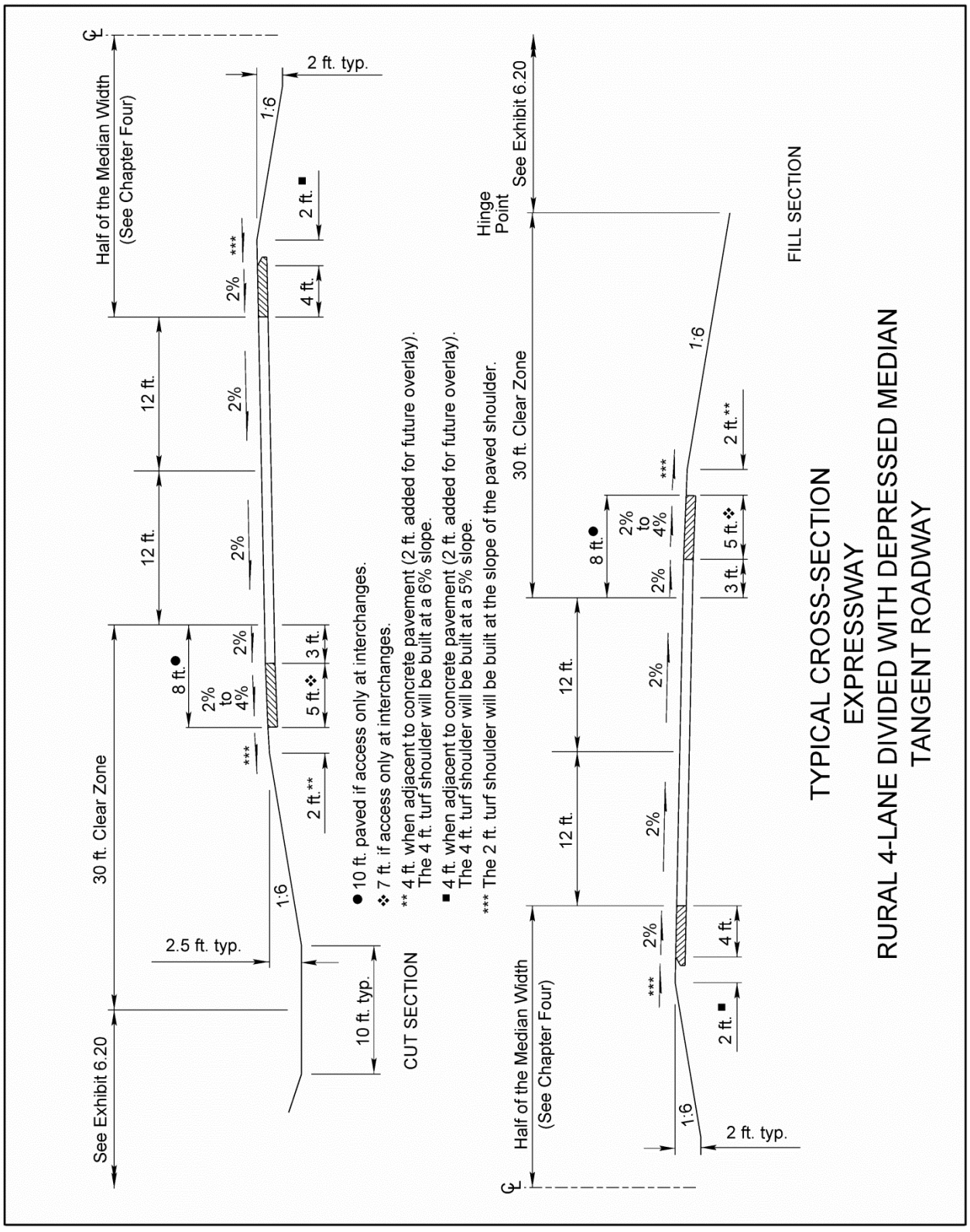


Exhibit 6.6 Typical Section - Rural Four-Lane Divided Expressway with Depressed Median (Tangent Roadway)

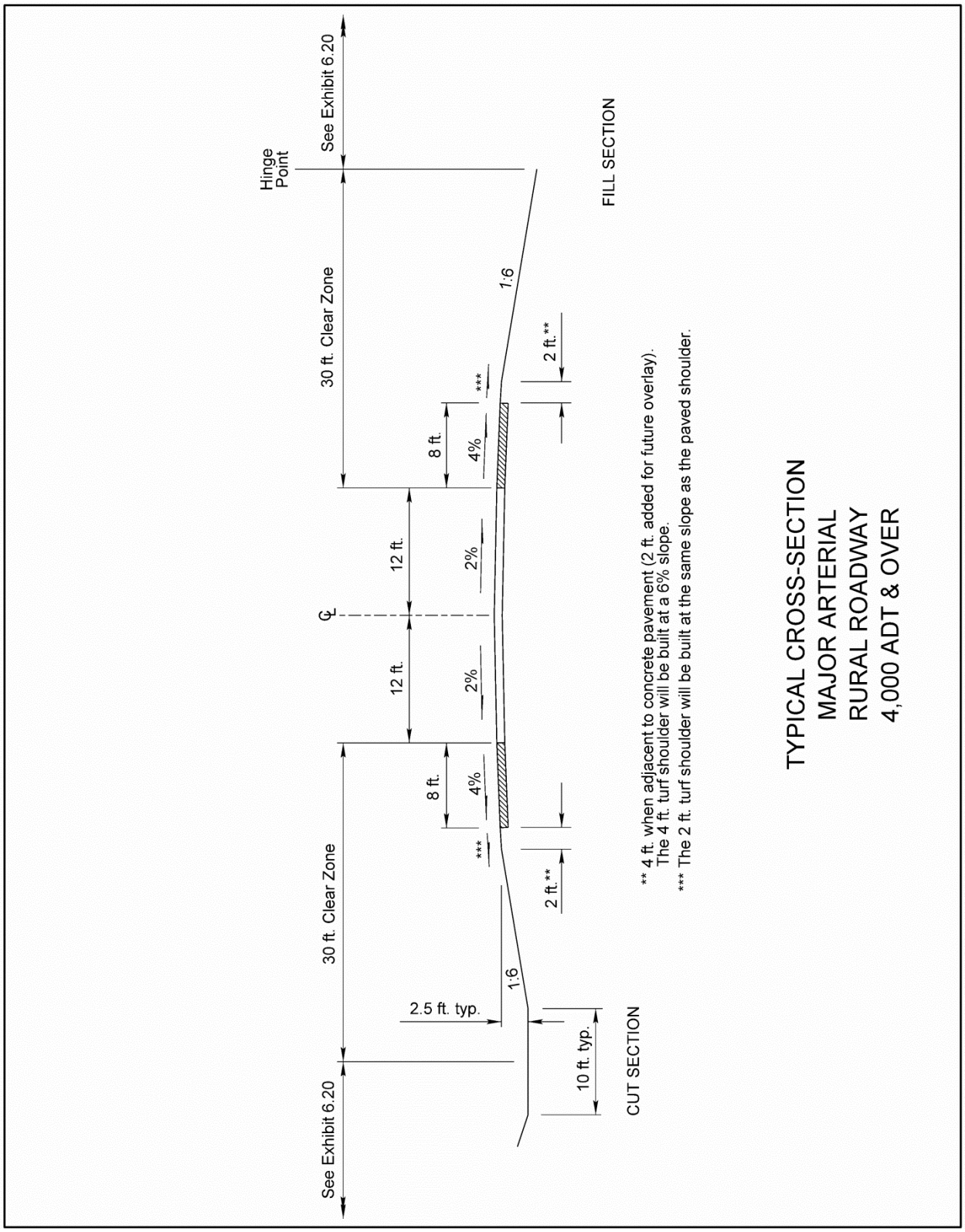


Exhibit 6.7 Typical Section - Rural Major Arterial 4,000 ADT and Over

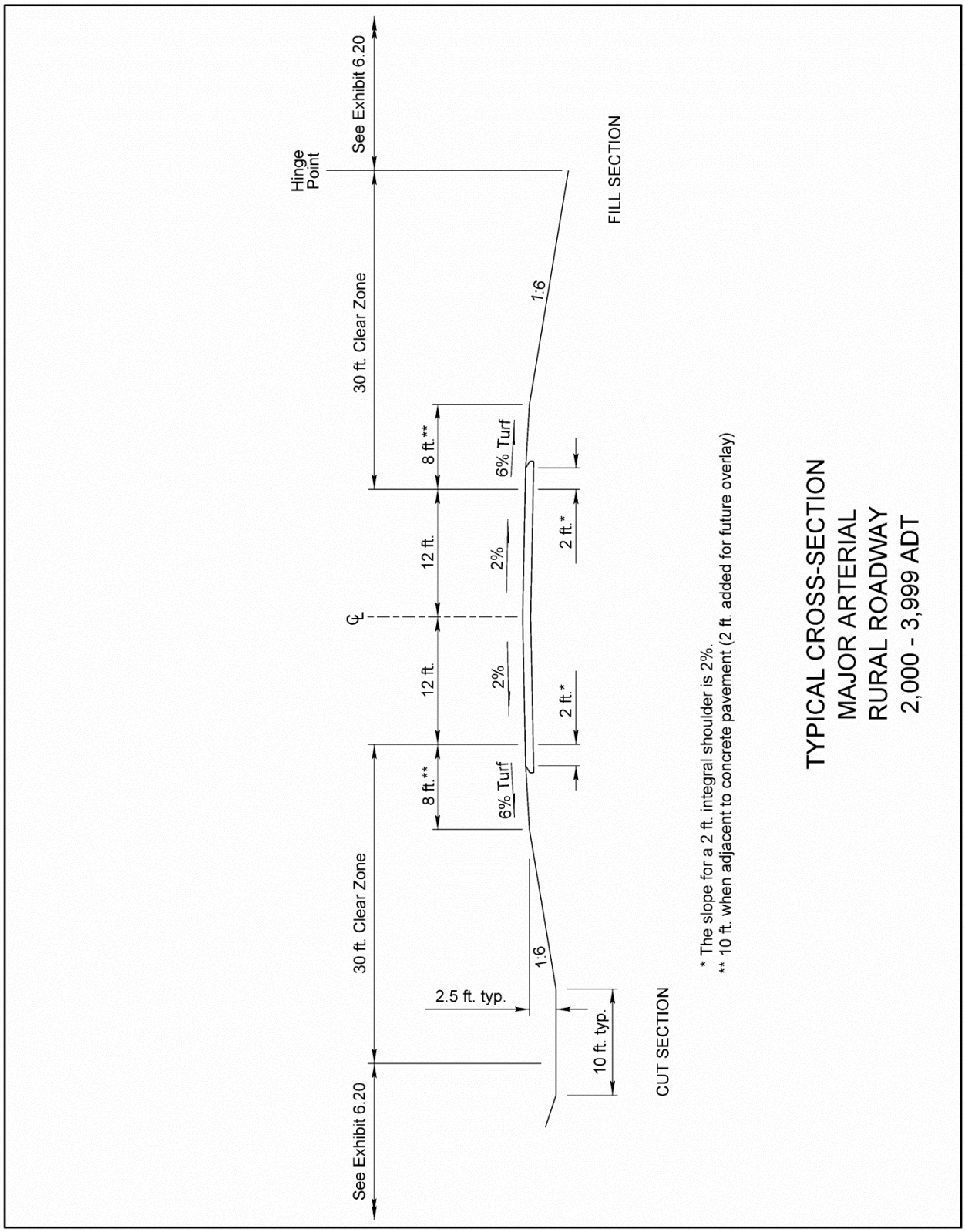


Exhibit 6.8 Typical Section - Rural Major Arterial 2,000 to 3,999 ADT

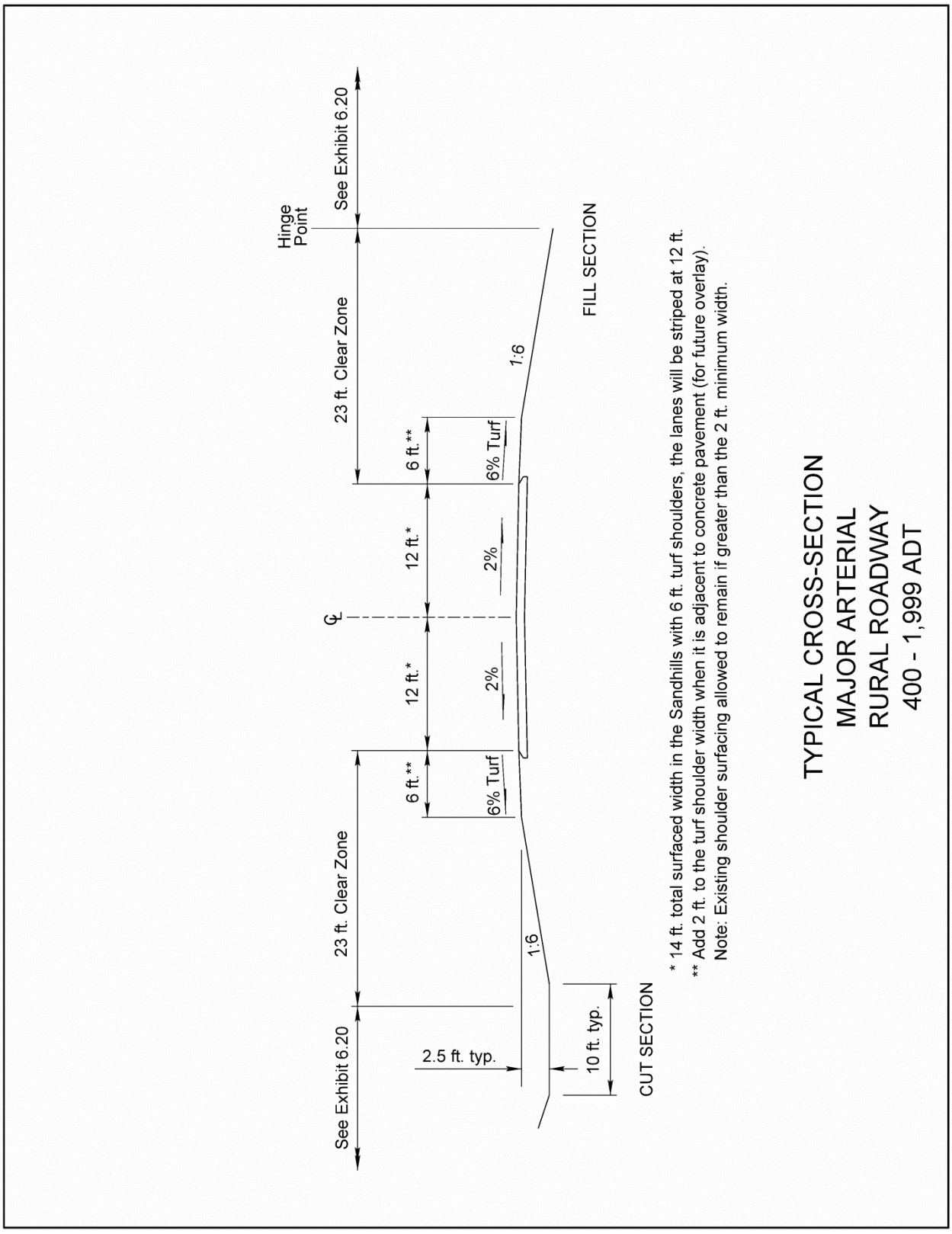


Exhibit 6.9 Typical Section - Rural Major Arterial 400 to 1,999 ADT

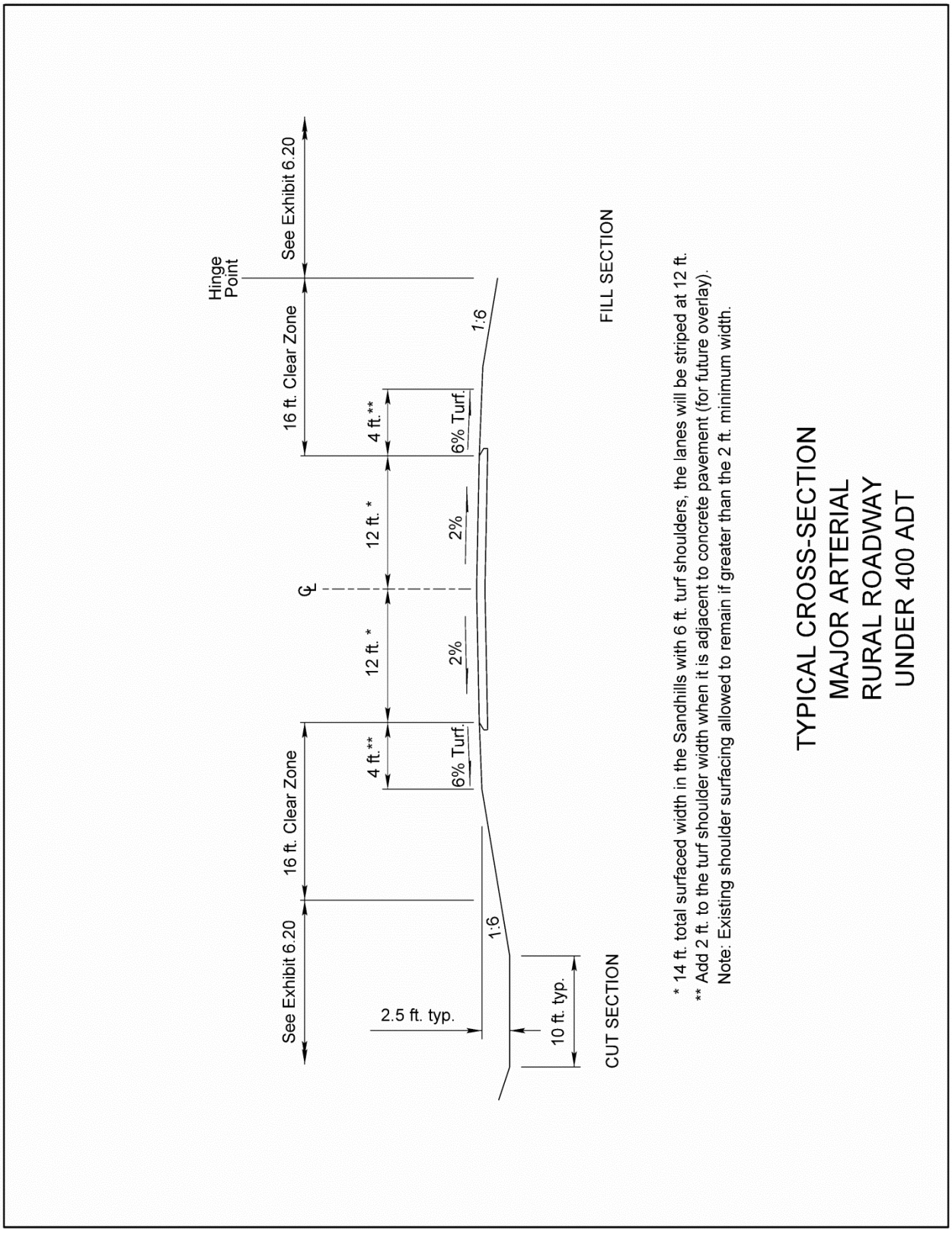


Exhibit 6.10 Typical Section - Rural Major Arterial Under 400 ADT

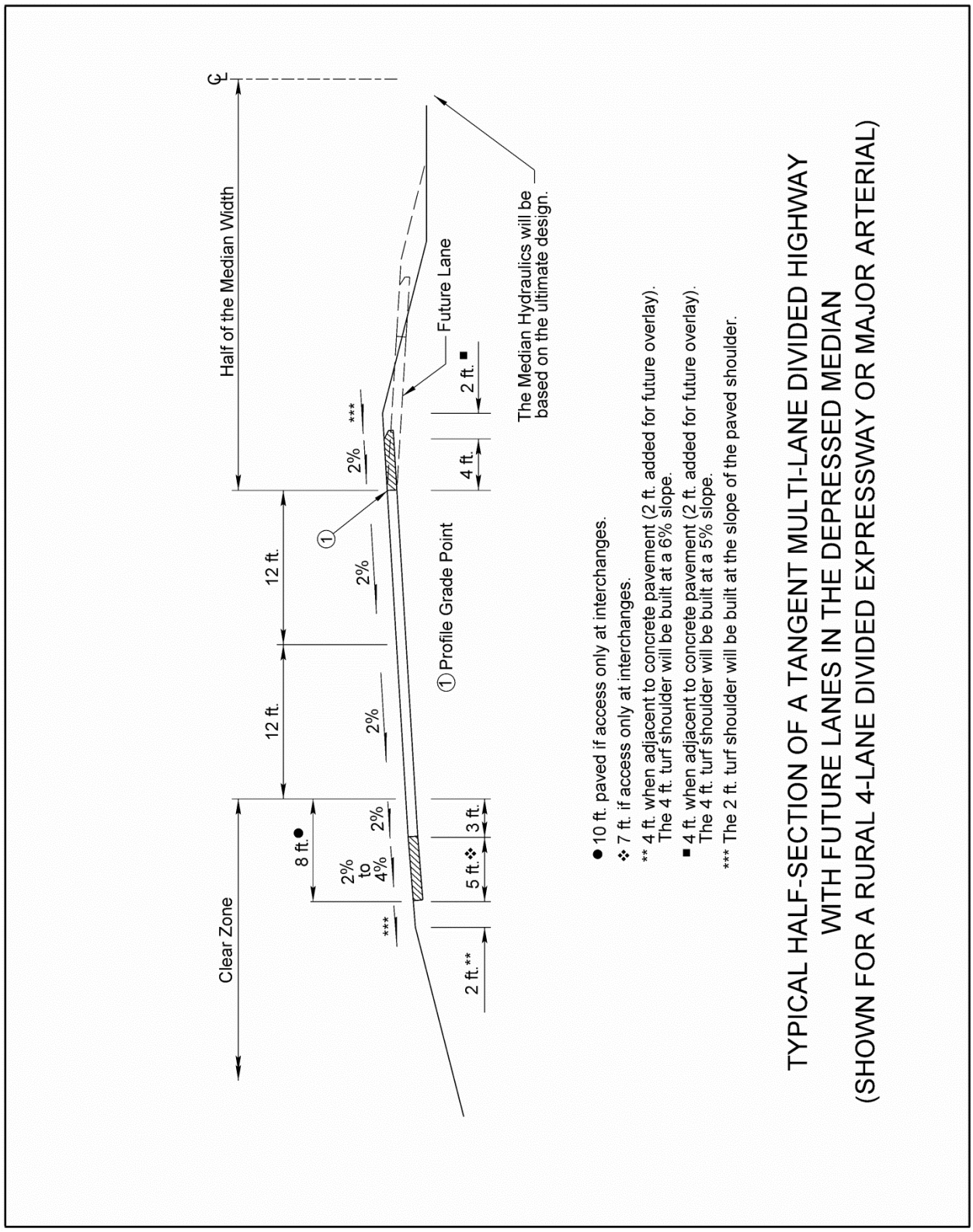


Exhibit 6.11 Typical Half-Section of a Tangent Multi-Lane Divided Highway with Future Lanes in the Depressed Median

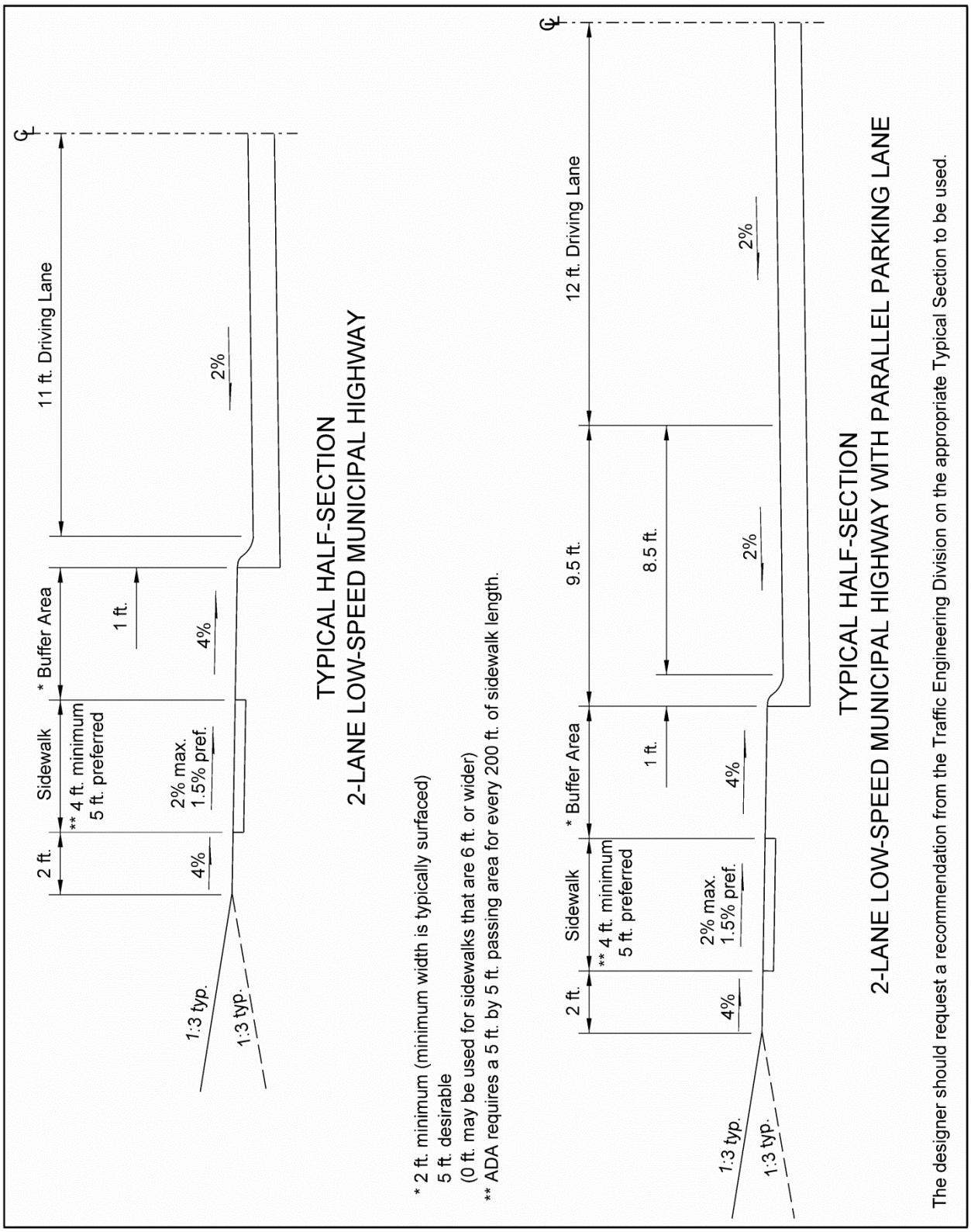


Exhibit 6.12 Typical Half-Sections of Two-Lane Low-Speed Municipal Highways

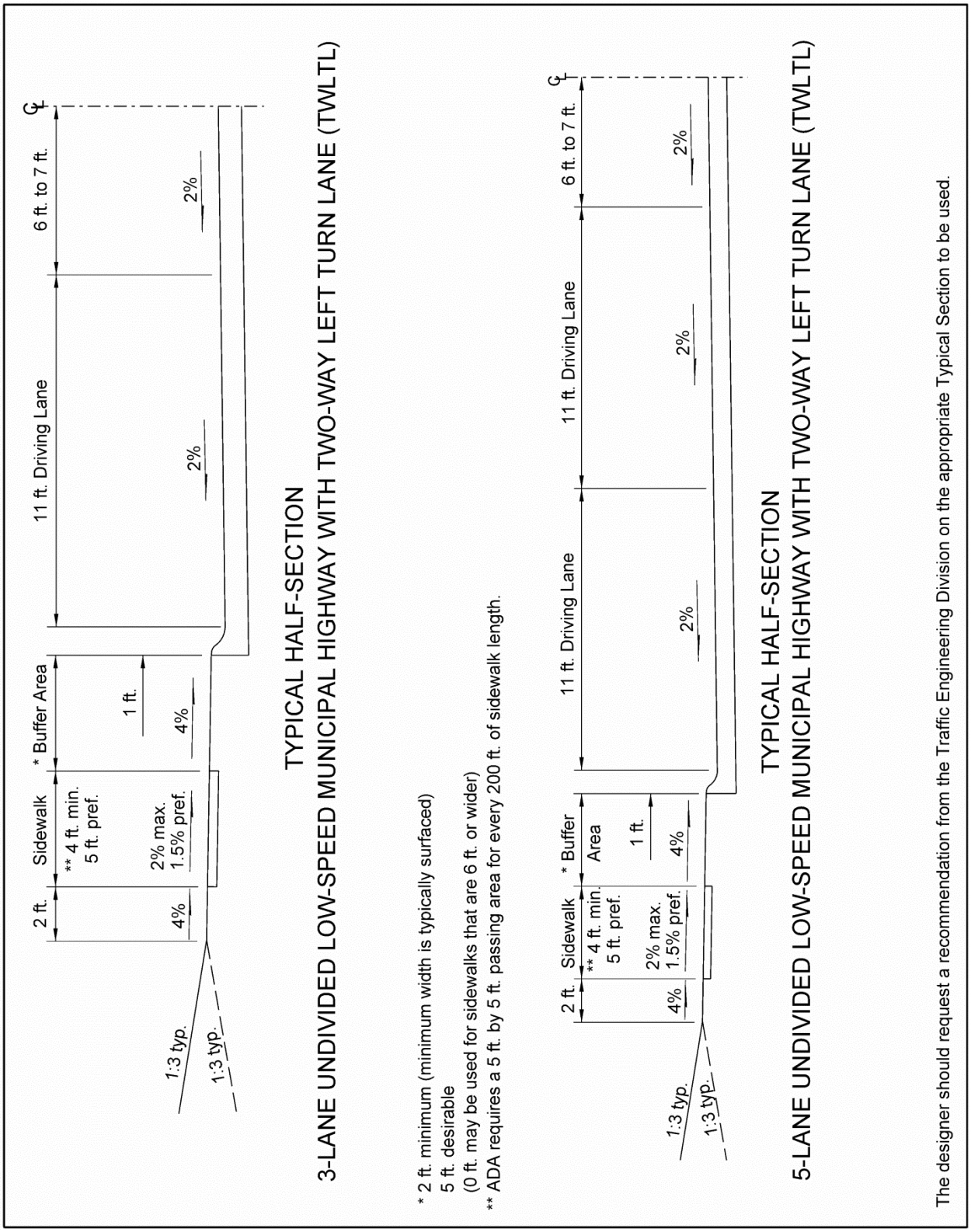


Exhibit 6.13 Typical Half-Sections of Three-Lane and Five-Lane Undivided Low-Speed Municipal Highways with Two-Way Left Turn Lanes

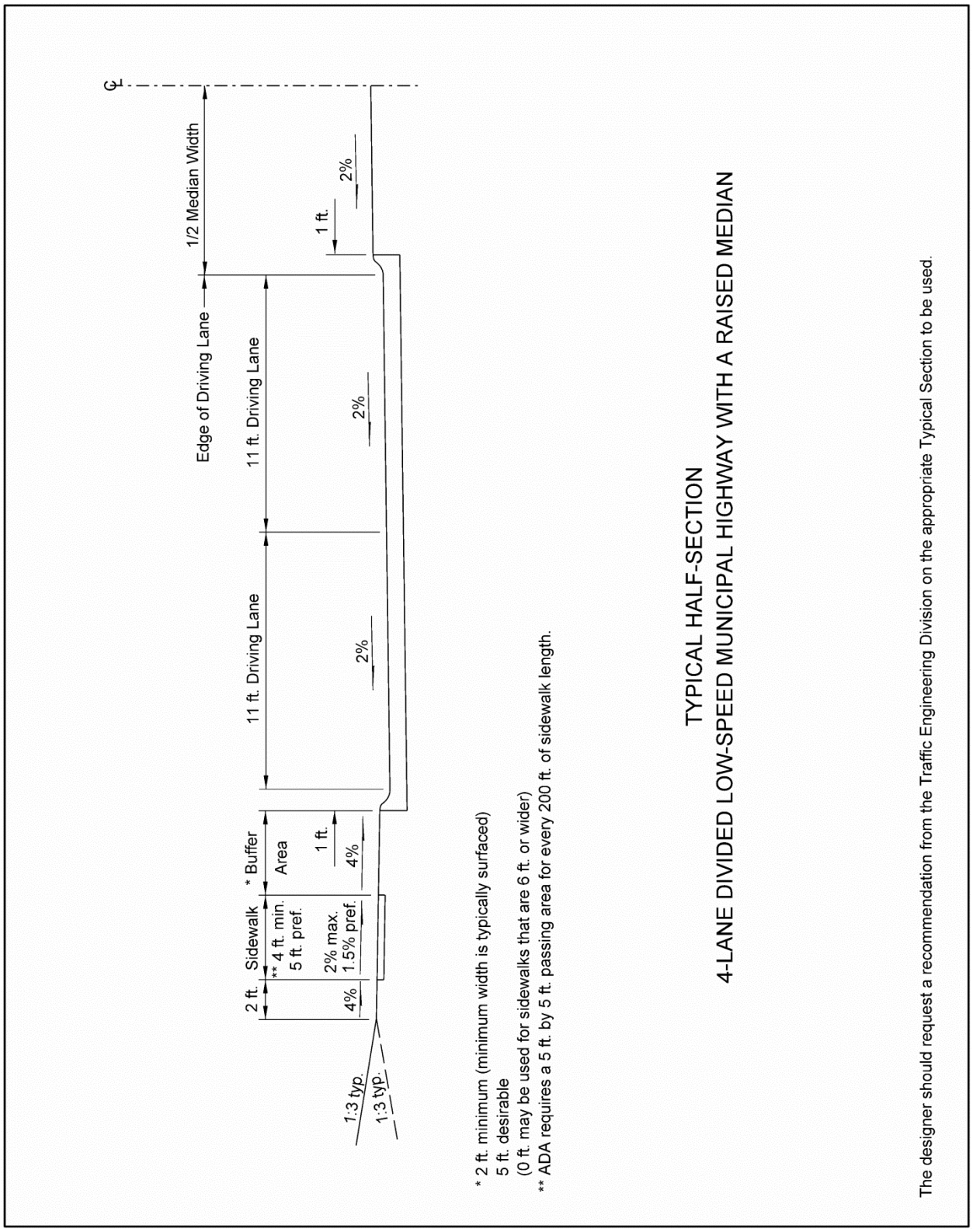


Exhibit 6.14 Typical Half-Section of a Four-Lane Divided Low-Speed Municipal Highway with a Twenty Feet Raised Median

3. CURBS

The type and location of curbs affect driver behavior and the utility of a highway. Most commonly found in urban areas, curbs may facilitate:

- Drainage
- Pavement edge delineation
- Delineation of pedestrian walkways
- Traffic channelization
- Access management

3.A Curb Warrants

The selection of a curbed roadway section depends on many factors including, but not limited to:

- Traffic management
- Design speed
- Urban/rural location
- Drainage
- Future or ultimate development
- Construction costs
- At a roundabout

Urban Locations - Curbed sections are typically used in urban locations due to:

- Traffic management
- Drainage requirements
- Right-of-way constraints
- Access management

Rural Locations - Curbs on rural highways may be warranted for the following conditions, as well as others:

- Traffic management
- Where a raised median is constructed
- Erosion control
- Right-of-way constraints

The need for and location of curbed sections should be discussed during the preliminary design.

3.B Curb Types

The three general types of curb are:

1. Barrier: Barrier curbs are relatively steep-faced and are intended to keep the vehicle from leaving the roadway.
2. Mountable: Mountable curbs (e.g. the integral concrete curb) are designed so that errant vehicles can cross them easily.
3. Slope: Sloping curbs are usually three or four inches in height with a simple angular rise. They are also designed to be easily crossed and are preferred over mountable curbs due to ease of hand construction.

Curbs are constructed of either Portland Cement Concrete or asphaltic concrete. Examples of various curb types are shown in EXHIBIT 6.16 and in the Standard/Special Plans Book (*Standard Plans*) (Ref. 6.3) (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/).

The following guidelines should be used to determine the appropriate curb height:

- High-speed roadways (design speed ≥ 50 mph): three inch asphaltic concrete curb, three inch concrete slope curb, or four inch concrete slope curb (See EXHIBIT 6.17).
- Low-speed roadways (design speed ≤ 45 mph): six inch curbs.
- Teardrop islands on side roads intersecting high-speed roadways: inside of the lateral obstacle clear zone of the mainline the curb will be three inch asphaltic concrete curb, three inch concrete slope curb, or four inch concrete slope curb (See EXHIBIT 6.15).
- Roundabouts: the splitter islands will be six inch integral concrete curb. A three inch truck apron curb will be used for the truck apron and a four inch sloping curb will be used for the inner circle of the center island (See EXHIBITS 6.16 AND 4.2).

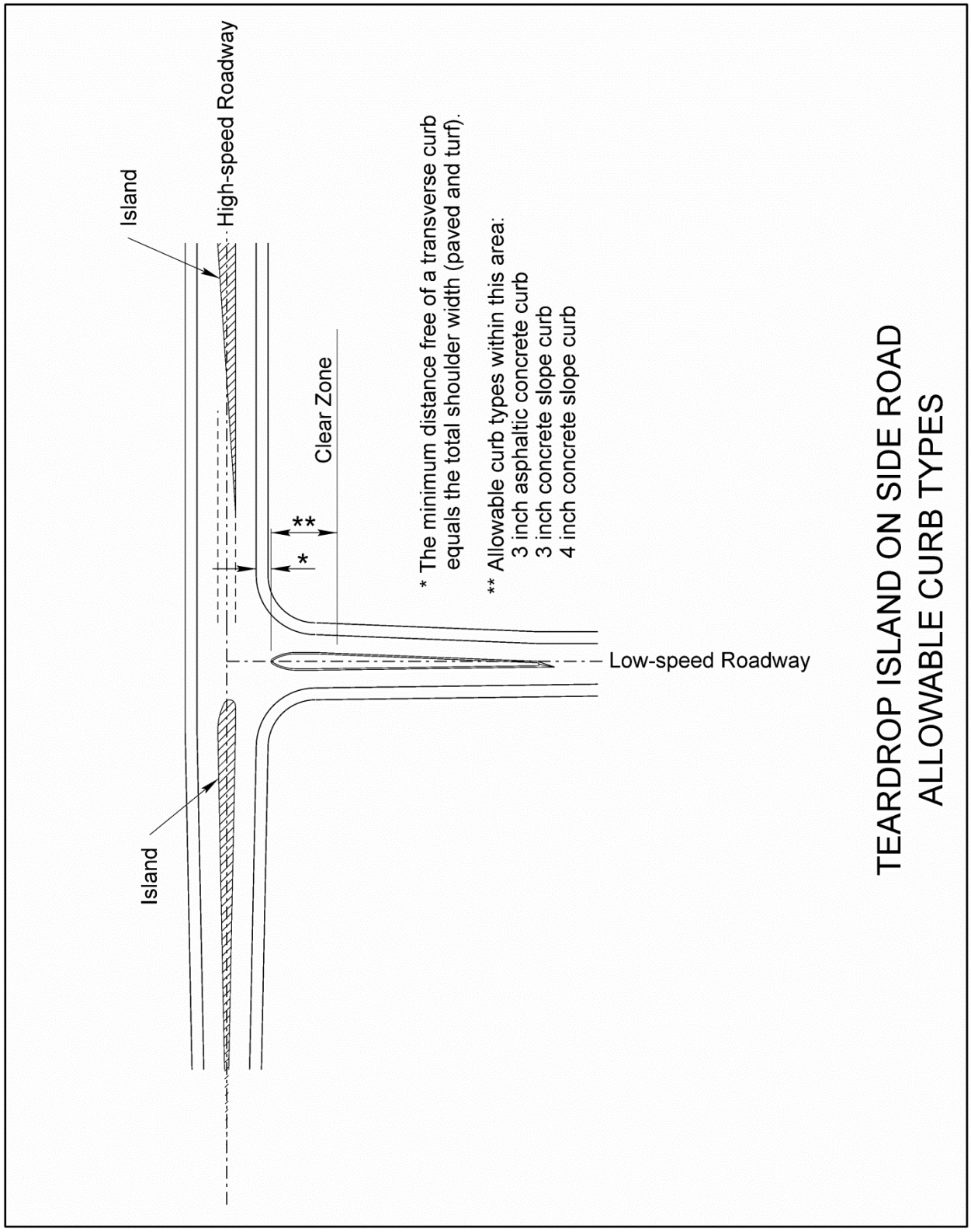


Exhibit 6.15 Teardrop Island on Side Road Allowable Curb Types

3.C Curb Design Considerations

Drainage - Curb height influences hydraulic design and analysis (See the Drainage Design and Erosion Control Manual (*Drainage Manual*) (Ref. 6.4), Chapter One: Drainage, Section 10) (http://www.roads.nebraska.gov/business-center/design-consultant/rd-manuals/).

Roadside Geometry - Side slope configuration is based on whether a curbed or uncurbed section is used.

Transitions - EXHIBIT 6.18 illustrates the standard procedure for curbed to uncurbed transition.

Erosive Soils - Curb and concrete flumes may be installed on a project to protect earth shoulders and side slopes from stormwater runoff in regions where native soils are commonly susceptible to soil erosion (such as the Sandhills Region and loess soil areas) (See the *Drainage Manual* (Ref. 6.4), Chapter Two: Erosion and Sediment Control, Section 7.E).

Design Guidelines - The following guidelines have been developed for the design of curbed roadway sections:

1. When curbs are constructed, the top of the abutting turf or sidewalk should be at the same elevation as the top of the curb (See EXHIBITS 6.12, 6.13 AND 6.14).
2. When a curb is used in high-speed conditions (design speed ≥ 50 mph), the gutterline of the curb should be located six feet from the edge of the lane or at the edge of the surfaced shoulder width given in the *MDS* (Ref. 6.2), whichever is greater (See EXHIBIT 6.17). The curb may also be located flush with or behind a bridge railing or guardrail.
3. When curb and flume is constructed at the edge of the shoulder, the edge of the through traffic lane will be at the same elevation or higher than the top of the curb to prevent the spread of water onto the high-speed travel lane. The drainage will be designed to conform to the design spread criteria (See the *Drainage Manual* (Ref. 6.4), Chapter One: Drainage Design, EXHIBIT 1.37).
4. When erosion control or sloping curbs are constructed in rural areas the typical section will show the earth portion of the shoulder to be a minimum of two feet in width and finished to the top of the curb. Four feet wide turf shoulders are preferred if there is an erosion problem or if the project is in the Sandhills region (See EXHIBIT 6.17). A wider turf shoulder may be necessary if guardrail is installed at curbed sections.
5. Installing an erosion control curb does not change the clear zone requirements presented in the *MDS* (Ref. 6.2).
6. Curb cuts will be provided as required for existing and future access drives (See Chapter Four: Intersections, Driveways and Channelization, Section 2.B).

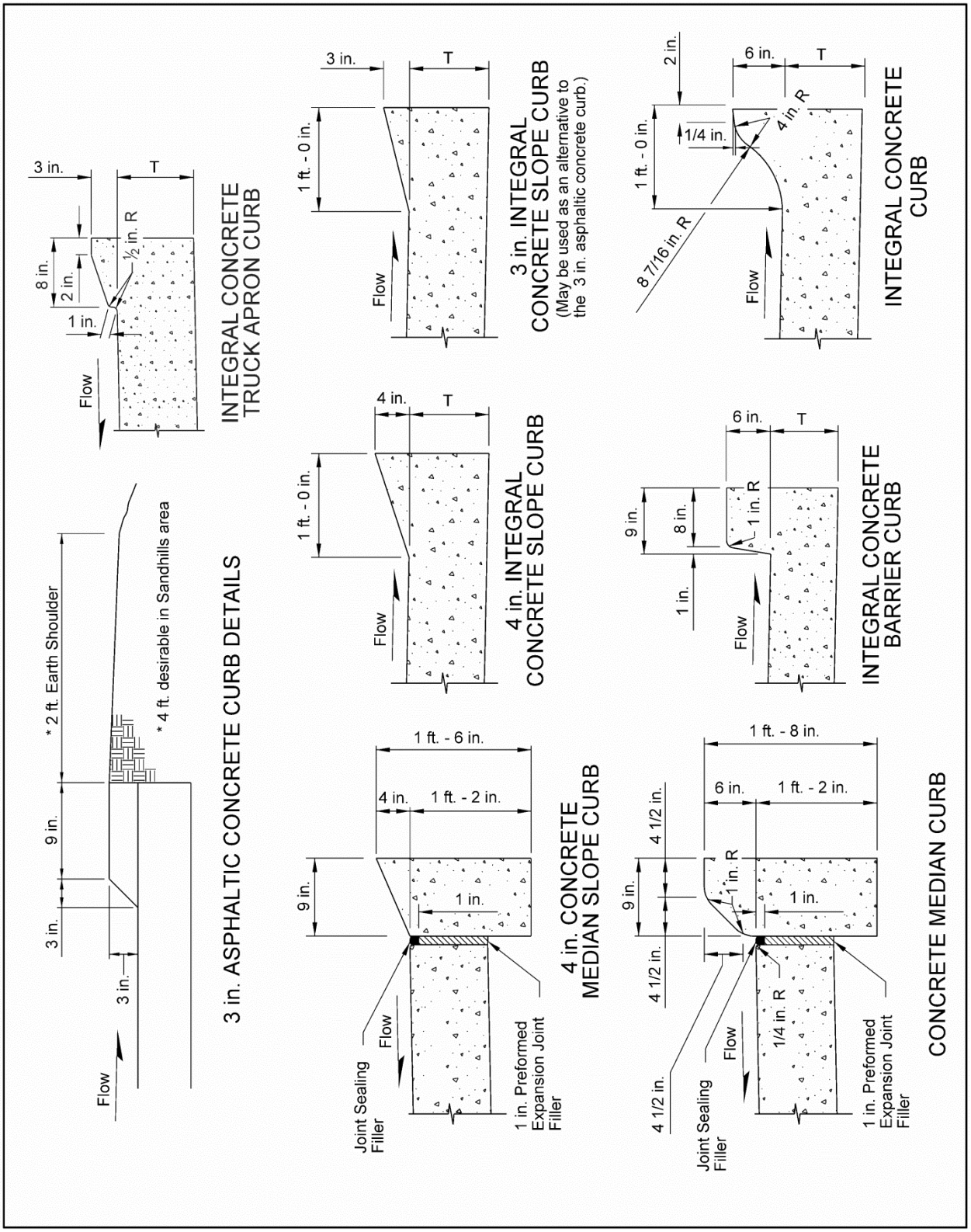
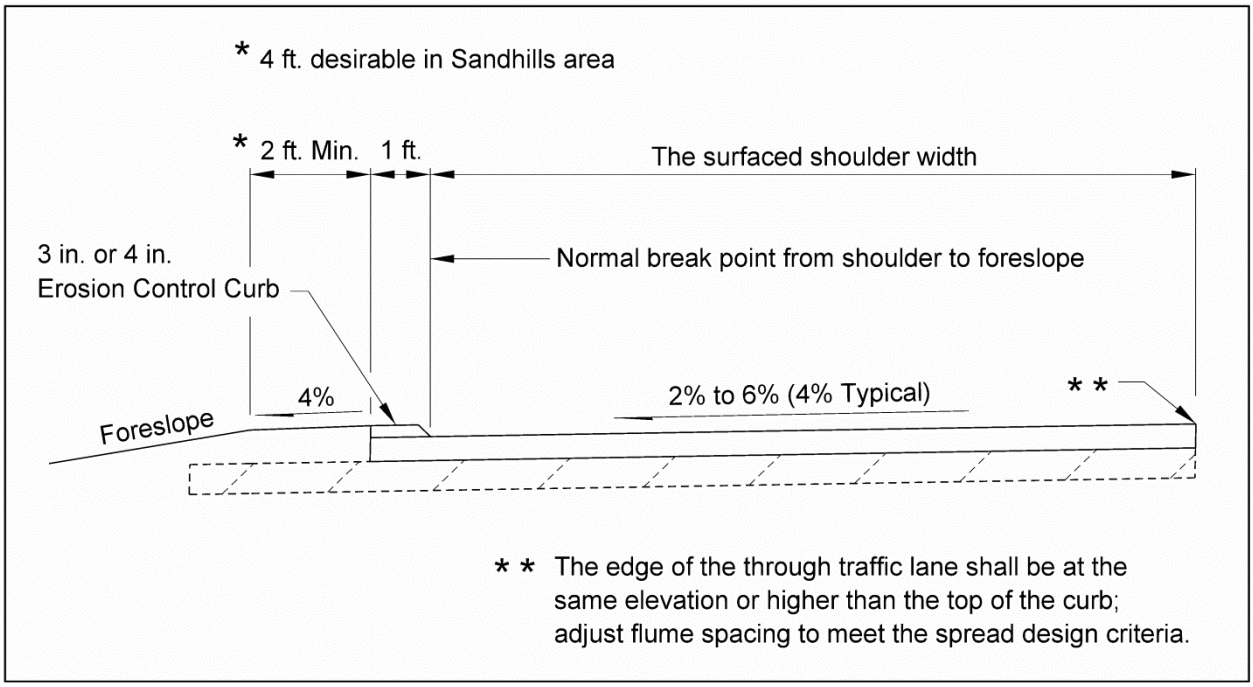
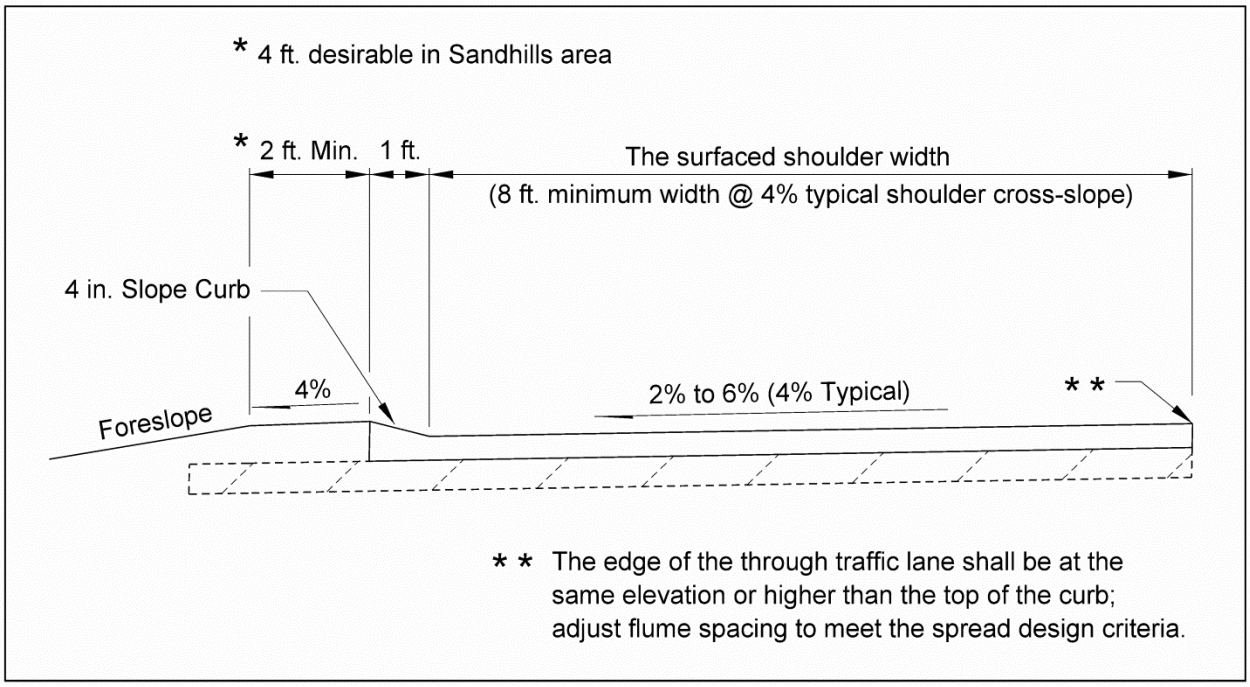


Exhibit 6.16 Typical Curb Details



3 inch or 4 inch Erosion Control Curb



4 inch Slope Curb

Exhibit 6.17 Erosion Control Curb Location

4. ROLLOVER RATES

The rollover rate is defined as the algebraic difference in rate of cross slope between adjacent paved surfaces. The maximum rollover rates used by the **NDOT** are:

- 5% between lanes for facilities with a design speed ≥ 50 mph
- 7% between the roadway and shoulder
- 5% for gore areas

The treatment of rollover through superelevated sections is shown in Chapter Three: Roadway Alignment, EXHIBITS 3.3a, 3.4a, & 3.5a.

For additional information see the *Green Book* (Ref. 6.1), Sections 4 and 9.

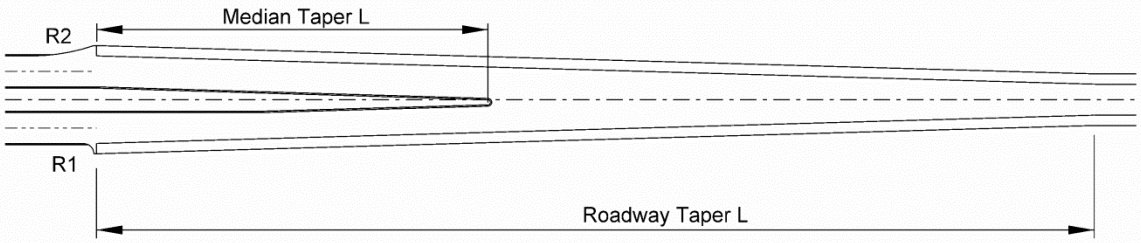
5. TRANSITION

Transition sections are required when one roadway cross-section changes to another roadway cross-section. Locations where transition sections are required include, but are not limited to:

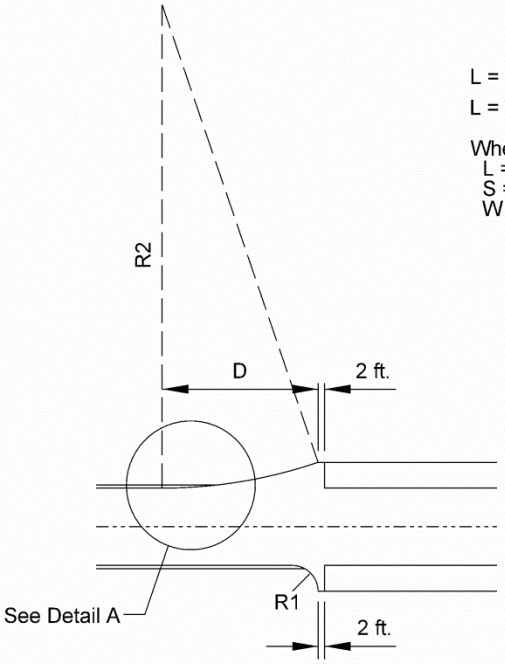
- The change from standard roadway sections to roadway sections with auxiliary lanes
- The change from multilane facilities to two-lane facilities
- At narrow existing bridge structures
- At ramps and turning roadways
- The change from rural to urban sections

EXHIBIT 6.18 illustrates common lane transition configurations.

Transitions for auxiliary lanes, especially turning lanes, often depend on the space available for the transition. Specific criteria for auxiliary lane transition sections and taper rates are discussed in Chapter 4 of the *Green Book* (Ref. 6.1).



Two Lane Rural Section with Surfaced Shoulders
to Four Lane Municipal Section with Raised Median

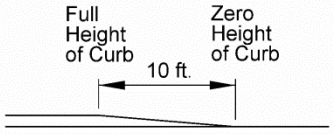


L = WS for Speeds ≥ 50 mph
$L = WS^2 / 60$ for Speeds ≤ 45 mph

Where:
L = Minimum Length of Taper
S = Posted Speed Limit
W = Change in Width

Width of Surfaced Shoulders	R1	R2	D
6 ft.	6 ft.	150 ft.	42.0 ft.
8 ft.	8 ft.	150 ft.	48.3 ft.
10 ft.	10 ft.	150 ft.	53.8 ft.

Two Lane Rural Section with Surfaced Shoulders
to Two Lane Municipal Section



Detail A
Longitudinal Section Along
6 in. Curb at Terminal End

NOTES: Intersections, driveways or flume discharge structures will also suffice as a curb terminal point if their location permits.

Exhibit 6.18 Examples of Rural to Urban Roadway Transitions

6. AUXILIARY LANES

Auxiliary lanes may be added to a roadway for various reasons, including:

- Turn lanes at intersections
- Two-way left-turn lanes
- Truck climbing/passing lanes
- Acceleration/deceleration lanes
- Continuous auxiliary lanes between two closely spaced interchanges

For further information see Chapter Three: Roadway Alignment, Section 3.A.4, Chapter Four: Intersections, Driveways and Channelization, Section 1.D, and Chapter 4 of the *Green Book* (Ref. 6.1).

7. ROADWAY CHANNELIZATION

See Chapter Four: Intersections, Driveways and Channelization, Section 5 and the *Green Book* (Ref. 1.1), Sections 4.11 and 9.6.3.

8. NEW FOUR-LANE DIVIDED HIGHWAY USING EXISTING TWO-LANE HIGHWAY

The following guidance should be followed when designing a four-lane divided highway which utilizes the existing two-lane roadway:

1. The new lanes and median will be designed to expressway or major arterial crowned standards (See EXHIBIT 6.5).
2. For existing crowned sections with eight feet wide surfaced shoulders which are in relatively good condition, the inside (median) eight feet wide surfaced shoulder should be removed or reduced to four feet in width.
3. The location of the axis of rotation and the profile grade point through superelevated sections of the new lanes is illustrated in Chapter Three: Roadway Alignment, EXHIBITS 3.3, 3.4, 3.5, & 3.6.
4. A depressed median should have sufficient width (edge of the driving lane to edge of the driving lane) to provide for proper drainage (a minimum width of 50 feet is typical for four feet wide surfaced inside shoulders with 1:6 fill slopes). For additional information see Chapter Four: Intersections, Driveways and Channelization, Section 5.

9. ROADSIDE DESIGN

9.A The Clear Zone

In the late 1960's the forgiving roadside concept was introduced, recognizing that motorists do run off of the roadway and that the number of serious accidents and injuries might be lessened if a traversable recovery area were provided. Ideally this recovery area, the clear zone, should be free of obstacles such as unyielding sign and luminaire supports, trees, non-traversable drainage structures, utility poles, steep slopes, etc. Design options for the treatment of these features have generally been considered in the following order:

- Remove the obstacle or redesign it so it can be traversed
- Relocate the obstacle to outside of the clear zone or to where it is less likely to be struck
- Reduce impact severity by using an appropriate breakaway device
- Redirect a vehicle by shielding the obstacle with a longitudinal traffic barrier and/or impact attenuator
- Delineate the obstacle if other alternatives are not practicable

Clear zone width varies with the roadway functional classification, project type, traffic volume, design speed, roadway location, and the grading section of the roadway. The *MDS* (Ref. 6.2) provides the **NDOT** minimum clear zone requirements for various roadway types. For additional information, see Chapter 3 of the Roadside Design Guide (Ref. 6.6).

9.A.1 Horizontal Clear Zone

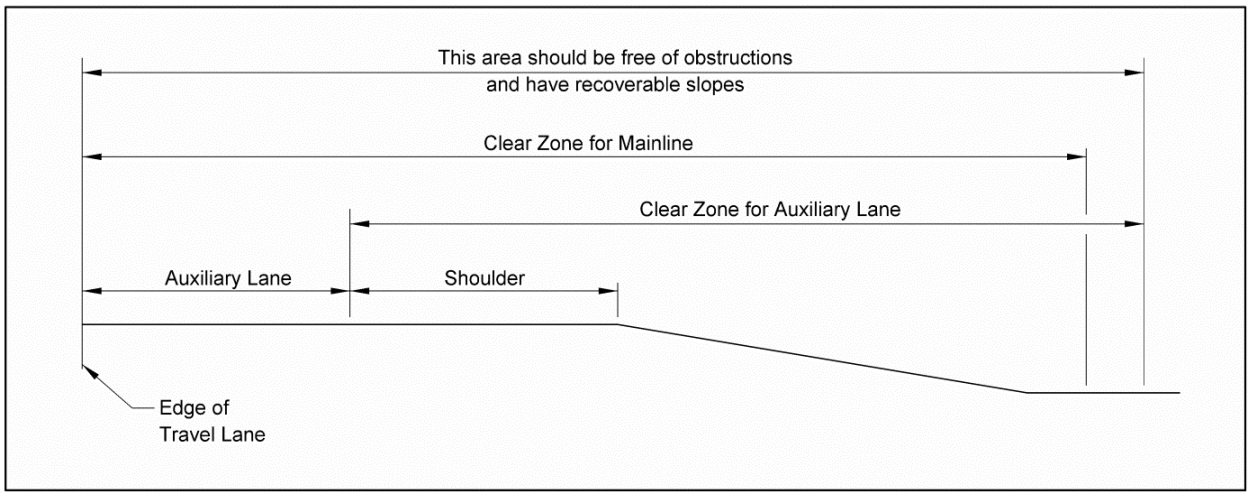
For new and reconstructed projects the horizontal clear zone is the roadside area, starting at the edge of the travel lane, which is available for the recovery of errant vehicles. It may consist of the shoulder, a recoverable slope, a non-recoverable but traversable slope, and/or a clear runout area. The required horizontal clear zone will vary depending upon the roadway classification (See the *MDS*, Ref. 6.2).

9.A.2 Fixed Obstacle Clearance

For 3R projects the fixed obstacle clearance, as given in the *MDS* (Ref. 6.2), provides an obstacle free zone in the roadside environment. For additional information see Chapter Seventeen: Resurfacing, Restoration and Rehabilitation (3R) Projects.

9.A.3 Clear Zone Requirements for Auxiliary Lanes

In some instances it will be necessary to calculate clear zone requirements for both the mainline driving lane and for an auxiliary lane. The clear zone must be calculated for each lane independently, based on the projected traffic volumes and design speeds of the individual lanes (See **TABLE 3.1** of the Roadside Design Guide, Ref. 6.6). The clear zone will be set at the greater of the two distances from the edge of travel way, as shown in EXHIBIT 6.19.



Note: Use the larger clear zone as measured from the edge of the travel lane or from the edge of the auxiliary lane.

Exhibit 6.19 Clear Zone Application for Auxiliary Lanes Adjacent to Mainline

9.B Roadside Geometry (Side Slopes)

The roadside geometry (foreslopes and backslopes) depends on many factors, including:

- The functional classification of the roadway
- Topography
- Urban/rural location
- The presence of curbs
- Snow Control

Criteria for roadside geometry for municipal highways are illustrated in EXHIBITS 6.12, 6.13 AND 6.14. The grading typical sections for rural projects are illustrated in EXHIBIT 6.20. Variations from the typical grading section will require the approval of the **ADE** and the reasons for the variation will be documented in the project file. For additional information regarding roadside geometry, see Section 3.2 of the Roadside Design Guide (Ref. 6.6).

9.B.1 Fill Slopes (Parallel)

Fill slopes within the clear zone should be recoverable slopes (1:4 or flatter) with no protruding fixed objects. Motorists on recoverable slopes generally can either stop their vehicles or slow them sufficiently to enable a return to the roadway. For new and reconstructed projects the **NDOT** requires 1:6 or flatter slopes to the outside edge of the horizontal clear zone (which is also known as the hinge point).

A non-recoverable traversable slope is defined as a slope which is steeper than 1:4 but equal to or flatter than 1:3. Motorists on non-recoverable traversable slopes generally will not be able to stop their vehicles or return to the roadway but should be able to reach the bottom of the slope without overturning. A section of non-recoverable traversable slope may be contained within the clear zone as long as an unobstructed runout area (which is 1:4 or flatter) is provided beyond the non-recoverable slope (this runout width will be included in the total recovery area).

A side slope which is steeper than 1:3 is considered to be a critical slope (non-recoverable and non-traversable, one on which a vehicle is more likely to overturn). A critical slope should not be included within the clear zone. If a critical slope cannot be eliminated from the clear zone an analysis of the slope will be performed using an applicable computer program (such as RSAP) to determine the economic benefit of installing a safety barrier system (See Chapter Nine: Guardrail and Roadside Barriers, Section 1.D).

9.B.2 Fill Slopes (Transverse)

Transverse fill slopes caused by the grading at crossroads, driveways/field entrances, median crossings, dikes, etc. are generally more critical to vehicles traveling on the mainline than parallel slopes since the transverse slope is head on to an errant vehicle. Transverse fill slopes of 1:6 or flatter are required in depressed medians and within the clear zone on high-speed roadways (≥ 50 mph) (the **NDOT** prefers a transverse slope of 1:10 or flatter). The transverse fill slope will be carried to the outside edge of the clear zone and may then be warped to a 1:3 foreslope in a minimum distance of 15 feet (See EXHIBITS 4.14, 4.15 & 4.18).

9.B.3 Cut Slopes

Typical cross-sections of cut slopes can be found in EXHIBIT 6.20. The 10 foot ditch bottom should be considered as the desirable ditch width. This width may be reduced when encountering front yards, mature shelterbelts or trees, center pivots and at other locations where there would be major damages to the property if right-of-way would be acquired based on the 10 feet ditch width. The designer may consider installing curb and/or culvert pipe, when practicable, to reduce right-of-way damages; however, right-of-way should be acquired to or beyond the limits of the clear zone.

The foreslope of a cut section with a special ditch (see Section 10.B) should meet the same slope and height criteria as the fill slope requirements presented in EXHIBIT 6.20. Ditches with steep backslopes, such as bench cuts through rock, should be designed so that the backslope is outside of the clear zone.

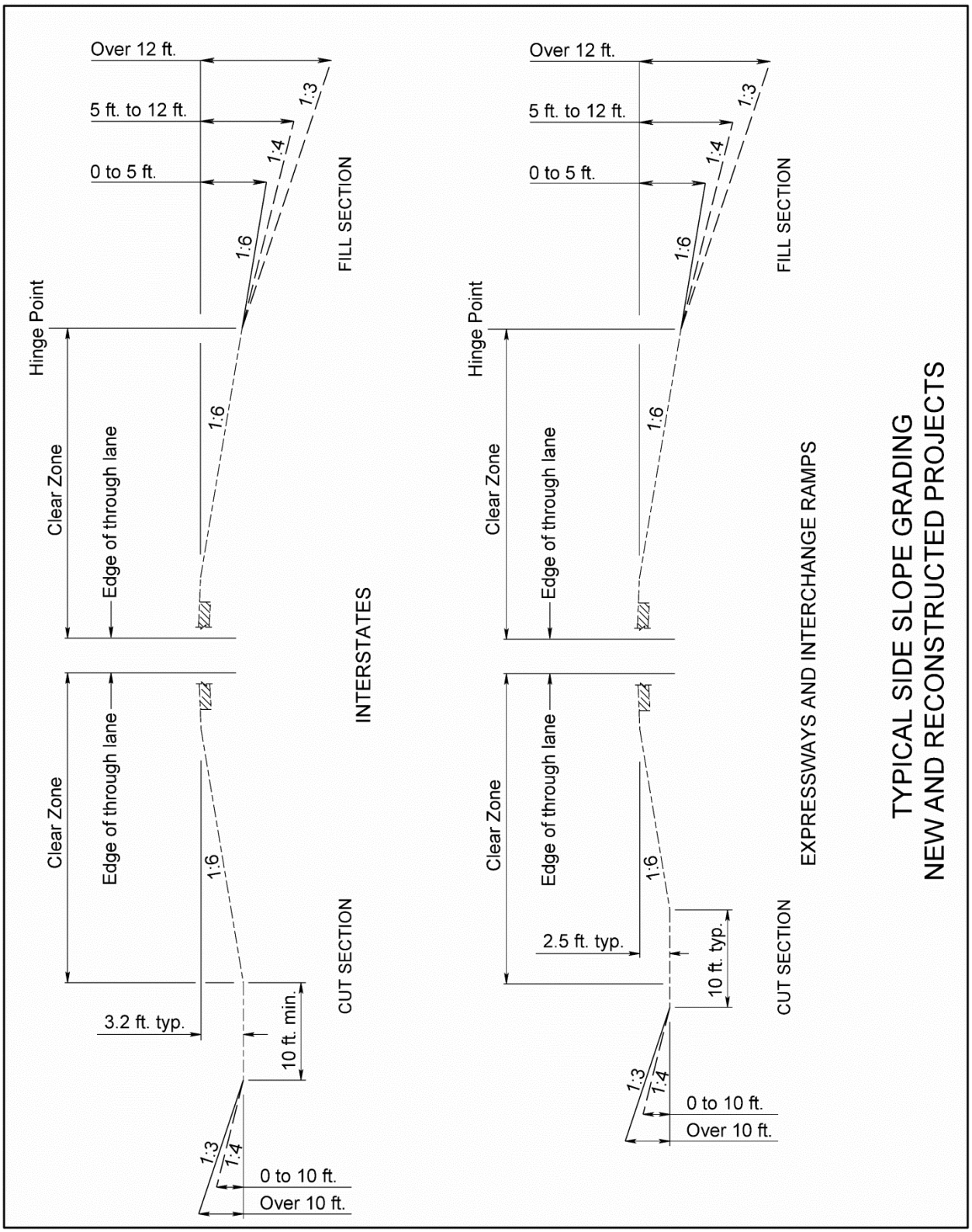


Exhibit 6.20a Typical Side Slopes for New and Reconstructed Projects

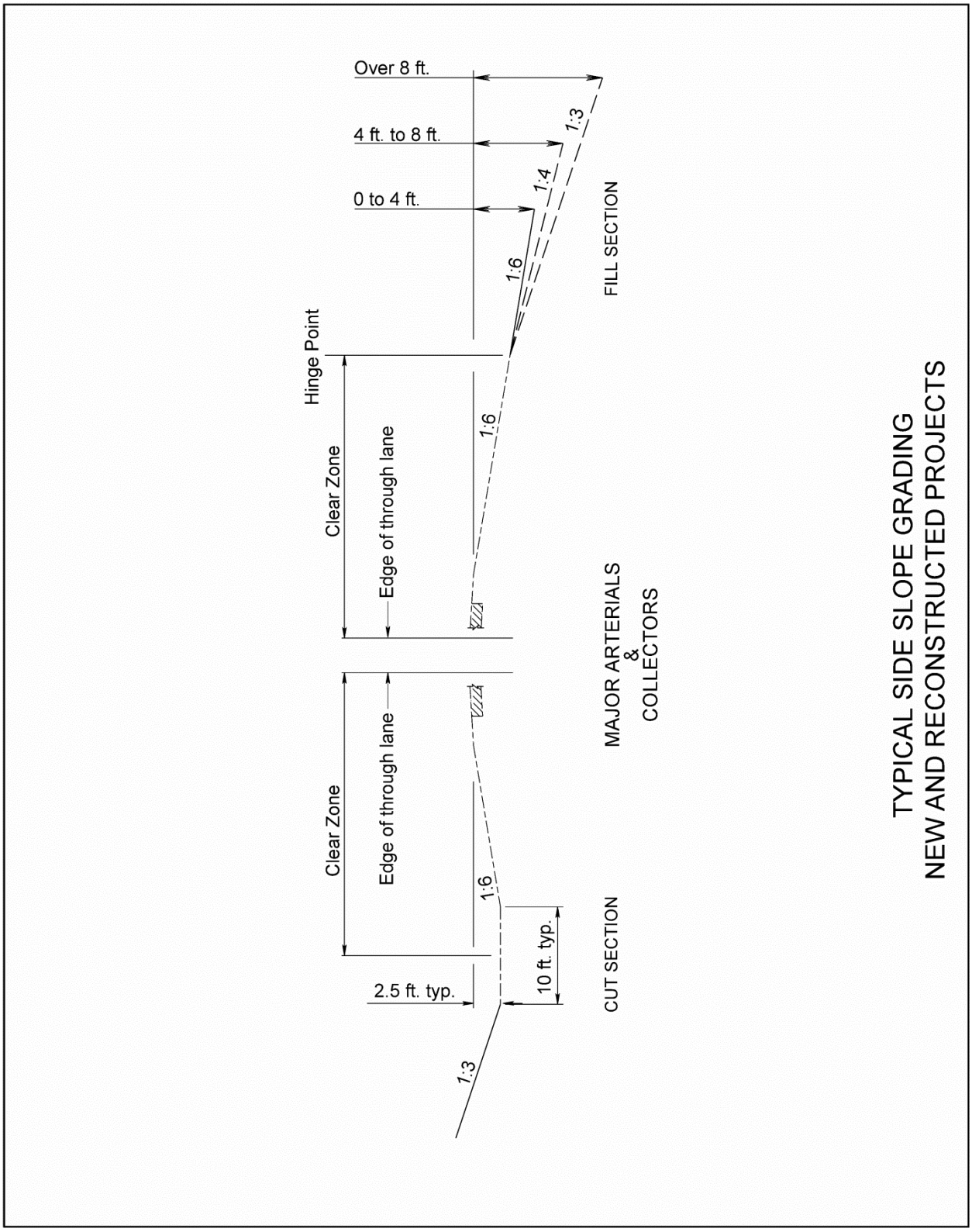


Exhibit 6.20b Typical Side Slopes for New and Reconstructed Projects

10. OTHER ELEMENTS AFFECTING THE ROADWAY CROSS-SECTION

10.A Right-of Way

Right-of-way requirements for street and highway design are discussed in Chapter Fifteen: Right-of-Way, Section 2.C.1. Right-of-way considerations which may impact the design of the roadway cross-section include, but are not limited to:

- Restricted Right-of-Way - Areas where right-of-way is restricted (e.g. environmental considerations, buildings) may require the use of steeper side slopes, retaining walls, adjustments to the vertical grade to reduce fill heights, and/or the provision of roadside barriers.
- Sight Distance - The purchase of additional right-of-way may be warranted at horizontal curves and intersections to provide and/or maintain the required horizontal sight distances.
- Constructability – Construction easements may be required for construction of bridge structures, for construction equipment access and storage, for materials storage and for other activities required for the construction of the project.

10.B Drainage

A roadside ditch will be of sufficient depth to meet the maximum allowable headwater (D + 1) policy (See the *Drainage Manual* (Ref. 6.4), Chapter One: Drainage, Section 8.G).

Ditches which are greater than the normal depths shown in EXHIBITS 6.1 THROUGH 6.10 AND 6.20 are referred to as special ditches. When placing a special ditch the designer should use a 1:6, 1:4, or a 1:3 foreslope as specified in EXHIBIT 6.20; the grading may go directly to a 1:3 foreslope from the hinge point with **Unit Head** approval and a decision letter to the project file. The minimum special ditch length that will be shown on the Plan and Profile Sheet is 150 feet (See Chapter Eleven: Highway Plans Assembly, Section 4.J); the grading contractor will build shorter special ditches based on the project slope stake data. The roadway designer will inform the **Roadside Development Unit** in the **Project Development Division** (**PDD**) of the location and slope of all ditches for their use in the design of the erosion control.

For curbed facilities, the type of facility limits the maximum width or spread of stormwater from the curb onto the roadway (see EXHIBIT 1.37 of the *Drainage Manual*, Ref. 6.4). Curb height, superelevation, and longitudinal slope all impact drainage design for curbed facilities.

Drainage design is discussed in Chapter One: Drainage of the *Drainage Manual* (Ref. 6.4).

10.C Environmental Considerations

It may be necessary to adjust the project side slopes to avoid impacting environmentally sensitive areas. The **Environmental Section** of **PDD** should be consulted about specific problem areas associated with the roadside landscape. Typical environmental considerations that may impact cross-section design include:

- Rare and/or endangered plant species (e.g. Prairie Fringed Orchid)
- Saving established vegetation on existing slopes, where practicable, in the Sandhills Region
- Saving existing trees which are outside of the clear zone but are within the project construction limits, where desired
- Avoiding excavation inside the dripline of a tree, which will damage its roots, if the tree is to be saved (the dripline is the perimeter of the area directly under the crown of the tree)

See Chapter Ten: Miscellaneous Design Issues, Section 3, for further information.

Changes to the roadway cross-section as it is described in the approved environmental (NEPA) document shall be submitted to the **Environmental Section** in **PDD** for review. For additional information, see Chapter Thirteen: Planning and Project Development.

10.D Erosion Control

Erosion control considerations which may impact the design of the roadway cross-section include, but are not limited to, the following:

- Building curb and flume (See Section 3.C)
- Providing flatter side slopes, where practicable, in the Sandhills Region and other areas where roadway side slopes are susceptible to erosion
- MS4 grass swales

See Chapter Two: Erosion and Sediment Control and Chapter Three: Stormwater Treatment of the *Drainage Manual* (Ref. 6.4) for additional information.

10.E Geotechnical Features

Geotechnical features within a project may impact cross-section design. The designer should review the soil, subgrade, and materials surveys from the **Materials and Research Division** (**M&R**) (See Chapter Seven: Earthwork, Section 6). Some features which may require special consideration include:

1. Cut or fill sections where the maximum height of cut or fill exceeds 20 feet or where embankment is to be constructed on a weak and compressible foundation material. These concerns are generally discussed in the foundation report and will affect construction phasing.
2. Soil and rock instability in cut/fill sections or natural slopes which are presently or potentially unstable, slide areas, slip plains, and unusual groundwater conditions. Mitigations for unstable conditions, such as geotextile soil reinforcement, permanent ground anchors, wick drains, stone columns, etc. may warrant special consideration.
3. Retaining walls where the maximum height along the length of a geotechnical feature exceeds four feet. Retaining wall design is discussed in Chapter Ten: Miscellaneous Design Issues, Section 7).

10.F Snow Control

Ditches may be widened and the backslope laid back from its normal 1:3 slope to provide more area for snow accumulation. See Chapter Ten: Miscellaneous Design Issues, Section 4, for a discussion of snowdrift abatement techniques.

10.G Earthwork Balances

Ditches or shoulders may be widened to provide for additional excavation or fill in order to balance the project earthwork (See Chapter Seven: Earthwork, Section 1).

10.H Daylighting

Daylighting occurs when the roadway backslope is flattened to intersect with the natural ground at a lower elevation than the typical backslope (See EXHIBIT 6.21). Daylighting may be used in order to gain excavation, to improve sight distance, or to eliminate snow drifting. When daylighting is used the following considerations should be taken into account:

- The consequences of removing the earth barrier related to impacts to environmentally sensitive areas, noise pollution, off-roadway glare, driver distraction, view from the roadway and from off of the roadway, and other aesthetic considerations
- Additional right-of-way may be required
- Current drainage patterns will be maintained

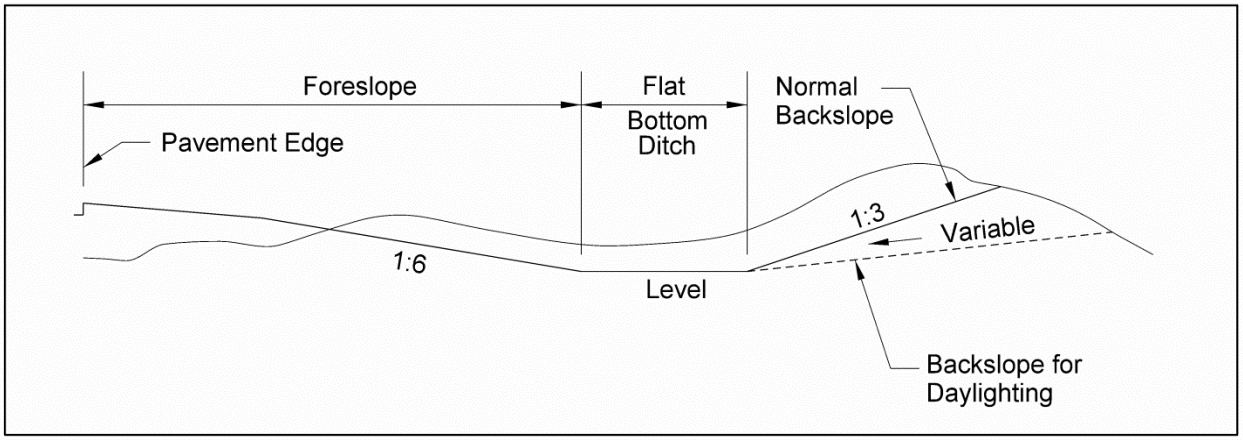


Exhibit 6.21 Daylighting

10.I Utilities

Highway and street improvements, whether within the existing right-of-way or on new right-of-way, generally entail adjustments of utility facilities. See Chapter Thirteen: Planning and Project Development, Section 6, for further information.

10.J Guardrail

Grading for guardrail may affect the roadway cross-section. See Chapter Nine: Guardrail and Roadside Barriers, Section 3.F, and the *Standard Plans* (Ref. 6.3) for further information.

10.K Bridges

The **Bridge Division** (**Bridge**) is responsible for the design of bridges and bridge-sized structures; the designer will coordinate with **Bridge** on projects involving bridges and bridge-sized structures (See Chapter Ten: Miscellaneous Design Issues, Section 2). Minimum bridge widths may be found in the *MDS* (Ref. 6.2).

10.K.1 Underpasses

The cross-section through an underpass should be the same as the approach roadway cross-section, including the clear zone or roadside barriers. Future widening of the roadway should be considered if significant traffic volume increases are anticipated in the foreseeable future (provide sufficient additional width for an additional lane in each direction to be added at a later date).

11. REFERENCES

6.1 American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets (*Green Book*), Washington D.C., 2011.

6.2 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards (*MDS*), Current Edition. (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/)

6.3 Nebraska Department of Transportation, Standard/Special Plans Book (*Standard Plans*), Current Edition. (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/)

6.4 Nebraska Department of Transportation, Drainage Design and Erosion Control Manual (*Drainage Manual*), Current Edition. (http://www.roads.nebraska.gov/business-center/design-consultant/rd-manuals/)

6.5 Federal Highway Administration, Manual on Uniform Traffic Control Devices, (*MUTCD*) 2009. (http://www.roads.nebraska.gov/business-center/contractor/mutcd/)

6.6 American Association of State Highway and Transportation Officials, Roadside Design Guide, Washington D.C., 2011.

Nebraska Department of Roads

Roadway Design Division – Policy Letter

Policy Number: **DES 17–01**

Approval Date: 6-5-17 By: _____ Roadway Design Engineer

Approval Date: 6-12-2017 By: _____ FHWA – Nebraska

This policy affects Roadway Design Manual: Chapters; One: Design Standards

Priority Commercial System: Shoulder Width

Purpose

The purpose of this policy is to address shoulder width on New & Reconstructed and Resurfacing, Restoration and Rehabilitation (3R) projects on the Priority Commercial System (PCS). This policy does not apply to curbed sections.

Policy

For **New and Reconstructed projects** on the Priority Commercial System with an ADT of at least 400 VPD but no more than 3,999 VPD, the minimum design standards for shoulder width and paved shoulder width is 8 ft. total shoulder width (6 ft. paved). If this policy is not followed a decision document shall be prepared for Assistant Design Engineer (ADE) approval. Factors to consider are:

1. System continuity,
2. Crash history attributable to shoulder width or to vehicles parked on the shoulders,
3. High heavy-truck volumes (250 Heavy Trucks per day),
4. Consultation with the District office, including anecdotal history of problems caused by parking on shoulders,
5. Alternative route for Interstate traffic,
6. Environmental impacts, and
7. Cost.

For **3R projects** on the Priority Commercial System, the minimum shoulder width shall follow the minimum design standard.

Implementation

The following will be eliminated from the Roadway Design Manual Chapter One Section 5.D.1: *The non-expressway portion of this system is being constructed with two 12 ft. (3.6 m) driving lanes and 10 ft. (3 m) shoulders, 8 ft. (2.4 m) of which is to be paved. In addition to the system as established, any route which has a design year traffic volume (the volume at the initial year of construction plus 20 years) of 3,000 ADT or greater will be developed with 8 ft. (2.4 m) paved shoulders. Bridges are to be widened to shoulder width.*

Sent to: NDOR Roadway Design, NDOR "Distribution B", and selected consultants.

The information contained in Chapter Seven: Earthwork, dated July 2006, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this chapter.

Chapter Seven
Earthwork

The following items **are not** earthwork items; **do not** include these items in your grading quantities:

- Shoulder Construction (Surfacing pay item, See Chapter Eight: Surfacing, Section 4.C).
- Median Construction (Surfacing pay item, See EXHIBIT 4.23 and the Standard Specifications for Highway Construction, (Reference 7.2), Section 308), (http://roads.nebraska.gov/media/6897/specbook-2007.pdf).
- Excavation for Box Culverts (Culverts pay item, See the Drainage Design and Erosion Control Manual, (Reference 7.1), Chapter One: Drainage, Section 8.R), (http://www.roads.nebraska.gov/business-center/design-consultant/rd-manuals/).
- Excavation for Culvert Pipes and Headwalls (Culverts pay item, See the Drainage Design and Erosion Control Manual, (Reference 7.1), Chapter One: Drainage, Section 8.R).

1. EARTHWORK

Earthwork is composed of two main components, excavation and embankment. Excavation is the amount of material that must be "cut" to construct the proposed roadway, ditches, channels, entrances, and other associated components. Embankment is the amount of material that must be "filled" or placed to construct the proposed roadway and its associated components.

Projects should be designed to produce balanced earthwork, material excavated from within the limits of the section should equal the amount needed to construct embankments to the designed grade. To attain balanced earthwork grade adjustments are generally preferable to ditch widening. The approximate change in elevation of a vertical PI required to produce a given volume of material can be computed using the formula found in EXHIBIT 7.1. In some instances, where grade controls are critical, it will not be possible to adjust grades to attain balanced earthwork. Provisions must be then made to borrow or waste material as necessary, see Section 1.B.

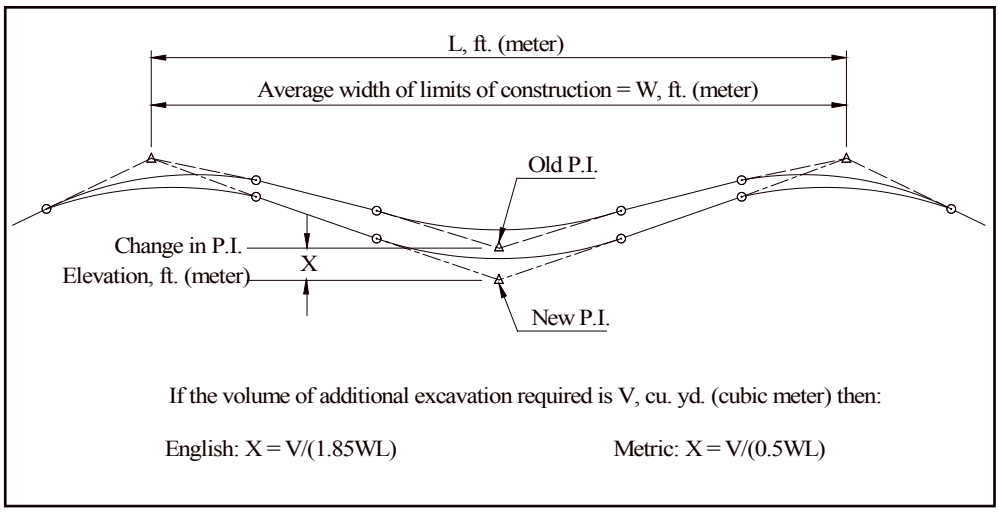


Exhibit 7.1 Earthwork Computation Formula

Adjustment to the roadway side slopes and adjustments to the grading within loops and ramps, to either slightly reduce fill requirements or gain excavation, should be weighed against safety criteria, possible aesthetic damage and maintenance problems in these areas. The following summarizes the earthwork considerations associated with mainline alignment design:

1. Urban/Rural. Earthwork balance is generally practical only in rural areas. In urban areas other considerations such as limiting right-of-way impacts and matching elevations of existing development may have a higher priority than balancing earthwork.
2. Borrow Sites. The availability and quality of borrow sites in the vicinity of the project will impact the feasibility of balancing earthwork. Environmental, archaeological and historical considerations can prevent the use of otherwise acceptable sites. Generally, the use of borrow should be minimized. When borrow cannot be avoided, borrow sites should be discussed at the plan-in-hand. Costs should be held to a minimum by obtaining borrow from wetland mitigation sites, existing borrow pits, snow control areas, etc.
3. Balance Points. Wherever practical, earthwork should be balanced at bridges, railroad crossings, roadway intersections, and at other manmade or natural interruptions in the roadway. Short balances of 100 to 300 ft. (30 to 100 m) should generally not be shown on the plans but should be shown as part of a combined larger balance. The desirable length of balances should be from 0.5 mile to 1 mile (0.80 km to 1.6 km), with one mile (1.6 km) being the preferred balance length.

1.A Computations

Currently there are a variety of computer programs available for earthwork computations. Although the methods may vary, the basic approach is the same:

- Identify existing ground cross-sections with elevations.
- Specify proposed roadway templates with centerline subgrade elevations.
- Compute cross-section end areas of cut and fill.
- Compute volumes of excavation and embankment.
- Establish balance points and perform an earthwork distribution analysis.

Regardless of the program used, earthwork computations are used to determine pay quantities and to verify final calculations in the field. **NDOT** designers should refer to the **Business Technology Support Division – IT Support** for assistance with the earthwork calculations computer programs.

1.A.1 Data Requirements

The following information is needed to perform earthwork calculations, regardless of the method used:

- Proposed horizontal and vertical alignments.
- Cross-sections of the existing terrain every 100 feet (25 meters) or where the terrain changes.
- Proposed design-cross-sections.

1.A.2 Balance Factors

Balance factors are multipliers applied to the embankment (fill) volumes to adjust for the shrinkage or swell of the soils used for the embankment. When soil is excavated, hauled and compacted into an embankment, the final volume of the compacted soil is usually less than when it is in its natural state. This difference in volume is usually defined as shrinkage. When rock is excavated, broken and placed into an embankment, it will occupy more space than rock in solid form due to the increase in void spaces. This increase in volume is known as swell.

The amount of shrinkage and swell are quantified as balance factors and are percentages of the original volume. In most cases, one balance factor is used for an entire project; therefore, an average balance factor must be determined for the various materials encountered over the length of a project. At the plan-in-hand field inspection possible balance factors can be discussed based on previous similar projects and individual design experience. The **Materials and Research Division** may also be consulted for recommendations on specific adjustments.

1.A.3 Distribution Analysis

Distribution analysis helps the designer to determine if the earthwork is going to be balanced, borrowed or wasted. A balance in earthwork is obtained when the amount of available excavation equals the amount of embankment needed in-place (after compaction).

The amount of adjusted embankment needed is the measured volume of embankment times the balance factor. Sometimes the adjusted embankment required exceeds the amount of excavation available. In those instances, borrow, from either contractor or state-furnished borrow pits, is required.

Waste occurs when the amount of available excavation exceeds the amount of needed embankment. The leftover material must be disposed of at approved waste sites or it may be used for shoulder construction (shoulder construction **is not** a part of the earthwork, it is a surfacing item and is paid for by the station, see Chapter Eight: Surfacing, Section 4.C).

It will be determined at the plan-in-hand field inspection if a project is to be balanced with material from the right-of-way, using contractor-furnished borrow, using state-furnished borrow, or if it will be necessary to waste excess material.

Considerations in determining if earthwork balance is practical for a given project include:

- Right-of-way limitations.
- Matching existing elevations of cross roads, bridges or existing roads.
- The availability and quality of borrow sites within the vicinity of the project.
- Will the borrow be State-furnished or contractor-furnished.
- Would earthwork balance require crossing bridges or going through towns with earth hauling equipment.
- The availability of waste sites within the vicinity of the project.
- Environmental, archaeological and historical considerations.

Information regarding the distribution of earthwork is required. Whether distribution analysis is generated manually or electronically, the following information must be shown in the distribution analysis for each station:

- End areas in sq. ft. (m^2) of excavation and embankment.
- Accumulated volume of excavation.
- Accumulated volume of embankment.
- Added quantities for intersections, large driveways, etc.
- Balance factor(s).
- Mass ordinate.

The above information, together with the identification of approximate balance points, is considered adequate. Mass diagrams generally are not plotted. The computer program provides a summary of earthwork distribution analysis.

The following guidelines should be used when doing the earthwork distribution analysis:

- Desirable balance lengths should be from one half mile (0.80 km) to one mile (1.6 km) with one mile being the preferred length.
- Short balances of 300 ft. (100 m) or less should not generally be shown on the plans, they should be shown as part of a combined larger balance.
- For rural projects constructed under traffic, earthwork distribution analysis for the left and right side of the roadway should be computed separately, for information only. This shows earthwork for each side so that the contractor knows how much material must be hauled across traffic.
- Earthwork should balance at major highway intersections, both sides of towns, rivers or major streams or other natural breaks. Do not haul across bridges or through towns if possible.
- An earthwork analysis should be developed and quantities shown on plans for each phase of construction, for information only.
- Haul distances should be kept to a minimum.
- The volume of existing pavement to be wasted or salvaged shall be eliminated from the earthwork run.
- Earthwork in urban areas should be either "Excavation Established Quantity" or "Earthwork Measured in Embankment." Urban projects usually will not be balanced.
- Earthwork quantities for temporary roads may be determined using established quantities. Temporary road material is put in as embankment and removed as excavation specified for the temporary road. Earthwork quantities for temporary roads may also be incorporated in the roadway earthwork if the designer includes the temporary road structure in the computer calculations.

1.A.3.a Haul Considerations

Haul is the distance excavated material is moved, as shown on the plans, from the location where the material is obtained to the location where the material is to be deposited. When distribution analysis is performed, the following questions should be considered in order to keep haul distances to a minimum:

- Is waste available from the other side of the road?
- Is waste available from adjacent balances?
- Could contractor-furnished borrow be used?
- Could balance points be adjusted?

1.A.4 Moisture Content

The moisture content of soil at the time of compaction shall be within the moisture range designated in the Soils and Situation Report (See Section 6.A.3). When the moisture content is not within the acceptable range, water must be added or the soil must be aerated depending upon the moisture content of the soil. EXHIBIT 7.2 should be used to estimate the amount of water that may need to be applied to obtain optimum moisture content when estimating grading costs. EXHIBIT 7.2 is based on excavation quantities; adjustments are required when paying for the quantity “Earthwork Measured in Embankment”, (See Section 1.A.5.a).

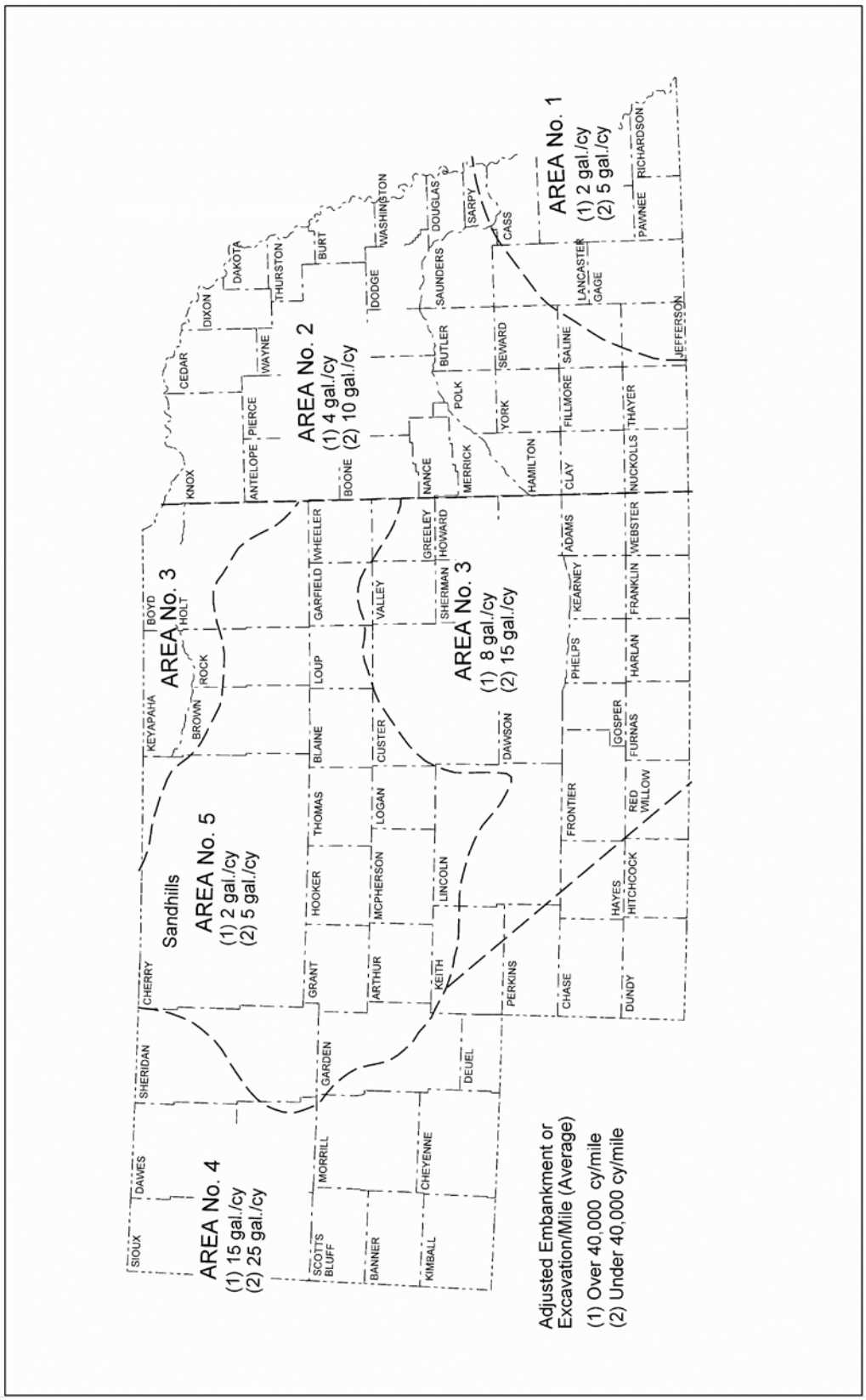


Exhibit 7.2 Map for Estimating Water Needed for Compaction

Types of Quantities	Case No. 1 Embankment Only	Case No. 2 Unbalanced - Mostly Embankment	Case No. 3 Balanced - Considerable Borrow	Case No. 4 Balanced - No Borrow	Case No. 5A Urban - More Excavation
Excavation			31,830	176,410	
Excavation- Borrow			144,580		
Excavation (Established Quantity)					10,000
Earthwork Measured in Embankment	38,110	11,910			
Water Applied, Mgal (kL)	745 (3715)	160 (805)	4,410 (22,050)	4,410 (22,050)	45 (220)

Exhibit 7.3 Example Grading Pay Items

Additional Requirements for Earthwork Calculations
ITEM 1: If an informational sheet is supplied with the plans showing a borrow pit where the contractor can obtain the embankment (optional or required pit), cross-sections should be provided showing the desired drainage and the computations made to reflect the available quantity.
ITEM 2: When earthwork is measured in embankment and there is a substantial anticipated subsidence, consideration should be given to furnishing soil information or allowing additional quantities for settlement such as surcharge on top of the fill.
ITEM 3: On projects involving embankments constructed with granular material obtained from river borrow pits, dewatered borrow areas, etc., whether borrow is state- or contractor-furnished, the earthwork should also be paid as "earthwork measured in embankment." No separate pay item is required for contractor-furnished borrow.
ITEM 4: Post construction cross-sections will be taken and the excavation to be paid for will be the material actually removed, measured by volume in its original position.
ITEM 5: Pre- and post-construction cross-sections will be taken on borrow pits to determine the actual quantity of borrow.
ITEM 6: Balance points should be shown on the plan and profile sheets or 2-N sheets.
ITEM 7: Post-construction cross-sections will not be taken and the contractor will only be paid for the quantity that is shown in the plans. No balance factor will ever be applied for earthwork measured in embankment but will be applied for excavation (established quantity).
ITEM 8: The volume of existing concrete/asphalt pavement removal shall be considered in all earthwork computations. See Section 1.C for discussion of removal of existing surfacing.
ITEM 9: On a project where the earthwork is measured in embankment, the earthwork for the construction of driveways and field entrances must be included in the earthwork totals.

Exhibit 7.4 Additional Requirements for Earthwork Calculations

1.A.5 Example Calculations

In this section different situations are described related to computing embankment and excavation quantities for highway projects. Grading items are summarized for the example cases in EXHIBIT 7.3. Except for the item "Water Applied", the same quantities, without conversion, are used for both the English standard and for the metric project examples. For example, in Case No. 1 "Earthwork Measured in Embankment" is either 38,110 cu. yds. or 38,110 m^3.

1.A.5.a Case 1: Embankment (Fill) Only

Many bridge and shoulder widening projects have only a fill quantity. No excavation is required for the roadway. Either the contractor or the state will be required to furnish borrow.

Given: An existing rural two-lane highway with 6 ft. (1.8 m) shoulders on level terrain in Buffalo County is to be improved to a two-lane highway with 10 ft. (3.0 m) shoulders for 5 miles (2.5 km). The highway is in fill for the full length of the project with 38,110 cu yds (m^3) of embankment calculated. At the plan-in-hand review it was determined that the balance factor should be 1.30. Determine the earthwork quantity for payment and the amount of water needed.

Station to Station (Metric)		Station to Station (English)		Excavation Available	Earthwork Measured in Embankment
0 + 00	22 + 86	0 + 00	75 + 00	0	10,975
22 + 86	45 + 72	75 + 00	150 + 00	0	11,310
45 + 72	68 + 58	150 + 00	225 + 00	0	11,780
68 + 58	80 + 48	225 + 00	264 + 00	0	4,045
Total				0	38,110

Exhibit 7.5 Earthwork Quantities - Case 1

Solution: The earthwork quantity and pay item will be 38,110 cu yds (m^3) of "Earthwork Measured in Embankment." It is the measured volume of embankment on the cross-sections and **is not** multiplied by the balance factor to obtain the pay item quantity, (Earthwork analysis is run at a 1.00 balance factor when paying for "Earthwork Measured in Embankment"). It is an established quantity and is not verified by field personnel after construction.

Water may be required in the compaction process to attain the proper density in the new embankment. To determine the quantity of water that needs to be applied for compaction, the measured volume of embankment must be adjusted for shrinkage by multiplying it by the balance factor, since EXHIBIT 7.2 is based on excavation quantities, (for "Embankment", a balance factor of 1.5 shall be used when calculating "Water Applied").

38,110 cu yds (m^3) X 1.50 = 57,165 cu yds (m^3).

The quantity of water that needs to be applied is determined by multiplying the adjusted volume of embankment by the number of gallons (liters) of water per cu. yd. (m^3) as indicated in EXHIBIT 7.2 for the area in which the project is located. For this example, Buffalo County is in Area 3 and the project averages less than 40,000 cu. yds. of excavation per mile (20,000 m^3/km). The rate at which water should be applied for compaction is 15 gal of water per cu. yd. (75 liters of water per m^3) of embankment:

57,165 cu. yds. X 15 gal/cu. yd. = 857,475 gal (call 857 Mgal),

or in Metric: 57,165 m^3 X 75 l/m^3 = 4,287,375 liter (call 4287 kL (reads kiloliter))

1 Mgal equal 1000 gallons (1000 liters of water = 1 kL).

According to the specifications, the contractor is paid for the quantity of "Earthwork Measured in Embankment" as shown on the plans (38,110 cu yd (m^3)) and the quantity of "Water Applied" in Mgal (kL).

The following standard note should be shown on the plans:

STANDARD NOTE 12
THE CONTRACTOR WILL BE REQUIRED TO FURNISH BORROW ON THIS PROJECT.

EXHIBIT 7.5 shows a typical earthwork table that should be included on the plans. See items 2, 3, 7 and 8 in EXHIBIT 7.4 for additional information pertaining to this example.

1.A.5.b Case 2: Unbalanced - Mostly Embankment

Some major projects have the majority of the earthwork in fill and just a small cut quantity. This may occur on projects that involve adding a lane to an existing road.

Given: An existing rural two-lane highway on mostly level terrain in Madison County is to be improved to a four-lane highway with a median. The project begins at Sta. 1+00 (0+00.000) and ends at Sta. 72+89 (21+91.867). There is a major crossroad at Sta. 27+32 (8+01.431), a stream crossing at Sta. 57+15 (17+10.686) and the city limits at Sta. 68+40 (20+53.467). At the plan-in-hand review it was determined that the balance factor should be 1.35.

Given the earthwork quantities in EXHIBIT 7.6, determine balance points for distribution analysis, the earthwork quantities for payment and the amount of water needed.

Solution: For this example, balance points should be at the following locations:

- Sta. 27+32 (8+01.431) - cross road
- Sta. 57+15 (17+10.686) - stream crossing
- Sta. 68+40 (20+53.467) - city limits.

Since these balance points occur at intervals of approximately 0.5 mile (0.80 km), no intermediate balance points are needed.

Station to Station (English)		Station to Station (Metric)		Excavation Available	Earthwork Measured in Embankment
1+00	27+32	0+00.000	8+01.431	1,050	3,520
27+32	57+15	8+01.431	17+10.686	500	5,340
57+15	68+40	17+10.686	20+53.467	0	2,640
68+40	72+89	20+53.467	21+91.867	0	415
Total (cu yds (m^3))				1,550	11,915

Exhibit 7.6 Earthwork Quantities - Case 2

The pay item will be 11,915 cu. yds. (m^3) of "Earthwork Measured in Embankment" of which 1,550 cu. yds. (m^3) will be excavated as shown on cross-sections (See Case 1, which explains “Earthwork Measured in Embankment” in greater detail).

For the amount of water that needs to be applied for compaction, the embankment quantity needs to be adjusted for shrinkage by multiplying it by the balance factor:

11,915 cu. yds. X 1.35 = 16,085 cu. yds. (m^3)

The quantity of water that needs to be applied is determined by multiplying the adjusted volume of embankment by the number of gallons (liters) of water per cu. yd. (m^3) as indicated in EXHIBIT 7.2 for the area in which the project is located. For this example, Madison County is in Area 2 and the project averages less than 40,000 cu. yds. per mile (20,000 m^3/km) of excavation. The rate at which water should be applied for compaction is 10 gallons (50 liters) of water per cu. yd. (m^3) of embankment:

16,085 cu. yds. X 10 gal/cu. yd. = 160,850 gal (call 161 Mgal.)

or in Metric: 16,085 m^3 X 50 l/m^3 = 804,250 liters (call 804 kL)

In this case, the following standard note should be shown on the plans:

STANDARD NOTE 12
THE CONTRACTOR WILL BE REQUIRED TO FURNISH BORROW ON THIS PROJECT.

EXHIBIT 7.6 shows an example of an earthwork table that shall be included on the plans. See items 2, 3, 7 and 8 in EXHIBIT 7.4 for additional information pertaining to this example.

1.A.5.c Case 3: Balanced – Considerable Borrow Furnished by Contractor

Often on major grading projects, such as adding lanes to an existing highway, the earthwork is paid as excavation even though a considerable amount of contractor-furnished borrow is required to complete the project.

Given: An existing two-lane highway in Cheyenne County is to be widened to a four-lane highway. The project begins at Sta. 100+00 (0+00.000) and ends at Sta. 497+00 (121+00.165). There is a side road at Sta. 363+00 (80+16.084), and improvements along the side road run from Sta. 3001+00 to Sta. 3077+00 (3000+00.000 to Sta 3020+42.041). There are no other side road crossings or major stream crossings. At the plan-in-hand inspection it was determined that the balance factor should be 1.45. Given the earthwork quantities in EXHIBIT 7.7, determine the balance points for the distribution analysis, the earthwork quantities for payment, and the amount of water needed.

Solution: For this example, balance points should be at the location of the side road and approximately every mile between the start and the side road and between the side road and the end:

- Sta 152+00 (15+84.484)
- Sta 204+00 (31+69.838)
- Sta 257+00 (47+85.254)
- Sta 310+00 (64+00.669)
- Sta 363+00 (80+16.084) - side road
- Sta 416+00 (94+48.522)
- Sta 467+00 (111+85.922)

The pay items will be:

- The measured excavation is 31,830 cu. yds. (m^3) and will be paid for as "Excavation."
- Since there is more embankment than excavation available, contractor-furnished borrow is necessary and is calculated by subtracting the excavation from the adjusted embankment. For the adjusted embankment volume, multiply the measured embankment by the balance factor:

121,665 cu/ yds. X 1.45 = 176,415 cu. yds. (m^3)

Then subtract the measured excavation from the adjusted embankment:

176,415 cu. yds. (m^3) - 31,830 cu. yds. (m^3) = 144,585 cu. yds. (m^3)

The quantity and pay item will be 144,585 cu. yds. (m^3) of "Excavation-Borrow."

The quantity of water that needs to be applied is determined by multiplying the adjusted volume of embankment by the number of gallons of water per cu. yd. (liters per m^3) as indicated by EXHIBIT 7.2 for the area the project is located. For this example, Cheyenne County is in Area 4 and the project averages less than 40,000 cu. yds. of excavation per mile (20,000 m^3/km). The rate at which water should be applied for compaction is 25 gal/ cu. yd. (125 liters of water per m^3) of embankment:

176,415 cu. yds. X 25 gal/cu. yd. = 4,410,375 gal (call 4,410 Mgal.)

or in Metric: 176,415 m^3 X 125 l/m^3 = 22,051,875 liters (call 22,051 kL)

In this situation post-construction roadway cross-sections will be taken and the excavation to be paid for will be the material actually removed, measured by the cu. yd. (m^3) in its original position. Also pre- and post-construction cross-sections will be taken on the borrow pit to determine the actual quantity of borrow used. Pay items in Case 3 shall be "Excavation" and "Excavation Borrow."

The standard note that should appear on the plans for this situation is:

STANDARD NOTE 12
THE CONTRACTOR WILL BE REQUIRED TO FURNISH BORROW ON THIS PROJECT.

EXHIBIT 7.7 shows an example of an earthwork table that shall be included on the plans. See items 1, 4, 5, 6 and 8 in EXHIBIT 7.4 for additional information pertaining to this example situation.

Earthwork						
Station to Station (English)		**Station to Station (Metric)**		**Excavation**	**Excavation-Borrow**	**Embankment**	**Balance Factor**
100+00	152+00	0+00	15+85	745	11,405	8,380	1.45
152+00	204+00	15+85	31+70	1,635	20,775	15,455	1.45
204+00	257+00	31+70	47+85	495	16,870	11,975	1.45
257+00	310+00	47+85	64+00	2,275	14,420	11,515	1.45
310+00	363+00	64+00	80+16	8,345	24,085	22,365	1.45
363+00	416+00	80+16	94+50	3,710	22,940	18,380	1.45
416+00	467+00	94+50	111+85	13,155	17,750	21,315	1.45
467+00	497+00	111+85	121+00	1,455	12,670	9,740	1.45
3001+00	3077+00	3000+00	3020+42	15	3,670	2,540	1.45
Total				31,830	144,585	121,665	

Exhibit 7.7 Earthwork Quantities - Case 3

1.A.5.d Case 4: Balanced - No Borrow

A balanced project with no borrow occurs when the material excavated from within the limits of the section is sufficient to construct embankments to the designed grade.

Given: The same existing highway, improvements and conditions as in Case 3 except that the earthwork quantities are those shown in EXHIBIT 7.8, determine the earthwork quantities and pay items.

Earthwork						
Station to Station (English)		Station to Station (Metric)		Excavation	Embankment	Balance Factor
100+00	152+00	0+00	15+85	12,150	8,380	1.45
152+00	204+00	15+85	31+70	22,410	15,455	1.45
204+00	257+00	31+70	47+85	17,365	11,975	1.45
257+00	310+00	47+85	64+00	16,695	11,515	1.45
310+00	363+00	64+00	80+16	32,430	22,365	1.45
363+00	416+00	80+16	94+50	26,650	18,380	1.45
416+00	467+00	94+50	111+85	30,905	21,315	1.45
467+00	497+00	111+85	121+00	14,125	9,740	1.45
3001+00	3077+00	3000+00	3020+42	3,685	2,540	1.45
Total				176,415	121,665	

Exhibit 7.8 Earthwork Quantities - Case 4

Solution: Adjust the embankment volume for shrinkage by multiplying it by the balance factor:

121,665 cu. yds. (m^3) X 1.45 = 176,415 cu. yds. (m^3).

Since the adjusted embankment volume is equal to the measured excavation quantity, the earthwork is balanced, additional excavation is not needed and no borrow is required; therefore, the only earthwork quantity and pay item will be 176,415 cu. yds. (m^3) of "Excavation." The quantity of “Water Applied” in this example is 4,410 Mgal (22,051 kL), similar to the quantities calculated in case 3.

The standard note that should appear on the plans for this situation is:

STANDARD NOTE 13
THE CONTRACTOR WILL NOT BE REQUIRED TO FURNISH BORROW ON THIS PROJECT.

EXHIBIT 7.8 shows an example of an earthwork table that shall be included on the plans. See items 4, 6, and 8 in EXHIBIT 7.4 for additional information pertaining to this example.

It should be noted that balance points for this example were shown at one-mile stations for simplicity. For actual projects, the designer should refer to the mass ordinate in the distribution analysis to determine locations of natural balances, i.e., balance points that naturally occur in the station-by-station accumulated volumes listing. Natural balances between 0.5 mile and 1.0 mile (0.80 km and 1.6 km) apart should be used whenever possible. Minor balance points between larger balances should be ignored. Often a designer will modify the template to increase embankment, excavation or both to balance the project (See Section 1.B.1). Depending on the

scope of the project the profile grade elevations and/or location may also be modified to balance the earthwork.

1.A.5.e Case 5: Excavation or Embankment in Urban Areas

In urban areas, where it is difficult to determine the quantity of earthwork performed because of curb/gutter and driveways, the earthwork will be paid for as "Excavation (Established Quantity)" or "Earthwork Measured in Embankment." For additional information see Section 4.B.

1.A.5.f Case 5A: More Excavation than Embankment in Urban Areas

Given: An existing four-lane urban highway is being widened to six lanes in Douglas County. The project begins at Sta. 1+00 (1+00.000) and ends at Sta. 55+00 (17+45.831). At the plan-in-hand inspection it was determined that the balance factor should be 1.45. Given the information in EXHIBIT 7.9, determine earthwork quantities, pay items and the water that should be applied.

Station to Station (English)	Station to Station (Metric)	Balance Factor	Excavation (Established Quantity)	Embankment	Waste
1+00 55+00	1+00.000 17+45.831	1.45	10,000	3,000	5,650
Total			10,000 cu yd (cubic meter)	3, 000 cu yd (cubic meter)	5,650 cu yd (cubic meter)

Exhibit 7.9 Earthwork Quantities - Case 5A

Solution: For the adjusted embankment, multiply the measured embankment by the balance factor:

3,000 cu. yds. (m^3) X 1.45 = 4,350 cu. yds. (m^3).

Since the adjusted embankment is less than the measured excavation, the quantity and pay item will be 10,000 cu. yds. (m^3) of "Excavation (Established Quantity)." There will be no cross-sections taken in the field to verify this quantity. There will be waste, the amount of which will be determined by subtracting the adjusted embankment from the excavation:

10,000 cu. yds. (m^3) - 4,350 cu. yds. (m^3) = 5,650 cu. yds. (m^3) of waste.

The quantity of water that needs to be applied is determined by multiplying the adjusted volume of embankment by the number of gallons of water per cu. yd. (liters per m^3) as indicated in EXHIBIT 7.2 for the area in which the project is located. For this example, Douglas County is in Area 2 and the project averages less than 40,000 cu. yds. of excavation per mile (20,000 m^3/km). The rate at which water should be applied for compaction is 10 gallons of water per cu. yd. (50 l/m^3) of embankment:

4,350 cu. yds. X 10 gal/cu. yd. = 43,500 gal (call 44 Mgal.)
or in Metric: 4,350 m^3 X 50 l/m^3 = 217,500 liters (call 218 kL)

The following notes should be shown on the plans:

STANDARD NOTE 13
THE CONTRACTOR WILL NOT BE REQUIRED TO FURNISH BORROW ON THIS PROJECT.

STANDARD NOTE 14
THE CONTRACTOR WILL BE REQUIRED TO FURNISH WASTE AREAS FOR EXCESS EXCAVATION ON THIS PROJECT.

See item 8 in EXHIBIT 7.4 for additional information pertaining to this example.

1.A.5.g Case 5B: More Embankment than Excavation in Urban Areas

Use the procedures described in Section 1.A.5.b.

1.B Borrow Pits and Waste Sites

Borrow pits are sources of approved material required for the construction of embankments or other portions of earthwork requirements.

Waste sites are areas established for the disposal of excess excavation or unsuitable materials.

The following items should be considered for state-furnished borrow pits and waste sites on new and reconstructed projects:

- The designer should consider all available options to balance the project or reduce borrow and/or waste.
- When borrow pits and/or waste sites are unavoidable, they should be discussed on the plan-in-hand field inspection.
- Locations for borrow and waste sites should be determined before L.O.C. plans (Activity #5500) are transmitted to **Right-of-Way Design**.
- Borrow pits and waste sites require clearance for historical and environmental impacts. If there are any changes to these sites after the R.O.W. Appraisal Plans have been designed the roadway designer shall notify the **State Historical Preservation Officer** and the **Environmental Section Manager** in the **Project Development Division**, (See Chapter Thirteen: Planning and Project Development, Section 4).

1.B.1 Alternatives to Providing Borrow or Waste Sites

NDOT prefers that borrow and waste sites not be used if there are alternatives available that eliminate the need for borrow/waste sites.

1.B.1.a Borrow Alternatives

- Daylighting: Daylighting is the flattening of the roadway backslope so that it intersects the natural ground at a lower elevation than the normal backslope. See Chapter Six: The Typical Roadway Cross-Section, Section 10.H.
- Ditch Widening: If adequate right-of-way is available ditches may be widened to provide additional excavation. When ditch widening is used it should be uniform and consistent over long stretches with gradual transitions between widths.
- Flattening Backslopes: If adequate right-of-way is available backslopes on ditches may be flattened. As with ditch widening, flattening should be uniform and consistent over long stretches with gradual transitions between slope changes. Backslopes in cut sections may be flattened from 3:1 to a flatter slope up to 4:1.
- Special Ditches: A special ditch is any ditch that varies in slope or depth from the standard ditch shown on the typical cross-section. If adequate right-of-way is available, special ditches may be designed to increase the available excavation as well as to provide better drainage.
- Modify Alignments: The horizontal and vertical alignments may be shifted along the entire length of the project or in isolated areas to help eliminate the need for borrow.

1.B.1.b Waste Alternatives

- Flattening Fill and Foreslopes: If adequate right-of-way is available fill and foreslopes may be flattened from 6:1 up to 10:1 to help eliminate the need to waste material. Flattened slopes should be uniform and consistent over long stretches, with gradual transitions between changes in slopes. The designer should try to increase embankment while keeping the required additional right-of-way to a minimum.
- Fill Low Areas: Additional excavation may be placed in low areas outside of the construction limits and within the right-of-way, provided that the fill does not adversely affect drainage or aesthetic conditions. Wetlands should be avoided (See Chapter Thirteen: Planning and Project Development, Section 4.B).
- Modify Alignments: The horizontal and vertical alignments may be shifted along the entire length of the project or in isolated areas to help eliminate waste.

1.B.2 Borrow Pit Restoration

If state-owned land is used for a borrow pit, restoration is required. See the Standard Specifications for Highway Construction, (Reference 7.2), Section 208.

1.C Removal of Existing Surfacing

If surfacing material is to be salvaged, removal is generally a pay item, (See Chapter Eight: Surfacing, Section 5.B for further information).

1.C.1 Rural Projects

The existing asphalt surface on full grading projects will normally be salvaged. Existing concrete surfacing may also be salvaged. The roadway designer should check with the **Materials and Research Division** during the pre-design of the project to find out the depth, width and length of the material that is to be salvaged. The preliminary cross-sections should then be recoded to

reflect the void left by the existing surface that is to be removed. The removal of this material will be paid for directly as a separate pay item.

If the existing asphalt surface is not to be salvaged, this surfacing may be placed in the outer slopes of the embankment 1 ft. (300 mm) below the finished shoulders and foreslope. No deductions to the earthwork quantities are required for the volume occupied by this surfacing.
If the existing surfacing is concrete and is not to be salvaged but is to be removed, the roadway designer should deduct the volume occupied by this surfacing in computing the earthwork balance, and the removal should be paid for directly. If the concrete is to be removed, crushed and replaced as foundation course, the removal is subsidiary to the crushed concrete foundation course item as long as the crushed concrete is solely used for foundation course (i.e., has one use only).

When less than 3 ft. (1 m) of embankment is to be placed over an existing concrete pavement or base course, the existing surfacing shall be removed and paid for. When the embankment is greater than 3 ft. (1 m), the grading contractor shall break the concrete into pieces of approximately 4 sq. ft. (0.4 m^2) in size and leave them in place. This activity is paid for as the item, "breaking pavement."

1.C.2 Urban Projects

Normally there is no place to bury existing surface material on urban projects, therefore removal is usually specified. In this case the roadway designer should deduct the volume occupied by this surfacing in computing the earthwork balance, and the removal should be paid for directly.

Alternatively, asphalt may be milled and salvaged. In this case, it is paid for as milling and the quantity is deducted from the earthwork.

If the project covers both rural and urban areas, the plans shall show the physical limits of asphalt removal to be paid for and the physical limits of asphalt removal, which is subsidiary to excavation.

2. STAGED CONSTRUCTION/PHASING

A distribution analysis shall be done for each separate phase of construction for a project. Cross-section cut and fill areas should reflect the staged construction and should correspond with the distribution analysis performed. Projects with phased construction, expressway projects for example, will show earthwork quantities on the cross-sections for each phase of construction. This distribution analysis shall be for information only, unless the given quantities are “Established Quantities”. In cases where the project requires more than one construction season, cover crop seeding will be calculated for each phase of construction. The 2N sheet will show the quantity of cover crop seeding required for each phase. The 2N sheet will also have a table showing the earthwork quantities for each phase of construction. Although it is the roadway designer's responsibility to provide reasonable phasing, the actual construction phasing is left to the discretion of the contractor with the approval of the **Project Engineer**. For additional information see Chapter Fourteen: Traffic, Section 6.

3. MISCELLANEOUS EARTHWORK CONSIDERATIONS

3.A Unsuitable Materials

Unsuitable materials are materials that are inappropriate for use in the embankment. They include rock, organic muck or any foreign objects, such as garbage, car bodies, etc. The Soil and Situation Report will list the location, type of material and treatments for the unsuitable material found. Often rock can be used in the toe of the fill. If organic muck is encountered unexpectedly by the contractor, a change order, (a written order to the contractor covering changes in the contract), will be necessary to excavate the unsuitable material and to haul in acceptable material to replace the unsuitable material, (See Chapter Thirteen: Planning and Project Development: Section 4.H for additional information).

3.B Contaminated Soils

See Chapter Thirteen: Planning and Project Development: Section 4.H.3.

3.C Guardrail

Additional embankment and grading may be required for the installation of guardrail. This earthwork is not considered subsidiary and should be calculated and included in earthwork quantities. Refer to Chapter Nine: Guardrail and Roadside Barriers, Section 3.F, and the guardrail special plans (Standard/Special Plans Book, Reference 7.3) (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/).

3.D Driveways

The method of handling the earthwork required for driveway construction varies according to the pay item, as shown below:

- "Excavation" or "Excavation-Borrow": The designer does not need to calculate the earthwork required to build the drives. The contractor will be paid for any necessary additional excavation as it is measured on the project.
- "Earthwork Measured in Embankment" or "Excavation (Established Quantity)": The designer shall calculate and add to the earthwork quantities all earthwork required to build all intersections, drives, field entrances and earth dikes.

3.E Settlement

When embankment is placed on existing ground, the weight of the embankment causes the existing ground to settle and thus the embankment also will settle. An excess of embankment may be placed to overcome the effects of consolidation. The Embankment Foundation Report (See Section 6.C) will usually indicate when additional embankment is necessary. The designer shall coordinate the design of the project in areas of embankment settlement with the **Soils Engineer** in the **Materials and Research Division**.

3.F Shear Lines

Shear lines are used for calculating earthwork volumes at intersections where side road alignments connect with the mainline alignment. Earthwork volumes are calculated along the mainline to a set distance from the centerline, assuming that the earthwork has a vertical line at that location (See EXHIBITS 7.10a AND 7.10b). Earthwork is then computed for the area outside of the shear line along the side road alignment. Shear lines may also be used at other locations where irregular excavations or embankments may be caused by channel changes, access roads, etc.

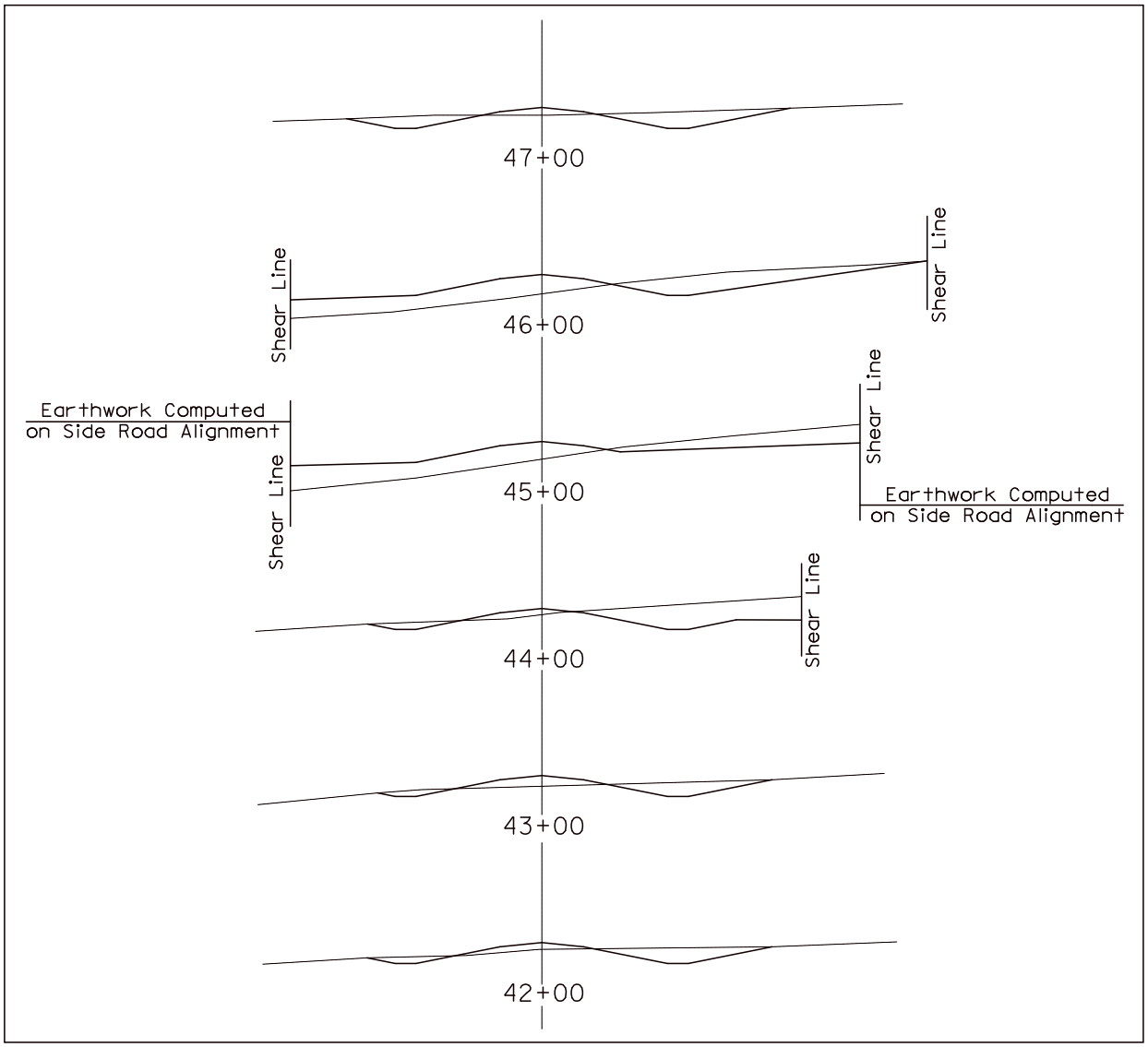


Exhibit 7.10a Shear Lines (Cross-Section)

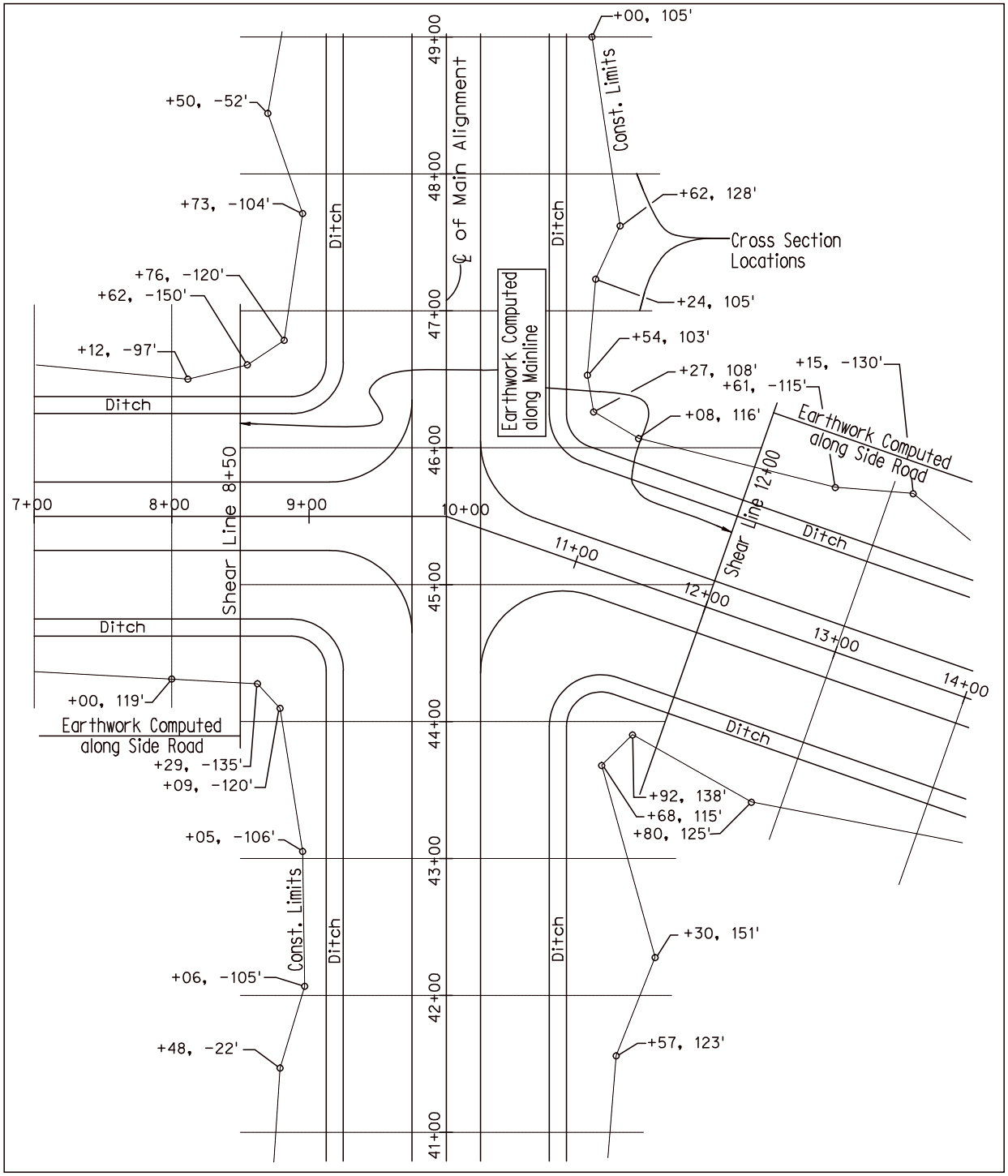


Exhibit 7.10b Shear Lines (Plan)

4. METHODS OF PAYMENT

4.A "Excavation" and "Excavation-Borrow"

"Excavation" and "Excavation-Borrow" are the preferred method of earthwork payment on projects with large quantities. Generally, grading projects that average more than 5000 cu. yds. per mile (2375 m^3 per km) will be paid for as "Excavation". On major grading projects where the earthwork is paid for as "Excavation" and where the contractor is required to furnish borrow, the excavation quantity within the right-of-way and the easements shall be calculated separately from what the contractor will furnish. A separate pay item, "Excavation-Borrow", will be used for the contractor furnished borrow. The quantities for these pay items will be measured in the field and then calculated for payment.

4.B "Established Quantities"

Sometimes it is difficult to determine in the field the quantity of earthwork performed. In this situation earthwork should be paid for as an established quantity, which is determined by roadway design from the cross-sections. This measured "established" quantity is used for payment of earthwork instead of field-measured quantities. Established quantities can be in excavation or embankment. This method of payment is most often used for urban roadway projects and for temporary roadways. In the Omaha area and on urban projects where the contractor will be required to furnish borrow the earthwork pay item will be an "Established Quantity", with no separate pay item for contractor furnished borrow.

4.B.1 "Earthwork Measured in Embankment" and "Excavation (Established Quantity)"

"Earthwork Measured in Embankment" is paid for according to the embankment measured from the cross-sections. It does not include excavation, nor is it adjusted by a balance factor. When earthwork is measured in embankment and there is a substantial anticipated settlement, consideration should be given to furnishing soil information or allowing additional quantities for the settlement. This method of payment is typically used on projects that have embankment only or on projects that are mostly embankment with very little excavation. On projects involving embankments constructed with granular material obtained from river borrow pits, dewatered borrow areas, etc. (whether borrow is state or contractor-furnished), the earthwork should be paid for as "Earthwork Measured in Embankment", with no separate pay item for contractor-furnished borrow.

"Excavation (Established Quantity)" is paid for according to the measured excavation from the cross-sections. A balance factor is included if there is any calculated embankment.

4.C Roadway Grading

For roadways constructed with only a typical section and without cross-sections, the appropriate pay item is "Roadway Grading". "Roadway Grading" consists of the furnishing, excavating, loading, hauling, placing, compacting, and finishing of all materials necessary for the completion of the roadway, including its embankments, intersections, driveways, and approaches as shown in the plans. For further information see the Standard Specifications for Highway Construction, (Reference 7.2), Section 206.

4.D Added Quantities

Earthwork for earth dikes, large drives and intersections should be added to the computer-generated quantities as an added quantity.

4.E Subsidiary Earthwork

Subsidiary earthwork is earthwork that is not paid for directly but is included in other earthwork or other construction items.

- Often on small urban projects with small amounts of earthwork all earthwork is made subsidiary.
- The construction of small earth dikes is subsidiary to the pay item “Excavation”.
- Earthwork for the construction of larger earth dikes should be calculated as “Earthwork Measured in Embankment” where no balance factor is considered, or they may be built as roadway embankment from a borrow pit, which will be paid for as “Excavation Borrow.”

For further discussion of earthwork payment, refer to the Standard Specifications for Highway Construction, (Reference 7.2).

5. EARTHWORK/CROSS-SECTION CHECK POLICY

5.A General

The following checks shall be made on earthwork and cross-section computations.

- Preliminary plans: the **Roadway Design Unit Head** will review the earthwork checklist with the roadway designer and supervisor and ask special questions if applicable on plan-in-hand.
- Functional plans: the **Roadway Design Unit Head**, designer and supervisor will review the checklist again and note anything that will need to change from the plan-in-hand plans.
- Limits of construction plans: The roadway designer, supervisor, and **Roadway Design Unit Head** should double check earthwork.
- Final plans submittal:
  1. Check the computer generated earthwork output.
  2. Check the earthwork data (stick-up) sheets.
  3. Final cross-sections: transfer work sheet data to final cross-sections.
  4. Check the field books.

Refer to EXHIBIT O of the Design Process Outline, (Reference 7.4), for the earthwork checklist (http://www.roads.nebraska.gov/media/6761/design-process-outline.pdf).

6. SOIL, SUBGRADE AND SITUATION REPORTS

The soil, subgrade and materials surveys are essential to preliminary engineering for location and design purposes. Information about the distribution of soils and groundwater conditions is required input for a reasonable and economic roadway design.

The **Materials and Research Division** reports provide pertinent information on the following aspects of highway design:

- Location of the grade line, both vertically and horizontally.
- Location and selection of borrow material for fills and subgrade treatment.
- Design and location of ditches and underdrains.
- Design of the roadway section.
- Need for subgrade treatment and type of treatment required.
- Location of local sources of construction material.
- Selection of the surface type and its design (See Chapter Eight: Surfacing, Section 1).

6.A Soil Survey/Soil and Situation Report

The soil survey will research the soil profile, soil horizons and the uniformity of the profile throughout the project, soil compaction and other soils characteristics by station, the water table condition and other concerns such as underground wet zones. The **Materials and Research Division** uses the following criteria to determine the minimum finished grade elevation above the expected high water table:

- 4 ft. (1.2 m) above the expected high water table if the entire profile is sand.
- 7 ft. (2.1 m) above the expected high water table if there is to be silt-clay within 4 ft. (1.2 m) of the finished grade elevation.

6.A.1 Soil Survey

A soil survey is usually performed with preliminary plans, which have the approximate grade line, prior to the final preparation of the grading plans. It usually consists of the research of soils maps, aerial photographs, geology reports and condition reports, preliminary field reconnaissance of the project, previous project reports, soil borings in areas of excavation and embankment, and recordings of water table locations. Laboratory soil tests are made on the samples taken and results are tabulated.

6.A.2 Preliminary Soil and Situation Report

If the soil survey reveals a condition that may present problems for the design or construction of a project, a Preliminary Soils and Situation Report is submitted to the **Roadway Design Division.** The preliminary report usually addresses water table concerns. It may include locations of usable quantities of sand in a silt-clay region or locations of borrow pits. Settlement and unsuitable material issues may also be addressed. Unless there is a big cut or fill, a preliminary report is not normally sent to **Roadway Design**.

6.A.3 Soil and Situation Report

The Soil and Situation Report presents the results of the soil survey in a standardized format. It includes the following:

- The location and length of the project.
- The topography and drainage situation.
- The water table.
- The geology of the project area.
- Soil horizons and formations.
- Soil descriptions, including engineering characteristics.
- Recommendations for subgrade treatments.
- Compaction requirements.

If selective handling of excavated materials is planned for the project, recommendations for the handling are also included. Selective handling is generally restricted to five general cases:

1. To produce embankment sections of uniform material, i.e., all silt-clay soils or all sandy materials in the upper embankment.
2. To place materials suitable for use in a bituminous sand base course in the upper subgrade.
3. To place highly undesirable materials at depth or in the outer slopes of the embankment.
4. To place select materials over heavy clay materials to reduce moisture problems.
5. To use select granular materials in lieu of a foundation course on Portland cement concrete pavement projects.

The Soil and Situation Report will divide the project, if necessary, into sections of one or more balances according to soil type or other factors. A detailed discussion of soil materials to be excavated is then developed for each section. The selective soil placement notes always reflect the surfacing plans for the project. The soil survey may also identify locations for possible sources of shoulder material, topsoil to support subsequent vegetation or soil binder material. It is the responsibility of the designer to ensure that the recommendations of the Soil and Situation Report, and the resulting design, are detailed on the project plan sheets.

6.B Subgrade Survey/Subgrade and Situation Report

6.B.1 Subgrade Survey

The subgrade survey is conducted on previously graded roads for which rigid or flexible pavement is being designed. Its principal objectives are:

- To sectionalize the project according to the type of soil in the upper subgrade.
- To locate and explore any portions of the project where the subgrade may be of questionable stability due to springs, seepage or wet zones.
- To evaluate gravel windrow or crust which may have been placed or developed under traffic with temporary gravel surfacing or clay surfacing.
- To obtain a check on the conditions resulting from the selective placement required by the grading plans.

6.B.2 Subgrade and Situation Report

The Subgrade and Situation Report is prepared for those projects where there is a period of time between grading and the preparation of paving plans. Whenever grading and paving are let in the same contract, the design of the base and surface courses is based on information obtained from the soil survey.

The Subgrade and Situation Report usually contains the following:

- A description of the existing surface conditions.
- The proposed construction.
- The foundation course requirements.
- The existing topography and pedology.
- A description of and recommendations for the surface and subsurface drainage.
- Compaction requirements.
- Any subgrade distress.
- Any embankment and/or slope stability problems.

The compaction requirements list will be added to the plans.

6.C Embankment Foundation Report

In known areas of poor foundation soils, a field investigation of foundation soils is made by the **Soils Mechanics Unit** to develop recommendations to minimize settlement and slope stability problems. An Embankment Foundation Report is submitted to the **Roadway Design Division** to advise of possible adverse conditions and to recommend possible remedies. The two most common solutions to correct settlement problems are:

- Construct surcharges to speed up settlement.
- Delay paving until settlement has reached a satisfactory level.

Other possible corrective measures include:

- Use of temporary bituminous paving until settlement has reached a satisfactory level, when permanent paving may be placed.
- Excavation of unsuitable material.
- Use of vertical sand drains to speed settlement.
- Lower the height of the fill.
- Realign the road to avoid the unsuitable area.
- Bridging over the unsuitable area.

To correct embankment stability problems during and after grading construction, several possible solutions are available (See the Earthwork Engineering Guide, Reference 7.5):

- Require special compaction of the embankment material, e.g., higher minimum density and lower maximum moisture content.
- Flatten side slopes of the embankment from 3:1 to 5:1.
- Build berms.
- Staged construction, the process of bringing fill up to maximum height in several stages over a period of time (usually two or more years).
- Excavate unsuitable material.
- Lower the height of the fill.
- Realign the road.
- Bridging.
- A combination of the above, e.g., special compaction and stage construction.

The recommendations contained in the Embankment Foundation Report, and the resulting design, will be detailed on the project plan sheets.

7. REFERENCES

7.1 Nebraska Department of Transportation, Drainage Design and Erosion Control Manual, Current Edition (http://www.roads.nebraska.gov/business-center/design-consultant/rd-manuals/)

7.2 Nebraska Department of Transportation, Standard Specifications for Highway Construction, 2007. (http://roads.nebraska.gov/media/6897/specbook-2007.pdf)

7.3 Nebraska Department of Transportation, Standard/Special Plan Book, Current Edition.

7.4 Nebraska Department of Transportation, Design Process Outline, Current Edition. (http://www.roads.nebraska.gov/media/6761/design-process-outline.pdf)

7.5 Nebraska Department of Transportation, Earthwork Engineering Guide, 1990.

The information contained in Chapter Eight: Surfacing, dated December 2015, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this chapter.

Chapter Eight presents guidance for the design of new, reconstructed and 3R projects; additional design guidance for 3R projects is provided in Chapter Seventeen. This chapter replaces Chapter Eight: Surfacing dated July 2006. This chapter also supersedes Nebraska Department of Transportation Policy Letters DES 06-03: "Milled-in Rumble Strips on Shoulders 6' & Wider" dated June 21, 2006, DES 11-01: "Policy for the Installation of Centerline Rumble Strips" dated June 13, 2011, and DES 14-01: "Policy for the Installation of Rumble Strips & Stripes" dated June 18, 2014. This chapter was approved by the Nebraska Division of the FHWA for use on the National Highway System and other federal projects on December 15, 2015.

Chapter Eight
Surfacing

1. PAVEMENT DESIGN DETERMINATION

The **Materials and Research Division** (**M&R**) will provide pavement determinations to the **Roadway Design Division** (**Roadway Design**). Pavement determinations may include:

- The type and thickness
- Whether a foundation course is required
- Type of subgrade treatment
- Type of subgrade drainage
- The shoulder treatment to be used

1.A Pavement Design Input

M&R uses design-year traffic projections, existing pavement structure, condition of pavement, performance period, reliability, maintenance history, project type, subgrade soil types, and environmental factors (e.g. roadbed swelling and frost heave), the number of lanes, the design speed, and the shoulder treatment as input into the pavement design determination. An additional important consideration is input of problem areas from the **District Engineer** (**DE**).

M&R uses traffic data from the **Nebraska Department of Transportation** (**NDOT**) "Pavement Optimization Program" for projects utilizing the existing roadway cross-section on the existing alignment. Other projects use traffic data available from the **Intermodal Planning Division**.

1.B Pavement Determination Development

The surfacing recommendation is developed as part of the "Project Process Initiation" (Form DR-73), which is routed to stakeholders, which includes the **Division Heads**, for review and comment. Once any changes to the document indicated by the routing have been approved by the **Program Management Engineer**, the **DE**, and the **Deputy Director-Engineering** an electronic copy of Form DR-73 will be placed in OnBase.

Changes may be made to the pavement determination throughout the life of the project as circumstances dictate (e.g. new information regarding surface condition, additional lanes). The opportunity to address these changes is included in the Clarity tasks "Pavement Determination", "Pavement Determination Review", and "Final Pavement Determination". The documentation for any changes will be filed in OnBase by **M&R** and transmitted to **Roadway Design** for review and comment.

The "Final Pavement Determination" requires the signature of the **Pavement Design Engineer**, the **M&R Engineer**, and the **DE** prior to distribution to **Roadway Design**.

2. PAVEMENT TYPES

There are three types of pavement, rigid, flexible, and a composite of rigid and flexible. **M&R** recommends the pavement type and thickness.

2.A Rigid (Concrete) Pavement

Rigid pavement is constructed with Portland Cement Concrete (PCC). Due to the potential for water infiltration at the joints, a foundation course and a means of draining the foundation course may be included in the design of a rigid pavement.

2.A.1 Portland Cement Concrete Pavement Design Policy

1. Rigid pavements will be plain jointed PCC. Epoxy coated dowel bars will be included at transverse joints.
2. The minimum pavement thickness of PCC pavement on the State Highway System will be as follows:

    - Interstate System ..... 12 inches
    - Expressway System..... 10 inches
    - Other Highways ..... 9 inches
    - Low Volume Highways..... 8 inches

    The concrete thickness should be shown in the plan build note and on the typical roadway cross-section(s).
3. The maximum spacing for transverse joints is 16 ft. - 6 in., placed perpendicular to the centerline of the roadway (See the Standard/Special Plans Book (*Standard Plans*), Ref. 8.1) (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/).
4. If PCC shoulders are built with the mainline they will be tied to the travel lanes and the tie bars will be subsidiary to the concrete pavement. If concrete shoulders are built adjacent to an existing concrete mainline the tie bars will be a separate pay item. For additional information see the *Standard Plans*, Ref. 8.1.

2.A.2 Pavement Joints

Diagrams showing the joint locations will be included in the plan set for PCC pavement; typical joint diagrams for concrete pavement are available in the *Standard Plans* (Ref. 8.1). A joint diagram plan must be developed, however, for complicated intersections and/or lane drops. When plans call for the widening of existing surfacing and the new joints are to match the existing joints, a note to that effect on the plans will be sufficient. Ideally, joints should correspond to the pavement markings. The designer will submit the joint diagrams to the **M&R Pavement Design Engineer** and to the **Traffic Engineering Division** (**Traffic Engineering**) for review.

PCC pavement requires the following types of joints to control cracking from the stresses induced by volume changes in concrete:

1. Contraction joints are located in the pavement to relieve stresses caused by shrinkage, thermal contraction, and moisture or thermal gradients. Joint spacing generally divides the pavement into sections of approximately the same length and width (the length to width ratio will not exceed 1.5). Longitudinal contraction joints are normally located between traffic lanes. Transverse contraction joints are perpendicular to the centerline and will include load transfer devices across the joint.
2. Expansion or Isolation joints are used primarily to provide separation between the pavement and other structures such as bridges and inlets or at other pavement sections such as pavement slabs at intersections.
3. Construction joints shall be placed at the end of each day's work or whenever the paving operation ceases for over 30 minutes. Construction joint location will be determined in the field.

Load transfer devices (smooth steel dowel bars) are used at transverse joints to transfer the load across the joints; these devices offer little resistance to longitudinal movement at the joint. Tie bars (deformed reinforcing steel) are used to hold the faces of adjacent slabs in firm contact with one another and are not designed to act as load transfer devices.

The following joints will have the specified connections:

Transverse Joints

Joint Type	Connection Type
Contraction	Dowel bar
Expansion	Dowel bar
Construction	Dowel bar

Longitudinal Joints

Joint Type	Connection Type
Between Lanes	Tie bar
Construction	Tie bar

See the *Standard Plans* (Ref. 8.1) for details of bars at joints and joint spacing.

2.A.3 Joining Existing Pavement

When a project includes new concrete pavement to be placed adjacent to existing concrete pavement it will be necessary to install tie bars on the longitudinal joints. Tie bars are pay items when joining to existing pavement, the designer is responsible for calculating the tie bar quantities. Build notes for these tie bars are not required, the information shown on the summary of quantities sheet is considered to be sufficient.

Dowel bars are required when joining new pavement to existing pavement at a transverse joint. Dowel bars are not paid for directly but are subsidiary to doweled concrete pavement.

2.A.4 Tining

PCC pavement will be tined when the posted speed limit of a roadway is 40 mph or greater. When a mainline is tined, intersections, acceleration lanes, deceleration lanes, left turn lanes, and ramps will also be tined; tining details are included in the *Standard Plans* (Ref. 8.1). If only part of a project is to be tined a note will be placed on the 2-T sheet itemizing the areas which will not be tined (See Chapter Eleven: Highway Plans Assembly, Section 4.B).

2.B Flexible Pavement

Flexible pavement is characterized by an asphaltic structure which depends on aggregate durability and gradation, air voids, binder content, and angularity for strength, cohesion and stability.

2.C Surfacing Aggregates

Crushed rock or gravel may be used to surface county roads, driveways, at the end of driveway or intersection returns, for temporary roads, for temporary access to properties during project construction, etc. When crushed rock or gravel surface course is specified for a temporary road the designer will also specify crushed rock or gravel embedment.

3. PAVEMENT SUBDRAINS

Because drainage is an important factor in pavement performance, subgrade drainage is an important consideration in pavement design. **M&R** determines the need for and type of subgrade drainage during the pavement determination process. **M&R** also prepares the special provisions for subgrade drainage.

Granular subdrains are built by digging a trench that is sloped to convey water away from the roadway which is then backfilled with granular material. When the granular subdrain runs parallel to the roadway it is referred to as a “Longitudinal Subdrain” and the pay item is in units of linear feet; all other material and labor is subsidiary. When granular material is used as an outlet to convey water to the roadside ditch it is referred to as a “Granular Subdrain” and the pay item is each, all other material and labor is subsidiary.

When additional water conveyance is needed a slotted pipe is placed at the bottom of the trench, which has been lined with a filter fabric, and is then back-filled with granular material. The pay

item for this installation is “Pipe Underdrain”, paid for by the linear foot, all other material and labor being subsidiary.

The measurement of the spacing between granular subdrain or pipe underdrain outlets should begin at the outlets located in sag locations. Outlets should be constructed at intervals of 200 feet where the grade is 1% or greater and at intervals of 100 feet on grades of less than 1%.

4. SHOULDERS

The minimum shoulder width is established by the functional highway classification as described in the Nebraska Minimum Design Standards (*MDS*) (Ref. 8.2) (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/).

4.A Concrete Shoulders

Concrete shoulders will be paid for as "** inch Concrete Pavement". “Earth Shoulder Construction” (See Section 4.D) must be paid for and will be shown on the Typical Section (2-T) sheet (See Chapter Eleven: Highway Plans Assembly, Section 4.B). “Shoulder Subgrade Preparation” may be used when shoulders are added to an existing highway; the excavated soil is used for shouldering and there is no pay item for earth shoulder construction in this case. The shoulder dimensions will be shown on the Typical Section (2-T) sheet, a note will be included on the typical section referring to the material to be removed by the surfacing contractor.

4.B Asphalt Shoulders

The pay items for asphalt shoulders include “Asphaltic Concrete” (in tons), “PG Binder” (in tons), “Tack Coat” (in gallons), “Hydrated Lime / Warm Mix Asphalt” (each), and “RAP Incentive” (each).

4.C Earth Shoulder Construction

Where new pavement is being built the subgrade will be designed an additional 0.2 feet high for trimming. This excess material is available for incorporation into the earth shoulder, as shown in EXHIBITS 8.1a & 8.1b. Soil materials used for earth shoulder construction must have the capability to support vegetation. Trimming of the subgrade for shouldering material will be completed prior to the Stabilized Subgrade operation. Sources of shoulder materials include:

- Excess excavation
- Located sites within state right-of-way (station-to-station)
- Locations outside the state right-of-way (borrow pits, contractor's responsibility)

Areas designated as sources of shoulder material should not be disturbed. Disturbed areas will be protected from erosion through cover crop seeding, sodding, etc. See Chapter Two: Erosion and Sediment Control, Section 6, of the Drainage Design and Erosion Control Manual (*Drainage Manual*) (Ref. 8.3) for additional information (http://www.roads.nebraska.gov/business-center/design-consultant/rd-manuals/).

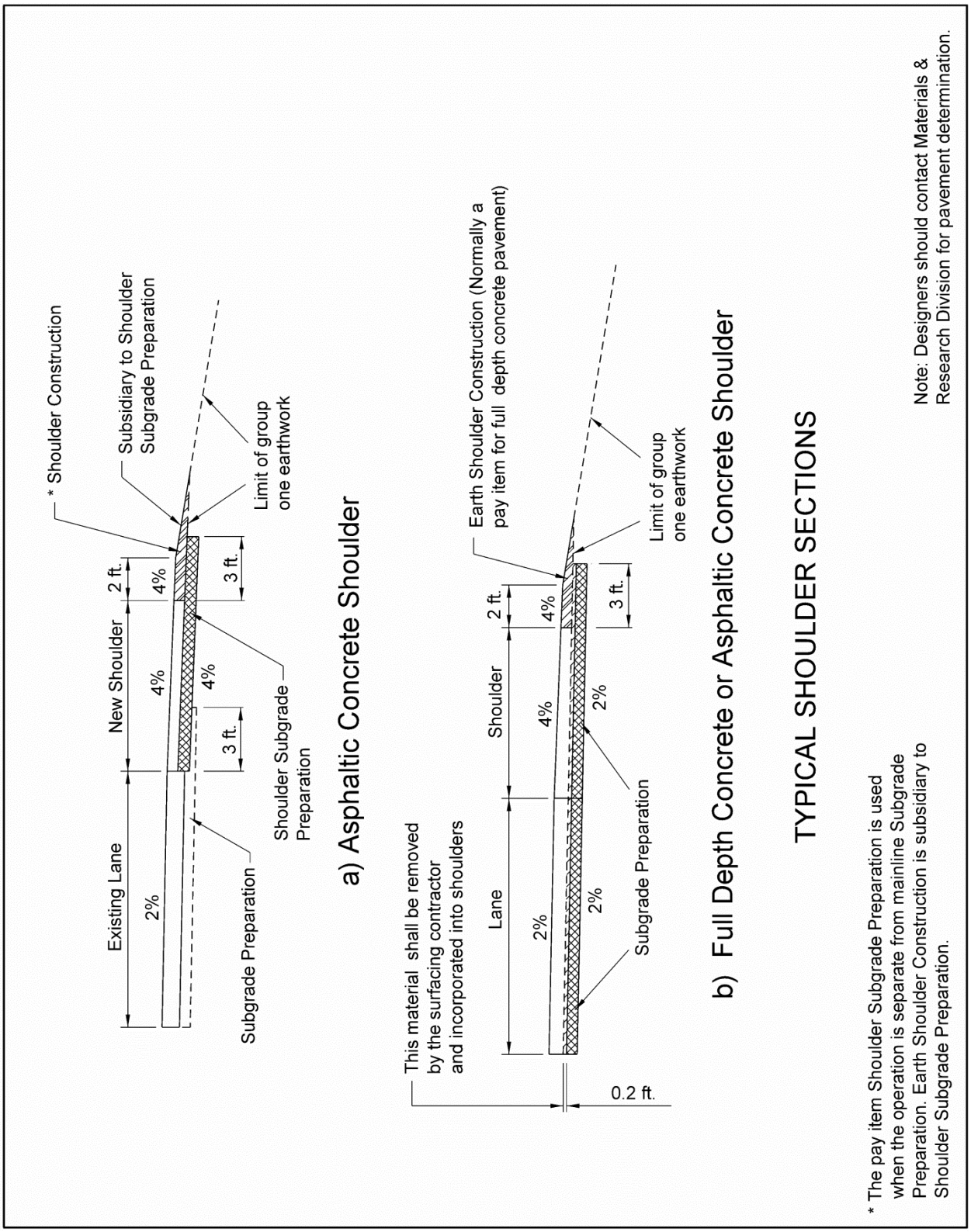


Exhibit 8.1a Typical Shoulder Construction (Uncurbed Section)

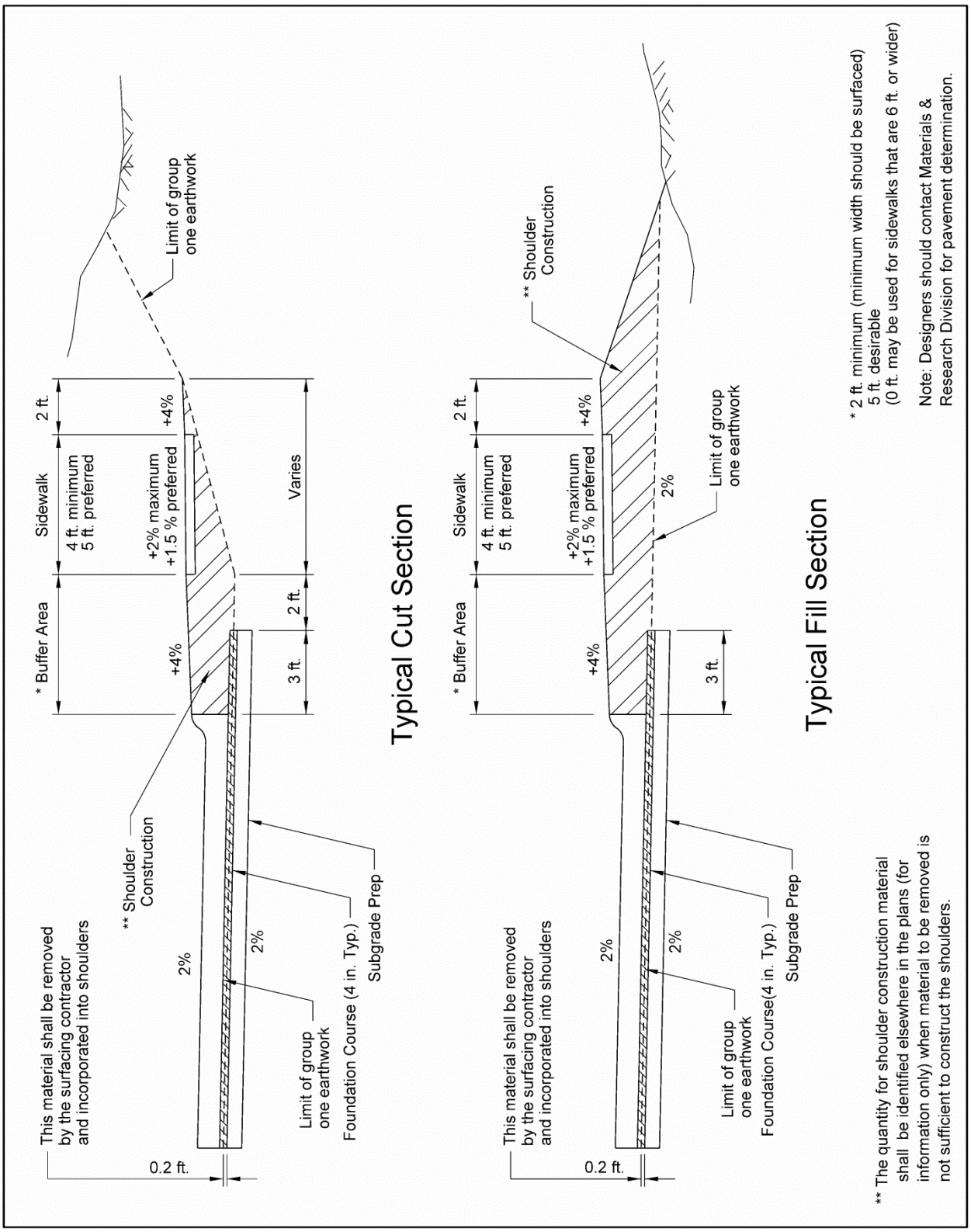


Exhibit 8.1b Typical Shoulder Construction (Curbed Section)

5. PAVEMENT REHABILITATION

Pavement rehabilitation techniques have been developed to extend or enhance the service life of a roadway. Pavement rehabilitation analysis is performed to:

- Determine the cause(s) of pavement distress
- Develop a list of possible solutions to cure and prevent recurrence of the problem(s)
- Select the preferred rehabilitation method, taking into account economic and other project constraints

Data used to determine the cause(s) of the problem(s) include those items described in Section 1.A as well as the pavement condition-distress severity and extent.

5.A Types of Rehabilitation

Maintenance work includes surface treatments up to a thickness of two inches and concrete repairs. Examples of maintenance work include, but are not limited to:

- Mill and place two inches or less of asphalt (thickness of mill and overlay can be greater for shoulders)
- Concrete repairs and diamond grinding
- Dowel bar retrofit
- Surface treatments
- Joint and crack sealing

Resurfacing, Restoration and Rehabilitation (3R) projects have surface treatments that exceed two inches and may include work up to the removal of the pavement or surfacing without modifying the roadway base. Examples of 3R projects include, but are not limited to:

- Mill and place more than two inches of asphalt
- The majority of recycle and overlay strategies
- Remove the pavement and build full-depth doweled concrete pavement

Reconstruction projects may remove the pavement and rebuild the roadway and base course.

5.B Removal of Existing Surfacing

The pay items “Remove Asphalt Surface” and “Remove Pavement” refer to the removal of the surfacing down to the roadway base. Existing surfacing may be removed when it is no longer cost effective to repair and to accommodate surfacing thickness requirements at railroad crossings, bridge ends or other locations shown on the plans. When the final thickness of surfacing is reduced by milling, **M&R** should be consulted to confirm that the reduced thickness will provide adequate structure. For additional information, see Chapter Seven: Earthwork, Section 1.C.

5.B.1 Cold Milling

Cold milling is the removal of existing asphaltic concrete by a milling machine. Cold milling may be one of several different types, depending on the depth of milling and slope requirements outlined in the pavement determination from **M&R**. The different types vary from milling to remove surface irregularities to milling to remove the entire depth of existing asphalt. Milling is paid for at

the contract unit price per Sta. or per SY as detailed in the *Spec Book* (Ref. 8.4), Section 510 (http://roads.nebraska.gov/media/6897/specbook-2007.pdf).

5.B.2 Brick Removal

A special provision is required whenever brick surfacing is removed and salvaged. The roadway designer will note the need for this provision in the final plans package for **PS&E**. For additional information see Chapter Twelve: Cost Estimating and Funding.

5.B.3 Concrete Surface Milling

Concrete Surface Milling is the removal of concrete by a milling machine and is described by the typical cross-sections and special provision. Concrete Surface Milling is paid for at the contract unit price per Sta. or per SY as detailed in the *Spec Book* (Ref. 8.4), Section 510.

5.C Concrete Repair and Bituminous Pavement Patching

Concrete Pavement - Repair of concrete pavement consists of the removal and replacement of irregular areas of existing concrete pavement including overlaying bituminous surfacing and/or unstable base course. See the *Spec Book* (Ref. 8.4), Section 605, for additional information.

Asphaltic Concrete - Patching of asphaltic concrete consists of the removal and disposal of unstable or deteriorated materials (including base course, if necessary) and the placing and compacting of the appropriate type of asphaltic concrete. Quantities for pavement patching will be included in the project cost estimate; the designer will include the pay items for the rental of loader, motor grader, and dump truck with asphalt patching. See Section 516 of the *Spec Book* (Ref. 8.4) for additional information.

5.D Overlays and Transitions

Asphaltic concrete overlays are used in a variety of situations. A specified depth or grade line of existing bituminous material is removed by cold milling and then the asphalt is laid down. At locations where differences in elevation occur as the result of an overlay, a transition detail or inlay detail is required on the 2-T Sheet (See Chapter Eleven: Highway Plans Assembly, Section 4.B). A minimum taper rate of 33 feet to one inch change in grade should be used on high-speed ($V \geq 50$ mph) roadways; the preferred taper rate of an overlay on a high-speed roadway is 50 feet to each inch change in grade (e.g. for a two inch mill with a four inch overlay: 2 x 50 = 100 feet). The taper rate for a low-speed ($V \leq 45$ mph) roadway is 25 feet to each inch change in grade.

5.D.1 Template Correction

Template correction is used when the existing cross slopes are different from the design cross slopes (e.g. 3% existing cross slope vs 2% design cross slope). **Roadway Design** will provide an estimate of the additional tons of asphalt needed for the cross slope correction to **M&R** when the project is being prepared for **PS&E** turn-in.

5.E Pavement Dropoffs During Construction

It is the responsibility of the roadway designer to inform **Traffic Engineering** of projects being built under traffic where grading operations are adjacent to the existing roadway. The *Standard Plans* (Ref. 8.1) covers the signing of dropoffs created during surfacing operations.

6. SURFACING QUANTITY COMPUTATIONS

The procedure for computing quantities of surfacing material depends on the type of pavement to be placed. Cost estimates will be made based on the computed quantities. For additional information see Chapter Twelve: Cost Estimating & Funding.

6.A Rigid Pavement

The roadway designer is responsible for computing PCC pavement pay quantities, including the following items:

- Concrete pavement, including intersections and driveways, for each design pavement thickness (See Chapter Four: Intersections, Driveways and Channelization, Sections 3.A and 3B)
- Concrete curb

The designer will compute separate total areas for each pavement thickness, including the mainline, intersections, driveways, approaches, turnouts, etc. This area, in sq. yds., is the estimated pay item quantity for each depth of concrete pavement.

Concrete pavement quantities should be itemized and shown on the computation sheets in such a manner that the segments of pavement represented can be easily recognized. In cases where the design is very complex sketches should be included with the computation sheets. The designer should refer to **EXHIBIT H** of the Design Process Outline (*DPO*) (Ref. 8.5) (http://www.roads.nebraska.gov/media/6761/design-process-outline.pdf) for a list of surfacing pay items. The designer will submit the typical sections, plan and profile or 2-L sheets, intersection and driveway sheets and locations, and the concrete pavement pay item quantities to **M&R**; **M&R** requires this information to compute the quantities for Subgrade Preparation and Foundation Course.

6.B Flexible Pavement

The designer will submit the essential project information, including typical sections, complete plan and profile or 2-L sheets, driveway sketches and locations, surfacing under guardrail details, etc. and the summary of asphaltic concrete quantities to **M&R**, which is responsible for computing the final pay quantities for asphaltic concrete surfacing.

The roadway designer will verify that the flexible pavement quantities include asphaltic concrete surfacing used for:

- Driveways and intersections (See Chapter Four: Intersections, Driveways and Channelization, Section 3)
- Mailbox turnouts (See Chapter Ten: Miscellaneous Design Issues, Section 9)

- Surfacing under guardrails (See Chapter Nine: Guardrail and Roadside Barriers, Section 3.G)
- Surfacing for detours, temporary roads, crossovers, and temporary pavement (See Chapter Fourteen: Traffic, Section 6)
- Asphaltic concrete curb

For a complete list of surfacing pay items, see **EXHIBIT H** of the *DPO* (Ref. 8.5).

6.C Surfacing Aggregates

Quantities for aggregates used for surfacing are computed either by the ton or cu. yd., depending on the **District**. In **Districts 1, 2 and 3** surfacing aggregate estimates will be calculated in tons; when surfacing aggregates are needed in **Districts 4 through 8** the designer should consult with the **DE** during the plan-in-hand to determine the unit of measurement and the type of aggregate to be used. The following weight to volume factors should be used in estimating:

Crushed rock for surfacing:	1.25 tons/cu. yd.
Gravel for surfacing:	1.35 tons/cu. yd.

On projects where grading disrupts property access, the designer should consult with the **DE** on the plan-in-hand field inspection regarding the use of gravel, crushed rock, or millings to provide temporary access to the impacted properties. The designer should include a lump sum for these quantities in the preliminary project estimates; the quantities should vary between 100 to 200 tons per mile, depending on the size of the access and the type of roadway (e.g. 2-lane vs. 4-lane, municipal vs. rural). Quantities will be shown to the nearest ton. The designer will submit plans, cross-sections, and preliminary quantity estimates of locations using surfacing aggregates to **M&R** for the computation of the final quantities.

For a complete list of surfacing pay items see **EXHIBIT H** of the *DPO* (Ref. 8.5).

6.D Foundation, Base, and Surface Courses

Pay item quantity units and methods of measurement for roadway foundation, base, and surface courses are found in the *Spec Book* (Ref. 8.4), Division 300.

6.E Sawing Pavement

The pay item “Sawing Pavement” will be included when removing pavement, sidewalk, driveway, integral curb, or similar flatwork when the removal does not extend to an existing joint. The pay item includes both full depth and partial depth cuts. “Sawing Pavement” is required when removing concrete overlaid with asphalt.

The designer should calculate the length of the transverse cut and longitudinal integral cuts required to remove a curb, portion of a lane, or similar cuts. The quantity should be rounded to the nearest 10 feet. “Sawing Pavement” is not calculated when the removal occurs at existing joints. Sawing notes should not be shown in the plans.

7. RUMBLE STRIPS AND RUMBLE STRIPES

Rumble strips are grooved patterns in the pavement, typically spanning 6 inches and either 12 inches or 16 inches wide on 12 inch spacing. When a vehicle crosses a rumble strip the vehicle shakes and the vibration causes a noise, alerting the driver that the vehicle is leaving the travel lane. Shoulder rumble strips are milled into the shoulder surfacing.

Rumble stripes are relatively narrow, 8 inches wide on 12 inch spacing. Edge line rumble stripes are placed in the location of the white edgeline and are generally used where the surfaced shoulders are less than 6 feet in width. Centerline rumble stripes are milled on each side of the joint separating opposing lanes of traffic. Rumble stripes are placed in the paint stripe of the centerline and/or at the edge line of the lane but not be on a joint.

Rumble strip installation should follow the Special Plan (See the *Standard Plans*, Ref. 8.1). Rumble stripes will be paid for as rumble strips. The appropriate pay items are “Rumble Strip, Asphalt” and/or “Rumble Strip, Concrete”.

When rumble strips, edge line rumble stripes or centerline rumble stripes are placed they will be perpetuated on subsequent projects and will not be obliterated without their function being replaced with a similarly effective mitigation measure for road departures (e.g. lighting). Since the installation of rumble strips/stripes will substantially modify the run off road crash history, use of the warrants to justify continued use of the rumble strips/stripes would be inaccurate. In the event that **NDOT** maintenance operations or activities obliterate the rumble strips/stripes, they are not required to be reinstalled until the next resurfacing project. Rumble strips/stripes may be restored earlier if directed by the **DE**. Rural areas which become urban may eliminate the rumble strip/stripe.

Additional information may be found at:

- NCHRP Report 641, Guidance for the Design and Application of Shoulder and Centerline Rumble Strips, 2009.
- Low Cost Treatments for Horizontal Curve Safety, FHWA, 2006.
- Shoulder and Edge Line Rumble Strips, FHWA Technical Advisory T 5040.39, November 7, 2011
- NCHRP Synthesis 339, Centerline Rumble Strips, 2005

For additional rumble strip/stripe guidance on 3R projects, see Chapter Seventeen: Resurfacing, Restoration and Rehabilitation (3R) Projects, “Safety Improvements”.

7.A Shoulder Rumble Strips

After reviewing the crash data and research literature, the **NDOT** has determined the following to be guiding principles for the installation of shoulder rumble strips on the state highway system.

- Shoulder rumble strips will be constructed on the shoulders, including the median shoulders, for all rural Interstate and rural expressway projects (new construction, reconstruction, and 3R).
- Shoulder rumble strips should be constructed on 6 foot wide or wider surfaced shoulders for all new construction and reconstruction projects on rural high-speed (V ≥ 50 mph) two-way two-lane highways.
- Shoulder rumble strips should be constructed on 3R projects over one-half mile in length on rural high-speed (V ≥ 50 mph) highways with continuous surfaced shoulder widths of 6 feet or greater.
- Existing rumble strips will be perpetuated on 3R projects over one-half mile in length. When project lengths are less than one-half mile, the rumble strips may be added to another project in the area to reduce mobilization fees.
- Projects with surfaced shoulders with curb and flume will be reviewed for inclusion of milled in rumble strips by **Roadway Design**.

Shoulder rumble strips may be placed at the direction of the **Traffic Engineer** or designee to address other traffic operations issues beyond those presented here.

7.B Edge Line Rumble Stripes

After reviewing the crash data and research literature, the **NDOT** has determined the following to be guiding principles for the installation of rumble stripes on the state highway system.

- Roadway type – Rural two-lane undivided with two way traffic.
- Lane width –12 feet with 2 feet integral shoulders for a 28 feet minimum total top width; Edge Line Rumble Stripes may be installed on shoulders up to 6 feet in width when recommended by **Traffic Engineering**.
- Pavement section with a recommended minimum overlay thickness of 2.5 inches of pavement and the surface in good condition.
- ADT in excess of 500 VPD.
- Posted speed limit of 50 mph or greater.

Edge line rumble stripes may be placed at the direction of the **Traffic Engineer** or designee to address other traffic operations issues beyond those presented here. An example would be when a documented history of run off road crashes is observed on an existing highway curve. Crash history reviews by **Traffic Engineering** will be performed at minimum evaluation length of three years.

7.C Centerline Rumble Stripes

After reviewing the crash data and research literature, the **NDOT** has determined the following to be guiding principles for the installation of centerline rumble stripes on the state highway system.

- Roadway type – Rural two-lane undivided with two way traffic.
- Lane width – no less than 11 ft.; the lane width will be 12 ft. minimum where edgeline rumble stripes are present.
- Pavement section with a recommended minimum overlay thickness of 2.5 inches of pavement and the surface in good condition.
- ADT in excess of 1,500 VPD.
- Posted speed limit of 50 mph or greater.
- Evaluation period of at least three years and minimum length of segment of three miles.
- Cross lane departure and opposite direction sideswipe crashes greater than 0.4 crashes per mile per year evaluated for a minimum three mile segment for a minimum of three years where the combination of cross lane departure and opposite direction sideswipe crashes exceeds 1.0 crash per year per hundred million vehicle miles traveled.
- Segments may be added for continuity when the gap between highway segments with centerline rumble strips is less than 5 miles in length.
- Highway segments in excess of 10 miles in length that warrant the installation of centerline rumble strips under the preceding warrants will be reviewed to determine if the entire segment warrants the installation of centerline rumble strips. Gaps in excess of 5 miles in a segment that exhibit no cross lane departure and opposite direction sideswipe crashes may be omitted from the roadway to receive centerline rumble strips.

Centerline rumble stripes may also be placed to delineate geometric features of the roadway which may differ from the overall character of the roadway. Examples include the delineation of broken back curves with intersections in the intermediate tangent, entrances to rural roundabouts, or approaches to channelized rural intersections.

Centerline rumble stripes may be placed at the direction of the **Traffic Engineer** or designee to address other traffic operations issues beyond those presented here.

8. BEVELED EDGE

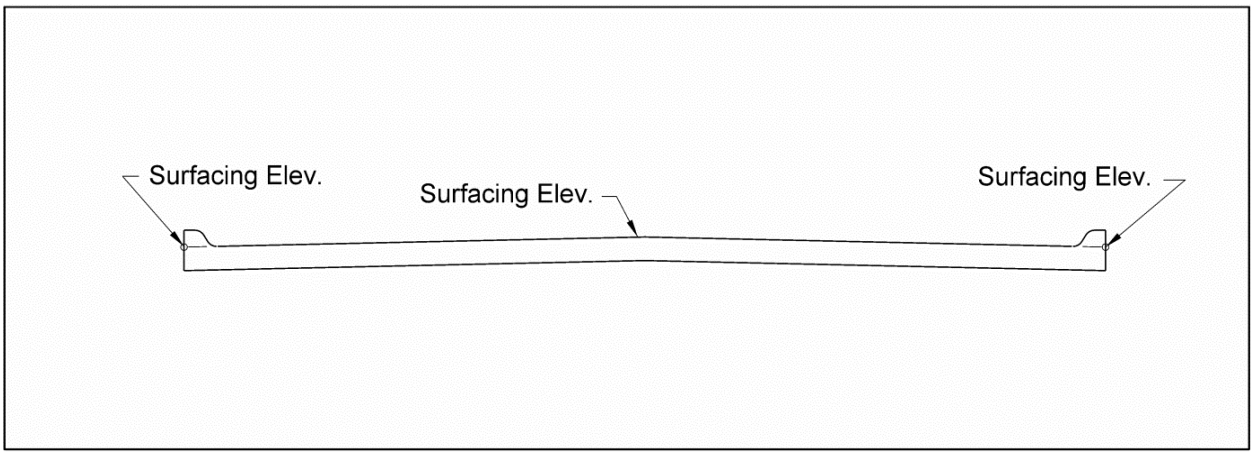
See Chapter Six: The Typical Roadway Cross-Section, Section 2.C.

9. SURFACING ELEVATIONS

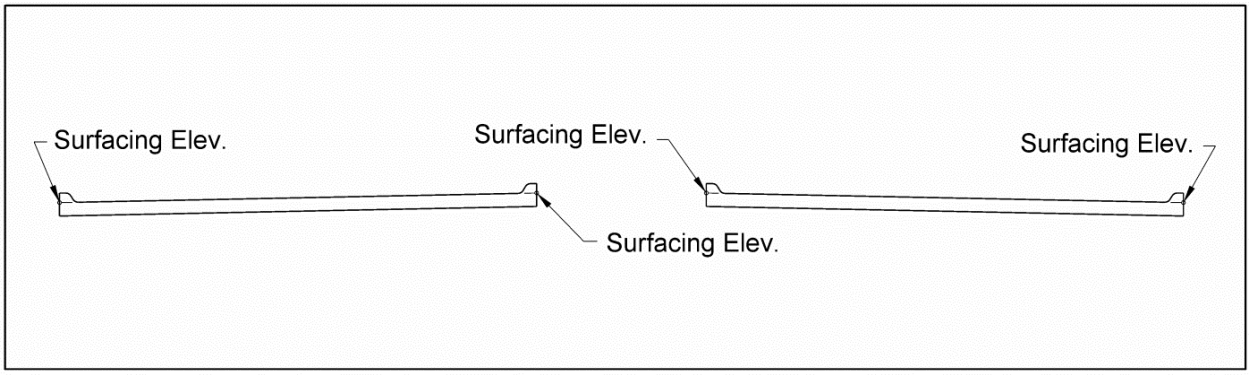
The roadway designer will provide surfacing elevations for new and reconstructed projects. The elevations should be provided at 25 feet intervals for the following locations:

- Municipal Undivided - Surfacing elevations should be shown at the centerline, at any breaks in the cross slope, and at the intersection of the back of curb and the pavement cross slope (See EXHIBIT 8.2).
- Municipal Divided - Surfacing elevations should be shown at locations where the back of curb and the pavement cross slope intersect and at any breaks in the cross slope (See EXHIBIT 8.2).
- Intersections - Surfacing elevations should be shown at locations where the intersection of the pavement cross slope and the back of curb would be for the normal roadway section (See EXHIBIT 8.2).

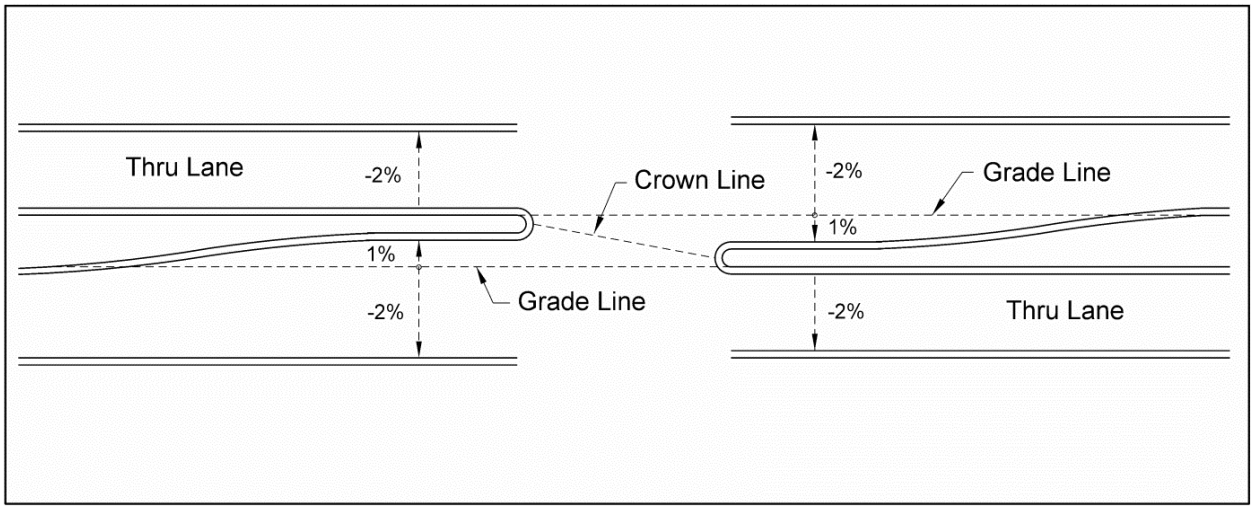
Whenever there is a deviation from the typical roadway cross-section the grade elevation should be shown. For example, when the gutterline is rolled in a flat profile section for drainage purposes the change in grade elevations will be indicated.



Municipal Undivided



Municipal Divided



Intersections

Exhibit 8.2 Surfacing Elevations

10. REFERENCES

8.1 Nebraska Department of Transportation, Standard/Special Plans Book (*Standard Plans*), Current Edition. (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/)

8.2 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards (*MDS*), Current Edition. (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/)

8.3 Nebraska Department of Transportation, Drainage Design and Erosion Control Manual (*Drainage Manual*), Current Edition. (http://www.roads.nebraska.gov/business-center/design-consultant/rd-manuals/)

8.4 Nebraska Department of Transportation, Standard Specifications for Highway Construction (*Spec Book*), 2007. (http://roads.nebraska.gov/media/6897/specbook-2007.pdf)

8.5 Nebraska Department of Transportation, Design Process Outline (*DPO*), Current Edition. (http://www.roads.nebraska.gov/media/6761/design-process-outline.pdf)

The information contained in Chapter Nine: Guardrail and Roadside Barriers, dated October 2012, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this chapter.

This chapter replaces Chapter Nine: Guardrail and Roadside Barriers, dated July 2006. This chapter also supersedes Nebraska Department of Transportation Policy Letter DES 06-04:"RSAP & Benefit / Cost Analysis" dated June 21, 2006. This chapter was approved by the Nebraska Division of the FHWA for use on the National Highway System and other federal projects on October 16, 2012.

Note: Except as otherwise noted, existing roadside barriers must be reviewed for compliance with the National Cooperative Highway Research Program (NCHPR) Report 350 or the Manual for Assessing Safety Hardware (MASH). Short radius installations (See Section 7.A) shall be in compliance with NCHRP Report 230.

Chapter Nine
Guardrail and Roadside Barriers

The **Nebraska Department of Transportation** (**NDOT**) will use the guidance found in the Roadside Design Guide (Ref. 9.1) for the evaluation and design of the roadside geometry, guardrail, and roadside barriers. This chapter includes additional **NDOT** guidance for new and reconstructed projects (see Chapter Seventeen: Resurfacing, Restoration and Rehabilitation (3R) Projects for barrier guidance on 3R projects).

A roadside barrier is used to shield traffic from steep slopes, cross-median traffic, and other obstacles along the roadside. The barrier is an obstacle itself and should not be used when it presents a greater crash potential than the object or condition being shielded.

Barrier installations at intersections will be checked against the required intersection sight distance (See Chapter Four: Intersections, Section1.C.2). Barrier selection and placement should also take snow drifting into consideration since the barrier may act as snow fence. Check with the **District Engineer** (**DE**) on the plan-in-hand field inspection for potential snow drifting areas.

In some locations a roadside barrier may be installed to shield pedestrians and bicyclists from motor vehicle traffic. Whenever significant pedestrian and/or bicycle traffic is anticipated special attention must be paid to the deflection characteristics of the barrier to be provided (see Section 3.D.1).

1. BARRIER JUSTIFICATION

The first step is to determine whether a barrier is desirable. This determination will include:

1. Determine the clear-zone distance.
2. Identify the obstacle.
3. Consider your options.
4. Perform a cost effectiveness analysis.

Note: Shielding a non-traversable slope or a fixed obstacle is usually justified only if the slope or fixed obstacle is located within the clear-zone distance, it is impracticable to re-grade the slope due to environmental or right-of-way constraints, the fixed obstacle cannot be economically or practicably removed, relocated, or made breakaway, and the cost effectiveness analysis indicates that shielding may be required.

1.A Determine the Clear-Zone Distance

For new and reconstructed projects the clear-zone distance is the roadside area, starting at the edge of the through lane, which is available for the recovery of vehicles leaving the roadway. The clear-zone distance provides an area free of fixed obstacles and may consist of:

- The shoulder and
- A recoverable slope or
- A non-recoverable but traversable slope with a clear runout area.

The minimum required clear-zone width is given in the Nebraska Minimum Design Standards (*MDS*) (Ref. 9.2) (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/) as determined by the roadway type, ADT, and design speed.

1.B Identify the Roadside Condition

EXHIBIT 9.1 is a partial list of potential roadside conditions.

1.C Consider Your Options

The designer should consider the following options when determining the appropriate treatment for an obstacle:

1. Remove the obstacle.
2. Redesign the obstacle so it can be traversed.
3. Relocate the obstacle to a location where it is less likely to be hit, preferably beyond the clear-zone distance.
4. If the obstacle is a sign support or utility pole that cannot be relocated, use breakaway devices.
5. Shield the obstacle.
6. If no other option is practicable, delineate the obstacle.

1.D Cost Effectiveness Analysis

Barrier installation is based on a cost effectiveness analysis and the premise that shielding should be installed if it will reduce the severity of crashes. The cost effectiveness analysis program used by **Roadway Design** is the "Roadside Safety Analysis Program" (RSAP). RSAP calculates the benefit to cost ratio, comparing the possible costs of impacting roadside obstacles to the expected benefit of shielding them. The analysis includes, but is not limited to, consideration of the costs of:

- Removing or minimizing the obstacle
- The barrier
- Barrier maintenance
- Crashes involving the barrier
- Crashes involving the roadside obstacle

The **Roadway Design Unit Head** (**Unit Head**) or his/her designee should run RSAP on obstacles and on existing unprotected non-traversable fill slopes (steeper than 1:3) within the clear-zone distance for barrier warrants. The length of the vehicle runout path should be included when running the analysis. The **NDOT** prefers a benefit-cost ratio of 1.0 or greater when shielding roadside obstacles.

Roadside Condition	Decision Considerations
Foreslopes and Backslopes	Consider the slope and the clear-zone distance. Shielding is not generally required.
Bridge piers, abutments and end of bridge rail	Consider the clear-zone distance. Shielding is generally required.
Cross-Median Traffic	Consider the median width, traffic speed, traffic volumes, and percentage of heavy trucks.
Boulders	Consider the nature of the obstacle and the likelihood of impact.
Culverts, pipes, headwalls	Crossroad culverts 36 inches or less in diameter with flared end sections, round-equivalent culverts 36 inches or less in width with flared end sections, and multiple-pipe installations of culverts 30 inches or less in diameter with flared end sections may be included within the clear-zone distance without protection. Larger culverts will require either a traversable end section, extension outside of the clear-zone distance, or a cost effectiveness analysis to determine if barrier protection is economically warranted. Driveway culvert pipes parallel to the highway should be placed at the back of the ditch, outside of the clear-zone distance.
Ditches (parallel)	Consider the foreslope, backslope, and the clear-zone distance. (See **FIGURES 3-6** & **3-7** of the Roadside Design Guide, Ref. 9.1).
Ditches (transverse)	Consider the approach transverse side slope (should be 1:10 or flatter) and the likelihood of impact.
Embankment / Steep Slopes	Consider the fill height, length of slope, slope geometry, and clear-zone distance. The minimum length of embankment requiring protection should be 100 feet for semi-rigid guardrail (MGS, W-Beam, and Thrie-Beam) and 150 feet for cable guardrail. When fixed obstacles exist on the embankment slope the slope may not be the controlling factor: a cost effectiveness analysis should be based on the severity of the fixed obstacle (e.g. large culverts).
Retaining walls	Consider the relative smoothness of the wall, anticipated maximum angle of impact, structural integrity of the wall when impacted, and the cost of repairs.
Sign/luminaire supports	Locate outside of the clear-zone distance whenever possible. Where feasible, all sign/luminaire supports should be a breakaway design, regardless of their distance from the roadway, if there is a reasonable likelihood of their being hit by an errant vehicle. The placement and locations of breakaway supports will also give consideration to the consequence to pedestrians from potential debris resulting from impacts. Shielding is generally required for non-breakaway supports.
Traffic signal supports	Isolated traffic signals within the clear-zone distance on high-speed rural facilities may warrant shielding with a roadside barrier or a crash cushion.
Trees	Consider the site-specific circumstances
Utility poles	Utility poles should be relocated outside of the clear-zone distance whenever possible. If utility poles cannot be relocated, a cost effectiveness analysis will be performed and, if appropriate, the utility poles will be shielded. See Chapter Thirteen: Planning and Project Development, Section 6, for information regarding coordination with utilities.
Permanent bodies of water	Consider the location and depth of the water and the likelihood of encroachment.

Exhibit 9.1 Barrier Considerations for Roadside Conditions

2. BARRIER TYPES USED IN NEBRASKA

Details of the barrier types used in Nebraska are shown in the Standard/Special Plans Book (*Standard Plans*) (Ref. 9.3) (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/). EXHIBIT 9.2 summarizes the guidance for barrier use.

Barrier	Location	Comments
Semi-rigid Guardrail (Midwest Guardrail System (MGS), W-beam, and Thrie-beam)	Used to shield motorists from fixed objects such as bridge piers. Shall not be placed on slopes steeper than 1:6. Semi-rigid systems will be designed with a minimum distance of 1 foot from the back of the post to a non-traversable slope (steeper than 1:3 but less than 1:1.5) when the system utilizes 6 feet long guardrail posts; the guardrail may be installed at the slope break point when 9 feet long posts are used.	Semi-rigid guardrail relies on energy absorption of posts rotating in soil. Posts should be placed to maximize available deflection distance around bridge piers and other point hazards.
Cable Guardrail (Low-Tension)	Most cost effective method of treating slopes and protecting objects. Can be placed within 4 feet of slope break point when slope is 1:2 or flatter. Should not be placed within 4 feet of a slope between 1:1.5 and 1:2 or within 12 feet of a fixed object. Preferred over semi-rigid guardrail where snow drifting is likely.	Relies on tensile forces in cables and the ability of impacting vehicles to ride down weak posts. Should not be place on the inside of curves with radii less than 1910 feet unless additional space at 1:6 or flatter slopes, free of obstacles, is provided. Do not place on inside of curve with an R < 716 feet.
Cable Guardrail (High-Tension)	Used for narrow medians (e.g. Interstate and expressway medians) to guard against cross-over crashes.	The price is approximately twice that of Low-Tension Cable Guardrail. **Roadway Design Engineer** approval is required for this installation.
Cable Guardrail Transition to W-Beam Guardrail	Used to transition from cable guardrail to W-Beam guardrail for long runs of guardrail.	Not cost effective if the length of need is less than 350 feet.
32 inch Concrete Protection Barrier	Used in areas where barrier deflections are intolerable, truck capacity is required, or barrier repair is difficult. Should only be placed adjacent to flat surfaced shoulders or medians.	Barrier will cause the impacting vehicle to lift and may cause a rollover. Rigidity causes somewhat higher injury rate.
42 inch Concrete Protection Barrier	Used when the ability to contain large trucks is of primary concern. Locations with high volumes and narrow medians or where widening into a median is planned are the most common applications.	Same performance as 32 inch high barrier. Height helps to reduce glare somewhat and holds up a semi-trailer to keep it from tipping over.
Vertical Concrete Barrier	Used where barrier deflections are intolerable, truck capacity is required, or barrier repair is difficult. Can be built to any height ≥ 32 inches.	Barrier provides high strength and low repair costs without high rollover rates. Rigidity causes somewhat higher injury rate. When initially taller than 32 inches, overlays do not affect performance.
Bridge Approach Section/Special Bridge Approach Section	Should be used any time semi-rigid guardrail is transitioned to a bridge rail.	End shoe should be lapped with adjacent traffic to minimize snag potential. Posts should be no closer than 2 feet from the hinge point.
Bullnose Median Barrier	Used in medians of 40 feet or less in width to shield motorists from sign bases, bridge ends, bridge piers, etc.	Requires 66 feet minimum clearance from the tip of the bullnose to the fixed object. The approaching terrain will be graded 1:10 or flatter for 60 feet prior to and under the bullnose.

Note: For additional information see **TABLE 5-3** of the Roadside Design Guide (Ref. 9.1).

Exhibit 9.2 Nebraska Barrier Summary

3. GUARDRAIL DESIGN PROCEDURES - A GRAPHICAL SOLUTION

Once it has been determined that guardrail is appropriate for a given location, its placement, length, type, etc. must be determined. The required length of a guardrail installation is a function of several variables, including:

- Design speed
- Design year ADT
- Runout length
- Lateral extent of the obstacle
- The tangent length of guardrail upstream from the obstacle
- The guardrail's lateral distance from the edge of the traveled way
- The flare rate for the specific type of guardrail installation

The following steps should be followed in guardrail design:

1. Determine the runout length and the lateral extent of the obstacle.
2. Plot the runout path.
3. Determine the appropriate guardrail flare rate.
4. Select the guardrail components.
5. Graphically locate the guardrail components on the plan.
6. Design the earthwork around the guardrail.
7. Determine the details of surfacing under guardrail.
8. Determine the pay item quantities.

These steps are expanded upon in the following sections.

3.A Determine Runout Length & Lateral Extent of the Obstacle

Runout Length: The distance used to graphically determine the required length of a barrier. The runout length is measured from where a vehicle leaves the roadway to the obstacle being shielded as measured along the outside edge of the through travel lane. The runout length may be determined based on the design speed and traffic volume using EXHIBIT 9.3.

Design Speed (mph)	Runout Length (L_R) for Given Traffic Volume (ADT)			
	Over 10,000 veh/day	5000 to 10,000 veh/day	1000 to 5000 veh/day	Under 1000 veh/day
80	470 feet	430 feet	380 feet	330 feet
70	360 feet	330 feet	290 feet	250 feet
60	300 feet	250 feet	210 feet	200 feet
50	230 feet	190 feet	160 feet	150 feet
40	160 feet	130 feet	110 feet	100 feet
30	110 feet	90 feet	80 feet	70 feet

Exhibit 9.3 Runout Length Values
(Source: Roadside Design Guide, Ref. 9.1)

Lateral Extent of the Obstacle: The distance from the edge of the traveled way to the far side of a fixed obstacle. If the obstacle extends beyond the clear-zone distance the lateral extent of the obstacle is measured to the outside edge of the clear-zone distance.

The clear-zone distance listed in the *MDS* (Ref. 9.2) also applies to curved roadway segments in the following cases:

- When the obstacle is located outside a curve with a radius greater than 2950 feet and there is no crash history
- When the obstacle is located inside the curve

When recommended by the **Traffic Engineering Division** (**Traffic Engineering**) based on the crash history and the obstacle is located on the outside of a curve with a radius of 2950 feet or less, the clear-zone distance for the tangent roadway may be multiplied by the appropriate curve correction factor to arrive at an adjusted clear-zone distance to be used in plotting the runout path. For additional information see Section 3.1 and **TABLE 3-2** of the Roadside Design Guide (Ref. 9.1).

On two-way two-lane roadways guardrail is needed to shield opposing traffic from the obstacle. The same guardrail design procedures are used but for the opposing traffic the lateral extent of the obstacle and the runout length will be measured from the centerline of the two-way roadway (See EXHIBIT 9.4).

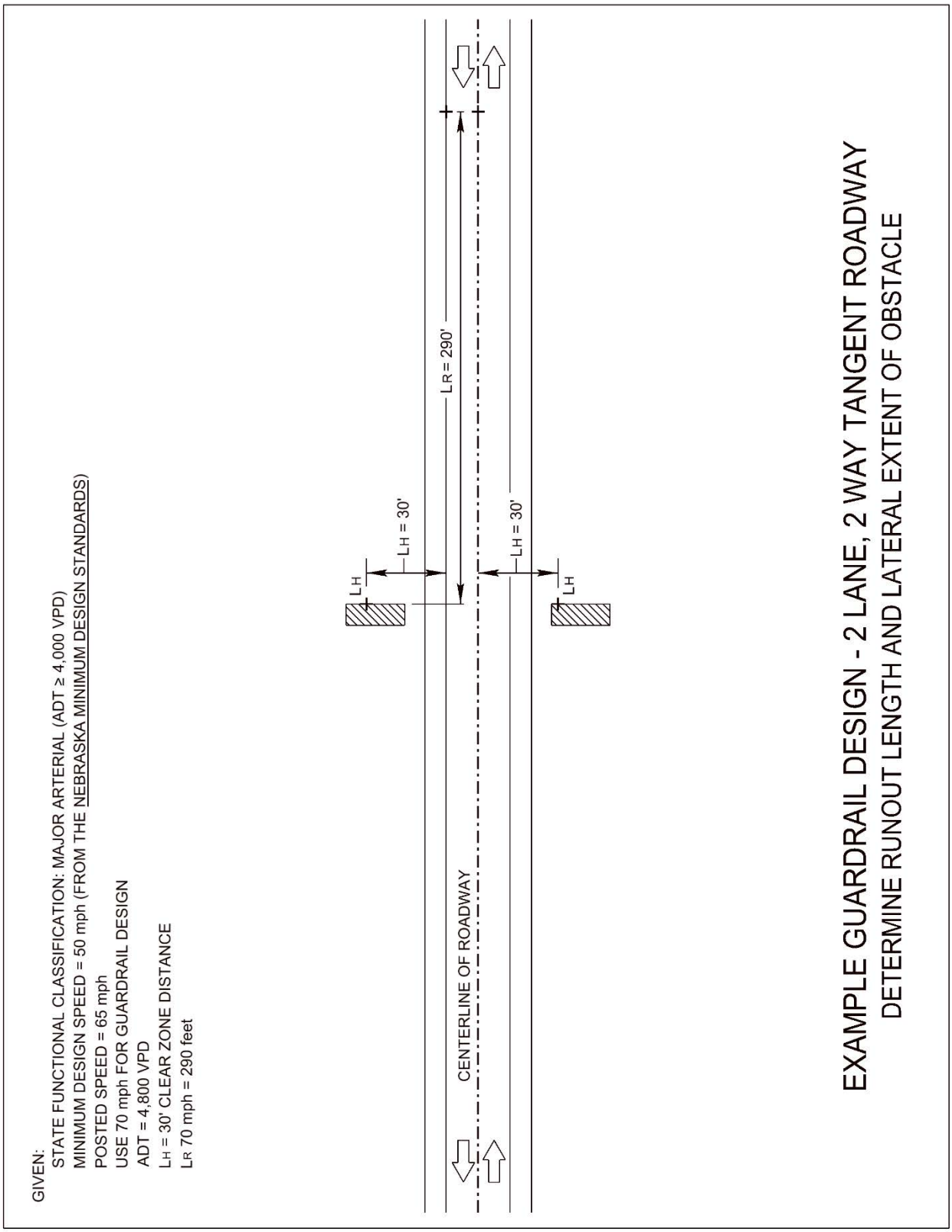


Exhibit 9.4 Determine the Runout Length & Lateral Extent of Obstacle

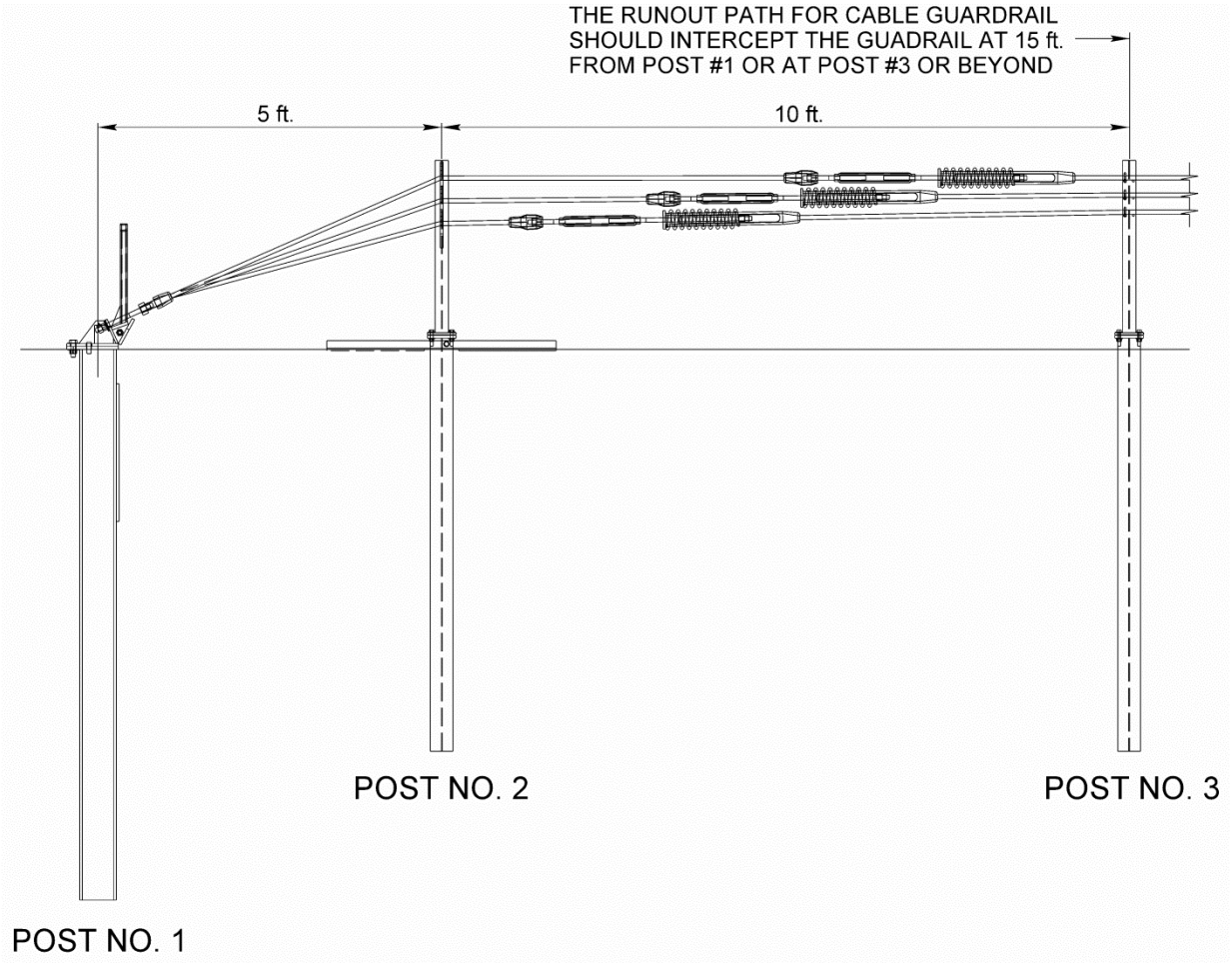
3.B Plot the Runout Path

On tangent roadway segments, the runout path runs from the lateral extent of the obstacle to a point on the outside edge of the nearest driving lane which is at the runout length distance from the obstacle as measured along the edge of the lane (See EXHIBIT 9.5). The same procedure should be used on curved roadway segments where the curve radius is greater than 2950 feet and for obstacles on the inside of the curve (See EXHIBIT 9.14).

On curves with a radius of 2950 feet or less, the runout path is plotted tangent to the outside edge of the driving lane so that it intersects the obstacle at the adjusted lateral extent of the obstacle (See Section 3.A and EXHIBIT 9.15).

For MGS, W-beam, and Thrie-beam guardrail installations, the last 12.5 feet of the guardrail end treatment will not be included in the length of need. The runout path must intersect these end treatments at a distance of 12.5 feet or more from the end post (See EXHIBIT 9.7).

For a low-tension cable guardrail installation, the runout path must intersect the guardrail at a distance of 15 feet or more from the end post of the in-line terminal anchorage system when used to shield a fixed object (See below and EXHIBIT 9.16).



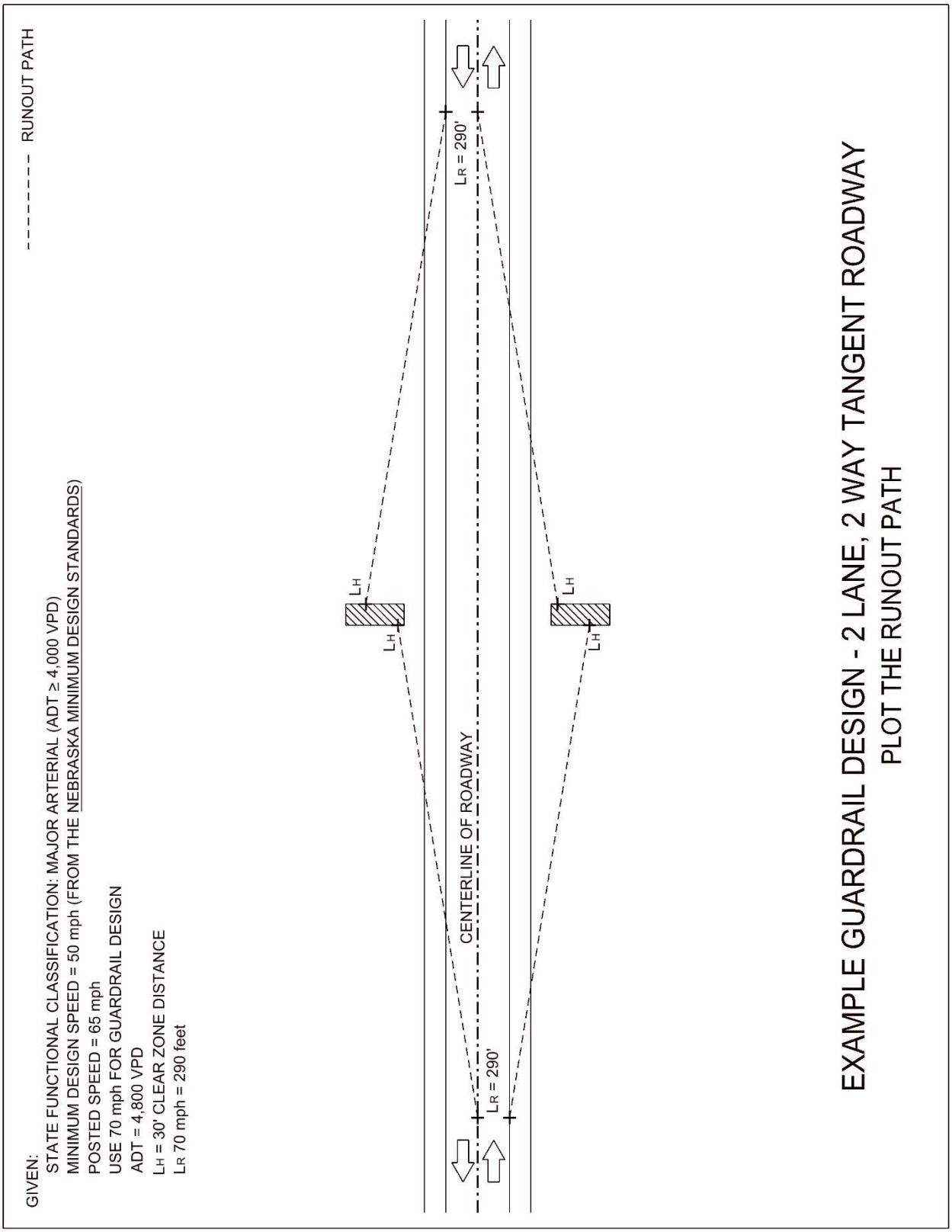


Exhibit 9.5 Plot the Runout Path

3.C Determine the Appropriate Flare Rate(s)

Flare is generally incorporated into guardrail installations to place the terminal section at a greater distance from the roadway and to shorten the required length of the barrier. Flare rate is a function of design speed and barrier type.

- A 25:1 flare rate is generally used for a Guardrail End Treatment, Type I (primarily installed on Midwest Guardrail System (MGS) and W-beam guardrail on multi-lane divided roadways)
- A 15:1 flare is used for a Guardrail End Treatment, Type II (generally used on MGS and W-beam guardrail on 2-lane, 2-way roadways).

Parallel installations or flatter flare rates are often used on projects with right-of-way constraints, to reduce environmental impacts, to reduce impacts to utilities, and/or where a limited amount of earthwork is desired. A parallel installation or a flatter flare rate increases the required length of the barrier. The *Standard Plans* (Ref. 9.3) include guardrail post locations for the various flare rates.

3.D Select the Guardrail Components

Factors influencing guardrail selection include but are not limited to:

- Design speed
- Traffic volume
- The nature of the obstacle
- Roadway geometry
- Median width (consider back-side impacts)
- Allowable deflection distance
- Cost

The following guidelines should be followed:

- Install cable guardrail whenever practicable.
- Design cable guardrail length in multiples of 4 feet, which is the standard post spacing.
- Guardrail, when justified, should be connected to concrete bridge rail with an appropriate transition section (See Section 5). MGS or W-beam guardrail may be used on the off-end of one-way bridges when an obstacle is required to be shielded.
- Design MGS, W-beam, and Thrie-beam guardrail length in multiples of 12.5 feet, which is the standard beam length. MGS, W-beam, or Thrie-beam guardrail may be designed in multiples of 6.25 feet due to site restrictions, if that satisfies the required runout length.
- Use the appropriate terminal sections based on:

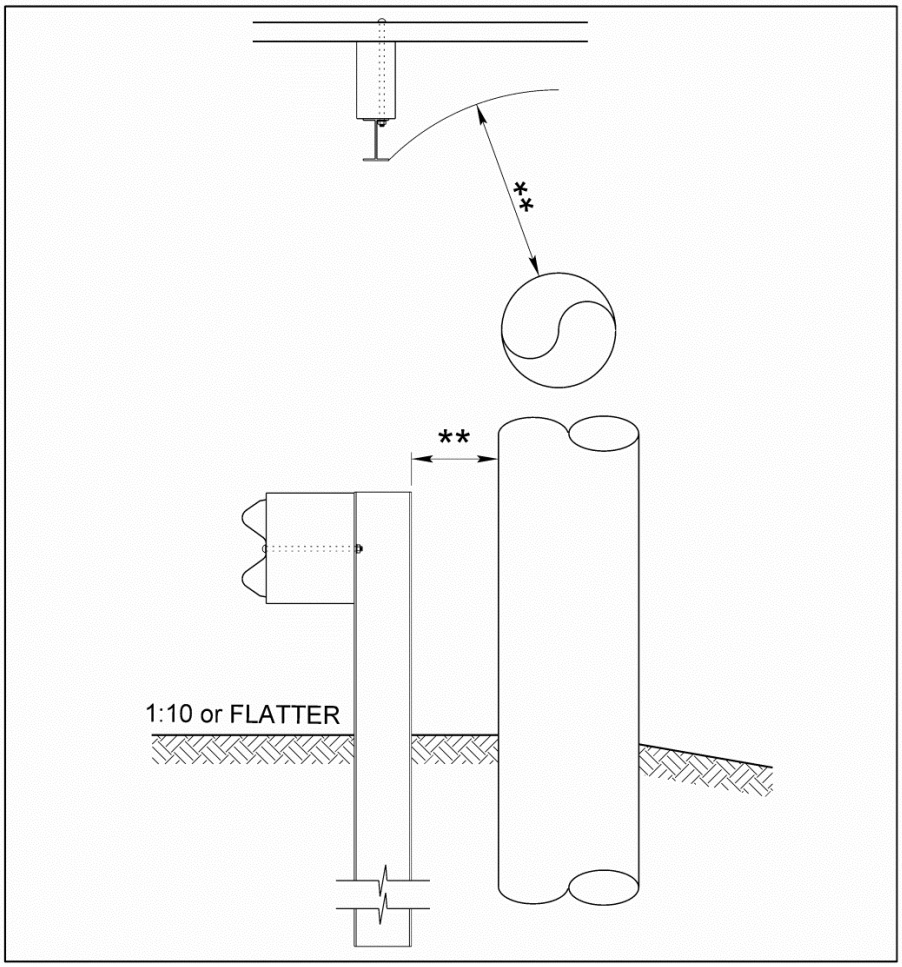
    1. Flare rate,
    2. The guardrail system,
    3. The roadway classification,
    4. The design speed, and
    5. **District** preference.

3.D.1 Deflection Distance

Selection and placement of guardrail is a function of the distance it will deflect upon impact. If the guardrail is shielding a rigid object the distance between the guardrail and the object must be sufficient to avoid a vehicle contacting the object. Guardrail may not function properly in protecting traffic from a rigid object if the guardrail post(s) come in contact with the obstacle. See EXHIBIT 9.6 for the required guardrail clearances and deflections.

- Low-tension cable guardrail deflects the greatest distance, in testing by as much as 11.5 feet. Low-tension cable guardrail should be designed with a 12 feet minimum deflection.
- High-tension cable guardrail systems have exhibited deflection distances between 7 feet and 9 feet in crash testing but deflections of up to 12 feet have been observed in field conditions.
- Deflection characteristics of semi-rigid systems (MGS, W-beam, or Thrie-beam guardrail) vary depending upon the strength of the post.
- Concrete (rigid) barriers are designed for virtually no deflection and may be used where space is limited between the obstacle and the travel lanes.

See the Roadside Design Guide (Ref. 9.1) for further information.



MINIMUM REQUIRED GUARDRAIL OFFSET	
FROM BACK OF POST TO A POINT OBSTACLE (e.g. PIER COLUMN) **	
GUARDRAIL INSTALLATION TYPE	**MINIMUM OFFSET ***
Three Strand Cable Guardrail (Low-Tension)	12’ (4’ and 16’ post spacing)
Cable Guardrail (High-Tension)	7’ to 12’, depending on the system
Midwest Guardrail System (MGS) & W-Beam Guardrail	3’-10” for normal post spacing (6’-3”)
	3’-5” for ½ post spacing (3’-1½”)
	2’-6” for ¼ post spacing (1’-6¾”)
Thrie Beam Guardrail	2’-3” for normal post spacing (6’-3”)
FROM BACK OF POST TO A LINEAR OBSTRUCTION (e.g. MSE WALL)	
MGS & W-Beam Guardrail	4’-1” for normal post spacing (6’-3”)
	3’-5” for ½ post spacing (3’-1½”)
	2’-6” for ¼ post spacing (1’-6¾”)
Thrie Beam Guardrail	2’-10” for normal post spacing (6’-3”)

* Based on the dynamic deflections from the NCHRP Report 350 standard strength test for the 4,400 lb pickup truck impacting a barrier at an angle of 25º at a velocity of 60 mph.

** Adjust the posts longitudinally so that they will not be placed directly opposite a point obstacle (e.g. pier column, tree). The minimum offset between the back of the guardrail post and the point obstacle may be found in the table above.

Exhibit 9.6 Minimum Guardrail Offsets When Adjacent to a Fixed Obstacle

3.E Graphically Locate the Guardrail on the Plan

The designer should lay out the guardrail components on the plan (See EXHIBIT 9.7). For MGS, W-beam, and Thrie-beam installations the components may include the bridge approach section, the appropriate guardrail radius section for the design flare rate, the tangent guardrail section, and the applicable guardrail end treatment(s) (See Section 4). The runout path will intersect the guardrail at a distance of 12.5 feet or greater from the end of the guardrail end treatment.

Cable guardrail installation components are the cable guardrail, the terminal anchorage sections, and the intermediate anchorage sections (if required). The runout path will intersect the low-tension cable guardrail at a distance of 15 feet or greater from the end of the in-line terminal anchorage section (See EXHIBIT 9.16).

For unique installations (e.g. on a curved roadway where the guardrail is curved in the opposite direction) the designer should provide the station and offset at the ends of the guardrail and at intermediate points as appropriate.

See the *Standard Plans* (Ref. 9.3) for details of the guardrail components.

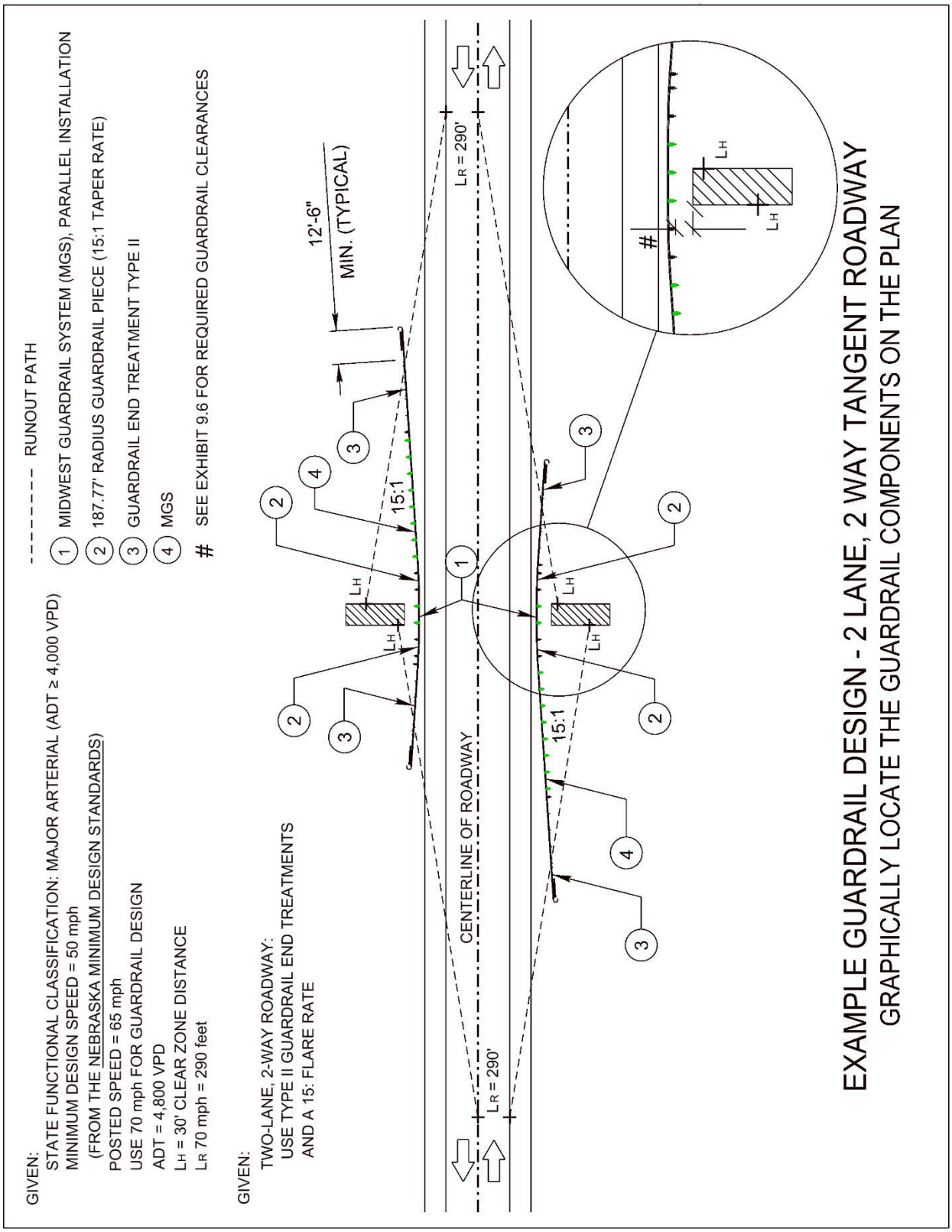


Exhibit 9.7 Graphically Locate the Guardrail Components on the Plan

3.F Design the Earthwork Around the Guardrail

The designer should refer to the *Standard Plans* (Ref. 9.3) for guidance in designing earthwork for guardrail (See EXHIBIT 9.8). Details of earthwork around the guardrail should be provided on guardrail layout sheets and on the project cross-sections for the benefit of the contractor and inspector. This earthwork will be included in the earthwork quantities.

3.G Determine the Details of Surfacing Under the Guardrail

Surfacing is placed under guardrail as a method to control weeds (See EXHIBIT 9.9). The designer should consult with the **DE** or the **District Construction Engineer** (**DCE**) during the plan-in-hand field inspection to determine if surfacing under guardrail is desired and the choice of material to be used. Surfacing may be concrete, asphaltic concrete, or millings. When concrete or asphaltic concrete surfacing is used the posts will be blocked out and backfilled with suitable materials (See the *Standard Plans* (Ref. 9.3) and the Standard Specifications for Highway Construction (*Spec Book*) (Ref. 9.4) (http://roads.nebraska.gov/media/6897/specbook-2007.pdf).

Typical sections of asphalt surfacing under guardrail for non-curbed and curbed conditions are shown in EXHIBITS 9.10 THROUGH 9.13. Designers will submit detailed plans, typical sections, and estimates for all asphalt surfacing under guardrail locations to the **Materials and Research Division** (**M&R**) for inclusion in the asphalt quantities; the designer is responsible for calculating concrete surfacing quantities.

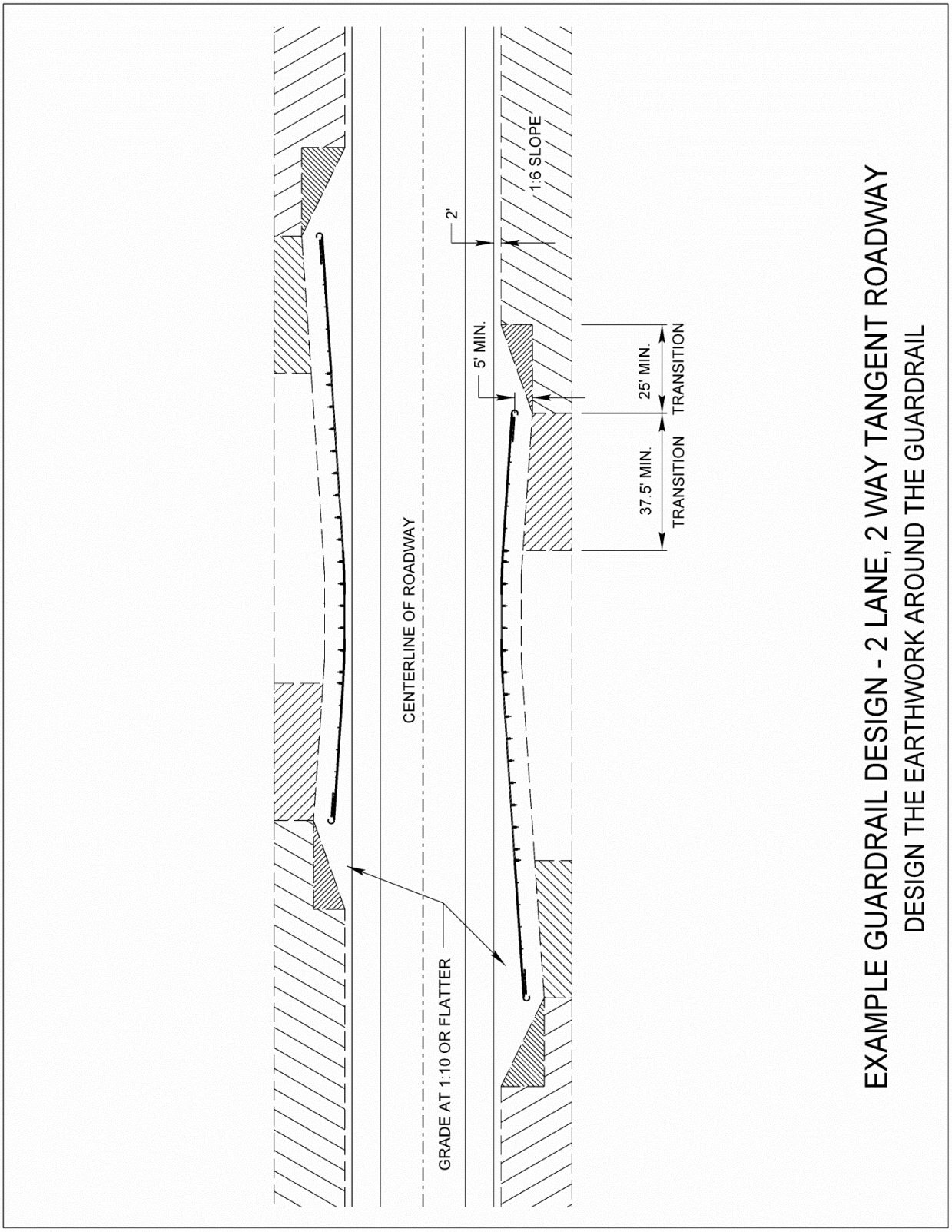


Exhibit 9.8 Design the Earthwork Around the Guardrail

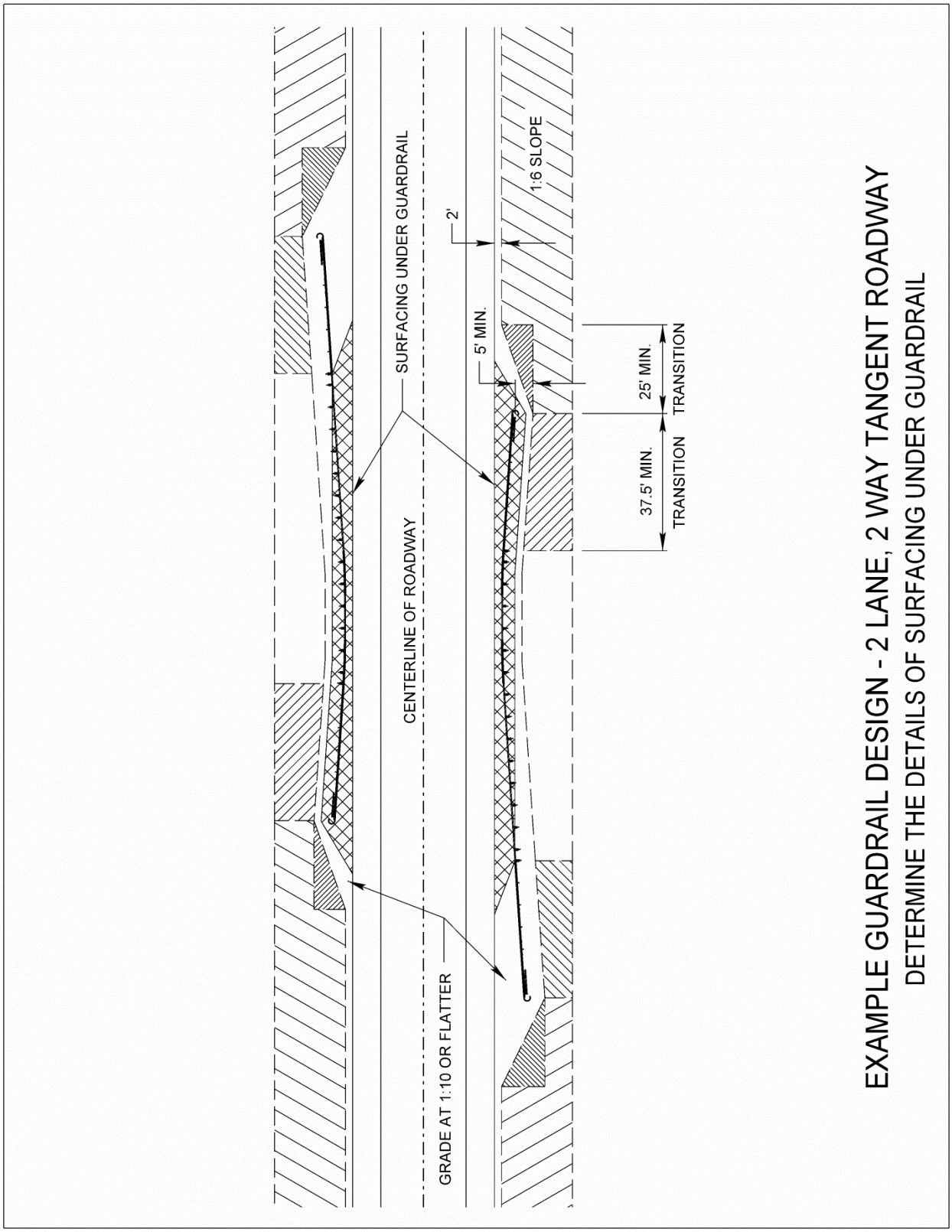


Exhibit 9.9 Determine the Details of Surfacing Under the Guardrail

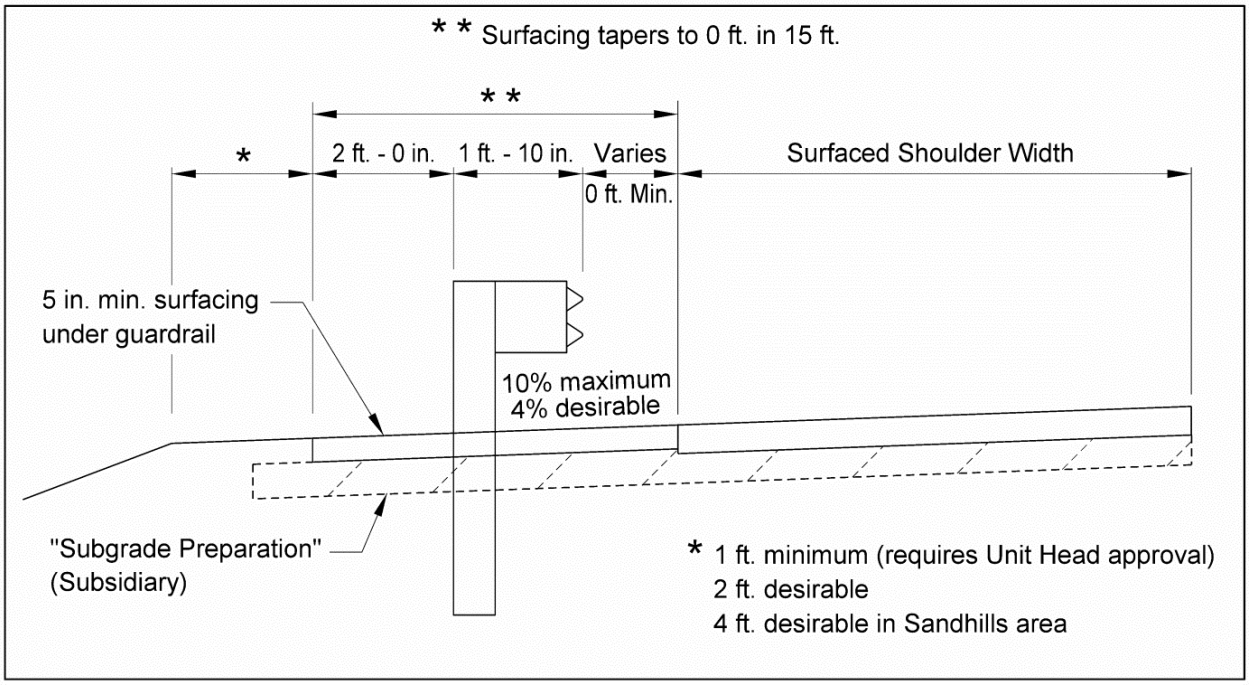


Exhibit 9.10 Surfacing Under Guardrail at Surfaced Shoulder

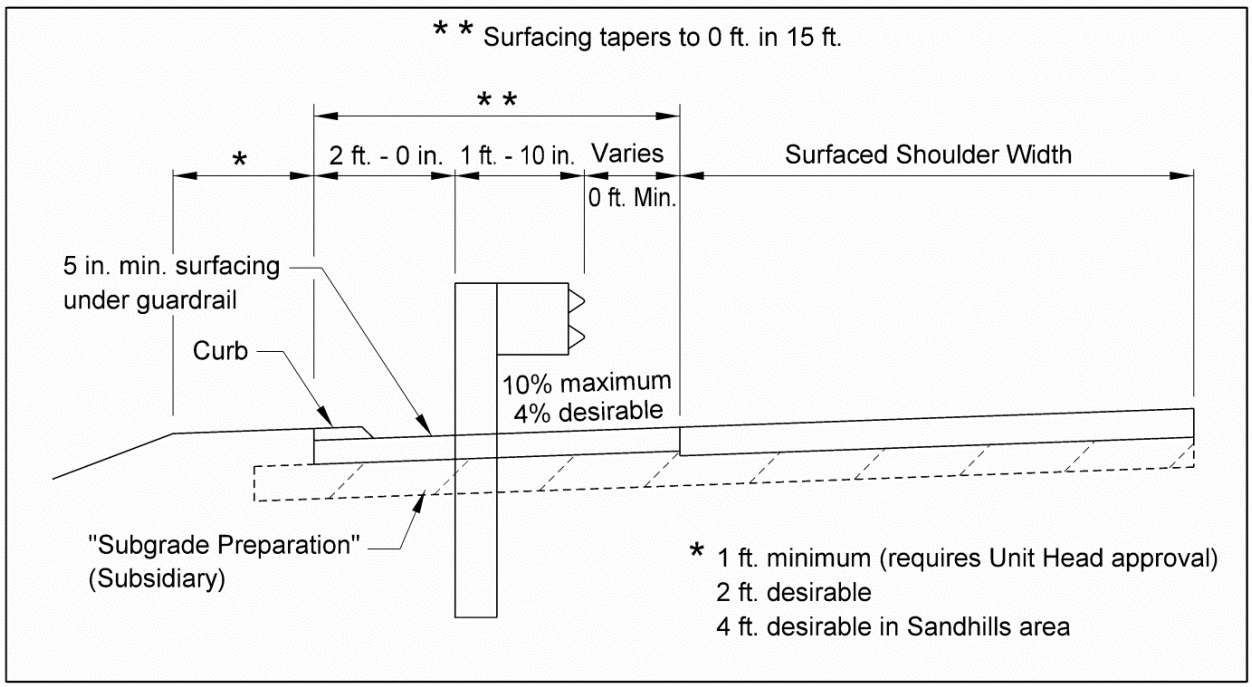


Exhibit 9.11 Surfacing Under Guardrail with Curb at Surfaced Shoulder

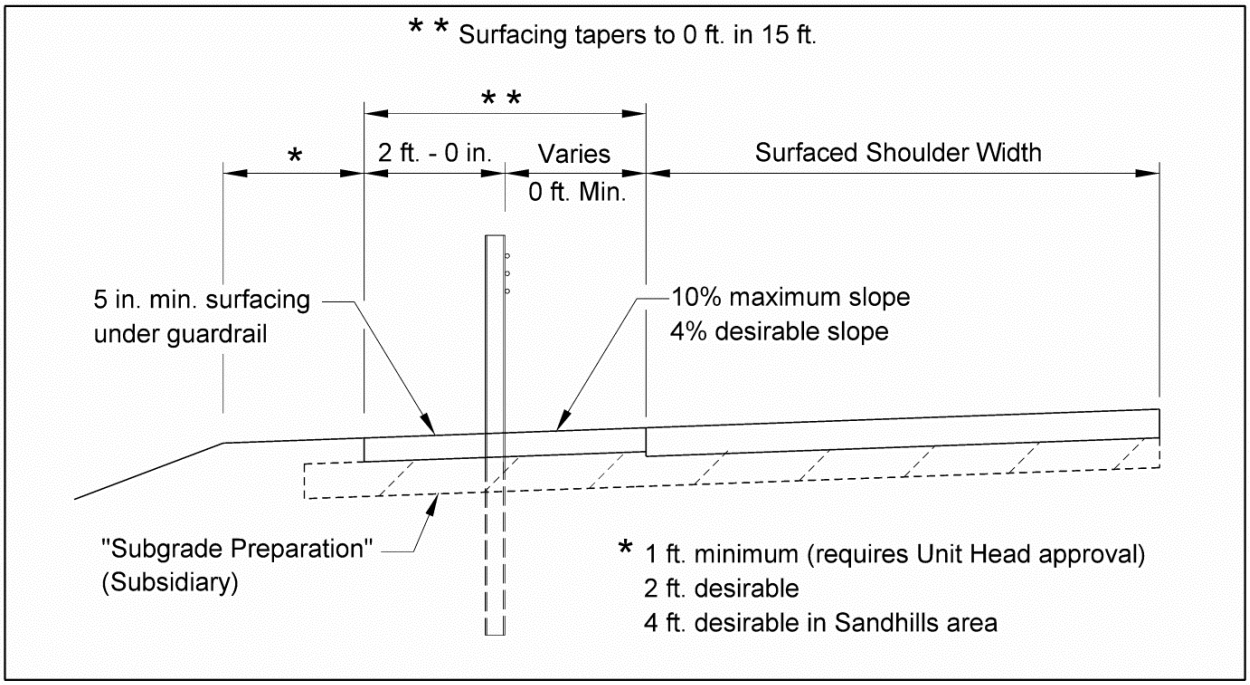


Exhibit 9.12 Surfacing Under Cable Guardrail at Surfaced Shoulder

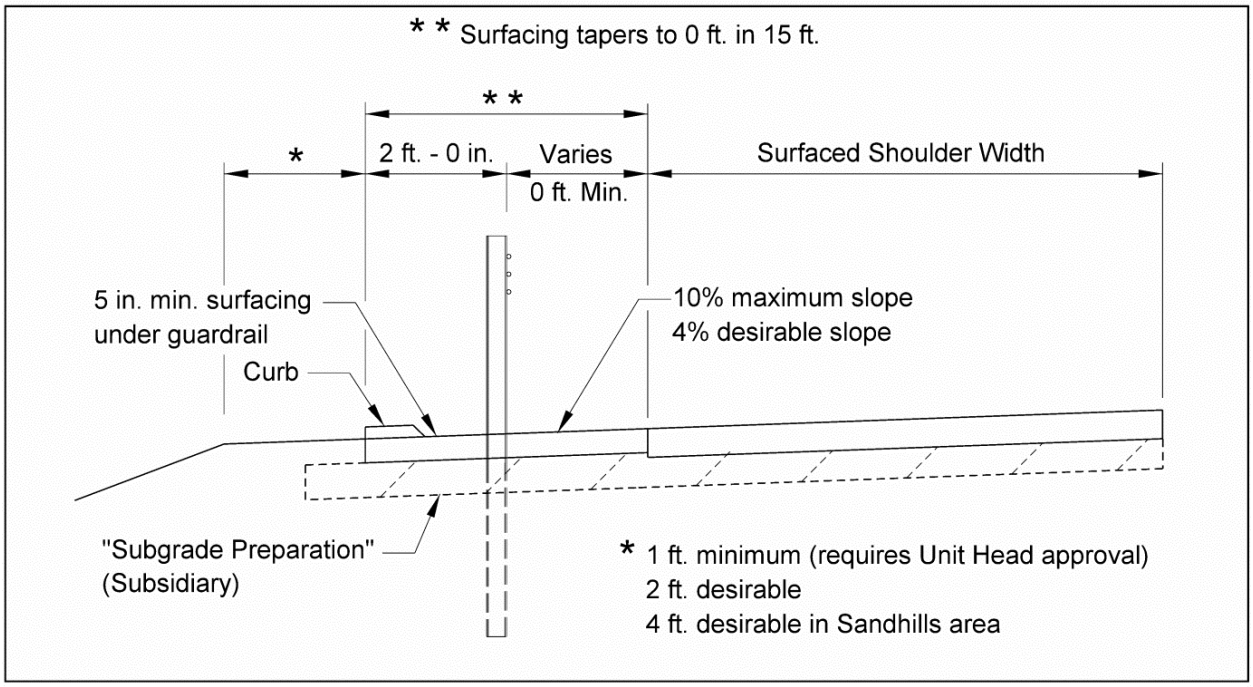


Exhibit 9.13 Surfacing Under Cable Guardrail with Curb at Surfaced Shoulder

3.H Determine the Pay Item Quantities

Guardrail pay items include, but are not limited to, the following:

- Remove Guardrail: Paid for by the linear foot. Used for the removal of both cable and semi-rigid guardrail. The removal length includes the approach and terminal sections for each continuous length of guardrail.
- Semi-Rigid Guardrail (MGS, W-Beam, and Thrie-Beam): Paid for by the linear foot. Measure the semi-rigid guardrail from the bridge approach section to the guardrail end treatment or from the guardrail end treatment to the guardrail end treatment. The semi-rigid guardrail length will include the guardrail radius section, if applicable. This pay item includes the guardrail posts, offset blocks, and hardware required for installation.
- Cable Guardrail: Paid for by the linear foot. Measure the cable guardrail from terminal anchorage section to terminal anchorage section (excluding intermediate anchorage sections). The cable guardrail length should be a multiple of 4 feet. This pay item includes the guardrail posts and hardware required for installation.
- Bridge Approach Sections: Paid for by each.
- W-Thrie Beam Transition Section: Paid for by each. Used to connect MGS or W-Beam guardrail to Thrie-Beam guardrail. This is a separate pay item when it is used separately from a BAS.
- Cable Guardrail Transition to W-Beam Guardrail: Paid for by each.
- Guardrail End Treatments: Paid for by each. Divided into the pay items Guardrail End Treatment Type I, Guardrail End Treatment Type II, SRT-75 and ET-Plus.
- End Anchorage Assembly: Paid for by each.
- Cable Guardrail Anchorage: Paid for by each. The designer will also include two anchorage units for each intermediate anchorage, if applicable.
- Culvert Mounted Guardrail Posts: Paid for by each. When the designer specifies culvert mounted guardrail posts, the posts are a separate pay item from the semi-rigid guardrail.
- Crash Cushions and Impact Attenuators: Paid for by each.
- Concrete Median Barriers: Paid for by the linear foot.
- Bullnose: Paid for by each. The pay item refers to the entire system from post 10 on the left to post 10 on the right and includes all Thrie-Beam guardrail, posts, cables, blockouts, and hardware necessary to complete the Bullnose installation.
- Surfacing Under Guardrail: Paid for by the sq. yd.

For further information see the *Standard Plans* (Ref. 9.3), the *Spec Book* (Ref. 9.4), and Chapter Twelve: Cost Estimating & Funding.

Further examples of typical guardrail installations may be found in EXHIBITS 9.14 THROUGH 9.16.

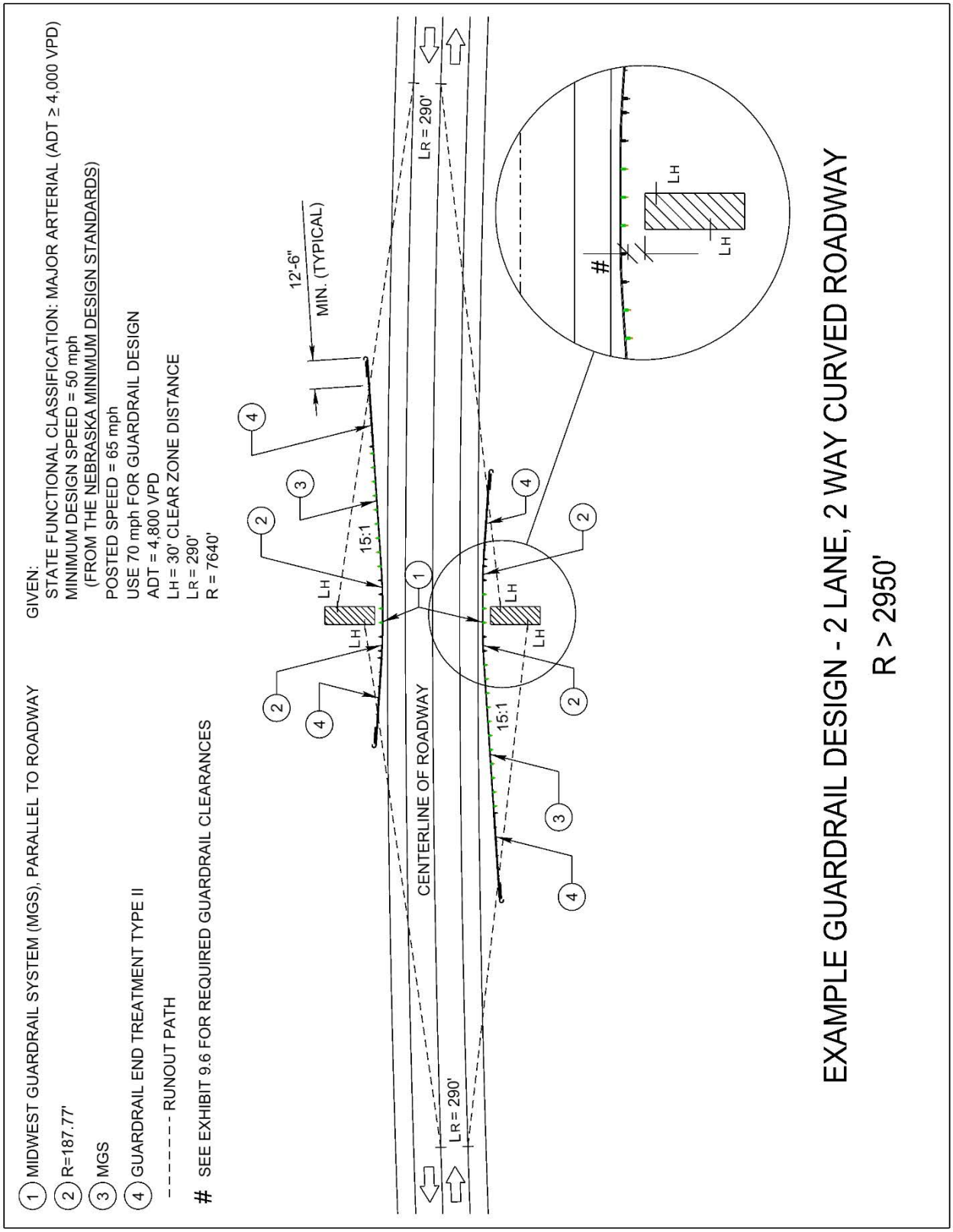


Exhibit 9.14 Example W-Beam or Thrie-Beam Guardrail Design: 2-Lane, 2-Way Curved Roadway: R > 2950'

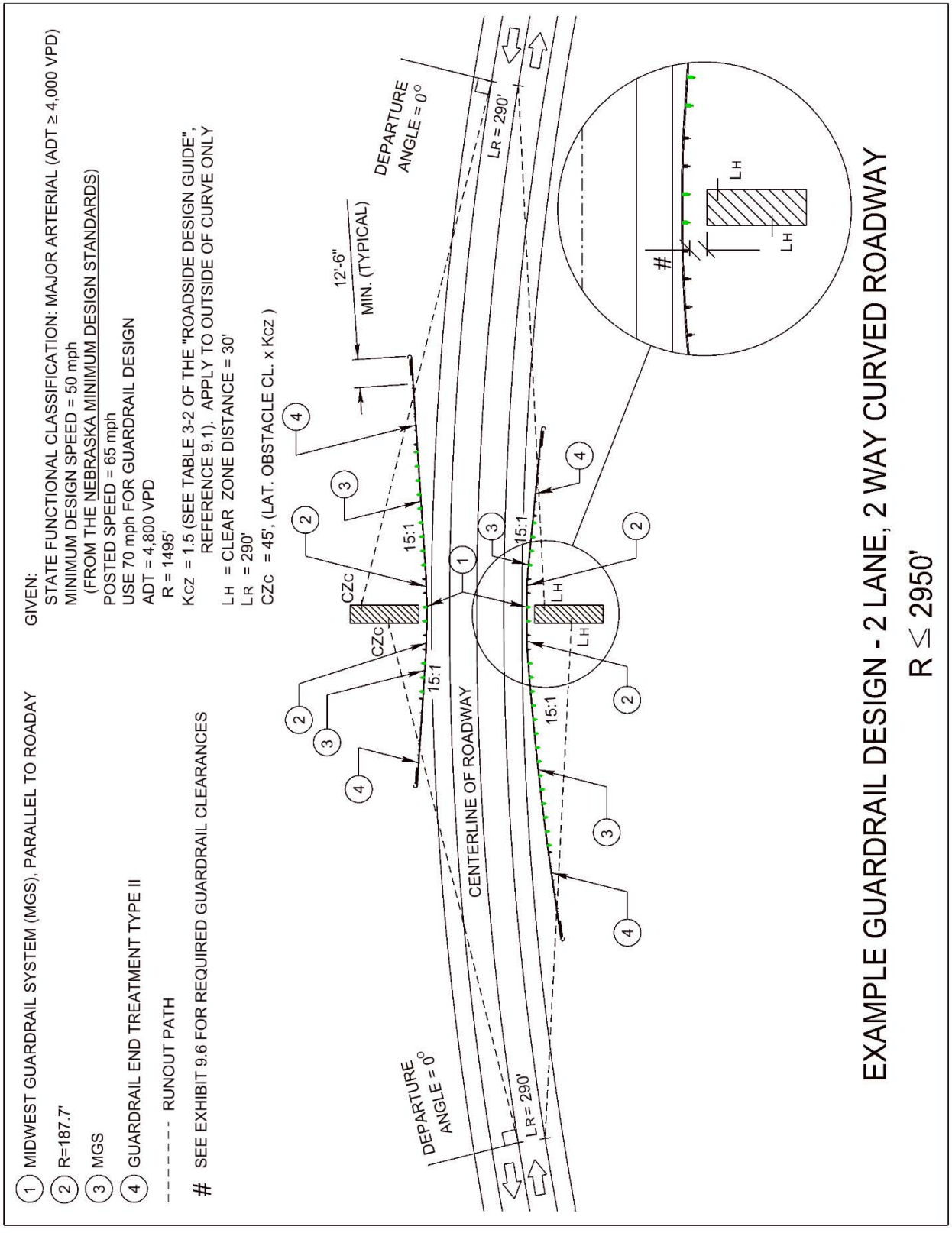


Exhibit 9.15 Example W-Beam or Thrie-Beam Guardrail Design: 2-Lane, 2-Way Curved Roadway; R ≤ 2950'

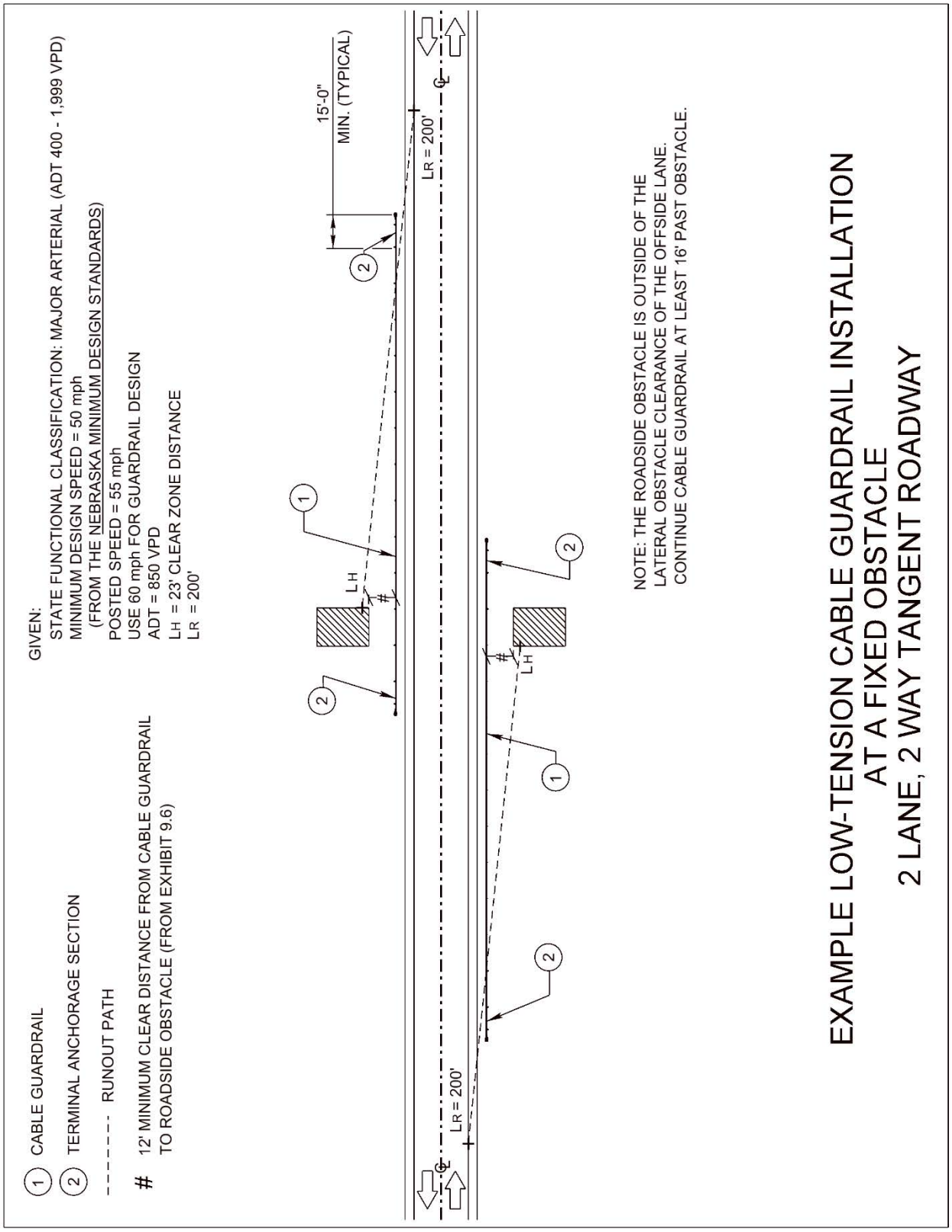


Exhibit 9.16 Example Low-Tension Cable Guardrail Design: 2-Lane, 2-Way Tangent Roadway

4. END TREATMENTS

Guardrail end treatments used in Nebraska may be found in the *Standard Plans* (Ref. 9.3).

4.A Guardrail End Treatment, Type I

A Guardrail End Treatment, Type I is used for design speeds of 65 mph and above for parallel guardrail installations or for installations with a 25:1 taper. This end treatment is used primarily for the Interstate System and on expressways, and may be installed in medians of 40 feet and wider.

4.B Guardrail End Treatment, Type II

A Guardrail End Treatment, Type II is primarily installed on high-speed (≥ 50 mph) two-lane, two-way roadways with a guardrail installation with a 15:1 taper.

4.C Low-Speed Roadways

The ET-Plus and the SRT-75 guardrail end treatments are installed on low-speed (≤ 45 mph) two-lane, two-way roadways with guardrail installations with a 15:1 taper. See the *Standard Plans* (Ref. 9.3) for details. The minimum guardrail installation at a low-speed bridge connection is shown in EXHIBIT 9.21.

4.D End Anchorage Assembly

The end anchorage assembly is permitted on the trailing ends of guardrail installations that are not exposed to oncoming traffic and on curved beam guardrail installations (with control releasing terminal posts) terminating on driveways to provide tension to the guardrail system. See the *Standard Plans* (Ref. 9.3) for details.

4.E Bullnose

See Section 6.B.

5. BRIDGE APPROACH SECTIONS

The bridge approach section is a transition section used where semi-rigid guardrail joins to a rigid bridge rail. Transition sections are designed to produce a gradual transition between the deflection capabilities of the two types of rail, reducing the potential of a vehicle pocketing, snagging, or penetrating the rail in the transition area. The bridge approach sections for both high-speed (≥ 50 mph) and low-speed (≤ 45 mph) installations in Nebraska may be found in the *Standard Plans* (Ref. 9.3). For examples of typical guardrail installations at a bridge, see EXHIBITS 9.17 THROUGH 9.20 AND EXHIBITS 9.23 & 9.24.

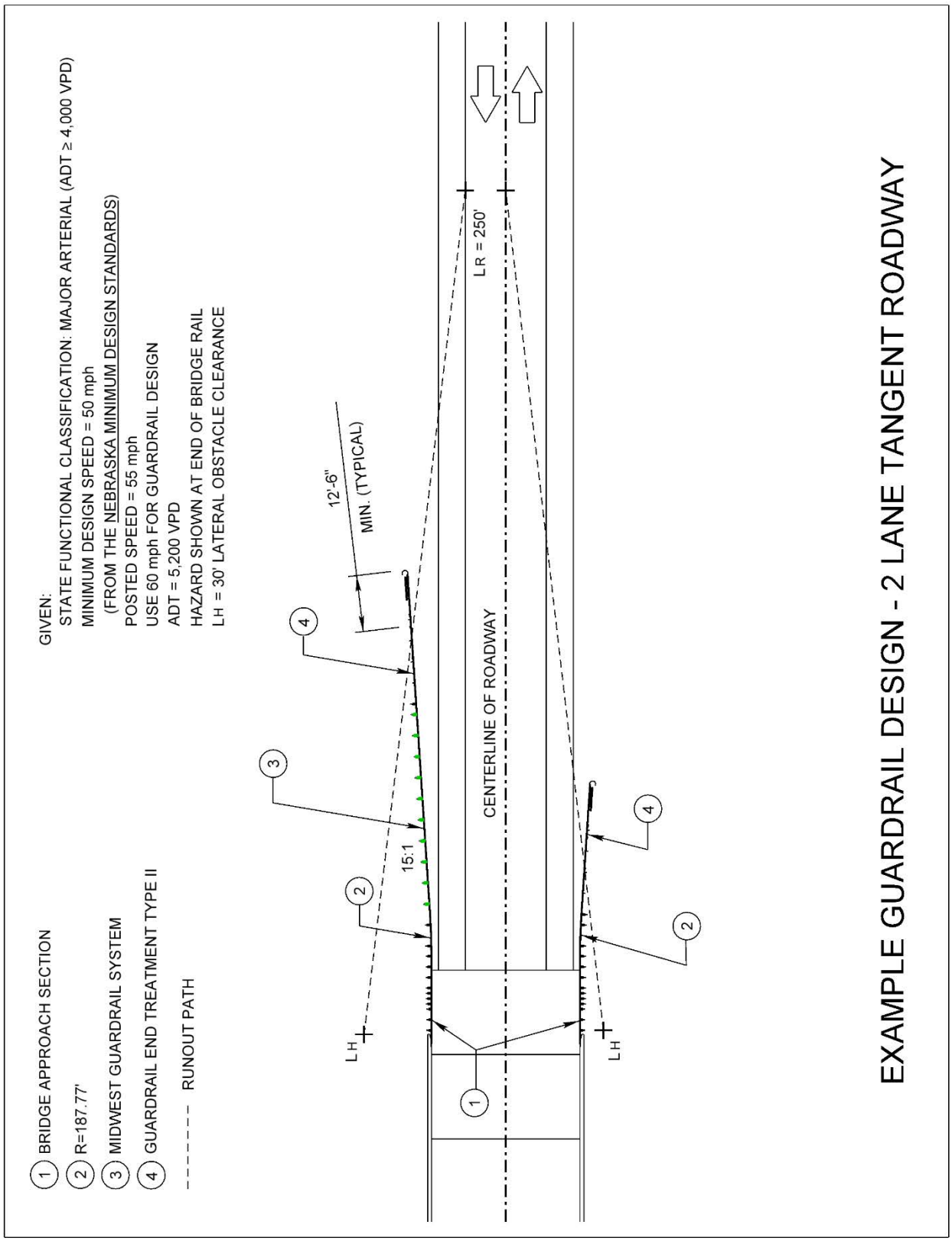


Exhibit 9.17 Example Guardrail Design at a Bridge: 2-Lane, 2-Way Tangent Roadway

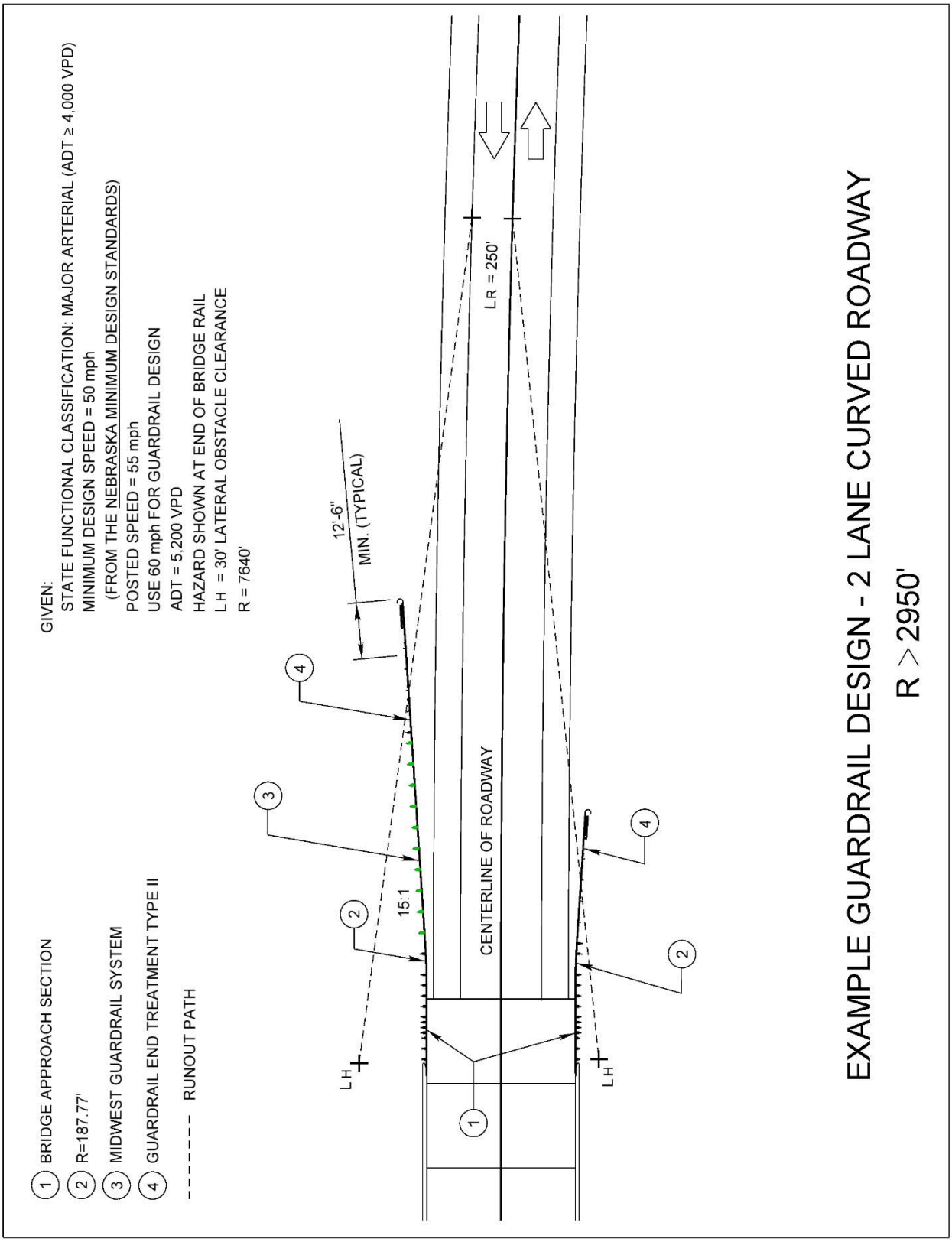


Exhibit 9.18 Example Guardrail Design at a Bridge: 2-Lane, 2-Way Curved Roadway; R > 2950'

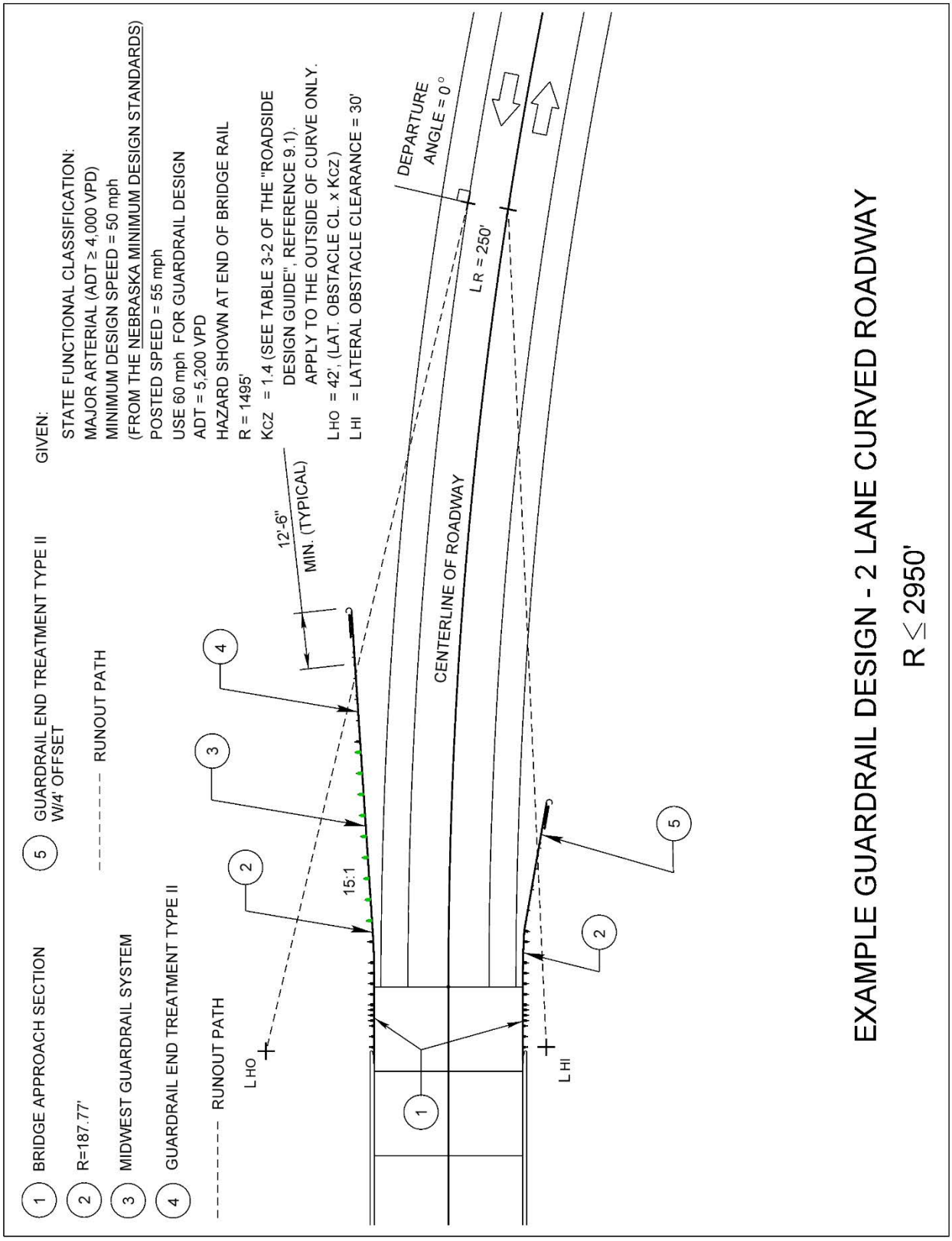


Exhibit 9.19 Example Guardrail Design at a Bridge: 2-Lane, 2-Way Curved Roadway; R ≤ 2950'

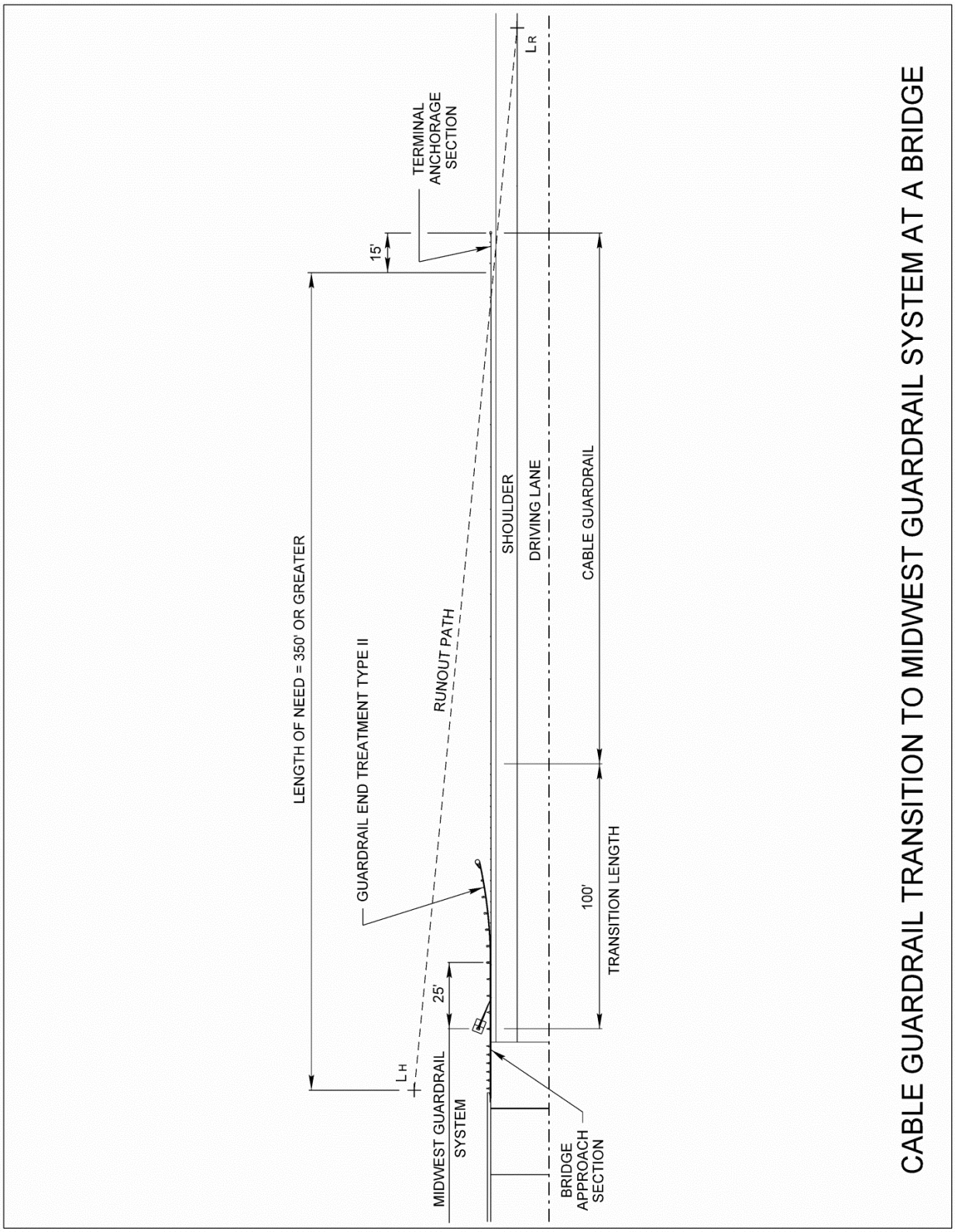


Exhibit 9.20 Cable Guardrail Transition to Midwest Guardrail System at a Bridge

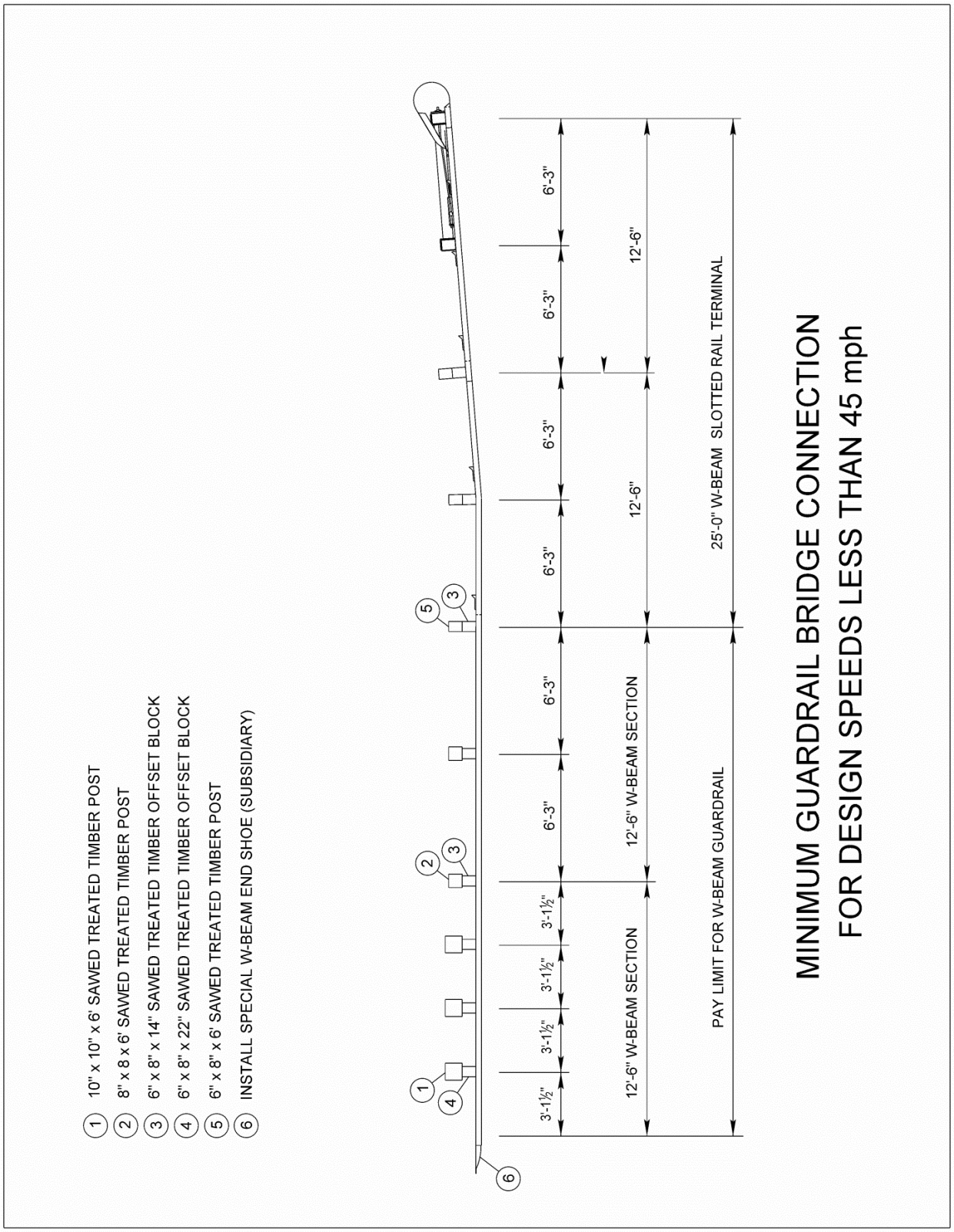


Exhibit 9.21 Minimum Guardrail Installation for a Low-Speed Bridge Connection

6. MEDIAN BARRIERS

A median barrier is typically placed on the left side of the traffic lanes of a divided highway to redirect vehicles striking from either side of the barrier. The design, height, and lateral placement of the median barrier is critical for proper performance.

6.A Median Barrier Installation Guidelines

1) The **NDOT** will follow the guidance found in Chapter 6 of the Roadside Design Guide (Ref. 9.1).
2) EXHIBIT 9.22 presents guidelines for median barrier installations on high-speed controlled access roadways that have relatively flat, unobstructed medians. These criteria may be used in the absence of cross median crash data for a specific site.
3) For median widths between 30 feet and 50 feet, the **NDOT** will analyze the crash history and determine if median barrier installation is warranted.

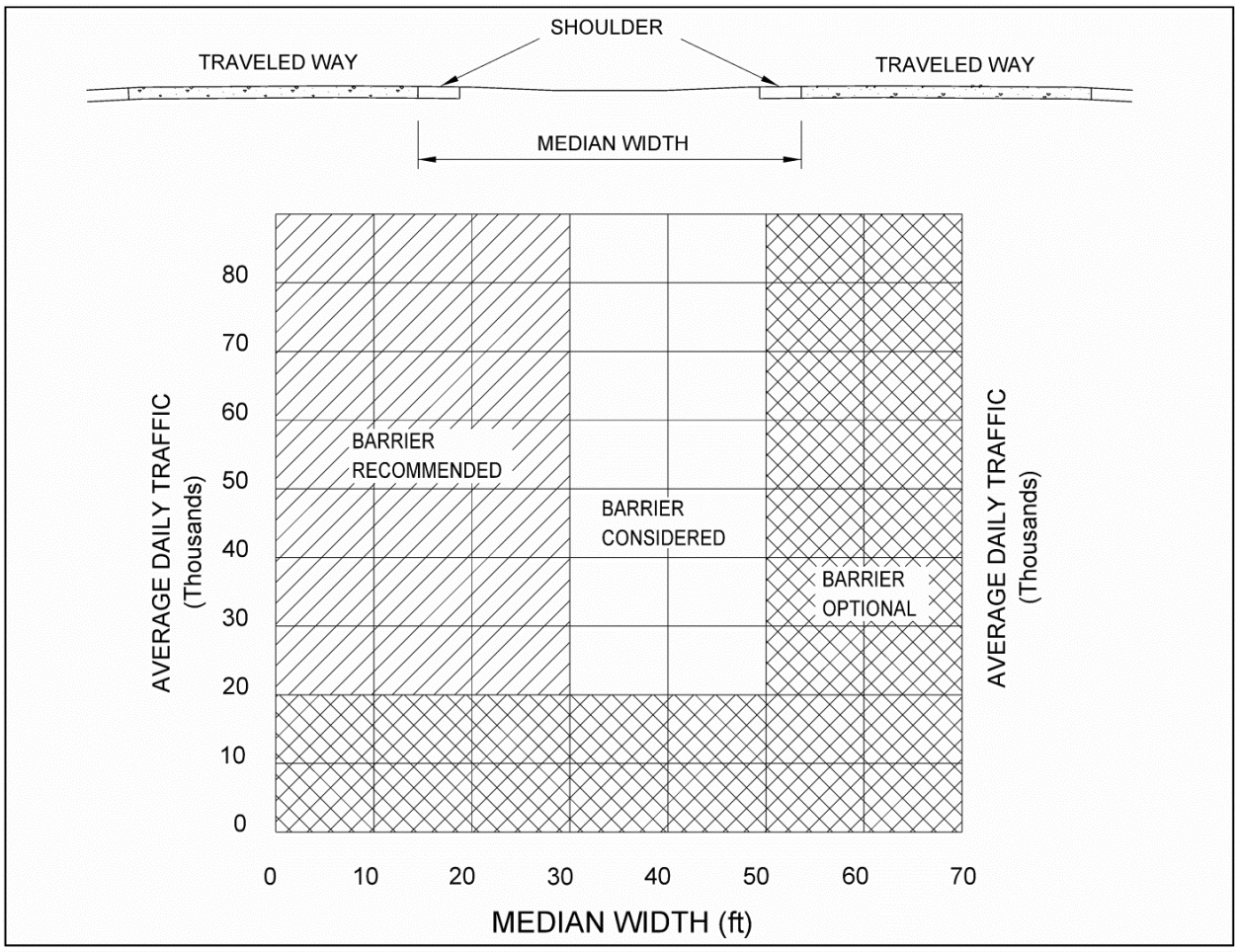


Exhibit 9.22 Guidelines for Median Barriers
Source: Roadside Design Guide (Ref. 9.1)

6.B Median Barrier Systems

Concrete Protection Barrier

The concrete protection barrier (32 inch or 42 inch) should be used in narrow flush medians, depending upon the traffic speed, ADT, and percentage of heavy truck traffic. Both the 32 inch and 42 inch heights provide for a future 3 inch overlay. Concrete median barriers may be precast or cast in place. The barrier ends should be treated with an appropriate terminal section. See the *Standard Plans* (Ref. 9.3) for details.

Semi-Rigid Guardrail

Guardrail may be installed in the median to deflect vehicles from hitting specific obstacles, such as piers, and at dual bridges on divided highways. The preferred installation at a bridge in a median with a width of 40 feet or greater includes a bridge approach section, MGS or W-beam guardrail, and a guardrail end treatment (See Section 4.A and EXHIBITS 9.23 & 9.24).

Cable Guardrail

Cable guardrail may be installed in medians which are of sufficient width to allow for the greater deflection of the cable, 12 feet for a low-tension installation (See EXHIBIT 9.6). Crash tests on high-tension cable guardrail systems have exhibited deflection distances of between 7 feet and 9 feet (deflections of up to 12 feet have been observed in field conditions), but the price of the system is approximately twice that of the low-tension cable guardrail. The installation of high-tension cable guardrail requires **Roadway Design Engineer** approval.

Bullnose

The bullnose guardrail installation may be used on multilane divided highways to protect the motorist from hitting sign bases, bridge ends, bridge piers, or other obstacles in the median or gore area (See EXHIBIT 9.25).

When a bullnose installation is used to protect bridge ends in medians of 40 feet or less in width some **Districts** prefer to connect the bullnose installation from one bridge to the paired parallel bridge; other **Districts** prefer the away side to be unattached so that maintenance has easy access for mowing behind the bullnose. The designer should contact the **DE** or **DCE** to ascertain the preferred installation method (See EXHIBITS 9.26 THROUGH 9.31 for design examples).

Bullnose attenuators are designed so that the front end of vehicles impacting the installation head-on will be wrapped by the guardrail and will decelerate to a stop; side-impacting vehicles will be redirected. The bullnose installation requires 66 feet minimum clearance from the tip of the bullnose to the fixed object. The approaching terrain should be unobstructed and graded 1:10 or flatter for a minimum of 60 feet prior to and under the bullnose for proper performance (See the *Standard Plans*, Ref. 9.3).

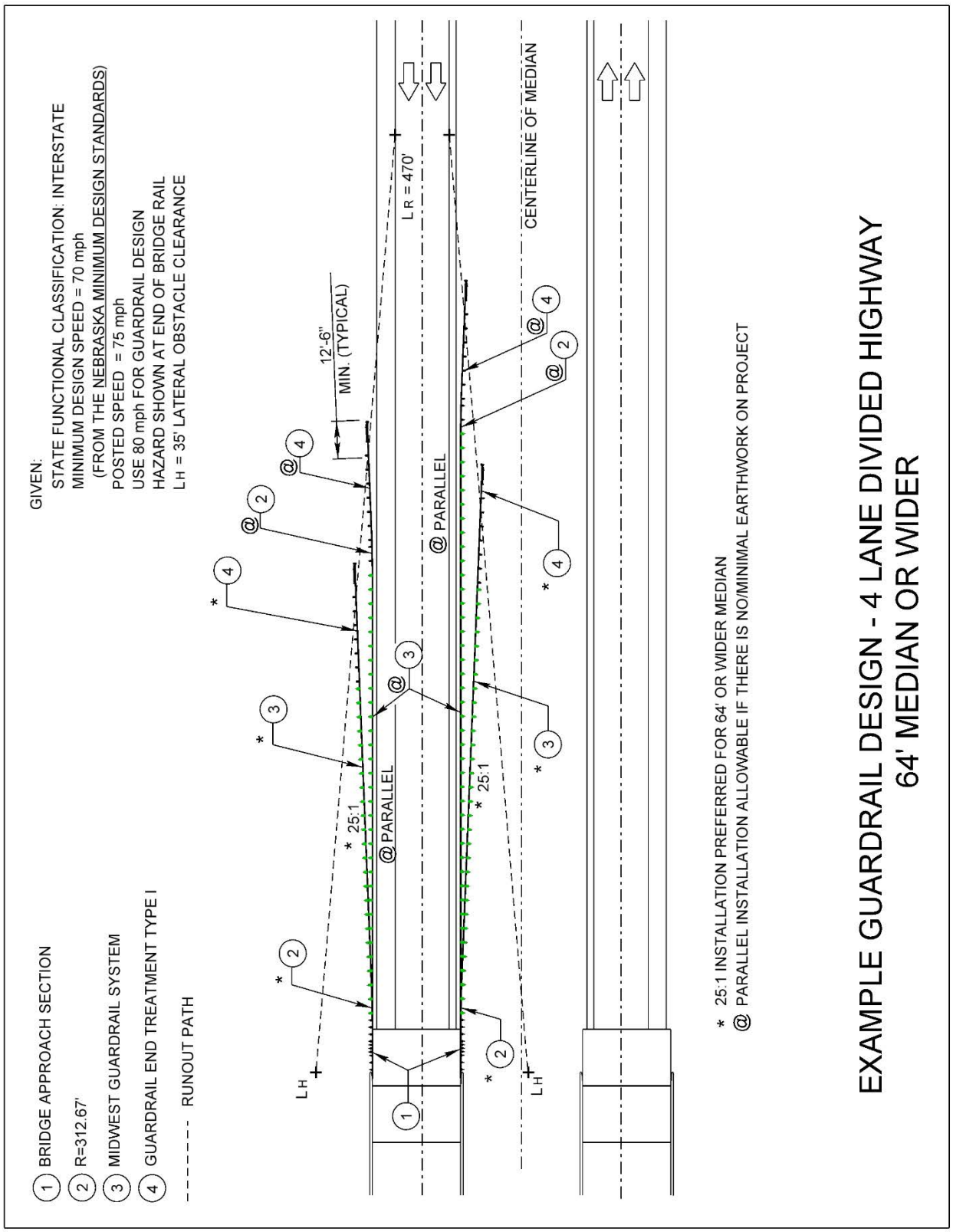


Exhibit 9.23 Example Guardrail Design – 4 Lane Divided Highway: 64 Feet and Wider Median Width

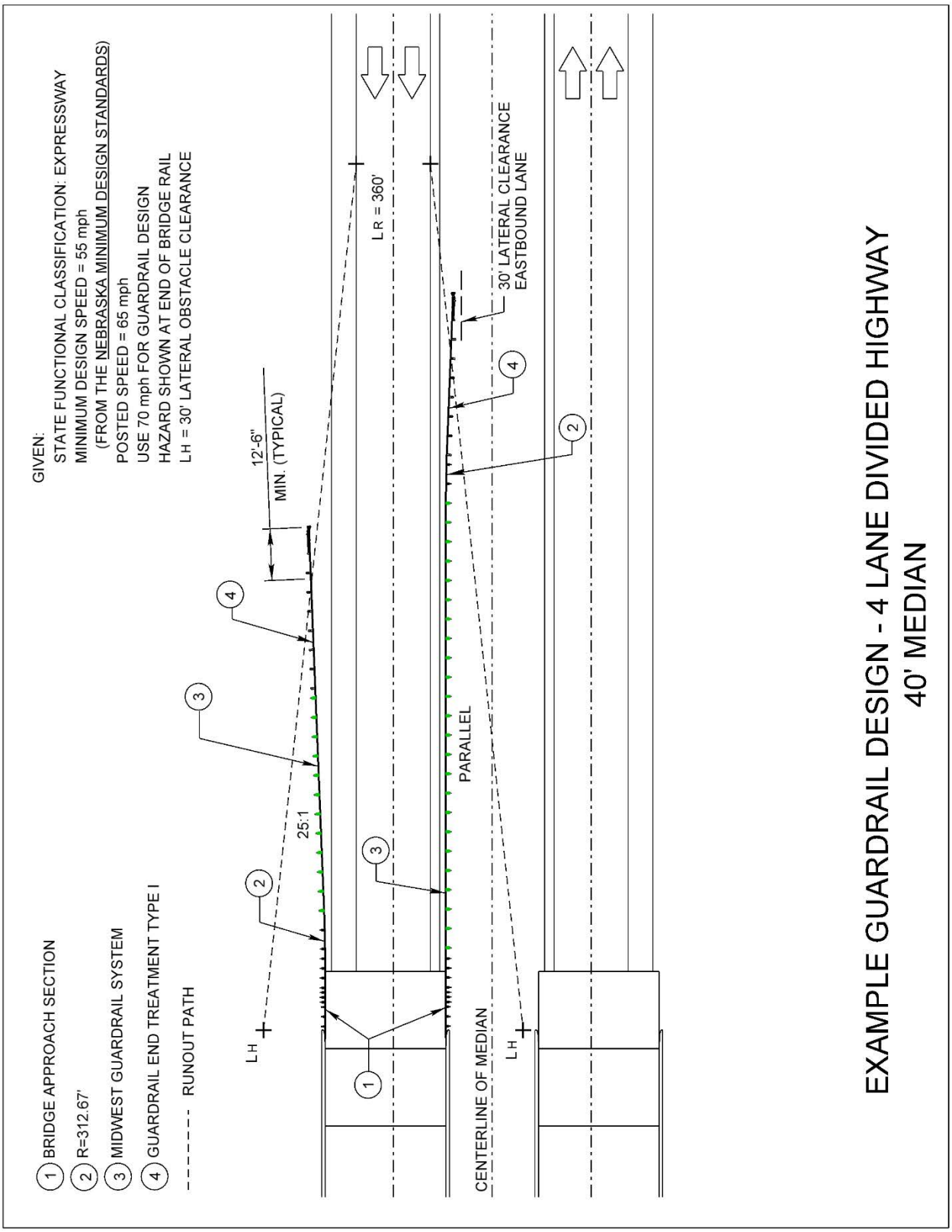


Exhibit 9.24 Example Guardrail Design – 4 Lane Divided Highway: 40 Feet Median Width

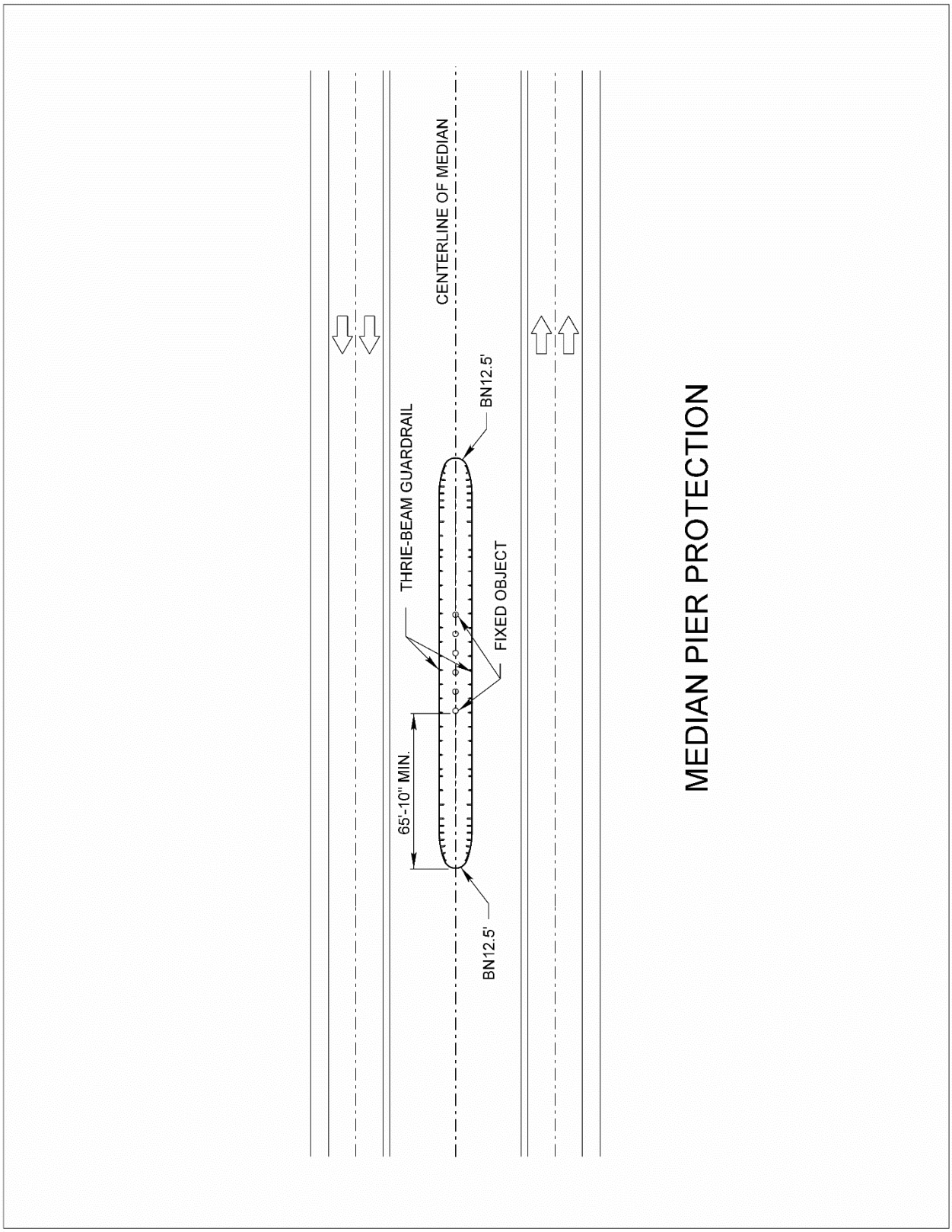


Exhibit 9.25 Example Bullnose Installation for Median Bridge Pier Protection

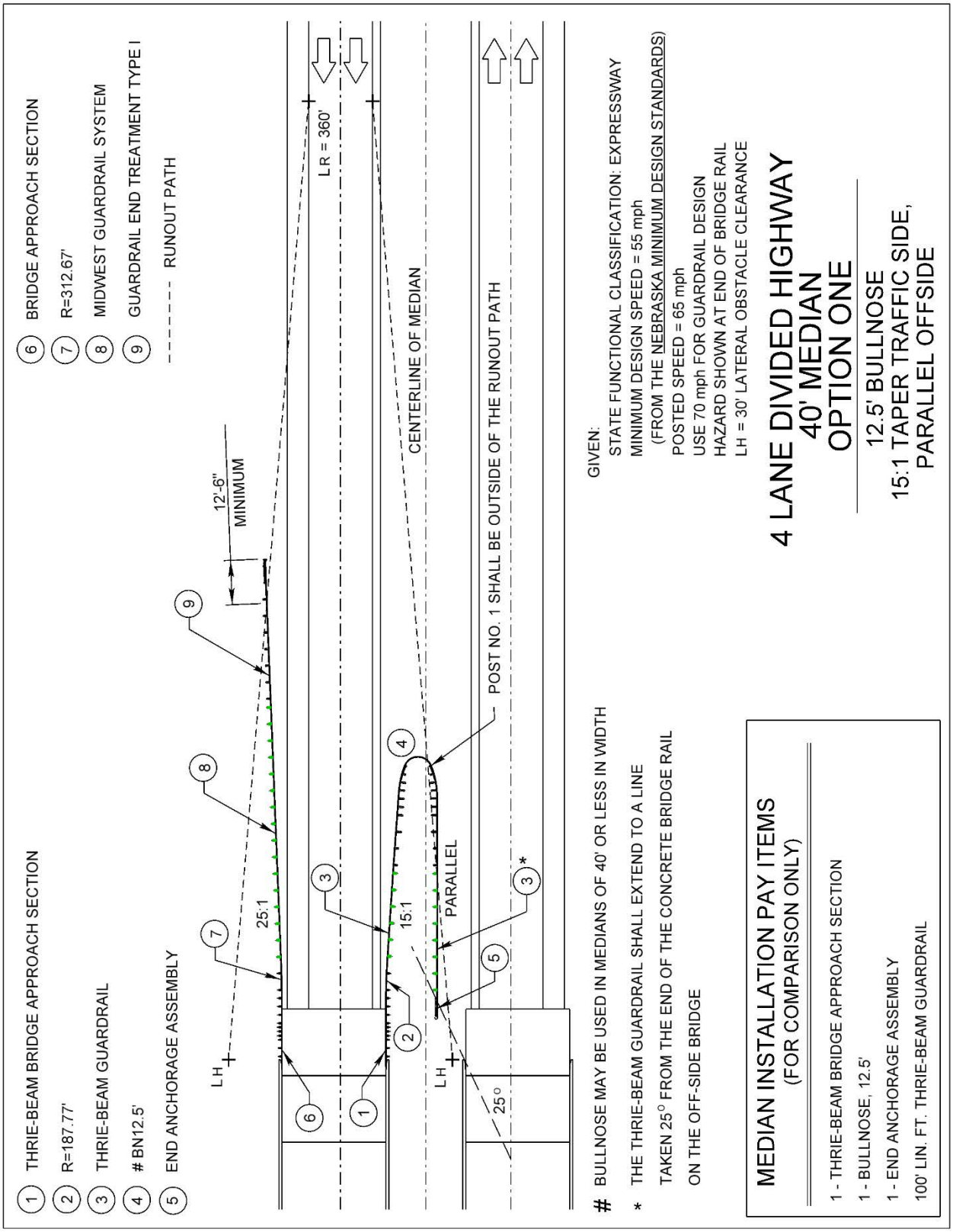


Exhibit 9.26 Example Bullnose Bridge Connection in a 40 Feet Median: Tapered Bullnose, Bridges not Connected

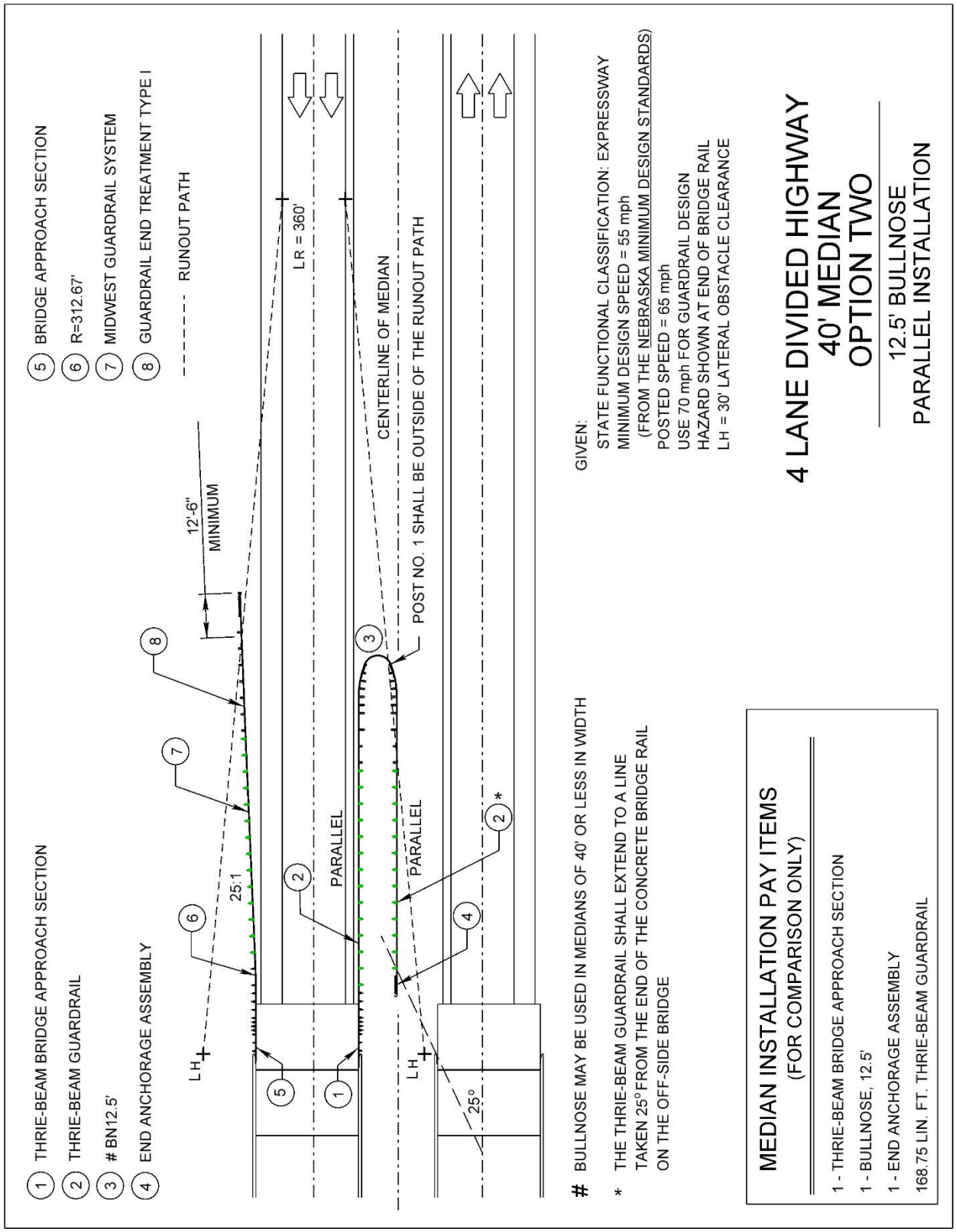


Exhibit 9.27 Example Bullnose Bridge Connection in a 40 Feet Median: Parallel Bullnose, Bridges not Connected

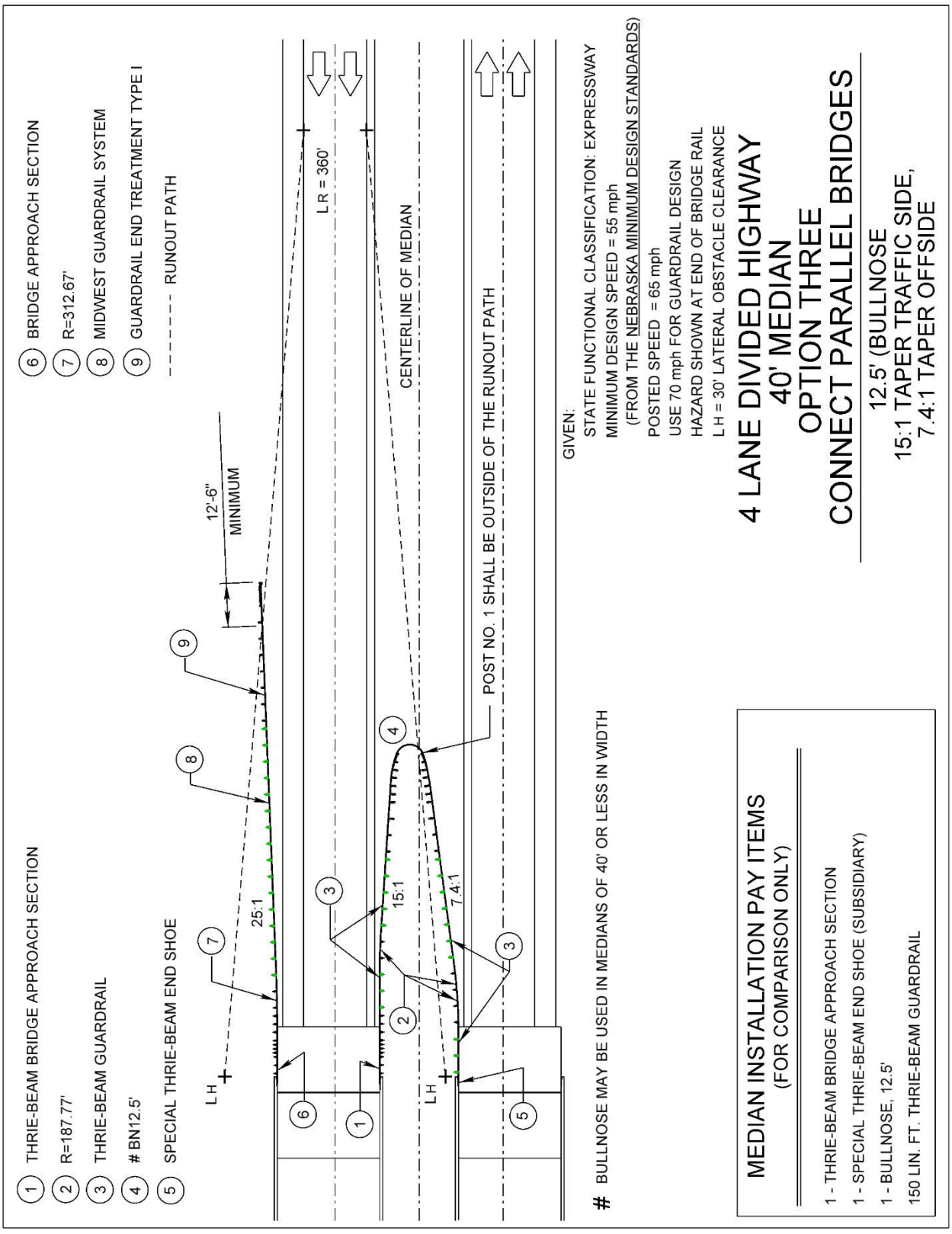


Exhibit 9.28 Example Bullnose Bridge Connection in a 40 Feet Median: Tapered Bullnose, Bridges Connected

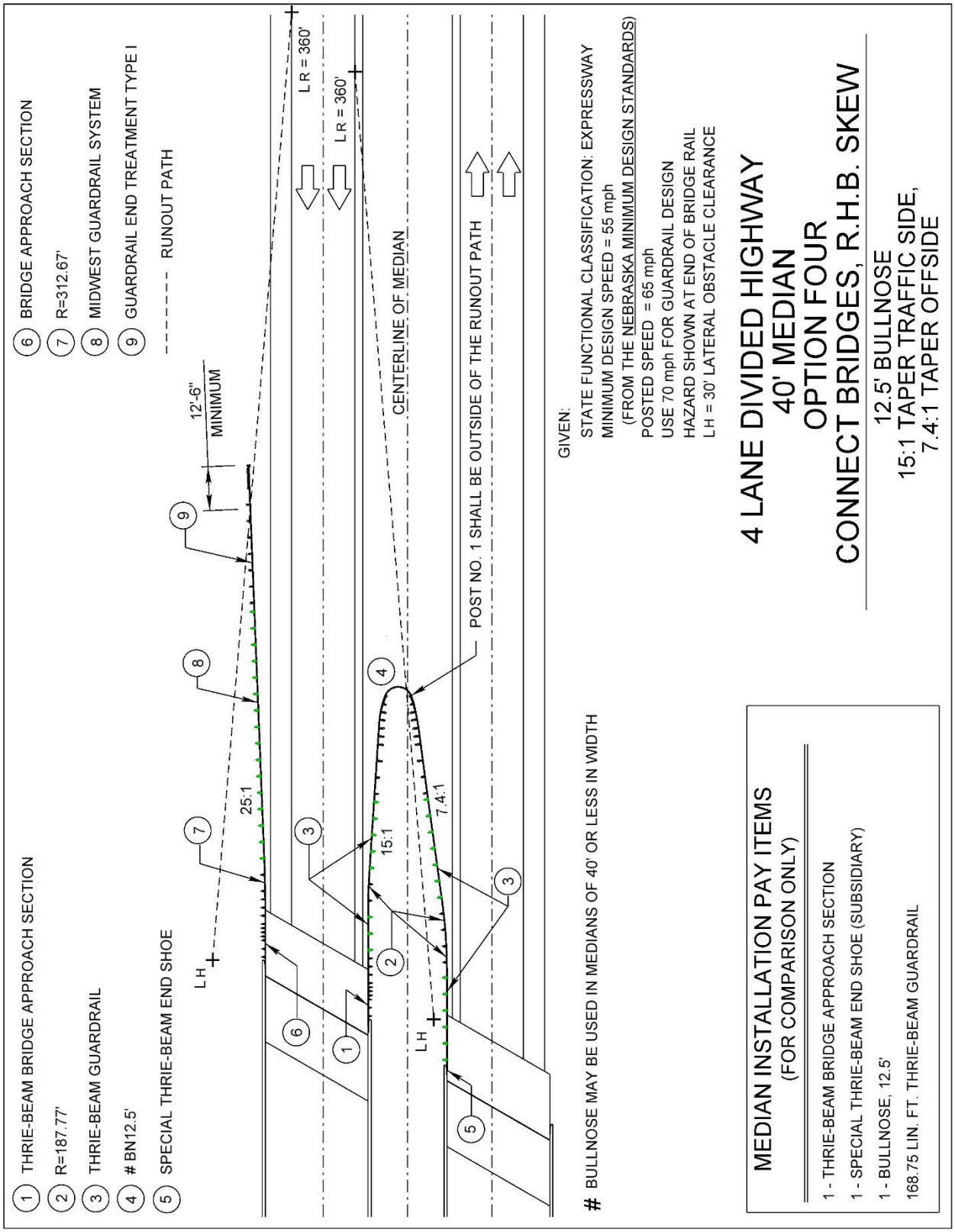


Exhibit 9.29 Example Bullnose Bridge Connection in a 40 Feet Median: Right-Hand-Back Skew, Tapered Bullnose, Bridges Connected

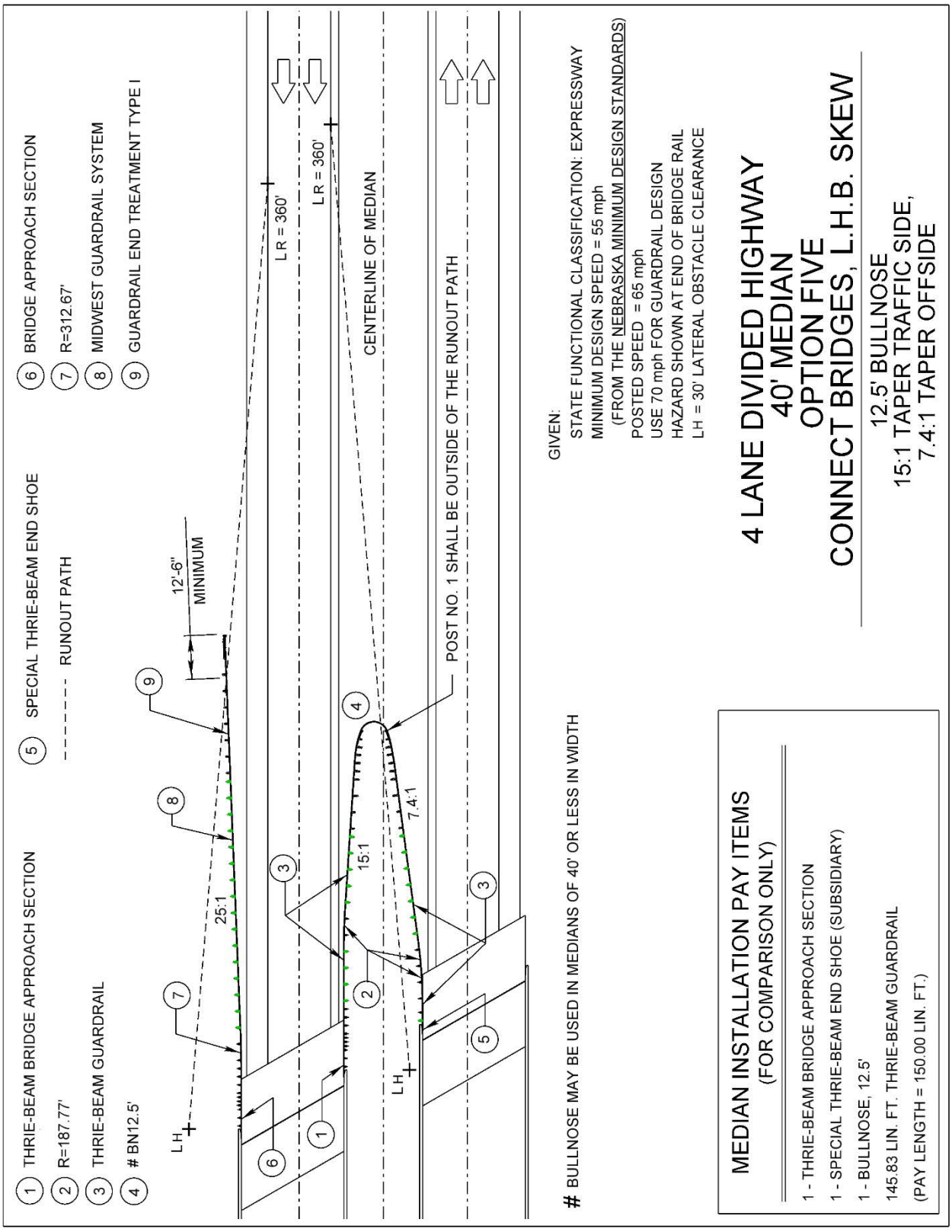


Exhibit 9.30 Example Bullnose Bridge Connection in a 40 Feet Median: Left-Hand-Back Skew, Tapered Bullnose, Bridges Connected

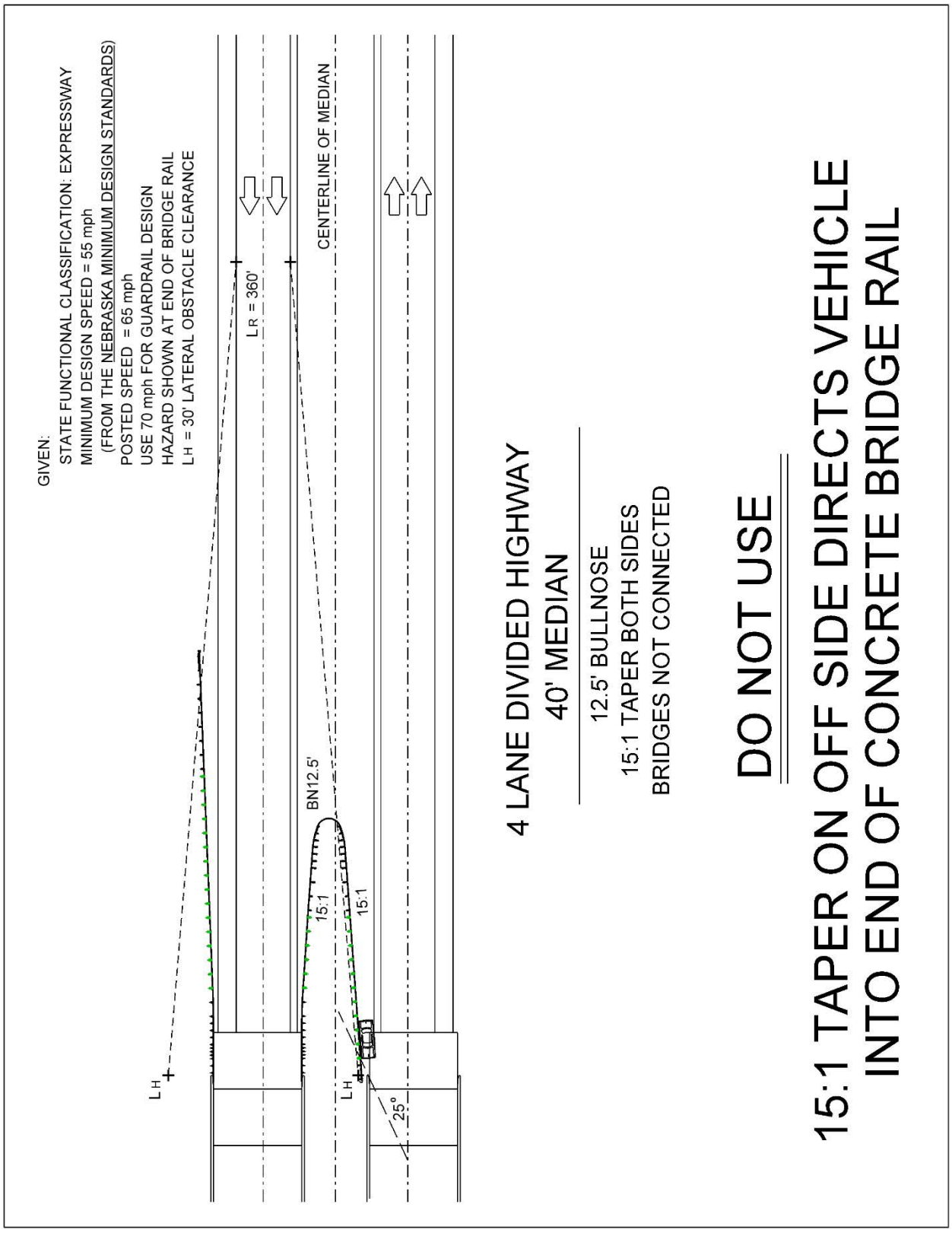


Exhibit 9.31 Example Bullnose Bridge Connection in a 40 Feet Median: Do Not Use

7. SPECIAL INSTALLATIONS

7.A Guardrail at Intersections

When a minor road or driveway intersects a main roadway near a bridge it may not be possible to shield the bridge rail end with a standard guardrail installation. If it is not feasible to relocate the intersecting road, a crash cushion or an impact attenuator should be installed to protect the end of the bridge rail. If no other option is available a curved beam guardrail installation may be used with **Unit Head** approval. An area behind the guardrail, based on the radius of the curved beam, should be free of fixed objects. The standard bridge approach section should be used to transition to a concrete bridge rail. Controlled releasing terminal (CRT) posts are used through the curved section. Low-speed (≤ 45 mph) guardrail end treatments (See Section 4.C) may be used for the terminal on the minor road, an end anchorage assembly may be used for the terminal on driveways, and a guardrail end treatment should be used for the terminal on state highways. See the *Standard Plans* (Ref. 9.3) for an example of this design and for plans of the guardrail components. Further information may be found in the Roadside Design Guide (Ref. 9.1).

7.B Guardrail Over Low Fill Culverts

The *Standard Plans* (Ref. 9.3) illustrates the culvert mounted guardrail post details to be used when full embedment of a guardrail post is not possible, such as over low-fill culverts. Designers should graphically lay out the guardrail post location to use the minimum number of special posts.

7.C Guardrail Spans with Posts Eliminated

The *Standard Plans* (Ref. 9.3) illustrates the MGS design to be used for long spans (up to 25 feet) where guardrail posts are eliminated, such as over low fill culverts or in places where a guardrail post cannot be placed. Note: Posts cannot be eliminated on either a guardrail end treatment or a bridge approach section.

7.D Guardrail and Curbs

If a curb is used in conjunction with a guardrail installation on a high-speed facility (≥ 50 mph), the curb will be either a 3 inch or 4 inch concrete slope curb or a 3 inch asphaltic concrete mountable curb. The desirable curb location will place the back of the curb a minimum distance of 2 feet behind the back of the guardrail post. If curb must be placed in front of a guardrail installation, the back of the curb should be flush with the front face of the guardrail posts.

On low-speed roadways (≤ 45 mph) 6 inch curbs should not be either in front of or for a distance in advance (upstream) of the guardrail end treatment. The minimum curb-free distance should be 25 feet in advance of the first post of the guardrail end treatment. For further information see the Roadside Design Guide (Ref. 9.1), the *Standard Plans* (Ref. 9.3), and EXHIBIT 9.32.

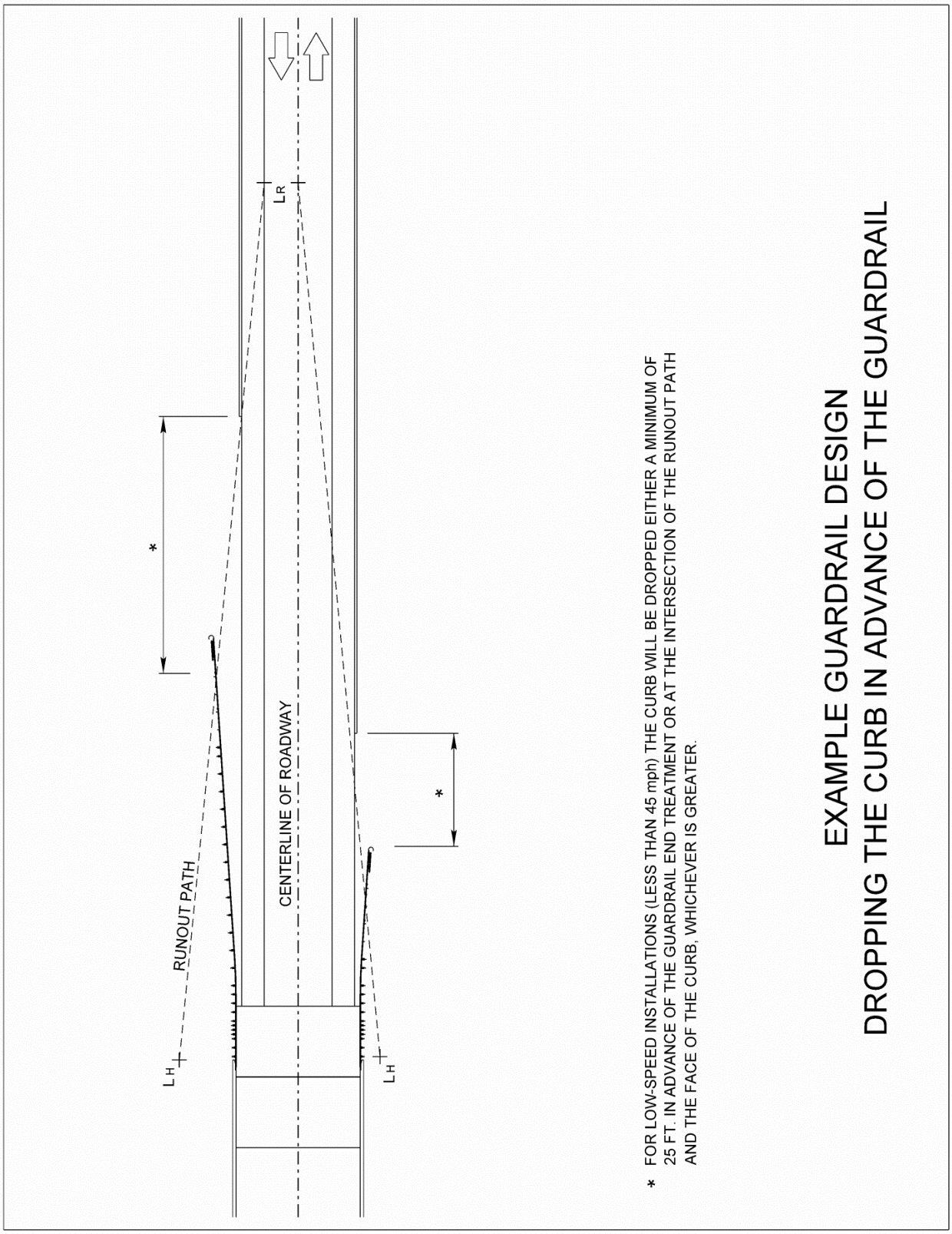


Exhibit 9.32 Dropping the Curb in Advance of the Guardrail

8. CRASH CUSHIONS AND IMPACT ATTENUATORS

Crash cushions are designed to decelerate a vehicle to a stop in head-on impacts and to redirect a vehicle away from rigid objects in side impacts. Crash cushions may be used alone or in conjunction with properly designed longitudinal barriers. Crash cushions may also be used in construction and work zones. See the Roadside Design Guide (Ref. 9.1) for further information on crash cushions and impact attenuators.

EXHIBITS 9.33 & 9.34 and the *Standard Plans* (Ref. 9.3) contain plans and examples of the crash cushions and impact attenuators used by the **NDOT**.

8.A Inertial Barriers

Inertial barriers are sand-filled barrel modules arranged with increasing amounts of sand in the barrels as they are placed closer to the obstacle. Standard module mass varies from 200 to 2100 lbs. Inertial barriers operate by dissipating the energy of an impacting vehicle, transferring the vehicle's momentum to the variable weights of sand in the barrels. Inertial barriers may be used to shield a variety of fixed object obstacles and are used primarily for protection of pole and column bases, lighting supports, and other rigid objects on the ground.

Inertial barriers should be set as far from the travel lanes as possible to avoid nuisance hits. The width of the last row of modules should be greater than the shielded object. The individual manufacturers supply design details for barrel layout. See the Roadside Design Guide (Ref. 9.1) for additional information.

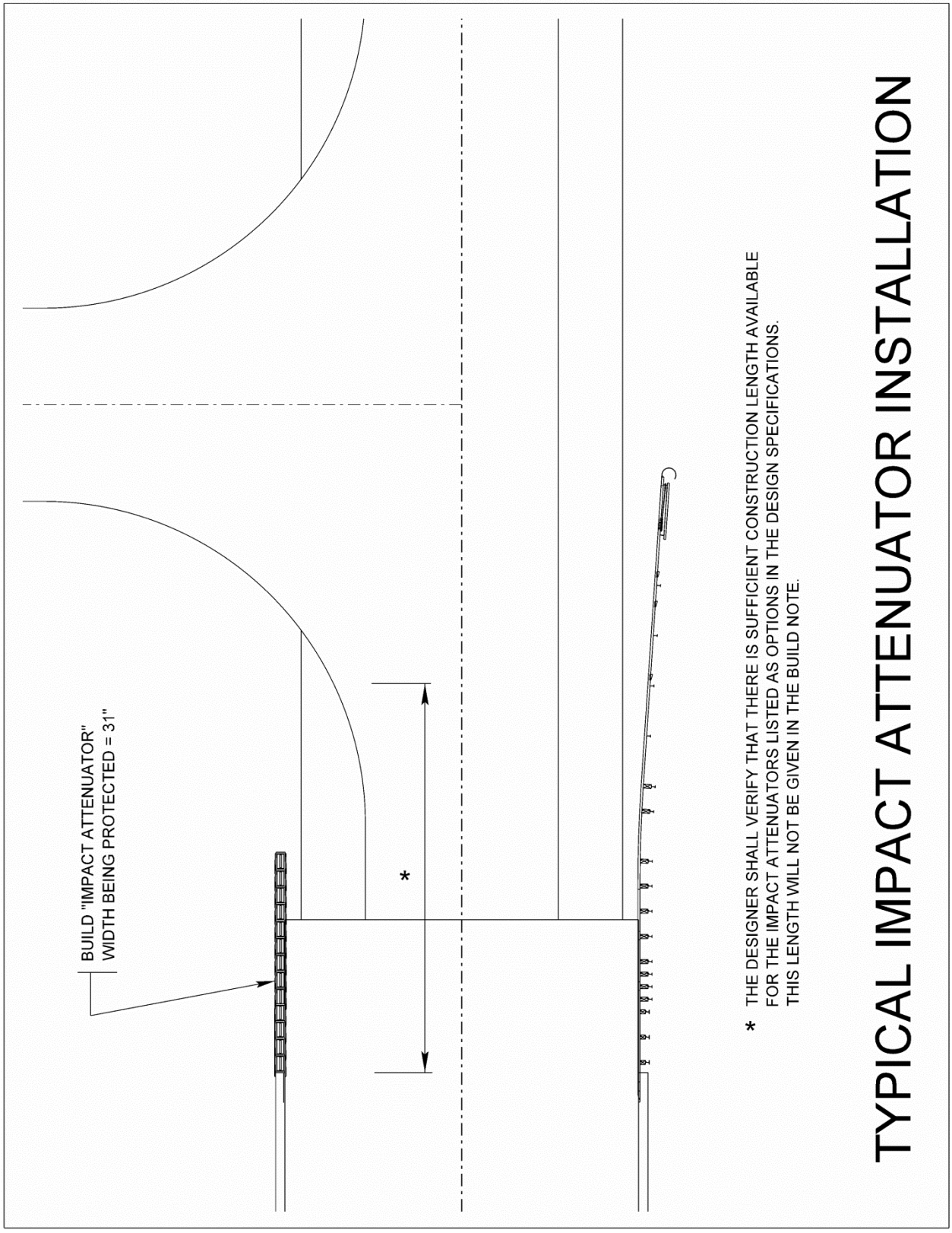


Exhibit 9.33 Typical Impact Attenuator Installation at a Bridge Adjacent to an Intersection or Driveway

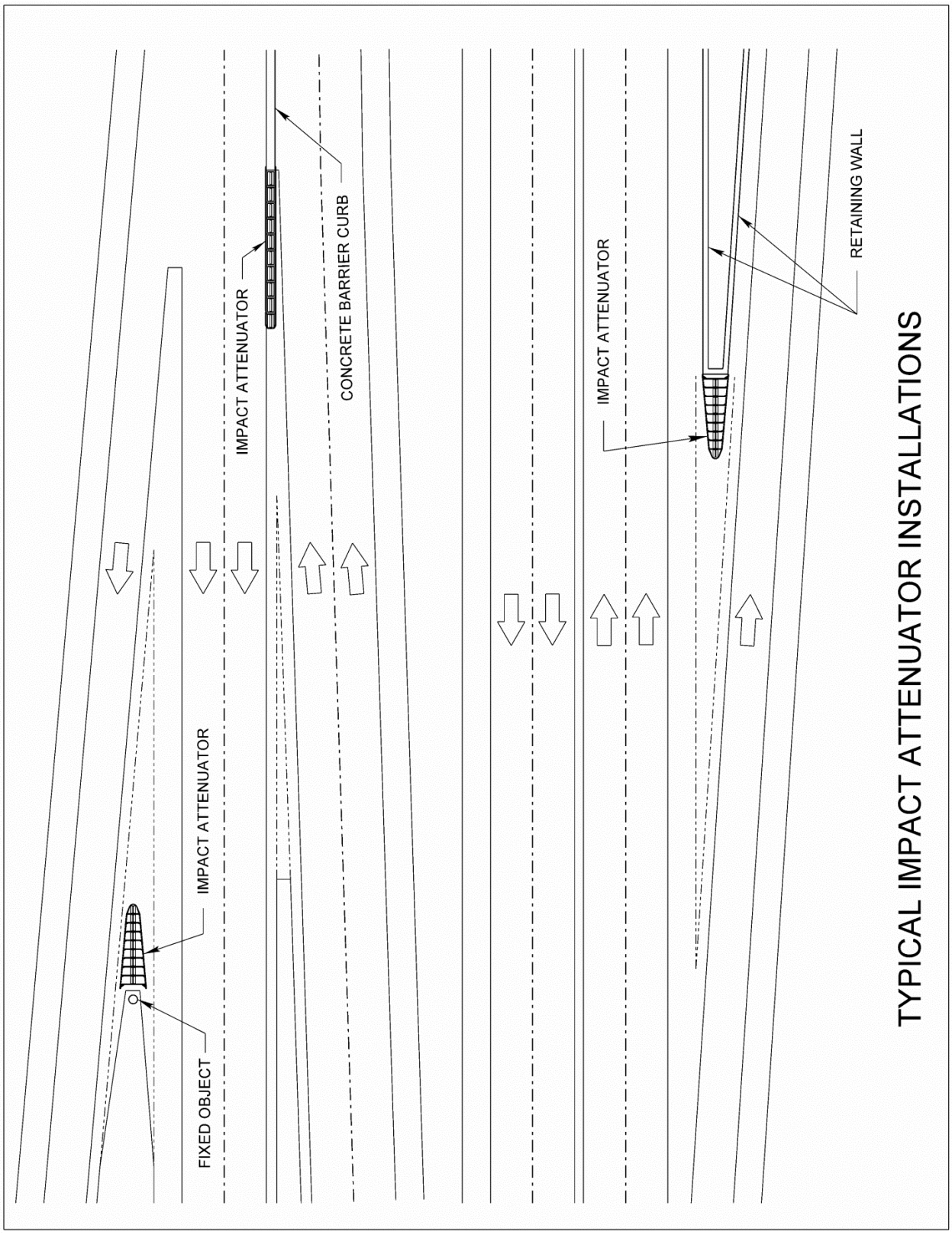


Exhibit 9.34 Typical Impact Attenuator Installations

9. REFERENCES

9.1 American Association of State Highway and Transportation Officials, Roadside Design Guide, Washington, D.C., 2011.

9.2 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards (*MDS*), Current Edition. (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/)

9.3 Nebraska Department of Transportation, Standard/Special Plans Book (*Standard Plans*), Current Edition. (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/)

9.4 Nebraska Department of Transportation, Standard Specifications for Highway Construction (*Spec Book*), 2007. (http://roads.nebraska.gov/media/6897/specbook-2007.pdf)

The information contained in Chapter Ten: Miscellaneous Design Issues, dated July 2006, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this chapter.

Chapter Ten
Miscellaneous Design Issues

1. RAILROAD/HIGHWAY GRADE CROSSINGS

Railroad-highway crossing design must consider approach grades, sight distance, drainage, highway traffic volume and the frequency of train movements. The traffic volumes and frequency of train movements should be used as the basis for evaluating the exposure factor. If the current number of vehicles using the crossing multiplied by the number of trains per day is 50,000 or greater, grade separation should be considered. Existing railroad and site conditions will dictate whether an underpass or overpass should be used.

The ideal crossing geometry at railroad/highway grade crossings is a right angle intersection of track and highway, with slightly ascending grades on both highway approaches to reduce the flow of surface water toward the crossing. For general coordination of mainline alignment at railroad grade crossings, the following design considerations apply:

1. Horizontal Alignment. The highway should intersect the railroad at a right angle without intersections or driveways nearby. This configuration maximizes the driver's view of the tracks and minimizes conflicting vehicular movements from crossroads and driveways. Crossings should not be located on either highway or railroad curvature where practical. Highway curvature limits the driver's sight distance and may cause the driver to concentrate on negotiating the curve rather than looking for a train. Railroad curvature may inhibit a driver's view down the tracks. Superelevation also complicates a crossing on a curve and may result in maintenance and rideability problems.

   If the intersection between track and highway cannot be made at right angles, the variation from 90^{o} should be minimized. At skewed crossings, motorists must look over their shoulders to view the tracks. Because of this awkward movement, some motorists may only glance quickly and not take the necessary precaution. Elimination, consolidation, relocation, realignment and signalization of crossings are all options that should be considered. Early coordination with the **Railroad Liaison Engineer** in the **Intermodal Planning Division** is required.

2. Vertical Alignment. Preferably, vertical alignment should be as flat as possible at railroad intersections to enhance sight distance, rideability, and braking and acceleration distances. Vertical curves should be of sufficient length to ensure an adequate view of the crossing. The roadway grade shall match the railroad grade. If the roadway crosses the railroad at a superelevated track section the roadway profile shall be designed to incorporate the railroad superelevation.

> A Policy on Geometric Design of Highways and Streets, (Reference 10.2c), Chapter 9, Exhibit 9-102 recommends that the crossing surface be in the same plane as the top of rails for a distance of 2 ft. (0.6 m) outside of the rails and that the surface of the highway shall not be more than 3 in. (75 mm) higher nor 6 in. (150 mm) lower than the top of the nearest rail at a point 30 ft. (9 m) from the rail, unless track superelevation dictates otherwise.

In cases where a railroad company has a maintenance road parallel to the tracks, it may be necessary to provide access for railroad maintenance across the highway. Cases such as this, and those involving horizontal clearances, may require special consideration. The designer should contact and coordinate with the **Railroad Liaison Engineer**.

When railroads and highways parallel each other in close proximity there is a possibility that long vehicles will not clear the railroad tracks when stopped at an access road to a state highway. The designer should provide sufficient distance along the parallel state highway for truck storage in these cases. When the highway is on new alignment, it is desirable to have 85 ft. (25 m) to 110 ft. (35 m) of storage between the railroad stop bar and the edge of the highway shoulders. This translates to about 110 ft. (35 m) to 145 ft. (45 m) from centerline of the closest railroad track to the edge of the closest through highway lane.

Where parallel railroad tracks run within 200 ft. (60 m) of the edge of the pavement and are intersected by surfaced roadways (highway, county or other), it is preferable to pave to the tracks instead of stopping at the end of the return. Work of this nature can be accomplished by a special provision only, as prepared by the **Railroad Liaison Office**. For additional information see Chapter Four: Intersections, Driveways, and Channelization, Section 3.A and EXHIBIT 4.20.

Geometric design of the railroad-highway grade crossing should be done in concert with the determination of the appropriate traffic control devices (e.g., signs, pavement markings, flashing light signals and automatic gates). The **Traffic Engineering Division** should be consulted to coordinate design.

1.A Railroad/Highway Crossing Surfacing

Each rail line has specific crossing requirements. Some railroads prefer crossings with high tonnage main line tracks to have at least 10 ft. (3.05 m) of asphalt surfacing between the edge of a crossing and a concrete roadway surface (See EXHIBIT 10.1). This allows replacement or installation of concrete cross ties with on-track equipment without removing concrete roadway surfacing. At other locations the concrete pavement should end at least 6 in. (150 mm) from the edge of timber or concrete crossings (See EXHIBIT 10.2). This 6 in. (150 mm) gap is filled with asphalt to keep the expansion of concrete from moving track out of line and allows the railroad to replace crossing and timber cross ties.

Railroad crossings may be of various types, (such as timber, concrete or rubber), and widths. The railroad company will construct the railroad crossing. The designer should contact the **Railroad Liaison Engineer** to determine the type and width of railroad crossing to be used. For further information see Chapter Twelve: Cost Estimating and Funding, Section 1.A.5 and Chapter Thirteen: Planning and Project Development, Section 5.G.

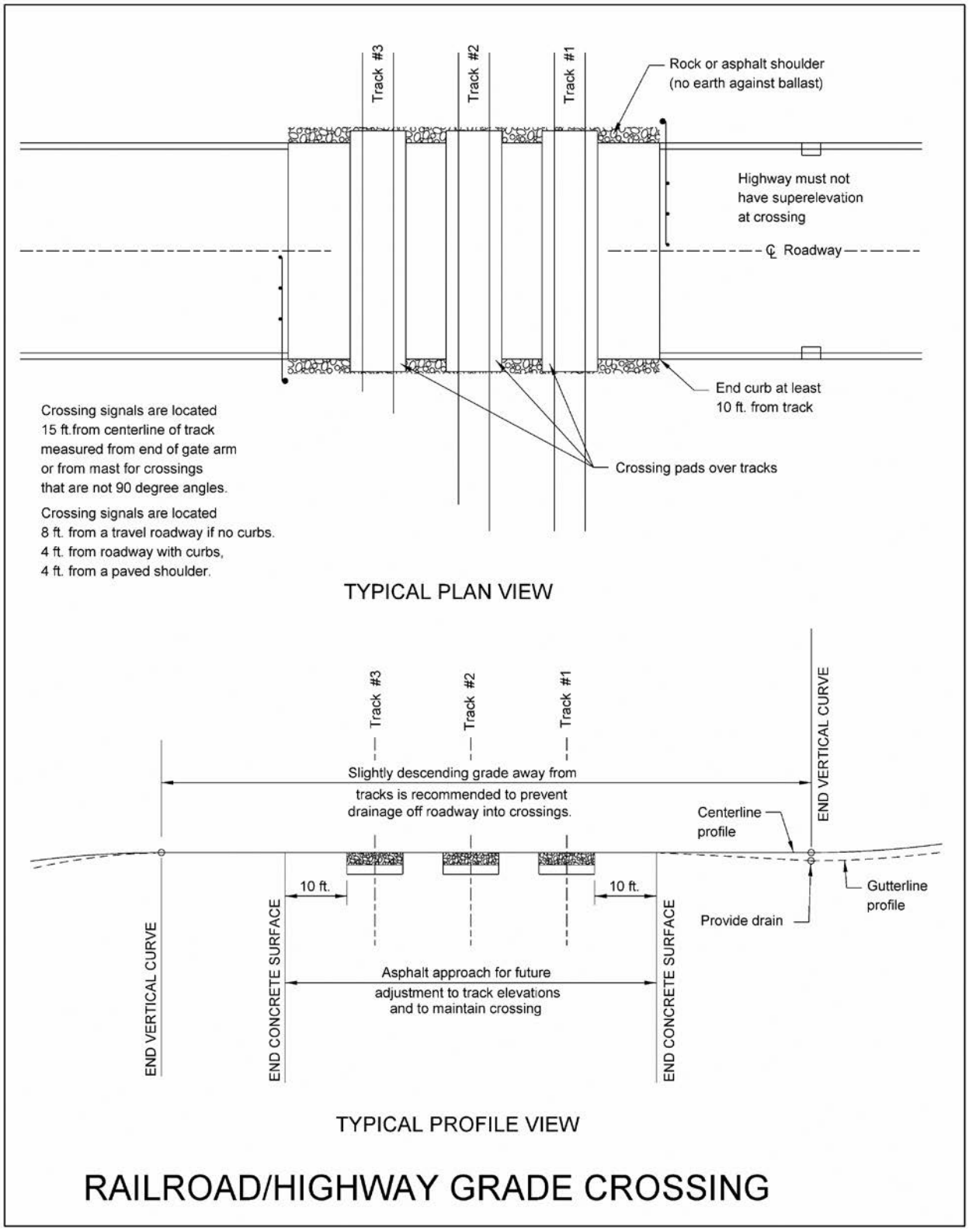
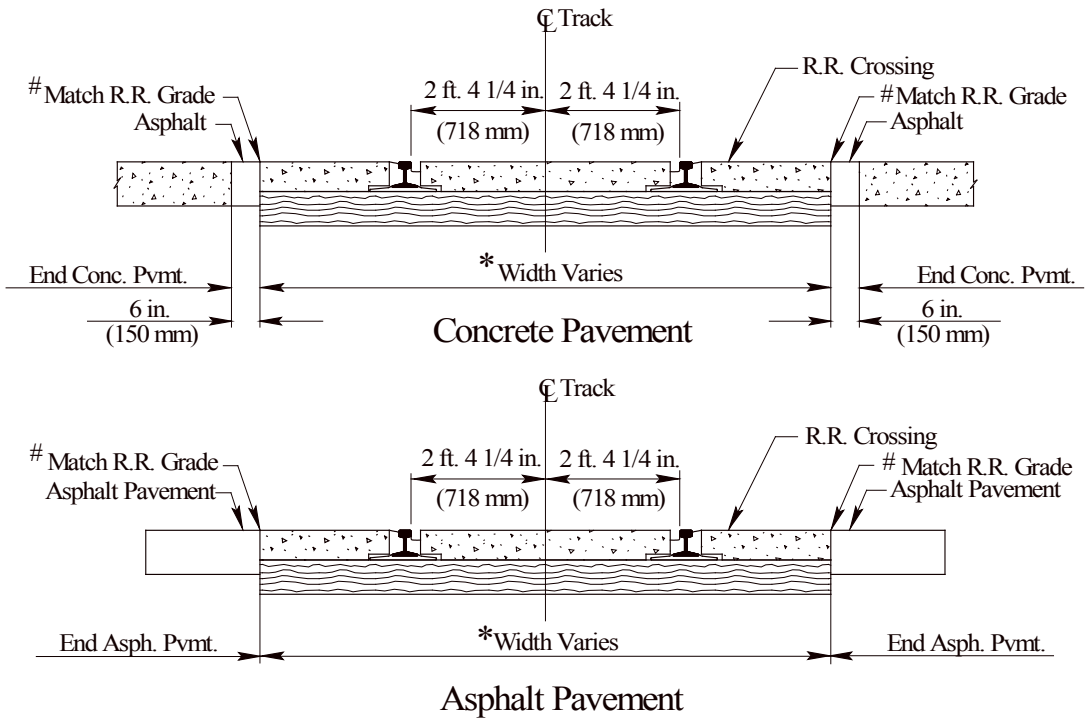


Exhibit 10.1 Railroad/Highway Grade Crossing



If the railroad track is in a superelevated section, the highway grade line will match the railroad superelevation.
*Contact the Railroad Liaison Engineer for the type and width of railroad crossing being used.

Railroad/Highway Grade Crossing

Exhibit 10.2 Railroad/Highway Grade Crossing

2. BRIDGE STRUCTURES

The **Federal Highway Administration** defines a bridge as "*A structure, including supports, erected over a depression or an obstruction, such as water, a highway, or a railway, having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 ft. between undercopings of abutments or spring lines of arches, or extreme ends of the openings for multiple boxes; it may include multiple pipes where the clear distance between openings is less than half of the smaller contiguous opening*." If a multiple span concrete box culvert, as measured from the inside surface of the outer wall to the inside surface of the outer wall, is less than 20 ft. along the centerline of the roadway it is a culvert and shall be designed by the roadway designer, (See the Drainage Design and Erosion Control Manual, Reference 10.3). If a multiple span concrete box culvert measures more than 20 ft. along the roadway centerline it is a bridge and its design shall be referred to the **Bridge Division Hydraulics Unit**. The designer shall pay particular attention to the effect of a skew on a box culvert as the skew may increase the length of a multiple span concrete box culvert, as measured along the roadway centerline, to bridge length.

The design of horizontal and vertical roadway alignments must be carefully coordinated with any bridges or other structures located within the project limits. Proper coordination may eliminate undesirable bridge characteristics.

2.A Horizontal Curvature

If practical, horizontal curves and superelevation transitions should be avoided on bridges. However, safety is the primary consideration and introducing sharp horizontal curvature on approaches to avoid placing a curve on a bridge is not considered practical. Where a curve is required on a bridge, developing the superelevation on the approaching roadways and carrying the fully superelevated section continuously across the structure can simplify both bridge design and bridge construction. Due to the prevailing snow and ice conditions, the maximum superelevation rate permitted by **NDOT** on bridge structures is 6%.

In some cases superelevation transitions are unavoidable on bridges and, while less desirable, can still be properly designed and constructed. The designer should coordinate the superelevation design with the **Bridge Division** in the early stages of design (before bridge design is completed).

Superelevated roadways on bridges should not have a break in cross slope where the travel lane meets the shoulder. In other words, shoulder rollover is not permitted on bridge decks. If a break is provided between shoulder and roadway on the superelevated approach to the bridge, the section should transition to a continuous plane prior to the bridge structure.

See Chapter Three: Roadway Alignment, Section 2, for further information

2.B Skewed Structures

EXHIBIT 10.3 illustrates the method for defining the crossing angle or skew, between the mainline facility and the feature intersected (e.g., topographic anomalies, railways, waterways, etc.). When a bridge structure intersects a feature at a skew, the bridge abutments and piers are usually constructed parallel to the feature intersected to provide adequate horizontal clearances and reduce span lengths. Piers for structures over waterways are set parallel to the direction of the flood flow. Skewed intersections increase structure length, complexity and costs.

For bridge structures over roadways, railways and waterways, the maximum practical skew is 45º. Larger skews can be accommodated for facilities intersecting roadways and railways but require additional design and construction work. For culverts, the maximum desirable skew is 35º. The Standard/Special Plans Book, (Reference 10.4), provide details for concrete box culverts with skew angles ranging from 5º to 35º, in 5º increments.

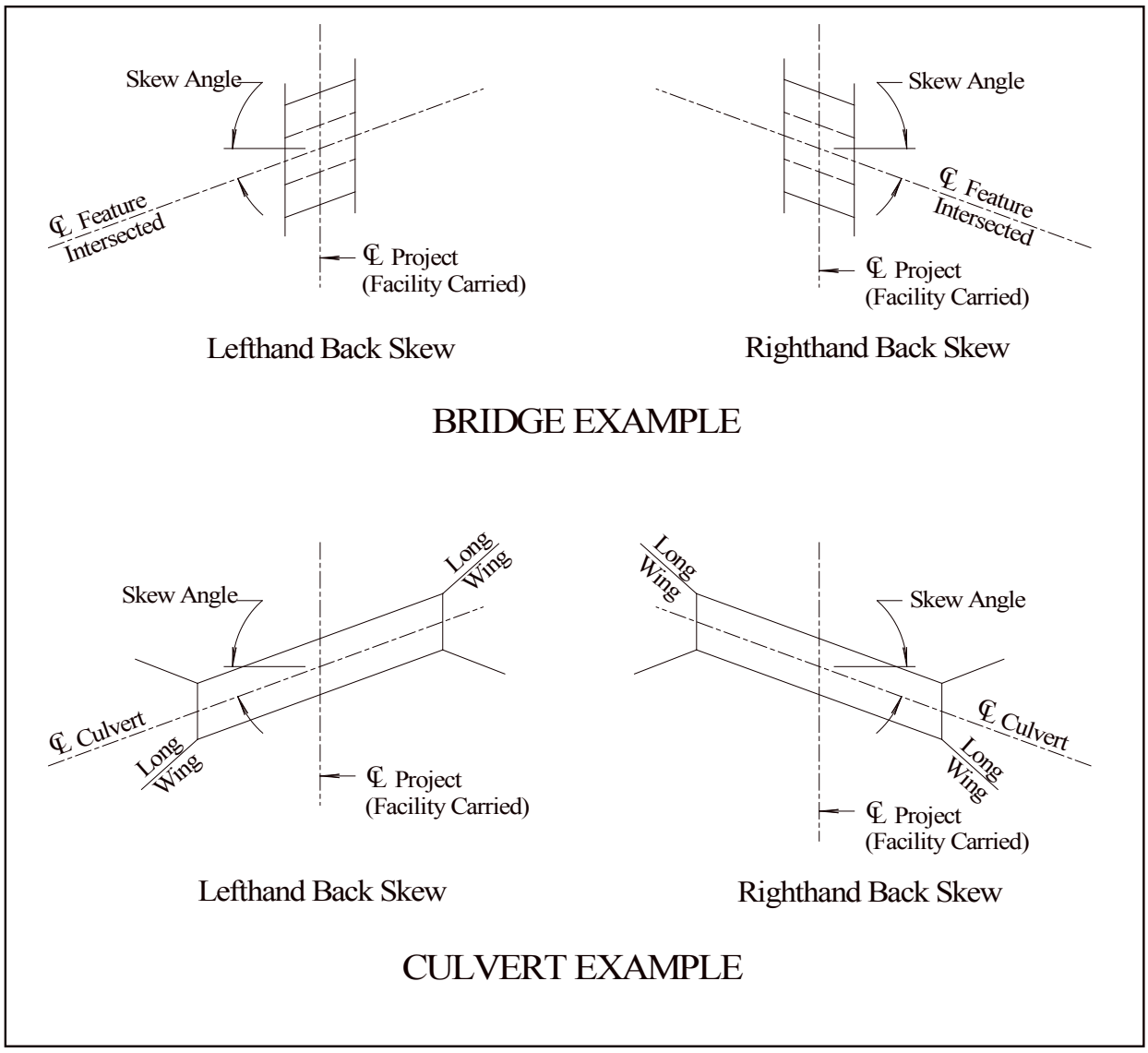


Exhibit 10.3 Skew Angle Definition

2.C Bridge Grades

Avoid vertical profile grades on bridges in excess of 5% to 6% as this can complicate the bearing design for certain types of bearing devices. Also, unanticipated movement can occur on bridges that are built to a steep grade. The grade line on bridge decks should preferably be tangent. For long bridges where drainage is confined to the bridge deck, a 0.5% grade is the desirable minimum.

2.D Vertical Curvature

Avoid placing bridges on crest and sag vertical curves with K values in excess of 143 U. S. Customary (43 Metric) as they may have an inadequate longitudinal slope to drain the bridge deck. Longitudinal drainage is not a significant concern for bridges with open, free-draining rail systems. See Chapter Three: Roadway Alignment, Section 3, for further information.

2.E Vertical Clearances

2.E.1 Grade Separations

Minimum vertical clearances for various conditions are shown in EXHIBIT 10.4. The minimum vertical clearance shall be measured from the high point of the roadway, including turf shoulders, which may or may not be at the profile grade point. The values provided are intended for general guidance only. Final grade decisions should be coordinated with the **Bridge Division**.

Vertical alignment will need to be coordinated with structural requirements for superstructure depth to allow for proper clearance between grade separations. The **Bridge Division** will provide a preliminary estimate of superstructure depth for the types of structures to be used so that preliminary grades can be designed.

Where practical, the low point of a sag vertical curve for a roadway under a bridge should be located at least 100 ft. (50 m) from the limits of the bridge structure. This will help to reduce the need for drainage structures under the bridge and will reduce the ponding of water that may weaken the earth foundation beneath the bridge. Ice accumulation on the roadway would also be minimized since the low point of the sag vertical curve would not be located within the shadow of the bridge structure.

Type	Minimum Clearance
New Structures *	16.40 ft. (5.00 m) (1)
Structure to be used in place, DR1 *	16.08 ft. (4.90 m) (2)
Structure to be used in place, DR2 – DR6 & 3R *	14.44 ft. (4.40 m) (2)
Roadway or pedestrian bridge over railroad	23.50 ft. (7.16 m) (3)
Roadway under pedestrian bridge	17.00 ft. (5.20 m) (4)

1. It is desirable to include a 0.50 ft. (150 mm) allowance for future resurfacing.
2. 16.40 ft. (5.00 m) is desirable.
3. Measured above the plane of the top-of-rails. If the required vertical clearance cannot be met, a minimum vertical clearance of 23.00 ft. (7.01 m) may be used with the approval of the **Assistant Bridge Engineer** in the **Bridge Division**.
4. The pedestrian overhead structures require an additional margin of safe clearance because they are relatively light in weight and could be knocked down by vehicle impact. Such an occurrence may cause accidents as the structure could drop across traffic lanes.

Note: Minimum vertical clearances also apply to roadway shoulders.

* See Section 001.02 of the Nebraska Minimum Design Standards, (Reference 10.5), "NEW AND RECONSTRUCTED RURAL – STATE HIGHWAY SYSTEM" and "NEW AND RECONSTRUCTED MUNICIPAL – STATE HIGHWAY SYSTEM" (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/).

Exhibit 10.4 Minimum Vertical Clearances for Structures

2.E.2 Stream Crossings

Bridges over meandering rivers, streams and other natural waterways preferably should not be located on a bend in the channel. This can result in less than desirable stream flow characteristics and may require excessive rock embankment to protect the structure from erosion and scour. Divided roadway facilities intersecting with a bend in a natural waterway may require construction of parallel bridges with different span configurations in lieu of the more desirable twin bridge configuration.

The vertical profile design in the vicinity of a stream crossing and the allowable overtopping frequency for the roadway dictate the required waterway opening for a bridge structure. The **Bridge Hydraulics Section** determines required waterway openings. Prior to preliminary design, the roadway designer will provide the **Bridge Hydraulics Section** with a very preliminary, "best guess" profile at bridge locations for use in hydraulic analysis. For some conditions required waterway openings may consist of the combined bridge opening and roadway overtopping. EXHIBITS 10.5 AND 10.6 illustrate the basic criteria used to establish bridge length and vertical profile for crest and sag or level profiles, respectively.

2.F Intersections

Avoid placing bridges close to intersections if possible, particularly where guardrail is required.

2.G High Embankments

Embankment for grade separation structures should be of sufficient height to ensure that adequate vertical clearance is provided over the facility intersected. Excessive embankment height will increase span length thus increasing costs.

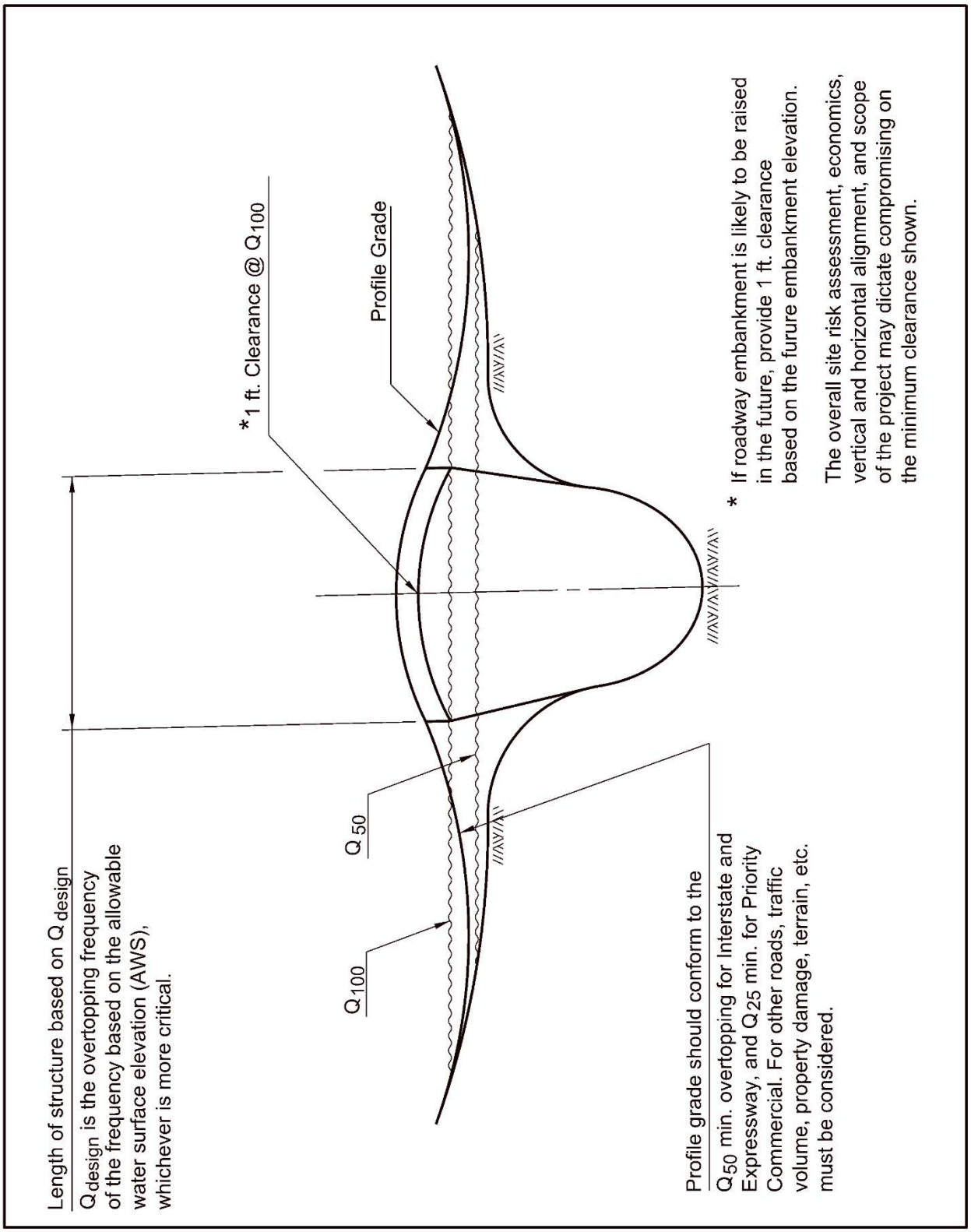


Exhibit 10.5 Vertical Stream Clearances for Crest Profile

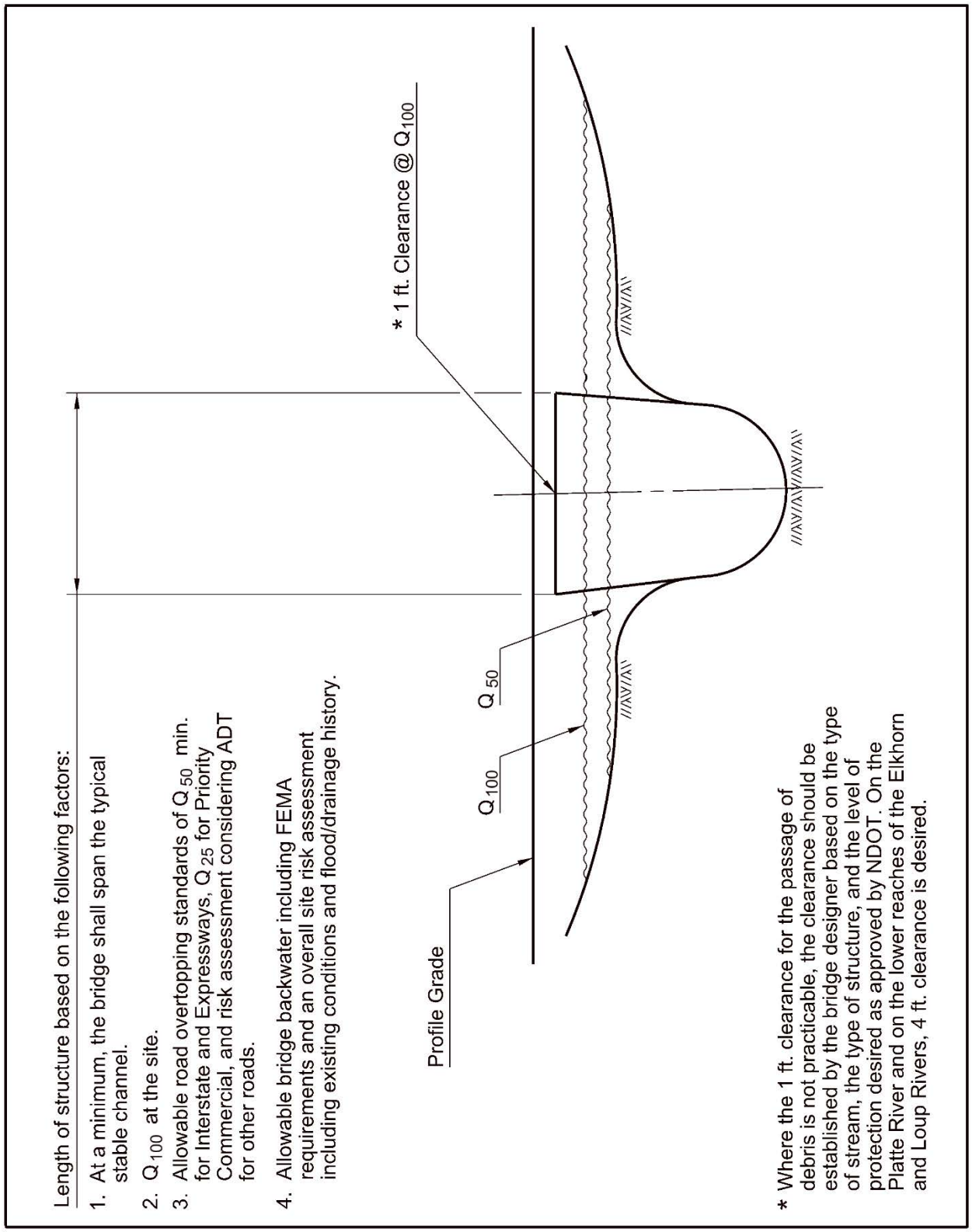


Exhibit 10.6 Vertical Stream Clearances for Sag or Level Profile

3. LANDSCAPING

Landscaping is an ongoing and essential part of **NDOT's** Six-Year Plan and is the responsibility of the **Project Development Division**. Landscaping includes, but is not limited to, plantings, scenic view development, use of retaining walls, median treatments, slope rounding, berms, aesthetic treatment for noise walls, and other treatments for environmental, functional or aesthetic purposes.

Landscaping provides many functional and aesthetic benefits that are as integral to good roadway design as are geometrics. Landscaping should enhance the visual quality of the roadway environment, thus reducing the impact of the roadway on the adjacent area. The goals of landscaping include:

- Enhance the safety of the roadway by maintaining recovery areas for errant vehicles.
- Accentuating the roadway features with appropriate plantings.
- Reduce maintenance costs by the use of living snow fences, erosion control, limited mowing, and the prompt removal of tree seedlings.
- Conserve, enhance and effectively display the natural environment and beauty of the roadway landscape, providing a pleasant driving experience for the traveler.
- Encourage wildlife conservation and habitat improvement, within the roadway right-of-way, through selected plantings and limited mowing.

Implementation of the landscaping policy includes the following activities:

1. During the development of major (normally not resurfacing, lighting, etc.) roadway projects, urban or rural, the **Roadside Stabilization Unit** in the **Project Development Division** will review and recommend an appropriate landscaping treatment for each project in accordance with the **AASHTO** manual A Guide for Landscape and Environmental Design, (Reference 10.6).
2. The **Roadside Stabilization Unit** involvement will begin at the engineering review or corridor study stage of project development to promote early identification of the potential for landscaping. Landscaping recommendations will be included in the engineering review report, corridor study report and in the design public hearing engineering statement.
3. The **Roadside Stabilization Unit** will review design plans prior to the plan-in-hand and will furnish written landscaping and erosion control recommendations to the roadway designer for evaluation during the plan-in-hand.
4. The **Roadside Stabilization Unit** will review the plan-in-hand report to estimate specific erosion control needs and to make further landscaping recommendations, as necessary.
5. Landscaping recommendations will be included in the design public hearing engineering statement.
6. The **Roadside Stabilization Unit** will review the limits of construction plans and forward final landscaping recommendations and specifications and final erosion control recommendations to the roadway designer.
7. Erosion control specifications will be sent to the roadway designer after a joint review of final cross-sections with the designer is completed.

3.A Tree Planting and Removal

Every effort will be made to minimize disruption to the surrounding environment. Where trees and other desirable flora can be saved, consistent with sound engineering judgment, they will be. Normally, trees and other flora located within the recovery area for out-of-control vehicles or the limits of construction will be removed, however, the retention of healthy trees and other desirable flora will be reviewed on a case-by-case basis by the **Roadside Stabilization Unit** in the **Project Development Division** and the **District Engineer** to determine appropriate action. Guardrail, retaining walls, and other alternatives may be considered before healthy trees are removed. The cost of protecting trees should not be the only determining factor when considering their removal. Tree removal may be a factor in determining the need for tree planting.

When a significant amount of additional right-of-way is required for a project that would not otherwise be classified as "major," the **Roadside Stabilization Unit** should review the project for appropriate landscaping treatment, even if the latter would require the purchase of additional right-of-way outside of the proposed construction limits. Right-of-way will not be acquired solely for tree planting, unless needed to comply with Section 404 Permit requirements, (See Chapter Thirteen: Planning and Project Development, Section 4.B.4).

A special provision is required for removing and resetting trees from the construction zone with the appropriate size tree spade. The **Roadside Stabilization Unit** will determine the feasibility of tree removal and tree spade size.

3.B Roundabout Landscaping

Landscaping for a roundabout should be selected and strategically placed to help improve the overall operation of the roundabout when possible. Plantings in the central island can help provide recognition of the roundabout by approaching drivers and aid in reducing their approach speeds. While allowing adequate sight distance to the left, these plantings help drivers make better judgments concerning the distance to approaching vehicles in the roundabout by filtering out other distracting movements.

All guidelines for intersection sight lines and roadside safety must be followed. The central island plantings must be of sufficient volume to be visible in advance of the intersection and reduce headlight glare across the roundabout, but not infringe on necessary sight distances for motorists and pedestrians. This is accomplished by deliberate positioning of plant material to maximize the view between vegetative elements and minimize the view of opposing vehicles. Plantings also need to address snow drifting concerns and shedding deciduous vegetation on the circulatory roadway. Plant types should be selected to limit excessive maintenance when possible.

4. SNOW CONTROL

Snow drifting may be a problem when the prevailing winds are from the north or west. Snowdrifts on roadways can be minimized by several different methods, including:

- Cross-section modification.
- Structural snow fencing, both temporary and permanent.
- Living snow fencing.

The **District's** input regarding the location of existing snow fences will help to identify locations susceptible to drifting snow. If aerial photos were taken in late fall or early winter they may show the location of existing snow fence. Designers are responsible for contacting the **District Engineer** to see if snow shots are desired for the plan-in-hand inspection. Snow shots are cut stations where the top of the backslope is less than 60 ft. (20 m) from the roadway centerline and the backslope elevation is greater than the centerline elevation.

Allowing a greater ditch area for the accumulation of snow at locations susceptible to drifting can minimize snowdrifts on roadways. Normally snowdrifts on a roadway occur at the ends of cut sections. Ditches may be widened to provide more area for snow accumulation. The backslope, especially at the ends of high cuts, should be laid back from its normal 3:1 slope.

Structural snow fencing is often used to reduce snow drifting. Annually, maintenance units will place temporary snow fence along the right-of-way in areas of known snow drifting. Along roadways with limited right-of-way, temporary snow fencing may be placed on private property. Permanent snow fencing panels may be needed where a cut section becomes a fill section. Living snow fencing may also be used to reduce snow drifting. If the right-of-way is sufficient, shrubs and trees can be planted along right-of-way or fence lines. Contact the **Roadside Stabilization Unit** for the possibility of using living snow fence at the right-of-way line.

5. FENCING

Generally interstates and freeways should be fenced and some expressways may be fenced. Chainlink fencing is used in urban, developing urban and suburban areas. Chainlink fencing is also used for pedestrian barriers on bridges, (the **Bridge Division** will provide details). The need for fencing expressway projects should be discussed at the plan-in-hand inspection. Refer to the Standard/Special Plan Book (Reference 10.4) for fencing details.

In rural areas, depending on the function and use of the adjoining property, barbed wire or woven wire fences will be erected. The responsibility for removing, resetting or rebuilding fences and cattle guards rests with the property owner, who is compensated by **NDOT** as necessary. Fencing is generally a right-of-way item and the roadway designer should contact the **Right-of-Way Division** for assistance. For further information see Chapter Fifteen: Right-of-Way, Section 7.D.

For additional information, see Section 7 for fencing adjacent to retaining walls and Chapter Sixteen: Pedestrian and Bicycle Facilities, Section 4.A for fencing behind sidewalks adjacent to steep slopes.

6. CATTLE PASSES

New cattle passes should be built if either of the following criteria is met:

- The appraised segregation damages equal or exceed the cost of constructing the structure.
- The property owner pays for the difference in the cost of the structure and any segregation damages.

Existing cattle passes should be perpetuated if either of the following criteria is met:

- The property owner's title or any other legal document indicates that the owner has a non-revocable right to use the existing structure as a livestock crossing.
- It is apparent that the structure was built to alleviate damage to a segregated property and is being used for a livestock crossing.

The design of cattle passes shall give the contractor the option of furnishing a precast unit, provided that the fill height is within the structural limits of the unit. It is important that cattle passes be designed without bends or grade breaks. If cattle cannot see out the other end of the passage, they will not enter it.

7. RETAINING WALLS

The need for a retaining wall may be determined during any of the following activities:

- Engineering review.
- Preliminary design.
- Plan-in-hand.
- Roadway design.

When a retaining wall with a height of 3 ft. (0.9 m) or greater is built in an urban area a chain link fence with a nominal height of 4 ft. (1.2 m) shall be erected adjacent to the retaining wall, (just behind it) on public right-of-way.

EXHIBIT 10.7 outlines **NDOT's** basic procedure to be followed in the design of retaining walls.

NDOT RETAINING WALL
DESIGN GUIDELINES
From Conception thru Shop Plan Review

Step 1) Identify the need for a retaining wall during Activity 5202-Engineering Review.

Step 2) **Project Development** requests Preliminary Foundation Report-Activity 5603 from **Materials & Research Division, Geotechnical Section**.

Step 3) Confirm the need during Activity 5307 - Preliminary Roadway Design and order Final Foundation Report - Activity 5604.

Step 4) The Final Foundation Report **shall** be submitted to the Roadway Designer and **Bridge Division**.

Step 5) The Roadway Designer shall schedule a meeting with the **Materials & Research Geotechnical Section** and **Bridge Divisions** in order to select the appropriate wall type (i.e. MSE Panel; MSE Block; or conventional Cast-In-Place wall). Prior to the meeting, the Roadway Designer should have compiled all relative information, such as wall length, height, surcharge loading and other factors relative to the wall construction.

Step 6) If an MSE Panel or Block wall was selected, the Roadway Designer shall design the wall's general characteristics to be incorporated into the bid plans, along with the appropriate generic Special Provisions. The approved wall vendors will be listed in the Approved Products List for Metric projects. As a minimum the wall plan should include:

- All wall geometrics - length, height, stationing, offsets, leveling pad elevations, etc.
- Traffic data
- Construction sequencing, if applicable
- Surcharge loading (due to traffic or embankment)
- Architectural notes
- The calculated "Established Quantities":

  Concrete Face Panels (SF)
  or
  Wall Materials (SF) (for Modular Block Walls)

  Concrete Leveling Pad (LF)
  or
  Compacted Earth Leveling Pad (LF) (for Modular Block Walls)

  Coping (LF) (if applicable)

  Select Granular Backfill for Mechanically Stabilized Earth Structure (CY)

  18 in. Corrugated Metal Pipe (LF) (if applicable)

  Shoring for Mechanically (Lump Sum)
  Stabilized Earth Structure

Exhibit 10.7 NDOT Retaining Wall Design Guidelines

- All the "External Site Factors" per the 'Design Requirements' section of the generic Special Provision. These factors should be found in **Materials & Research Geotechnical Section's** Final Foundation Report.
- Ensure the following note is placed on the plan near the "External Site Factors":
  The Contractor, in conjunction with the MSE Wall vendor, shall determine the wet unit weight of the select granular backfill material used in the reinforced soil zone. The unit weight shall be shown on the wall shop plans.
- Utilities
- On metric plans, list wall vendors per the "Approved Products List"

If the MSE wall is to be used at a bridge location, submit MSE Wall Special Plan to **Bridge Division** for review. If a conventional wall was selected, the **Bridge Division** shall design the wall and submit the special plan and associated Special Provisions to the Roadway Designer.

Step 7) Advertise Project

Step 8) Bidding Contractors send MSE Wall plans and Special Provisions to the approved wall vendors (listed in Special Provisions or the Approved Products List) in order to secure bids.

Step 9) The awarded Contractor submits six sets of shop plans and working drawings (stamped by a Nebraska P.E.) to the **Construction Division**. The **Construction Division** shall place a REVIEWED Stamp on the first sheet of all six sets (similar to the one shown below).

REVIEWED by: **Roadway Design**
Materials & Research Geotechnical Section
Bridge
Construction

Construction Division will then forward all six sets to the Roadway Designer.

Step 10) The Roadway Designer shall review the submitted plans for the wall geometrics and to ensure the plans reflect the bid plans. Corrections, deletions or concerns should be marked in red on all six sets. Sign and date the Reviewed stamp on the plans.

Step 11) The Roadway Designer shall then forward all six sets to **Materials & Research Geotechnical Section** to review the "External Stability" of the wall. After **Materials & Research** signs and dates the review stamp on all six sets, they will forward all six sets to **Bridge Division**.

Step 12) The **Bridge Division** shall review the structural aspects of the wall. Again marking corrections, deletions and concerns in red, on all six sets. After Bridge signs and dates the review stamp on all six sets, they will forward one set to **Roadway Design**, one set to **Materials & Research Geotechnical Section** and four sets to **Construction**.

Step 13) The **Construction Division** will then distribute one set to the **District Office**, and the remaining three sets to the Contractor.

8. OLD ROAD OBLITERATION

Once existing pavement on an abandoned alignment is no longer needed, (such as for phasing or property access), the pavement may be removed. The quantities of removed pavement shall be paid for by the sq. yd. (m^2). The plans for old road obliteration should be put on 2-N sheets (See Chapter Eleven: Highway Plans Assembly, Section 4.G). The Standard/Special Plans Book, (Reference 10.4) illustrates cross-sections for old road obliteration.

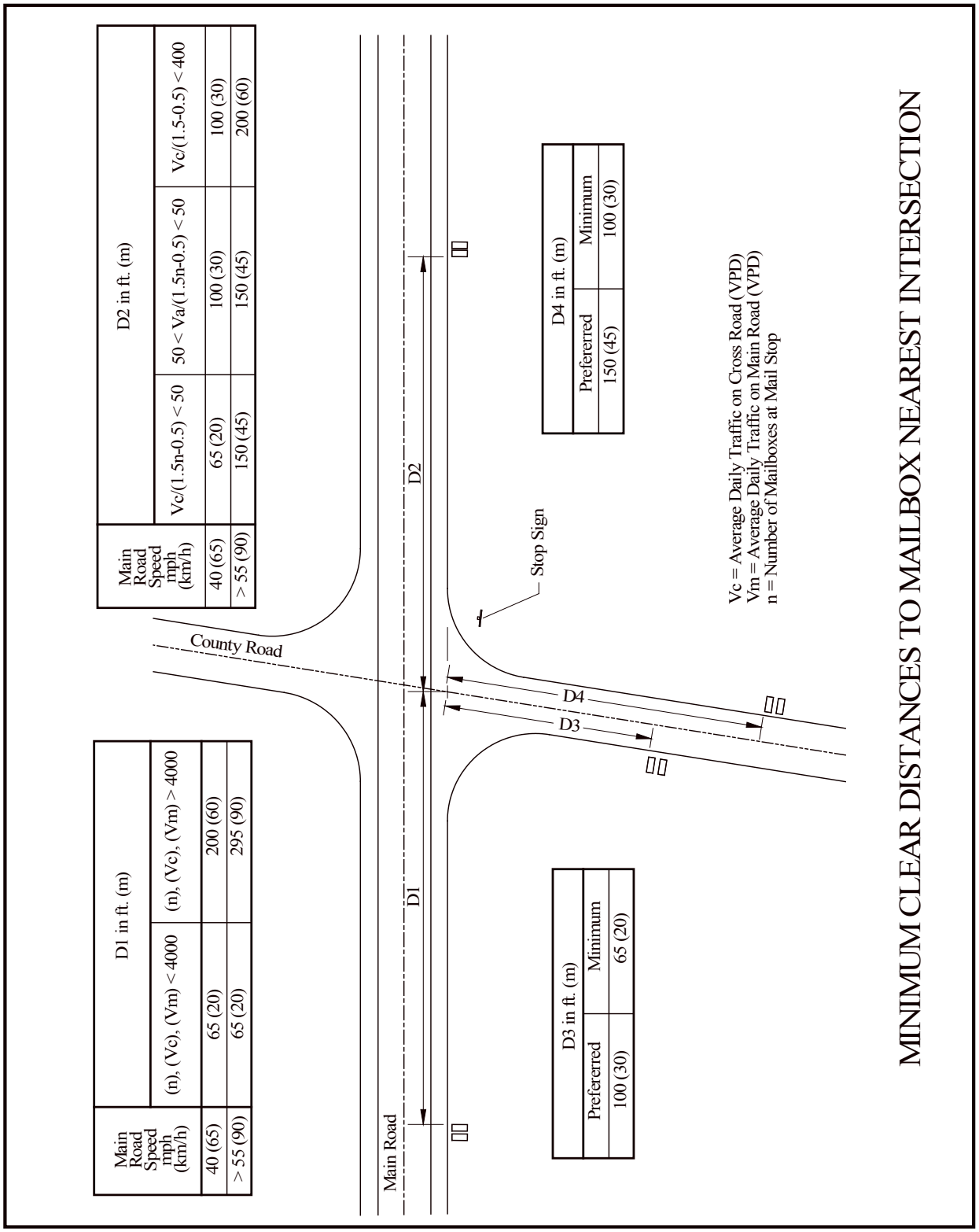
9. MAILBOX TURNOUTS AND SUPPORTS

On one-way streets, mailboxes may be on the left side if designated by the local postmaster. Where a mailbox is located at a driveway, it shall normally be placed 17 ft. (5.2 m) beyond the driveway surfacing on the right hand side of the road in the direction of travel as designated by the local postmaster for each delivery route. A mailbox should not be located on urban roadways where through driving lanes are adjacent to the curb. EXHIBIT 10.8 shows minimum clearance distances for mailboxes near intersections with county roads.

Asphalt surfacing shall be used for mailbox turnouts, if available. New and Reconstructed projects shall have a minimum 8 ft. (2.4 m) wide mailbox turnout (or a total of 20 ft. (6.0 m) of surfacing width from the centerline)). See Chapter Seventeen: Resurfacing, Restoration and Rehabilitation (3R) Projects for 3R project design guidance. The Standard/Special Plans Book (Reference 10.4) (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/) illustrates mailbox turnouts for various roadway types, (these plans provide surfacing quantities for typical mailbox turnouts, but additional surfacing will be needed for turnouts that have more than one mailbox support post).

No more than two mailboxes may be mounted on a single support structure, (See the Standard/Special Plans Book, Reference 10.4). **NDOT** provides mailbox supports to the contractor, so the roadway designer needs to have a mailbox support count. The plan build note shall include the number of supports, the mailbox location(s), and the required area of special mailbox surfacing.

For additional information see a Guide for Erecting Mailboxes on Highways (Reference 10.8) and the Roadside Design Guide (Reference 10.12).



Main Road Speed mph (km/h)	D1 in ft. (m)	
	(n), (Vc), (Vm) < 4000	(n), (Vc), (Vm) > 4000
40 (65)	65 (20)	200 (60)
> 55 (90)	65 (20)	295 (90)

Main Road Speed mph (km/h)	D2 in ft. (m)		
	Vc/(1.5n-0.5) < 50	50 < Va/(1.5n-0.5) < 50	Vc/(1.5-0.5) < 400
40 (65)	65 (20)	100 (30)	100 (30)
> 55 (90)	150 (45)	150 (45)	200 (60)

D3 in ft. (m)	
Prefererred	Minimum
100 (30)	65 (20)

D4 in ft. (m)	
Prefererred	Minimum
150 (45)	100 (30)

Exhibit 10.8 Clearance Distances for Mailboxes Near Rural Intersections

10. ROADWAY LIGHTING

The **Roadway Design Lighting Unit** is responsible for ascertaining the need for roadway lighting for each project, and for the design of the lighting systems. Lighting will be considered at the plan-in-hand inspection. The **Lighting Engineer** shall be notified if the **District Engineer** determines that a project will include lighting in order to avoid right-of-way problems and utility, driveway and drainage conflicts.

10.A Guidelines for the Installation Of Roadway Lighting

Highway projects that have existing roadway lighting will continue to have roadway lighting. City agreements will need to include the operational and maintenance costs of the system. Requests for new lighting should be transmitted to the **Lighting Engineer**, who will conduct a study for each request. If the results of the study satisfy the conditions of one of the warrants in the following sections, **NDOT** may add lighting to a programmed project or schedule a lighting project to design and build a lighting system at the requested location (subject to the availability of funds). The **Lighting Engineer** will determine the type and style of the system. Even though a lighting request meets the appropriate warrants the state is not obligated to provide lighting. **NDOT** will own all lighting systems within state highway right-of-way.

10.A.1 Urban Lighting

10.A.1.a Warrants

- **Warrant I Accident History (Continuous or Intersection):** The number of nighttime accidents (N) per year is greater than 2 times the number of daytime (D) accidents in a three year accident history study with more than 4 nighttime accidents per year per intersection or per mile ($N > 2 \times D$, & $N > 4$).
- **Warrant II Traffic Signals:** All intersections warranting traffic signals will also warrant roadway lighting.
- **Warrant III Two Way Left Turn Lane (TWLTL):** Continuous lighting may be warranted with a two way left turn lane when there is 80% or more of commercial lighting along the state highway and more than 15 driveways per mile. Consideration will be given to continuous lighting when the mainline curves have a radius of less than 573 ft. (175 m) with a two way left turn lane.
- **Warrant IV Local Responsibility:** If none of the previous warrants are met the local governing authority (city, town, village, or S.I.D.) can choose to install lighting if sufficient benefits are found in the form of convenience, safety, policing, community promotion, or public relations. The local governing authority will pay 50% of the installation cost and 100% of the operation and maintenance cost of the lighting system.

10.A.1.b Festoon Outlets

Festoon outlets (electrical outlets for holiday decorations) will be installed on urban projects as a project cost with a prior written request from the **City/Village**. Festoon outlets will only be installed in the core business area. If additional festoon outlets are requested, their cost will be the sole responsibility off the **City/Village**.

10.A.1.c Costs

When specifying lighting for an urban project be sure that local government officials are aware that the cost of maintaining and operating the system is a **City/Village** responsibility. Lighting cost estimates should be obtained from the **Roadway Lighting Section** and given to local officials, prior to the agreement signing, so that the **City/Village** may plan and budget for the expense. They should also be informed that the lighting system might include poles that are outside of corporate limits. A signed city covenant agreement is required before a public hearing can be scheduled.

Lighting Projects INSIDE the corporate limits meeting warrant I, II, or III and not installed as part of a "New and Reconstructed", "3R", or "Maintenance" project: The local governing authority will pay for 50% of the installation cost and 100% of the operation and maintenance costs of the lighting system.

Lighting Projects INSIDE the corporate limits meeting warrant I, II, or III and installed as part of a "New and Reconstructed", "3R", or "Maintenance" project: Installation will be a project cost. 100% of the operation and maintenance costs of the lighting system will be the responsibility of the local governing authority.

10.A.2 Rural Intersection Lighting

10.A.2.a Warrants

- **Warrant A Accident History:** The number of nighttime accidents per year is greater than one-third the number of daytime accidents per year and the average number of nighttime accidents per year is greater than three in a three year accident history study, or since the intersection was last modified ($N > D/3$, & $N > 3$).
- **Warrant B ADT/Topography/Geometrics:** A current ADT greater than 2500 vehicles/day at the intersection (combine all traffic ADT's from all legs and divide by two, with a minimum 250 ADT at each leg) combined with two or more of the following conditions would be sufficient to warrant lighting:
    1. There are complex or unusual geometrics.
    2. The intersection sight distance is less than 660 ft.
    3. There is frequent pedestrian traffic (more than 200 per day).
    4. Adjacent development creates confusing background lighting.
    5. There are raised medians on the mainline highway.
- **Warrant C Traffic Signals:** All locations meeting warrants for traffic signals will warrant roadway lighting.
- **Warrant D Local Responsibility:** If none of the warrants A, B, or C are met the local governing authority (city, town, village, or S.I.D.) can choose to install lighting if sufficient benefit is found in the form of convenience, safety, policing, community promotion, or public relations. The local governing authority will pay for 50% of the installation cost and 100% of the operation and maintenance costs of the lighting system.
- **Warrant E 4-Lane Bypass:** Whenever a 4-lane highway bypasses a city, town, or village, access roads which intersect the bypass but do not meet lighting warrants may have lighting installed as a project cost if the local governing authority feels that such lighting is necessary. The local governing authority is responsible for 100% of the operation and maintenance costs of the lighting system.

10.A.2.b Costs

Lighting projects OUTSIDE of the corporate limits meeting warrant A, B, or C: The state will assume responsibility for the cost of installation, operation, and maintenance of lighting system.

10.A.3 Rural Continuous Lighting

Rural continuous lighting is only warranted when it is an extension of a continuous urban lighting system being installed as part of an urban project, and the lighting extension meets an urban lighting warrant. The installation of warranted lighting extensions will be a project cost and 100% of the operation and maintenance costs will be the responsibility of the state. If the extended lighting is at the request of the local governing authority, 100% of the operation and maintenance costs of the lighting system will be the responsibility of the local governing agency. **NDOT** will not pay for unwarranted rural continuous lighting located outside of the corporate limits and which was built at the request of the local governing authority.

10.A.4 Interchange Lighting

Warrants for interchange lighting on Interstates or Expressways will be determined using the warrants in An Informational Guide for Roadway Lighting (Reference 10.9). If the lighting is located in an urban area the local political subdivision will have the responsibility for 100% of the operation and maintenance costs of the lighting system.

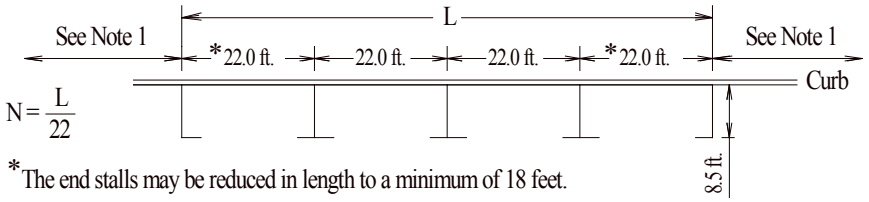
11. PARKING

EXHIBITS 10.9 & 10.10 provide parking stall dimensions for curb/street parking and for parking lot/parking garage designs for passenger cars. The designer should check local standards before designing parking facilities. Parking modifications should be discussed with local city officials, especially if existing parking is eliminated on the proposed facility. This should be done as early as possible in the design process. The designer should check with the **Traffic Engineering Division** if there is a need to provide for longer or wider vehicles. For further information see Sections 60-6, 164 and 60-6, 168 of Nebraska Bridge Law (Reference 10.10), (http://uniweb.legislature.ne.gov/laws/browse-chapters.php?chapter=39).

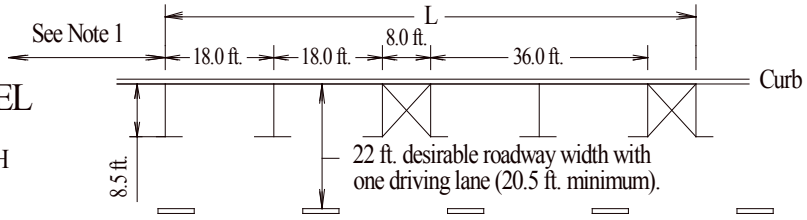
11.A Accessible Parking

When the **Nebraska Department of Transportation** constructs or re-stripes parking spaces, it must provide accessible parking spaces as required by the Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities (Reference 10.7). Accessible parking spaces must be located to provide the shortest possible accessible route of travel to an accessible facility. Accessible parking spaces for automobiles must have a minimum 5 ft. (1.5 m) wide access aisle located next to the designated parking space and accessible parking spaces for vans require a minimum 8 ft. (2.4 m) access aisle. The access aisle must be level (2% maximum slope in all directions) and the same length as the parking stall(s) it serves. Access aisles may serve two parking stalls. Ramps will not extend into the access aisle. EXHIBIT 10.11 shows a typical access aisle layout and the required minimum number of accessible stalls for a given number of parking spaces. The designer should check local standards and consult with the local city officials regarding the number of accessible parking spaces. Further information may be found at (http://www.access-board.gov).

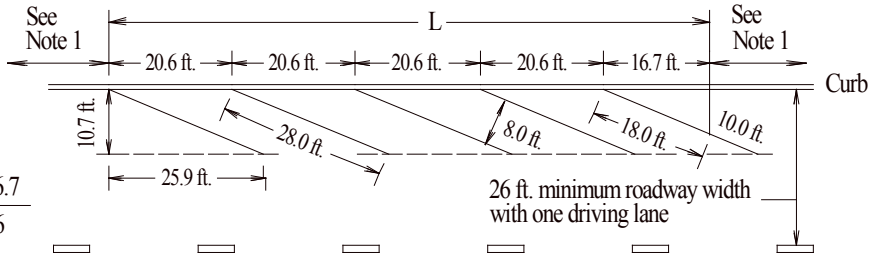
FOR CURB AND STREET PARKING



*The end stalls may be reduced in length to a minimum of 18 feet.

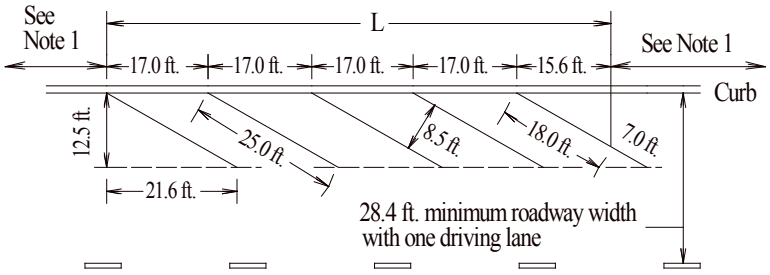


PARALLEL
8.5 FOOT
STALL WIDTH



22.5°
8.0 FOOT
STALL WIDTH

$N = \frac{L - 16.7}{20.6}$



30°
8.5 FOOT
STALL WIDTH

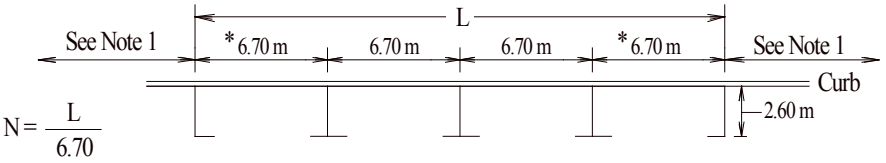
$N = \frac{L - 15.6}{17}$

1. All parking shall be a minimum of 20 feet from the crosswalk, 30 feet from the stop sign, yield sign or traffic signal, and 15 feet from a fire hydrant. For other situations see Section 60-6, 166 Nebraska Rules of the Road.
2. White paint shall be used for marking; a 4 inch width is recommended for marking lines.

N = Number of stalls L = Usable curb length

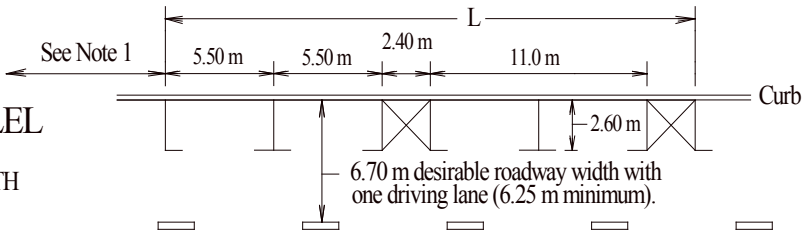
Exhibit 10.9a Parking Stall Dimensions for Curb and Street Parking (English)

FOR CURB AND STREET PARKING



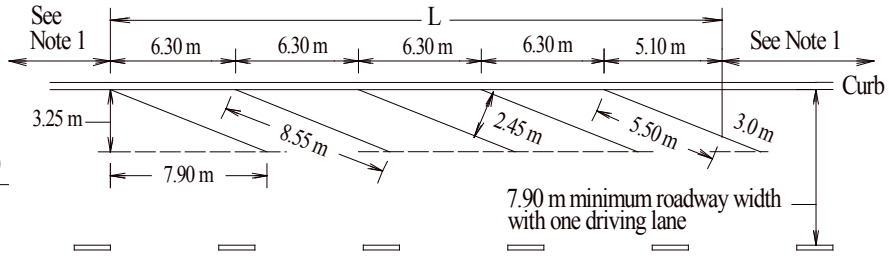
* The end stalls may be reduced in length to a minimum of 5.50 m.

PARALLEL
2.60 METER
STALL WIDTH



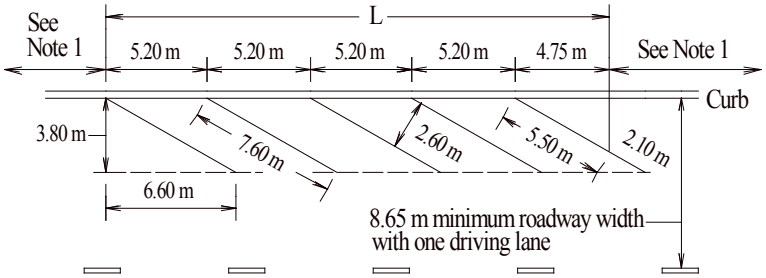
22.5°
2.45 METER
STALL WIDTH

N = (L - 5.10) / 6.30



30°
2.60 METER
STALL WIDTH

N = (L - 4.75) / 5.20



1. All parking shall be a minimum of 6.10 meter from the crosswalk, 9.15 meter from the stop sign, yield sign or traffic signal, and 4.55 meter from a fire hydrant. For other situations see Section 60-6, 166 Nebraska Rules of the Road.
2. White paint shall be used for marking; a 100 mm width is recommended for marking lines.

N = Number of stalls L = Usable curb length

Exhibit 10.9b Parking Stall Dimensions for Curb and Street Parking (Metric)

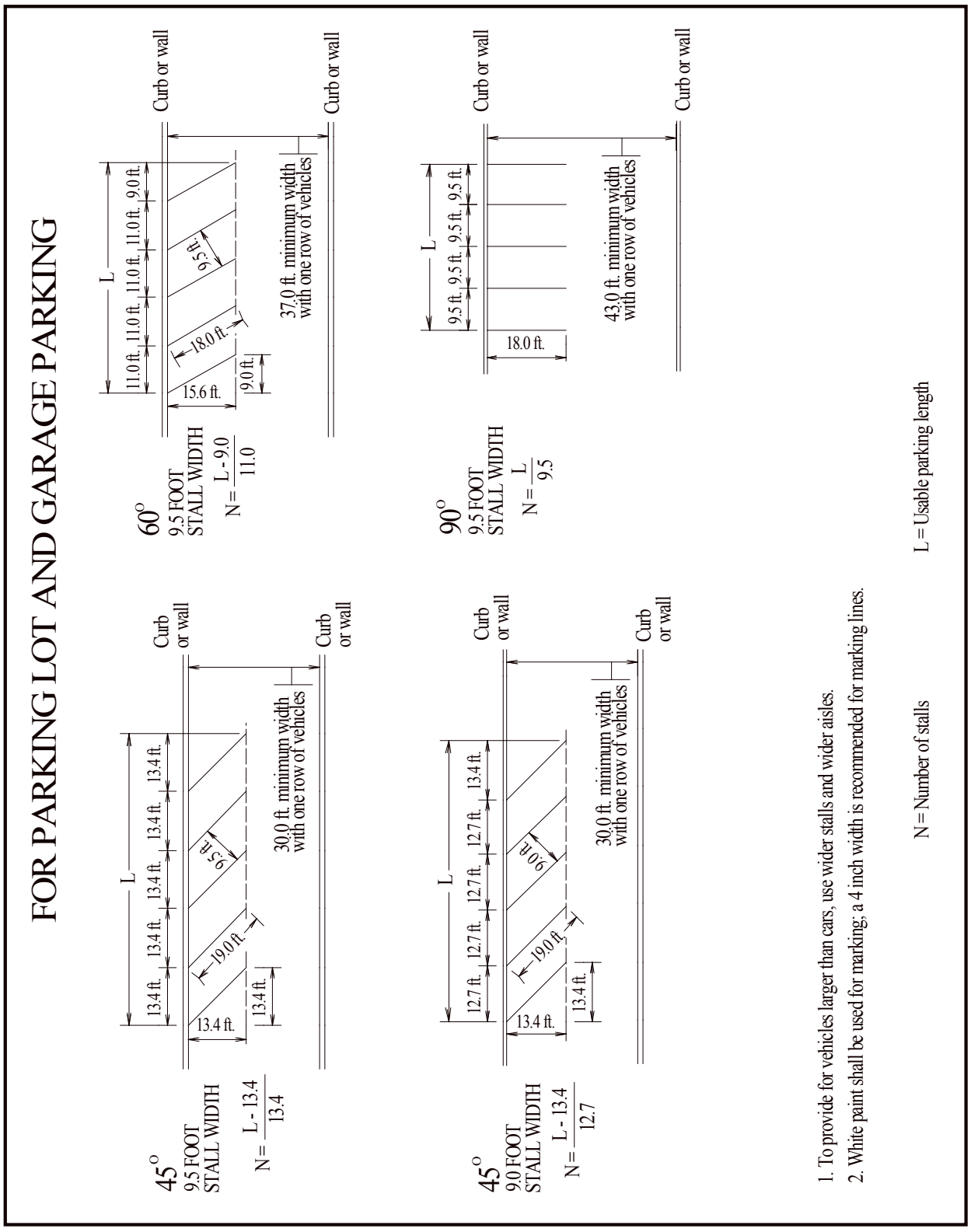


Exhibit 10.10a Parking Stall Dimensions for Parking Lots and Garages (English)

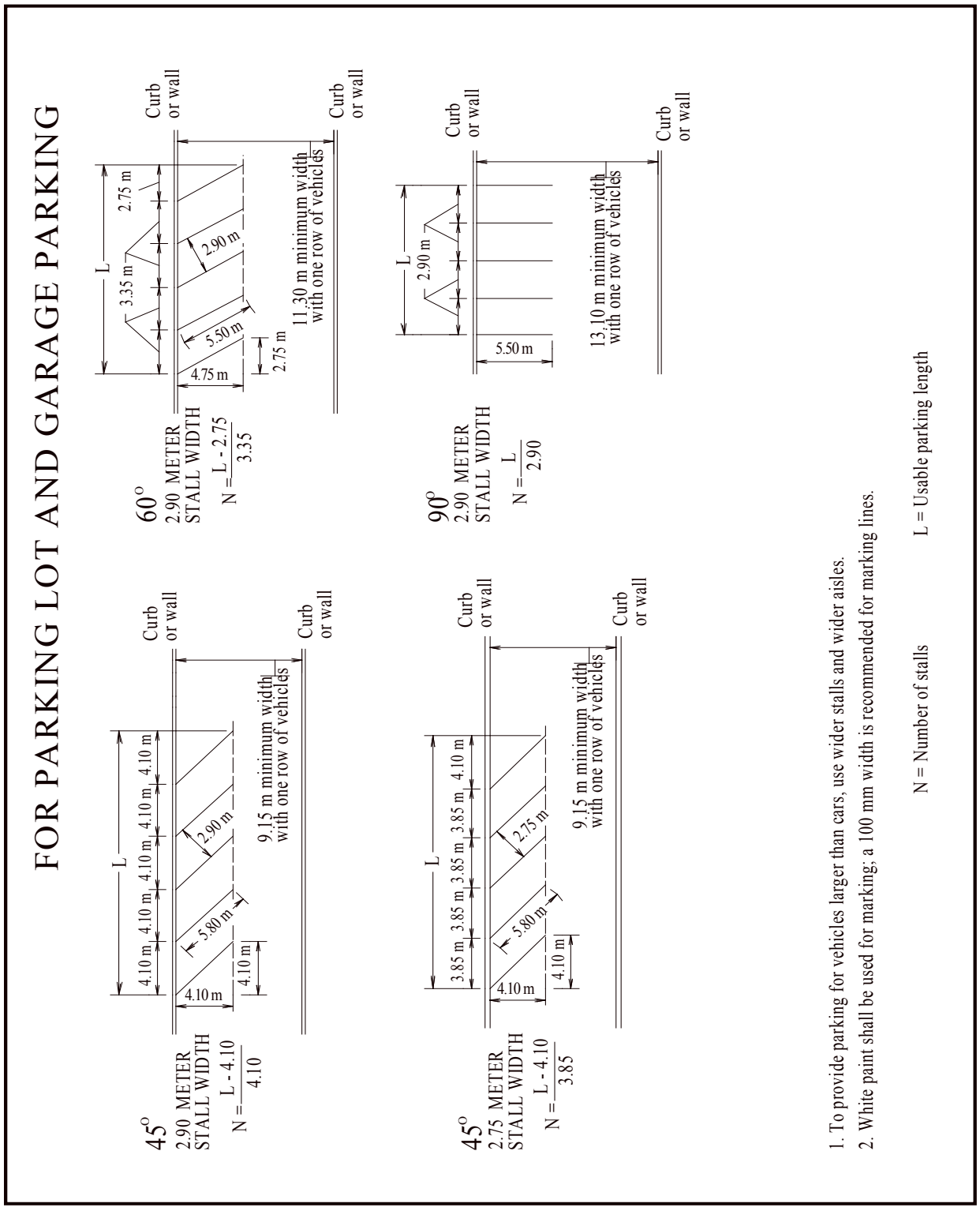


Exhibit 10.10b Parking Stall Dimensions for Parking Lots and Garages (Metric)

Total spaces in parking area	Required minimum number of accessible spaces	Van accessible spaces (8 ft. min. aisle width)	Car accessible spaces (5 ft. min. aisle width)
1 to 25	1	1	0
26 to 50	2	1	1
51 to 75	3	1	2
76 to 100	4	1	3
101 to 150	5	1	4
151 to 200	6	1	5
201 to 300	7	1	6
301 to 400	8	1	7
401 to 500	9	2	7
501 to 1000	2% of total	❶	❷
1001 and up	20 plus 1 for each 100 over 1000	❶	❷

❶ One of every 8 accessible spaces
❷ 7 of every 8 accessible spaces
Source: ADA Design Guide 1 – Restriping Parking Lots, (Reference 10.11), (http://www.usdoj.gov/crt/ada/restripe.htm)

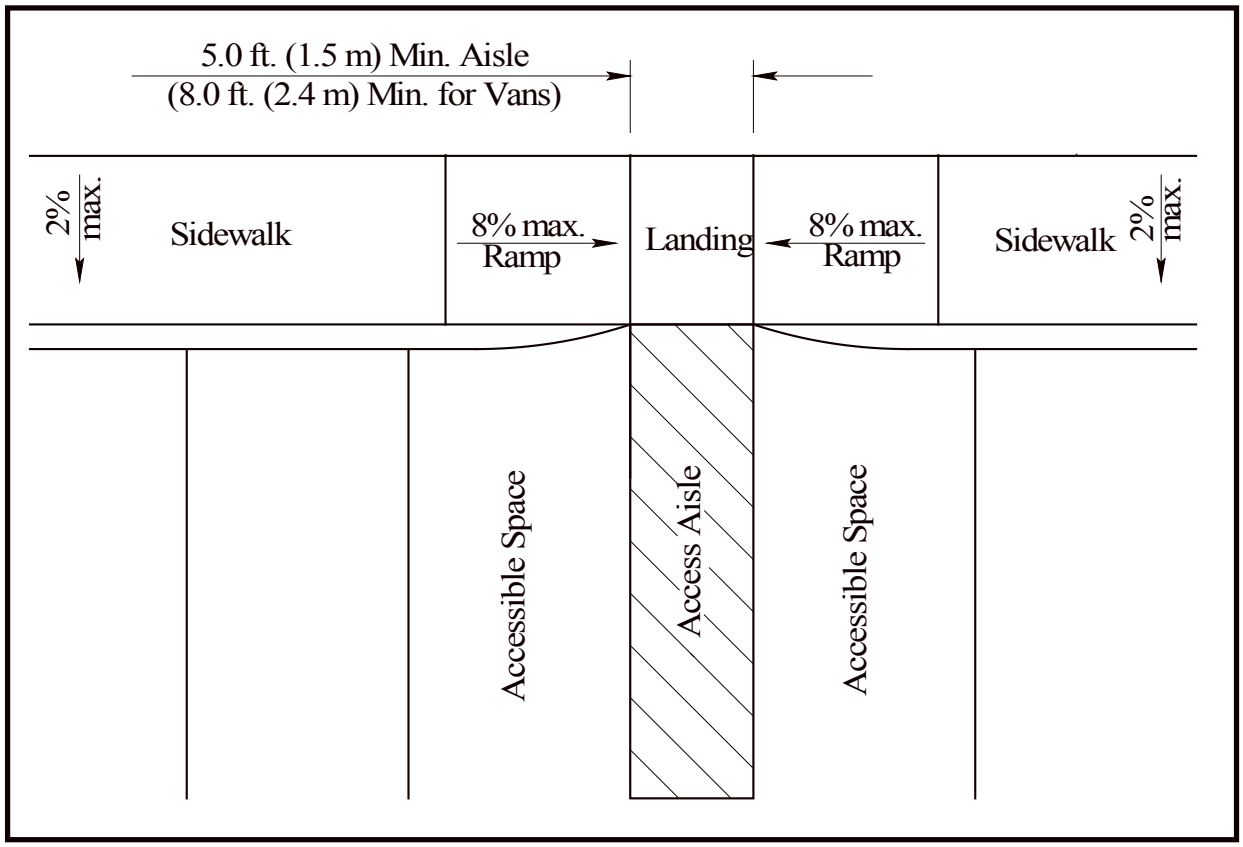


Exhibit 10.11 ADA Accessible Parking Guide

12. REFERENCES

10.1 Nebraska Department of Transportation, Design Process Outline (*DPO*), Current Edition. (http://www.roads.nebraska.gov/media/6761/design-process-outline.pdf)

10.2 American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, D.C., 2011.

10.3 Nebraska Department of Transportation, Drainage Design and Erosion Control Manual, Current Edition.

10.4 Nebraska Department of Transportation, Standard/Special Plans Book, Current Edition. (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/)

10.5 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards, Current Edition. (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/)

10.6 American Association of State Highway and Transportation Officials, A Guide for Landscape and Environmental Design, 1991, Washington D.C.

10.7 U.S. Architectural and Transportation Barriers Compliance Board (Access Board), "Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities,", Washington, D.C., 2002. (http://www.ada.gov/2010ADAstandards_index.htm)

10.8 American Association of State Highway and Transportation Officials, Guide for Erecting Mailboxes on Highways, Washington, D.C., 1985.

10.9 American Association of State Highway and Transportation Officials, An Informational Guide for Roadway Lighting, Washington, D.C., 1985.

10.10 Nebraska. Laws, Statutes, Etc., Nebraska Highway and Bridge Law; Consisting Of Chapter 39, Highways And Bridges; Sections 49-801 And 49-802, Definitions And Rules of Construction; Article 6 Of Chapter 60, Nebraska Rules Of The Road. Revised Reissued Statutes of Nebraska, Current edition. (http://uniweb.legislature.ne.gov/laws/browse-chapters.php?chapter=39)

10.11 U.S. Department of Justice, ADA Design Guide 1 – Restriping Parking Lots, Jan. 2002, Washington D.C. (http://www.usdoj.gov/crt/ada/restripe.htm)

10.12 American Association of State Highway and Transportation Officials, Roadside Design Guide, Washington, D.C., 2011.

The information contained in Chapter Eleven: Miscellaneous Design Issues, dated February 2017, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this chapter.

Chapter Eleven presents guidance for the design of new and reconstructed and 3R projects; additional design guidance for 3R projects is provided in Chapter Seventeen. This chapter replaces Chapter Eleven: Highway Plans Assembly, dated July 2006. This chapter was approved by the Nebraska Division of the FHWA for use on the National Highway System and other federal projects on (Insert Date).

Chapter Eleven
Highway Plans Assembly

This chapter pertains to the assembly and indexing of the project plans. There is also a brief description of each type of plan sheet that is to be indexed and general information that may be useful in preparing the sheets.

Refer to the current version of the CADD Policy and the Design Process Outline (*DPO*) (Ref. 11.1), both of which may be found at (http://www.roads.nebraska.gov/business-center/design-consultant/), for information related to project plan preparation.

1. DESIGN PLANS

There are several types of project plans which occur at various stages of roadway design. The roadway designer should furnish the design technician with the information required for the production of plans at each stage of the project. See the *DPO* (Ref. 11.1) for the plan information requirements. The various project plan types are:

- Base Plans (either plotted survey or base plans created from as-built project plans).
- Initial Footprint Plans (used as an early indicator of areas requiring special investigation).
- Preliminary Design Plans (used for the plan-in-hand field inspection).
- Functional Plans (required for design public hearings).
- Design Plans (used to design the project right-of-way and as the **PS&E** turn-in and contract plans).

The plans should be thoroughly checked for completeness, accuracy, and formatting by the design technician, the roadway designer, the **Roadway Design Unit Head** (**Unit Head**), and the **Roadway Design Plans Manager** (**Plans Manager**) at each of these plan stages.

1.A Base Plans (Phase 2: Planning – Activity 5200)

Base plans are the initial project plan sheets, showing the topography and roadway alignment(s), which are plotted from either a project survey or from the as-built plans of previous projects. The survey information is given to the **Plans Manager** by the **Geodetic Survey Section** in the **Project Development Division** (**PDD**) before the Base Plan Coordination Meeting (See the current version of the CADD Policy). The project is then assigned to a squad leader in the **Roadway Design Plans Development Unit** (**PDU**) and then to a technician; they will then schedule a meeting with the designer to discuss plan set-up. The existing vertical alignment for the project centerline is required if plan and profile sheets are being requested (See Section 4.J of this chapter). The base plan set will include:

- A location map
- Alignment and control point (2-H) sheet(s) for surveyed projects (See Section 4.F of this chapter)
- The aerial (2-W or 2-A) sheet(s) may be developed at this time if the required information is available (See Section 4.E of this chapter)
- General information (2-N) sheet(s) (See Section 4.G of this chapter)

1.B Initial Footprint Plans (Phase 2: Planning – Activity 5200)

The Initial Footprint Plan (See the *DPO* (Ref. 11.1), Activity 5200, Clarity Task Code 5238) consists of an initial generation of the project corridor using the horizontal and vertical alignments, the superelevation, and the roadway typical section using the initial pavement recommendation. The Initial Footprint Plan is used by the designer and by the **PDD** to identify areas requiring additional investigation (e.g. wetlands impacts).

1.C Preliminary Design Plans (Phase 3: Design – Activity 5300)

Preliminary design plans are used to produce cost update 1 and on the plan-in-hand field inspection (See the *DPO* (Ref. 11.1), Activity 5300, Clarity Task Codes 5368 and 5380). The Preliminary Plan Coordination Meeting will be held at this time to determine the requirements for the project plans (See the current version of the CADD Policy). The design technician will be provided with the necessary information as outlined in the *DPO*, Activity 5300, Clarity Task Code 5350 (Ref. 11.1), and in the CADD Policy.

Aerial sheets (2-A's or 2-W's, see Section 4.E of this chapter) will usually be required and should be developed at this stage of the project.

1.D Functional Design Plans (Phase 4: Environmental Approval – Activity 5400)

Functional design plans are required only if there is a design public (NEPA) hearing and for cost update 2 (See the *DPO* (Ref. 11.1), Activity 5400, Clarity Task Codes 5428, 5446, 5435 and **EXHIBIT L**). The project design should be approximately 75% to 80% complete by this milestone. The roadway designer should:

- Allow three months lead time to prepare the plans and exhibits for a design public hearing
- Schedule the Functional Plan Coordination Meeting with **PDU** (See the current version of the CADD Policy).
- Provide the design technician with the information as described in the *DPO*, Activity 5400, Clarity Task Code 5428 (Ref. 11.1)

1.E Design Plans (Phase 5: Plan Details – Activity 5500)

Right-of-Way Design (**ROW Design**) uses the design plans to design the right-of-way and easements required to build the project (See the *DPO* (Ref. 11.1), Activity 5500, Clarity Task Code 5576). The roadway designer will incorporate the decisions made regarding the input from the design public hearing and right-of-way negotiations into the design and will schedule the Coordination Meeting for PS&E Turn-in Plans (See the current version of the CADD Policy), providing the design technician with the information necessary for the production of the design plans as described in the *DPO*, Activity 5500, Clarity Task Code 5508 (Ref. 11.1). The designer will use the design plans to produce cost update 3 (See the *DPO* (Ref. 11.1), Activity 5500, Clarity Task Code 5584).

Design plans are also the plans which will be let to contract. The designer will create the plans package for the **Plans, Specifications and Estimates Unit** (**PS&E**) in the **Construction Division** using these plans (See the *DPO* (Ref. 11.1), Activity 5700, Clarity Task Code 5790). The roadway designer should verify that the appearance of the plans is uniform and consistent, containing the information required for the construction of the project. The use of duplicate data and cross references should be avoided; this is unnecessary and only complicates the task of assembling, checking and revising the plans.

The design plans will have the corrections made prior to submission to **PS&E**. The “Plans not Final” (PNF) cell will be removed and the “Engineer’s Seal” placed on the plan sheets at this time.

PS&E will submit their blue-line corrections to the roadway designer who will coordinate with the design technician in **PDU** to complete the corrections. When the design plans have been submitted to **PS&E**, the CADD files are locked to prevent unauthorized changes to the contract plans.

Once the design plans have been advertised for letting **they are considered legal documents**. Between the time that a project has been advertised for letting and it is let to contract, requests to the **Design Division** for plans and/or electronic files will be forwarded to the **Highway Construction Scheduling Manager** in the **Construction Division**. Changes to the plans after they have been advertised for letting must be processed as a plan revision, following the guidelines outlined in Section 8 of this chapter.

2. STANDARD PLANS, SPECIAL PLANS, AND DETAILS

The Standard/Special Plans Book (*Standard Plans*) (Ref. 11.2) (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/) contains Standard Plans, Special Plans, Standard Typical X-Sections, Standard Details, Information Plans, and Design Guides. The plans contained in the *Standard Plans* require the review and approval of the **Standard Plans Committee** and the **Federal Highway Administration** (**FHWA**). This book should be referred to during the design of the project.

2.A Standard Plans

Standard plans are plans which are in common use on a multitude of projects, such as curb inlets. Standard plans have been reviewed by, and have received approval from, the **Nebraska Department of Transportation** (**NDOT**) and the **FHWA**.

The standard plans applicable to a particular project are listed, in numerical order, under the "Index of Sheets" on the plan set title sheet (See Section 4.A of this chapter). Standard plans are not submitted with the design plan set to **PS&E**, but the roadway designer will provide a list of standard plans required for the project. The standard plans are updated periodically; it is the responsibility of the roadway designer to verify that the standard plan number submitted to **PS&E** is current.

Changes or alterations to the standard plans by the roadway designer are not allowed. If a designer believes that a standard plan needs to be changed or updated, the desired change must be brought to the attention of the **Standard Plans Committee** through the **Design Standards Engineer**.

2.B Standardized Special Plans

A standardized special plan may be used on multiple projects. The designer will contact the **PDU** or the **Traffic Engineering Division** (**Traffic Engineering**) to have the required special plan(s) inserted into the design plan set and into the project file. The roadway designer must verify that the standardized special plans required for a project are included with the design plan set (See Section 1.E of this chapter).

2.C Special Plans

Special plans are plans which are either subject to frequent change or are unique to one project or location (guardrail installation plans, superelevation plans for Interstate projects, etc.). Certain special plans must be requested from the **Bridge Division Special Projects Unit** approximately two months prior to PS&E turn-in during Plan Details (See the *DPO* (Ref. 11.1), Activity 5500, Clarity Task Code 5508). The designer should request concrete box culverts using the "Concrete Box Culvert Request Sheet", Form DR-67. Retaining Walls, Headwalls, etc. may be requested using the "Custom Special Plan Request Sheet", Form DR-66. Custom special plans must be included in the design plan set (See Section 1.E of this chapter).

2.D Standard Typical Cross-Sections

The standard typical cross-sections are a collection of standard details, such as "Rural Intersections and Driveways" and "Joint/Pavement Repair". Depending on the size of the detail, the information found on the standard typical cross-sections may be included in the plan package as a typical cross-section (2-T) sheet (See Section 4.B of this chapter) or the details may be added to a general information (2-N) sheet (See Section 4.G of this chapter). Standard typical cross-section sheets and details are available from the **PDU** and must be included in the design plan set (See Section 1.E of this chapter).

2.E Information

The information section of the *Standard Plans* (Ref. 11.2) contains details that remain constant from project to project, such as contour cultivation. These details are available from the **PDU** for inclusion in the design plan set (See Section 1.E of this chapter).

2.F Standard Details

Standard details are items which are not drawn to a large enough scale to fill a plan sheet or are items which may not be paid for directly. Standard details are normally placed on the general information (2-N) sheet (See Section 4.G of this chapter), the typical cross-section (2-T) sheet (See Section 4.B of this chapter), or the guardrail installation special plan. Existing standard details can be used to create a plan sheet containing an assemblage of details, such as for concrete pavement repair.

2.G Design Guides

Design guides provide details to aid the roadway designer and the design technician in developing the project design and plans. These details are not generally included in the design plan sets (See Section 1 of this chapter).

3. STANDARD FORMATS

Clarity and consistency are essential to good communication. Information regarding the levels, line styles, and line weights to be used in plan preparation can be found in the current version of the CADD Policy. The project plans will follow the guidelines described in the *DPO* (Ref. 11.1) for the various project milestones.

3.A Plan Border Sheets

The **NDOT** has the basic types of plan border sheets available. These sheets may be found at (http://www.roads.nebraska.gov/business-center/design-consultant/) under

"NDOT MicroStation and PowerGeopak Resources"
"Downloads"
"Download all GEOPAK SS4 Standards"
"Microstation" folder
"dgn" folder

The available sheets include:

- Typical Cross-Section (2-T)
- Aerial Photo (2-A/2-W)
- Control Points (2-H)
- General Information (2-N)
- Large Scale Plans (2-L)
- Plan and Profile
- "Piggyback" Plan over Plan
- Cross-Section (for Drainage Sections, etc.)

3.B Standard Symbols

Most of the symbology and patterning commonly used in the roadway design plans have been standardized and may be found in the **Roadway Design Division** (**Roadway Design**) Cell Libraries (http://www.roads.nebraska.gov/business-center/design-consultant/) under

"NDOT MicroStation and PowerGeopak Resources"
"Downloads"
"Download all GEOPAK SS4 Standards"
"Microstation" folder
"cell" folder

The cells are shown in the Cell Book, which may be found under "Design Documentation". These cells may change periodically.

3.C Standard Notes

The **Roadway Design** Construction Notes and Tabular Notes may be found at (http://www.roads.nebraska.gov/business-center/design-consultant/) under

"NDOT MicroStation and PowerGeopak Resources"
"Downloads"
"Download all GEOPAK SS4 Standards"
"Microstation" folder
"cell" folder

The "Standard Notes" and "Tabular Notes", found under "Design Documentation", contain numerous examples of cells used for construction notes. The number to the left of the note is for identification purposes only (it is also the name of the cell). These cells will cover the majority of instances where a construction note is required, but may be edited as needed.

Tabular notes are normally used on the large scale (2-L) sheets (See Section 4.I of this chapter) or when notes are placed on a general information (2-N) sheet (See Section 4.G of this chapter).

Individual construction notes are generally used on plan and profile sheets (See Section 4.J of this chapter). The construction notes should be framed in with a leader line drawn, except for existing pipe note descriptions. Notes for pipe culverts that are to be used in place do not need to be framed in and do not require a leader line (nor does the note need to state "Use in Place").

Occasionally a unique construction note must be used. In this situation, the roadway designer or design technician is at liberty to create the note that is needed, keeping in mind that the construction and removal notes must conform to the "Standard Item List" (http://www.roads.nebraska.gov/business-center/business-opp/hwy-bridge-lp/item-history/) and must be formatted in a style similar to the approved note cells. Tabular note blocks have been set up using only three widths; if a new note must be created one of these formats will be used. The design technician should verify that the details and notes shown on the plans will be legible after the plans have been reduced to half size. Acceptable abbreviations for use in the construction or tabular notes are listed in the Glossary.

3.D Horizontal Alignment Data

The horizontal alignment data should be represented as follows:

- Represent the stationed project centerline (CL) by a solid line with tic marks, indicating a station, every 100 feet.
- Identify the horizontal curve points (PI, PC, PT, TS, SC, CS, and ST) by station.
- Label every station that is divisible by 5 or 10 for the plan views of the 1" =100' and 1" = 50' scales (e.g. 220, 225, 230).
- Label every station on the 1" = 20' scale (e.g. 220, 221, 222).
- The curve radius (R) will be shown to the nearest foot.
- Deflection angles are shown to the nearest minute. The other curve data are will be shown to the nearest 0.01 foot.

The following curve data items are to be listed near the PI's in this order:

Circular Curve

PI	Point of Intersection
Δ	Deflection Angle
T	Tangent Length
R	Radius of Curve
e	Percent of slope for the full Superelevation, followed by Standard Plan Number, if applicable.
PC	Point of Curvature
PT	Point of Tangent
e	Alternate note location, when superelevation is added at a later time.

Spiral Curve

PI	Point of Intersection
Δ	Deflection Angle
T	Tangent Length
Δc	Circular Deflection Angle
Lc	Length of Circular Curve
Θs	Spiral Deflection Angle
Ls	Length of Spiral Curve
Lt	Long Tangent for Spiral Curve
St	Short Tangent for Spiral Curve
E	External
TS	Tangent to Spiral
SC	Spiral to Curve
CS	Curve to Spiral
ST	Spiral to Tangent
e	Rate of full Superelevation followed by the Plan number, if applicable.

For further information see Chapter Three: Roadway Alignment, Section 3.

3.E Vertical Alignment Data

Vertical Alignment Data should be presented as follows:

- Show the profile of the existing ground line along the project centerline.
- The design profile will be placed in relation to the existing ground line.
- Note every station along the bottom of the profile. Stationing should fall directly below the dominant vertical grid lines, for example:
  150 1 2 3 4 155 6 7 8 9 160 etc.
- The existing elevation text is placed vertically, directly above the datum elevation line and to the left side of the vertical grid line.
- The existing centerline elevations (provided by the survey) will be given to the nearest 0.1 foot.
- The existing centerline elevations will be recorded at each station, every 100 feet. The elevations of the essential breaking points are also required.
- The design elevation text is placed vertically, offset above the existing ground elevations and to the right of the vertical grid line.
- The design elevation will be given to the nearest 0.01 foot.
- The design elevations are to be recorded at each station on the profile sheets. Through a vertical curve profile, the design elevations will be recorded at intervals of 50 feet.
- Reference elevations will be shown as even 10 feet intervals in the columns on each side of the profile sheet (labeled on the dominant horizontal grid lines).
- The datum elevation will be shown in the lower left corner of the profile sheet, 1-grid up from the bottom.
- The station equations are to be clearly shown in the profile view (show a gap in the profile line, if needed).
- Tangent slope percentages will be labeled to four decimal places.
- Proposed vertical alignment will not be shown in overlay areas (overlay projects are not normally drawn on plan and profile sheets unless special ditches need to be shown).
- Special ditch lengths of less than 150 feet will not be shown on the plans (See Chapter Six: The Typical Roadway Cross-Section, Section 10.B).
- If the profile portion of the plan sheet is heavily congested, the special ditch information may be presented in chart form (if one sheet requires that you use the special ditch chart, it should be used for all special ditches).
- PC's and PT's will be indicated by a small circle (cell) on the grade line. No further information is required.
- PI's will be indicated by a small triangle (cell) at the intersection of the dashed tangent lines. The notes for the vertical PI's will indicate the following:

  - PI Sta. (normally located at a vertical grid line or PI Sta.)
  - Elev. = (elevation at the vertical PI)
  - L = (length of the vertical curve)

3.F Drainage and Hydraulic Information

The build notes and drainage and hydraulic information will be shown in the plan set as noted below. When the hydraulic information is given, the items to be shown on the plans are:

- **Q_{xx}** - Peak flow in cfs (cubic feet per second)
  (xx = subscript for the design period, e.g. 50 yr.)
- **DA** - Drainage Area (in acres)
- **HW** - Head Water in feet above the flow line of the inlet

3.F.1 New and Reconstructed Projects

- New culverts: The drainage and hydraulic information is placed in the culvert construction notes on the Plan Sheets (See Sections 4.I and 4.J of this chapter) and on the Culvert Cross-Sections (See Section 4.M of this chapter). This includes drop pipes and driveway culvert pipes requiring pipes larger than the standard 24 inch diameter.
- Existing culverts used in place or extended: These culverts will be analyzed and the drainage and hydraulic information is placed in the culvert construction notes on the Plan Sheets (See Sections 4.I and 4.J of this chapter) and on the Culvert Cross-Sections (See Section 4.M of this chapter).

3.F.2 3R Projects

- New culverts: The drainage and hydraulic information is placed in the culvert construction notes on the Plan Sheets (See Sections 4.I and 4.J of this chapter) and on the Culvert Cross-Sections (See Section 4.M of this chapter). This includes drop pipes and driveway culvert pipes requiring pipes larger than the standard 24 inch diameter.
- Existing culverts used in place or extended: Unless a hydraulic analysis has been completed, only build notes will be required (a hydraulic analysis not required unless there is a known problem). If a hydraulic analysis shows that a new pipe is required, the procedure for new culverts will be followed.

3.G Plan Sheet Scales

3.G.1 Urban

Plan and Profile Sheets:

Horizontal: 1" = 50' Vertical: 1" = 10'

Large Scale (2L) Plan Sheets:

The large scale plan sheets are normally scaled at 1" = 20', especially if curb ramps, storm sewers, and grades are present.

For a project with a lesser degree of complexity, a scale of 1" = 50' may be used.

3.G.2 Rural

Plan and Profile Sheets:

Horizontal: 1" = 100' Vertical: 1" = 10'

"Piggyback" Plan over Plan Sheets:

Rural projects are usually scaled at 1" = 100'

Large Scale (2-L) Plan Sheets:

Large scale plan sheets may be prepared for rural projects to show details of construction more clearly, such as roadway/intersection geometry, raised islands, grades, etc. These large scale sheets are normally scaled at 1" = 20'; a 1" = 50' scale may be used for projects with a lesser degree of complexity.

4. PLAN SET ORGANIZATION

Depending on the type and scope of a specific project, each set of contract plans will contain plan sheets selected from and in the order presented in EXHIBIT 11.1.

Sheet Number & Order	Plan Sheet	Created By	Sheet Description	Sheets Required for Plan Sets			
				Prelim. Design	Functional	Design (L.O.C.)	Design (PS&E)
1	Preliminary Title Sheet	Plans	See Section 4.A.1	X	X	X	
1	Title Sheet	Plans	See Section 4.A				X
2-T	Typical Cross-Sections	Plans	See Section 4.B	X	X	X	X
2-S	Summary of Quantities	Plans	See Section 4.C				X
2-K	Summary of Soil and Materials Survey Information (if required)	M & R	See Section 4.D				X
2-W	Wetlands Sheets (if required)	Plans	See Section 4.E	X	X	X	X
2-A	Aerial Photo Sheets (If project doesn't include wetlands)	Plans	See Section 4.E	X	X	X	X
2-H	Horizontal Alignment and Control Points	Plans	See Section 4.F	X	X	X	X
2-N	General Information Sheet (if required)	Plans	See Section 4.G	X	X	X	X
2-P	Phasing Plans (if required)	Plans	See Section 4.H	X	X	X	X
2-L1 Thru 2-L_	Large Scale Plans (as required):	Plans	See Section 4.I				
2-L_	Geometrics and Grades	Plans	See Section 4.I				X
2-L_	Drainage	Plans	See Section 4.I			X	X
2-L_	Construction (and Removal, if space available)	Plans	See Section 4.I			X	X
2-L_	Removal (if separate sheets required)	Plans	See Section 4.I			X	X
2-L_	Erosion & Sediment Control and Wetland Areas	Plans	See Section 4.I			X	X
2-L	Utility Rehabilitation (if required)	Plans	See Section 4.I				X
3*	Plan and Profile Sheets (or Resurfacing Plan Sheets)	Plans	See Section 4.J	X	X	X	X
*	Traffic Control Plan	Traffic	See Section 4.K				X
*	Temporary Pavement Marking Plan (if required)	Traffic	See Section 4.K				X
*	Roadway Lighting Plans (if required)	Lighting	See Section 4.I				X
*	Landscaping (if required)	Project Develop.	See Section 4.I				X
*	Earthwork Data Sheets	Designer	See Section 4.L				X
*	Drainage Structure Cross-Section Sheets	Designer	See Section 4.M	X	X	X	X
SP*	Bridge and Special Plans (as required):						
SP 1	Deck Steel Girder Bridge-Widening	Bridge	See Section 4.N				X
SP 2	Concrete Slab Bridge-Widening	Bridge	See Section 4.N				X
SP 1C	Guardrail Special Plans ** and Installation Plan	Plans	See Sections 2.B & 2.C				X
SP 2C	Superelevation Plan (if Std. Plan not used)	Plans	See Section 2.C				X
SP 3C	Reinforced Conc. Box Culv. (if Std. Plan not used)	Bridge	See Section 2.C				X
SP _C	Other	Plans	See Section 2.C				X
R1 Thru R_	Right-of-Way Plans	R.O.W. Design	See Section 4.O and Chap. Fifteen: Right-of-Way				
	Ownership		Chap. Fifteen, Section 2.B	X	X		
	Appraisal		Chap. Fifteen, Section 2.D			X	
	PS&E Turn-in		Chap. Fifteen, Section 2.F				X
X1 Thru X_	Roadway Cross-Sections	Designer	See Section 4.P	X	X	X	X
	Listing of Standard Plans (not the plans themselves)	PS&E	See Section 2.A				X

* The first Plan and Profile Sheet will be Sheet Number 3. The following Sheets, through the Special Plan Sheets, will be numbered with separate sequential whole numbers except for the Standard Plans, which are packaged separately.

** Standard Special Plans, which are available from the **PDU**.

Exhibit 11.1 Plan Sheet Organization

4.A Title Sheet

The **PDU** prepares the title sheet for the letting plans. The roadway designer will furnish the **PDU** with the necessary information on the Length Sheet (Form DR-415) and the PS&E Required Sheet (Form DR-280).

4.A.1 Preliminary Title Sheet

The **PDU** can prepare a preliminary title sheet for use with the preliminary design plans (See Section 1.C of this chapter), the functional design plans (See Section 1.D of this chapter), and the design plans (See Section 1.E of this chapter). The roadway designer is responsible for requesting this sheet and for providing the design technician with the necessary information, including:

- Project Name
- Project Number
- Control Number
- Beginning and Ending Reference Posts & Stationing
- **FHWA** Oversight Stamp (if Project of Division Interest, See Section 8 of this chapter)

4.B Typical Cross Section Sheets (2-T)

Generic typical cross-section (2-T) sheets are required for the preliminary design plans (See Section 1.C of this chapter). The preliminary design plans 2-T sheet(s) may be created using the preliminary pavement design thickness from the **Materials and Research Division** (**M&R**) and the appropriate typical section for the project design standard, as copied from the Nebraska Minimum Design Standards (*MDS*) (Ref. 11.3) (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/). The design plan set 2-T sheet details will be developed by the **PDU** from information submitted by the roadway designer and/or **M&R**.

The typical sections of the through highway should be shown first, followed by subsequent typical sections in the order that they appear along the through roadway. Details (such as transitions, feathers, inlays, grading and/or surfacing under guardrail, etc.), will be included on the final 2-T sheet(s). The cross-section view of the roadway should show the following:

- The profile grade point (unless it is located at the roadway centerline) at the finished grade elevation.
- Types, thickness, and widths of surfacing materials.
- Slopes and dimensions necessary to define the typical section. Slope hinge points will be defined on surfacing sections as well as grading sections.
- The location or station range of the road to which the typical section applies will be shown directly below the section.
- The notes pertinent to the specific typical section.
- A note referencing the applicable standard plans.
- The type of sealant to be used on concrete projects.
- Either the lateral obstacle clearance or the fixed obstacle clearance will be dimensioned and labeled on the typical sheet.
- The Engineer's Seal and Signature are required on the lower right hand corner of the sheet.

4.C Summary of Quantities Sheets (2-S)

The **PDU** creates tables for the summary of quantities (2-S) sheet(s) from the project quantities, which are submitted by the roadway designer, after **PS&E** has reviewed the Design Plans. The 2-S sheet shows separate summaries for each group of pay items included in the project. The types and grades of asphalt cement, emulsified asphalt, or asphaltic oil will also be shown. This sheet may also include:

- Compaction requirements
- Other pertinent information necessary to fully summarize the items on the project

4.D Soil and Materials Survey Information Sheets (2-K)

Soil boring information and test data will be shown on the soil and materials survey information (2-K) sheets, provided by **M&R**.

4.E Aerial Sheets (2-W or 2-A's)

2-W sheets are aerial photo sheets showing the delineated wetlands, impacted wetlands, and mitigation sites. If wetlands are present on a project, the aerial sheets for the project will be 2-W sheets. 2-A sheets are aerial photo sheets for a project that does not have wetlands. When aerial photo sheets are included in the plan set, they will cover the entire station range of the project.

The following scales will be used for aerial sheets:

1"=200' for rural project 2-A sheets
1"=100' for rural project 2-W sheets or for urban projects
1"=50' for a short urban project

Aerial Sheets should show the following information:

- The stationed project centerlines
- Stationing ties for intersecting centerlines
- North Arrow
- Project Name (on the first sheet only)
- Project Number
- Control Number
- County Name(s) (on the first sheet only)
- Photo Date
- Flight Number
- Scale
- Limits of Construction
- Edge of Pavement
- Existing culverts
- Restricted & Do Not Disturb Areas
- Legend

4.F Alignment and Control Point Sheets (2-H)

Alignment and control point (2-H) sheets are prepared by the **PDU** and may contain three separate sets of information:

- Alignment design data, with stations and coordinates (includes control points)
- Control point tie sheets (numbered using reference posts)
- Bench mark information

4.G General Information Sheets (2-N)

2N sheets may be used to reduce the amount of information shown on other plan sheets. Information normally placed on these sheets includes:

- A legend depicting the cells used for topographic features
- Standard notes, such as the utility note
- Earthwork tabular notes
- Sketches of surfaced driveways and intersections (including quantities for each)
- Detour routes (but not temporary roads)
- Mailbox and mailbox turnout information
- Standard details, such as dikes or riprap for scour holes

4.H Phasing Plan Sheets (2-P)

Phasing plan (2-P) sheets show construction phasing, temporary construction, and the completed construction. Normally, the only construction note that should appear on the phasing plans would be a note for temporary surfacing. Phasing for drainage items is shown on the drainage cross section sheets (See Section 4.M of this chapter).

4.I Large Scale Plan Sheets (2-L)

Large scale plan (2-L) sheets are normally used for urban, expressway, or Interstate projects. 2L sheets may also be prepared for rural projects to show details of construction more clearly, such as roadway/intersection geometry, raised islands, grades, etc. The 2-L sheets may consist of a combination of the following sheet sets, depending on the type and complexity of the project:

- Geometrics (combine with grades if space allows)
- Joints (combine with the geometrics if the longitudinal joints require geometrics)
- Grades (See Chapter Eight: Surfacing, Section 9, for additional information)
- Drainage
- Construction (combine with removal if space allows)
- Removal
- Erosion & Sediment Control and Wetland Areas
- Lighting
- Landscaping

If the construction and removal notes are to be combined on one set of plans, the notes will be kept separate. For example; place the removal notes on the upper half of the sheet and the construction notes on the lower half of the sheet. For some less complex urban projects the drainage, construction, and removal notes may be combined into one set of plans. Information regarding existing conditions will be in capital letters in the tabular notes.

4.J Plan and Profile Sheets

Rural projects are usually presented on plan and profile sheets, which are split sheets showing the plan view of the project on the top half of the sheet and the project profile below. Individual construction notes on a plan and profile sheet should be written vertically. The length of the note box should be uniform throughout the length of the project. The notations will be written so that they read from either the bottom or the right side of the sheet.

4.K Traffic Sheets

Traffic Engineering will provide the roadway designer with the required traffic plans, including the “Traffic Control Plan”, the “Temporary Pavement Marking Plan”, and the required traffic control devices (such as, signs, signals, pavement markings, delineators, traffic detector loops, etc.). **Traffic Engineering** will also provide the roadway designer with a listing of the standard plans required for the project (See Section 2.A of this chapter).

4.L Earthwork Data Sheets

Earthwork sheets consist of the computer generated computations, showing the cumulative project earthwork, station by station. If the pay item for the project is “Earthwork Measured in Embankment”, the earthwork data sheets will not show a balance factor, adjusted quantities, or a mass ordinate. For additional information see Chapter Seven: Earthwork.

4.L.1 Earthwork Notations

Earthwork balance points should be shown for new and reconstructed projects. The earthwork is usually presented as a tabular note on the general information (2-N) sheet (See Section 4.G of this chapter). Examples of earthwork tabular notes may be found in the Tabular Notes (See Section 3.C of this chapter). For additional information see Chapter Seven: Earthwork, Section 1.A.3.

4.M Drainage Structure Cross-Section Sheets

The roadway designer is responsible for producing the drainage structure cross-section sheets. Drainage items (culvert pipes, box culverts, storm and sanitary sewers, curb inlets, manholes, flared-end-sections, headwalls, etc.) will be shown on the drainage cross-section sheets (cross-sections are normally not required for driveway culvert pipes). These cross-sections will be drawn along the flow line of the structure, accompanied by the construction notes, the hydraulic information (See Section 3.F of this chapter), and quantities for the structure. If an existing box culvert is being extended the designer should include a table listing the thickness of the existing culvert top, floor, and walls. The construction notes and quantities will correspond to the items tabulated in the summary of quantities (2-S) sheets (See Section 4.C of this chapter) and in the construction and removal notes (See Sections 4.I and 4.J of this chapter), as shown in the plans.

The preferred scale for the drainage cross-section sheet is 1" = 10' although scales of 1" = 5' or 1" = 20' may be used as circumstances dictate. The horizontal and vertical scales used should be consistent throughout the individual drainage structure cross-section sheets. The scale used will be shown near the sheet identification block in the upper right hand corner of the sheet.

4.N Bridge Plan Sheets

The **Bridge Division** (**Bridge**) provides the roadway designer with the bridge special plans for each project, as needed. The special plan number for a bridge structure, excluding bridge-size box culverts, will not have a C following the special plan number. The other special plans will have the letter C following the number (See EXHIBIT 11.1).

For uniformity and consistency, the bridge plans will consist of:

- Layout Sheet
- Geology and Pile Layout
- Substructure Details
- Superstructure Details
- Girder Layout
- Cross-Sections and Deck
- Approach Slabs
- Slope Protection

4.O Right-Of-Way Plan Sheets (R1 Through R*)

Right-of-Way Design prepares the right-of-way plans in stages (See Chapter Fifteen: Right-of-Way). The design plan set submitted to **PS&E** (See Section 1.E of this chapter) will include a set of right-of-way "PS&E Plans" (See Chapter Fifteen: Right-of-Way, Section 2.F); the right-of-way plans title sheet will not be included.

4.P Roadway Cross-Sections (X1 Through X*)

The roadway designer is responsible for creating the roadway cross-sections, which are usually computer generated sheets using GeoPak. The cross-section scales should be consistent throughout the plan set and should be placed near the sheet identification block, in the upper right hand corner of the sheet.

Cross-sections should not overlap each other. Where cross-section slope lines would extend beyond sheet limits, the slope line should be broken and indented, showing the break points by elevation and offset distance from the centerline (See EXHIBIT 11.2).

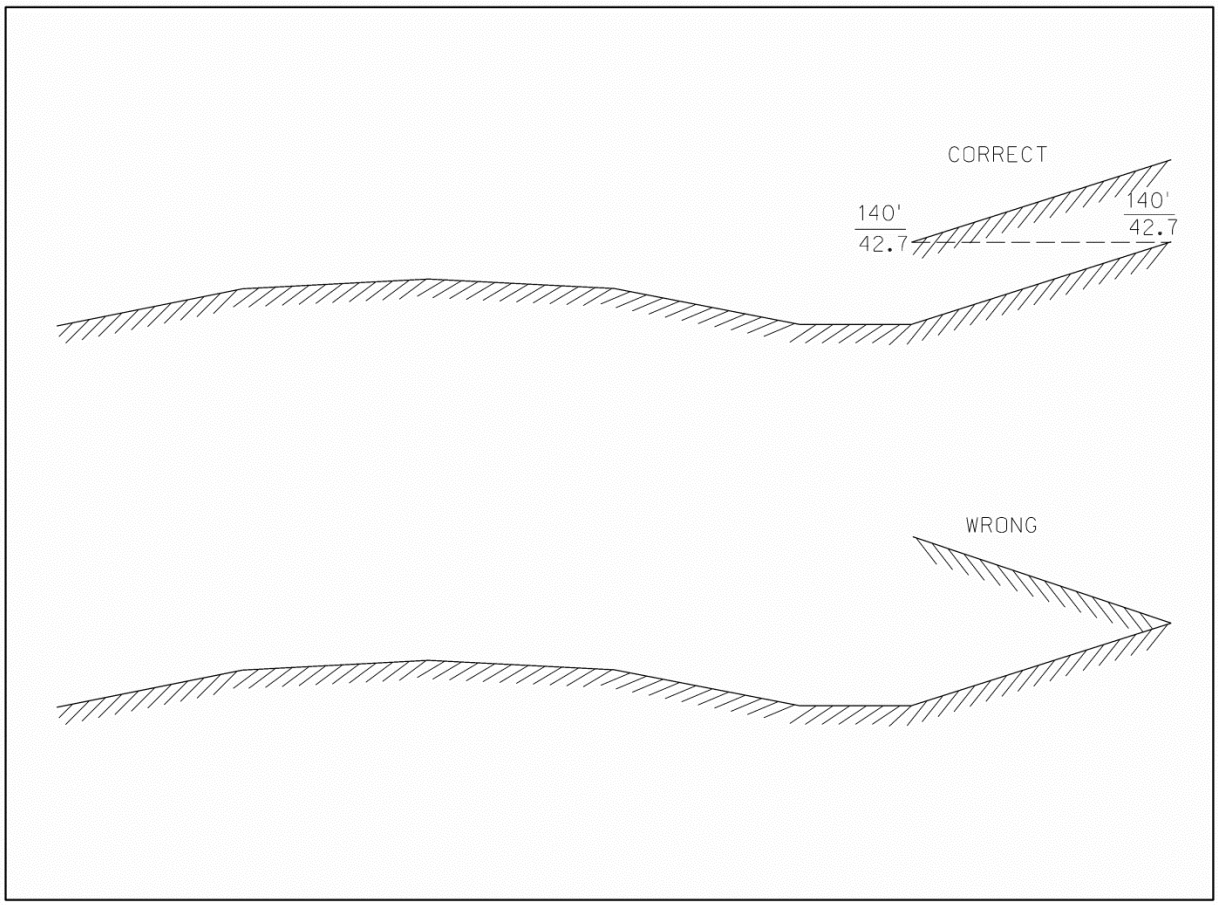


Exhibit 11.2 Roadway Cross-Section Break Lines

5. RESURFACING, RESTORATION AND REHABILITATION (3R) PROJECTS

3R projects are most often shown as plan view over plan view (piggyback) sheets. A resurfacing project may be drawn on plan and profile sheets (See Section 4.J of this chapter) if there are special ditches on the project; the use of plan and profile sheets for resurfacing projects can be avoided by placing a special ditch chart on the general information (2-N) sheet (See Section 4.G of this chapter).

6. PROFESSIONAL ENGINEER SEAL AND SIGNATURE

Projects which are to be let to bids by the **Nebraska Dept. of Roads** shall have the pages of the design plans sealed, signed, and dated by a Professional Engineer in accordance with the Engineers and Architects Regulation Act (Neb. Statute Sections 81-3401 to 81-3455). The license must be issued by the **Nebraska Board of Engineers and Architects** and shall be valid the year the project is let to contract. Engineers will not sign the plan sheets until the required plan changes have been processed by the **PDU** and checked by **PS&E**.

7. ADDENDUMS TO A PROJECT

After a set of plans has been advertised for letting, relatively minor items which impact the bids on a project (e.g. an incorrect quantity or a previously unknown or overlooked culvert pipe) will be handled with an addendum to the project. The addendum is a separate 8½" x 11" sheet, created by the **Construction Division**, which is posted with the project plans detailing the change in quantities and, if required, including a detail of the item in question. If a detail is required it will be created by the responsible **Division/Section/Unit** (e.g. **Bridge**, **Roadway Design**, **Lighting**). Substantial changes to the project (e.g. a change in roadway grade impacting drainage and right-of-way) will usually result in the project being withdrawn from the letting. Changes typically will not be made to the plans at this time but will be handled as a plan revision after the project has been let to contract (See Section 8 of this chapter). If the addendum relates to a **Roadway Design** item the designer will coordinate the change with the **Construction Division** and with any other **Divisions/Sections/Units** impacted by the change, for example a temporary easement may be required from the **Right-of-Way Division**.

8. REVISIONS TO A PROJECT

Once the project plans have been executed **they are legal documents** (executed means that both parties, contractor and **NDOT**, have signed the contract). After the project letting, the plan sheets for active projects are returned to the **Roadway Design** vault (except for the bridge plans) and may only be removed for printing or to make revisions to the plans. Revisions cannot be processed and dated until after the execution date; a plan revision may be prepared prior to the execution date but cannot be dated and returned to **Construction** until after the execution date. Once the requested revisions have been made to the plans, the revisions will be sent to the **Environmental Section** of **PDD** for review. The plans are then returned to **Construction**, noting that they have been reviewed by the **Environmental Section**, and the CADD files are locked to prevent unauthorized changes to the contract plans. The roadway designer will contact the **Plans Manager** to unlock the CADD files prior to making plan revisions (if the **Plans Manager** is not available, the designer should contact the **Business Technology Support Unit** to unlock the CADD files).

For plan revisions prepared by **Roadway Design**, the designer will send a notification (which can be an e-mail) detailing the proposed revision to the **Assistant Design Engineer** (**ADE**) and the **Unit Head**. The notification should include the following information:

- Project Name & Number
- Control Number
- Revision Number
- Tract Numbers affected
- A brief description of the changes
- An approximate completion date for the revision

If the **ADE** approves of the proposed revision the **Unit Head** will forward the notification to the following:

- **Environmental Section**
- **DE**
- **District Construction Engineer** (**DCE**)
- **Plans Manager** (responsible for unlocking CADD files)
- **Construction Engineer**
- **District Project Manager**
- **Bridge** (if applicable)
- **Traffic Engineering**
- **ROW Design Engineer**
- **Utilities Unit ADE**
- **FHWA** (on federal oversight projects, See Section 8.A of this chapter)
- Other affected **Divisions/Sections/Units**

This notification alerts project stake-holders that a change is being made and allows for plan changes from different divisions to be consolidated into one plan revision.

Plan revisions *must* be signed and sealed by a Professional Engineer (P.E.). The **Unit Head** and **ADE** will be informed of the changes to the plans, regardless of whether the changes are made in **Roadway Design** or in the **District**. The **ADE** will decide whether a plan change should be handled with a change order or as a plan revision. The **DE** or the **DCE** may assume the responsibility to seal and sign plan revisions processed in the **District**, as long as the **Unit Head** and **ADE** are consulted about the design of the proposed revisions **before** they are finalized. If **Roadway Design** authorizes or transmits a plan revision to the **District** by fax, phone, or e-mail, the seal and signature of the responsible P.E. in **Roadway Design** will be affixed to the transmittal, which will then be scanned and sent to the **District**.

8.A Federal Oversight Projects

Under the terms of MAP-21 (http://www.fhwa.dot.gov/map21/) and the NDOT/FHWA Stewardship & Oversight Agreement (http://roads.nebraska.gov/media/6796/steward-oversight-agr.pdf), the **FHWA** will exercise oversight for plan revisions on federal-aid projects as follows:

1. Revisions for Projects of Division Interest (PoDIs) selected for **Construction** oversight (the designer should check Clarity for the project status) which are on the National Highway System (NHS) shall have **FHWA** approval to proceed *before* the plan revisions are made (the **Unit Head** is responsible for informing the **Plans Manager** when **FHWA** approval has been received). The processed plan revisions must be approved by the **NDOT** and must then be approved by the **FHWA** as outlined in Section 8.A.1 of this chapter.
2. Revisions for PoDIs selected for **Construction** oversight which are not on the NHS will be sent to the appropriate **FHWA Transportation Engineer** for review and comment but will be approved by the **NDOT**.
3. All other federal-aid projects, regardless of location, will be approved by the **NDOT**.

8.A.1 FHWA Plan Revision Approval Process

For PoDIs selected for **Construction** oversight which are on the NHS, the plan sheets affected by the revision will be sent to the **FHWA** as a pdf with the "DRAFT PLAN REVISION X" cell placed in the upper right corner of the draft plan revision pdf. A draft copy of the revision letter will be attached with the plan pdfs (See EXHIBIT 11.3) and the **FHWA** will be informed that the revisions have been reviewed by the **Environmental Section** of **PDD**. Additional coordination may be required between the **FHWA** and the **Environmental Section** of **PDD** as is necessary for the re-evaluation of the NEPA document. The plan sheets and document may be e-mailed to **FHWA** if possible; larger revisions will be sent to the **FHWA** on a recordable data medium. After an **FHWA** approval e-mail has been received, full size plans and the approved plan revision letter will be attached with the plans to **Construction**. The letter is the same as the request letter sent to the **FHWA**, except that a line is placed at the bottom citing the **FHWA** approval, such as "FHWA concurred on May 24, 2016 through _____, FHWA Transportation Engineer" (or whoever at the **FHWA** did the approval).

8.B Revision Procedures

The roadway designer may mark-up corrections on prints of the plans for the revised work and give the corrections to the **PDU**. The approved revisions will be made, printed on full size sheets, and returned to the roadway designer, along with the marked-up work sheets.

After **Unit Head** review, the registered engineer responsible for the revision shall re-seal (or seal, if not the original engineer), sign, and date the revised sheet. Revised sheets that have a signature block will require a new signature with the following exceptions:

- The revised title sheet – the revision symbol and a note stating the original date that the **Specification Engineer** signed the plan are required for only the first revision
- The summary of quantities sheet – the responsible engineer's seal and signature is required but the **Specification Engineer's** signature is not required

The roadway designer will submit the *original full size plan sheets* and the revised full size plans to the **Construction Division**, along with a letter written to the **Construction Engineer** (see EXHIBIT 11.3) noting which sheets have been revised, added, or deleted. The letter must give an explanation of each change to the plans resulting from the revision; the date on the revision letter will correspond to the date on the revised sheets. The designer will also e-mail the **Highway Project Manager** in **Construction** with a justification/reason for the revisions.

The **Construction Division** is responsible for returning the revised plan sheets to the roadway design vault.

Date: January 11, 2017

To: Mike Ondrak (Highway Construction Manager, Construction Division)

From: Brian Johnson (Roadway Design Unit Head)

Subject: Plan Revision R3 for Project 80-9(832)
Dated April 20, 2012
Project Location: Greenwood to Mahoney
C.N. 12450A

Attached are full-size revised sheets for the above mentioned project.

This plan revision is required for the following reasons:

1. Phasing changes for cross-over which ties into the Waverly to Greenwood project, 80- 9(842), CN 12469. Previous cross-over did not account for that project being let. The cross-over surfacing was revised from 10" concrete to 13" doweled concrete due to the extended time frame of use during the two projects.

The following plan sheets were revised: 1, 2, 2-S1, & 2-S2.

The following CN 12450A sheets were added: 2-P19A, 2-P30A, & 66A.

The following CN 12450A sheets were deleted: 2-P19, 2-P30, & 66.

Quantity Changes are listed below:

Group	Item	Old Quantity	New Quantity	Differential
3	Crushed Rock Surface Course	37,725.000	37,181.000	-544.000 SY
3	13" Doweled Concrete	434,563.000	436,602.000	+2,039.000 SY
3	10" Concrete Pavement	7,663.000	4,490.000	-3,176.000 SY
3	Foundation Course, 6"	437,465.000	439,504.000	+2,039.000 SY
4	18" Culvert Pipe Type 2, 3, 4, 5, 6, 7, or 8	31.000	631.000	+600.0000 LF

This revision has been reviewed by the Environmental Section of the Project Development Division.

FHWA concurred on December 30, 2016 through Pritesh Mehta (Transportation Engineer)

Exhibit 11.3 Example Revision Letter

8.B.1 Revised Sheet

If a project plan sheet was created in CADD, the revisions will be made in the CADD files. Revisions to the project plans should be made in the original sheet file wherever feasible. The original information that is to be revised must be retained, **do not** eliminate an original item. The change will be crossed out, so as to remain legible, and the revised information added.

A quantity or line of text which is to be revised will be shown with a single line through the text (~~text~~). The original text will not be erased or edited. The new text will be written in near proximity to the original text, along with the revision number (R1). This revision symbol will be used to point out each change on a revised sheet.

Revised sheets will have the revision symbols and revision dates in their upper right corners (the revision date shall correspond with the date on the letter to the **Construction Engineer**, See Section 8.B of this chapter). The revision symbols and revision dates will be shown as follows:



8.B.2 Added Sheet

Revisions which are so extensive as to preclude their being made on the original plan sheet will be made on a new added sheet. This sheet will be placed immediately after the original sheet and will be differentiated by the addition of a letter to the sheet number. For example, added sheet No. 43A would be placed immediately following original sheet No. 43, which will then be retained in the plan set as a deleted sheet.

On special plan sheets, the plan number will remain the same (e.g. 6C) but the sheet number will change.

The following designation will be placed on the added sheets:



The revision date shall correspond with the date on the letter to the **Construction Engineer**, See Section 8.B of this chapter.

8.B.3 Deleted Sheet

Sheets which are to be cancelled, voided, or deleted from the plans will remain in their location within the plan set and a large “X” will be placed across the sheet. The revision symbol, deleted sheet note, and date (corresponding with the date on the letter to the **Construction Engineer**, See Section 8.B of this chapter), will be noted at the top right-hand corner of the sheet (See EXHIBIT 11.4).

8.B.4 Quantity and/or Pay Item Changes

Quantity changes will be added to or subtracted from the quantity shown on the summary of quantities sheets. The revision symbol will be used to point out each change and the symbol and date (corresponding with the date on the letter to the **Construction Engineer**, See Section 8.B of this chapter) will appear at the top right-hand corner of the summary of quantities sheets (See EXHIBIT 11.6).

Changes in quantities resulting from the revision will be detailed in the letter to the **Construction Engineer** (See Section 8.B of this chapter). The funding source(s) of the pay items will also be specified (See Chapter Twelve: Cost Estimating & Funding, Section 5). When plan revisions add pay items which are not already in the plans or that create the need for a special provision, the special provision will be submitted as part of the letter to the **Construction Engineer**, along with the revised plan sheets.

8.B.5 Detail Sheet

Deleted details should have a box drawn around them, an “X” drawn from corner to corner, and will be labeled (within the block) with the revision balloon (R1). (See EXHIBIT 11.7). There are times when this would not be the most appropriate method, such as when text for one sketch may overlap within the block area of adjoining sketches.

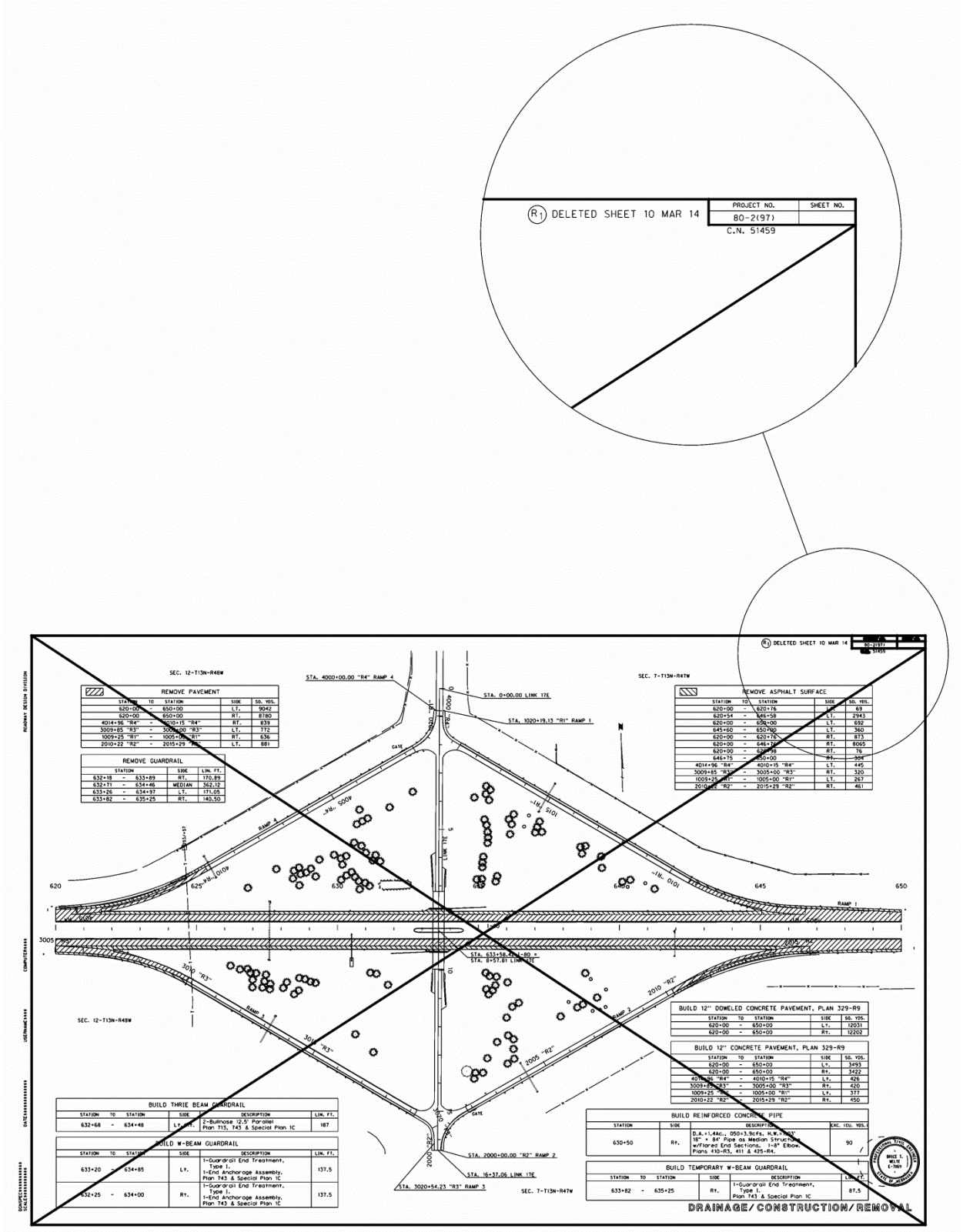


Exhibit 11.4 Deleted Sheet

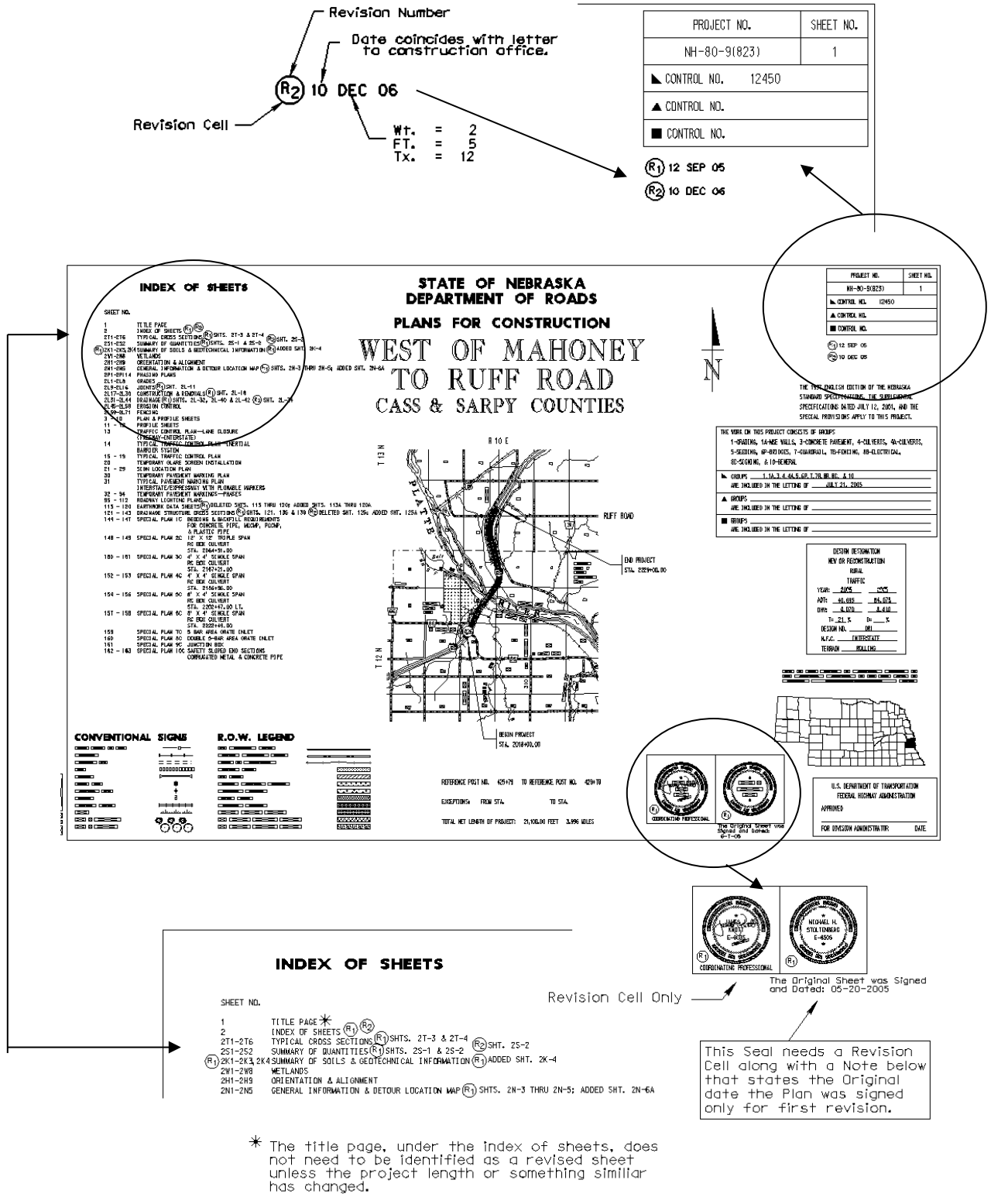


Exhibit 11.5 Revised Title Sheet

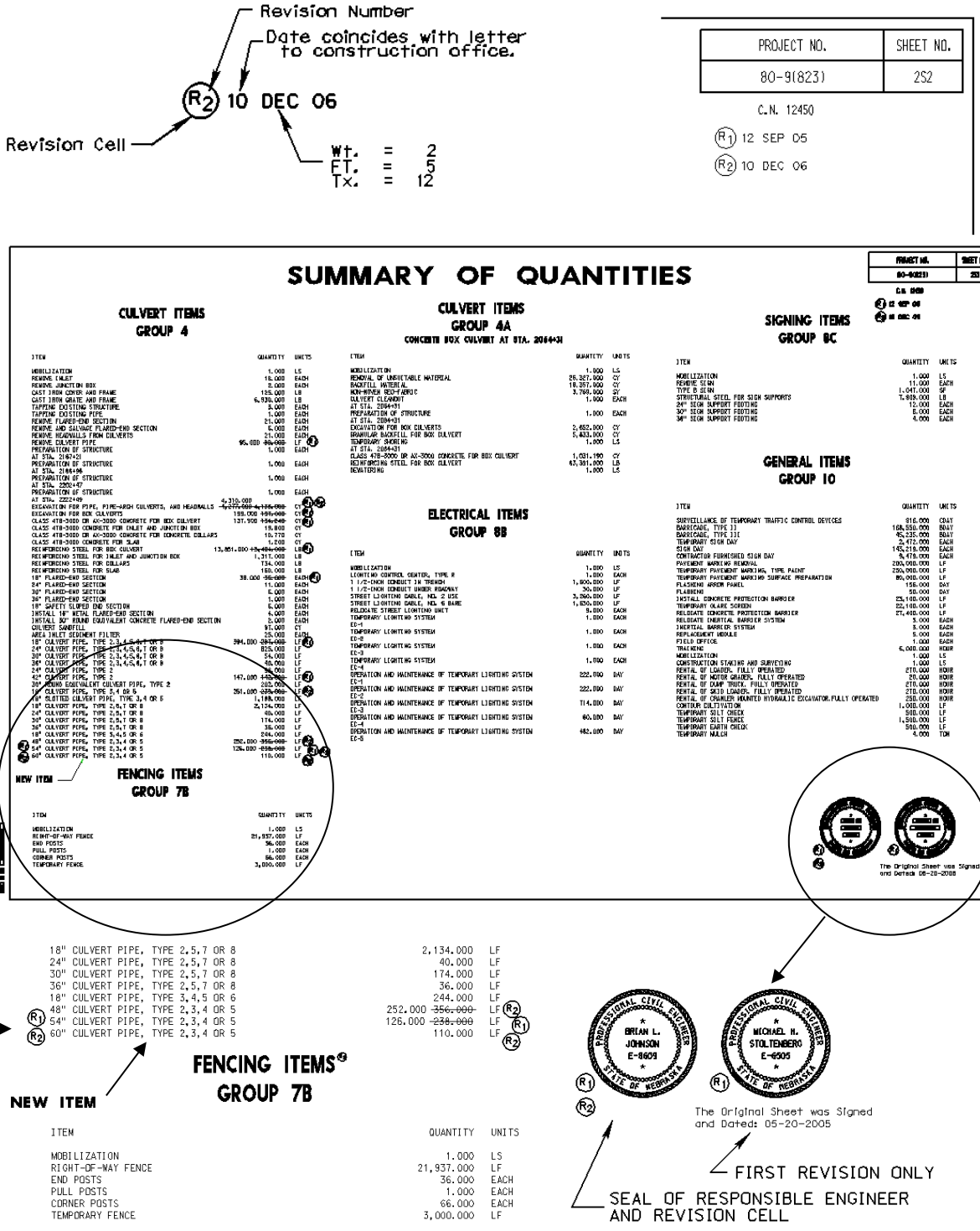


Exhibit 11.6 Revised Summary Sheet

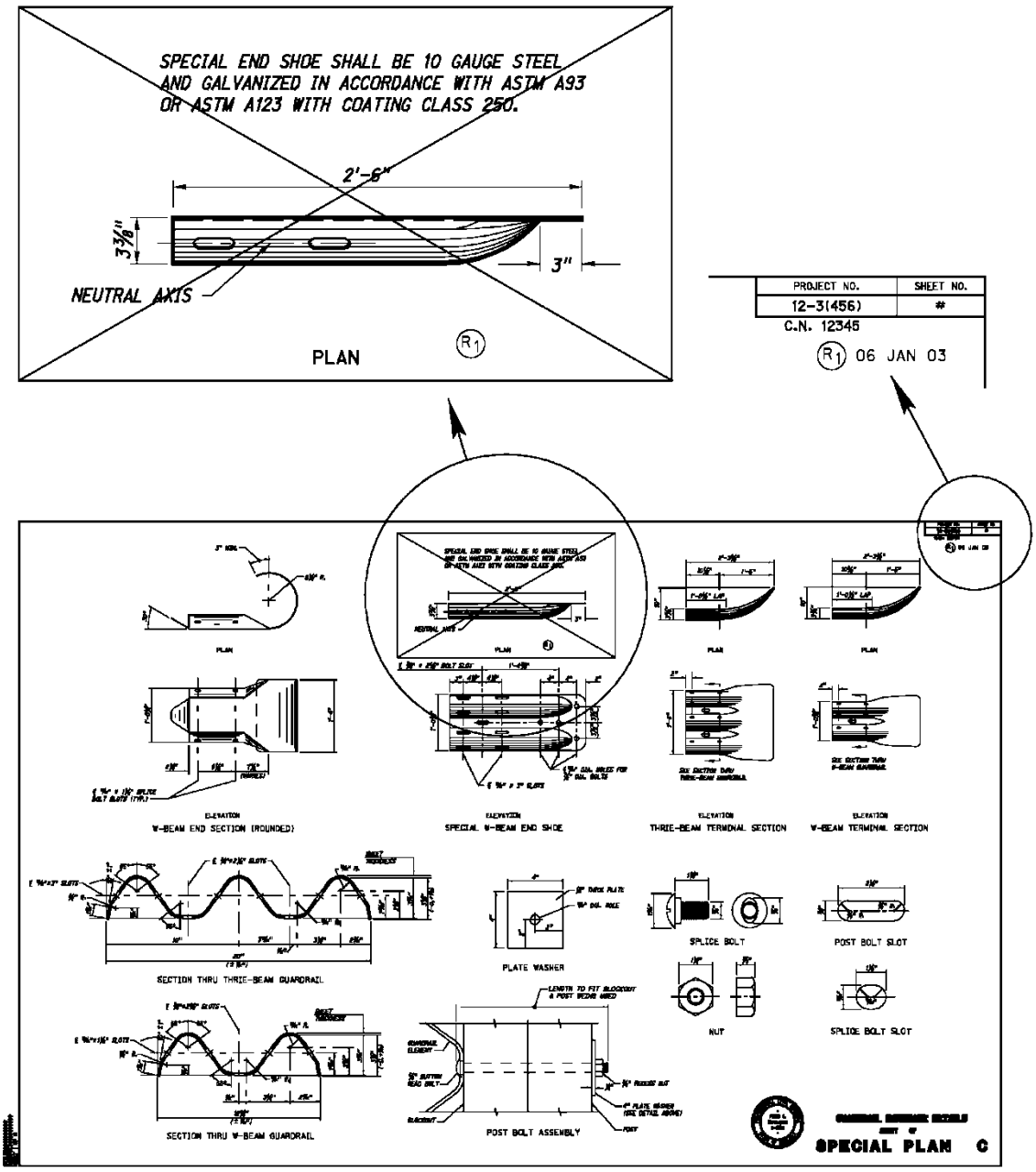


Exhibit 11.7 Revised Detail Sheet

8.C Revising a Project Which Has Been Rejected or Withdrawn From a Letting

A project which has been rejected or withdrawn from a letting will be returned to the **PS&E Unit**.

If project which has been rejected or withdrawn from a letting requires a revision, the project sheets will be revised in the same manner as if the project had been let, with four (4) exceptions:

- Added sheets that are replacing a deleted sheet; in the upper right hand corner of the sheet, where the revision is dated, note as follows: (R1) Revised Sheet DD MMM YY, (Day, Month, Year).
- Added sheets that are not replacing a deleted sheet: in the upper right hand corner of the sheet, where the revision is dated, note as follows: (R1) Added Sheet DD MMM YY, (Day, Month, Year).
- Deleted sheets will be pulled from the plan set and will not be printed with the project.
- The revised title sheet and summary of quantities sheet(s) **will** be re-signed and dated by the **Specifications Engineer**, using the date provided by the **PDU**.

	PROJECT HAS BEEN AWARDED & LET TO CONTRACT:	**PROJECT HAS BEEN REJECTED OR WITHDRAWN FROM A LETTING:**
Revised Sheets will read:	(R1) DD MMM YY	(R1) DD MMM YY
Added Sheets will read:	(R1) Added Sheet DD MMM YY	(R1) Revised Sheet DD MMM YY
Deleted Sheets will read:	(R1) Deleted Sheet DD MMM YY	Will not be included with the project

8.C.1 Title Sheet (Project Has Been Rejected or Withdrawn From a Letting)

The **PS&E Unit** is responsible for revising the title sheet for a project which has been rejected or withdrawn from a letting. A project which has been rejected or withdrawn from a letting will have one of these notations by the group block; these comments will not be identified with a revision symbol:

- No bids received
- Withdrawn
- Rejected

9. REFERENCES

11.1 Nebraska Department of Transportation, Design Process Outline (*DPO*), Current Edition (http://www.roads.nebraska.gov/business-center/design-consultant/)

11.2 Nebraska Department of Transportation, Standard/Special Plans Book (*Standard Plans*), Current Edition. (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/)

11.3 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards (*MDS*), Current Edition. (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/)

Pete Ricketts
Governor

STATE OF NEBRASKA
DEPARTMENT OF ROADS
Kyle Schneweis, P.E., *Director*
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The Nebraska Department of Roads Roadway Design Manual Chapter Twelve, "Cost Estimating & Funding", August 2017, has been approved for use.

Approved by: _____ / 8/16/17
Mike Owen, Roadway Design Engineer, P.E. Date

Approved by: David Mraz / 8-16-2017
David Mraz, FHWA Date

Chapter Twelve presents guidance for the design of new, reconstructed and 3R projects; additional design guidance for 3R projects is provided in Chapter Seventeen. This chapter replaces Chapter Twelve: Cost Estimating & Funding, dated July 2006. This chapter was approved by the Nebraska Division of the FHWA for use on the National Highway System and other federal projects on (Insert Date).

Chapter Twelve
Cost Estimating & Funding

Cost estimating is an integral part of a roadway project. The roadway designer is responsible for providing the project quantity computations to the **Cost Estimating Unit** of the **Construction Division** (**Cost Estimating**) for their use in the production of accurate, reliable, and up-to-date cost estimates.

1. USES OF COST ESTIMATES

The degree of detail and accuracy required for each estimate increases throughout the design process. Estimates, therefore, vary from general approximations at the early stages of a project to very detailed cost estimates at the bid letting stage. Cost estimates are used for a variety of purposes, including:

- Planning, allocation, and funding (See Section 1.A)
  - Distribution of funds to the **Districts**
  - Program decisions (State and local)
- Design alternative comparisons (See Section 1.B)
- Bid comparison and analysis (See Section 1.C)
- Agreements (See Section 1.D)
- Railroad protective liability insurance (See Section 1.E)
- NEPA (See Section 1.F)
- Public meetings (See Section 1.G)

1.A Planning, Allocation, and Funding

Estimated project costs, inflated to account for costs in the year of construction, are used in determining the distribution of funds to the **Districts** and in developing State and local programs.

Estimated project costs may be supplied to **City** and/or **County** governments (with **Assistant Design Engineer** (**ADE**) approval) with the understanding that the information contained in the estimate is to remain confidential. Cost estimates are used by the **City** and **County** governments to plan and program their roadway improvements. **Cities** and **Counties** may also provide matching funds or participate in the **Nebraska Department of Transportation** (**NDOT**) projects (See Section 2 of this chapter).

1.B Design Alternative Comparisons

Designers in the **Roadway Design Division** (**Roadway Design**) may use cost estimates to compare design strategy alternatives. **Cost Estimating** can provide scratch cost estimates for these comparisons.

1.C Bid Comparison and Analysis

Advance planning with reliable cost estimates and updates is important for the timely letting and construction of roadway projects. Cost estimates are also used to compare and review bids.

1.D Agreements

Cost estimates are required for the financial portion of agreements regarding municipal utility relocation, participation by other agencies in the project, etc.

1.E Railroad Protective Liability Insurance (% of Work Near Railroad)

The **Construction Division** must provide the contractor with the percentage of work, by cost, within 50 feet of the centerline of the nearest railroad track on railroad right-of-way and the percentage of work within the railroad right-of-way that is further than 50 feet from the centerline of the nearest railroad track. The contractor needs this information to obtain railroad protective liability insurance. The roadway designer will calculate these percentages for the PS&E package using the following equations:

% of work on RR ROW within 50 feet of the centerline of the nearest track (Group _) = [(The cost of Group _ on RR ROW within 50 feet of the centerline of the nearest track) ÷ (The cost of Group _ total)] x 100%.

% of work on RR ROW outside of 50 feet of the centerline of the nearest track (Group_) = [(The cost of Group _ on RR ROW beyond 50 feet of the centerline of the nearest track) ÷ (The cost of Group _ total)] x 100%.

Cost Estimating can assist the roadway designer in calculating costs.

1.F NEPA

The amount of Federal funding, based on the cost estimate, is one threshold in determining the need and level of NEPA documentation for a project.

1.G Public Meetings

The cost estimate is used to both to inform and solicit feedback about the project at public meetings.

2. FUNDING AND COST SHARING

Funding for projects may come from a variety of sources (e.g. Federal, other State Agencies, Municipal).

2.A Federal Funding Programs

As stated in the Nebraska Revised Statutes, Chapter 39, Section 1365.02 "The Department of Roads shall apply for and make maximum use of available federal funding, including discretionary funding, on all highway construction projects which are eligible for assistance." Federal funding available to the **NDOT** includes the following programs.

2.A.1 National Highway Performance Program (NHPP)
(https://www.fhwa.dot.gov/fastact/factsheets/nhppfs.cfm)

The NHPP provides funding for the operational performance and condition of the National Highway System (NHS) and for the construction of new facilities on the NHS. Funding is provided as a lump sum for each state, which is then divided among apportioned programs including a 2% set-aside for planning and research. The NHPP also ensures that federal-aid funds for highway construction are used to meet State established targets.

2.A.2 Surface Transportation Block Grant Program (STBG)
(https://www.fhwa.dot.gov/fastact/factsheets/stbgfs.cfm)

The STBG is a funding program that includes public roads (including the NHS) which *are not* functionally classified as minor rural collectors, local roads, or streets. It includes some collector routes that were not previously on the federal-aid system. In addition to being a funding source for these routes, the program specifies some set-aside funds for obstacle elimination projects and for transportation alternatives.

2.A.3 Highway Safety Improvement Program (HSIP)
(https://www.fhwa.dot.gov/fastact/factsheets/hsipfs.cfm)

The HSIP utilizes a data driven approach for improving highway safety. The purpose of HSIP funding is the reduction of traffic fatalities and serious injuries on all public roads. HSIP funds are provided to the States as a lump sum which is then divided among apportioned programs, including Safety Improvement Projects (See Chapter One: Roadway Design Standards, Section 5.D).

2.A.4 Rail Highway Crossings (RRZ)
(https://www.fhwa.dot.gov/fastact/factsheets/railwayhwycrossingsfst.cfm)

The RRZ program provides funds for the elimination of railway-highway crossings on all public roads. They are usually matched with State Train Mile Tax (TMT) funds and the NDOT only uses the funds to build new viaducts.

2.B Statewide Transportation Improvement Program (STIP)

(http://dot.nebraska.gov/projects/publications/stip/)

A STIP is a key document in the Federal transportation planning and programming process. States are required to develop STIPs covering at least four years of federally-funded surface transportation projects in consultation with **Metropolitan Planning Organizations'** (**MPOs**), Tribal governments, and local governments in nonmetropolitan areas, and with the participation of the public and interested parties. Projects contained in the STIP must be consistent with the statewide transportation plan and when applicable **MPO** transportation plans. The STIP includes the projects and project phases in approved **MPOs** Transportation Improvement Programs (TIPs) by reference. The **Program Management Division** develops the STIP and must demonstrate fiscal constraint, ensuring that there are sufficient revenue sources available to construct the listing of projects contained in the STIP. The STIP can be amended throughout the fiscal year when projects need to be added, removed, cost estimates updated, or change substantially in scope while still demonstrating fiscal constraint of the STIP.

Estimate updates trigger the majority of STIP amendments and, when in **MPO** areas, potentially the transportation plan. The **NDOT** is required to submit an amendment any time there is a change in federal funds that exceeds 20% or $2 million, whichever is greater. The **FHWA** and the **Federal Transit Administration** (**FTA**) must approve the amendments and the approval process may take up to two months. For this reason it is important to notify the **ADE** and/or **Program Management Division** when the project estimate changes significantly. This is especially critical as the project nears letting because the project cannot be advertised for letting until it is listed correctly in the STIP.

2.C Federal Funding - Participating

Many projects use multiple types of federal funding. For example, surface transportation funds may be used for the roadway portion of a project while bridge replacement and rehabilitation funds may be used for the structures. Project costs for participating projects must be itemized by funding types (See Section 2.G of this chapter).

2.C.1 Salvaging Items

The determination to salvage an item should be made prior to or on the plan-in-hand. If the **District** or another **Division** (e.g. **Materials and Research**) request that an item be salvaged, the roadway designer will note this on the plans and in the **PS&E** package to inform the contractor of the item(s) disposition. The roadway designer will quantify and provide a listing of the salvage items to **Cost Estimating** who will estimate a salvage value for the item(s) so that either the **NDOT** (on delegated projects) or the **FHWA** (on PODI) can determine if reinvestment back to the Federal-aid (FA) program is required. The value of salvaged items greater than $5000 total for a FA project would need to be documented and reinvested back to the FA program. A note will be placed in the contract (PS&E) documents that items to be salvaged need to be stored on the project site for removal by the **NDOT**. Examples of salvaged items include:

- Guardrail
- Delineators
- Culverts
- Millings
- Crushed concrete

2.D Federal Funding – Nonparticipating Items

A project using federal funding may include nonparticipating items. For example, a new and reconstructed project on the National Highway System may include federal funding while an overlay of a State Spur which is a part of the same project involves state funds only. The reason for work being nonparticipating will be documented in the project file. The nonparticipating pay items, including their stationing, will be indicated as such on the quantity sheet in the computation file (See Section 2.G of this chapter).

2.E State of Nebraska Funding

The **State of Nebraska** may fund roadway projects from a variety of state agency funding sources (e.g. **Game and Parks**).

2.F Participation by Others

Some roadway projects may be joint ventures between the **NDOT** and local government agencies (e.g. **City** or **County**) or other **States**. When other governmental agencies are sharing the cost of the improvement these costs should be split out in the cost estimate (See Section 2.G of this Chapter). However, if the agreement with the other governmental entity indicates that their participation is to be a lump sum amount, it is not necessary to break out or split quantities on the segments in which they are participating. Cost sharing guidelines are outlined in NDOT Operating Instruction 60-11, "Municipal Cost Sharing" (Appendix B, "Selected NDOT Operating Instructions"). Guidelines for agreements are found in NDOT Operating Instruction 45-5, "Agreements" (Appendix B, "Selected NDOT Operating Instructions").

2.F.1 Utilities

If utilities need to be adjusted or relocated due to a roadway project, the utility owner will complete the relocation of the facility unless otherwise specified. The **NDOT** will pay the utility owner directly for the eligible non-betterment expenditures. If utility work results in a betterment of the facility, the utility owner will be responsible for those costs. See Section 7.C of this chapter, Chapter Thirteen: Planning and Project Development, Section 6, and NDOT Operating Instruction 45-1, "Utility Rehabilitation Negotiations" (Appendix B, "Selected NDOT Operating Instructions") for further information.

2.F.2 Railroad

Railroad owners will perform the necessary work associated with their property and will be reimbursed by the **NDOT**. See Sections 1.E and 7.D of this chapter; Chapter Thirteen: Planning and Project Development, Section 5.G; and NDOT Operating Instruction 45-2, "Utility and Railroad Payments" (Appendix B, "Selected NDOT Operating Instructions") for further discussion.

2.G Funding Splits Defined by Stations

There are times when other governmental agencies share the cost of only a segment of a project (for example a project on the NHS, with Federal participation, which includes a State spur built with State funds only or a project which includes both rural and municipal segments). The quantities for that segment will be split out and the limits of the segment will be identified by station. For example, if a project includes municipal cost sharing the quantities for that portion of the project which lies within the corporate limits, as identified by project stationing, will be tabulated separately from the remainder of the project; the pay items and quantities within these limits will be separated out on individual computation sheets for each funding type. Funding splits will not be shown on the project plan sheets.

When a plan revision results in a change in project quantities, the funding source(s) of the affected pay items will be identified in the revision letter to the **Construction Engineer** (See Chapter Eleven: Highway Plans Assembly, Section 7.A.4). Questions regarding funding split(s) on a project should be directed to **Cost Estimating**.

For additional information, see the NDOT Operating Instruction 60-11, “Municipal Cost Sharing” (Appendix B, “Selected NDOT Operating Instructions”).

2.G.1 Lump Sum Funding Splits

If another entity is contributing funds to a project based on a lump sum agreement, quantities do not have to be split out (unless the lump sum dollar amount is to be determined based on the quantities).

3. SOURCES OF PROJECT INFORMATION

3.A Integrated Highway Inventory System

The “Integrated Highway Inventory System”, found in the CICS1 program on the computer mainframe, provides on-line project facts and funding information. To enter the “Integrated Highway Inventory System”:

1. Click on the “Mainframe Sessions” icon.
2. Enter CICS1 by entering C1 and your DR# and password.
3. Select 2 – “Dept. of Transportation”.
4. Select 4 – “Integrated Highway Inventory System”.

The roadway designer will notify the **Program Management Division** (**Program Management**) if discrepancies are found between the information listed in the inventory and the information presented on other project forms, such as Form DR-73, “Highway Improvement Programming Request”.

3.B Highway Improvement Programming Request (Form DR-73)

Form DR-73, the “Highway Improvement Programming Request Form”, should be reviewed by the roadway designer to obtain information about the project. Normally this form is initiated by the **District**.

4. SCHEDULE OF ESTIMATES IN ACTIVITY SEQUENCE

4.A General

Cost estimating activities must be coordinated with the participating parties (**Project Development Division** (**PDD**), **Roadway Design**, **Bridge Division** (**Bridge**), **Right-of-Way** (**ROW**), **Roadway Design Utilities Unit** (**Utilities**), **Intermodal Planning**, **Agreements**, etc.). The originator of the change will notify the **Divisions**/**Sections**/**Units** involved in the project of altered conditions, scope changes, or new requirements related to the project. EXHIBIT 12.1 summarizes the cost estimate schedule, including the timing and the responsible party.

The Initial Estimate (Status Code 05, "Program Phase") is developed by **Program Management**. At this early stage, the project costs are estimated on average per mile construction costs provided by the **Materials and Research Division** (**M&R**) together with estimated costs for preliminary engineering, construction engineering, contingencies, utility costs, right-of-way costs, and costs for bridge work, as required by the project (See Section 7 of this chapter). The roadway designer should verify that utility, right-of-way, bridge, and other items that are part of the project are included in the cost estimate from the earliest stages of design.

Cost estimates are required throughout the planning and design process and generally coincide with project milestone activities, such as Plan Details. Estimates should be updated at least annually up through Cost Update 3 (Status Code 45, "Plan Details Phase") and will also be updated whenever changes in the concept or in the scope of the project occur outside of the normal estimate activity schedule.

4.B Level of Detail

As part of the planning process, average costs per mile of construction are used to estimate the project cost. As the project's design develops in greater detail cost estimates begin to reflect the actual quantities of materials that are to be used.

Estimates should be as detailed as possible. Items necessary for the construction of the project will be included in each estimate, even though detailed quantities may not have been developed for some of the items. **Cost Estimating** will be informed of special conditions that would affect a bid estimate, such as tight work schedules, restricted working hours, incentives/disincentives, etc.

Approximately 80% of a project's cost is usually found in 20% of the pay items. The roadway designer should allocate his/her time accordingly, not spending an inordinate amount of time developing detailed quantities for minor items.

Status Code	Estimate Name	Time Frame	Level of Detail	Source of Estimate
Prior to Roadway Design Division Involvement				
05	Initial	Program Phase (5100)	Average per mile construction costs (from **M&R**) and estimated preliminary engineering, engineering construction and contingencies, utilities, right-of-way, and bridge costs.	**Program Management**, based on Initial DR-73 information provided by the **District**
10	Initial Estimate Update	Planning Phase (5200)	The Initial Estimate refined by the results of a review of the project location/corridor for any deficiencies, as well as inputs from other **Divisions** and the **District**.	**PDD** based on DR-73/Planning Document
Roadway Design Division Involvement				
30	Cost Update 1 (Pre-Plan-in-Hand)	Design Phase (5300): After the preliminary plans are complete and just before the plan-in-hand (accompanies the plan-in-hand report). Updated annually up to Status Code 45 and if there is a change in project scope or concept.	Quantities from preliminary plans, special plans, etc. Includes preliminary bridge estimate and estimated preliminary engineering, engineering construction and contingencies, utilities, and right-of-way costs.	Roadway Designer and **Cost Estimating**
40	Cost Update 2 (Post-Plan-in-Hand) ***Only required when a Public Hearing will be held***	Environ. Approval Phase (5400): After the plan-in-hand report is approved.	Project quantities from functional plans, updated special plans, approved pavement determination, utilities, right-of-way, etc.	Roadway Designer and **Cost Estimating**
45	Cost Update 3 (Post Roadway Design Details)	Plan Details Phase (5500): After design is complete and Design Plans have been distributed.	Project quantities from the Design Plans including right-of-way, bridge quantities, utilities, etc.	Roadway Designer and **Cost Estimating**
50	Plans, Specifications and Estimates (PS&E)	Plan Package Phase (5700): Just prior to bid letting.	Estimated plan quantities.	Roadway Designer and **Cost Estimating**
60	Awarded Bid	Bid Letting.	Actual contract cost from awarded bid.	**Contractor**

Exhibit 12.1 Cost Estimate Submittals

5. ESTIMATE REQUEST FORMS

The roadway designer will submit Form DR-342 ("Project Information Sheet") and Form DR-343 ("Project Quantity Sheet") to **Cost Estimating** for each cost estimate request.

5.A Project Information Sheet (Form DR-342)

Using Form DR-342, the roadway designer provides **Cost Estimating** with a summary of right-of-way needed, utility costs, preliminary engineering costs, data about the type of construction to be performed for the roadway surface and shoulders, and the type of bridge construction needed. This form also provides space for notes about traffic control and other elements of the project.

5.B Project Quantity Sheet (Form DR-343)

Form DR-343 lists standard pay items by standard item number and name. This form also lists the unit of measurement for each item. Quantities for each of the appropriate items should be calculated and listed on this sheet for each project. The quantities for some sections of this form (e.g. bridges, electrical, signing) may be supplied by other **Divisions**/**Sections**/**Units** and submitted to the roadway designer before it is sent to **Cost Estimating**.

6. COST ESTIMATE REQUEST PROCEDURES

Coordination, communication, and cooperation are essential elements in the cost estimating process. The roadway designer needs to coordinate with the parties involved with the project for the process to be most efficient and effective. If consultants are hired for design work the **Roadway Design Consultant Coordinator** assigned to the project is responsible for reviewing, communicating, and coordinating activities between the consultant and the **NDOT**.

6.A Routing from the Roadway Designer

The roadway designer will obtain input from the **Divisions/Sections/Units** involved in the project to verify that the cost estimate request includes the items required to build the project. **Bridge**, the **Traffic Engineering Division** (**Traffic Engineering**), **PDD**, **ROW**, **M&R**, etc. provide information to the roadway designer, who compiles the necessary information and then submits the cost estimate request to **Cost Estimating**.

The roadway designer should review the previous cost update request and cost estimate for needed changes before requesting a cost update. The previous cost estimate request form may be submitted to **Cost Estimating** with changes noted in red. The roadway designer should perform a careful review of the cost estimate request, verifying that the construction items needed to build the project are included.

6.B Timeliness

It is essential that the roadway designer submit cost estimate requests to **Cost Estimating** as early as possible. The time allocated to produce the cost estimate includes the time needed for **Roadway Design** review and for resulting corrections to be made to the cost estimate.

6.C Change in Project Scope or Concept

The roadway designer will request an updated cost estimate from **Cost Estimating** and will inform any other **Division**/**Section**/**Unit** which is involved in the project (e.g. **Environmental**, **ROW**) whenever a change is identified in the project scope, project concept, or when special conditions arise during design (e.g. a change in pavement determination, a change in bridge determination, removal of unsuitable material). A change in cost affects the project budget and schedule; the change in project scope shall be vetted by the appropriate **Divisions** (e.g. **Roadway Design Engineer**, **ROW**, **Project Development**, **Program Management**).

6.D Estimate Review

Cost Estimating routes the completed cost estimate to the roadway designer through the appropriate **ADE** and **Roadway Design Division Unit Head** (**Unit Head**). The roadway designer and the **Unit Head** will review the cost estimate carefully for possible omissions, incorrect information, coding errors, deletions, etc. A comparison with the previous estimate can be a good check for mistakes. Cost estimating is an iterative process, intended to produce the best possible estimate.

7. CONTENTS OF COST ESTIMATES

Cost estimates basically consist of quantities and prices. Roadway designers provide the quantities and cost estimators provide the prices. Inaccurate or incomplete quantities and/or prices will produce cost estimates which are both inaccurate and inadequate. Project costs are subdivided into the following categories:

- Preliminary Engineering
- Right-of-Way
- Utilities
- Railroad Items
- Construction Costs
- Construction Engineering
- Contingencies
- Relinquishments (See Chapter Fifteen: Right-of-Way, Section 7.E)

7.A Preliminary Engineering

Preliminary engineering costs are normally estimated as a percentage of the construction costs. Various factors may affect the actual costs of preliminary engineering, such as unusual site conditions for the project. The cost factors presented in EXHIBIT 12.2 are provided for the roadway designer's information, showing the percentages used by **Cost Estimating** in calculating the preliminary engineering costs for a project for Cost Update 1 (Status Code 30, "Design Phase") and Cost Update 2 (Status Code 40, "Environmental Approval Phase"), and Cost Update 3 (Status Code 45, "Plan Details Phase").

Chapter Section	Project Cost Category	Cost/Cost Factor
7.A	**Preliminary Engineering**	Calculated by **Cost Estimating**
7.A	Resurfacing Projects	0.5% of base Construction Costs
7.A	New and Reconstructed Projects	4.4% of base Construction Costs
7.A	Consultant Projects	8.0% of base Construction Costs
7.B	**Right-of-Way**	
7.B.1	Rural Land Values	http://digitalcommons.unl.edu/agecon_farmrealestate/
7.B.1	Urban Land Values	Contact **ROW Appraisal** for urban land values
7.B.2	Fencing	http://www.roads.nebraska.gov/media/5346/fence-schedule.pdf
7.B.3	Improvement Values	Contact **ROW Appraisal** for costs of damages to improvements
7.B.4	Relocation Assistance	Contact **ROW Relocation Unit** for relocation costs
7.B.5	Other R.O.W. Costs	40% of the cost of right-of-way land acquisition
7.C	**Utilities**	Calculated by **Cost Estimating** 2.9% of base Construction Costs
7.D	**Railroad**	Contact **Railroad Liaison** in **Intermodal Planning**
7.E	**Construction Engineering**	Calculated by **Cost Estimating** 12% of base Construction Costs if ≤ $2 million 5% of base Construction Costs if > $2 million
7.F	**Contingencies**	Calculated by **Cost Estimating** Contingency Costs may vary yearly
7.G.7	**Bridge** (to be included in **Construction Costs**)	Calculated by **Cost Estimating** or supplied by **Bridge** Based on Bridge Size and Type as supplied by the roadway designer (See EXHIBIT 12.4)

Exhibit 12.2 Preliminary Cost Estimate Values/Cost Factors

7.B Right-of-Way

The roadway designer will prepare a preliminary right-of-way cost estimate for inclusion with Cost Update 1 (Status Code 30, "Design Phase"), Cost Update 2 (Status Code 40, "Environmental Approval Phase"), and Cost Update 3 (Status Code 45, "Plan Details Phase"). The roadway designer should coordinate these cost estimates with **ROW Appraisal**, informing them of items which will affect the right-of-way cost estimate (such as clear tract, remove building, remove sign base) and requesting preliminary costs. The total right-of-way costs consist of five main elements:

1. Land Values (See Section 7.B.1)
2. Fences (See Section 7.B.2)
3. Improvements (See Section 7.B.3)
4. Relocation Assistance (See Section 7.B.4)
5. Other Right-of-Way Costs (See Section 7.B.5)

See the **NDOT** Right-of-Way Manual (http://www.roads.nebraska.gov/media/5012/row-manual.pdf) (Ref. 12.1) and Chapter Fifteen: Right-of-Way for additional information.

7.B.1 Land Values

Preliminary land value estimates for Cost Update 1 (Status Code 30, "Design Phase"), Cost Update 2 (Status Code 40, "Environmental Approval Phase"), and Cost Update 3 (Status Code 45, "Plan Details Phase") are based on the approximate number of acres of land to be acquired for right-of-way, as calculated by the roadway designer, multiplied by the average per acre cost of the type of land being acquired. **ROW Appraisal** develops actual area figures for the PS&E Estimate (Status Code 50, "Plan Package Phase").

7.B.1.a Rural

The average values of farmland, classified by agricultural usage, are compiled annually by the University of Nebraska. This information may be viewed on the Internet at (http://digitalcommons.unl.edu/agecon_farmrealestate/).

7.B.1.b Urban

Land values in urban and suburban areas exhibit greater fluctuation than rural land values. Variations in land values for different land uses, and variations among those values for different cities, make it impossible to generalize cost figures for urban land. The **ROW Appraiser** should be consulted for non-agricultural land values.

7.B.2 Fences

The roadway designer will include fencing costs For Cost Update 1 (Status Code 30, “Design Phase”), Cost Update 2 (Status Code 40, “Environmental Approval Phase”), and Cost Update 3 (Status Code 45, “Plan Details Phase”) based on the average cost per mile for two sides of the roadway (See the Fencing Schedule at http://www.roads.nebraska.gov/media/5346/fence-schedule.pdf). Fence costs are usually included in the **ROW** cost estimate for the PS&E Estimate (Status Code 50, “Plan Package Phase”). Privately owned fencing is generally not built as part of the project, the property owner is paid to replace the fence, but this amount will be included in the right-of-way cost estimate.

Certain fencing items may be included in the construction items (typically Interstate and freeway fencing, deer fence, wetland fencing, and pedestrian fencing). The roadway designer should check with **ROW Appraisal** to ascertain whether fencing has been included in the **ROW** estimate or if it is to be handled as a construction cost. If fencing is a construction item, the roadway designer shall include this fencing in the **Roadway Design** PS&E Estimate (Status Code 50, “Plan Package Phase”). See Chapter Ten: Miscellaneous Design Issues, Section 5, for further information.

7.B.3 Improvements

Improvements on property which may be acquired for right-of-way will be identified by size and type (homes, business structures, outbuildings, parking lots, parking spaces, center pivots, wells, etc.). **ROW Appraisal** maintains average values of improvements on property and should be consulted for costs for damages to an improvement or costs to purchase the improvement.

7.B.4 Relocation Assistance

Relocation costs are payments beyond the purchase cost. A person or business displaced by a construction project is eligible to participate in the Relocation Assistance Program; this program is designed to help pay the expenses for relocating residential occupants, businesses, farm/ranch buildings, and non-profit organizations if they are displaced as a result of a highway improvement. The roadway designer should contact the **ROW Relocation Unit** for relocation assistance costs.

7.B.5 Other Right-of-Way Costs

Other right-of-way costs, covering such items as appraisals and legal fees, are included in a project cost estimate as a factor of the sum of the previously described right-of-way costs (e.g. land, fences, improvements, and relocation assistance). Currently a factor of 40% (based on historical project costs) is used to estimate "Other Right-of-Way Costs”.

7.C Utilities

Cost Estimating generally calculates preliminary utilities costs at 2.9% of construction costs. For projects with very minor utility work this figure may be lower while on projects with major utility work costs may be higher. The roadway designer will work with **Cost Estimating**, updating project costs as the scope and complexity of the utility work required for the project become apparent. For example, projects involving fiber optic cable or major overhead power lines will generally have greater utility costs, as will projects with major water line and/or sanitary sewer work. The roadway designer should coordinate the utilities impacts with **Utilities** during the preparation of the Plan-in-Hand Report. When actual utility costs are received (typically during Cost Update 3, Status Code 45, "Plan Details Phase") the roadway designer will verify that the 2.9% cost factor has been removed from the cost estimate.

If a contractor is to perform water main and/or sanitary sewer work as part of the state contract, these items will be included in the construction items estimate. If, however, this work is to be performed by someone else, the costs will be accounted for in the utilities cost estimate

See Section 2.F.1 of this chapter, Chapter Thirteen: Planning and Project Development, Section 6, and the Nebraska Dept. of Transportation Operating Instruction 60-11, "Municipal Cost Sharing" (Appendix B, "Selected NDOT Operating Instructions") for additional information.

7.D Railroad

The **Railroad Liaison Office** in the **Intermodal Planning Division** reviews the design plans and coordinates the project with the railroad companies. See Sections 1.E and 2.D.2 of this chapter; Chapter Ten: Miscellaneous Design Issues, Section 1; and Chapter Thirteen: Planning and Project Development, Section 5.G for further discussion on railroad-involved projects.

7.E Construction Engineering

The estimate for the construction engineering cost is based on a percentage of the base construction costs. At present, construction engineering is estimated by **Cost Estimating** to be 12% of the base construction cost when it is less than or equal to $2 million and 5% of the base construction cost when it is over $2 million.

7.F Contingencies

Contingencies are included in the cost estimate by **Cost Estimating** to account for possible cost overruns; contingency costs may vary yearly.

7.G Construction Items

Construction items are those items that will be let to contract. The roadway designer is responsible for providing accurate quantities and specifications so that **Cost Estimating** may produce accurate cost estimates for the roadway items required for the project. The "Cost Estimate Checklist" (**EXHIBIT H** of the Design Process Outline (*DPO*), Ref. 12.2) (http://www.roads.nebraska.gov/business-center/design-consultant/) lists many of the standard construction items used on a roadway project.

The roadway designer and the **Unit Head** should refer to this checklist, making sure that every item required for the construction of a roadway project is included in the cost estimate request and cost estimate. While the roadway designer is not responsible for calculating the quantities for every construction item (e.g. **M&R** calculates the final quantities for flexible pavement), he/she is responsible for verifying that the items required for the construction of the project are included in the various cost estimate updates and in the PS&E turn-in packet.

7.G.1 Mobilization

Several categories in the "Cost Estimate Checklist" (**EXHIBIT H** of the *DPO*, Ref. 12.2) have a mobilization item. Mobilization is the costs associated with startup activities such as movement of personnel, equipment, supplies, and other incidentals to the project site. Mobilization is a separate pay item for those categories where it is listed separately and is an incidental item subsidiary to other work when it is not listed separately. Mobilization costs are calculated by **Cost Estimating**.

7.G.2 Specifications and Special Provisions

The Standard Specifications for Highway Construction (*Spec Book*) (Ref. 12.3) (http://roads.nebraska.gov/media/6897/specbook-2007.pdf) defines the scope and control of work in a standard pay item, including an item description, listing of material requirements, equipment, hauling and distributing materials description, method of measurement, and basis of payment. An item which is not covered by, or that differs from, the *Spec Book* (Ref. 12.3) will require a special provision. Special provisions should be initiated during "Functional Design" and finalized during the "Final Plans Package & Review for PS&E" (See the *DPO* (Ref. 12.2), Clarity Task Codes 5428 and 5790).

7.G.3 Standard Pay Items

Construction items have been standardized for ease of identification and clarity in communication. There is a current listing of the standard pay items located on the **NDOT** website (http://www.roads.nebraska.gov/business-center/business-opp/hwy-bridge-lp/item-history/). The standard pay item listing may be explored using the search function on the screen. An item may be identified in a variety of ways; for example, a search for the item "reinforcing steel" may be made using any of the following criteria:

- REINFORCING STEEL
- REINF
- STEEL
- 4163.25
- LB

All items which meet the criteria will be listed. A general term search will result in a very long listing of items (e.g. a search using "TON" will locate every pay item which is measured in tons).

If a pay item is required that does not appear in the standard pay item listing, **Cost Estimating** should be contacted for assistance.

7.G.4 New Materials

Construction projects sometimes require special treatments or solutions to problems that have not been encountered previously and for which standards have not been developed. At times new construction materials, which have not been included in previous projects, are accepted for use. The use of a new material may require a special provision (See Section 7.G.2 of this chapter).

Costs and/or special provisions for new materials must be researched both for their suitability and for their incorporation into the specifications and cost estimates. As early as possible in the design process, the roadway designer will provide the cost estimator with sufficient information regarding what the work consists of so that a reliable cost estimate may be made.

7.G.4.a Sole Sourcing

By law and regulation (23 cfr 635.411, http://www.gpo.gov/fdsys/pkg/CFR-2011-title23-vol1/pdf/CFR-2011-title23-vol1-sec635-411.pdf) a designer may not specify only one product for use on a project unless a Certification or Public Interest Finding is completed. Specifying only one product without requisite justification on Federal-aid projects may lead to non-participation of federal funds. A Certification or Public Interest Finding must be written by the **Unit Head** and processed, based on project type and location, as follows:

- For any Federal-aid project on the NHS or Project of Division Interest (PoDI) on the NHS: The Certification or Public Interest Finding will be signed by the **ADE** and the **Federal Highway Administration** (**FHWA**)
- For a PoDI which is not on the NHS: The Certification or Public Interest Finding shall be signed by the **ADE** and transmitted to the appropriate **FHWA Transportation Engineer** for review and comment
- For a Federal-aid project which is not on the NHS: The Certification or Public Interest Finding will be signed by the **ADE** (the document does not need to be transmitted to the **FHWA**; per MAP-21 (https://www.fhwa.dot.gov/map21/) and the FHWA/NDOR Stewardship and Oversight Agreement (http://roads.nebraska.gov/media/6796/steward-oversight-agr.pdf) **NDOT** has assumed the responsibility to process the document in accordance with applicable Federal-aid requirements)

In each of these cases, the signed document will be copied to the **Construction Engineer** and placed into the project file.

Certifications

Certifications are completed when the product specified is either necessary for synchronization with existing facilities (for function, aesthetics or logistics) or a unique product is being used for which there is no equally suitable alternative. Certifications must include a statement from the **Unit Head** attesting that the specified product is essential for synchronization with existing facilities or that no equally suitable alternative exists. The Certification should contain detailed information and supporting documentation upon which it was based. Such documentation may include:

- A detailed description of how the product will benefit the public
- The unique needs that are being addressed with either synchronization or that no equally suitable alternative exists
- Specific details on why other products could not meet the need
- An estimate of additional costs due to the item being used

Certifications may cover multiple related products.

Public Interest Findings

Public Interest Findings are completed when requiring the use of a specific product is in the public interest even though other equally acceptable products are available. The Public Interest Finding shall contain information and supporting documentation upon which it was based. Such documentation may include:

- A detailed description of the need of the product
- A detailed description on how the product required will benefit the public
- An evaluation of the pool of equally acceptable products
- An estimate of additional costs incurred as a result of the required product
- An engineering and economic analysis supporting the claim that the specified product will benefit the public

The **NDOT** (or the appropriate **City**) will commit to a yearly review of the industry to determine if new technology has been developed which would satisfy the criteria or need addressed in the Certification or Public Interest Finding.

Certifications and Public Interest Findings should be used sparingly and will be coordinated with the **Highway Contracts Manager** in the **Construction Division**. The majority of approved Certifications and Public Interest Findings have been used for context sensitive design purposes. For example, on the West Dodge projects in Omaha multiple suppliers were initially considered for the retaining wall finishes. However, once the wall finish was selected for the first project a Public Interest Finding was approved on the ensuing projects so that the entire continuum of projects presented a uniform appearance in the retaining wall finish. Certifications and Public Interest Findings will be sent to the **Highway Contracts Manager** and to **PS&E**.

7.G.5 Quantities

Pay items may be specified and described in several ways. For example, based on weigh scale location and availability, **Districts 1, 2, and 3** pay for aggregate by the Ton while **Districts 4 through 8** pay for aggregate by the cu. yd. The appropriate standard pay item unit of measurement will be used based on the project location. The units of measurement for items specified on the project plans should be consistent with the units of measurement of the standard pay items. The degree of accuracy applied to each unit of measure can be found in EXHIBITS 12.6 & 12.7.

The roadway designer should keep notes regarding the development of the quantities and lump sum items for each estimate. The notes should include the assumptions made in producing the quantities, for example the roadway designer may include the assumption that the project will be built under traffic. That assumption should be recorded in the project file and also should be shared with the cost estimator so that conflicting assumptions are not made at a later date and/or by others involved.

Quantities will be calculated for every construction pay item pertaining to a given project. EXHIBIT 12.3 presents a partial listing of quantity calculation guidance found in this manual and in the Drainage Design and Erosion Control Manual (*Drainage Manual*) (Ref. 12.4) (http://www.roads.nebraska.gov/business-center/design-consultant/rd-manuals/). The "Cost Estimate Checklist" (**EXHIBIT H** of the *DPO*, Ref. 12.2), and the "Pavement Item Checklist" (EXHIBIT 12.8) are helpful references for items to be included in the cost estimate.

Roadway Design Manual		
Item	**Chapter**	**Section**
Bridge Channel Work	13	4.B.6.a
Cold Milling	8	5.B.1
Crossovers	14	6.A.1
Delineators	14	3
Earthwork	7	1
Guardrail Quantities	9	3.H
Mailbox Turnouts/Supports	10	10
Old Road Obliteration	10	8
Pavement Patching	8	5.C
Re-establishing Land Monuments and Property Corners	15	7.C
Right-of-Way Markers	15	7.B
Shoulder Construction	8	4.C
Surfacing Quantities	8	6
Temporary Road Pay Items	14	6.B
Temporary Surfacing	14	6.A.2
Drainage Design and Erosion Control Manual		
Item	**Chapter**	**Section**
Culvert Excavation	1	8.R
Culvert Lengths	1	8.D
Permanent Erosion and Sediment Control Measures	2	6
Riprap	2	8.A
Stormwater Treatment	3	7
Temporary Erosion and Sediment Control Measures	2	5
Temporary Slope Drain	2	7

Note: This is not a complete listing. The roadway designer should refer to the Standard Specifications for Highway Construction (Ref. 12.3) and the appropriate Sections of the Roadway Design Manual and the Drainage Design and Erosion Control Manual (Ref. 12.4) for guidance when computing project quantities.

Exhibit 12.3 Quantity Calculation Guidance Locations

7.G.6 Traffic Control Items

For Cost Update 1 (Status Code 30, "Design Phase"), Cost Update 2 (Status Code 40, "Environmental Approval Phase"), and Cost Update 3 (Status Code 45, "Plan Details Phase") a lump sum amount is used for temporary traffic control items. **Cost Estimating** calculates this sum based on the type of work involved. This lump sum estimate includes the following items:

- Barricades Type III
- Temporary Signs
- Flashing Arrow Panels
- Flagging

The **Construction Division** provides the roadway designer with quantities for the above items for the PS&E Estimate (Status Code 50, "Plan Package Phase").

The items found below *are not* included in the **Construction Division** cost estimate. Quantities must be furnished for these items when they are needed on a project. The roadway designer will coordinate with **Traffic Engineering** on quantities for the below items for Cost Update 1 (Status Code 30, "Design Phase"), Cost Update 2 (Status Code 40, "Environmental Approval Phase"), and Cost Update 3 (Status Code 45, "Plan Details Phase").

- Temporary Traffic Signals
- Concrete Protection Barriers
- Temporary Pavement Markings
- Impact Attenuators
- Inertial Barrier Systems
- Temporary Safety Lighting

Traffic Engineering will review the traffic control plans and provide final quantities and special provisions for items in the traffic signals, permanent signing, and the permanent pavement marking categories (Group #8) for the PS&E Estimate (Status Code 50, "Plan Package Phase"). For additional information see Chapter Fourteen: Traffic.

7.G.7 Bridge Items

Bridge construction may involve building a new bridge, widening, rehabilitating or repairing an existing structure. The type of structure must be included in the detailed cost estimate (e.g. Deck Steel Girder Bridge) because the type affects the cost for new and rehabilitated bridges. The preliminary bridge cost estimates are calculated based on the bridge dimensions (as shown in EXHIBIT 12.4) until detailed bridge item quantities are available. The area of the bridge structure is based on out-to-out measurements, not the clear roadway width except for overlays, which are based on the clear width.

The following bridge items are included in the preliminary bridge cost estimate:

- The bridge materials
- Preparation of the existing structure
- Excavation and backfill for abutments and piers
- Riprap
- Slope protection
- Painting of structures

The preliminary bridge cost estimate will also include items that are ultimately the responsibility of **Roadway Design** (e.g. guardrail, temporary roadway grading and surfacing, excavation for Concrete Box Culverts). When assigned a project which includes bridge and bridge-sized structures the roadway designer will review the "Planning Bridge Determination", placed in OnBase by the **Bridge Management Section**, for a detailed breakdown of the items included in the preliminary bridge cost estimate from **Bridge**. As the design of the project progresses and the roadway designer establishes quantities for the roadway items that have been included in the preliminary bridge cost estimate the roadway designer will remove those items, and their cost, from the preliminary bridge cost estimate. When submitting an estimate request, the roadway designer will inform **Cost Estimating** of the reduction in the preliminary bridge cost estimate and its cause.

The bridge designer will provide the roadway designer with detailed bridge construction quantities for inclusion in the PS&E turn-in packet.

The following items *are not* included in the detailed bridge construction estimate, the roadway designer shall include these items in the PS&E Estimate (Status Code 50, "Plan Package Phase") as required:

- Channel work (See Chapter Thirteen: Planning and Project Development, Section 4.B.6)
- Retaining walls
- Mechanically stabilized earth (MSE) walls

For additional information see Chapter Ten: Miscellaneous Design Issues, Sections 2 and 7.

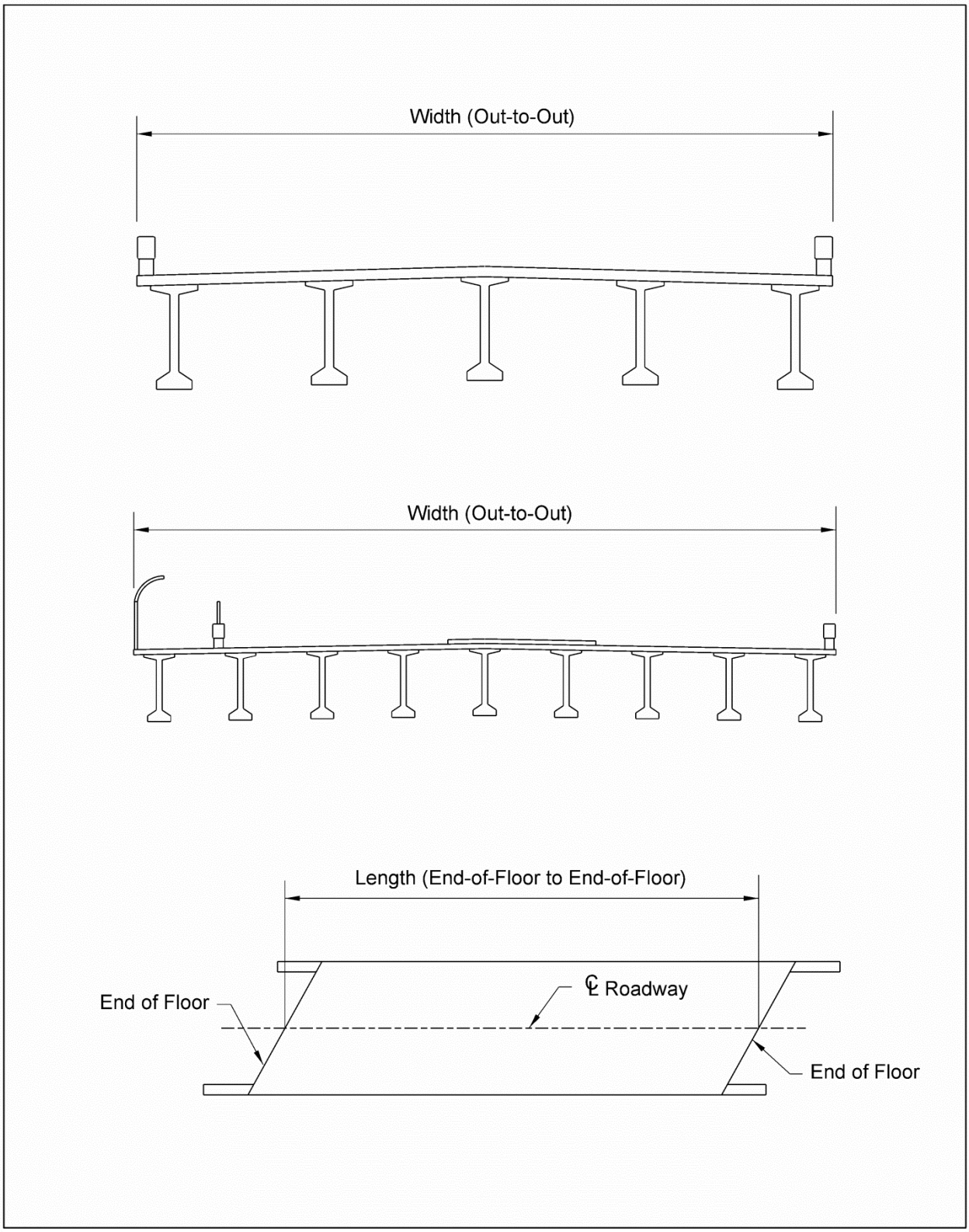


Exhibit 12.4 Dimensions to Use in Calculating Area of Bridge Structures

7.G.8 Other Construction Items

PDD will provide information for cost items related to wetlands and noise walls (See Chapter Thirteen: Planning and Project Development, Sections 4.B and 4.D), for landscaping items (such as tree and shrub plantings), and for erosion control items (See Chapter Ten: Miscellaneous Design Issues, Section 3, and the *Drainage Manual* (Ref. 12.4), Chapter Two: Erosion Control).

The **Lighting Unit** (**Lighting**) in **Roadway Design** will provide the roadway designer with specifications and estimates if lighting is included in the project. For further information, see Chapter Ten: Miscellaneous Design Issues, Section 10.

8. ITEMS AFFECTING CONSTRUCTION COSTS

Construction costs are affected by a variety of factors, such as supply and demand for individual items of material and the cost of labor. The following items are provided for the designer's information. If these items impact a project, the designer should verify that the effects on project costs have been included in the cost estimate received from **Cost Estimating**.

8.A Construction Schedule

The construction schedule may affect the cost of construction. For example, complicated work sequences or wintering a project may increase the construction costs while economies of scale (e.g. buying materials in bulk, keeping workers occupied by shifting crews between projects) may reduce the construction cost if projects in close proximity are combined.

8.B Construction Location

The location of the project, accessibility to the site, and the availability of materials also affect the project cost.

8.B.1 Site-Specific Features

Site-specific features will impact the cost. For example:

- Rock Excavation
- Sandhills Vegetation (Fertilizer)
- De-watering
- Storm Water Treatment
- Environmental Considerations

8.B.2 Urban/Rural

Urban locations often have higher construction costs than rural sites due to higher costs of right-of-way acquisition, greater traffic control requirements, pedestrian accessibility, pedestrian accessibility during construction, utility relocations, more access points, etc. Congestion may necessitate nighttime construction scheduling, which would also impact costs.

8.C Maintaining Traffic During Construction

Phasing - The phasing of construction activities while maintaining reasonable traffic flow and pedestrian access is an important design consideration and an added cost to the project. Phasing for a project is preferably determined during the "Planning Phase" (Activity 5200) prior to the plan-in-hand field inspection. Traffic control measures (e.g. barricades, signs, markings, flaggers) are an integral part of the project and add to its cost. Additional temporary surfacing may be needed for lane or shoulder widening or to provide access to properties. These surfacing quantities will be included in the cost estimate and paid for separately.

Detours - If detours require temporary improvements to the geometry and surfacing of the route, the construction and maintenance of the improvements are project costs. Pavement needed for detour improvements is paid for under a separate pay item group. Signage, public notification, and other costs associated with detours also impact the total project cost.

Temporary Roads – If temporary roads are built to route traffic around construction, the costs associated with the temporary road (e.g. surfacing quantities, culverts, erosion control, traffic control measures) will add to the total project cost.

Night Work – When phasing of projects causes significant impact to traffic operations, night work may be needed for construction. Cost for construction may need to be inflated and should be noted in the cost estimate.

For additional information see Chapter Fourteen: Traffic, Section 6 and Chapter Sixteen: Pedestrian and Bicycle Facilities, Section 11.

9. ITEMS OFTEN OVERLOOKED OR OMITTED

Requests for cost estimates should only be made after a careful review of the items included in the request. The roadway designer should understand which elements are included in each pay item and how the items relate to one another. Failure to include the proper information in a cost estimate may result in costly delays and extra work while the changes are made. EXHIBIT 12.5 is a partial listing of estimate items which are often omitted and items subject to misinterpretation.

Changes in Pavement Determination:	These changes require updating the quantities.
Covercrop Seeding:	This should be used when there is a major grading project and the permanent seeding is to be done at a later date. In the Sandhills Region, Slope Protection is used in lieu of Covercrop and Types A & B Seeding.
Detour Group (#2, 2A, or 9A):	This group should not be overlooked. Consult with the **DE** to determine if gravel surfacing is required. Include temporary road surfacing and temporary connections. Additionally, some projects will require winter gravel. Contact **Traffic Engineering** regarding the need for temporary signals.
Engineering and Contingencies:	See Sections 7.E and 7.F of this chapter.
Erosion Control and Temporary Erosion Control:	These costs are frequently underestimated. The roadway designer should compare erosion control with the items on the Erosion Control Plan-in-Hand Checklist (See **EXHIBIT F** of the *DPO*, Ref. 12.2), and coordinate the design with the **Roadside Development Unit** in **PDD** and with the **District**. Temporary erosion control must be placed at the end of each working day. Even though the actual placement will be determined by the contractor and the **District** as the situation warrants, the roadway designer shall include a total for the project in the estimate.
Flared End Sections:	Split out those flared end sections that must be metal or concrete (e.g. if extending a concrete pipe with Culvert Pipe Type 2, the appropriate pay item is Concrete Flared End Sections). Some projects will have three FES quantities, for example: 24 inch Metal FES, 24 inch Concrete FES, and 24 inch FES.
Foundation Course:	This is equal to the sq. yd. of surfacing.
General Clearing and Grubbing:	"General Clearing and Grubbing" may be used by itself in a few cases (e.g. Sandhills areas) where no trees or stumps could be found over 24 inches in diameter. In these cases the "Grading Item Summary Sheet" will be submitted to **PS&E** stating that "No large trees or stumps were found".
Gravel Embedment:	This item should be used for gravel frontage roads, county roads, and driveways (drive returns are not included). This pay item does not include furnishing the gravel.

Exhibit 12.5 Estimate Items Often Overlooked or Omitted

Hydrated Lime for Warm Mix Asphalt:	This item will be used with asphaltic concrete projects.
Items Done by Other Governmental Agencies:	Sometimes some construction items are performed by other governmental agencies (e.g. surfacing of a detour). These items are still project costs and will be included in the estimate.
Jacking Pipes:	This is used on phased projects where new culvert is at a new location. Jacking pipe does not include the cost of the culvert pipe and a higher class of pipe may be required for jacking (See Chapter One, Section 13.C of the *Drainage Manual*, Ref. 12.5).
Large Tree Removal:	Required on projects where the trees or stumps to be removed are larger than 80 inches in circumference. The number of trees should be estimated, even if a tree count survey is not available. “One Each” should not be listed; this can produce unbalanced bids where a contractor will use a very large unit price, knowing that the quantity will be much higher. This item is in addition to “General Clearing and Grubbing”.
MSE Walls:	This item is the responsibility of the roadway designer; it is not included in the **Bridge** estimate.
MS4 Community Stormwater Treatment Installations:	In many cases stormwater treatment for MS4 Communities (See Chapter Three of the *Drainage Manual*, Ref. 12.5) will be included in other project costs (i.e. “Grass Swales” quantities are integral to grading and seeding). For unique installations, such as a “Principal Spillway”, the roadway designer will coordinate with the **Environmental Liaison Engineer** in **Roadway Design** to determine the necessary pay items to be included in the project estimate.
Preliminary Engineering:	See EXHIBIT 12.2 for the appropriate cost factor. Please check the appropriate box on the “Project Information Sheet” (See Section 5.A of this chapter).
Railroad Involvement:	A project which is adjacent to or crosses railroad property may require estimate items for such items as right-of-way easements, surfacing, railroad crossings, signals and communication lines. The roadway designer should coordinate with the **Intermodal Planning Division** regarding the necessary estimate items. If a detour crosses a railroad, the roadway designer should contact the **Intermodal Planning Division** regarding the need for temporary signalization.

Exhibit 12.5 Estimate Items Often Overlooked or Omitted (Continued)

Related Construction Items:	Be sure that related items are included. For example: "Concrete Pavement" should be accompanied by "Subgrade Preparation" and "Foundation Course". "Subgrade Preparation" should be accompanied by "Water, Applied". Excavation pay items should be accompanied by "General Clearing and Grubbing", "Large Tree Removal", and "Water, Applied".
Relocation Costs:	The roadway designer will verify that relocation costs are included in the **ROW Division** estimate before submitting the project to **PS&E**.
Remove Sign, Post, and Footing:	The relocation of most signs is paid for by the **ROW Division** but the removal of the footing is usually a contract item requiring a build note and a project quantity. The pay item "Clear Tract" covers the removal of the sign, post, and footing. When "Clear Tract" is not used, the pay item "Remove Sign, Post, and Footing" will be added to the quantities.
Salvage and Place Topsoil:	This will be used when the embankment is, or could be, granular material. If the contractor is to furnish borrow and it is likely that he/she will furnish granular embankment, the Special Provisions will state that the contractor must salvage and place topsoil. This would also be a special circumstance and the unit price should account for this.
Shoulder Construction:	Pay for "Shoulder Construction" when overlaying an existing roadway. This will not be calculated when "Shoulder Subgrade Preparation" is a pay item.
Shoulder Subgrade Preparation:	"Shoulder Subgrade Preparation" will be paid for when adding surfaced shoulders to an existing roadway. Do not calculate "Shoulder Construction" when this is a pay item.
Sign Supports:	Contact **Traffic Engineering** to determine if sign supports will be required on the project. Sign supports are often included in interchange designs. The roadway designer should also check for other traffic items, such as traffic signals.
Subgrade Preparation:	This is equal to the sq. yd. of surfacing.
Subgrade Stabilization:	This item is a replacement for "Subgrade Preparation". The same segment of roadway should not have both items in the estimate.

Exhibit 12.5 Estimate Items Often Overlooked or Omitted (Continued)

Temporary Access:	On rural and urban new and reconstructed projects which disrupt access to adjacent property, the roadway designer should discuss the use of gravel, crushed rock, or millings with the **DE** at the plan-in-hand and include a lump sum quantity for temporary access in the cost estimate. The quantities should vary between 100 to 200 tons per mile, depending on the size of the access and the type of roadway (two-lane vs four-lane, rural vs urban). These quantities are for design purposes only. The quantities should be shown to the nearest ton.
Temporary Shoring:	Temporary shoring is sheet piling used to hold the embankment when the earthwork operation is being phased in close proximity to traffic. It is also used when new bridge construction is too close to an existing bridge.
Traffic Control, Field Office, Mobilization:	These items will be added by **Cost Estimating**.
Traffic Control Items:	See Section 7.G.6 of this chapter for those items which *are not* included in the estimate provided by the **Construction Division** for the PS&E Estimate (Status Code 50, "Plan Package Phase").
Traffic Signals, Permanent Signing, Roadway Lighting, etc.:	The roadway designer will verify that these items are included in the estimate if they are a part of the project.
Trenched Widening:	Paid for when widening a roadway from an existing 24 feet wide to 28 feet.
Unusual Circumstances:	Known special circumstances that will affect the contractor's bids should be noted. For example, rock excavation, long hauls, unsuitable materials, phased construction, etc. will affect the contractor's bids.
Utilities:	Utilities can be a major project cost. The roadway designer should take this into account when designing and try to avoid the need for expensive rehabilitation. A major utility rehabilitation must be included in the estimate, *do not* use the standard 2.9% of project cost.
Utilities – City Owned:	Generally, utilities located within corporate limits will be a project cost and must be included in the estimate. Reimbursement of a city-owned utility located outside of corporate limits depends on whether or not the utility is located within state right-of-way. This should also be accounted for during design to avoid possible conflicts.
On-Site Wetland Mitigation:	This item can be very costly and may necessitate the purchase of additional right-of-way. The roadway designer should coordinate with the **Environmental Section** in **PDD** on an approximate area of wetlands involved and on the cost.

Exhibit 12.5 Estimate Items Often Overlooked or Omitted (Continued)

UNIT	APPLIES TO	ACCURACY
Each	Contract items with a unit of each	Whole number
Cu Yd	Contract items with a unit of cubic yard except: 1. Aggregate surfacing items 2. Concrete 3. Base course material, granular foundation course material, sand soil binder, filler & material aggregates	Nearest cu yd Nearest 5 cu yd 0.01 cu yd Nearest 10 cu yd
Sq Yd	Contract items with a unit of square yard	Nearest 1 sq yd
Sq Ft	Contract items with a unit of square foot	Nearest 1 sq ft
Mile	Contract items with a unit of mile	0.001 Mile
Station	Contract items with a unit of station	0.001 Sta
Lin Ft	Contract items with a unit of linear foot except: 1. Safety beam guardrail 2. Cable guardrail 3. Bridge railing, handrail, etc. 4. Wood sign supports 5. Concrete protection barriers 6. Culvert Pipe	Nearest 1 lin ft Nearest 0.5 lin ft Nearest 1 lin ft Nearest 0.01 lin ft Nearest 0.5 lin ft Nearest 1 lin ft Nearest 1 lin ft
Vert Ft	Contract items with a unit of vertical foot	0.1 ft
Day	Contract items with a unit of day	Nearest 0.5 day
Ton	Contract items with a unit of ton except: Asphaltic concrete	Nearest 1 ton Nearest 10 tons
Cu Yd Sta	Contract items with a unit of cubic yard station	Nearest 1 cu yd Sta
Acre	Contract items with a unit of acre	Nearest 1 acre
M Sq Yd	Contract items with a unit of thousand square yards	Nearest M sq yd
Hour	Contract items with a unit of hour	Nearest 1 hour
Lb	Contract items with a unit of pound	Nearest 1 lb
Gal	Contract items with a unit of gallon	Nearest 10 gal
MGal	Contract items with a unit of thousand gallons	Nearest MGal

Exhibit 12.6 Pay Item Accuracy

ITEM	ENGLISH
Subgrade Preparation	0.001 STA
Subgrade Preparation	1 SY
Subgrade Stabilization	0.001 STA
Water	1 Mgal
Soil Binder	10 CY
Asphaltic Concrete	10 Ton
Asphalt Cement	0.005 Ton
Tack Coat	10 Gal
Shoulder Constructions	0.001 STA
Preparation of Intersections and Driveways	1 SY
Placement of Asphaltic Concrete for Driveways and Intersections	1 SY
Concrete Pavement	1 SY
Foundation Course	10 Ton
Foundation Course	1 SY
Concrete Driveway	1 SY
Cold Milling	0.001 STA
Salvaging and Stockpiling Bituminous Material	10 Ton
Gravel Surface Course	10 CY
Gravel Surface Course	10 Ton
Gravel Embedment	0.001 STA
Removing, Crushing, Screening and Stockpiling old Concrete Pavement	1 SY

Exhibit 12.7 Rounding of Surfacing Item Quantities

Asphaltic Concrete Surfacing
Asphaltic Concrete, Type "*"
Performance Graded Binder (xx_xx)
Hydrated Lime for Asph. Mixtures
Cold Milling, Class "*"
Tack Coat
Earth Shoulder Construction
Shoulder Subgrade Preparation (Includes Shoulder Construction)
Water

Asphaltic Concrete Full Depth Construction
Asphaltic Concrete, Type "*"
Performance Graded Binder (xx_xx)
Hydrated Lime for Asph. Mixtures
Tack Coat
Earth Shoulder Construction
Shoulder Subgrade Preparation (Includes Shoulder Construction)
Subgrade Construction
Subgrade Preparation
Water

Bituminous Sand Base Course
Asphaltic Oil or Emulsified Asphalt
Mineral Filler
Fog Seal
Water

Bituminous Surface Course
Bituminous Surface Course
Fog Seal

Portland Cement Concrete Full Depth Construction
Foundation Course (Aggregate, Bituminous, Crushed Conc., etc.) - optional, see pavement determination
Drainage (Subgrade)
Subgrade Preparation
Earth Shoulder Construction
Shoulder Subgrade Preparation (Includes Shoulder Construction)
Water

Temporary Road or Detour
Gravel Embedment
Gravel Surface Course
Calcium Chloride, Applied - use if required by District
Subgrade Preparation
Earth Shoulder Construction
Water
Temporary Surfacing

Exhibit 12.8 Pavement Item Checklist

QUANTITY AND AREA COMPUTATIONS FOR GRAVEL AND CRUSHED ROCK

The table below gives the area (in sq. yds.) and quantities (in cu. yds.) for various roadway widths, distances, and depths.

Width of Roadway	Sq. Yds		1 in. Depth			1 ½ in. Depth			2 in. Depth			2 ½ in. Depth			3 in. Depth		
	Per Sta.	Per Mile	1 Cu. Yd. covers Lin. Ft.	Cu. Yds.		1 Cu. Yd. covers Lin. Ft.	Cu. Yds.		1 Cu. Yd. covers Lin. Ft.	Cu. Yds.		1 Cu. Yd. covers Lin. Ft.	Cu. Yds.		1 Cu. Yd. covers Lin. Ft.	Cu. Yds.	
				Per Sta.	Per Mile		Per Sta.	Per Mile		Per Sta.	Per Mile		Per Sta.	Per Mile		Per Sta.	Per Mile
10	111.11	5866.7	32.40	3.09	162.96	21.00	4.63	244.44	16.20	6.17	325.93	12.96	7.72	407.41	10.80	9.26	488.59
11	122.22	6453.3	29.45	3.40	179.26	19.64	5.09	268.89	14.73	6.79	358.52	11.78	8.49	448.15	9.82	10.19	537.78
12	133.33	7040.0	27.00	3.70	195.56	18.00	5.56	293.33	13.50	7.41	391.11	10.80	9.26	488.89	9.00	11.11	586.67
13	144.44	7526.7	24.92	4..01	211.85	16.62	6.02	317.78	12.45	8.02	423.70	9.97	10.03	529.63	8.31	12.04	635.56
14	55.56	8213.3	23.14	4.32	228.15	15.43	6.48	342.22	11.57	8.64	456.30	9.26	10.80	570.37	7.72	12.96	684.44
15	166.67	8800.0	21.60	4.63	244.44	14.40	6.94	366.67	10.80	9.26	488.89	8.64	11.57	611.11	7.20	13.89	733.33
16	177.78	9335.7	20.25	4.94	260.74	13.50	7.41	391.11	10.13	9.88	521.48	8.10	12.35	651.85	6.75	14.81	782.22
17	188.89	9973.3	19.06	5.25	277.04	12.71	7.37	415.56	9.53	10.49	554.07	7.62	13.12	692.59	6.35	15.74	831.11
18	200.00	10560.0	18.00	5.56	293.33	12.00	8.33	440.00	9.00	11.11	586.67	7.20	13.89	733.33	6.00	16.67	880.00
19	211.11	11146.7	17.05	5.86	309.63	11.37	8.80	464.44	8.53	11.73	619.26	6.82	14.66	774.07	5.69	17.59	928.89
20	222.22	11733.3	16.20	6.17	325.93	10.80	9.25	488.89	8.10	12.35	651.85	6.48	15.43	814.81	5.40	18.52	977.78
21	233.33	12320.0	15.43	6.48	342.22	10.29	9.72	513.33	7.72	12.96	684.44	8.17	16.20	855.56	5.14	19.44	1026.67
22	244.44	12905.7	14.73	6.79	353.52	9.82	10.19	537.78	7.36	13.58	717.04	5.89	16.98	895.30	4.91	20.37	1075.56
23	255.56	13493.3	14.09	7.10	374.81	9.39	10.65	562.22	7.04	14.20	749.63	5.63	17.75	937.04	4.70	21.30	1124.44
24	266.67	14080.0	13.50	7.41	391.11	9.00	11.11	586.67	6.75	14.81	782.22	5.40	18.52	977.78	4.50	22.22	1173.33
25	277.78	14666.7	12.95	7.72	407.41	8.64	11.57	611.11	6.48	15.43	814.81	5.18	19.29	1018.52	4.32	23.15	1222.22
26	288.89	15253.3	12.45	8.02	423.70	8.31	12.04	635.56	6.23	16.05	847.41	4.98	20.06	1059.26	4.15	24.07	1271.11
27	300.00	15840.0	12.00	8.33	440.00	8.00	12.50	660.00	6.00	16.67	880.00	4.80	20.83	1100.00	4.00	25.00	1320.00
28	311.11	16426.7	11.57	8.64	456.30	7.71	12.96	684.44	5.79	17.28	912.59	4.63	21.60	1140.74	3.86	25.93	1368.89

2 Gravel for Surfacing = 1.35 Tons / Cu. Yd.

Crushed Rock for Surfacing = 1.25 Tons / Cu. Yd.

Exhibit 12.9 Quantity Computations for Gravel and Crushed Rock

10. REFERENCES

12.1 Nebraska Department of Transportation, Right-of-Way Manual, Current Edition. (http://www.roads.nebraska.gov/media/5012/row-manual.pdf)

12.2 Nebraska Department of Transportation, Design Process Outline (*DPO*), Current Edition. (http://www.roads.nebraska.gov/business-center/design-consultant/)

12.3 Nebraska Department of Transportation, Standard Specifications for Highway Construction (*Spec Book*), 2007. (http://roads.nebraska.gov/media/6897/specbook-2007.pdf)

12.4 Nebraska Department of Transportation, Drainage Design and Erosion Control Manual (*Drainage Manual*), Current Edition. (http://www.roads.nebraska.gov/business-center/design-consultant/rd-manuals/)

Estimating Quantities in English & Metric

Reference to 2007 NDOR Standard Specifications for Highway Construction

General Information:

Items are listed in alphabetical order.
Conversion factors are in English and Metric.
R.A.P. is an acronym for Recycled Asphalt Pavement other term used Bituminous Millings.
Weight of RAP – 144 lbs/ft^3
One gallon of emulsified asphalt or water weighs 8.333 lbs.
Beveled edges in asphalt and concrete pavements are subsidiary. The required material is included in asphalt tons or concrete square yards.

Asphaltic concrete projects. Add the following equipment rental items and hours.
"Rental of Loader, Fully Operated" – 50 Hour
"Rental of Motor Grader, Fully Operated" – 50 Hour
"Rental of Dump Truck, Fully Operated" – 50 Hour
"Rental of Skid Loader, Fully Operated" – 50 Hour

Armor Coat – Section 515

"Armor Coat Aggregate" – Cubic Yard (meter)	23 lb/yd^2	conversion factor 1.3 tons = 1 yd^3
	14.1 kg/m^2	conversion factor 1.54 Mg = 1 m^3
"Armor Coat Emulsified Asphalt" – Gallon (kiloliters)	0.28 Gal/yd^2	(0.9 L/m^2)

Asphaltic Concrete – Section 503, Section 1028 & Special Provision

"Asphaltic Concrete, Type "___" – Ton (megagram) Tables on pages 6 & 7 for types and weight
Include material required for beveled edge
"Hydrated Lime/WMA" – Each Table on page 6
"RAP Incentive Payment" – Each Asphaltic Concrete Type "**" tons x 1.7 = Each

Asphaltic Concrete Curb – Section 505

"Constructing Asphaltic Concrete Curb" – Linear Foot (meter)

Factor for 3" (75 mm) Curb	1.35 Tn/Sta	(4.0 Mg/Sta)
Factor for 4" (100mm) Curb	2.00 Tn/Sta	(6.0 Mg/Sta)
Factor for 6" (150mm) Curb	2.10 Tn/Sta	(6.25 Mg/Sta)
Factor for Tack Coat	1.0 Gals/Sta	(4 L/Sta)

Asphaltic Concrete For Patching – Section 516

"Asphaltic Concrete for Patching, Type "___""– Ton (megagram)

Asphalt Pavement Smoothness Testing ID – Mile - Special Provision

Bituminous Patching of Concrete Pavement – Section 520

"Bituminous Patching" – Ton (megagram)

Bituminous Sand Base Course – Section 509

"Bituminous Sand Base Course Asphaltic Oil" – Gallon	1000 Gal/Sta for (5" x 24')
(liter)	[12400 L/Sta for (130 mm x 7.3 m)]
"Bituminous Sand Base Course Emulsified Asphalt" – Gallon	1200 Gal/Sta for (5" x 24') 6% residual
(liter)	[14900 L/Sta for (130 mm x 7.3 m) (6%)]
"Bituminous Sand Base Course" – Station	
"Mineral Filler for Bituminous Sand Base Course – Cubic Yard	**10 CuYds/Sta for (5"x24')
(cubic meter)	**25 m^3/Sta for (130mmx7.3m)
"Mineral Aggregate" – Cubic Yard (cubic meter)	Do not use for estimate.
"Water" – MGallon (kiloliter)	1 Mga/Sta (12 kL/Sta)
"Fog Seal" – Gallon (liter)	0.15 Gal/yd^2 (0.68 L/m^2)

** Quantity of Mineral Filler will vary depending on type of soil.

Bituminous Surface Course – Section 512

"Bituminous Surface Course" – Square Yard (square meter)
"Fog Seal" – Gallon (liter) 0.6 Gal/yd^2 (2.5 L/m^2)

Calcium Chloride, Applied – Section 309

"Calcium Chloride Applied" – Ton (megagram) 3 lb/yd^2 (1.6 kg/m^2 or 0.0015 Mg/m^2)

Cement Stabilized Bituminous – Special Provision

"Cement Stabilized Bituminous" – Station
"Cement" – Ton (megagram) 7% weight of RAP
"Water for Cement Stabilization" – Mgallon (kiloliter) 5% weight of RAP & Cement (convert to MGal)
"Cold Milling, Class 2" – Station
"Fog Seal" – Gallon (liter) 0.24 Gal/yd^2 (1.1Lm^2)
Note: If trimming is required, estimate 2 applications.

Chip Seal – Special Provision

"Chip Seal Aggregate" – Cubic Yard 25 lb/yd^2 (aggregate weight 1.4 tons = 1 yd^3)
(cubic meter) [11.0 kg/m^2 (aggregate weight 1.54 Mg = 1 m^3)]
"Chip Seal Emulsified Asphalt" – Gallon (liter) 0.36Gal/yd^2 (1.4 L/m^2)

Cold In-Place Recycling (w/Foamed Asphalt) – Special Provision

"Cold In-Place Recycling with Foamed Asphalt" – Station
"Performance Graded Binder (58-28)" - Ton 2% RAP (4"x24'= 1.15 ton/sta) (4'x28'= 1.34 ton/sta)
"Fog Seal" – Gallon 0.10 Gal/yd2

Cold Milling – Section 510

"Cold Milling, Class _____" – Station, Square Yard (square meter)

Concrete Pavement Repair, Flexible Polymer Modified"

"Concrete Pavemenrt Repair, Flexible Polymer Modified" – Square Yard
Note: Special Provision describes depth of repair. Preparation of concrete, primer, bulking aggregate, and surfacing aggregate are subsidary.

Concrete Surfacing Milling – Section 510

"Concrete Surface Milling" – Square Yard or Station

Cracking & Seating Concrete Pavement – Special Provision

"Cracking & Seating" – Square Yard (square meter)

Diamond Grinding and Texturing Pavement – Special Provision

"Diamond Grinding and Texturing Pavement "– Square Yard

Earth Shoulder Construction – Section 304

"Earth Shoulder Construction" – Station *Shoulders are measured separately*
"Water" – MGallon (kiloliter) 0.25 MGal/Sta (3.0 kL/Sta)

Earth Shoulder Restoration – Special Provision

Use this item when the project has "Trenched Widening 1' " and 1 inch grade raise or less.
" " " " " " " " "Trenched Widening 3' " and 2 inch grade raise or less.

"Earth Shoulder Restoration" – Station		*Shoulders are measured separately*
"Seeding, Type B" – Acre	Use 8' wide x ength	1 Acre = 43,560 sqft
"Mulch (Hay or Straw) – Ton		2.25 tons/acre

Fabric Reinforcement Crack Repair – Section 518

"Fabric Reinforcement Crack Repair" – Linear Feet (LF)

Fly Ash Stabilized Bituminous – Special Provision

"Fly Ash Stabilized Bituminous" – Station	
"Fly Ash" – Ton (megagram)	10% weight of RAP
"Water for Fly Ash Stabilization" – Mgallon (kiloliter)	5% weight of RAP & Fly Ash
"Fog Seal" – Gallon (liter)	0.24 Gal/yd^2 (1.1Lm^2)

Note: If trimming is required. Estimate 2 applications.

Fog Seal – Section 513

"Fog Seal" – Gallon (kiloliter) / CSS-1 & CSS-1H

Factor for mainline & shoulder	0.12 Gal/ yd^2 (0.54 L/m^2)
Factor for open graded friction course	0.16 Gal/ yd^2 (0.72 L/m^2)
Factor for milled surface of Asph. Conc.	0.07 Gal/ yd^2 (0.32 L/m^2)
Factor for milled surface of Bit. Sand	0.10 Gal/ yd^2 (0.45 L/m^2)

Foundation Course – Section 307

"Foundation Course _____" – Square Yard Note: Use this item for estimates.

Note: Foundation Course calculated as total pavement footprint including bevel. Water calculated for pavement footprint plus 3' beyond. Plans show Foundation Course 3' beyond pavement footprint.

"Bituminous Foundation Course _____" – Square Yard (square meter)
In place weight = 123 lb/ft^3 or 1.66 Tn/yd^3 (1.98 Mg/m^3)
Stockpiled Bituminous = 1.43 Tn/yd^3

"Crushed Concrete Foundation Course _____" – Square Yard (square meter)
In place weight for 4"+1/4" trimming = 0.190 Tn/yd^2 (100 mm + 5 mm trimming = 0.2079 Mg/m^2)
Stockpiled crushed concrete = 1.35 Tn/yd^3 (1.61 Mg per m^3)
Concrete Pavement in Place = [yd^3 x 1.94 Tn/yd^3 x 90% (10% loss)] = tons of crushed concrete available
{ [m^3 x 2.31 Mg/m^3 x 92% (8% loss)] = Mg of crushed concrete available}

"Aggregate Foundation Course "D"_____" - Square Yard (square meter)
"Aggregate Foundation Course _____" - Square Yard or Ton (square meter or megagram)
In place weight for 4"+1/4" trimming = (yd^2 x 0.2222 Tn/yd^2) = Tons
[100 mm + 5 mm = (m^2 x 0.2415 Mg/m^2) = Mg]

Gravel Embedment – Special Provision

"Gravel Embedment" – Station
"Gravel" – Cubic Yard (cubic meter) (Designer's item)
Note: Design is usually 2" (50mm) gravel embedded in the upper 4" (100mm) & cap with 1" (25mm).

Granular Subdrains - Section 915

"Granular Subdrains" – Each

Guardrail Surfacing – Special Provision
"Surfacing Under Guardrail" – Square Yards (square meters)
Note: Pay item includes asphalt or concrete surface (contractor's option) and subgrade preparation.

High Friction Surface Treatment – Special Provision
"High Friction Surface Treatment (1-Layer)" - SqYd
"High Friction Surface Treatment (2-Layer)" - SqYd

Hot In-Place Recycling – Special Provision
"Hot In-Place Recycling" – Station
"Emulsified Asphalt for Hot In-Place Recycling" - Gal 1.0% of RAP (2"x24'=69 gal/sta) (2"x28'=81 gal/sta)

Hydrated Lime Slurry Stabilization – Special Provision
"Hydrated Lime Slurry Stabilization" – Station
"Hydrated Lime" – Ton 1.50% weight of RAP (4''x24'= 0.9 tons/sta) (5''x24'= 1.1 tons/sta)
"Emulsified Asphalt For HLSS" – Gal. 1.75% weight of RAP & Lime (4''x24'= 245 gal/sta)(5''x24'= 307gal/sta)
"Fog Seal" – Gallon 0.10 Gal/yd^2
Note: Growth factor approx. ¾" for a depth of 3'' to 5''. 1'' for a depth of 6"

Intersections and Driveways – Section 302 & Section 503
"Preparation of Intersections and Driveways" – Square Yards (square meters)
"Placement of Asphaltic Concrete For Intersections and Driveways" – Square Yards (square meters)
Note: Asphaltic concrete paid for by roadway tonnage or megagrams.

Joint Sealing Asphalt to Concrete – Section 508
"Joint Sealing – Asphalt to Concrete" – Station (one side)

Mail Box Turnouts – Section 912 & Special Provision
"Preparation of Intersection and Drives" - Square Yard
"Placement of Drives and Intersections" - Square Yard

Microsurfacing – Section 514
"Microsurfacing Placement - Station
"Emulsified Asphalt for Microsurfacing" – Gallon (liter) 12.0% of total tons 240 Gal = 1 ton (1000L=1Mg)
"Aggregate for Microsurfacing" – Ton (megagram) 83.8% of total tons (Mg)
"Mineral Filler for Microsurfacing" – Ton 1.7% of total tons (Mg)
Note: Weight Factor is 6.6 Tn/100 ft^3 (2.1 Mg/m^3)
Note: Lift thicknesses are ¼" and calculate rut depth if applicable.

Milling Concrete For Inlays – Section 510
"Milling Concrete For Inlays" – Each

Non-Woven Pavement Overlay Fabric – Special Provision
"Non-Woven Pavement Overlay Fabric" – Square Yard

Performance Graded Binder (-**) – Special Provision**
Use the table on page 6 to estimate the tons.

Perforated Pipe – Section 914
"_____Perforated Pipe" – Linear Foot (LF)
"_____ Non-Perforated Pipe" - Linear Foot (LF)

Removal and Processing of Concrete Pavement – Section 312
"Crush Concrete Pavement" – Square Yard (square meters)

Rubblization of Concrete Pavement (Resonant Breaker) – Special Provision
"Rubblization of Concrete Pavement (Resonant Breaker)" – Square Yard (square meters)
Note: Also include quantity for "Asphaltic Concrete for Patching, Type "___""

Rumble Strips – Special Provision
"Rumble Strips Asphalt" – Edge of Roadway – pay per side - Station
"Rumble Strips Asphalt 8"" – Centerline – pay times 2 - Station

Shoulder Subgrade Preparation – Section 302
"Shoulder Subgrade Preparation" – Station
"Water" – MGallon (kiloliter) 0.5 MGal/Sta (6.0 kL/Sta)
Note: Shoulders are measured separately

Special Surface Course – Special Provision
Note: Use this item if placing millings on driveways or under guardrail
"Special Surface Course" – Square Yard (square meter)
"Fog Seal" – Gallon 2 applications, 0.20 Gal/yd^2 for soil and 0.30 Gal/yd^2 for the surface
(liter) (2 applications, 0.91 L/m^2 for soil and 1.36 L/m^2 for the surface)

Subgrade Preparation – Section 302
"Subgrade Preparation" – Station or Square Yard (square meter)
"Water" – MGallon (kiloliter) 1.0 MGal/Sta (12.0 kL/Sta) or 0.003 MGal/yd^2 (0.014 kL/m^2)

Note: Subgrade Preparation calculated as total pavement footprint including bevel. Water calculated for pavement footprint plus 3' beyond. Plans show Subgrade Preparation 3' beyond pavement footprint.

Subgrade Preparation for Widening – Special Provision
Note: Use for concrete pavement widening
"Subgrade Preparation for Widening" – Station (one side)
"Water" – MGallon (kiloliter) 0.5 MGal/Sta (6.0 kL/Sta)

Subgrade Stabilization – Section 303
"Subgrade Stabilization" – Station or Square Yard (square meter)
"Soil Binder" – Cubic Yard (cubic meter) 12.5 yd^3/Sta for (6" x 30') [31 m^3/Sta for (150mm x 9m)]
"Water" – MGallon (liter) 1 MGal/Sta or 0.003 MGal/yd^2 (12.0 kL/Sta or 0.014 kL/m^2)
Subgrade Stabilization calculated as total pavement footprint including bevel. Soil Binder and Water calculated for pavement footprint plus 3' beyond. Plans show Subgrade Stabilization 3' beyond pavement footprint.

Surfacing – Special Provision
"Surfacing "___"" – Square Yard (square meter)
Note: Contractor's choice for pavement type, asphaltic concrete or portland cement concrete.

Surfacing Under Guardrail – Special Provision
"Surfacing Under Guardrail" – Square Yard

Stabilized Subgrade (8"depth) – Special Provision

"Stabilized Subgrade Type Cement" – Square Yard use if PI of soil is 20 or more
"Cement" – Ton 46 lbs/yd^2 cement quantity is **7% of soil tons

"Stabilized Subgrade Type Fly Ash" – Square Yard use if PI of soil is 19 or less
"Fly Ash – Ton 66 lbs/yd^2 fly ash quantity is **10% of soil tons

"Stabilized Subgrade Type Lime" – Square Yard use if PI of soil is 20 or more
"Hydrated Lime" – Ton 33 lbs/yd^2 hydrated lime quantity is **5% of soil tons

"Water" – MGallon 1 MGal/Sta or 0.003 Mgal/yd^2

Note: Stabilized Subgrade Type ___ calculated as total pavement footprint including bevel. Cement, Fly Ash, Hydrated Lime, and Water calculated for pavement footprint plus 3' beyond. Plans show Stabilized Subgrade Type ___ 3' beyond pavement footprint.

***Soil weight compacted in place, 110 lbs/ft^3*

Tack Coat – Section 504
"Tack Coat" – Gallon (liter)
Factor for existing surface 0.150 Gal/yd^2 (0.680 L/m^2)
Factor for between lifts 0.050 Gal/yd^2 (0.230 L/m^2)

Temporary Surfacing – Special Provision
"Temporary Surfacing "___"" – Station or Square Yard (square meter)
Note: Contractor's choice for pavement type, asphaltic concrete or portland cement concrete.
Note: Subgrade Preparation, earth shoulder construction, water applied and removal are subsidiary.

Trenched Widening 1'– Special Provision
"Trenched Widening 1"" – Station *Measured separately.*

Note: Include "Earth Shoulder Construction" or
"Earth Shoulder Restoration"

Trenched Widening 3'– Special Provision
""Trenched Widening 3'" – Station *Measured separately.*

Note: Include "Earth Shoulder Construction" or
"Earth Shoulder Restoration"

Widening – Special Provision
"Widening" – Station Measured separately.

Ultra Thin Bonded Wearing Course – See sheet 7
Note: Do not pay for Tack Coat

Performance Graded Binder (**–**) Table

Renaming PG Binder Types. Beginning with the January 2017 letting.

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Asph. Conc. Type	PG Binder (**-**) Type	Gradation bands (0.5) multiply Asph. Conc. tonnage by	Gradation bands (0.375) multiply Asph. Conc. tonnage by	Gradation bands (0.19) multiply Asph. Conc. tonnage by
GGCRM	(58-28)	8.5%	NA	NA
GGCRMLV	(58-28)	8.5%	NA	NA
LC	(58V-34)	NA	NA	5.2%
SLX	(58V-34)	NA	4.2%	NA
SPR	(58H-34) (58V-34) if Current TADT>150	3.4%	NA	NA
SPR(Fine)	Same as SPR	NA	3.4%	NA
SPS	(58S-34)	3.2%	NA	NA
SPH	(58V-34)	3.8%	3.8%	NA
SRM	(58H-34)	2.8%	NA	NA

UTBA Wearing Course will be SLX or SPR (Fine) or SPH (0.375)
Add 15% to Asphalt Tons for slope and profile correction for 1” SLX thin lifts

Hydrated Lime / Warm Mix Asphalt

Example: If you have.10534 tons of Asphaltic Concrete Type “SPR” there will be 10534 Each of “Hydrated Lime/WMA”.

Asph. Conc. Type	“Hydrated Lime/WMA” Pay item is “Each” multiply tons of asphalt by
GGCRM	1
GGCRNLV	1
LC	1
SLX	1
SPR	1
SPR (Fine)	1
SPS	NA
SPH	1
SRM	1

Asphaltic Concrete Tonnage Table

Asphaltic Concrete Types

	Bit Sand Base Crse	Bit Fnd Crse	OGFCCRMM	GGCRM	GGCRMLV	LC	SLX	SPS SPH	SPR(Fine) SPR SRM
Tons per 100 Cubic Feet	6.0	6.2	6.3	6.75	6.95	7.15	7.25	7.30	7.35	7.40
Pounds per Cubic Foot	120	124	126	135	139	143	145	146	147	148
Tons/SqYd/Inch										
Inches										
1	0.045	0.050	0.050	0.051	0.052	0.054	0.054	0.055	0.055	0.055
1.5										
2	0.090	0.093	0.095	0.101	0.104	0.107	0.109	0.110	0.110	0.111
2.5										
3	0.135	0.140	0.141	0.151	0.156	0.161	0.163	0.164	0.165	0.166
3.5										
4	0.180	0.186	0.189	0.202	0.208	0.214	0.218	0.219	0.221	0.222
4.5										
5	0.225	0.233	0.236	0.253	0.260	0.268	0.272	0.274	0.276	0.278
5.5										
6	0.270	0.279	0.284	0.303	0.313	0.322	0.326	0.329	0.331	0.333
6.5										
7	0.315	0.326	0.331	0.354	0.365	0.375	0.381	0.383	0.386	0.388
8	0.360	0.372	0.378	0.405	0.417	0.429	0.435	0.438	0.441	0.444
9	0.405	0.419	0.425	0.456	0.469	0.483	0.489	0.493	0.496	0.500
10	0.450	0.465	0.473	0.506	0.521	0.536	0.544	0.548	0.551	0.555

Asphaltic Concrete Megagram Table

Asphaltic Concrete Types

	Bit Sand Base Crse	Bit Fnd Crse		LC	SRM SLX	SPH SPS	SPR(Fine) SPR HRB
			Megagrams per Cubic Meter				
	1.922	1.986	2.291	2.323	2.339	2.355	2.371
			Megagram per Square Meter - Millimeter				
mm							
13	0.0250	0.0258	0.0298	0.0302	0.0304	0.0306	0.0308
25	0.0481	0.0497	0.0573	0.0581	0.0585	0.0589	0.0593
30	0.0577	0.0596	0.0687	0.0697	0.0702	0.0707	0.0712
40	0.0770	0.0795	0.0916	0.0929	0.0936	0.0942	0.0948
45	0.0865	0.0904	0.1031	0.1045	0.1053	0.1060	0.1067
50	0.0962	0.0994	0.1146	0.1162	0.1170	0.1178	0.1186
60	0.1154	0.1193	0.1375	0.1394	0.1404	0.1414	0.1424
80	0.1539	0.1590	0.1833	0.1858	0.1872	0.1885	0.1898
90	0.1732	0.1789	0.2062	0.2091	0.2106	0.2120	0.2134
100	0.1924	0.1988	0.2291	0.2323	0.2340	0.2356	0.2370
105	0.2018	0.2085	0.2406	0.2439	0.2456	0.2473	0.2490
120	0.2309	0.2386	0.2749	0.2788	0.2808	0.2827	0.2846
130	0.2501	0.2584	0.2978	0.3020	0.3042	0.3063	0.3084
135	0.2595	0.2681	0.3093	0.3136	0.3158	0.3179	0.3218
150	0.2886	0.2982	0.3437	0.3485	0.3510	0.3534	0.3558
180	0.3463	0.3578	0.4124	0.4181	0.4212	0.4241	0.4270
205	0.3940	0.4071	0.4697	0.4762	0.4795	0.4878	0.4961
230	0.4425	0.4572	0.5269	0.5343	0.5382	0.5419	0.5456
255	0.4901	0.5064	0.5842	0.5924	0.5964	0.6005	0.6046
280	0.5387	0.5566	0.6415	0.6504	0.6552	0.6597	0.6642
305	0.5862	0.6057	0.6988	0.7085	0.7134	0.7183	0.7232
330	0.6343	0.6554	0.7560	0.7666	0.7719	0.7772	0.7825
355	0.6823	0.7050	0.8133	0.8247	0.8303	0.8360	0.8417

The information contained in Chapter Thirteen: Planning and Project Development, dated July 2006, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this chapter.

Chapter Thirteen
Planning and Project Development

1. INTRODUCTION AND GENERAL CONSIDERATIONS

Prior to the preliminary design stage a roadway project goes through extensive planning, analysis, and evaluation to assure that **NDOT** provides improvements when and where they are most needed. Among the many factors that are considered during the planning and project development stages are:

- Traffic counts and forecast evaluation.
- Needs study criteria evaluation.
- Environmental effects of the project.
- Public participation and input into the project.
- Social and economic effects of the project.
- Alternative courses of action.

The **Materials and Research Division**, the **Intermodal Planning Division**, the **Project Development Division** and the **Project Scheduling Section of the Program Management Division** are responsible for the planning and project development processes and for liaison with other agencies and organizations that are involved in a project. The **Communications Division** coordinates the public meetings and hearings that are part of the process.

2. PLANNING AND SCHEDULING

- The **Materials and Research Division Classification, Needs, and Pavement Management Unit** performs ongoing data collection, analysis, prioritization and evaluation involving roadway inventories, pavement condition, traffic forecasts, demographic and economic information.
- The **Project Scheduling Section of the Program Management Division** plans and programs highway improvements and then manages Clarity , which programs, schedules and monitors projects through preconstruction stages.
- The **Project Scheduling Section of the Program Management Division** develops One Year Programs and Five Year and Beyond Programs.

The factors noted in Section 1 are used to develop the highway plan for non-metropolitan areas. In metropolitan areas such as Omaha, Lincoln, and South Sioux City, transportation planning is part of the continuing, cooperative and comprehensive (3C) planning process performed by metropolitan planning organizations (MPOs) consisting of state and local government officials and citizen representatives. Transportation modeling in urban areas consists of trip generation, distribution, assignment and modal split models that forecast system needs.

3. ENGINEERING REVIEW AND LOCATION STUDIES

3.A Engineering Review

Once a project has been initiated with a "Highway Improvement Programming Request", DR Form 73, but before it has been approved, the scope of the project and the initial cost estimate (Status 05) are determined (See Chapter Twelve: Cost Estimating & Funding, Section 2).

After the DR 73 has been approved, the **Project Development Division Location Studies Section** conducts an engineering review. Engineering review is a process performed very early in the development of a project to establish the concept of work to be performed and the initial itemized cost estimate for the project (Status 10) (See Chapter Twelve: Cost Estimating & Funding, Section 2). Engineering reviews are generally performed for major, non-interstate projects such as resurfacing, major bridge work, reconstruction, relocation, etc. Usually an engineering review is not performed for safety projects, traffic signal projects or other minor engineering projects.

The engineering review summarizes the existing highway condition, pavement condition, traffic volumes, and highway classification and includes a description of the existing typical roadway section and of adjacent roadway sections. It outlines or describes the horizontal and vertical alignment geometrics. The engineering review includes a listing of any structures within the proposed project limits and their condition. It also includes a listing of historical bridges, wetland involvement, underground fuel tanks, hazardous waste locations, safety history, railroad involvement, utilities, etc.

The **Project Development Division** then reviews the existing conditions, confers with the **District Engineer** and other engineers, reviews the photolog or visits the site, if necessary, and decides upon a recommendation for the type of project to be undertaken. The engineering review and its recommendations then are circulated to the **Roadway Design Engineer**, the **District Engineer** and the **Deputy Director-Engineering** for their approval.

The engineering review provides a starting point and direction for the roadway designer. The designer must use it as a guideline but has the option of making significant scope modifications, with proper documentation and approval, as more information becomes available.

From the engineering review, the **Scoping Section** of the **Project Development Division** prepares a Scoping Document, containing project data, a brief description of the proposed work and a recommendation as to the environmental classification of the proposed project, (See Section 4). This form is submitted to the **Federal Highway Administration** (**FHWA**) for review, comments, and concurrence in the environmental classification. Once **FHWA** environmental classification concurrence is obtained, preliminary design may proceed.

3.B Location Studies

Location studies are conducted to address social, economic, environmental and other issues associated with alternative project locations. Location studies may be conducted for specific "spot" locations, such as new bridge crossings of the Missouri River, or for longer corridors.

Corridor study projects often involve some relocation and some community bypasses. Corridor study results are published in report form. Contents of a corridor report include information similar to that in an engineering review, e.g., alignment location factors, cost estimates, etc. They may include plan and profile sheets developed from as built plans or **U.S. Geological Survey (USGS)** contour maps.

Location studies usually take from eighteen months to two years to complete. Public information meetings and a location public hearing are usually part of the study. Location studies are also circulated among various **NDOT** divisions for comment and input. Projects on new location are normally taken to the **State Highway Commission** and the **Governor** for location approval shortly after the location hearing.

4. ENVIRONMENTAL STUDIES

4.A. Environmental Classification and Documentation

The National Environmental Policy Act (NEPA) (Ref. 13.1), (https://ceq.doe.gov/), specifies that all federal agencies, including the **Federal Highway Administration (FHWA)**, must protect the environment through their policies, goals and actions. The **Project Development Division** is responsible for the required research, documentation and applications for approvals and permits.

Roadway design should be coordinated with environmental impact mitigation measures. If the designer encounters potential problems during design, e.g., learns of the possible presence of an endangered species, underground fuel tank, electrical substation, wetland, channel relocation, etc., he/she should contact the **Environmental Section Manager** of the **Project Development Division**.

4.A.1 Environmental Classification

Federal regulations divide all projects into three classes, depending on their potential for impacting the environment. The three classes are:

A. Class I Projects may significantly affect the environment and require preparation of an environmental impact statement (EIS), and the issuance of a Record of Decision (ROD) by **FHWA.** Basically, new four-lane construction on new location or projects with a significant environmental impact will be Class I projects.

   When **FHWA** concurs that a project is a Class I project, the **Project Development Division** conducts a social, economic and environmental review (SEE). Issues of significant impact and possible alternatives are identified. Appropriate federal, state and local agencies are contacted for coordination and comments throughout the development of the project.

B. Class II Projects, based on past experience, do not have a significant effect on the environment. These will include projects such as overlays, bridge replacement, lighting and various other projects with no significant impact. Class II projects, identified as categorical exclusions (CE), are divided into two groups:

- Group 1 CE - normally do not require NEPA documentation or **FHWA** approval as a CE.
- Group 2 CE - normally do require minimal environmental documentation and **FHWA** approval of the proposed CE.

C. Class III Projects are projects on which the significance of the effect on the environment must be determined. Class III projects require the preparation of an environmental assessment (EA) and result in a finding of no significant impact (FONSI). Class III projects that find possible significant impact are reclassified as Class I.

4.A.2 4(f) Evaluation (Publicly Owned Lands/Historic Places)

Section 4(f) of the 1966 Transportation Act (Ref. 13.3), (http://environment.fhwa.dot.gov/4f/index.asp) applies to **U.S. Department of Transportation** agencies and projects. It limits use of the following publicly owned lands:

- public parks.
- recreation areas.
- wildlife/waterfowl refuges.
- lands having historic sites of national, state or local significance.

These lands are known as 4(f) lands.

FHWA may not approve use of 4(f) lands for roadway improvements unless *"no feasible and prudent alternative is possible and all possible planning has been done to minimize harm".* Among the impacts that are considered in 4(f) evaluations are: amount of land to be used for the project, facilities and functions affected, noise/air pollution, visual impact, etc. The designer must contact the **Environmental Documents Unit** if any of the above listed facilities may be impacted by the project.

4.A.3 6(f) Lands (Land Water Conservation Funds Used For Park Improvements)

In addition to 4(f) documentation, the **Project Development Division** must also determine if any improvements to the public park lands were funded with monies from Section 6(f) of the Land Water Conservation Fund Act (Ref. 13.4), (http://www.fhwa.dot.gov/wadiv/envir/section6f.cfm), administered by the **National Park Service**. Use of areas improved with 6(f) funds for roadway projects will require coordination with the **National Park Service** and possible replacement of any lands used for the roadway project. Contact the **Environmental Documents Unit** to determine if 6(f) lands are present on the project. If 6(f) lands are present, the designer should attempt to avoid impacting them, minimize the impact if avoidance is not possible, and/or mitigate the impact.

4.B Wetlands and Section 404 Permits

Under Section 404 of the Clean Water Act, (Ref. 13.5), (https://www.epa.gov/cwa-404/section-404-permit-program), and under Title 117 of the Nebraska Surface Water Quality Standards, (http://www.deq.state.ne.us/NDEQProg.nsf/SearchWeb.xsp?search=nebraska%20surfae%20water%20quality%20standards), impacts to wetlands are to be avoided if possible, minimized if avoidance is not possible, and/or mitigated.

4.B.1 Wetlands Definitions

The **U.S. Army Corps of Engineers** and the **U.S. Environmental Protection Agency** define wetlands as follows:

> *"Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."*

Wetlands generally include swamps, marshes, bogs and similar areas.

Wetland determination is based upon an evaluation of soil type, hydrology and plants that live in the area. Situations that suggest that a wetland determination should be made include:

- Area is in a floodplain or otherwise has low spots in which water stands at or above the soil surface during the growing season (however, most wetlands lack both standing water and waterlogged soils during at least part of the growing season).
- Area has plant communities that commonly occur in areas having standing water for part of the growing season.
- Area has soils that are peats or mucks.
- Area is designated on a National Wetlands Inventory Map as being a wetland.

4.B.2 Wetlands Procedures

A primary goal of roadway design is to avoid wetlands as much as practicable. If this is not possible, then wetlands encroachment should be minimized. Mitigation for wetland encroachment may be required. Wetlands are replaced at a minimum rate of 1:1 or more. If any work is planned in or near a river, stream, pond or wetland, contact the **Environmental Permits Unit** in the **Project Development Division** as early as possible during project planning. The following procedures should be followed to coordinate roadway design, wetland delineation and wetland mitigation design.

1. During engineering review, the **Wetlands Biologists** will inspect the project site and delineate the wetlands on air photos (2-W sheets).
2. The **Environmental Permits Unit** drafts the wetland delineation on CADD and sends the CADD file and Waterway Permit Data Sheet to the roadway designer (EXHIBIT 13.1). This permit data sheet covers waterway permit information, historic bridges and other environmental issues.
3. The designer will use the 2-W sheets and his/her cross-sections to calculate the areas in acres (hectares) of impacted wetland for each type of wetland as delineated on the 2-W sheets (See DR Form 290, EXHIBIT 13.1).

4. At the plan-in-hand, the impact on wetlands will be discussed and alternative designs may be considered.
5. After the plan-in-hand changes, if any, have been incorporated into the project the designer completes the Waterway Permit Data Sheet using the limits of construction. The completed 2-W sheets, with the limits of construction, and Waterway Permit Data Sheet will be returned to the **Environmental Permits Unit** for preparation of the waterway permit applications.
6. If mitigation is required for a project the roadway designer and the **Environmental Permits Unit Manager** will study alternate mitigation sites and select the proper mitigation site prior to the public hearing dry run.
7. The **Environmental Permits Unit** will review the information and will send mitigation requirements, suggested mitigation sites, reconstruction sites, etc. to the designer. The designer will make final site decisions based on this information, present land use and other engineering considerations.
    - When possible, only one mitigation site should be shown on the public hearing plans.
    - When no apparent suitable mitigation site is available, public hearing plans should not show any wetland mitigation sites.
    - If mitigation will be accomplished at a wetland mitigation bank site, the bank's name and legal description should be stated at the public hearing, (See **EXHIBIT 'L'** of the Design Process Outline, Ref. 13.2).
8. If mitigation is required along the project, the roadway designer designs the mitigation site area with wetland design parameters from the **Environmental Permits Unit** before the public hearing.
9. After considering public hearing inputs, the final mitigation site design is incorporated into the project plans.
10. Once the mitigation area is designed the **Roadway Design Division** sends the plan and profile sheets and the cross-sections to the **Environmental Permits Unit** for further processing.
    - Mitigation areas should be noted on the profile and on the cross-sections to assure that areas specifically designed not to drain are not changed during construction.
11. The **Environmental Permits Unit** then develops and sends to the designer an environmental summary sheet (EXHIBIT 13.2) that includes threatened and endangered species, specifications, special provisions, conditions, copies of the applicable permits and instructions on additional plans needed and aerials to be included in the final plans. The **Environmental Permits Unit** will also send this package to other concerned parties.
12. The roadway designer will provide the necessary pay item quantities, plans, cross-sections and other relevant information for the plans, specifications and estimates (PS&E) package.
13. The **Environmental Permits Unit Manager** will provide the 2-W sheets delineating wetlands both on and off the project, special provisions and the permit documents with conditions for the PS&E package.

Deeds for land acquired for wetlands mitigation shall be written specifying the reason for the acquisition to forestall selling this land in the future. It is the responsibility of the roadway designer to inform the **Right-Of-Way Design Division** when, and what, land is being acquired for wetlands mitigation.

Nebraska Department of Transportation

WATERWAY PERMIT DATA SHEET

FIGURES ARE TO BE COMPLETED IN ACRES

DATE:

FROM:

TO: Jason Jurgens, Environmental Permits Unit Manager

Project Name: **Letting Date:**

Project Number: **Delineation Date:**

Control Number: **Biologist:**

County:

IS THE PROJECT LOCATED IN A MAPPED FLOODPLAIN/FLOODWAY AREA: ☐ **Yes** ☐ **No**

If YES, please attach Certification and Compliance with Floodplain and Floodway Regulations

Please provide the following:

- ☐ Location Map.
- ☐ 2 – ½ size copies of 2W plans *(turn on wetland feature file levels 54, 61, 62, 63 for 2W sheets submitted to EPU for Section 404 permitting)*.
- ☐ Report wetland impacts *(attached)*.
- ☐ Report all roadway structure crossings that will be replaced or modified *(attached)*.
- ☐ Report all channel change information with applicable cross sections *(attached)*.
- ☐ Provide applicable bridge/structures data sheets and/or TS&L *(Type, Span & Length)* plans provided by Bridge Division.
- ☐ Provide plans for specific features (weirs, jetties, drop structures, etc.)

Project Description: *(include existing facility, proposed improvements, design standard, etc. Please describe special features affecting delineated waterways such as weirs, jetties, drop structures, etc.)*

WETLANDS DRAFTING INFORMATION:
Wetland delineation information available by:
Project Control No./division/wetlands/_____wf.dgn

Exhibit 13.1a Waterway Permit Data Sheet

Nebraska Dept. of Roads

IMPACTED WETLANDS (ACRES)

Return to:
Project Development
Environmental Permits Unit

Project Name:

Control No.:

Project No.:

Date Submitted:

Station to Station	PEMA	PEMC	PEMF	PSSA	PFOA1	Other	Stream Channel	
							Area	Length (Ft.)
Totals	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Exhibit 13.1b Waterway Permit Data Sheet (continued)

Nebraska Department of Transportation

CHANNEL CHANGES

Project Name: **Stream Name:**

Project No.: **Location:**

Control No.: **County:**

Structure No.: **Date Submitted:**

Project Station:

EXISTING CHANNEL:

Depth:
Width:
Side Slopes:
Length:

NEW CHANNEL:

Depth:
Width:
Side Slopes:
Length:

RIP-RAP REQUIRED:

Type:
Length:
Cubic Yards Below Ordinary High Water:
Purpose:

Describe Channel Shaping/Grading Activities: *(Please attach cross sections)*

Reason for Channel Change:

Attach Structure Data Sheet/TSL Plans, if applicable

Return to:
Project Development Division
Environmental Permits Unit

Exhibit 13.1c Waterway Permit Data Sheet (continued)

Nebraska Department of Transportation

STRUCTURES

(Road Crossings)

Project Name: **Project Station:**
Project No.: **Date Submitted:**
Control No.:

Project Station/Structure No. and Feature Crossed	Existing Structure Size And Type	Proposed Improvement

If shoo-flys are built, enclose Plan & Profile and typical section of shoo-fly.

Return to:
Project Development Division
Environmental Permits Unit

Exhibit 13.1d Waterway Permit Data Sheet (continued)

Project No.:
Control No.:
Location:

SPECIAL ENVIRONMENTAL CONDITIONS
PROJECT DEVELOPMENT SUMMARY SHEET

WATERWAY PERMITS

Type of Permit	Location	Permit Number
Sample Nationwide #14 Floodplain Permit	between Section 13+24, T2N-R23W Section 13+24 T2N-R23W	NE 99-11158

Special Plans (to be included in final plan package):

2WA Sheets	☐ Yes	☐ No
Mitigation Plan	☐ Yes	☐ No
Special Cross-Sections	☐ Yes	☐ No
Others	☐ Yes	☐ No

Special notes on plans:

None

Special provisions (see attached):

See Attachment A: Fact sheet for a Nationwide #14 permit.

Special conditions (see attached):

See Attachment B: The Corps of Engineers Authorization.

Additional comments:

See Attachment C: Floodplain permit from _____ City/County.

This project was delineated for the presence of wetlands on _____. Mandatory criteria, as defined in the 1987 Corps of Engineers Wetlands Delineation Manual, were used for wetland determinations. These findings were based on hydric soil, wetland plant, and wetland hydrology information gathered during this on-site evaluation.

_____
Environmental Permits Unit Manager *(Signature & Date)*

Exhibit 13.2a Sample Environmental Summary Sheet

Project No.:
Control No.:
Location:

HISTORIC SITES

Historic bridges ☐ Yes ☐ No

Special provisions (See Attached):

Additional comments:

_____
Environmental Section Manager *(Signature & Date)*

OTHER ENVIRONMENT ISSUES

Special conditions:

Special notes on plans:

Additional comments:

_____
Environmental Section Manager *(Signature & Date)*

Exhibit 13.2b Sample Environmental Summary Sheet (continued)

4.B.3 Public Notification of Wetland Mitigation

It is **NDOT's** intent to make the public aware of wetland issues as early in the life of a project as is feasible. To that end **NDOT** has adopted the following policy regarding public notification of wetland mitigation:

A. Public information meetings held for Engineering Reviews or Location Studies
1. A preliminary determination of wetlands will be done on aerial photos for use in the development of alternative concepts.
2. Information about the anticipated impact to wetlands will be made available to the public, either on handout material or on the displays. The wetland impact will be described as either major (more than 3 acres (1.2 hectares)) or minor (less than 3 acres (1.2 hectares)).

B. Major projects on new alignments that have a corridor study and hearing.
1. Location Hearing
   a. The Location Studies Engineer provides avoidance analysis and preliminary estimate of wetland impacts to the Environmental Permits Unit.
   b. The Environmental Permits Unit biologist returns the required mitigation area and potential mitigation sites.
   c. At the location hearing, existing wetlands and potential mitigation sites that are truly feasible are shown.
2. Before Plan-In-Hand
   a. The designer sends updated wetland impacts, based on limits of construction, to the Environmental Permits Unit (4 weeks prior to plan-in-hand). Include revised avoidance analysis if impacted wetlands are different from corridor study.
   b. The Environmental Permits Unit biologist sends the designer updated mitigation areas and prioritized mitigation sites.
3. During Plan-In-Hand
   a. The preferred mitigation site is decided upon.
4. After Plan-In-Hand
   a. The designer notifies the Environmental Permits Unit of the preferred mitigation site and continues design. (Include in plan-in-hand report.)
5. Design Hearing
   a. The preferred mitigation site is shown.
   b. Show existing wetlands and other alternate mitigation sites, if they are truly feasible.
   c. The public hearing notice will include a location map with preferred site and other potential sites shown.

C. Design Hearing Held and Corridor Hearing Not Held
1. Before Plan-In-Hand
   a. For a project with proposed new alignments, the designer sends avoidance analysis and estimated wetland impact based on limits of construction, to the Environmental Permits Unit. (Four weeks prior to plan-in- hand.)
   b. The Environmental Permits Unit biologist sends the designer required mitigation areas and prioritized mitigation sites.
2. During Plan-In-Hand
   a. The preferred mitigation site is decided upon.

3. After Plan-In-Hand
   b. The designer notifies the Environmental Permits Unit of the preferred mitigation site and continues design. (Include in plan-in-hand.)
4. Design Hearing
   a. The preferred mitigation site is shown.
   b. Show existing wetlands and other alternate mitigation sites, if they were truly feasible.
   c. The public hearing notice will include a location map with preferred site and other potential sites shown.

D. Design Hearing Not Held and Three Acres (1.2 Hectares) or More Mitigation Required

1. Before Plan-In-Hand
   a. The designer sends avoidance analysis and estimated wetland impacts, based on limits of construction, to the Environmental Permits Unit. (Four weeks prior to plan-in- hand.)
2. During Plan-In-Hand
   a. The preferred mitigation site is decided upon.
3. After Plan-In-Hand
   a. The designer notifies the Environmental Permits Unit of the preferred mitigation site and continues design (Include in plan-in-hand report.)
4. Hold Wetlands Information Meeting
   a. The preferred mitigation site is shown.
   b. Show existing wetlands and other alternate mitigation sites, if they were truly feasible.
   c. The public information meeting notice will include a location map with preferred site and other potential sites shown.

E. Design Hearing Not Held and Less Than Three Acres of Mitigation Required

1. Before Plan-In-Hand
   a. The designer sends avoidance analysis and estimated wetland impacts, based on limits of construction, to the Environmental Permits Unit. (Four weeks prior to plan-in- hand.)
   b. The Environmental Permits Unit biologist sends the designer the required mitigation area and prioritized mitigation sites.
2. During Plan-In-Hand
   a. The preferred mitigation site is decided upon.
3. After Plan-In-Hand
   a. The designer notifies the Environmental Permits Unit of the preferred mitigation site and continues designing. (Include in plan-in-hand report.)
   b. A location map with the preferred site and other potential sites will be sent to local newspapers with a note that **NDOT** will be mitigating the loss of wetlands due to the construction of pending Project No. _____.
      For more information contact _____.

F. If wetland mitigation is handled by taking credit from a wetland bank, specific wetland information meetings are not necessary.

4.B.4 Section 404 Permits

Section 404 of the Clean Water Act (Ref. 13.5) requires that anyone interested in depositing dredged or fill material into waters of the United States, including wetlands, must receive authorization for such activities through permitting from the **U.S. Army Corps of Engineers**. Activities in wetlands for which permits may be required include: placement of fill material, ditching activities, levee and dike construction, mechanized land clearing, land leveling, most road construction and dam construction.

The **Corps of Engineers** issues three types of permits: individual, regional and nationwide (NWP) general permits. An individual permit is required when a project is not exempted from regulation and is of a scope and magnitude that it does not fall under the other two categories. Regional and nationwide permits are issued for projects that have minimal environmental impacts. In evaluating a permit application, the **Corps of Engineers** analyzes the following factors:

- Conservation
- Economics
- Aesthetics
- General environmental concerns
- Historic values
- Fish and wildlife values
- Flood damage prevention
- Land use, navigation
- Recreation
- Water supply and water quality
- The needs and welfare of the people

For an individual permit on new alignments, the **Corps of Engineers** will require alternatives analysis. Impacts for alternate alignments must be calculated and retained in the project file by the designer. Required alternatives analysis includes:

- What was done to avoid wetlands impacts?
- What was done to minimize wetlands impacts?

Erosion control is a condition of the Section 404 permit, (See Chapter Two: Erosion and Sediment Control of the Drainage Design and Erosion Control Manual, Ref. 13.6) (http://www.roads.nebraska.gov/business-center/design-consultant/rd-manuals/). Plans must include control of water (and siltation due to runoff) into any water body including wetlands. The **Project Development Division** will identify any location where roadway runoff or other non-point source pollution may adversely impact sensitive water resources such as water supply reservoirs, ground water recharge areas, high quality streams and threatened and endangered aquatic species.

The **Project Development Division** submits the necessary applications for Section 404 permits.

4.B.5 Section 10 of the Rivers and Harbors Act

Structures or work affecting navigable waters of the U.S. are regulated under Section 10 of the Rivers and Harbors Act of 1899 as amended (Ref. 13.7), (http://water.epa.gov/lawsregs/guidance/wetlands/sect10.cfm). In Nebraska, only the Missouri River is considered a navigable river. If required, the **Environmental Permits Unit** will obtain a Section 10 permit from the **U.S. Army Corps of Engineers**.

4.B.6 Channel Changes

When a channel change is required to meet project objectives, site conditions should be evaluated early in the design process. Channel width and length, vegetation, ponding, existing erosion control measures, etc. should be noted and the new channel should be designed so as to equal or better these conditions. The **Environmental Permits Unit** of the **Project Development Division** should be notified of the proposed channel change as soon as possible in order to determine mitigation, special conditions, and to get the necessary outside agencies involved at the beginning of the project. This will benefit **NDOT** in the permitting process.

The **Nebraska Department of Environmental Quality** and the **United States Army Corps of Engineers** typically requires the following conditions for channel changes for Nationwide (404) Permits:

1. A 30 ft. (9.1 m) minimum width buffer strip of native vegetation on each side of the channel, starting at the top of the bank and measuring outward.
2. In some cases 2:1 tree and shrub replacement, planted in the buffer strip.
3. Construction of a channel wide enough so that the new stream bottom area is equal to or greater than that of the channel to be filled and the cross-sectional area of the new channel is equal to or greater than that of the old channel.
4. New channel banks should be sloped no steeper than 3:1, (2:1 if certified by an engineer).
5. Channel length shall be equal to or greater than that of the channel to be filled if the total channel length is less than 100 ft. (30.5 m) (net loss).
6. No more than 300 ft. (91.4 m) of channel can be impacted.

If these conditions cannot be met, meet with the **Environmental Permits Unit Manager** as soon as possible because an individual 404 permit will be required, increasing the time required for the permit process.

The **United States Army Corps of Engineers** also requires that any channel change designed without a grade control structure must have a registered engineer verify, in writing, that a grade control structure is not required. The following example statement has been accepted by **Project Development** and by the **Army Corps of Engineers** as fulfilling this requirement:

“I have determined that the channel change from Station 252 +/- 50 Rt. to Station 253 +/- Rt. does not require a grade control structure.”

A copy of this transmittal shall be kept in the project file.

Deeds for land acquired for channel changes shall be written specifying the reason for the acquisition to forestall selling this land in the future. It is the responsibility of the roadway designer to inform the **Right-Of-Way Design Division** when, and what, land is being acquired for channel changes.

4.B.6.a Bridge Channel Work

The pay limits provided for channel work as a **Bridge Division** pay item will be from ROW to ROW (or as specified on the Bridge Data Sheet) and from centerline of abutment to centerline of abutment, (See EXHIBIT 13.3. Payment for channel work (and riprap) beyond the Bridge Plan quantity limits may be paid for as either Excavation (Established Quantity) or Earthwork Measured in Embankment. Excavation (Established Quantity) will be provided if the greatest earthwork net volume is excavation while Earthwork Measured in Embankment will be used if the greatest net volume is in fill. The Roadway Designer will coordinate with the **Bridge Designer** to decide how the work will be shown in the plans and how the limits of payment will apply.

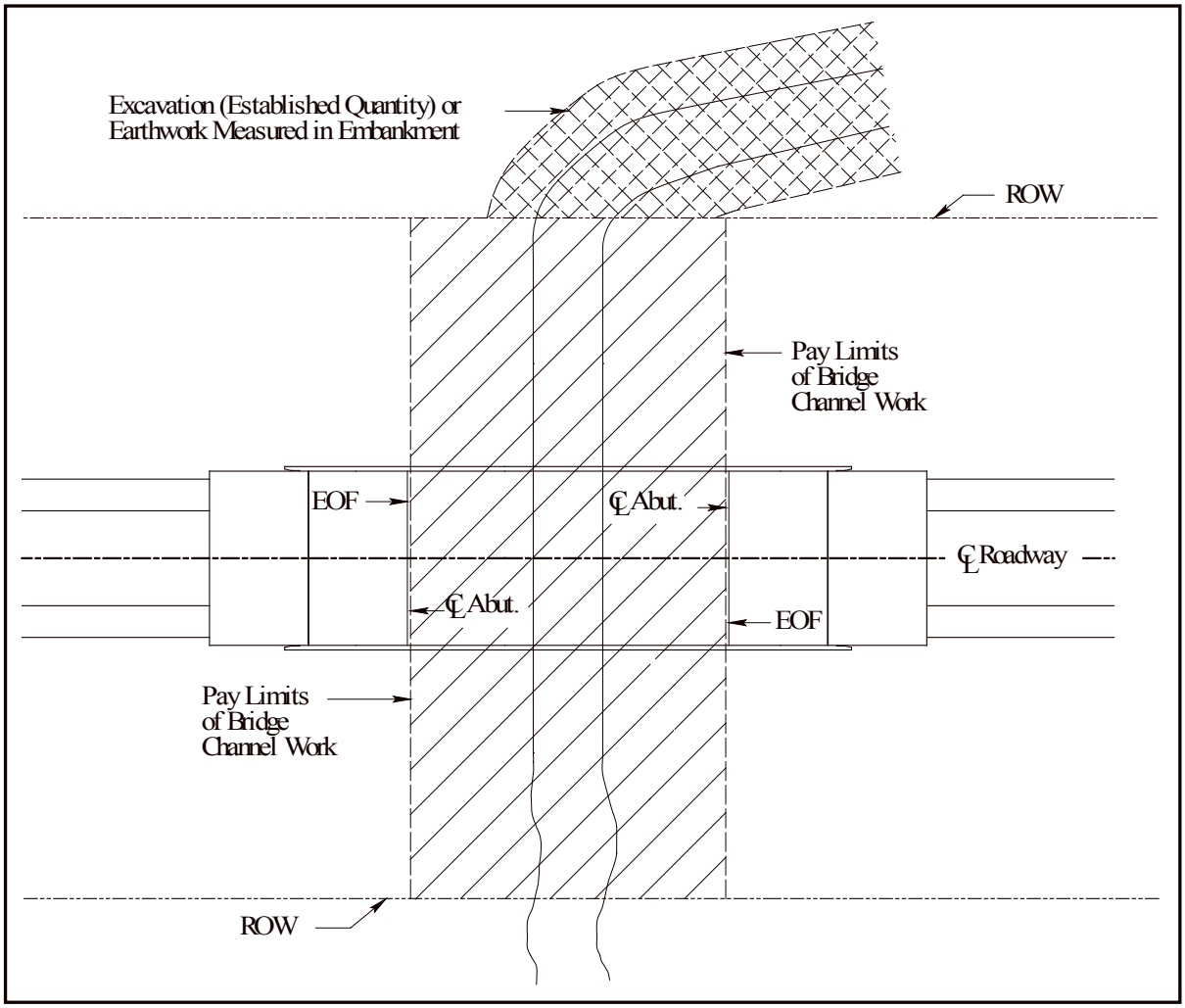


Exhibit 13.3 Pay Limits for Bridge Channel Work

4.B.7 Floodplains

The **Federal Emergency Management Agency (FEMA**) administers the National Flood Insurance Program (NFIP). **FEMA** has established regulations for the modification of floodways and floodplains.

There can be no surcharge or increase of the 100-year flood profile resulting from highway construction in floodway (See the Drainage Design and Erosion Control Manual, (Ref. 13.6), Chapter One: Drainage, Section 5.C). If an area is mapped **FEMA** zone A or a flood fringe area on a Flood Insurance Rate Map (FIRM) and there is a local (**Town, City or County**) designated regulating authority, **NDOT** must obtain a Floodplain/Floodway permit if construction activities occur in the mapped area. To apply for the permit a "No-Rise" certificate is required along with the application. For bridge construction activities in the mapped area the **Bridge Division** provides a "No-Rise" certificate and a bridge data sheet. For roadway construction activities in the mapped area **Roadway Design** provides a "No-Rise" certificate and a memo explaining the construction activities. Refer to References 13.8 through 13.12 for further guidance.

4.B.8 Water Quality

NDOT must comply with federal regulations related to water quality including the Clean Water Act (Ref. 13.5) and the Safe Drinking Water Act (Ref. 13.13), (http://www.epa.gov/safewater/sdwa/sdwa.html). A Water Quality Certificate must be obtained from the **NDEQ**.

The **Project Development Division** will also research impacts of the project on any areas designed as principal or sole-source aquifers under Section 1424(e) of the Land Water Conservation Fund Act, (Ref. 13.4). If a rest area with a point source discharge is proposed as part of the project, the **Project Development Division** will also obtain a Section 402 permit (Procedures for Coordinating Highway Encroachments on Floodplains with Federal Emergency Management Agency, Ref. 13.8), (http://environment.fhwa.dot.gov/guidebook/vol1/doc6d.pdf).

4.C Air Quality

The Clean Air Act (Ref. 13.14), (http://www2.epa.gov/laws-regulations/summary-clean-air-act), was passed to protect and enhance the quality of the nation's air resources. The **Environmental Protection Agency** has established air quality standards that must be followed. The **Noise and Air Section** of the **Project Development Division** will make all necessary air quality evaluations. Air analysis will be made for projects where the traffic exceeds 15,000 vehicles in the year of construction or 30,000 vehicles in the design year.

4.D Noise

Noise is defined as unwanted sound. Vehicles generate noise, and designers should work with the noise analyst to evaluate expected noise levels and measures to reduce traffic noise levels through location and design features. Sometimes embankment design and design features may serve to reduce noise levels. Criteria have been developed to analyze anticipated noise levels to determine if additional noise abatement measures should be incorporated into design. Noise sensitive areas, e.g., residences, businesses, schools, parks, etc., should be noted in the early project stages for both developed and undeveloped lands for which development is planned,

designed and programmed. The designer should work with the **Noise and Air Section** of the **Project Development Division** if noise levels are expected to be a problem.

Noise levels should be considered during design of alignment, cross-section, earthwork balance and right-of-way. Sometimes natural barriers from the terrain may be effective noise barriers. Noise barrier structures should be located outside of the lateral obstacle clearance zone if practicable. Stopping sight distance should be maintained. Some noise barrier designs incorporate concrete safety shapes. Barriers should begin or terminate at least 200 ft. (60.0 m) from the nose of gore areas. Refer to **American Association of State Highway and Transportation Officials' (AASHTO)** A Policy on Geometric Design of Highways and Streets (Ref. 13.15), Chapter 4, for further information.

4.E Wildlife Issues

Transportation agencies are responsible for recognizing potential conflicts between wildlife and transportation facilities and for minimizing those conflicts during all phases of roadway development. The **Project Development Division** coordinates wildlife and habitat studies and will notify the **Roadway Design Division** of project-related concerns. The designer should consider the effects of roadway design on wildlife habitat and incorporate appropriate measures in project design.

Direct impacts on wildlife by roadway development stem from the disturbance of essential habitat components such as key forage areas, nesting sites, breeding grounds and essential escape cover. The Migratory Bird Act (http://www4.law.cornell.edu/uscode/16/ch7.html) protects nesting bird habitat. Tree removal cannot be done during primary nesting season, (from April 1 through July 15), without a survey to check for nesting activity. If the tree removal activity will disrupt nesting, a permit must be obtained. The contractor shall be responsible for the nesting survey and for obtaining the permit. Wildlife also may be disturbed by interruptions of migration paths and highway mortality. The placement of fencing should take into consideration any restrictions it will have on animal movement. Any use of or modification to water bodies that may impact wildlife will also be included in any environmental documentation, (See Section 4.A).

The **Project Development Division** provides early project coordination with the **Nebraska Game and Parks Commission** to identify endangered species concerns for use in design, copies of the determination will be provided to the designer. An endangered species is defined as any species that is in danger of extinction throughout all or a significant portion of its range. A threatened species is any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. If endangered or threatened species are concerns on a project, the **Environmental Permits Unit** will work with the designer to avoid or minimize impacts. If, at a public meeting/hearing or during other design activities, concerns are raised regarding the presence of endangered species, contact the **Environmental Permits Unit** of the **Project Development Division**.

AASHTO's A Design Guide for Wildlife Protection and Conservation for Transportation Facilities (Ref. 13.16) provides additional information, terms and concerns of the biological community.

4.F Social, Economic, and Environmental Impacts

As part of the social, economic and environmental review (SEE) for Class I and Class III projects (See Section 4) the following social impacts are considered:

1. Changes in community or neighborhood identity, such as splitting neighborhoods, isolating ethnic groups, separating residents from community facilities such as police and fire protection, school districts, churches, businesses, etc.
2. Travel patterns, accessibility, transit captives such as elderly, handicapped, non-drivers, pedestrian, bicyclists, etc.
3. Relocation impacts (See Chapter Twelve: Cost Estimating & Funding, Section 4.B.4).
4. Impacts on the handicapped and minorities.
5. Economic impacts both for the region as well as adjacent highway-related and other businesses, etc.

Executive Order 12898 (2/11/94) (http://www.hud.gov/offices/fheo/FHLaws/EXO12898.cfm) covers Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations. **FHWA** has developed policies and procedures to use in complying with this Executive Order. Any project with Federal funding will require **NDOT**, through the NEPA process, to identify and address disproportionately high and adverse effects on minority and low-income populations. In design, avoidance, minimization, and/or mitigation must be considered for disproportionately high and adverse effects. Public involvement opportunities must be provided to the affected populations for proper alternative consideration. The **Project Development Division** will notify the **Roadway Design Division** when Environmental Justice issues must be addressed.

4.G Archeological and Historical Features

Section 106 of the National Historic Preservation Act of 1966 (Ref. 13.17), (http://www.achp.gov/nhpa.html), requires an investigation be made for possible impacts of transportation projects on historic or archeological resources. A determination is necessary if any historic or archeological resources that are on or may be eligible to be on the National Register of Historic Places will be adversely impacted.

NDOT works with the **State Historic Preservation Officer (SHPO)** to evaluate sites to determine if they should be preserved or if they may be researched only, without the need for preservation. Historic sites may be bridges, buildings, neighborhoods, farmsteads, sites where significant events occurred, etc. If historic sites are present, the designer should coordinate with the **Environmental Documents Unit Supervisor**.

4.H Hazardous Materials

4.H.1 Materials Prohibited or Restricted as Fill Materials

The **U.S. Army Corps of Engineers** has issued generic prohibitions of use of certain materials as fill in waters of the **United States** as defined by the Clean Water Act (33 U.S.C. 1344) (Ref. 13.5). The following materials are prohibited or restricted as fill materials in waters of the United States within the regulatory boundaries of the **Omaha District of the Corps of Engineers**:

1. Vehicle bodies, farm machinery and metal junk including appliances, containers and barrels (including plastic barrels).
2. The use of small aggregate, in the form of streambed material, for bank stabilization and erosion control below the ordinary high water mark of a waterbody or wetland when the material to be discharged is removed from a stream or river for such purpose. Small aggregate, from any source, placed below the ordinary high water mark of a waterbody or wetland when the proposed project will be unstable and subject to frequent failure.
3. The use of old or used asphalt as a fill material and the use of asphalt in general for bank stabilization or erosion control.
4. The use of organic debris (properly anchored trees and treetops are excluded).
5. Biodegradable building materials including wood debris, sheetrock, roofing materials, and chemically treated materials subject to leaching when placed in an aquatic environment. The use of clean brick and broken concrete will continue to be allowed on a case-by-case basis. Broken concrete should be free of exposed rebar and old asphalt.
6. Tires shall be prohibited unless placed in the form of a mat or other design and anchored to preclude entering the waterway.

The **Location Studies Unit** of the **Project Development Division** will obtain proper authorization from the **U.S. Army Corps of Engineers** for any discharge of dredged or fill material into a water of the **United States**.

4.H.2 Guidelines for Handling Petroleum Tanks/Leaks on Construction Projects

The Resource Conservation and Recovery Act (RCRA) (Ref. 13.18), (http://www4.law.cornell.edu/uscode/42/ch82.html), and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (Ref. 13.19), (http://www4.law.cornell.edu/uscode/42/ch103.html), regulate hazardous waste sites. The locations of permitted and non-regulated hazardous waste sites should be identified.

On federal-aid highway projects, **FHWA** expects early investigation of all potential hazardous waste/petroleum sites to preclude costly delays. An initial site assessment should be done, as early as possible in the project development stages, to identify any known or potential waste site within the project limits.

For projects where no significant excavation is involved and a paper review of the tank sites reveals no problems, **NDOT** will not perform on-site drilling and testing. For projects with major excavation in the vicinity of fuel tanks, site drilling and testing may be required with the results incorporated into the EIS, (See Section 4.A.1).

During the on-site engineering review of projects, the locations of active and inactive fuel stations should be noted. Any stations converted to other uses should be flagged for follow-up. Once preliminary design is begun and the design is roughed out, the designer can request that the **Location Studies Unit** of the **Project Development Division** make a paper review of any fuel tank locations. The following activities will be included in the paper review:

1. Plans will be checked to see that the tank fill pipes/gas pumps are shown. A fill pipe is usually but not always directly over the tank. Vent pipes are almost always remotely located.
2. Cross-sections will be checked for cuts and fills, presence of storm sewer pipe, longitudinal or cross pipes. Even if the old grade line is matched, excavation may be needed for pavement widening, storm sewer pipes, or modern ditch sections.
3. The amount of right-of-way and its impact on existing tanks will be reviewed.
4. The **Fire Marshall's Office** will be contacted to find out tank registrations, approximate ages and sizes, when the sites were last inspected, and the results of any precision (tightness) testing.
5. The **NDEQ** will be contacted for sites on the active spill/leak list.
6. City Hall and long time residents may be contacted for history.
7. The CERCLA map will also be checked.

Upon completion of this review, the **Location Studies Unit** will write a memo to the **Roadway Design Division** (and **FHWA**, as appropriate, for the EIS) summarizing their findings.

In some cases, contaminated soil is not anticipated. In other cases, where questions remain, on-site drilling and testing may be needed. In those cases, the **Location Studies Unit** of the **Project Development Division** will request that the **Materials and Research Division** arrange testing. The **Materials and Research Division** will send a report to the **Project Development Division** which is then forwarded to the **Roadway Design Division** and, if necessary, to **FHWA**.

4.H.3 Guidelines for Handling Contaminated Soils on Highway Right-of-Way

Sometimes unanticipated contaminated soils are encountered during construction activities. **Nebraska Department of Environmental Quality** has issued guidelines for handling petroleum-contaminated soils from an excavation or construction activity (e.g., during a trenching operation). The soils may be temporarily removed within the area of contamination and subsequently redeposited back into the excavation and contaminated area under the following conditions:

1. The placement of underground equipment, such as a storm sewer line, cannot be allowed to act as a conduit for further migration of the contamination.
2. Impervious geological features, such as clay silt, cannot be punctured so as to open a path for contamination to migrate into an aquifer.
3. Cross-contamination of stacked fill material that expands the area of contamination cannot be allowed, i.e., the soil should not be stirred.
4. Migration of contamination from storm runoff due to the stockpiling of consolidated excavated soil cannot be allowed. The material shall be redeposited at the end of the day or be covered with plastic cover until it is redeposited.
5. Inversion of the layers of contamination in the replaced soil is not allowed. The contaminated soil needs to be placed back in the trench at the same layer from which it came.

These **NDEQ** guidelines do not apply to mass grading operations (e.g., cut and fill) in which contaminated soils are encountered. If contaminated soils are found during a mass grading operation, these soils need to be kept separate from the "clean" soils as recommended by **NDEQ**. Special handling will be needed.

5. LIAISON WITH OTHER AGENCIES AND ORGANIZATIONS

5.A Agreements

Intergovernmental agreements outlining the scope and participation of all parties will be executed for projects involving other units of government. The **Agreements Unit** in the **Project Development Division** prepares all agreements, except relinquishment agreements**.** Prior to the public hearing, covenant relinquishment agreements are prepared by the **Materials and Research Division** (See the *DPO* (Ref. 13.2), Activity 5400, Clarity Task Code 5434). Final relinquishment agreements are prepared prior to plans submittal to the **Plans, Specifications and Estimates Section (PS&E)**. **Roadway Design** may provide input for exhibits and/or displays which may be needed for the agreements.

5.B Federal Agencies

Ordinarily, **FHWA** is the lead federal agency for **NDOT** contact. However, **NDOT** may also work with the **U.S. Environmental Protection Agency**, **U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, National Park Service, Federal Emergency Management Agency, U.S. Forest Service, Bureau of Land Management, Bureau of Indian Affairs, the Architectural and Transportation Barriers Compliance Board (Access Board)** and other federal agencies. The **Project Development Division** serves as liaison with these agencies.

5.C Other State Agencies

NDOT works with many state agencies including the **Nebraska State Historical Society**, the **Natural Resource Commission**, the **Game and Parks Commission**, etc. In addition, the **Department of Environmental Quality** issues water quality certification, the **Advisory Council on Historic Preservation** works with **NDOT** on historic site issues, and the **Paleontological and Archaeological Highway Salvage Program** addresses archeological issues.

5.D Local and Regional Agencies

The **Project Development Division** coordinates with **MPOs** (Metropolitan Planning Organizations) in metropolitan areas, and the **Government Affairs Division** coordinates with city and county governments, natural resource districts, etal.

5.E Public Participation and Input

Federal Policy requires public involvement in the development of transportation plans. The public participates in the planning process through the **State Highway Commission**, the **Board of Public Roads Classifications and Standards** and through other committees, meetings and hearings. In addition, information about transportation plans, projects and programs is disseminated through the public media and through mailings to interested organizations and individuals such as the **Nebraska Highway Coalition,** the **American Automobile Association,** the **Nebraska Motor Carriers Association**, etc.

Types of public meetings that are held by the **Roadway Design Division** are: public information meetings, city officials meetings, pre-hearings, location public hearings, and design public hearings. (See the Design Process Outline, Ref. 13.2, **EXHIBIT 'C'**).

Communication between **NDOT** and the public is an important ongoing activity coordinated by the **Public Hearings Officer** in the **Communications Division**. Depending upon the nature of the project, several types of contact may be made during the course of a project.

The **Public Hearings Officer** publishes notices of opportunity for hearings in general circulation newspapers in project areas to provide general information about the proposed projects to the general public and also to provide them the opportunity to submit a written request to **NDOT** to hold a public hearing. If no requests are submitted, **NDOT** may notify **FHWA** that no requests were received and that hearing requirements were thus satisfied.

5.F Consultants

Consultants are hired to assist **NDOT** on various projects. The **Agreements and Consultant Services Section** of the **Project Development Division** provides liaison with consultants, including:

- Participating in the selection of and negotiation with consultants.
- Maintaining certification records of consultants.
- Reviewing consultant billings.

Engineers who work in the **Consultant Design Units** in the **Roadway Design Division** will be responsible for day to day business contacts with consultants including transmittal of data, progress inspections and meetings as set out in the scope of work. This does not include authorization to change the scope of work for the project, to exceed the agreed upon project cost or to extend the completion date. These authorizations come from the **Agreements Engineer**. If a change in scope of work is necessary, it should be discussed with the **Agreements Engineer** and that office will prepare a supplemental agreement for the additional cost. If a time extension is necessary, the **Agreements Engineer** will ask the consultant to provide a written extension request and will discuss this with the appropriate Division for approval of the time extension.

The **Agreements Engineer** should be informed of design public hearings so he/she can be prepared to have the consultant ready to go on final design. The **Agreements Engineer** will set up the scope of work and be in charge of the negotiations. Following a design public hearing, the negotiations will be completed so the consultant will be ready for final design as soon as approval is received from the **State Highway Commission** and **Governor.**

5.G Railroads

(Map at http://roads.nebraska.gov/media/2746/railroad.pdf)

Many roadways in Nebraska are in close proximity to railroads. The roadway designer for any roadway project that is near a railroad (within 300 ft. (100 meters) from the centerline of the nearest track) should inform the **Railroad Liaison Office** in the **Intermodal Planning Division** as early as possible. The designer should complete the DR form 95 and forward it with plans to the **Railroad Liaison Office**.

The applicable railroad company will review design issues such as earthwork and drainage near the railroad. Railroad insurance, purchased by the contractor, will be required for work within 50 ft. (15 m) of the centerline of the outside tracks. The roadway designer needs to estimate the percentage of work done in each group of work within the 50 ft. (15 m) limit for insurance purposes. The roadway designer will provide cost estimates for all of these items. If the project is a major project which will involve a viaduct or overpass, the railroad will need to be involved in discussions in the early planning stages. Roadway designers may also initiate safety improvements with improved crossing design and may expand the project by possible consolidation of nearby crossings. See Chapter Chapter Ten: Miscellaneous Design Issues, Section 1 and Chapter Twelve: Cost Estimating & Funding, Section 1.A.5 for further information.

Any changes in design, such as adding a safety section, may change the level of involvement with the railroad. The **Railroad Liaison Office** should be informed of changes of this nature immediately.

6. UTILITIES

6.A Utility Liaison

Highway construction projects frequently require the revision and relocation of utilities. The **Utilities Unit** of the **Roadway Design Division** (**Utilities Unit**) is responsible for providing liaison with public and privately owned utilities. This includes:

- Reviewing plans and performing field inspections to determine utility ownership and identify potential conflicts.
- Providing utility input to help determine the most satisfactory and economical location or design adjustments versus utility adjustments.
- Requesting input from utility companies and reviewing and approving their plans, specifications and estimates.
- Coordinating with municipalities for the rehabilitation of their owned and operated utilities on highway projects.
- Reviewing utility billings and submitting them for payment and subsequent audit review.

It is the responsibility of the roadway designer to work with the **Utilities Unit** in identifying and resolving utility conflicts. As soon as the designer identifies a possible conflict, he/she should meet with the **Utilities Unit** to determine the best rehabilitation procedure. If utility relocation is required, the **Utilities Unit** will notify the utility owner.

The **Utilities Unit** submits preliminary design plans, received from the roadway designer, to the utility owners at the time of plan-in-hand, for the identification of any utilities not shown on the plans. When the **Utilities Unit** sends plans to the utility owners on a project, they will furnish the **Roadway Design Division** with a memo indicating when and to whom the plans were sent. At the plan-in-hand it is important that the roadway designer notes any utilities not located on the plans and identifies any potential conflicts. As right-of-way appraisal plans are nearing completion, the **Utilities Unit** sends right-of-way and limits of construction plans to the utility owners for preparing utility rehabilitation plans and cost estimates. Throughout the development of the project it is very important that the roadway designer notifies the **Utility Coordinator** whenever design changes occur. This will enable proper coordination with the affected utility owners (See “Utility Rehabilitation Negotiations”, Ref. 13.20). Failure to inform the **Utilities Unit** of design changes may result in a utility relocating their facility and then being informed they will have to move again because they are still in conflict with the proposed construction. This could result in a delay to the contractor and additional expense to the state.

6.B Utility Rehabilitation Plan Review

The **Utilities Unit** will submit utility rehabilitation plans, as the utility owners return them, to the **Roadway Design Unit Head** for review unless the utility work is minor. The **Utilities Coordinator** will have previously reviewed the plans and will indicate any comments from his/her review. The **Roadway Design Unit Head** and/or designer will review the plans and return them to the **Utilities Coordinator** with any comments regarding the plans on the transmittal letter received from utilities.

6.C City/County Utility Cost Reimbursement

Responsibility for determining cost sharing to relocate city utilities is also a joint effort by both the **Utilities Unit** and the appropriate **Roadway Design Section**. However, any financial commitment to a city for a utility relocation shall be submitted by the **Utilities Unit** in agreement form. Reimbursable costs represent the eligible non-betterment expenditures of the utility required to install, revise, and/or relocate utilities. Municipally owned utility facility non-betterment relocation costs are 100% reimbursable whether they are on public or private right-of-way inside the corporate limits. Outside the corporate limits the eligible reimbursement is based on the right-of-way/private easement criteria.

Not all utility relocation costs are reimbursable. Utilities located within existing state right-of-way that must be moved for a project are not eligible for reimbursement and the utility owner must bear the cost of the relocation expense. If a utility line is outside of existing state right-of-way and additional right-of-way is to be acquired, necessitating relocation of the utility, the relocation expense is reimbursable. The utility may stay within the new right-of-way but must obtain a permit to occupy state right-of-way. The **Right-of-Way Division** maintains a computerized listing of all utility permits by utility type. Designers may consult this listing to assist in determining utility locations. To access this listing in the CICS1 program:

1. Click on the “Mainframe Sessions” icon on your computer desktop.
2. Enter CICS1 by entering CI and your DR# and password.
3. Select 2 – “Dept. of Roads”.
4. Select 5 – “IHI Integrated Highway Inventory System”.
5. Select 22 – “Use and Occupancy Permits”.
6. Select 2 – “Query”.
7. Select 3 – “Use and Occupancy Permit by Hwy/Cnty/Type/Status Query”.
8. Enter the highway # and a reference post range (county, type and status may be left blank).

On all projects, especially federal-aid projects not on the state highway system, the **District Project Manager** shall notify the **Roadway Design Division** or **Secondary Roads Unit** and the proper city or county officials (if necessary) if utility work, not originally anticipated, is required during construction. If the utility work is eligible for reimbursement and the **City/County** wants federal aid, the **City/County** should contact the **Urban Design Engineer** or the **Government Affairs Manager**. The **District Project Manager** will coordinate with the utility involved to expedite the utility work to minimize delays to the construction contractor.

6.D Utility Accommodation on State Highway Right-of-Way

Utilities are permitted to occupy public highway right-of-way at the discretion of **NDOT**. On state highways, **NDOT** is responsible for regulating utility right-of-way occupancy. All requests to place utilities within state right-of-way are submitted to the **Utilities Unit**. See a Policy for Accommodating Utilities on State Highway Right-of-Way, (Ref. 13.21), (http://roads.nebraska.gov/media/6872/utilaccom.pdf) for additional information.

Any underground utility facility that crosses a drainage course within the right-of-way must be installed a minimum of 4 ft. (1.2 m) below the flow line of the drainage structure or drainage course, whichever is lower. Underground utility lines that cannot be installed with minimum cover due to

natural conditions or conflict with other utilities may be required to protect the lines with suitable bridging, concrete slab, casing or other appropriate means. Utility route and line markers shall be placed on the right-of-way line identifying the name, address, and telephone number of the utility owner in case of emergency.

6.D.1 Aerial Lines

Aerial electrical power and communication lines constructed within the public right-of-way must be constructed in accordance with the current National Electric Safety Code (Ref. 13.22). The alignment of the overhead lines shall be as near the right-of-way line and parallel to the highway centerline as is practicable, ignoring minor irregularities in the right-of-way line. Joint use of utility poles is encouraged to avoid placing additional poles within the right-of-way. All poles and anchors shall conform to the following horizontal clearances:

1. In rural areas, all rigid poles and anchors must be located beyond lateral obstacle clearance, right-of-way permitting, (See Nebraska Minimum Design Standards, Ref. 13.23), (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/). If sufficient right-of-way is not available, **NDOT** may require the use of breakaway design or a regrading of the right-of-way.
2. On urban or suburban highways with 45 mph (70 km/h) or lower speed limits and rural cross-sections, all rigid poles and anchors shall be located at least 15 ft. (4.5 m) from the edge of the traveled way, preferably near the right-of-way line.
3. On city, town and urban highways with curbed sections, rigid poles and anchors may be located at the back of the sidewalk or at a minimum of 6 ft. (1.8 m) back of the curb where feasible.
4. Exceptions to these clearances may be made where curbside parking is permitted or where poles and anchors can be placed at locations behind guardrails, beyond deep ditches or on top of high banks, or at other similar locations that would not present additional hazards to the traveling public.

Poles located closer than the limits shown above should contain breakaway bases or other breakaway characteristics to permit the pole to collapse upon sharp impact or should be shielded. If poles are in urban conditions with high pedestrian traffic, breakaway bases should not be used (See the Roadside Design Guide, Ref. 13.24).

The following vertical clearances for utilities above the traveled way are required:

1. Aerial lines with 750 volts or less shall have a minimum clearance of 18 ft. (4.5 m) above the traveled way (the minimum clearance shall be measured from the high point of the roadway, including the turf shoulders).
2. Installation of aerial lines within and crossing public highway right-of-way and having 750 or more volts of electrical power shall comply with the regulations in Ref.12.6 for vertical clearances and conductor sizes.

Longitudinal utility occupancy inside the fenced right-of-way of an interstate or freeway is considered only as a "last resort" when no other feasible route can be followed by the utility facility or when such utility facility exclusively serves a highway facility. Specific details for each installation will be determined at the time the utility occupancy is authorized.

New aerial installations should be avoided at scenic locations and will be considered only if installation in alternative locations is unusually difficult and unreasonably costly, where installing the line underground is not technically or economically feasible, or if the installation can be made in such a manner that adequate attention to the visual qualities of the area will be addressed.

6.D.2 Underground Electrical Power and Communication Lines

Underground electrical power and communication lines constructed within highway right-of-way shall conform to the current electrical safety regulations (National Electric Safety Code, Ref. 13.22) and the current Nebraska Standard Specifications for Highway Construction (Ref.13.25), (http://roads.nebraska.gov/media/6897/specbook-2007.pdf)

- In villages and cities, the preferred location of parallel underground electrical power and communication lines installation is near the right-of-way line. They may be installed under the shoulder, however this may cause possible conflicts with future construction.
- On highways in villages and cities without sufficient right-of-way or a suitable location for underground lines outside of the traveled way, lines may be placed under the surfacing if it is determined to be in the best interest of the traveling public.
- Installations of underground electrical power and communication lines may occupy a position near the toe of the fill slope or the top of back slope if insufficient right-of-way exists or if topography prohibits placement near the right-of-way line. **NDOT** shall designate the specific location of such facilities and any additional conditions concerning the right-of-way occupancy.
- All manholes shall be placed outside of the traveled way where possible, and shall not protrude more than 4 in. (102 mm) above the surrounding ground or shall comply with the horizontal clearances listed in Section 6.D.1.
- Underground electrical power and communication lines within right-of-way with large cut and fill sections shall be placed at or near the toe of the fill or top of back slope.
- Installation of underground electrical power and communication lines under the traveled portion of an existing highway must be performed by jacking, tunneling or dry boring from the toe of the fill slope to the toe of the opposite fill slope.
- The utility shall be placed at a minimum depth of 4 ft. (1.2 m) below the bottom elevation of the parallel road ditch or, in the absence of ditches, the minimum depth of cover of 3 ft. (0.9 m) below the elevation of the natural ground. Additional cover may be required to protect the traveling public.
- In areas with scenic designation, new underground utility installations may be permitted where they do not require extensive removal or alteration of trees or other natural features visible to the highway user or do not impair the visual quality of the lands being traversed.

6.D.3 Pipelines

Pipelines include sewer, water, gas, petroleum products, chemicals and irrigation lines. Approved materials for the construction of pipelines shall include cast iron, ductile iron, steel pipe with protective coating, vitrified clay, concrete, specially treated concrete, composite pipe (truss pipe), copper pipe and flexible pipe with some restrictions. Pipeline and casing construction within highway right-of-way shall conform to current appropriate standards.

- The preferred location of pipeline installation parallel to the highway is near the right-of-way line.
- Installations within villages and cities may require the use of shoulders or driving lanes and should take into consideration the provisions discussed for underground electrical and communication lines in Section 6.D.2.
- Where insufficient right-of-way or topographic features prevent pipeline installation near the right-of-way line, pipelines may be installed near the toe of the fill or top of back slope at locations designated by **NDOT**.
- Pipelines located within right-of-way with large cut or fill sections shall be placed at or near the toe of the fill or top of back slope.
- All manholes and shutoffs shall be placed outside of the traveled way where possible, and shall not protrude more than 4 in. (102 mm) above the surrounding ground or shall comply with the horizontal clearances listed in Section 6.D.1.
- The minimum depth of earth cover over pipelines shall be 3 ft. (0.9 m) unless polyvinyl chloride (PVC) pipe is used. PVC pipelines carrying liquids shall be installed a minimum depth of 5 ft. (1.5 m). PVC pipelines carrying natural gas shall be installed a minimum depth of 3 ft. (0.9 m), however additional cover may be required.
- Backfill of pipeline trenches shall conform to the standard specifications (Nebraska Specifications for Highway Construction, Ref. 13.25).
- All pipelines attached to structures shall be placed in a neat manner beneath the structure's floor and inside of the outer girders or beams or in cells specifically designed for the installation.

6.D.4 Water Mains

Water mains shall be laid at least 10 ft. (3 m) horizontally from any existing or proposed storm sewer, sanitary sewer, or sanitary sewer force main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10 ft. (3 m) separation, the **Nebr. Dept. of Health** may allow deviation on a case-by-case basis, if supported by data from the designer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer or at such an elevation that the bottom of the water main is at least 18 in. (0.45 m) above the top of the sewer.

Water mains crossing storm sewers, sanitary sewers, or sanitary sewer force mains shall be laid to provide a minimum vertical distance of 18 in. (0.45 m) between the outside of the water main and the outside of the sewer. This shall be the case whether the water main is above or below the sewer. At crossings, one full length of water pipe shall be located so that both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required.

The **Nebr. Dept. of Health** must specifically approve any variance from the requirements of these instructions when it is impossible to obtain the specified separation distances. Where sewers are being installed and these instructions cannot be met, the sewer materials shall be water main pipe or equivalent and shall be pressure tested to ensure water tightness.

Water pipe shall not pass through or come into contact with any part of a sewer manhole. For additional information see Recommended Standards for Water Works, (Ref. 13.26), (http://www.leafocean.com/test/10statepreface.html).

7. REFERENCES

13.1 National Environmental Policy Act of 1969: 42 U.S.C. 4321-4347, 23 CFR 771 Environmental Impact and Related Procedures, 40 CFR 1500-1508 Council on Environmental Quality Regulations. (https://ceq.doe.gov/)

13.2 Nebraska Department of Transportation, Design Process Outline, Current Edition. (http://www.roads.nebraska.gov/media/6761/design-process-outline.pdf)

13.3 Section 4(f), U.S. Department of Transportation Act of 1966. (http://environment.fhwa.dot.gov/4f/index.asp)

13.4 Section 6(f), Land Water Conservation Fund Act. (http://www.fhwa.dot.gov/wadiv/envir/section6f.cfm)

13.5 Clean Water Act of 1977, 33 U.S.C. 1251 et seq. (http://water.epa.gov/lawsregs/guidance/wetlands/sec404.cfm)

13.6 Nebraska Department of Transportation, Drainage Design and Erosion Control Manual, Current Edition. (http://www.roads.nebraska.gov/business-center/design-consultant/rd-manuals/)

13.7 Section 10, Rivers and Harbors Act of 1899, 33 U.S.C. 403, as amended and supplemented, 33 CFR 114-115. (http://water.epa.gov/lawsregs/guidance/wetlands/sect10.cfm)

13.8 U.S. Department of Transportation, Federal Highway Administration, "Procedures for Coordinating Highway Encroachments on Floodplains with Federal Emergency Management Agency." (http://environment.fhwa.dot.gov/guidebook/vol1/doc6d.pdf)

13.9 "The Floodway: A Guide for Community Permit Officials," Federal Emergency Management Agency.

13.10 Executive Order No. 11988: Floodplain Management (as amended by Executive Order 12148). (https://www.hsdl.org/?abstract&did=463236)

13.11 Executive Order No. 11990: Federal Wetlands. (https://www.epa.gov/cwa-404/protection-wetlands)

13.12 U.S. Department of Transportation, Federal Highway Administration, "Location and Hydraulic Design of Encroachments on Flood Plains, "Federal Aid Policy Guide, Volume 6, Chapter 7, Section 3, Subsection 2. (https://www.gpo.gov/fdsys/pkg/CFR-2011-title23-vol1/pdf/CFR-2011-title23-vol1-part650-subpartA.pdf)

13.13 Safe Drinking Water Act: 42 U.S.C. 300f, 300h and 300j-6, 23 CFR 650, Subpart E. (http://www.epa.gov/safewater/sdwa/sdwa.html)

13.14 The Clean Air Act: 23 U.S.C. 109(1) as amended, 42 U.S.C. 7401-7428. (http://www2.epa.gov/laws-regulations/summary-clean-air-act)

13.15 American Association of State Highway and Transportation Officials, A Policy on the Geometric Design of Highways and Streets, Washington, DC., 2011.

13.16 American Association of State Highway and Transportation Officials, A Design Guide for Wildlife Protection and Conservation for Transportation Facilities, 1976, Washington, DC.

13.17 Section 106, National Historic Preservation Act as amended: 16 U.S.C. 470f. (http://www.achp.gov/nhpa.html)

13.18 Resource Conservation and Recovery Act of 1976 (RCRA) as amended: 42 U.S.C. 6901, 40 CFR 260-271. (http://www4.law.cornell.edu/uscode/42/ch82.html)

13.19 Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended: 42 U.S.C. 9601-9657 (http://www4.law.cornell.edu/uscode/42/ch103.html)

13.20 Nebraska Department of Transportation, "Utility Rehabilitation Negotiations," Operating Instruction 45-1, December 17, 1993.

13.21 Nebraska Department of Transportation, Policy for Accommodating Utilities on State Highway Right-of-Way, Current Edition. (http://roads.nebraska.gov/media/6872/utilaccom.pdf)

13.22 Institute of Electrical and Electronic Engineers, Inc., National Electric Safety Code, New York, NY.

13.23 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards, Current Edition. (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/)

13.24 American Association of State Highway and Transportation Officials, Roadside Design Guide, Washington, D.C., 2011.

13.25 Nebraska Department of Transportation, Standard Specifications for Highway Construction, 2007. (http://roads.nebraska.gov/media/6897/specbook-2007.pdf)

13.26 Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, Recommended Standards for Water Works, 2003 (http://www.leafocean.com/test/10statepreface.html)

The information contained in Chapter Fourteen: Traffic, dated October 2016, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this chapter.

Chapter Fourteen presents guidance for the design of new and reconstructed projects; design guidance for 3R projects is provided in Chapter Seventeen. This chapter replaces Chapter Fourteen: Traffic Engineering, dated July 2006. This chapter was approved by the Nebraska Division of the FHWA for use on the National Highway System and other federal projects on October 19, 2016.

Chapter Fourteen
Traffic

1. TRAFFIC ENGINEERING STUDIES

The **Traffic Engineering Division** (**Traffic Engineering**) is responsible for conducting a variety of studies, which are summarized in the following sections. The roadway designer is responsible for requesting information from **Traffic Engineering**.

1.A Capacity Analysis

The principal objective of capacity analysis is to estimate the amount of traffic that can be accommodated by a given set of geometric features and to provide metrics for comparison of alternatives while maintaining a desired level of service. For example, this information can be used to determine whether improvements are needed or not. If so, the information can be further utilized to evaluate alternative geometric configurations. The designer should confirm with **Traffic Engineering** that the design typical section and alignment contained in the Planning Document provides the intended capacity and level of service for the project (See Chapter One: Design Criteria, Section 12.A, and Chapter Four: Intersections, Driveways and Channelization, Section1.C.1).

1.B Safety Analysis

A safety analysis uses factors such as crash history, traffic volume data and roadway configuration to predict the future performance of the roadway in terms of crash frequency and severity. A safety analysis may be used to determine the extent of project improvements, which may include:

- Roadway geometry
- Intersection improvements
- Shoulder width
- Rumble strips/stripes
- Superelevation rates
- Roadside improvements
- Roadside barrier installation/retention
- Speed limits
- Auxiliary lanes

A safety analysis may be used in evaluating the expected average crash frequency under both existing and proposed conditions. This evaluation may be assessed with other considerations such as, but not limited to, capacity, right-of-way costs and environmental impacts, aiding the designer in focusing project resources in areas which are in the greatest need of improvement thereby maximizing the efficient expenditure of **Nebraska Department of Transportation**, federal, and local funding.

1.C Volume Studies

Traffic volume studies are conducted to determine the levels of traffic along highways or at intersections during specified time periods (e.g. annual average daily traffic (ADT), peak hour traffic). Traffic study results are used to recommend the appropriate design standard and for planning, capacity analysis, accident rate analysis, and for other studies as needed.

1.D At-Grade vs. Interchange Recommendations

Traffic Engineering assists in the development of recommended interchange types and designs to be considered where two or more roadways intersect (at-grade intersection, interchange, roundabout or other alternatives). For additional information see Chapter Four: Intersections, Driveways and Channelization, Section 1.

1.E Weaving Section Analysis

Traffic Engineering analyzes weaving sections where traffic entering and exiting a roadway facility will cross paths. The length and number of lanes necessary in a weaving section are determined using capacity analysis techniques.

1.F Lane Configuration

Auxiliary lanes may be provided for left turns, right turns, or free flow right turns as recommended by **Traffic Engineering**. The length of the turn lane is typically determined by a combination of storage length and deceleration/taper requirements. Storage needs are often developed through a capacity analysis while deceleration/taper is typically obtained from design guidance documents. Turn lane length should be verified with **Traffic Engineering** (See Chapter Four: Intersections, Driveways and Channelization, Section1.D).

1.G Traffic Control Studies

Traffic control determination is the responsibility of **Traffic Engineering**. Recommendations for traffic control devices at intersections are made with regard to the type of traffic control necessary (none, yield sign, stop sign, or traffic signal) (See the Manual on Uniform Traffic Control Devices for Streets and Highways (*MUTCD*), Ref. 14.1, and the State of Nebraska, Supplement to the Manual on Uniform Traffic Control Devices, Ref. 14.2, http://www.roads.nebraska.gov/business-center/contractor/mutcd/). If traffic signalization is recommended, **Traffic Engineering** will also develop the traffic signal design. For additional information, see Section 4 of this chapter and Chapter Four: Intersections, Driveways and Channelization, Section 1.E.

1.H Pedestrian Crossings

Pedestrian crossings are used to facilitate the movement of the walking public and/or bicyclists across highways, railroad tracks, and rivers or streams. Warrant analysis for mid-block pedestrian crossings are the responsibility of **Traffic Engineering**. The roadway designer will coordinate the design of the pedestrian crossing with the design of the highway, sidewalk/bikeway/shared-use path, railroad crossing, or bridge. For additional information, see Section 4.A of this chapter, Chapter Four: Intersections, Driveways and Channelization, Section 1.C.10, and Chapter Sixteen: Pedestrian and Bicycle Facilities, Section 7.

2. ROADWAY SIGNS

Roadway signs are used to regulate traffic operations by advising/informing motorists of roadway rules, hazards, or function. These signs are provided to promote efficient vehicle operation on highways. Signing should be considered as an integral part of design and should be designed concurrently with the geometry of the roadway. The designer will submit a preliminary alignment design to **Traffic Engineering** at "Preliminary Roadway Design", Activity 5300, Clarity Task Code 5336 (See the Design Process Outline (*DPO*), Ref. 14.3) (http://www.roads.nebraska.gov/business-center/design-consultant/).

Supports for highway signs are considered as obstacles to motorists. The supports should be crashworthy or shielded if they are inside the horizontal clear zone or they should be located outside of the horizontal clear zone (See Chapter Six: The Typical Roadway Cross-Section, Section 9.A).

Traffic Engineering determines the need for overhead signs. Although the roadway designer does not design the signs, the designer will confirm that overhead signs are included in the cost estimate for the project and will verify that the locations of overhead signs meet horizontal and vertical clearances as defined in the Nebraska Minimum Design Standards (*MDS*), Ref. 14.4 (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/) and in Chapter Three: Roadway Alignment, Section 3.D.

3. MARKINGS

Markings are an integral part of roadway design and should be designed concurrently with the geometry of the roadway. There are three general classifications of markings: pavement markings, object markers, and delineators.

Pavement markings are line markings such as center lines, edge lines, lane lines, parking lines, cross walk lines and other symbols and legends. The designer will consider the location of pavement markings when creating pavement jointing diagrams for Portland Cement Concrete pavement (See Chapter Eight: Surfacing, Section 2.A.2); the joints should be in the same location where the markings will be to provide positive guidance to the driver when the markings may be difficult to see. The roadway designer will submit a preliminary jointing diagram to **Traffic Engineering** for review as soon as the alignment and roadway geometry are designed during "Functional Design", Activity 5400, Clarity Task Code 5428 (See the *DPO*, Ref. 14.3).

Object markers warn of physical obstructions within or adjacent to the roadway that pose an obstacle to motorists such as piers, bridge abutments, flumes, and culvert headwalls. Object markers may warn of roadside conditions, such as abrupt changes in alignment or the end of a roadway.

Delineators are retroreflective devices mounted at the side of the roadway. They are used to guide traffic, especially at night. The units are installed at specified heights and spacing to delineate changes in the roadway. Designers are responsible for determining the locations, spacing, and quantity of the delineators for a project and should refer to the Standard/Special Plans Book (*Standard Plans*) (Ref. 14.5) (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/) for information concerning location and spacing of delineators. The designer should discuss the lateral offset distance of the delineators with **District** on the plan-in-hand; the offset determines the length of the delineator post which impacts the item cost.

4. TRAFFIC SIGNALS

Traffic signals are used to direct conflicting movements of vehicles and/or pedestrians by assigning the right-of-way to various movements at different times. The design of traffic signals and signal timing is the responsibility of **Traffic Engineering** and should be coordinated with the design of the intersection geometry. **Traffic Engineering** may recommend the installation of conduits and loops for future work. Refer to Chapter Four: Intersections, Driveways and Channelization, Section 1.E.2, for additional information concerning the coordination of signal design with intersection design.

4.A Pedestrian Signals

Warrant analysis for pedestrian crossing signals, as outlined in the *MUTCD* (Ref. 14.1), is the responsibility of **Traffic Engineering**. For further information, see Section 1.H of this chapter.

Accessible pedestrian signals are devices that provide non-visual guidance for those with visual disabilities. They are not routinely installed on signal projects, but can be installed upon request and the completion of an engineering study determining their need. The engineering study generally includes a discussion of need and locations with the requesting party. If pedestrian signals are installed on a project the designer should account for any project impacts such as the need for additional right-of-way for signal poles and pavement sawing, removal and replacement for the installation of detection conduits.

5. INTELLIGENT TRANSPORTATION SYSTEM

An Intelligent Transportation System (ITS) uses technology (e.g. traffic sensors, traffic cameras, computers, modern communications) to collect and analyze transportation data such as traffic flow, traffic speed, crashes, and other information. This information is sent to a control center where traffic control and enhancement strategies (such as anti-icing systems, signal timing or alternate routes) may be developed using real-time data. The strategy may then be transmitted to the driving public through such methods as message boards, radio announcements, GPS systems, self-driving cars, and other communication methods. The effective use of ITS may enhance the transportation system in many ways including reduced congestion, improved traffic flow, reduced crash potential, drivers alerted to adverse road conditions, improved efficiency of public transportation, a reduction in fuel usage and a reduction in air pollution. An efficient transportation system may also negate or delay the need for the expensive construction of additional traffic lanes.

In accordance with 23 CFR 940.11, “Project Implementation”, (http://www.ecfr.gov/cgi-bin/text-idx?rgn=div5&node=23:1.0.1.11.50) (Ref. 14.6) all ITS projects funded with highway trust funds shall be based on an engineering systems analysis. This analysis should be on a scale commensurate with the project scope.

When a project impacts existing ITS elements (e.g. cutting the power, moving the device, damaging the system), the designer will coordinate with the **Operations Division** to verify that the project includes sufficient plans, provisions, and right-of-way to place the elements back to working order. This may include in-pavement systems into new pavement construction and/or sawing pavement for a retro-fit of the system. New ITS deployments are the responsibility of the **Operations Division**. For additional information see Intelligent Transportation Systems and Systems Engineering Process Document (Ref. 14.7).
(http://www.transportation.nebraska.gov/operations/pdfs/ne-its-se-process-doc.pdf)

6. WORK ZONE TRAFFIC CONTROL

Traffic Engineering is responsible for developing a traffic control plan (TCP) consisting of warning signs, markings, channelization devices or other methods. The roadway designer will address construction-sequencing issues and coordinate the development of the traffic control plan with **Traffic Engineering** as early as possible in the design process.

When preparing roadway and construction phasing plans, the roadway designer should consider:

- The use of a detour versus construction under traffic
- The delay cost of a detour
- The capacity of a detour or temporary road to handle the expected traffic around or through the construction zone
- If the detour/temporary roadway geometry will meet or exceed minimum guidelines
- Roadside safety and clear zone requirements
- The constructability of the phasing
- The economic costs to users and adjacent property owners and businesses
- Community and social impacts, local festivals
- The maintenance of access to adjacent property owners

6.A Construction Under Traffic

The majority of projects will be built under traffic, when practicable. It may be necessary to encroach upon travel lanes, shift lanes, or even close lanes during construction. The frequency and length of time that traffic must be routed through the construction zone should be kept to a minimum and adequate warning will be provided to motorists.

The roadway designer should consider construction sequencing and the maintenance of traffic during construction throughout the entire design process. The following items should be considered and provided for in the design of a project that is to be built under traffic:

- Provide a minimum of four feet for worker protection (two feet for barrier width and a two feet clear space behind the barrier). Consult with **Traffic Engineering** regarding the barrier layout.
- Taper lengths for lateral lane transitions and lane drops should meet or exceed the minimums set by the *MUTCD* (Ref. 14.1).
- Day and night sight distances should meet or exceed the minimums presented in **AASHTO's** A Policy on Geometric Design of Highways and Streets (*Green Book*) (Ref. 14.8).

Often road improvements such as milling, armor coat, asphalt surfacing, and shoulder work will require the closing or partial closing of travel lanes on highways during construction. On highways of four lanes or more this may simply involve reducing the number of lanes in each direction so construction work can be completed or in the closing of two of the directional lanes (e.g. the eastbound lanes), shifting the traffic to the other lanes in an opposing traffic configuration by the construction of crossovers (See Section 6.A.1 of this chapter). On two-lane highways this may involve such methods as closing one lane and using a flagger to direct traffic through the construction, the use of stop signs, yield signs, temporary signals, or other methods as the

situation allows. **Traffic Engineering** will recommend the type of traffic control that is suitable. On roadways with high traffic volumes it may be practicable to schedule construction at night, closing the roadway and detouring traffic to another route. The roadway designer will coordinate with the **Construction Division** and with **Traffic Engineering** regarding the construction schedule (day or night) and the number of lanes that will be open to traffic.

6.A.1 Crossovers

Crossovers are used on multi-lane divided highways to temporarily route traffic across the median to the opposite lanes so that construction can progress on the vacated side. Additional earthwork needed to construct the crossovers will be included in the earthwork quantities (See Chapter Seven: Earthwork, Section 2). Single lane crossovers should be designed with 16 feet lane widths. The crossover pavement quantities will be included in the cost estimate and paid for separately (See Chapter Twelve: Cost Estimating & Funding, EXHIBIT 12.8).

6.A.2 Temporary Surfacing

Additional temporary surfacing may be needed during different phases of construction for lane or shoulder widening, property entrances, etc. These surfacing quantities will be included in the cost estimate and paid for separately (See Chapter Twelve: Cost Estimating & Funding).

On new and reconstructed projects with major grading involving disrupted accesses the designer should discuss the use of gravel, crushed rock, or millings with the **District** on the plan-in-hand field inspection. These materials may be used to provide temporary access to adjacent properties during construction (See Chapter Twelve: Cost Estimating & Funding, EXHIBITS 12.5 & 12.8).

6.B Temporary Roads

In certain situations (e.g. the construction of culverts) it may be more practicable to construct a short route around the work zone than to build the project under traffic or to utilize a detour (See EXHIBIT 14.1). The following considerations apply in the design of a temporary road:

Right-of-Way - Right-of-way should be adequate to construct the temporary road or an easement will be acquired.

Design Vehicle – The temporary road should be designed using the same design vehicle as the project (See Chapter Four: Intersections, Driveways and Channelization, Section 1.C.5).

Design Speed – As a rule-of-thumb, the design speed for the temporary road should be 10 mph less than the existing posted speed.

Sight Distance – Stopping sight distance and intersection sight distance will be based on the design speed of the temporary road. The designer should pay particular attention to sight distance where there is a combination of horizontal and vertical curves. For additional information see Chapters 3 and 9 of the *Green Book* (Ref. 14.8).

Typical Section - Typical temporary road sections are shown in EXHIBIT 14.2.

Grades – Grades will be designed based on the temporary road design speed, the maximum allowable grade is 10% (See Chapter Three: Roadway Alignment, Section 3.A).

Transitions – Traffic may be moved between the main roadway and the temporary road by the use of tapers, curves, or a combination of the two.

1. CURVES – Horizontal curves should be designed according to the design speed of the temporary road. High-speed temporary roads (V ≥ 50 mph) should be designed according to the e_{max} = 6% superelevation table found in Chapter Three: Roadway Alignment, EXHIBIT 3.4c. Low-speed temporary roads (V ≤ 45 mph) should be designed in accordance with **FIGURE 3-14** of the *Green Book* (Ref. 14.8), using a relative gradient of 185:1.

   See Chapter Three: Roadway Alignment, Section 2.A, for information on the design of horizontal curvature.

2. TAPERS – Taper rates between 29:1 (2°) and 11:1 (5°) are allowed. A 20:1 taper rate is recommended.

Lateral Clearance to the Work Zone (Buffer Space) - The distance required between the centerline of a temporary road section and the project centerline will be determined on a case-by-case basis. Factors affecting the required width of this space include construction clearances, side slope geometry, and temporary drainage requirements.

When a temporary road is required adjacent to bridge construction/reconstruction, the highway designer will coordinate with the **Bridge Division** (**Bridge**) regarding the lateral offset of the temporary road to the bridge (See EXHIBIT 14.2) and the required size of the drainage structure(s) needed to handle the water flow or the use of a temporary bridge structure.

Drainage - Existing drainage patterns will be maintained to prevent flooding of the existing roadway and surrounding properties. Drainage structures needed to construct the temporary road will be included in the cost estimate and any required connection bands will be added to the build notes and cost estimates. If temporary drainage pipe is to be retained by the **District** they should be consulted regarding the pipe lengths and diameters that can be used when the pipe is salvaged.

The designer should pay particular attention to the drainage of the temporary road surface where there is a combination of horizontal and vertical curves.

Earthwork - Earthwork quantities for temporary roads will be included in the project earthwork calculations. Temporary road material will be placed as embankment and removed as excavation, specified for the temporary road. Construction phasing and material location should be considered in the earthwork quantities, verify that material is available for the construction of the temporary road.

Surfacing - The **District** will determine the type of surfacing for each temporary road at the plan-in-hand inspection. The following considerations should be kept in mind:

- Pavement used to construct the temporary road will be structurally adequate to handle expected traffic.
- Pavement used to construct the temporary road will be estimated for the same quantity items as for the main roadway (See Chapter Twelve: Cost Estimating & Funding, EXHIBIT 12.8) and will be included in the pavement quantities.
- If gravel surfacing is used, gravel embedment is required.

The roadway designer will do the preliminary calculations. The following individuals will calculate the final quantities, depending on the type of temporary road surfacing to be used:

Temporary Road Surfacing Type	Final Quantity Calculations by:
Concrete	Roadway Designer
Asphaltic Concrete	**M&R**
Gravel & Gravel for Embedment	Roadway Designer
Embedment of Gravel	**M&R**
Calcium Chloride	**M&R**

Traffic Engineering – The designer will submit the temporary road design, including design speed, to **Traffic Engineering**. Pavement markings and signals needed to construct the temporary road will be determined by **Traffic Engineering** and included in the cost estimate.

Erosion Control – Temporary erosion control measures will be required for temporary road construction. Temporary erosion control methods may be found in Chapter Two: Erosion and Sediment Control, Section 5, of the Drainage Design and Erosion Control Manual (*Drainage Manual*) (Ref. 14.9) (http://roads.nebraska.gov/business-center/design-consultant/rd-manuals/). The designer will review the temporary road design with the **Roadside Stabilization Unit** in the **Project Development Division**.

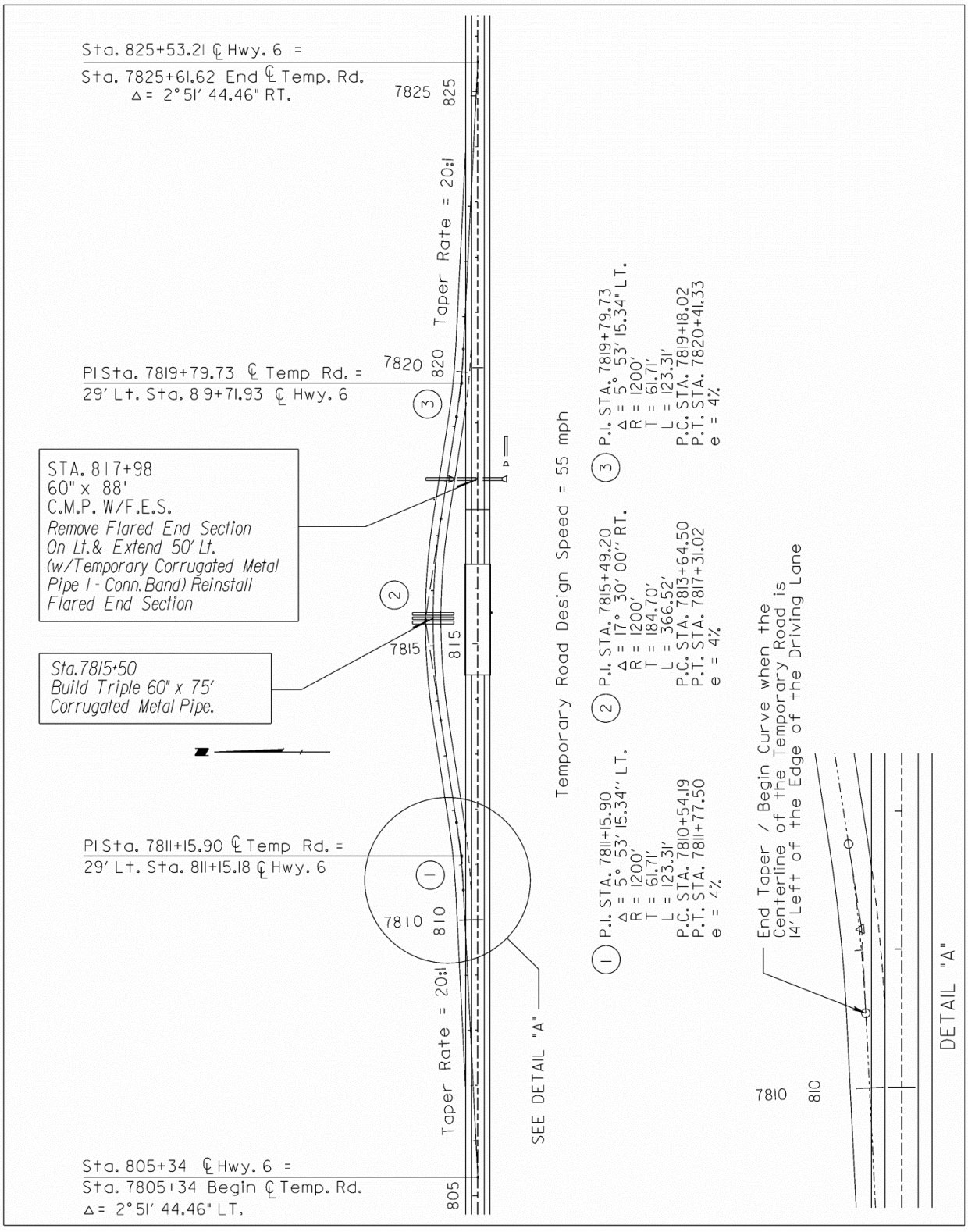


Exhibit 14.1 Example Temporary Road

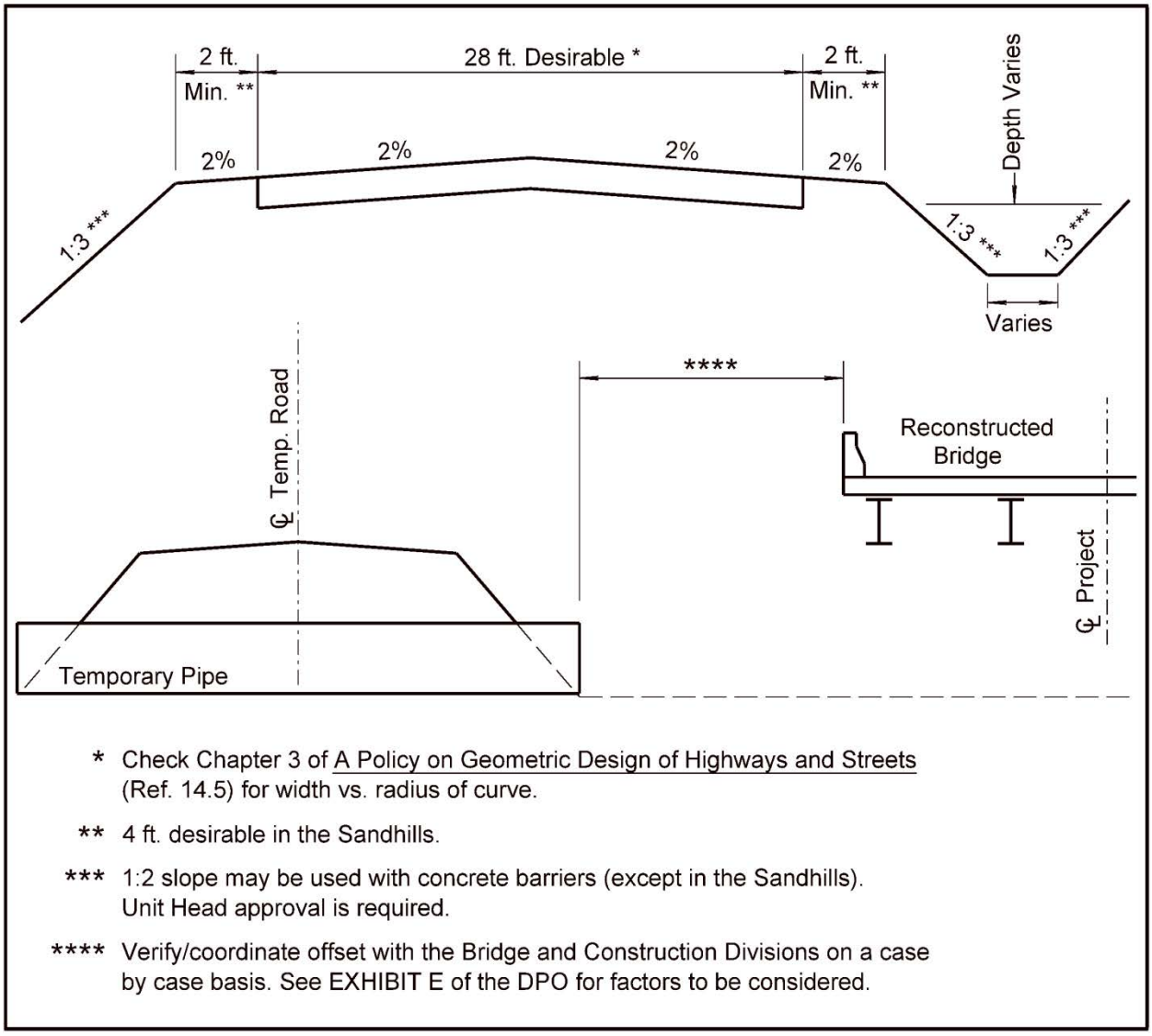


Exhibit 14.2 Typical Temporary Road Section

6.C Detours

Detours may guide traffic around construction zones outside of the project limits. A detour is a signed route within an existing roadway system that is appropriate for the intended traffic and the intended duration. The detour route(s) should be determined prior to the plan-in-hand for NEPA review and processing.

The following items should be considered in determining if a detour route is feasible and should be verified at the plan-in-hand:

- The delay cost of the detour; the designer should coordinate with the **Final Plans Coordinator** in the **Construction Division**.
- Existing road(s) will be able to handle the expected volumes of traffic generated by the proposed detour. The roadway designer will design any required improvements to the detour roadway and/or intersection geometry.
- The bridges on the detour route shall be structurally adequate for the expected traffic composition. The roadway designer will coordinate bridge/bridge size structures on the detour route with **Bridge**.
- The existing pavement(s) shall be structurally adequate to handle the expected traffic volumes; the roadway designer will coordinate with the pavement engineer in the **Materials and Research Division** regarding necessary surfacing improvements.
- Environmental considerations/impacts along the detour route.
- The detour route should be a reasonable length, not requiring the motorist to travel too far from the normal route.
- The impact of the detour route on the operation of businesses, both along the project route and the detour.
- Local access will be provided to residents and businesses.
- The impact of the detour route on emergency vehicle operations.
- The impact of the detour route on school bus routes and schedules.
- Railroad crossings on the detour route; railroad crossing upgrades, crossing signals, and agreements with the railroad company will be coordinated with the **Intermodal Planning Division**.

The **District Operations & Maintenance Manager** should be consulted at the plan-in-hand about the feasibility of maintaining the detour during construction.

The roadway designer will coordinate the detour route selection and any improvements with the **District** and with all impacted **Divisions**/**Units** (e.g. **Bridge**, **Project Development**, **Construction**). The roadway designer will submit the proposed detour route to **Traffic Engineering** for review.

The selected route may require temporary geometric and surfacing improvements to handle the intended detour traffic. Pavement needed for detour improvements is paid for under a separate pay item group; the designer will compute quantities of surfacing and other construction items required for the detour improvements (See Chapter Twelve: Cost Estimating and Funding, EXHIBIT 12.5).

If roads other than state highways are proposed for use as a detour a signed agreement must be obtained from the appropriate governing agencies. The agreement will outline the surfacing, geometric, and other improvements to be accomplished and will depict the detour route. The **City/County** should be contacted early in the design process, informing them about the proposed detour route(s) and requesting information regarding local construction projects or special events (e.g. parades, local festivals) that will affect the choice and/or allowable time frame of a detour route. Proposed detour routes will be addressed at public meetings. See the *DPO* (Ref. 14.3), Activity 5300, Clarity Task Code 5350 and **EXHIBIT C** and Chapter Thirteen: Planning and Project Development, Section 5.A, for additional information.

7. REFERENCES

14.1 United States Department of Transportation Federal Highway Administration, Manual on Uniform Traffic Control Devices for Streets and Highways (*MUTCD*), Washington, D.C., 2009. (http://www.roads.nebraska.gov/business-center/contractor/mutcd/)

14.2 State of Nebraska, Supplement to the Manual on Uniform Traffic Control Devices, 2011 (http://www.roads.nebraska.gov/business-center/contractor/mutcd/)

14.3 Nebraska Department of Transportation, Design Process Outline (*DPO*), Current Edition. (http://www.roads.nebraska.gov/business-center/design-consultant/)

14.4 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards (*MDS*), Current Edition. (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/)

14.5 Nebraska Department of Transportation, Standard/Special Plans Book (*Standard Plans*), Current Edition. (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/)

14.6 Title 23 of the "Code of Federal Regulations", Chapter I – Subchapter K – Part 940 (23 CFR 940.11) (http://www.ecfr.gov/cgi-bin/text-idx?rgn=div5&node=23:1.0.1.11.50)

14.7 Nebraska Department of Transportation, Intelligent Transportation Systems and Systems Engineering Process Document, May 18, 2015 (http://www.transportation.nebraska.gov/operations/pdfs/ne-its-se-process-doc.pdf)

14.8 American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets (*Green Book*), Washington, D.C., 2011.

14.9 Nebraska Department of Transportation, Drainage Design and Erosion Control Manual, Current Edition (http://roads.nebraska.gov/business-center/design-consultant/rd-manuals/)

The information contained in Chapter Fifteen: Right-of-Way, dated July 2006, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this chapter.

Chapter Fifteen
Right-of-Way

This chapter provides guidance to the roadway designer regarding issues associated with the design and acquisition of right-of-way. Refer to the Right-of-Way Manual (Reference 15.1), (http://www.roads.nebraska.gov/media/5012/row-manual.pdf), for additional right-of-way information.

1. RIGHT-OF-WAY (R.O.W.) SURVEY

Whenever a proposed highway improvement requires the acquisition of easement rights and/or the purchase of additional land for construction purposes a right-of-way survey will be required. The **Survey Coordinator** in the **Geodetic Surveys Section** of the **Project Development Division** determines which projects need to have a right-of-way survey. Information used to determine whether or not a right-of-way survey is required includes:

- The Highway Improvement Programming Request DR Form 73, provided by the **Project Scheduling and Program Management Section**.
- The Initial Project Data DR Form 333 and the Project Data Revision DR Form 334, which are initiated by a request from the **District Engineer**.
- The Engineering Review Report, which is provided by either **Project Development** or **Roadway Design**.
- Additional input from the **Right-of-Way Design Engineer**.
- Additional input from the **District Engineer**.

Preliminary survey parties assigned to the project, assisted by the **Deputy State Surveyor**, make a right-of-way survey in conjunction with the roadway design survey. The two surveys then are combined into a single set of preliminary survey notes. The ultimate goal for all projects is the accurate completion of right-of-way surveys in a timely manner to allow for completion of the right-of-way Ownership Plans for the public hearing.

2. RIGHT-OF-WAY DESIGN PLANS

The **Right-of-Way Design Section** is responsible for the coordination and preparation of the following right-of-way design plans:

1. **Corridor protection plans** - Corridor protection plans generally are prepared in advance of other design activity for projects in areas of potential development. These plans are often aerial sheets from corridor study reports. Ownerships and the protected corridor are shown on the plan. Plans are filed with the **County**, and **NDOT** is notified before any preliminary subdivision plat or building permit is approved.
2. **Ownership Plans** – Ownership plans are prepared prior to the plan-in-hand activity. Preliminary survey, topography, land lines, previous right of way, previous controlled access, property lines and ownership data are shown on the Ownership Plans.
3. **Preliminary ROW Design** – Proposed limits of construction (LOC's) are added to the Ownership Plans and right-of-way is designed, along with any permanent or temporary easements, and permanent or temporary railroad easements and rights of entry or occupation areas as needed. These plans are used in the Preliminary ROW Plan Review, (See the Design Process Outline (*DPO*) (Ref. 15.8), Activity 5600, Clarity Task Code 5610).
4. **Appraisal Plans** – The changes made during the Preliminary ROW Plan Review are shown, areas of taking(s) are computed, legal descriptions are written and summarized on the right-of-way plans summary of areas sheet. The Appraisal Section and others use the resulting Appraisal Plans. The appraiser may request a plan review with the roadway designer using the appraisal plans.
5. **Negotiation Plans** – Following preparation of the right-of-way contracts, the Appraisal Plans are updated to reflect any changes made during appraisal. The negotiators use the resulting Negotiation Plans when dealing with property owners.
6. **Finalized Half-Size Plans** - After the right-of-way property deeds are recorded in the county **Register of Deeds Office**, the plans are checked and modified to reflect the properties which were acquired. Plans are then half-sized and filed in the **Right-of-Way Division**.

A more detailed description of these plans is presented in the following sections.

2.A Corridor Protection Plans

Highways in areas that have the potential for development prior to a planned highway improvement will be reviewed for corridor protection. Corridor protection is a procedure whereby **NDOT** notifies the appropriate local government agencies and the general public of the intent to acquire right-of-way along a highway corridor. Corridor protection is designed to allow **NDOT** to review proposed development that may occur adjacent to the selected highway corridor, minimizing acquisition costs and reducing or eliminating development impacts to the highway project.

The **Right-of-Way Division** has the responsibility for establishing corridor protection on state highways and notifying the public that corridor protection has been filed. If there is a need for corridor protection, a recommendation will be made by the **Project Development Division, Roadway Design Division, Right-of-Way Division**, or the **District**. If a corridor hearing is held

and a relinquishment is involved, the relinquishment agreement must be signed before project corridor approval is presented to the **Highway Commission**, (See Section 7.E).

For projects on existing alignment for which it is deemed necessary to file corridor protection, a strip 300 ft. (100 m) wide will be designated on both sides of the existing right-of-way. In the case of projects on a new alignment, a strip 400 ft. (120 m) wide on both sides of the proposed centerline will be designated for corridor protection. These widths are guidelines only and may vary depending on the terrain and roadway design standard. Applicable projects will have corridor protection procedures initiated after the project concept and alignment have been defined.

When a property owner files a preliminary subdivision plat or a request for a building permit in an area with corridor protection, the local zoning authority informs the owner that **NDOT** has filed corridor protection and that the preliminary plat cannot be approved or that the permit cannot be issued unless **NDOT** releases the corridor protection. **NDOT** has two months to approve or disapprove the request after notification by the local authority. If **NDOT** disapproves the request it has six months to negotiate and acquire the necessary right-of-way. If **NDOT** has not acquired the right-of-way within six months, the local authority can issue an approval of the preliminary subdivision plat or the building permit. See Revised Statutes of Nebraska, Chapter 39, Section 39-1311 (http://nebraskalegislature.gov/laws/statutes.php?statute=39-1311.02) and the Nebraska Dept. of Roads Operating Instruction 60-9, "Corridor Protection", (Appendix B, "Selected NDOT Operating Instructions), for additional information about corridor protection.

2.B Ownership Plans

The **Right-of-Way Design Section** begins the right-of-way design process with the production of a set of plans that depict preliminary survey, topography, current ownerships, property lines, and previous right-of-way in the area of the project. The plans are reproduced and forwarded to **Roadway Design** for use in public hearings.

The following items are used in the creation of Ownership Right-of-Way Plans:

- The sheet files from **Roadway Design** provide the base plan layout, (coordinate the base plan layout with the **Right-of-Way Design Section** at Meeting "A", see the current CADD Policy, http://www.roads.nebraska.gov/business-center/design-consultant/).
- The right-of-way survey provides section corners, quarter-section corners and lot corners.
- Title research provides a five-year record of ownership.
- Previous right-of-way and controlled access is researched by reviewing old plans, deeds, railroad maps, railroad leases and city plats.

Ownership Plans are prepared prior to the plan-in-hand activity during "Preliminary Roadway Design", Activity 5300, Clarity Task Code 5350 (See the *DPO*, Ref. 15.8). It is desirable that the ownership plans be available for the project plan-in-hand inspection.

2.C Preliminary Right-of-Way Design

The roadway designer should submit the following items to **Right-of-Way Design** for their use in designing right-of-way for the project:

- Typical sections.
- 2-A sheets with alignment plotted.
- Final Design plans (Activity 5500, Clarity Task Code 5508) with limits of construction, (See the *DPO*, Ref. 15.8).
- Cross-sections.
- Culvert cross-sections.
- Access Control letter, if applicable (See Section 3).
- Identify the locations where the **Roadway Design Division** has identified and promised the extent of right-of–way to be purchased (e.g. from information meetings, meetings with property owners, in the release of corridor protection).

Possible conflicts with pivot irrigation systems should be investigated during Roadway Design (Activity 5500). A review of the design and pivot damages will be made at the Preliminary ROW Plan Review.

2.C.1 New Right-of-Way Design

Right-of-way will be designed using the following guidelines:

1. Design urban right-of-way about 2 ft. (0.6 m) behind the sidewalk to allow space for utilities.
2. Design rural right-of-way about 10 ft. (3 m) behind limits of construction in low cuts.
3. Design rural right-of-way about 20 ft. (6 m) behind limits of construction in high fills and high cuts.
4. Designers should try to minimize the impact of damages to irrigation pivots, wells, homes, yards, windbreaks and utilities.
5. Easements will be used where appropriate.
6. Design widths along reconstructed county roads should be tighter (0-10 ft. (0-3 m) behind limits of construction) than design width along state highways. On long county road relocations, right-of-way should be designed parallel and at a uniform offset from the centerline.
7. A standard break in controlled access is 40 ft. (12 m) wide. For intersections and anywhere else where it is desirable to have an access break opening wider than 40 ft. (12 m), access control should have an end station and a begin station (See Section 3).
8. Right-of-way shall be acquired to or beyond the lateral obstacle clearance.
9. When right-of-way is designed at the beginning and ending of a project, and either of those points are within the limits of an individual ownership, consideration should be given to acquiring right-of-way through the ownership for future connecting projects so that the owner will not have to be contacted again.

Normal right-of-way widths have been established by the **Board of Public Roads Classifications and Standards** and approved by **FHWA** (See the Nebraska Minimum Design Standards, Reference 15.2), (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/). Sound engineering judgment should be used to obtain a balance between right-of-way costs and widths.

2.C.2 Permanent Easements

It is generally desirable to purchase land for the highway. However, sometimes a permanent easement should be considered. In the case of a permanent easement **NDOT** has rights to a parcel of land for a specific purpose while the land remains in private ownership and will be taxed. The owner may fence the land or do with it whatever he/she chooses as long as it does not conflict with the purpose of the permanent easement. A permanent easement usually damages the land because it restricts the land use. Some examples of permanent easement uses are to:

- Build and maintain embankments, dikes, retaining walls, drainage structures, etc.
- Channel relocations and required buffer strips, (See Chapter Thirteen: Planning and Project Development, Section 4.B.6).
- Provide access to two or more adjacent properties.
- Minimize impact on adjacent property.
- Maintain a uniform right-of-way width.

2.C.3 Temporary Easements

Temporary easements permit the use of private property for a time period not to exceed the duration of the project. Temporary easements typically will be used when construction activities must take place outside of the area that is needed for the highway. Temporary easements are requested for:

- Site clearing (e.g., removal of a structure, such as a granary, that is bisected by the right-of-way line. Please note that a special provision should be written to provide that the contractor will remove both the structure and the foundation.).
- Culvert, channel, ditch cleanout.
- Borrow pit or excess material disposal.
- Replacement of existing driveways or building new driveways.
- Build, maintain and remove temporary roads.
- Build sewers or inlets that drain water from private property (e.g., an inlet in a private parking lot).
- Shaping (e.g., to blend in fill or cut in urban areas where the slope is 4:1 or flatter).

2.C.4 Railroad Easements, Rights or Leases

NDOT normally does not acquire land from railroads in fee. All land required at crossings or which is parallel to the highway will normally be acquired in the form of an easement, right of entry, right of occupation, or lease.

2.C.5 Preliminary ROW Design Review

When the preliminary right-of-way design is completed, it is sent to the **Roadway Design Unit Head** for review and coordination. The roadway designer then schedules a Preliminary ROW Plan Review to coordinate the right-of-way design and to identify potential right-of-way impacts, (See the *DPO* (Ref. 15.8), Activity 5600, Clarity Task Code 5610). After this meeting the Appraisal Plans are prepared.

2.D Appraisal Plans

The preparation of Appraisal Plans involves the actual design of the project right-of-way. These plans should be representative of the proposed right-of-way takings needed for construction. Two inputs are necessary for Appraisal plans: Ownership Plans and the limits of construction. The major steps undertaken by **Right-of-Way Design** at this stage are:

1. Receive (reference) the project design and limits of construction.
2. Design the right-of-way, referenced to the project centerline.
3. Design control of access.
4. Review the design and coordinate with **Roadway Design**.

Following approval of the right-of-way design, areas of all takings are computed and the metes and bounds legal descriptions are written. Appraisal Plans show the right-of-way design and stations/offsets. The **Utility Unit** in **Roadway Design**, **Railroad Liaison** in the **Intermodal Planning Division**, and appraisers use the Appraisal Plans.

Station and offset to utilities will not be shown on right-of-way plans until the Appraisal Plan stage. The roadway designer should not change DTM Alignment after the Appraisal Plan stage.

2.E Negotiation Plans

Negotiation Plans reflect any changes made to the Appraisal Plans as a result of the appraisal process. Right-of-way negotiators use Negotiation Plans to explain the offers to purchase right-of-way to landowners. If agreement cannot be reached with a landowner on an amount to settle, the **State of Nebraska** will file a condemnation to acquire the right-of-way. On all projects, all right-of-way required for the project should either be acquired and paid for or condemned and paid for prior to advertising a project for bid letting.

2.F PS&E Plans

When the roadway designer is ready to take plans to the **Plans, Specifications and Estimates Unit (PS&E)** for review, he/she should request a reproducible set of right-of-way design plans and a right-of-way certificate, (See Section 6). Right-of-way plan revisions following submittal to **PS&E** will be coordinated with the **District, Roadway Design, PS&E, Roadway Design Utilities Unit,** and others involved.

2.G Revisions

Right of way plan revisions may be made during any stage of development but most often occur during the Appraisal and Negotiation stages. As per revision process documented July 2, 1997, the requesting individual will notify the **Right of Way Design Engineer** and/or **Roadway Design Division** of possible conflict and concerns. The appraiser or negotiator will also report back specific suggestions or questions from the landowner and will ask the designer to review (and change if possible or necessary) the design related to the questions. Some change requests and/or revisions may also be brought to the **Roadway Design Division** through the **District Engineer**. Requests for right-of-way plan revisions must be formal and should include a transmittal letter and plan sheets showing the changes. A recommended right-of-way design offset or easements should be shown if applicable. Requests for plan revisions should be sent to the **Right-of-Way Design Engineer**. The following design or plan changes should be coordinated with **Right-of-Way Design**:

- Updated topography.
- Revised culvert design.
- Revised driveway design or location.
- Revised alignments.
- Revised limits of construction.

Final right-of-way plans are completed only after all land is purchased.

3. ACCESS CONTROL

Access control is a restriction of the number and location of access points, (intersections, driveways and field entrances), along a highway. Access control along a highway reduces interruptions in the traffic flow, increasing the efficiency and safety of the facility. Typically, access rights will be acquired on all:

- Interstates.
- Freeways.
- Expressways and other multi-lane divided highways.

Access control will be considered on all other highways when:

- The 20 year forecast traffic (ADT) is 3,001 or greater, as shown on the current 20 Year Forecast Traffic Map (See Chapter One: Design Standards, Section 6.A).
- The route is within the present or projected two mile (3.0 km) zoning limits of cities of the first class (population 5,000 to 99,999) and within the present or projected three mile (5.0 km) zoning limits of primary (population 100,000 to 299,999) and metropolitan class cities (population more than 300,000).
- There are 3 miles (5.0 km) or less between the interstate and the connecting or parallel highway.
- The development of any major highway, particularly where mobility is important.

The degree of access control should be balanced between three essential public functions: access to property, travel mobility and motorist safety.

By statute, (Revised Statutes of Nebraska, Chapter 39, Section 39-1302, Paragraph (9), Reference 15.3), (http://nebraskalegislature.gov/laws/statutes.php?statute=39-1302), **NDOT** may acquire, in public or private property, such rights of access as are deemed necessary, including but not necessarily limited to air, light, view, egress and ingress. The **State of Nebraska** cannot condemn property from one owner to provide access to property for another owner if the owner to be served by the access already has another access to his/her property. This is the case no matter how inconvenient the existing access may be or if the existing access is only a right-in, right-out situation because of median restrictions.

For additional information on access control and on the access control project review procedure, refer to the Access Control Policy to the State Highway System, (Reference 15.4), (http://www.roads.nebraska.gov/media/3460/access-control-policy.pdf).

3.A Access Control Design

There are currently two types of driveway classification: access and future access. Access locations identified, but not built as part of the highway project, shall be designated as future access. Access should be provided for each property along a project to provide for possible future development.

At the time that the access points are designed, existing entrances may be removed or relocated to connect to the designed access locations as a part of the highway project. **NDOT** shall be responsible for constructing the entrances at the designed access locations as a part of the project. **NDOT** will not construct the access locations referred to as future access. Driveways at the quarter-section line will typically be "joint drives" and will provide access to two or more properties. EXHIBIT 15.1 is an example of the typical permanent easement acquired for a joint access.

The roadway designer shall designate access locations for a project during “Preliminary Design”, (See the *DPO* (Ref. 15.8), Activity 5300, Clarity Task Code 5350). This may be accomplished by:

1. Obtaining relevant information from the **District Engineer** and others.
2. Reviewing the zoning, existing and future land use.
3. Conducting a field examination.
4. Giving consideration to intersection sight distance, natural barriers, property lines, the development of future frontage roads and traffic signal spacing.

All property adjacent to the highway project must be permitted access to a public road, unless the project results in the abutment of property that previously did not have direct egress and ingress to the highway. If a parcel is "landlocked" and access cannot be provided economically, the parcel may be purchased as part of the right-of-way taking.

If a roadway has previous controlled access, and access is being revised as part of a current project, some items to consider are:

- When providing an access (unrestricted) to a property that previously had restricted access, the property may be considered enhanced. The potential for enhancement will be considered during appraisal. Typically **NDOT** has no obligation to provide access rights other than what presently exists. A decision to provide enhanced access shall be justified.
- When access is restricted to a property that previously had unrestricted access, it is likely the property value has been damaged. **NDOT** appraisers will consider these damages before acquisition.

Once the roadway designer is prepared to make recommendations about acquiring access control, he/she should contact the **Highway Right-of-Way Associate** in the **Property Management Section** of the **Right-of-Way Division** and request to be put on the agenda for the next available access control meeting. The designer should present to the **Control Access and Permit Review Committee** his/her recommendations for or against acquiring access rights and should be able to support the recommendations. The roadway designer should provide an aerial photo with property lines and locations of access sites that meet the policy for the **Committee’s** review and approval.

The **Committee** reviews the project as part of the functional design review to determine access control. The **Committee's** decision is based on the following considerations:

- Traffic count.
- Highway classification.
- Safety of persons using the highway.
- Preservation of the public's investment in the existing highway.
- Effect of vehicles using the access point on the traffic-carrying capability of the highway.
- Existing sight distance.
- Highway alignment and configuration.
- Volume and speed of traffic on the highway at the proposed access point.
- Traffic volumes generated by the development served by the access and extent to which improvement to the highway facilities by persons requesting access will mitigate adverse effects caused by the access point to the highway.
- Closure or relocation of existing access points.
- Moving the new access to a property line for a joint-use drive.
- Conformance of proposed development to zoning regulations.
- Dedication of right-of-way for future public streets to provide for the orderly development of the property abutting the highway.

The roadway designer shall be responsible for preparing the CA (control access) Letter, which indicates the decisions made by the **Control Access and Permit Review Committee**.

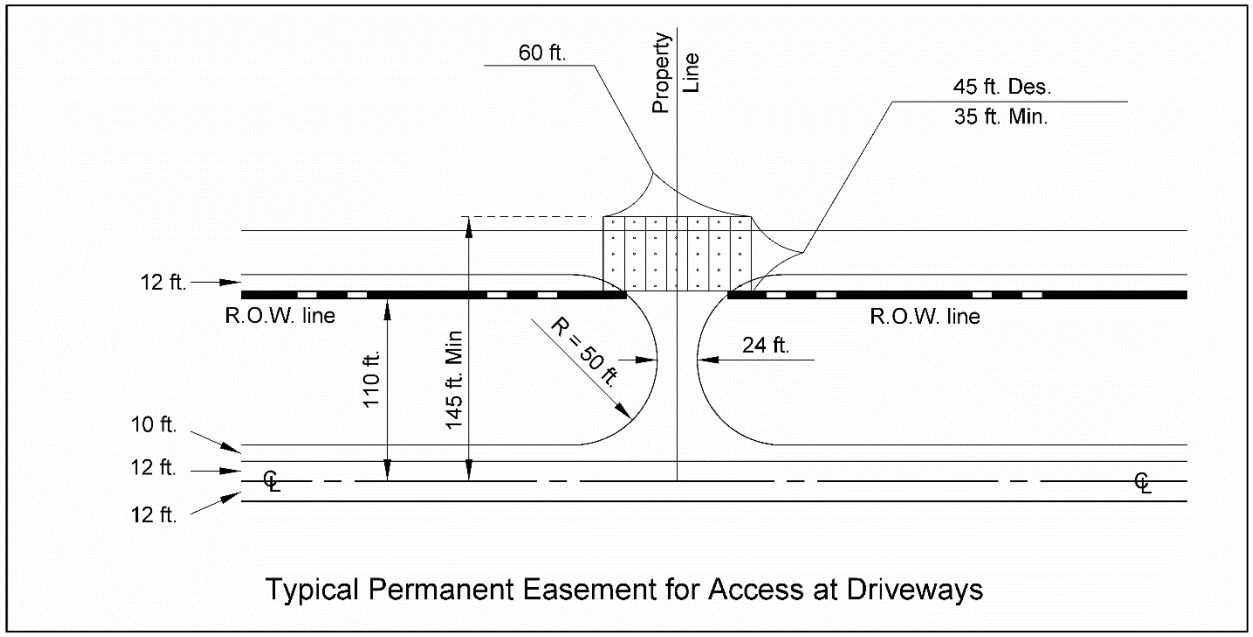


Exhibit 15.1 Typical Access Control at Joint Driveways

3.B Access Control on the Interstate and Freeways

The interstate and freeway systems are divided highways for through traffic with full control of access and no at-grade intersections. Access to the facility is allowed only at interchange locations. Access control should be acquired a minimum of 660 ft. (200 m) beyond the interchange terminal, (See EXHIBIT 15.4).

3.C Access Control on Expressways and Other Four-Lane Divided Highways

An expressway is a divided highway for through traffic with full or partial control of access, generally with grade separations at intersections. An expressway highway is, or will ultimately be, a four-lane divided highway with interchanges at major intersections and at-grade intersections at designated minor public road intersections.

Selected public road intersections will be permitted at-grade. At-grade access from abutting property to the expressway at approved points will also be considered and allowed as noted in the Access Control Policy to the State Highway System, (Reference 15.4). In rural areas and in undeveloped urban areas, desirable spacing is no more than one access per mile (1.6 km) with 2,000 ft. (610 m) as the minimum distance between access locations (See EXHIBIT 15.2). Maximum allowable spacing is no more than three access locations per mile (1.6 km) with 1,000 ft. (305 m) between access locations. The maximum allowable spacing should be used only for access to landlocked parcels or farmsteads.

Desirable spacing for expressways in developed urban areas will consolidate access locations. Access locations should be no closer than two blocks. Maximum allowable spacing should also consider consolidating access locations and may match the existing street system and/or development. If possible, an access location on one side of the highway should be located opposite access on the other side of the highway.

3.D Access Control on All Other Highways

In rural areas, spacing of access locations on all other access controlled highways shall take into consideration all access of the property involved, including that from adjacent county roads or streets. Access locations required to provide reasonable access shall be provided by **NDOT** (See EXHIBIT 15.2).

An effort should be made to consolidate access locations. When consolidating access locations, driveways on one side of the highway should be located opposite the driveways on the other side of the highway. Future access openings should be provided for each property, where warranted, to provide for possible future development.

In undeveloped urban areas, rural rules apply. In developed areas, an effort will be made to consolidate access locations. Future access openings should be provided for each property, where warranted, to provide for possible future development.

Table I				
Expressway and Other Multi-lane Divided Highways **Including Non Multi-lane Highways with future ADT over 6000**				
Area Type	**Desirable Access**		**Maximum Allowable Access***	
	Number of Access Locations per Mile (1.6 km)	**Spacing Between Access Pts.**	**Number of Access Locations per Mile (1.6 km)**	**Minimum Spacing Between Access Points**
Rural and Undeveloped Urban	1	2,000 ft. (610 m)	3	1,000 ft. (305 m)
Developed Urban	Consider consolidation of drives	2 blocks	Consider consolidation of drives	Consider street system and/or development

* Maximum allowable access is no more than three access locations per mile with 1000 ft. (305 m) as the minimum distance between access locations. Minimum spacing should only be used for access to developed properties such as occupied farmsteads, residences, businesses, and land-locked parcels.

Table II				
All Other Controlled Highways				
Area Type	**Desirable Access**		**Maximum Allowable Access**	
	Number of Access Locations per Mile (1.6 km)	**Spacing Between Access Points**	**Number of Access Locations per Mile (1.6 km)**	**Minimum Spacing Between Access Points**
Rural and Undeveloped Urban	3**	1,000 ft. (305 m)	Provide access to all properties **	Consider consolidation of drives
Undeveloped Urban	7**	600 ft. (183 m)	Provide access to ll properties **	Consider consolidation of drives
Urban	Provide access to all properties **	Consider consolidation of drives	Provide access to all properties **	Consider consolidation of drives

** Future access openings should provide for each property, where warranted, to provide for possible future development.

Exhibit 15.2 Desirable and Minimum Access Locations

3.E Access Control on Side Streets and Roads

On projects that include the purchase of access control, access points along intercepting public roads and highways shall be located a sufficient distance from the intersection to avoid conflicts and to improve the efficiency of the highway intersection. Access control shall be extended along these intercepting roads to ensure the proper distance from the intersection remains clear of all intersections, driveways and field entrances.

Access control shall be purchased for a minimum distance of 220 ft. (67 m) along intercepting public roads and for 660 ft. (200 m) along intercepting highways, (See EXHIBIT 15.3). To account for multiple through lanes, turning lanes, and variable median widths this distance shall be measured from the closest edge of the nearest through lane of the mainline, (See EXHIBIT 15.4). **Roadway Design** will calculate these distances in relation to the project centerline and provide the necessary information to **Right-of-Way Design** for the design of the access control.

Skewed intersections will have the access control measured along the centerline of the intersecting roadway from the closest edge of the nearest through lane of the mainline, (See EXHIBIT 15.5). The access control limits will be offset to left and/or right of the intercepting road at this station. Intersections of greater than 15º skew should be evaluated on a case by case basis to determine if the minimum distances should be increased to maintain the integrity of the intersection.

Drives and field entrances along the intercepting roadway shall be placed so that the driveway throat is beyond the access control limits. Exceptions to this policy must have approval of the **Control Access and Permit Review Committee**.

Specific or unusual intersections shall be evaluated on a case-by-case basis, with recommendations brought before the **Control Access and Permit Review Committee** for approval.

3.F Public Notification

The normal public notification and public hearing process should be followed when access is to be affected. There are instances when, even though access control is not changed, access to individual properties may be affected, such as when islands are installed. A public hearing is considered adequate notification if these situations arise. However, if a public hearing is not held, an information meeting should be conducted when four or more properties are affected. If no public hearing is held and if there are fewer than four properties involved, final plans shall be sent to the **District Engineer** who will be asked to contact the property owners and show them the proposed design and its effect on their property.

A Highway Commission Statement shall be prepared for all projects that include new access control, (See the *DPO* (Ref. 15.8), Activity 5400, Clarity Task Code 5434 for additional information).

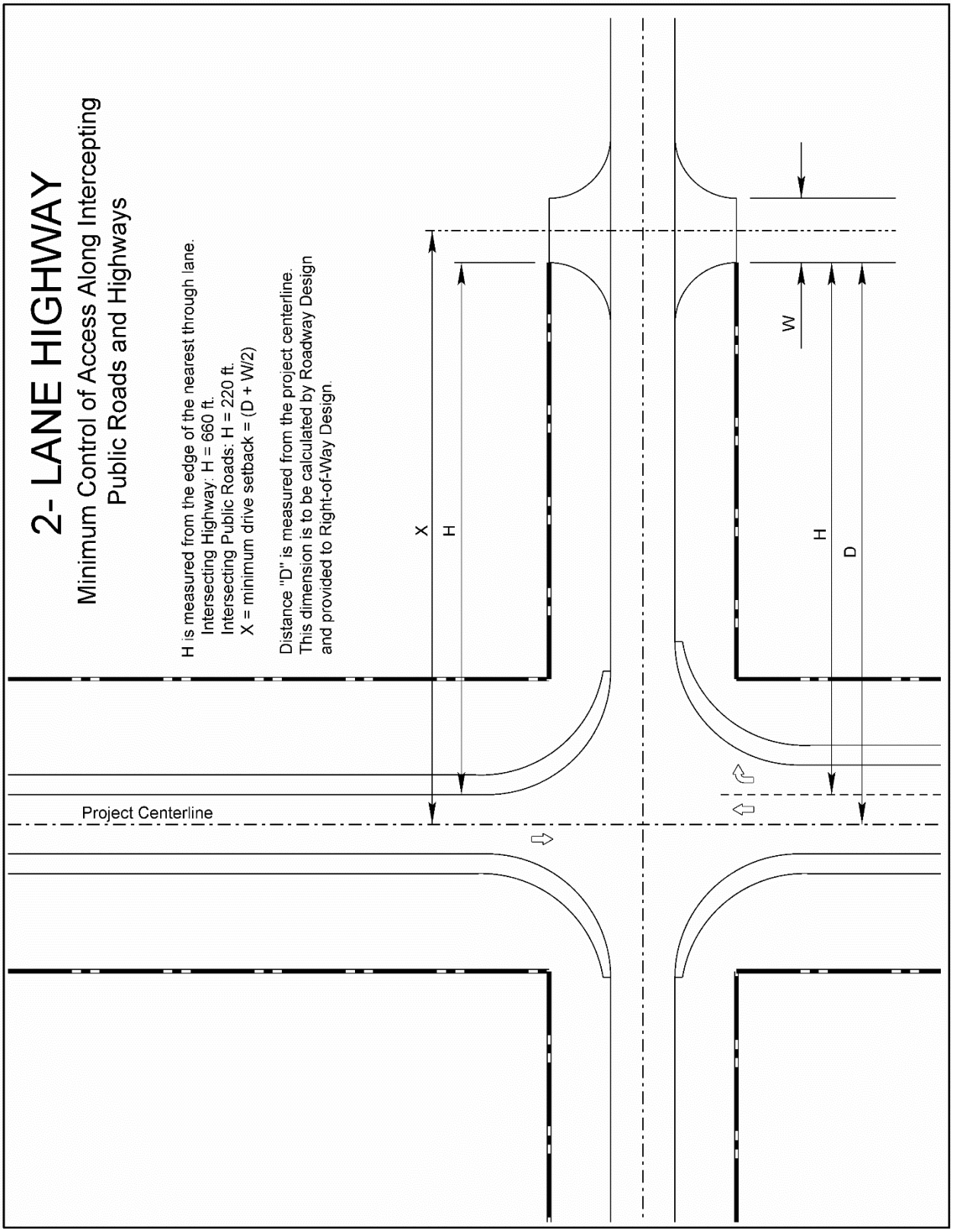


Exhibit 15.3 Control of Access Along Intercepting Public Roads and Highways
2-Lane Highway

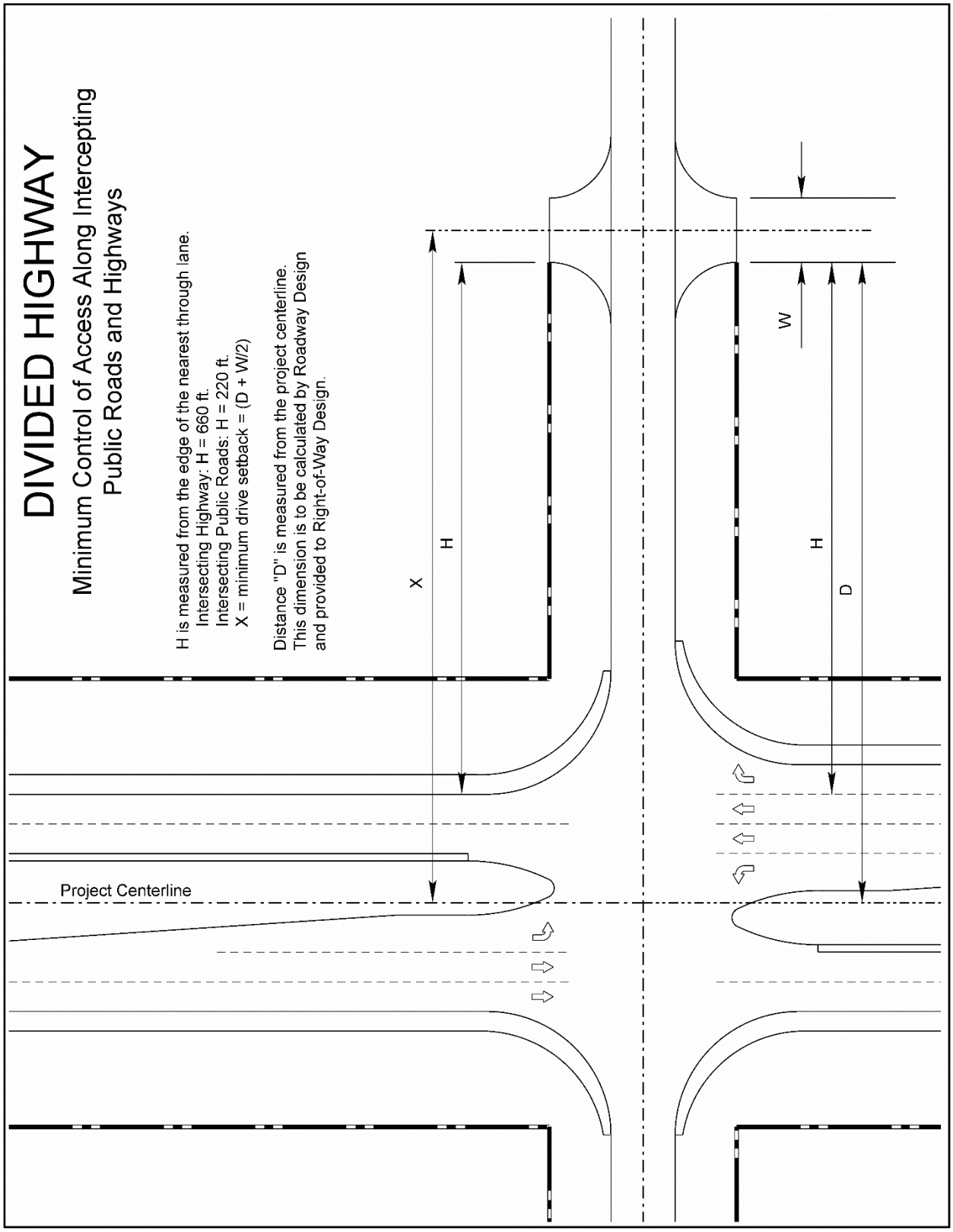


Exhibit 15.4 Control of Access Along Intercepting Public Roads and Highways
Divided Highway

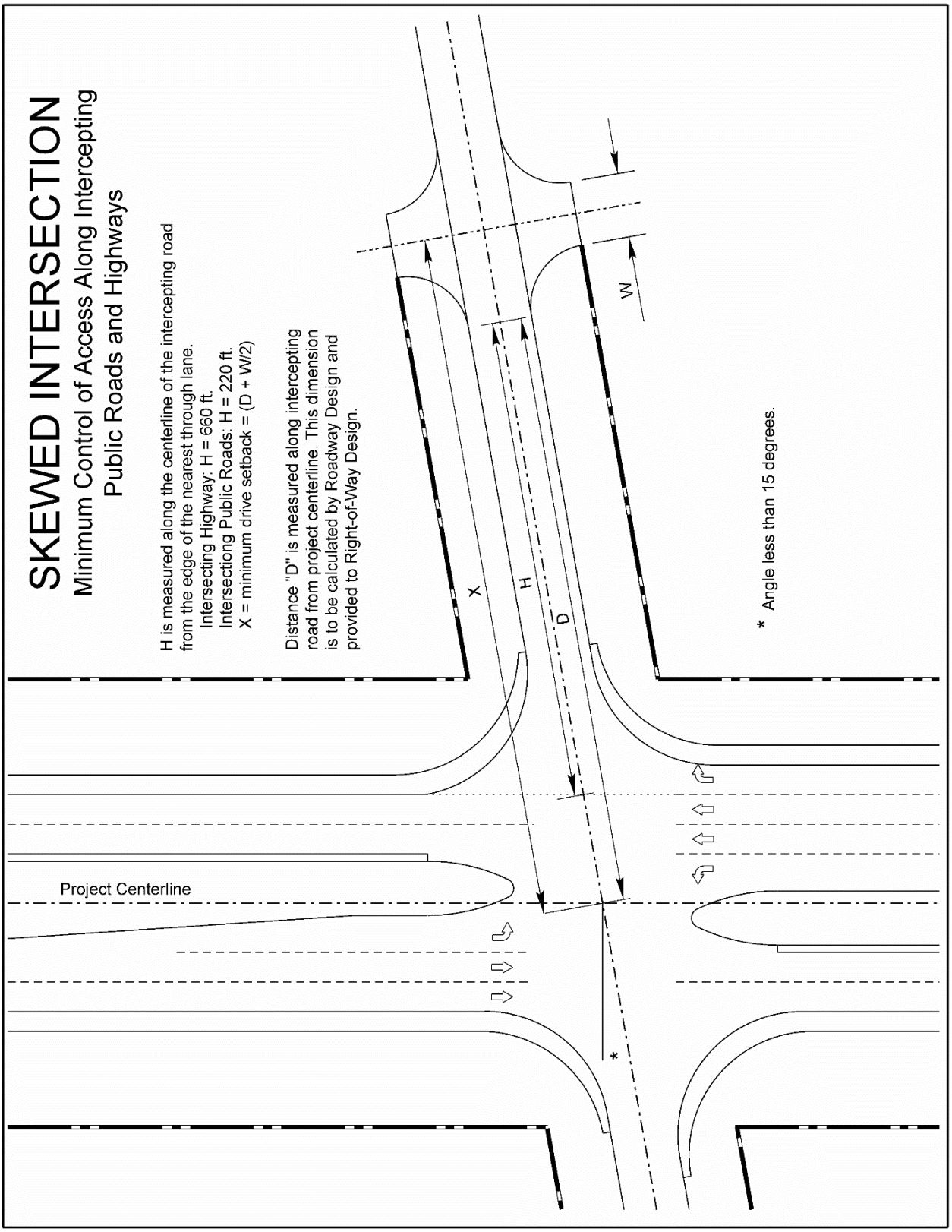


Exhibit 15.5 Control of Access Along Intercepting Public Roads and Highways
Skewed Intersection

4. APPRAISAL

Right-of-way appraisal begins with the Appraisal Plan distribution. On some projects the **Roadway Design Division** will hold an information meeting prior to appraisal and acquisition, which may be attended by appraisers from the **Right-of-Way Division**, (See the *DPO* (Ref. 15.8), Activity 5600, Clarity Task Code 5620). This is a meeting to present plans, right-of-way needs and the appraisal and negotiation process to the public. Public input and suggestions should be reviewed for consideration.

Following this public information meeting, if held, the appraisal process begins. Appraisers are required to meet with landowners where the taking and property damages are estimated to be more than a set dollar amount. Appraisers will notify the roadway designer and/or the right-of-way designer of questions, concerns or suggestions from the landowners concerning the plans.

5. ACQUISITION

The right-of-way agent will contact property owners in person or by mail when property is to be acquired.

5.A Contract Preparation

After appraisals are prepared and reviewed, they are sent to the **Right-of-Way Division Negotiation Section**. Contracts are prepared showing itemized descriptions of the property to be acquired and the dollar value associated with each item. When the contracts to purchase and legal instruments to file are prepared, the **Negotiation Section** notifies the **Right-of-Way Design Section**. The **Right-of-Way Design Section** makes any necessary changes and sends out "tentative final" Negotiation Plans.

5.B Condemnation

If the **State** and the landowner cannot agree on a settlement amount, the negotiator will notify the **Chief Negotiator**. The **Chief Negotiator** will request a condemnation plat from the **Right-of-Way Design Section**. The plat will be prepared and sent to the **Roadway Design Division** for review and coordination.

The roadway designer should review the plat for errors, omissions, or design revisions in the condemnation area. Check the alignment information, the North arrow, the situation sketch, and the county. If there is a possible change on the tract, an error or omission on the plat or a question concerning the plat, the roadway designer shall notify the **Right-of-Way Design Section**. If the plat needs to be corrected, the **Right-of-Way Design Section** will make the required changes.

6. RIGHT-OF-WAY CERTIFICATION

The **Right-of-Way Division**, prior to the advertising letting date of a project, shall furnish a certificate stating either that all of the right-of-way is available to the contractor and clear of improvements, or stating the estimated date when non-complying tracts will be clear and available. The **Property Management Supervisor** shall furnish the factual information for the right-of-way certificate, which shall be signed by the **Right-of-Way Manager**. This certificate is sent to the **Roadway Design Division** and, on federal-aid projects, to **FHWA**.

The **Right-of-Way Design Section** should provide the roadway designer with a listing of all removal items which will appear on the Right-of-Way Certificate during the Review Appraisal Process, approximately three months prior the project letting. For additional information, see the *DPO* (Ref. 15.8), Activity 5700, Clarity Task Code 5790.

6.A Public Interest Letters

All right-of-way should be acquired prior to the project letting date. Sometimes, however, right-of-way acquisition is delayed, e.g., through condemnation proceedings, etc. To maintain project construction schedules, it is sometimes necessary to request special exception from **FHWA** on federally funded projects to proceed with the scheduled letting dates. This request should be in the form of a public interest letter (See EXHIBIT 15.6) that includes:

- Information about the project.
- The status of all right-of-way acquisitions.

This public interest letter shall conform to the requirements of Title 23 CFR 635.309 (b) (http://www.fhwa.dot.gov/real_estate/right-of-way/corridor_management/pdg/pdg13.cfm) and a "Memorandum of Understanding" with the **Federal Highway Administration** (See Appendix C, "Public Interest Letters"). It is very important that all pertinent information be included in this request to avoid additional delay.

The **R.O.W. Division** provides a right-of-way status report to the **Roadway Design Unit Heads** monthly. Roadway designers should use this report when developing a public interest letter. Upon completion of the public interest letter:

1. The **Assistant Design Engineer** will send the public interest letter, through the **Roadway Design Engineer**, to the **Deputy-Director of Engineering** (with a cc to the **Project Scheduling and Program Management Engineer**).
2. When the letter has been approved, the **Deputy-Director of Engineering** will notify the **Roadway Design Engineer**, with a cc to:
    - **FHWA**.
    - The **Contracts Manager**.
    - The **Roadway Design Office Supervisor** (vault/file copy).
    - The **Assistant Design Engineer**.
    - The **P.S. & E. Engineer**.
    - The **Project Scheduling and Program Management Engineer**.
    - The **District Engineer**.
    - The **District Construction Engineer**.
    - The **Right-of-Way Manager**.

On some projects, right-of-way certificates and utility statements are not required because the project does not require additional right-of-way and will not have utility conflicts. The types of projects that do not normally require right-of-way certificates include:

- Armor coat
- Fog seal
- Slurry seal
- Bridge painting
- Aggregate surfacing
- Crack sealing
- Concrete pavement repair
- Joint repair, seeding
- Mill resurfacing

A statement, however, will need to be included in the project proposal that no additional right-of-way is needed and no utility conflicts are anticipated.

NDOR
Nebraska
Department of Roads

Memorandum

DATE October 10, 2002

TO Monty W. Fredrickson, Deputy Director-Engineering

FROM Eldon D. Poppe-Roadway Design Engineer

SUBJECT Project EACSTPD-BR-S40D(102), Prosser North, CN 41987.

I request your authorization under the provisions of Title 23 CFR 635.309(c) and per the Memorandum of Understanding with the Federal Highway Administration dated December 7, 1998, to proceed with the contract letting of Project EACSTPD-BR-S40D(102) on November 14, 2002.

All of the right-of-way required to build this project has not been acquired at this time. The total number of tracts is 7. Tracts 1, 3, 5 and 7 have been paid. Tract 6 has been signed, but not paid. The remaining tract 4 is being negotiated. This taking is for 0.38 acre for $690.00, temporary easement for $660.00 and fence for $1555.00, for a total of $2,905.00.

It is expected that all of the right-of-way will be acquired and physical possession held by the State prior to the project's November 14, 2002 letting date, well in advance of the project's tentative starting date of June 3, 2003. If not, the bid proposal does specify that the contractor will not be allowed to perform work on any tract until legal and physical possession has been acquired by the State. If necessary, the contractor will be granted an extension of time if a delay has been caused because of a tract not being acquired.

The project has been scheduled for 90 working days, with a completion date of Nov. 29, 2003. It is feasible to move this project to a later letting and still begin work on June 3, 2003. However, per our Standard Specifications, the contractor could request an earlier starting date, which gives flexibility to the contractor's schedule of work and potential cost savings. Moving the letting to a later date would eliminate this flexibility and potential cost savings, which is not in the public's interest. Also, moving this project to later lettings, which are already large, necessitates the risk of accepting higher bids, which is not in the public's interest.

I believe it is in the public's interest that this project remain in the November 14, 2002 letting as scheduled, because of the potential cost benefits as described above. I do not believe the significance of the remaining tract necessitates moving the project to a later letting date.

I request your concurrence in this determination.

cc: Randy Needham
Chuck McCann
Claude Oie
Liz Wunderlich
Roger Winkelhake
Eldon Poppe
Barb Engel

Exhibit 15.6 Sample Letter of Public Interest

7. MISCELLANEOUS

7.A Liaison with Local Public Agencies

The **Right-of-Way Design Division** will coordinate with the **Local Public Agency Right-of-Way Coordinator** for right-of-way concerns for off-system projects.

7.B Right-of-Way Markers

Right-of-way markers will be required on most projects. One marker should be set at each of the following points:

- At each point where the right-of-way width changes.
- At each PC and PT.
- At each PI without a curve.
- At such other points required to accurately delineate the right-of-way, but not less than 20 per mile (1 per StaM average).

Where it is undesirable to set concrete right-of-way markers, such as on lot or block lines in an urban area, the concrete markers will be omitted and authorized **NDOT** personnel will place iron pipes or pins.

On projects where the existing right-of-way will be altered, the existing markers should be reset. The summary of quantities should separately identify the quantities of new markers and markers to be reset. Markers should be located so that it is possible for a person standing at one marker to see either adjacent marker.

7.C Re-establishing Land Monuments and Property Corners

When construction disturbs or threatens to disturb existing land monuments or lot corners, and when requested by the landowner or **District Engineer**, the new lot corners and the new right-of-way breaks shall be re-established under the construction contract by a licensed land surveyor hired by the contractor. This work shall consist of establishing new right-of-way breaks where **NDOT** has purchased additional right-of-way and re-establishing property corners on the new right-of-way line where, through work that occurred in the area, the monuments were destroyed.

7.D Access Control Fencing

When access control fencing is specified (as it is on all interstate and freeway projects), the fencing is run along the right-of-way line according to the policy set by the Standard Specifications for Highway Construction, Section 910 (Reference 15.5), (http://roads.nebraska.gov/media/6897/specbook-2007.pdf). The following exceptions and criteria should be kept in mind:

- Where there is a frontage road, the fence is placed between the frontage road and the mainline.
- Access fences should tie into the ends of box culverts or cattle passes.
- Fences should tie into the ends of existing fences and grade separation structures. Where the crossroad runs underneath, fences may run underneath the structure.
- If a portion of a utility line within the right-of-way may be left undisturbed, the access fence may be run inside the utility line so that it can be serviced.
- At all rural interchanges, access fencing should extend 500 ft. (150 m) along the cross road from the ramp termini.

For further information see Chapter Ten: Miscellaneous Design Issues, Section 5.

7.E Relinquishment and Abandonment

When a segment of highway is relocated, the functional classification of the old highway will be changed. **NDOT** will offer to relinquish to the political or governmental subdivision(s) or public corporation(s), any portion of the old state highway that has been relocated. If an offer to relinquish a highway segment is not accepted by the local jurisdiction(s), the **State** may abandon it as provided by law. **NDOT** will relinquish the highway to the local agency after following the approved policy for relinquishment of highways. See Reference 15.6, (http://nebraskalegislature.gov/laws/statutes.php?statute=39-1313), Reference 15.7 (http://nebraskalegislature.gov/laws/statutes.php?statute=39-1314), and Nebraska Dept. of Roads Operating Instruction 60-13, "Relinquishment of Roads from the Highway System", (Appendix B, "Selected NDOT Operating Instructions"), for additional information.

Before the highway is relinquished, the surfacing shall be brought up to the minimum standards of its' new functional classification, (city street, county road, etc.), if necessary. The roadway designer has the responsibility of producing the necessary plans and estimates for any upgrades required before relinquishment, and has the responsibility for the preparation of the exhibits for the public hearing and of the agreements with the local government(s) regarding the relinquishments.

Early acceptance by the local government is important. A signed Covenant Relinquishment Agreement is required before the public hearing. If a public hearing is not held, the signed agreement and petition are needed before presenting the project to the **Highway Commission** for location approval, (See the *DPO* (Ref. 15.8), Activity 5400, Clarity Task Code 5434).

8. REFERENCES

15.1 Nebraska Department of Transportation, Right-of-Way Manual, Current Edition. (http://www.roads.nebraska.gov/media/5012/row-manual.pdf)

15.2 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards, Current Edition. (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/)

15.3 Nebraska Revised Statutes, Section 39-1302, Paragraph (9) (http://nebraskalegislature.gov/laws/statutes.php?statute=39-1302)

15.4 Nebraska Department of Transportation, Access Control Policy to the State Highway System, Current Edition. (http://www.roads.nebraska.gov/media/3460/access-control-policy.pdf)

15.5 State of Nebraska Department of Transportation, Standard Specifications for Highway Construction, 2007. (http://roads.nebraska.gov/media/6897/specbook-2007.pdf)

15.6 Nebraska Revised Statutes, Section 39-1313 (http://nebraskalegislature.gov/laws/statutes.php?statute=39-1313)

15.7 Nebraska Revised Statutes, Section 39-1314 (http://nebraskalegislature.gov/laws/statutes.php?statute=39-1314)

15.8 Nebraska Department of Transportation, Design Process Outline (*DPO*), Current Edition. (http://www.roads.nebraska.gov/media/6761/design-process-outline.pdf)

The information contained in Chapter Sixteen: Resurfacing, Restoration and Rehabilitation, dated February 2016, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this chapter.

Chapter Sixteen presents guidance for the design of new and reconstructed projects; design guidance for 3R projects is provided in Chapter Seventeen. This is a new chapter, replacing Section 10, "Pedestrian and Bicyclist Accessibility" of Chapter Ten: Miscellaneous Design Issues, dated July 2006. This chapter was approved by the Nebraska Division of the FHWA for use on the National Highway System and other federal projects on February 8, 2016.

Chapter Sixteen
Pedestrian and Bicycle Facilities

1. RESOURCE PUBLICATIONS

Pedestrians:

The **Nebraska Department of Transportation** (**NDOT**) will follow the guidance found in the Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (*Proposed Guidelines (2011)*) (Ref. 16.1), issued by the Architectural and Transportation Barriers Compliance Board (http://www.access-board.gov/guidelines-and-standards/streets-sidewalks/public-rights-of-way/proposed-rights-of-way-guidelines). Pedestrian facilities may follow local ordinances, at the **Assistant Design Engineer's** (**ADE's**) discretion, if they meet or exceed the **NDOT** requirements.

Proposed Guidelines (2011) (Ref. 16.1) requirements which the **Roadway Design Engineer** determines are technically infeasible on a project shall be documented in the project's correspondence file with the **Roadway Design Engineer's** signature. The documentation must clearly demonstrate why it is technically infeasible to fully comply with the requirements and that the requirements have been met to the maximum extent practicable. For additional information see the **NDOT** Operating Instruction 60-10, "ADA Accessibility Requirements in Transportation Projects" (Appendix B, "Selected NDOT Operating Instructions").

Bicycles:

For further guidance beyond what is found in this manual the designer should refer to the **American Association of State Highway and Transportation Officials** (**AASHTO's**) Guide for the Development of Bicycle Facilities (Ref. 16.2).

Roundabouts:

Requirements for pedestrian and bicycle access at a roundabout may be found in the *Proposed Guidelines (2011)* (Ref. 16.1). For further guidance the designer should refer to NCHRP Report 672, "Roundabouts: An Informational Guide", Second Edition (Ref. 16.3) (http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_672.pdf).

2. DEFINITIONS

ACCESSIBLE ROUTE – A continuous and unobstructed pedestrian circulation path in the public right-of-way, the various components of which comply with the guidance found in the *Proposed Guidelines (2011)* (Ref. 16.1).

ADA - The Americans with Disabilities Act of 1990 (http://www.ada.gov/), which provides comprehensive civil rights protection to individuals with disabilities in the areas of employment, transportation, public accommodations, state and local government services, and telecommunications.

ALTERATION - Defined by the *Proposed Guidelines (2011)* (Ref. 16.1) as "A change to a facility in the public right-of-way that affects or could affect pedestrian access, circulation, or use. Alterations include, but are not limited to, resurfacing, rehabilitation, reconstruction, historic restoration, or changes or rearrangement of structural parts or elements of a facility."

BICYCLE FACILITIES – Defined by the Manual on Uniform Traffic Control Devices for Streets and Highways (*MUTCD*) as "A general term denoting improvements and provisions that accommodate or encourage bicycling, including parking and storage facilities, and shared roadways not specifically defined for bicycle use."

BICYCLE LANE - Defined by *MUTCD* as "A portion of a roadway that has been designated for preferential or exclusive use by bicyclists by pavement markings and, if used, signs."

BIKEWAY – Defined by *MUTCD* as "A generic term for any road, street, path or way that in some manner is specifically designated for bicycle travel, regardless of whether such facilities are designated for the exclusive use of bicycles or are to be shared with other transportation modes."

BLENDED TRANSITION – Defined by the *Proposed Guidelines (2011)* (Ref. 16.1) as "A raised pedestrian street crossing, depressed corner, or similar connection between the pedestrian access route at the level of the sidewalk and the level of the pedestrian street crossing that has a grade of 5 percent or less."

CROSS SLOPE – Defined by the *Proposed Guidelines (2011)* (Ref. 16.1) as "The grade that is perpendicular to the direction of pedestrian travel."

CROSSWALK - The Nebraska Revised Statutes, Chapter 60 Motor Vehicles defines a crosswalk as:

1. "That part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of such roadway measured from the curbs or, in the absence of curbs, from the edge of the roadway; or
2. Any portion of a roadway at an intersection or elsewhere distinctly designated by competent authority and marked for pedestrian crossing by lines, signs, or other devices."

CURB RAMP - A connection between the pedestrian access route at the level of the sidewalk and the level of the pedestrian street crossing that has a grade which is between 5 percent and 8.3 percent inclusive in the direction of pedestrian travel. Curb ramps can be perpendicular or parallel, or a combination of parallel and perpendicular ramps.

PEDESTRIAN – Defined by *MUTCD* as "A person on foot, in a wheelchair, on skates, or on a skateboard."

PEDESTRIAN CROSSING – A pedestrian crossing facilitates the movement of the non-motorized public (e.g. pedestrians, bicyclists) across highways, railroad tracks, and rivers or streams.

PEDESTRIAN RAMP – A part of an accessible route that has a running slope which is between 5 percent and 8.3 percent inclusive in the direction of pedestrian travel.

PUBLIC RIGHT-OF-WAY - Defined by the *Proposed Guidelines (2011)* (Ref. 16.1) as "Public land or property, usually in interconnected corridors, that is acquired for or dedicated to transportation purposes.

RUNNING SLOPE - Defined by the *Proposed Guidelines (2011)* (Ref. 16.1) as "The grade that is parallel to the direction of pedestrian travel."

SHARED ROADWAY - Defined by *MUTCD* as "A roadway that is officially designated and marked as a bicycle route, but which is open to motor vehicle travel and upon which no bicycle lane is designated."

SHARED-USE PATH - Defined by *MUTCD* as "A bikeway outside the traveled way and physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent alignment. Shared-use paths are also used by pedestrians (including skaters, users of manual and motorized wheelchairs, and joggers) and other authorized motorized and non-motorized users."

SIDEWALK – Defined by *MUTCD* as "That portion of a street between the curb line, or the lateral line of a roadway, and the adjacent property line or on easements of private property that is paved and intended for use by pedestrians.".

TECHNICALLY INFEASIBLE – Defined by the Department of Justice in the 2010 ADA Standards for Accessible Design as "…or because other existing physical or *site* constraints prohibit modification or *addition* of *elements, spaces,* or features that are in full and strict compliance with the minimum requirements." (emphasis original to DOJ) A finding of "technically infeasible" still requires that the element of the pedestrian path in question be built to the minimum applicable standards to the maximum extent possible.

3. BIKEWAYS AND SHARED USE PATHS

The **State of Nebraska** permits bicycles on roadways and roadway shoulders except for the freeway and the Interstate systems.

In some cases, the scope of work of a highway improvement project may include construction of separate bicycle or pedestrian facilities. In many instances design features of separate bicycle facilities are controlled by the adjoining roadway and are an element of the design of the roadway itself. For further information on bicycle facilities, see the Guide for Development of Bicycle Facilities (Ref. 16.2).

SIDEWALK & SHARED USE PATH MINIMUM WIDTHS		
	ON ROW	**ON BRIDGES**
*** SIDEWALK**	Four feet, providing five feet by five feet passing spaces every 200 feet (**NDOT** prefers a continuous five feet width).	Four feet, providing five feet by five feet passing spaces every 200 feet (**NDOT** prefers a continuous five feet width).
**** SHARED USE PATH**	Ten feet Shared use path widths of 11 feet to 14 feet should be used where pedestrian use is ≥ 30% of the total pathway volume and there are 300 total pathway users in the peak hour.	*** Ten feet

* *Proposed Guidelines (2011)* (Ref. 16.1)
** Guide for the Development of Bicycle Facilities (Ref. 16.2)
*** Bridge Office Policies and Procedures (Ref. 16.6)

NOTE: Designers should check municipal ordinances in regard to sidewalk and bikeway width requirements. This check is for information; the **NDOT** is not required to design to local ordinances; however, the **NDOT** may design to the local ordinance as long as it meets minimum guidance and the additional work is accomplished at the municipality's cost.

Exhibit 16.1 Sidewalk and Shared Use Path Minimum Widths

4. SIDEWALKS

The need for sidewalk should be considered during the preliminary design of a project. The final determination regarding the need to include sidewalk in a project will be made at the plan-in-hand inspection, giving consideration to the input of the local governing authority and public. Items to consider in determining the need for sidewalk to be included in the project are:

- When sidewalk currently exists along a roadway, non-compliant sidewalk should be brought into compliance.
- Build new sidewalk only as required to match into the existing sidewalk in 15 feet or less of length unless this results in a grade greater than 15%. **ADE** approval is required to exceed a length of 15 feet and/or a grade greater than 15%.
- Areas which are accessible prior to the project should remain accessible at the conclusion of the project, unless technically infeasible.
- If an existing bridge structure with a sidewalk is to be rehabilitated or replaced, sidewalk will typically be retained or included on the new structure.
- When provided, new sidewalk should connect the origins and destinations of existing pedestrian trips within the project limits, e.g. residential development and schools.

4.A Sidewalk Design Considerations

Widths - Sidewalk widths may vary; the minimum width is four feet, however, the **NDOT** prefers a continuous width of five feet. For sidewalks less than five feet in width a passing area shall be provided at intervals of 200 feet or less. The passing area shall be a minimum of five feet by five feet. See EXHIBIT 16.1 for additional information.

Cross Slope - The maximum allowable cross slope is 2%, except as noted elsewhere herein. The **NDOT** prefers a cross slope of 1.5% to allow for construction tolerance.

Grade – Where the sidewalk is contained within the right-of-way, its grade shall not exceed the general grade established for the adjacent street or highway. When the sidewalk profile is independent of the roadway alignment, the maximum allowable sidewalk grade is 5%; if the grade of the sidewalk exceeds 5% a pedestrian ramp will be required.

Buffer Areas - Generally, based on the available right-of-way, a five feet wide buffer area between the back of curb and the edge of sidewalk is the preferred section (EXHIBIT 16.2 illustrates the typical sidewalk section). Where right-of-way is limited a minimum buffer width of two feet should be provided to allow adequate space for hydrants, parking meters, and other roadside appurtenances. If no buffer is provided, a sidewalk width of six feet is provided to accommodate both these appurtenances and a minimum continuous four feet width for an access path.

Protruding Objects – No object will be allowed to protrude more than four inches into the pedestrian circulation path between a height of two feet six inches and six feet eight inches above the sidewalk surface.

Curb Ramps - See Section 7.

Fencing – When a sidewalk is adjacent to a steep slope (steeper than 1:3) which is sloping away from the sidewalk, is over six feet in depth and where no handrail or barrier is present a chainlink fence should be installed, typically one foot from the sidewalk (See EXHIBIT 16.3). The fence should have a minimum height of four feet with the chainlink fabric facing the sidewalk. If the sidewalk and the steep slope are on the approach to a viaduct or overpass the concrete bridge railing should be extended onto the approach slab and, where possible, the sidewalk flared away from the traffic.

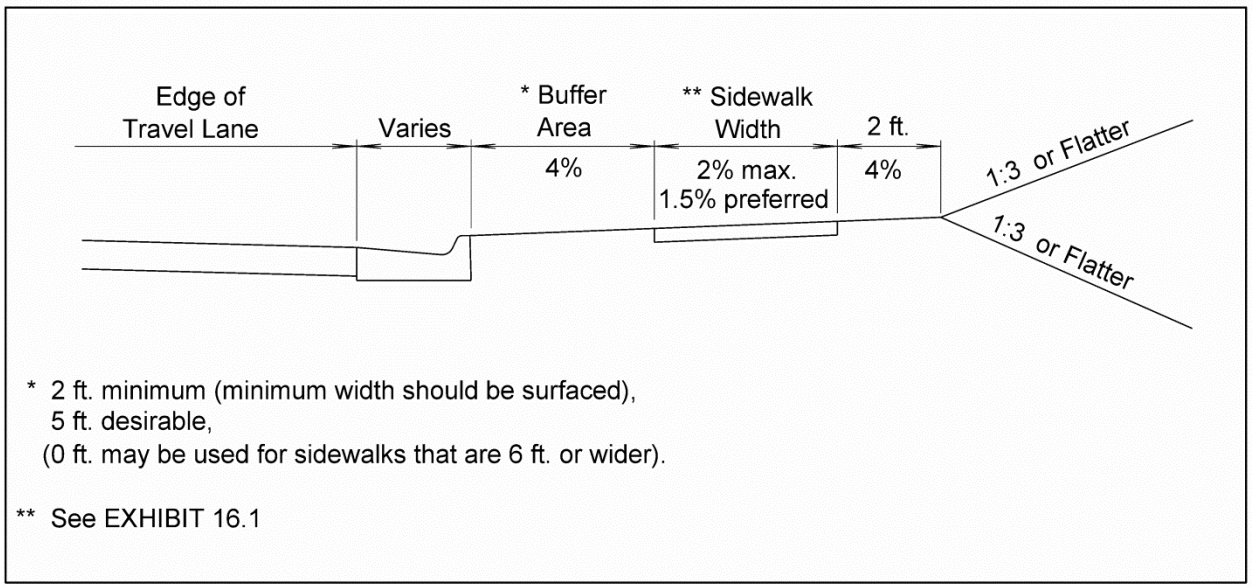


Exhibit 16.2 Typical Sidewalk Section

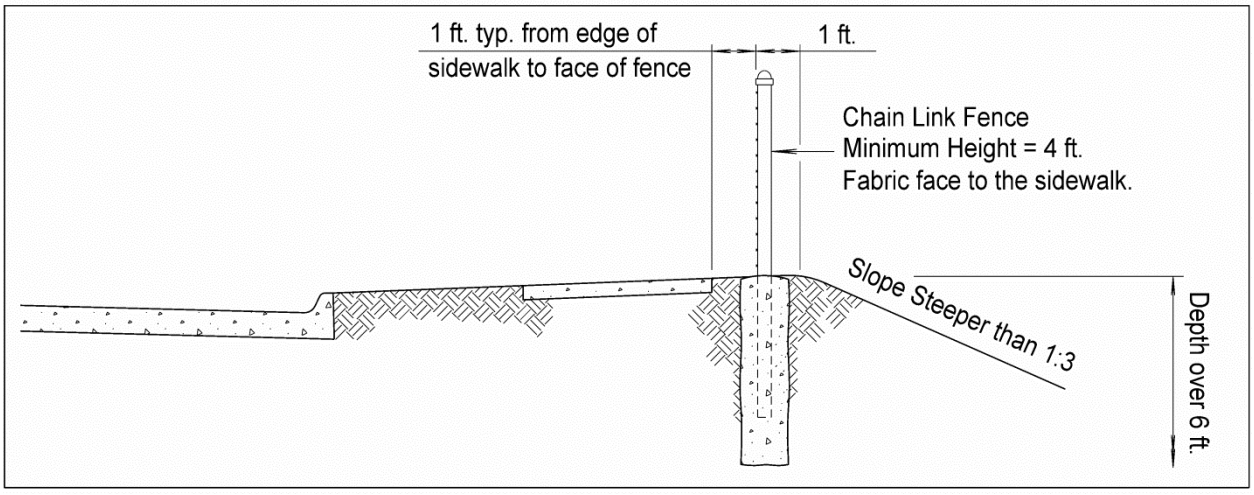


Exhibit 16.3 Fencing on Steep Slopes Adjacent to a Sidewalk

5. PEDESTRIAN UNDERPASSES

The minimum width of an underpass should be the clear width of the approaching sidewalk/shared use path; the desirable width is the sidewalk/shared use path width plus two feet clearance on each side. The minimum vertical clearance should be ten feet. For underpasses over 60 feet in length both dimensions may be increased. Sight lines should be unobstructed, providing a clear view of the open ends of the tunnel. The designer will address the concerns of the underpass users (including location and ventilation) and the drainage of the facility when designing the underpass. Lighting of the underpass will be coordinated with the **Roadway Design Lighting Unit**.

6. PEDESTRIAN CROSSINGS

Warrant analysis for mid-block pedestrian street crossings, pedestrian crossings at railroad tracks, and for pedestrian structures (overpasses and underpasses) is the responsibility of the **Traffic Engineering Division** (**Traffic Engineering**) and will be developed during the plan-in-hand or public hearing processes. The roadway designer will coordinate the design of the pedestrian crossing with the design of the highway, sidewalk/bikeway, railroad crossing, and/or bridge.

The design guidance for a pedestrian crossing includes:

- A pedestrian street crossing (hereafter referred to as a crosswalk) will connect departure and arrival sidewalks.
- Pedestrian street crossings shall continue through medians. The designer will verify that raised medians in the urban section of a project adhere to the *Proposed Guidelines (2011)* (Ref. 16.1), providing pedestrian access across the street from curb ramp to curb ramp.
- On wide, divided roadways, **Traffic Engineering** may require a pedestrian refuge area in the median. A pedestrian refuge is an area a minimum of six feet wide in the direction of pedestrian travel that allows a pedestrian to stop and wait for traffic mid-crossing.
- Marked crosswalks shall be a minimum six feet wide.
- The maximum cross-slope at a yield or stop sign controlled crosswalk shall be 2%.
- The maximum cross-slope at a crosswalk that is not yield or stop sign controlled is 5%.
- The cross-slope of a mid-block crosswalk is permitted to match the street grade.
- Where a pedestrian structure is required, the **Bridge Division** (**Bridge**) is responsible for the design the structure.
- Accessible pedestrian signals are optional devices that provide non-visual guidance for those with visual disabilities. They are not routinely installed on signal projects but can be installed upon request for, and the completion of, an engineering study that determines if they are needed for the project. The designer will coordinate the provision of accessible pedestrian signals at crosswalks with **Traffic Engineering**; for further information see Chapter Fourteen: Traffic, Section 4.A.

7. CURB RAMPS

Curb ramps compliant with the *Proposed Guidelines (2011)* (Ref. 16.1) ***are required***:

- At crosswalks (marked or unmarked)
- At an intersection having curb or other barriers to entry from a walkway
- Where accessible on-street parking is provided

Curb ramps ***shall be*** constructed or reconstructed on any new or reconstructed project where surfacing of any thickness, with or without milling, is placed on a crosswalk, whether the crosswalk is on the project mainline, on a side street, or at an signalized driveway or alley. Curb ramps are not required if the new surfacing does not extend to the crosswalk. Curb ramps may be built on any project with the concurrence of the **District Engineer** (**DE**) and the **Roadway Design Engineer**.

Curb ramps will be built using the curb ramp plan (See the Standard/Special Plans Book (*Standard Plans*), Ref. 16.4) http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/).

Design guidance for curb ramps includes, but is not limited to:

- A curb ramp is a transition from the pedestrian access route to the pedestrian street crossing with a grade which is between 5% and 8.3% inclusive in the direction of pedestrian travel (the roadway designer is advised to design curb ramps to an 8% maximum slope whenever possible to allow for construction tolerance).
- A blended transition connects a pedestrian access route and a pedestrian street crossing with a grade of less than 5% in the direction of pedestrian travel. A blended transition will hereafter be referred to as a curb ramp and will be built using the curb ramp plan (See the *Standard Plans*, Ref. 16.4).
- The desirable orientation of a curb ramp is perpendicular to the direction of crossing vehicular traffic.
- When tying a curb ramp to existing sidewalk, build new sidewalk only as required to match into the existing sidewalk in 15 feet or less of length unless this results in a grade greater than 15%. **ADE** approval is required to exceed a length of 15 feet and/or a grade greater than 15%.
- On reconstruction projects, the *Proposed Guidelines (2011)* allows a transitional segment of sidewalk to match the cross slope of the existing sidewalk; this transition does not require technically infeasible documentation to the project file.
- Curb ramps should be the width of the sidewalk and shall be a minimum of four feet wide (exclusive of flared sides). Curb ramps on shared-use paths will be the width of the path.
- The maximum allowable ramp cross slope (perpendicular to the direction of pedestrian travel) is 2%; the preferred cross slope is 1.5%.
- Curb ramp length shall not exceed 15 feet.
- Where a side of a perpendicular curb ramp abuts a public sidewalk, the sides of the ramp shall be flared with a maximum 10% slope.
- A four feet by four feet minimum landing area will be provided at either the top or bottom of the curb ramp. The landing area will have a 2% maximum slope in any direction (the **NDOT** prefers a slope of 1.5%). A five feet diameter for wheel chair foot rest swing is required if the landing area is adjacent to a vertical obstruction.

- The surface of a curb ramp shall be stable, firm, and slip-resistant.
- Gratings and similar access covers shall not be located on curb ramps or landings.
- A detectable warning area for the visually impaired consisting of truncated domes shall be provided at each pedestrian curb ramp located at intersections, crosswalks, islands that are six feet in width or greater, and at signalized drives and alleys where a vehicle is not intended to stop.
- The detectable warning panels shall contrast visually with the adjacent gutter, street, or sidewalk (either darker or lighter).
- Detectable warning panels will typically be cast-in-place when built with a new curb ramp.
- When a surface applied detectable warning panel is used on an existing curb ramp, the bid pay item is "Detectable Warning Panel".
- Transitions shall be free of abrupt changes:

    1. If the project changes the grade at the gutterline of an existing roadway through a crosswalk with existing curb ramps by one-quarter inch or less, no adjustment is required.
    2. If the project changes the grade at the gutterline of an existing roadway through a crosswalk with existing curb ramps by one-quarter inch to one-half inch, the grade change should be beveled at a maximum 1:2 ratio.
    3. If the project changes the grade of the existing roadway at the gutterline through a crosswalk with existing curb ramps by more than one-half inch, either match the grade at the gutterline through the crosswalk or reconstruct the curb ramp to current standards.

- Counter slopes of adjoining gutters and road surfaces connecting to the full width of a curb ramp shall be a maximum of 5%, measured perpendicular to the direction of pedestrian travel, for a distance of two feet as measured from the base of the curb ramp or landing edge at the street.
- Pavement drainage is a particular concern at curb ramps. Consideration will be given to the locations of inlets and sidewalks or crosswalks to verify that there is sufficient room for the five feet blockout width required for a curb inlet and that neither grates nor ponded water are impediments to pedestrian travel (See the Drainage Design and Erosion Control Manual (*Drainage Manual*), Ref. 16.5, Chapter One: Drainage, Section 10.B.1) (http://www.roads.nebraska.gov/business-center/design-consultant/rd-manuals/)
  Curb ramps may be constructed to meet local ordinances if those requirements meet or exceed the **NDOT** requirements. Additional project costs associated with local ordinances will normally be the responsibility of the Municipality.
- Exemptions to the above requirements for curb ramps may be granted if:

    1. The curb ramp has been constructed to the standards to the maximum extent practicable,
    2. It is "technically infeasible" to construct a curb ramp which meets all of the standards, **and**
    3. There is an accessible alternate route approved by the municipality (a Municipal agreement will be required).

- An exemption to the construction of a curb ramp requires the **Roadway Design Engineer's** written approval in the project file. This exemption letter will document that the curb ramp was constructed to the maximum extent practicable, which aspects of the curb ramp were not built to the standards, and why it is technically infeasible to meet all of the requirements of the *Proposed Guidelines (2011)* (Ref. 16.1).
- When there are no pedestrian facilities crossing the project, the designer ***must*** document this fact in the plan-in-hand report or in a decision document saved in the project file as the reason why curb ramps were not provided with the project.

Design details for curb ramps may vary according to many factors, including:

- Intersection radius
- Angle of street intersections
- Location of obstacles (e.g. fire hydrants, signs, and signal control devices)
- Possible sight obstructions
- Suitable location for stop bar

For additional information see the Nebraska Department of Transportation Operating Instruction 60-10, "ADA Accessibility Requirements in Transportation Projects" (Appendix B, "Selected NDOT Operating Instructions").

8. PEDESTRIAN RAMPS

A part of an accessible pedestrian route that has a slope which is between 5% and 8.3% inclusive in the direction of travel will be considered a pedestrian ramp and shall comply with the *Proposed Guidelines (2011)* (Ref. 16.1) requirements, including:

- The maximum allowable slope of a pedestrian ramp in new construction shall be 8.3% in the direction of travel (with a desirable maximum slope of 8%).
- The maximum allowable cross slope shall be no greater than 2% (the **NDOT** preferred cross slope is 1.5%).
- The maximum allowable rise for a length of run shall be 30 inches.
- Pedestrian ramps shall have a minimum clear width of four feet and shall have landings at the top and bottom of each ramp.
- The maximum allowable cross slope of a landing is 2% in any direction (the **NDOT** prefers a cross slope of 1.5%).
- Landings shall be at least as wide as the pedestrian ramp and the length of the landing shall be at least five feet. If the pedestrian ramp changes direction at the landing, the landing shall have a minimum size of five feet by five feet.
- Pedestrian ramps which have a rise of more than six inches or are six feet or greater in length shall have handrails on both sides of the ramp (curb ramps are not required to have handrails).
- The surface of the pedestrian ramp run and landing shall extend a minimum of 12 inches beyond the inside face of the handrail (See EXHIBIT 16.4).
- Pedestrian ramps and their approaches will be designed so that water will not pond on walking surfaces.
- The surface of the pedestrian access route shall be firm, stable, and slip resistant.

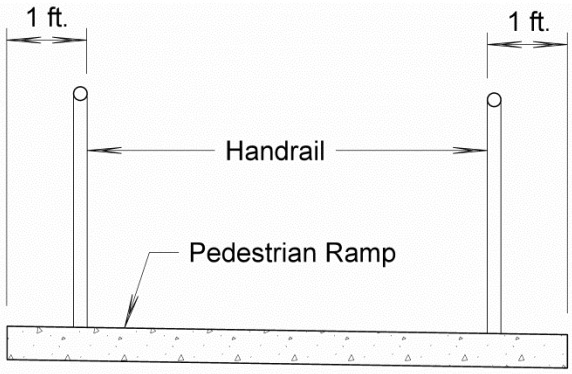


Exhibit 16.4 Typical Section of a Pedestrian Ramp
(Adapted from the *Proposed Guidelines (2011),* Ref. 16.1)

9. STEPS AND STAIRS

Exterior stairs which connect levels that are not connected by an elevator, ramp, or other accessible means of vertical access must comply with the following the *Proposed Guidelines (2011)* (Ref. 16.1) guidelines:

- Steps on a flight of stairs shall have uniform riser heights of between four inches and seven inches and uniform tread widths of not less than 11 inches as measured from riser to riser.
- Stairway treads shall include a minimum two inch wide strip which contrasts visually with the tread and riser. The strip shall be located at the front of and shall run the full width of the tread.
- The undersides of nosings shall not be abrupt. The radius of curvature at the leading edge of the tread shall be no greater than one-half inch.
- Risers shall be sloped or the underside of the nosing shall have a maximum angle of 30° from the vertical. Nosings shall project not more than one and one-half inches.
- Stairways shall have handrails on both sides of the stairs (See Section 10).
- Exterior stairs and their approaches shall be designed so that water will not pond on the walking surface.

The **Special Projects Unit** in **Bridge** will provide site-specific plans upon request from the roadway designer.

10. HANDRAILS FOR PEDESTRIAN RAMPS AND STAIRS

Handrails shall comply with the *Proposed Guidelines (2011)* (Ref. 16.1) and will have the following features:

- Where required, handrails shall be provided along both sides of stairs and pedestrian ramp segments. The inside rail shall be continuous.
- If handrails are not continuous, they shall extend at least one foot beyond the top and bottom of the pedestrian ramp segment and the extension shall be parallel to the landing (See EXHIBIT 16.5).
- The minimum clear space between handrails and a vertical surface shall be one and one-half inches.
- Gripping surfaces shall be continuous.
- The top of handrails shall be between 34 and 38 inches vertically above the walking surface, stair nosing, and pedestrian ramp surface. The height of the handrail shall be consistent.
- Ends of handrails shall be rounded or smoothly turned to the wall, floor, or post.
- Handrails shall not rotate within their fittings.

The **Special Projects Unit** in **Bridge** will provide site-specific plans upon request from the roadway designer.

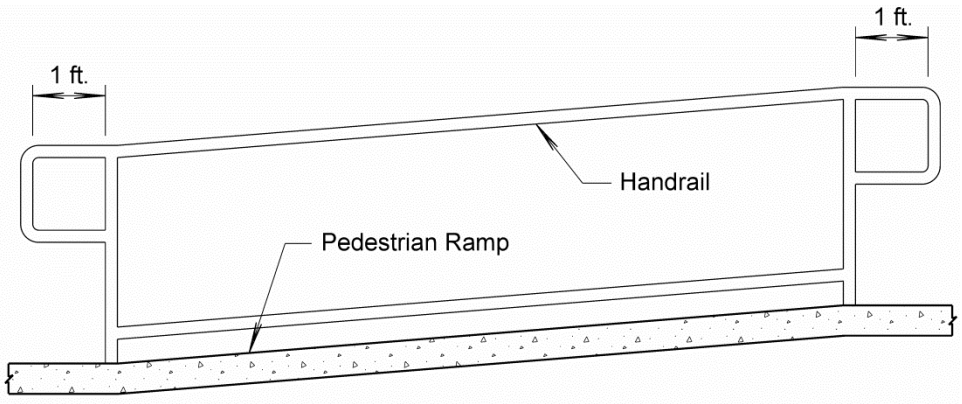


Exhibit 16.5 Typical Handrail Extension at a Pedestrian Ramp
(Adapted from the *Proposed Guidelines (2011)*, Ref. 16.1)

11. PEDESTRIAN ACCESS DURING CONSTRUCTION

When construction obstructs sidewalk access, the roadway designer will consider the need for temporary access measures for pedestrians with disabilities to businesses or other publicly-used facilities during the construction of the project. The designer will also address the needs of disabled individuals crossing the project during construction and the need for implementing temporary measures to meet these needs when identified. Special consideration will be given to schools (when in session), publicly-accessed government offices and medical facilities. The designer will inform **PS&E** of the need to include the Special Provision titled "Pedestrian Access During Construction" on projects where there are pedestrian facilities within the limits of the project.

11.A Pedestrian Access Review

The roadway design process includes an investigation to determine the need for accessibility of the sidewalk and street crossings for disabled individuals during the construction of the project as follows:

Preliminary Design: Prior to the plan-in-hand field inspection the roadway designer will take into account the possible need for disabled individuals to use the sidewalks and street crossings in and through the project area (See Activity 5300, Clarity Task Code 5336 of the Design Process Outline (*DPO*) Ref. 16.7) (http://www.roads.nebraska.gov/business-center/design-consultant/). The designer will estimate the time of closure for the sidewalk construction phase of the project, including utilities and other construction items, to assist in:

- Determining the type of temporary access required
- Designing the phasing of the pedestrian access
- The preparation of NEPA documents (if required)

This information will be made available to the public at a public meeting.

The roadway designer will request that the **District** investigate the need for access in and across the project area by pedestrians with disabilities and that the **District** contact public officials, business owners, and others, reporting the findings to **Roadway Design** at the plan in hand inspection. The evaluation of the use of the sidewalks/crossings in and through the construction zone by individuals with disabilities should include, but not be limited to:

- Contacting organizations in the community that provide support for persons with disabilities for their input
- An identification of people with disabilities living in, working in, or using the area of the project
- A determination of how, when, and in what way the area of the project is likely to be used by specifically identified persons with disabilities
- Obtaining the recommendations of the local officials regarding which temporary access measures should be considered during the construction of the project

Plan-In-Hand: The roadway designer and **District** personnel should review commercial or publicly-used buildings along the project where the public sidewalk provides the primary or only public pedestrian access to the building. The **District** should further identify how the project will

impact pedestrian access to schools, governmental offices, medical facilities, and other buildings that are likely to generate regular pedestrian traffic on the public sidewalk. **Municipality/Village** representatives should be invited to attend the plan-in-hand to discuss handicapped accessible routes and known accessibility needs, both when the project is complete and during construction.

Public Meetings: The engineering statement or video for public meetings (See **EXHIBIT C** of the *DPO*, Ref. 16.7) should address temporary pedestrian access during the construction of the project, e.g. "We are reviewing and will address pedestrian access", and request information to identify needs for access in or across the project area during construction.

The roadway designer will compile the available information concerning disabled pedestrian access and discuss the need for temporary facilities which are to be constructed as a part of the project with his/her **Roadway Design Unit Head** (**Unit Head**) and with the **District**. If there is no identifiable need for special accommodation for access to use the project area during the construction period, special accommodations will not be included with the plans, however a special provision will be added to the project stating that the **District** will be responsible for providing pedestrian access identified during construction.

Roadway Design: Before final design plans are transmitted (See the *DPO* (Ref. 16.7), Activity 5500, Clarity Task Code 5576) **District** personnel should meet with local officials, property owners, and local resource agencies for disabled persons to:

- Verify that the information concerning the usage patterns and subsequent needs of disabled pedestrians is current
- Inform the local officials and resource agencies of the proposed temporary pedestrian access facilities and of the tentative project schedule

11.B Example Special Provisions

- The contractor will construct sidewalks in such a way that will minimize the time that pedestrian access to properties along the project is closed.
- The contractor will maintain pedestrian traffic at all times that the business is open or provide an accessible route to be used during the closing of sidewalk at Station _____.
- The contractor may close the sidewalk from Friday to Monday (after normal business hours or when the business is closed).
- The contractor must construct a temporary ADA pedestrian accessible path or access at Station _____.
- The contractor will develop and implement a plan for the phasing of work that involves the obstruction, removal, or construction of sidewalks to minimize the disruption of pedestrian access to adjoining businesses. A plan will be implemented to provide reasonable temporary access during sidewalk construction to a business that uses the public sidewalk for its only or ADA accessible pedestrian access.

12. ADA UPGRADES - COST SHARING

See the Nebraska Dept. of Roads Operating Instruction 60-11, "Municipal Cost Sharing" (Appendix B, "Selected NDOT Operating Instructions").

13. REFERENCES

16.1 Architectural and Transportation Barriers Compliance Board, Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (*Proposed Guidelines (2011)*), Washington, D.C., 2011. (http://www.access-board.gov/guidelines-and-standards/streets-sidewalks/public-rights-of-way/proposed-rights-of-way-guidelines)

16.2 American Association of State Highway and Transportation Officials, Guide for the Development of Bicycle Facilities, Fourth Edition, Washington, D.C., 2012.

16.3 Transportation Research Board, "Roundabouts: An Informational Guide – Second Edition", NCHRP Report 672, Washington, DC, 2010. (http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_672.pdf)

16.4 Nebraska Department of Transportation, Standard/Special Plans Book (*Standard Plans*), Current Edition. (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/)

16.5 Nebraska Department of Transportation, Drainage Design and Erosion Control Manual (*Drainage Manual*), Current Edition. (http://www.roads.nebraska.gov/business-center/design-consultant/rd-manuals/)

16.6 Nebraska Department of Transportation, Bridge Office Policies and Procedures (*BOPP*), 2013. (http://www.roads.nebraska.gov/media/2912/bopp-manual.pdf)

16.7 Nebraska Department of Transportation, Design Process Outline (*DPO*), Current Edition. (http://www.roads.nebraska.gov/business-center/design-consultant/)

The information contained in Chapter Seventeen: Resurfacing, Restoration and Rehabilitation, dated March 2014, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this chapter.

Chapter Seventeen presents guidance for the design of 3R projects. This is a new chapter which consolidates and replaces 3R design guidance found in multiple chapters of the July 2006 Roadway Design Manual. This chapter was approved by the Nebraska Division of the FHWA for use on the National Highway System and other federal projects on March 26, 2014.

Chapter Seventeen
Resurfacing, Restoration and Rehabilitation (3R) Projects

1. RESURFACING, RESTORATION AND REHABILITATION PROJECTS

Resurfacing, Restoration and Rehabilitation projects are generally undertaken to preserve the highway assets, improve the reliability of the transportation system, maintain the mobility of the highway user, and mitigate highway safety issues identified through an analysis of the crash history. The standards to which a project was previously constructed will not be diminished on a 3R project. These projects may include, but are not limited to:

- Changing the roadway geometry
- Improving intersections
- Building or upgrading curb ramps
- Building or upgrading roadway appurtenances, such as guardrail
- Improving or widening the shoulders
- Removing or shielding roadside obstacles
- Improving the stopping sight distance
- Incidental improvements relating to safety or traffic operations (e.g. rumble strips, striping)
- Designing short segments to new and reconstructed standards
- Segments designated as maintenance activities
- Bridge work of all types

Application of 3R design standards to a pavement resurfacing project is, for the most part, determined by the pavement recommendation. Pavement recommendations that require placement of more than 2 inches of surfacing or its equivalent will be designed to 3R standards (Note: the **Materials and Research Division** (**M&R**) has determined that a roadway gains approximately 1/4 inch of new structure for every inch of a reclamation or recycle strategy, e.g. a pavement determination of 2 inches of reclamation followed by a 1.5 inch overlay is equivalent to a 2 inch thickness; therefore, a pavement rehabilitation strategy requiring the reclamation of 2 inches and resurfacing with 1.5 inches would be equivalent to a 2 inch resurfacing). Pavement recommendations that require removal of the entire pavement structure and the construction of a new base or the modification of the existing base will be designed to reconstruction standards.

Pavement recommendations that require pavement replacement and restoration of the base can be designed to 3R standards. Restoration of the base is defined as restoring the original condition of the base (subgrade preparation). A portion of the existing base may be removed to allow the required pavement thickness under 3R standards. Modification of the base is defined as improving (addition of a drainage layer) or strengthening the existing base through chemical (fly ash, lime, etc.) or mechanical (geofabric, geogrid, etc.) means and will require designing to reconstruction standards.

In general, 3R projects will require the **Nebraska Department of Transportation** (**NDOT**) to evaluate the geometry of the roadway for compliance with standards and guidance and to include crash mitigation measures as agreed to by the **Roadway Design Division** (**Roadway**) and the **Traffic Engineering Division** (**Traffic Engineering**). As a standard practice, 3R projects will only include enhancements to the highway which are required by standard or as a crash mitigation measure. Requests for further enhancements require the approval of the **Roadway Design Engineer**.

Development Schedules for 3R projects

In general, 3R projects are developed and assigned on three activity templates; the Standard 3R template, the Modified 3R template, and an M&R template.

1. The Standard 3R template is used for projects where there is a substantial level of design. These projects are usually assigned to one of the Interstate, Expressway, or Resurfacing units or to a Consultant.
2. The Modified 3R template is used for projects where the majority of the design tasks are assigned to the **Bridge Division** (**Bridge**), **Traffic Engineering**, and **M&R** and the activities assigned to **Roadway** are limited to the design of a couple of runs of roadside barrier, coordination with other divisions, and completion of agreements and environmental tasks. These projects are usually assigned to a **Consultant Coordination Unit** in **Roadway**.
3. The M&R template is used for those projects where a segment of roadway can be certified by the **Roadway Design Engineer** to meet the 3R design standards for the proposed scope of work. The activities for these projects will be assigned to **M&R**. The **Roadway Design Engineer** will forward a certification document to **M&R** for inclusion in the P.S. & E. submittal indicating the project is in compliance with the 3R standards. The title sheet of the plans will indicate a 3R design Standard and will be signed by the **Roadway Design Engineer** as Coordinating Professional.

2. 3R DESIGN GUIDELINES

National Highway System (NHS):

Interstate NHS Projects

Interstate projects will be designated as Interstate 3R. The bridge width, cross slope, superelevation, lateral offset to obstruction, and vertical clearance will be designed to new and reconstructed guidance as cited in the **American Association of State Highway and Transportation Officials** (**AASHTO's**) publication A Policy on Design Standards Interstate System (Ref. 17.1). The remaining thirteen controlling design criteria (See Appendix H, "Application of Design Standards") may be designed to the **AASHTO** Interstate guidance that was in effect at the time of the latest new and reconstructed project on the section of the project. Deviation from either the new or existing guidance will require a design exception (See Appendix H, "Application of Design Standards"). In addition, 3R type work on Interstates must conform to the Nebraska Minimum Design Standards (*MDS*) (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/) (Ref. 17.3) or a design relaxation must be obtained from the **Board of Public Roads Classifications and Standards** (**Board of Public Roads**) (See Appendix H, "Application of Design Standards").

Non-Interstate Freeway NHS Projects

The federal design criteria for work in excess of pavement preservation (maintenance) on non-Interstate freeways regardless of project funding are the thirteen controlling criteria (See Appendix H, "Application of Design Standards") as detailed in A Policy on Geometric Design of Highways and Streets (the *Green Book*) (Ref. 17.2). Work on non-Interstate freeways on the NHS must conform to the thirteen controlling criteria or a design exception will be required (See Appendix H, "Application of Design Standards"). 3R type work on non-Interstate freeways on the NHS must also conform to the *MDS* (Ref. 17.3) or a design relaxation must be obtained from the **Board of Public Roads** (See Appendix H, "Application of Design Standards").

Non-Interstate, Non-Freeway NHS Projects

3R work on NHS highways which are not designated as either Interstate or freeway work must conform to the recommendations presented in Special Report 214: Designing Safer Roads – Practices for Resurfacing, Restoration, and Rehabilitation (*TRB SR-214*) (Ref. 17.4) as cited in the *Green Book* (Ref. 17.2). Deviations from this requirement will require a design exception (See Appendix H, "Application of Design Standards") and will be documented in the project file. If the project does not meet the standards found in the *MDS* (Ref. 17.3) the procedure for the relaxation of the minimum design standards will be followed (See Appendix H, "Application of Design Standards").

Non – NHS State Highway System:

The minimum design standards for 3R projects on State highways have been issued by the **Board of Public Roads** in the *MDS* (Ref. 17.3). If these standards cannot be satisfied, the procedure for the relaxation of the minimum design standards will be followed (See Appendix H, "Application of Design Standards").

ADDITIONAL GUIDANCE FOR THE DESIGN OF 3R PROJECTS

Design Year:

- The design year for 3R projects is the year of initial construction plus the expected life of the pavement. The **NDOT** has established by policy an average surface life of 10 years for 3R projects constructed with hot-mixed asphalt pavement and 20 years for 3R projects constructed with Portland Cement Concrete pavement.

Design Speed:

- The design speed to be used is the speed limit determined by **Traffic Engineering** to be posted at the completion of the construction.
- For segments designed to new and reconstructed standards, the design speed of the segment will be the appropriate new and reconstructed project design speed (See Chapter One: Roadway Design Standard, Section 6.B).

Safety Improvements:

- Each 3R project will have a crash history and analysis conducted by **Traffic Engineering** to determine if there are crash issues along the proposed improvement and, if so, what mitigation measures could be implemented. **Traffic Engineering** will review and, if appropriate, recommend mitigation measures for the project based on the crash history, which may be considered for inclusion in the project. These recommendations will be reviewed for consistency with the scope of the project. Recommendations that exceed the scope of the proposed project should be forwarded to the **NDOT Safety Committee** for a recommendation to program a safety project.
- If indicated by the crash history and if recommended by **Traffic Engineering**, the designer may evaluate the acceleration and deceleration lengths of interchange, rest area, and weigh station ramps to see if they are compatible with the design speed (See Chapter 10 of the *Green Book*, Ref. 17.2). Coordinate with **Traffic Engineering** as required.
- Existing rumble strips will be perpetuated on projects over one-half mile in length. When project lengths are less than one-half mile, the rumble strips may be added to another project in the area to reduce mobilization fees.
- Shoulder rumble strips will be constructed on the shoulders for rural Interstate 3R projects. For projects shorter than one-half mile in length the rumble strips may be added to another project in the area to reduce mobilization fees.
- Shoulder rumble strips should be constructed on 3R projects over one-half mile in length on rural high-speed ($V \geq 50$ mph) highways with continuous surfaced shoulder widths of 6 feet or greater.
- Rumble stripes are relatively narrow rumble strips (approximately 8 inches in width) placed in the location of the white edgeline. Shoulder rumble stripes should be constructed on rural high-speed two-way two-lane highways with a 28 feet top width and an ADT in excess of 500.
- Shoulder rumble stripes may be constructed on rural high-speed two-way two-lane highways with surfaced shoulder widths of less than 6 feet, when recommended by **Traffic Engineering**.

- Centerline rumble strips may be placed on rural high-speed highways when warranted by policy. **Traffic Engineering** will advise if a roadway meets these warrants. For additional information on rumble strips, see Chapter Eight: Surfacing, Section 7.
- A beveled edge is a sloping finish to the edge of the pavement (both asphaltic concrete and Portland Cement Concrete). The beveled edge will be installed on rural high-speed (V ≥ 50 mph) highways when:

    1. The project includes 2 inches or greater of surfacing placement
    2. Surfaced shoulders are less than 6 feet in width, not including segments of erosion control curbed shoulders
    3. The highway is not curbed
    4. At other project locations identified by **Traffic Engineering** as a mitigation measure for a crash history

- Guardrail connections and bridge rail on the project will be evaluated and, if necessary, upgraded to current criteria. For additional information see **Roadside Barrier Design** in this section.

Plan-in-hands:

- The designer will transmit plan-in-hand plans and the "Plan-In-Hand Checklist For 3R Projects" (**EXHIBIT J** of the Design Process Outline (*DPO*), Ref. 17.5) (http://www.roads.nebraska.gov/business-center/design-consultant/) to the **District**. The need for **Roadway** participation on a plan-in-hand will be determined on a project-by-project basis by the **Unit Head** in conjunction with the **District**. The roadway designer is responsible for writing the plan-in-hand report.
- In general, plan-in-hand inspections will not be conducted on projects being developed on a modified 3R or M&R development schedule. Individual projects may dictate a need to visit a project or to have the **District** conduct an inspection.
- Before the plan-in-hand, the designer should review raised medians on high-speed roadways (V ≥ 50 mph) with **Traffic Engineering** to determine if they should remain in place, be modified, or be removed (See **Raised Medians** in this section).
- Median removals or modifications should be noted on the plan-in-hand report.
- Before the plan-in-hand field inspection the roadway designer should:

    1. List segments of the roadway which are on the low side of superelevated curves and/or which have grades between 2% and 3.5% and evaluate erosion control techniques for these segments with the **Roadside Stabilization Manager** in the **Project Development Division** (**PDD**).
    2. Provide a list of grades over 3.5% for the possible inclusion of curb and flume (See the Drainage Design and Erosion Control Manual (*Drainage Manual*), Ref. 17.7, Chapter Two: Erosion and Sediment Control, Section 7.E). (http://www.roads.nebraska.gov/business-center/design-consultant/rd-manuals/)

- Installation of new curb and flume locations on 3R projects is not mandatory and should be avoided when it involves acquisition of property rights on a project where right-of-way activities are not already included.

- New and existing curb locations will be evaluated for potential ponding on the travelled way. If ponding is identified as a potential, remedial actions consistent with the *Drainage Manual* (Ref. 17.7), Chapter One: Drainage, Sections 9 and 10 should be considered.
- Projects located within the corporate limits of a municipality, **Sanitary Improvement District** (**SID**), or in rural areas that demonstrate urban traffic characteristics should be reviewed before the plan-in-hand for ADA work, lighting, and applicable cost sharing. **City/Village/SID** representatives should be invited to the plan-in-hand and be informed of the estimated cost. For additional information, see **ADA** and **Lighting** in this section and DOT-OI 60-11, "Municipal Cost Sharing" (Appendix B, "Selected NDOT Operating Instructions").
- Discussion with the **City/Village** representatives regarding handicapped accessible routes and known accessibility needs shall take place on the plan-in-hand. For further guidance, see **ADA** in this section and Chapter Sixteen: Pedestrian and Bicycle Facilities, Section 12.
- The designer should review the project with the **Utility Coordinator** in **Roadway Design** before the plan-in-hand for possible utility conflicts and after the plan-in-hand to determine if additional survey for utilities is required.
- The condition of a railroad crossing, the width of the crossing, and the distance to the center and nearest point of the signals should be noted.
- Guardrail connections and bridge rail on the project will be evaluated and, if necessary, upgraded to current criteria. The designer should request the determination by **Bridge** prior to the plan-in-hand field inspection.
- The designer should request the **District** to provide a list of issues to be considered on the plan-in-hand visit including hydraulic, traffic operations, and maintenance issues.
- Work beyond pavement preservation on a 3R project (e.g. added turn lanes or spot safety segments designed to new and reconstructed standards) which was not included on the Form DR-73 should be noted as a change in the plan-in-hand report and requires the approval of the **Roadway Design Engineer**.
- When a scoping report has not been prepared and the project has progressed into functional design, the plan-in-hand report will serve as the scoping document.
- See the *DPO* (Ref. 17.5), Activity 5300, Clarity Task Codes 5380 & 5388 and **EXHIBITS J & K** for further information.

Vertical Alignment Design:

- Vertical curvature is generally not corrected on a 3R project unless there is a crash history that would make correction of the vertical curve cost effective.
- The designer will use the K values from **TABLES 3-34** and **3-36** of the *Green Book* (Ref. 17.2) to evaluate the existing vertical alignment for stopping sight distance and will check the existing alignment against the 3R standards in the *MDS* (Ref. 17.3).
- If the existing alignment does not meet 3R standards, the designer will review the crash history of the curve and recommendations provided by **Traffic Engineering**. If **Traffic Engineering** indicates there is a significant crash history related to the geometry of the curve, the designer will perform a cost-effective analysis comparing reconstructing the curve vs. leaving in place. The costs to be considered should include additional construction, NEPA compliance, Preliminary Engineering, Construction Engineering, ROW, Utilities, Contingencies, and estimated costs of delay including maintenance costs to maintain the roadway during the delay as well as the inflation costs associated with the delay. Maintenance costs can be estimated by using the average of the last five years and confirming the estimate with the **DE**. If there is a crash cost reduction benefit greater than the cost of reconstructing the curve, then reconstruction of the curve may be considered.

    1. If reconstruction of the curve is determined to be the appropriate course of action, the curve will be reconstructed to the criteria for new and reconstructed projects as detailed in Chapter Three: Roadway Alignment, Section 4.
    2. If the curve does not meet the requirements of the *MDS* (Ref. 17.3) and is not reconstructed, a design relaxation must be obtained (See Appendix H, “Application of Design Standards”)

- If a vertical curve is perpetuated at less than the posted speed limit, the **District** and **Traffic Engineering** will be advised of the computed maximum allowable speed.
- The addition of climbing lanes may be considered on 3R projects if warranted by a safety analysis and recommended by **Traffic Engineering**. The auxiliary climbing lane should be designed using the criteria presented in Chapter Three: Roadway Alignment, Section 3.A.

Horizontal Alignment Design:

- **The following guidance applies to non-freeway / non-Interstate 3R projects with roadways on or off the NHS, regardless of funding.**

I. Design Considerations that apply:

1. Correcting a curve to meet the requirements of the posted speed limit is a desirable condition; however it is not a mandatory condition. Many factors come into consideration when determining whether the correction of the curve is necessary. These factors include:

   A. Crash history
   B. Impacts to obtain full standards
      1. Right-of-way
      2. Environmental
      3. Project Schedule
      4. Project Cost
   C. Degree of deficiency
   D. User Benefits
      1. Reduction in frequency and severity of crashes

2. Analysis of benefit – cost relationship

   A. The designer will request crash data analysis for the curve. If the crash analysis indicates that the traveling public may benefit from correcting the curve, the dollar amount of benefit will be requested from the **Traffic Engineering Highway Safety, Evaluation, and Analysis Unit**.
   B. The costs to be considered for correction of the curve should include additional construction, NEPA compliance, Preliminary Engineering, Construction Engineering, ROW, Utilities, Contingencies and estimated costs of delay, including maintenance costs to maintain the roadway during the delay as well as the inflation costs associated with the delay. Maintenance costs can be estimated by using the average maintenance costs of the last five years and confirming the estimate with the **DE**. If there is a crash reduction benefit greater than the cost of reconstructing curve, then reconstruction of the curve should be considered.
   C. The environmental impacts associated with correcting the curve: Significant impacts are to be weighed as a cost to the project and should not be incurred unless there is a significant benefit to the traveling public. Significant impacts to environmental resources may not be allowed under the NEPA process and may not be permitted by the **U.S. Army Corps of Engineers**.
   D. The impacts to adjacent property rights: Acquisition of additional property rights may result in controversy and delay to the project due the acquisition process or the public involvement process. Significant impacts to adjacent property owners should be avoided unless there is significant benefit to the traveling public.
   E. The economic costs to the state associated with correcting the curve, including the costs in constructing the correction (traffic control, construction costs, acquisition of property rights, cost of delay in producing the project, cost of additional NEPA activities if required).

3. If correcting the curve is not warranted, other measures may be considered, such as:

   A. Widening lanes
   B. Widening and paving shoulders
   C. Flattening steep sideslopes
   D. Removing, relocating or shielding the roadside obstacles
   E. Installing traffic control devices, such as:
      1. Advisory curve and speed signs
      2. Raised pavement markings
      3. Reflective guideposts

4. If the benefit to the traveling public of correcting the horizontal curve is at least the total costs associated with the correction, the correction is warranted and should be accomplished with the project. However, other factors often affect the ability to incorporate the correction in the project. If the correction of the horizontal curve will result in the loss of federal funds due to delay of the project beyond the federal fiscal year or will result in significant inflation costs to the project due to delay, the correction may be removed from the project and programmed as a "Phased 3R Project" according to DOT-OI 60-16, "Policy for Phase Constructed 3R Projects" (See Appendix B, "Selected NDOT Operating Instructions"). Use of Federal Safety funds should be considered for funding the second phase project. In this case, the work in the area of the curve correction for the first phase project should be reduced to maintenance level, if possible, to minimize unnecessary expenditures.

II. Policy:

1. Correction of horizontal curves to accommodate the posted speed limit is a desirable condition for 3R projects both on and off the NHS. The correction of horizontal curvature is not a mandatory condition under either State or Federal guidance. The designer is advised that if a curve does not meet the design speed of the roadway, some correction is better than no correction.
2. According to Title 23 – Code of Federal Regulations 625 – Federal Aid Policy Guide (*23 CFR 625*) (http://www.access.gpo.gov/nara/cfr/waisidx_02/23cfrv1_02.html) (Ref. 17.8), the design standards to be used are found in the *Green Book* (Ref. 17.2) which states on page xli, "When designing 3R projects the designer should refer to TRB Special Report 214 – Designing Safer Roads: Practices for Resurfacing, Restoration and Rehabilitation and related publications for guidance." The following is based upon recommendations in *TRB SR-214* (Ref. 17.4).

   A. **Roadways with a design year traffic of less than or equal to 750 vpd:** Horizontal curves on roadways with ADT of 750 vpd or less do not require correction by standard. However, these curves should be evaluated as follows:

      Horizontal curves will be evaluated for the calculated design speed based upon the existing radius or degree of curvature and superelevation rate. The curves are then addressed as follows:

      1. If the final configuration of a curve has a calculated design speed within 5 mph of the posted speed limit, no further consideration is required.

2. If the final configuration of a curve has a calculated design speed greater than 5 mph and less than or equal to 10 mph less than the posted speed limit and does not warrant reconstruction or correction as dictated in Section I above, the placement of advisory curve and speed signs is **recommended** and both the **DE** and the **Traffic Engineer** will be notified for the appropriate action.
3. If the final configuration of a curve has a calculated design speed greater than 10 mph and less than or equal to 15 mph less than the posted speed limit and does not warrant reconstruction or correction as dictated in Section I above, the placement of advisory curve and speed signs is **mandatory** and both the **DE** and the **Traffic Engineer** will be notified for the appropriate action.
4. If a curve has a theoretical design speed greater than 15 mph less than the posted speed limit, the designer will request a review of the crash data for the curve from **Traffic Engineering**. If the crash data for the curve indicates that additional review should be considered, the designer will evaluate the impacts associated with correcting the curve. If the impacts associated with the correction of the curve involve no acquisition of property rights, no impacts to environmental resources, and will not significantly impact the project cost or schedule, then correction of the curve is appropriate.

B. **Roadways with a design year ADT greater than 750 vpd:** Horizontal curves will be evaluated for the computed design speed based upon the existing radius or degree of curvature and super elevation rate.

Horizontal curves on roadways with an ADT of greater than 750 vpd that do not meet the design speed shall be considered for correction. This correction may include reconstruction of the curve if cost effective. These curves should be treated as follows:

1. If the difference between the calculated speed for the curve and the posted speed limit is less than or equal to 15 mph, the designer will follow the guidance given in Section II, Subsections 2.A.1 through 3 as appropriate.
2. If the difference between the calculated speed for the curve and the posted speed limit is greater than 15 mph, the designer will evaluate the curve for correction according to the procedure given in Section I, Subsection 2.
    A. The designer is advised that some correction is better than no correction and that horizontal curves should be corrected to maximum extent possible without incurring the impacts prohibited above.

- **Radius of Curve:** If the decision is made to reconstruct a curve, the criteria presented for new and reconstructed projects in Chapter Three: Roadway Alignment, Section 2, should be used.
- **Pavement Widening on Curves:** The **NDOT** recommends a 2 feet pavement widening on the inside lane of a horizontal curve if all of the following conditions occur:

1. The curve radius is less than 1910 feet.
2. The operating speed is 45 mph or greater.
3. The roadway does not have surfaced shoulders.
4. The projected average daily truck traffic is more than 50 per day.

Superelevation:

The superelevation for 3R projects will be designed in accordance with Chapter Three: Roadway Alignment, Section 2.B, except as follows:

- See **Horizontal Alignment Design** in this section for guidance.
- The designer should check the existing superelevation using the as-built e_{max}. In the event no as-built information is available, the e_{max} = 6% table (See Chapter Three: Roadway Alignment, EXHIBIT 3.3c) can be used and, if necessary, the existing superelevation should be corrected to match the table. If the existing superelevation rate is over 6%, the existing superelevation should be checked using the e_{max} = 8% table (**TABLE 3-10b** of the *Green Book*, Ref. 17.2). An 8% superelevation will not be exceeded without the approval of the **Roadway Design Engineer**.
- For low-speed urban applications (V ≤ 45 mph) the designer should check the superelevation using the e_{max} = 4% table (See Chapter Three: Roadway Alignment, EXHIBITS 3.3d & **TABLE 3-13b** of the *Green Book*, Ref. 17.2).
- The rate of superelevation (e) should be listed in the curve data on the plans for all curves; it is not acceptable to place the phrase "Use Existing Superelevation" on the plans.
- Existing spiral transitions should be perpetuated on 3R projects.

Driveways and Intersections:

- On 3R template projects, the adequacy of intersection/driveway geometry should be reviewed and discussed on the plan-in-hand. If adequate, the existing intersection/driveway geometry will be matched. For Modified and M&R template projects, the existing driveway and intersection geometry will be matched.
- Intersection sight distance is a desirable condition on 3R projects.
- For projects assigned a 3R or a Modified template, **Traffic Engineering** will review the crash history for the entire project including intersections and driveways and, if necessary, identify mitigation methods for reducing the potential for or severity of crashes.
- If indicated by the crash history, intersection sight distance should be evaluated. The designer should run a cost effectiveness analysis if the intersection sight distance is deficient.
- If justified by a cost effectiveness analysis based on the crash history, intersections and driveways on 3R projects may be evaluated for intersection sight distance using departure sight triangles for Case B1 (left turn from a minor road) found in Chapter 9 of the *Green Book* (Ref. 17.2). If the existing conditions do not meet the required sight distance, the designer should either adjust the design or inform the **District** and **Traffic Engineering** so that the approach to the intersection or driveway may be signed accordingly. If modifying the intersection, driveway, or the highway is the selected alternative, the designer will perform a cost comparison of reconstructing the driveway, intersection, or the highway vs. leaving in place, The costs to be considered should include additional construction, NEPA compliance, Preliminary Engineering, Construction Engineering, ROW, Utilities, Contingencies and estimated costs of delay including maintenance costs to maintain the roadway during the delay as well as the inflation costs associated with the delay. Maintenance costs can be estimated by using the average of the last five years and confirming the estimate with the **DE**. If there is a crash reduction benefit greater than the cost of modifying the driveway, intersection, or highway, reconstruction of the highway, intersection or drive should be considered and the decision documented in the project file. If the improvement is cost effective but the delay incurred by the improvement is

unacceptable, the improvement may be submitted to the **NDOT Safety Committee** for construction with Federal Safety funds on a future project.

- The existing skew of an intersection will not be changed unless justified by the crash history and a cost-effectiveness analysis or if realignment is made necessary by other design features of the project.
- When a roadway is resurfaced, the intersections and driveways will also be resurfaced unless the **DE** specifically indicates otherwise.
- The intersection/driveway surfacing material should be decided on the plan-in-hand.
- On pavement preservation projects produced in **M&R** and on 3R Modified development template projects designed by **M&R** and managed by **Roadway**, **M&R** will provide the quantities and locations of the driveways and intersections.
- On 3R projects designed and managed by **Roadway**, **Roadway** will provide the location and area of each driveway and intersection and **M&R** will provide the asphalt quantities.
- If the resurfacing of an existing intersection/driveway which ties into rock or gravel surfacing results in a grade raise in excess of 0.5 inch, either crushed rock or gravel will be placed behind the intersection/driveway surfacing. An estimate of 10 CY for intersections and 5 CY may be used for driveways (10 tons and 5 tons respectively in **Districts 1 & 2**).
- Driveways and intersections with steep side slopes perpendicular to the through roadway which are inside the fixed obstacle clearance should be considered for 1:10 side slopes if there is sufficient existing right-of-way or as recommended by **Traffic Engineering** based on the crash history. See Chapter Four: Intersections, Driveways and Channelization, EXHIBITS 4.14 and 4.15, for grading examples.
- Work on railroad right-of-way must conform to Title 415, Nebraska Administrative Code, Chapter 6 (Highway-Rail Crossings – Construction, Repair and Maintenance) and requires a special provision prepared by the **Railroad Liaison Office** in the **Intermodal Planning Division**. Chapter 6 may be found at (http://roads.nebraska.gov/media/7036/415nac4-7rail-xings.pdf).

Raised Medians:

- In general, curb heights adjacent to high-speed roadways (posted speed limit ≥ 50 mph) should be no greater than 4 inches and should slope at no greater than 45º from the gutter to the top of curb. There are instances where a 4 inch curb is insufficient to adequately address the existing hydraulic needs of the roadway; in these instances the permission to retain a curb height greater than 4 inches requires the approval of the **Roadway Design Engineer** (for pavement drainage considerations see the *Drainage Manual* (Ref. 17.7), Chapter One: Drainage, Sections 9 and 10). Six inch high curbs are allowed for roundabout curb and splitter islands and within 400 feet of an intersection.
- Raised medians with 6 inch curb on 2-lane high-speed roadways (V ≥ 50 mph) should be modified or removed. If **Traffic Engineering** determines that the raised curb median should be retained, the median curb height will be reduced to 4 inches or less (See **Plan-in-Hands** in this Section). The slope of the curb face will not be altered.
- Median removals or modifications should be noted on the plan-in-hand report.
- Where there are raised medians on cross-roads which are proposed to be modified, the medians should be reviewed by **Traffic Engineering**. Raised medians should be located outside of the mainline total shoulder width and the intersection should be checked with the appropriate design vehicle turning template (See Chapter Four: Intersections, Driveways and Channelization, EXHIBIT 4.8).

Typical Roadway Cross-Sections:

- Existing standards will not be diminished. As a minimum condition, the designer will maintain either the clear zone distance which was built on a previous new and reconstructed project or provide the 3R fixed obstacle clearance from the *MDS* (Ref. 17.3), whichever is greater. This distance should be shown and labeled on the main typical section for the project. For example; if a project has a previously built clear zone distance of 30 feet with traversable foreslopes and the fixed obstacle clearance from the *MDS* is 20 feet, the previously constructed 30 feet clear zone shall be maintained. The typical sections will label the 30 feet distance as "Horizontal Clear Zone".
- The designer should use a slope no steeper than 1:4 when blending shoulder construction to an existing 1:6 or flatter side slope. A 1:3 slope should be used to blend the shoulder construction to an existing side slope which is steeper than 1:6. Except where a slope is shielded, slopes steeper than 1:3 should not be used.
- If warranted by the crash analysis, an auxiliary lane may be added to a 3R project without grading to new and reconstructed standards as long as the existing standards are not diminished (e.g. maintain the existing shoulder and side slopes). In the event that the existing shoulders or side slopes exceed the reconstruction standards, reconstruction standards for the design year traffic may be used. Relaxations of this guidance require **Roadway Design Engineer** approval.
- Lane configuration changes may be accomplished by re-striping the roadway, based on recommendations by **Traffic Engineering**, as long as the new condition does not violate the minimum standards for shoulder or surfaced shoulder width. For example, an existing 24 feet wide roadway only requires 6 feet surfaced shoulders but the existing section has 8 feet surfaced shoulders; when the roadway is restriped to a 36 feet wide three lane section, 2 feet surfaced shoulders result. This arrangement would require either expanding the existing surfaced shoulders to 6 feet or obtaining a design relaxation (See Appendix H, "Application of Design Standards").
- An existing sub-standard right-turn lane on a rural un-signalized high-speed (V ≥ 50 mph) roadway (where a surfaced shoulder has been re-striped to provide a turn lane) will be reviewed by **Traffic Engineering** to determine if it is warranted, if so a new offset right-turn lane may be constructed (see Chapter Four: Intersections, Driveways and Channelization, Section 1.D.3).
- If an existing non-offset right-turn lane on a rural un-signalized high-speed (V ≥ 50 mph) roadway is encountered, **Traffic Engineering** will review the crash history and recommend whether the right-turn lane remains as it is or is converted to an off-set right-turn lane (see Chapter Four: Intersections, Driveways and Channelization, Section 1.D.3).
- Mailbox turnouts will be built on 3R projects assigned to **Roadway Design** as detailed in Standard Plan 307, "Mailbox Turnout" (See the Standard/Special Plans Book, Ref. 17.9) (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/).

Mainline Surfacing Taper Rate:

- For an overlay on a high-speed (V ≥ 50 mph) roadway, the taper rate at the end of the project is 50 feet to each inch of change in grade (e.g. for a 2 inch mill with a 4 inch overlay: 2 x 50 = 100 feet).
- The taper rate at the end of an overlay on a low-speed (V ≤ 45 mph) roadway is 25 feet to each inch change in grade, or ending at an intersection if it is within the taper length.

Culverts and Hydraulic Considerations:

- Department review is required of projects crossing or parallel to (and encroaching in) mapped:

    1. Floodplains - which allow no increase greater than one foot in the existing base flood elevation for the 100-year event, and
    2. Floodways – which allow no increase in the existing base flood elevation for the 100-year event.

- Watersheds in excess of 640 acres (one square mile) in areas without floodplain mapping will be evaluated and certified as floodplains.
- The designer should take projects to the **Roadway Design Hydraulics Engineer** once Final Design plans, including limits of construction, have been completed.
- The responsibility for completing certification of compliance with floodplain regulations rests with:

    a. The **Bridge Hydraulics Section** for structures with at least a 20 feet span (multiple culverts, bridge or box culvert), or
    b. The **Roadway Design Hydraulics Section** for other structures (bridge, box culvert or multiple pipe culverts with less than a 20 feet span, encroachments into a floodplain by the highway embankment, and other obstructions).

- The certification of compliance with floodplain regulations will be forwarded to the **Environmental Permits Manager** in **PDD** for:

    a. Floodplain permits in counties or communities regulating floodplains, or
    b. Placement in project files for counties or communities not regulating floodplains.

- 3R projects do not require a hydraulic analysis of culverts unless there is a known hydraulic problem, discussed with **District** personnel on the plan-in-hand. However, if a culvert is to be replaced, a hydrologic and hydraulic analysis must be completed to determine the size of the replacement structure.
- The designer should be consistent with culvert extensions, looking at the project as a whole. In general, culverts that are extended will be extended to the fixed obstacle clearance. Culverts may be extended to the clear zone distance with the written approval of the **Roadway Design Engineer**.
- When extending a culvert in a location where additional property rights are being acquired, the designer should review the existing right-of-way and try to provide 10 feet of cleanout space beyond the ends of the culvert.
- There are instances where limitations to impacts in channels/wetlands or absence of time in the schedule to acquire property rights prohibits extending concrete box culverts to the appropriate clear zone. In these instances it may be possible to extend the parapet and wings vertically to account for a raise in grade. The ability to increase the height of the parapet and wings is structure dependent and requires the approval of the **Bridge Special Projects Unit** prior to the plan-in-hand visit. The designer shall contact the **Bridge Special Projects Engineer** prior to the plan-in-hand visit to discuss the needs of the project and, if appropriate and following analysis, gain the written concurrence of the

Bridge Special Projects Engineer to raise the parapets and walls on each culvert or bridge sized box culvert prior to assuming that the parapets will be raised. In the event none of these options are feasible, an acceptable solution may be to remove the wings and a portion of the box and extend back the same distance with a taller parapet and wings designed to handle the increased soil pressures.

- Concrete box culverts with a span of 3 feet or less may be extended with culvert pipes (the designer will request special plans from the **Special Projects Unit** in **Bridge**).

- When box culverts are extended:

    a. The preferred method is to remove the wings and 2 feet of the culvert barrel before extending the culvert.
    b. As an option (e.g. for phasing) the wings of the box culverts may be removed to the parapet line and the extension doweled into the existing box (a special plan will be required from the **Special Projects Unit** in **Bridge**).

  Discuss the preferred method with **District** on the Plan-in-Hand.

- Headwalls within either the fixed obstacle clearance or clear zone distance, as applicable, should be removed and replaced with flared end sections.
- Where an existing concrete headwall is in place, the concrete will be completely removed.
- Culvert pipes should be extended in kind: a minimum of 2 feet for metal pipes and 4 feet for concrete pipes. Culvert pipes should be extended in 2 feet increments.
- When a metal culvert pipe is extended that does not have an existing end treatment or which is on a skew, a minimum of 2 feet should be removed from the end of the culvert before extending.
- If a corrugated metal pipe is extended, the pipes will be connected with an approved water-tight connecting band.
- If a corrugated metal pipe is shortened and then extended, a concrete collar will be used.
- When metal arch pipes are extended, concrete collars will be used instead of a connecting band.
- A pipe culvert extension may be skewed up to 3° without an elbow.

Earthwork/Shoulder Construction:

- For projects without survey for a majority if not all of the project, shoulder earthwork will be paid for with "Earth Shoulder Construction" (See Chapter Eight: Surfacing, Section 4.C). Roadway grading may be added as required by the project (e.g. at guardrail and culvert locations). The required roadway grading details will be shown on the typical sections or on the 2N Sheet.
- If paying for embankment as an established quantity (EQ), a balance factor of 1.0 shall be used and the pay item will be "Earthwork Measured in Embankment (EQ)" (See Chapter Seven: Earthwork, Section 4.B.1).
- When using "Earthwork Measured in Embankment (EQ)" as the pay item: the embankment quantity will be multiplied by an assumed balance factor of 1.5 when calculating the pay item "Water Applied".
- The designer should provide design data and earthwork quantity plan sheets for projects with adequate surveys.
- Cross-sections, when included, should show grading (e.g. for culverts, guardrail grading).
- See Chapter Seven: Earthwork for additional information.

Fill Slopes:

- If the project includes grading, small slivers of fill slope should be avoided.
- Earth dikes built with the project within the appropriate clear-zone distance (See **Typical Roadway Cross-Sections** in this Section) which are perpendicular to the traffic will have a 1:10 slope facing the traffic. A 1:6 slope is acceptable for the offside (downstream) face of the dike. Dikes in a median will have 1:10 slopes on both faces of the dike. When reconstructing a median dike, the designer will verify that the median pipe and/or inlet still drains.

Roadside Barrier Design:

- Existing roadside barriers must be reviewed for compliance with the National Cooperative Highway Research Program (NCHRP) Report 350 or the Manual for Assessing Safety Hardware (MASH) 2009 and, if necessary, upgraded to current criteria.
- For roadside barrier analysis and design, the designer will use either the clear-zone distance from the previous new and reconstructed project or the fixed obstacle clearance from the *MDS* (Ref. 17.3), whichever is greater.
- Check existing fill slopes within the applicable 3R obstacle clearance for barrier desirability using EXHIBIT 17.1. The **Unit Head** or his/her designee should run a "Roadside Safety Analysis Program" (RSAP) cost effectiveness analysis to determine the desirability for barrier installation for other obstacles within the applicable 3R obstacle clearance.
- Culverts 36 inches or less in diameter and round-equivalent culverts 36 inches or less in width which have flared end sections and are within 45° of perpendicular to the direction of travel may be included within the fixed obstacle clearance if they meet 1:3 or flatter side slopes.
- The **Unit Head** or his/her designee should run a RSAP cost effectiveness analysis to determine the desirability for barrier installation for concrete box culverts and for culvert pipes with a diameter greater than 36 inches which are located within the applicable 3R obstacle clearance (See Chapter Nine: Guardrail and Roadside Barriers, Section 1.D).

- If a culvert is within the 3R fixed obstacle clearance and a cost-effectiveness analysis indicates that the culvert should be used in place without shielding (shielding is less than a 1:1 benefit to cost), a note should be placed in the project file stating: "Use in Place – Not cost effective to extend to fixed obstacle clearance or shield" (include the analysis data in the project file).
- Existing guardrail **will not** be removed without mitigating the hazard it is intended to shield. If the hazard has been mitigated, the guardrail may be removed with the approval of the **Roadway Design Engineer**.
- Existing guardrail which a cost-effectiveness analysis indicates is not required **may not** be removed without the written approval of the **Roadway Design Engineer** as evidenced by a Design Decision Document.
- When it is not possible to install sufficient roadside barrier length to shield either the clear zone distance or the fixed obstacle clearance, as appropriate (e.g. a railroad access drive which cannot be relocated and is within the development length of the guardrail), the designer will obtain the concurrence of the **Unit Head** and document the reason in the project file.
- A short radius guardrail may be used in rare situations with **Unit Head** approval (See Chapter Nine: Guardrail and Roadside Barriers, Section 7.A).
- The designer should use the tables found in Chapter Nine: Guardrail and Roadside Barriers, EXHIBIT 9.3, for runout length (L_r) values. Interpolate L_r values for speeds not listed in the table.
- A Guardrail End Treatment Type I (See Chapter Nine: Guardrail and Roadside Barriers, Section 4.A) should be installed to minimize earthwork and to avoid buying right-of-way on projects where right-of-way is not being purchased for other features of the project.
- The area behind the roadside barrier (either new installation or existing) will be evaluated for the required barrier deflection (See Chapter Nine: Guardrail and Roadside Barriers, EXHIBIT 9.6) and cleared as necessary.
- Whenever practicable and acceptable, cable guardrail should be installed at the locations that warrant a roadside barrier, including culvert locations.
- See Chapter Nine: Guardrail and Roadside Barriers for typical guardrail designs.

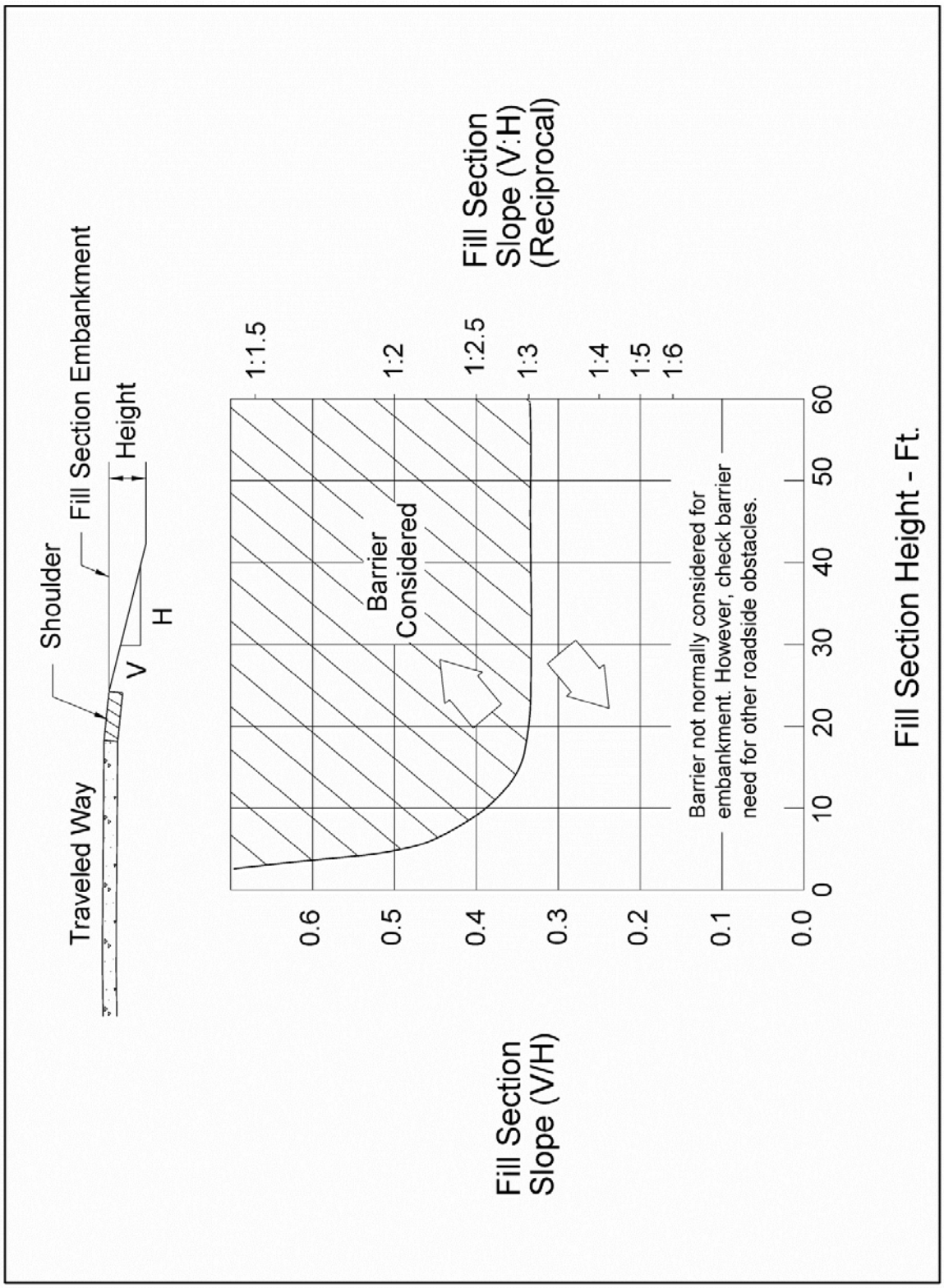


Exhibit 17.1 Comparative Barrier Consideration for Embankments
Source: Roadside Design Guide (Ref. 17.10)

Americans with Disabilities Act (ADA):

The **NDOT** has adopted the guidance in the 2011 Draft Public Rights-of-Way Accessibility Guidelines (*PROWAG*) (Ref. 17.6), issued by the **Public Right-of-Way Access Advisory Committee** (**PROWAAC**) (http://www.access-board.gov/). Facilities for the handicapped may be made to meet local requirements if those requirements meet or exceed **NDOT** policy.

Curb ramps compliant with *PROWAG* (Ref. 17.6) will be required as specified in Chapter Sixteen: Pedestrian and Bicycle Facilities, Section 8.

- A "curb ramp" is a transition from the sidewalk to the gutterline of the crosswalk consisting of a ramp with a grade which is between 5% and 8.3% inclusive in the direction of pedestrian travel (the roadway designer is advised to design new curb ramps to an 8% maximum slope, whenever possible, for construction tolerance).
- A "blended transition" connects a sidewalk and a crosswalk with a grade of less than 5% in the direction of pedestrian travel. A blended transition will hereafter be referred to as a curb ramp and will be built using the curb ramp plan (See the *Standard Plans*, Ref. 17.9).
- The 2009 Nebraska Code, Chapter 60 Motor Vehicles defines a crosswalk as:

    1. "That part of a roadway at an intersection included within the connections of the lateral lines if the sidewalks on opposite sides of such roadway measured from the curbs or, in the absence of curbs, from the edge of the roadway; or
    2. Any portion of a roadway at an intersection or elsewhere distinctly designated by competent authority and marked for pedestrian crossing by lines, signs, or other devices."

- **City/Village** representatives should be invited to attend the plan-in-hand to discuss handicapped accessible routes and known accessibility needs, both when the project is complete and temporarily during construction.
- Existing curb ramps will be reviewed for compliance with *PROWAG* (Ref. 17.6):

    1. Running slope will be 8.3% maximum in the direction of pedestrian travel.
    2. Cross slope will be 2% maximum perpendicular to the direction of pedestrian travel.
    3. A 4 feet minimum curb ramp width.
    4. A 15 feet maximum curb ramp length.
    5. A 4 feet x 4 feet minimum landing area at the top of the curb ramp, which has a 2% maximum slope in any direction. A 5 feet dimension is required for wheel chair foot rest swing if the landing area is adjacent to a vertical obstruction.
    6. Detectable warning panels are required when a sidewalk meets the highway, street, and signalized driveway where a vehicle is not intending to stop; they are not required on alleys and driveways, these are stop controlled or stop implied.
    7. The presence and correct installation of detectable warning panels (truncated domes) will be verified. The detectable warning panels shall contrast visually with the adjacent gutter, street, or sidewalk (either darker or lighter).

        a. Detectable warning panels will be cast-in-place when built with a new curb ramp and will be paid for by the sq. ft.

b. When a surface applied detectable warning panel is used on an existing curb ramp the bid pay item is "Detectable Warning Panel".

8. A transition of the curb ramp to the sidewalk, gutter, and street must be free of abrupt changes in height (no vertical changes over 0.25 inch).
9. The counter slope of the gutter or street at the foot of a curb ramp will be 5% maximum, perpendicular to the direction of pedestrian travel, for a distance of 2 feet as measured from the base of the curb ramp or landing edge at the street.
10. New sidewalk will be constructed only as required to match into the existing sidewalk, not to exceed 15 feet in length.

- Non-compliant curb ramps will be upgraded or reconstructed to current **NDOT** guidance (see Chapter Sixteen: Pedestrian and Bicycle Facilities, Section 8) and *PROWAG* (Ref. 17.6) standards.
- An exemption to the above requirements for *PROWAG* (Ref. 17.6) compliant curb ramps may be granted if:

1. The curb ramp/blended transition has been constructed to the standards to the maximum extent possible,
2. It is "technically infeasible" to construct a curb ramp or blended transition which meets all of the standards, **and**
3. There is an accessible alternate route approved by the municipality.

- "Technically infeasible" is defined by the Department of Justice in the 2010 ADA Standards for Accessible Design as "…or because other existing physical or *site* constraints prohibit modification or *addition* of *elements, spaces,* or features that are in full and strict compliance with the minimum requirements." (emphasis original to DOJ)
- An exemption to the construction of a curb ramp requires the **Roadway Design Engineer's** written approval in the project file. This exemption letter will document which aspects of the curb ramp were not built to the standards and why it is technically infeasible to meet all of the requirements of *PROWAG* (Ref. 17.6).
- If curb ramps are not provided, the designer ***must*** document in the plan-in-hand report or in a decision document in the project file (that there are no pedestrian facilities crossing the area of the project that will be altered.
- The designer will verify that raised medians in the urban section of a project adhere to *PROWAG* (Ref. 17.6) standards, providing pedestrian access across the street from curb ramp to curb ramp.
- Marked crosswalks shall be a minimum 6 feet wide.
- The maximum cross-slope at a yield or stop controlled crosswalk shall be 2%.
- The maximum cross-slope at a crosswalk that is not yield or stop controlled is 5%.
- The cross-slope of a mid-block crosswalk may be warped to match the street grade.
- The maximum running slope of a crosswalk, measured in the direction of pedestrian travel, is 5%.
- If traffic signals are being modified, the designer will coordinate the alteration/inclusion of accessible pedestrian signals at crosswalks with **Traffic Engineering** (See the Nebraska Department of Transportation Operating Instruction 60-10, "ADA Accessibility Requirements in Transportation Projects", Appendix B, "Selected NDOT Operating Instructions).

- If the project includes the resurfacing of on-street parking, the project should be reviewed to determine if it is possible to provide ADA parking (See *PROWAG*, Ref. 17.6, Sections R214 and R309).
- For ADA cost sharing information see Chapter Sixteen: Pedestrian and Bicycle Facilities, Section 13 and DOT-OI 60-11, "Municipal Cost Sharing" (Appendix B, "Selected NDOT Operating Instructions").
- For ADA access during construction see Chapter Sixteen: Pedestrian and Bicycle Facilities, Section 12.
- For additional information, see Chapter Sixteen: Pedestrian and Bicycle Facilities and the Nebraska Department of Transportation Operating Instruction 60-10, "ADA Accessibility Requirements in Transportation Projects" (Appendix B, "Selected NDOT Operating Instructions).

Bridges:

- Guardrail connections and bridge rail on the project will be evaluated and, if necessary, upgraded to current criteria. The designer should request a determination of the acceptability of the bridge rail by **Bridge** prior to the plan-in-hand field inspection.
- If the project includes an overlay of the bridge deck, the bridge rail will be a minimum 29 inches in height.

Railroads:

- Work on railroad right-of-way must conform to Title 415, Nebraska Administrative Code, Chapter 6 (Highway-Rail Crossings – Construction, Repair and Maintenance) and requires a special provision prepared by the **Railroad Liaison Office** in the **Intermodal Planning Division**.
- The designer should e-mail the **Intermodal Planning Division Railroad Liaison Engineer** with the Project C.N., Project No., Designer, and Designer's Phone Number for the initiation of the "Railroad Project Information Sheet" (Form DR-95) after the plan-in-hand.
- For PS&E turn-in, the designer should compute separate quantities for the work which is on railroad right-of–way (See Chapter Twelve: Cost Estimating & Funding, Section 1.E).

Lighting:

- The designer should request a review of state highway junctions for lighting warrants from the **Roadway Design Lighting Unit** (**Lighting**) before the plan-in-hand.
- Refer to DOT-OI 60-11, "Municipal Cost Sharing" (Appendix B, "Selected NDOT Operating Instructions") for cost sharing information.
- See Chapter Ten: Miscellaneous Design Issues, Section 10, for additional information.

Temporary Roads:

- See Chapter Fourteen: Traffic, Section 6.

Wetland Impacts and Environmental Permits:

- The designer will provide sufficient information to the **Environmental Program Manager** in **PDD** to determine if wetland delineation is required (e.g. culvert extensions or grading).
- See Chapter Thirteen: Planning and Project Development, Section 4, for further information.

Erosion Control

- See the *Drainage Manual* (Ref. 17.7), Chapter Two: Erosion and Sediment Control.

Seeding:

- Type B seeding for an overlay project should be based on the width of the estimated disturbance. Generally, seeding equipment works in 4 feet increments so an overlay project may only require a 4 feet or 8 feet width of Type B seeding (See Chapter Two: Erosion and Sediment Control, Section 6.A.1 of the *Drainage Manual*, Ref. 17.7, for further information).

Cost Sharing:

- See the Nebraska Dept. of Roads Operating Instruction 60-11, “Municipal Cost Sharing” (Appendix B, “Selected NDOT Operating Instructions”).

3. REFERENCES

17.1 American Association of State Highway and Transportation Officials, A Policy on Design Standards Interstate System, Washington, D.C., 2005.

17.2 American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets (the *Green Book*), Washington, D.C., 2011.

17.3 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards (*MDS*), Current Edition. (http://www.roads.nebraska.gov/business-center/lpa/boards-liaison/design-standards/)

17.4 Transportation Research Board, National Research Council, Special Report 214: Designing Safer Roads – Practices for Resurfacing, Restoration, and Rehabilitation (*TRB SR-214*), Washington, D.C., 1987

17.5 Nebraska Department of Transportation, Design Process Outline (*DPO*), Current Edition (http://www.roads.nebraska.gov/business-center/design-consultant/)

17.6 Public Right-of-Way Access Advisory Committee (PROWAAC), "2011 Draft Public Rights-of-Way Accessibility Guidelines" (*PROWAG*), Washington, D.C., 2011 (http://www.access-board.gov/)

17.7 Nebraska Department of Transportation, Drainage Design and Erosion Control Manual (*Drainage Manual*), Current Edition (http://www.roads.nebraska.gov/business-center/design-consultant/rd-manuals/)

17.8 Title 23 of the "Code of Federal Regulations" (*23 CFR 625*) (http://www.access.gpo.gov/nara/cfr/waisidx_02/23cfrv1_02.html)

17.9 Nebraska Department of Transportation, Standard/Special Plans Book, Current Edition. (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/)

17.10 American Association of State Highway and Transportation Officials, Roadside Design Guide, Washington, D.C., 2011.

Nebraska Department of Roads

Roadway Design Division – Policy Letter

Policy Number: **DES 17–01**

Approval Date: 6-5-17 By: _____ Roadway Design Engineer

Approval Date: 6-12-2017 By: _____ FHWA – Nebraska

This policy affects Roadway Design Manual: Chapters; One: Design Standards

Priority Commercial System: Shoulder Width

Purpose

The purpose of this policy is to address shoulder width on New & Reconstructed and Resurfacing, Restoration and Rehabilitation (3R) projects on the Priority Commercial System (PCS). This policy does not apply to curbed sections.

Policy

For **New and Reconstructed projects** on the Priority Commercial System with an ADT of at least 400 VPD but no more than 3,999 VPD, the minimum design standards for shoulder width and paved shoulder width is 8 ft. total shoulder width (6 ft. paved). If this policy is not followed a decision document shall be prepared for Assistant Design Engineer (ADE) approval. Factors to consider are:

1. System continuity,
2. Crash history attributable to shoulder width or to vehicles parked on the shoulders,
3. High heavy-truck volumes (250 Heavy Trucks per day),
4. Consultation with the District office, including anecdotal history of problems caused by parking on shoulders,
5. Alternative route for Interstate traffic,
6. Environmental impacts, and
7. Cost.

For **3R projects** on the Priority Commercial System, the minimum shoulder width shall follow the minimum design standard.

Implementation

The following will be eliminated from the Roadway Design Manual Chapter One Section 5.D.1: *The non-expressway portion of this system is being constructed with two 12 ft. (3.6 m) driving lanes and 10 ft. (3 m) shoulders, 8 ft. (2.4 m) of which is to be paved. In addition to the system as established, any route which has a design year traffic volume (the volume at the initial year of construction plus 20 years) of 3,000 ADT or greater will be developed with 8 ft. (2.4 m) paved shoulders. Bridges are to be widened to shoulder width.*

Sent to: NDOR Roadway Design, NDOR "Distribution B", and selected consultants.

The information contained in Appendix A: Project Numbering System, dated July 2006, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this appendix.

Nebraska Department of Transportation
Operating Instruction 60-4
April 12, 2000

PROJECT NUMBERING

1. **Purpose**: To provide policy for numbering highway construction projects. The office of primary responsibility is the Project Scheduling and Program Management Section. This DOT-OI supersedes DOT-OI 60-4 dated February 26, 1993.

2. All project numbers assigned since 1972 consist of three major parts:

A. In part one, the **Prefix** indicates the appropriation type or the highway system. See attachment #1.

B. The second part is the **Route Number/Zone** field, consisting of not more than four digits. For projects on the state highway system, the first three digits are the state highway **route number**. The final digit is the **zone** of the route in which the project begins. Zones are established for the state from west to east and from south to north. Each state highway is assigned a direction for zoning purposes. Zones for the interstate system differ from those on the rest of the highway system. See attachments #3 and #4. Projects off the highway system, but on a federal-aid route, use the four digit federal-aid route number as the second part of the project number. For projects off the state highway system, all four digits are in a single entity and have no relationship to highway route numbers or zones. They instead reference the county or indicate that the project is statewide.

C. Part three is the **Unit** number consisting of not more than four digits. Numbering is sequential within each zone by highway route number. Projects not on the highway system and federal-aid interstate projects begin their sequential series with number 1. Other federal-aid projects on the highway system begin their series with number 101. Highway system projects not using federal funds (including interstate) begin their series with 1001. Projects that contain four digits in part three of their project number ***do not*** involve federal funds.

When inputting project numbers into the various computer systems (PPM, Clarity), an eight character standard is used, consisting of the 4 digit Route/Zone field and the 4 digit Unit field. Prefixes, dashes and parenthesis are omitted and preceding zeros are used as placeholders, e.g.: EACIM-80-4(110) is coded as 08040110.

Prefix	Route Number	Zone	Unit	Written On Plans and Other Documents	Input into PPM, Clarity, Etc.
STPD	26	1	102	STPD-26-1(102)	02610102
BRO	7084		5	BRO-7084(5)	70840005
STPP	STWD*		25	STPP-STWD(25)	STWD0025

*Note that STWD references the location of the project (statewide) and is not part of the prefix.

3. The general types of project numbers include:

A. Projects on the state highway system are numbered using the highway number, zone and sequential number (in parenthesis), e.g.: NH-2-3(112). Projects on links and spurs use the state spur/link number and a sequential number, e.g.: STPD-S55G(101).

B. Urban system projects in cities of 5,000 or more population use the urban system (5000-6000 series) and the sequential number, e.g.: STPD-5044(3).

C. Federal-aid secondary system projects off the state highway system (major and minor collectors) use the system number and a sequential number, e.g.: STPE-2755(2). Major collectors are numbered from 2000-3000, and minor collectors have a 7000 series number.

D. Projects not on a federal-aid system use the county number and a sequential number, e.g.: STPB-55(110). Off-system county bridge projects use the county number preceded by “70” and a sequential number, e.g.: BRO-7055(125).

E. There are other miscellaneous projects, particularly those with federal-aid special funding, which use project numbers not included in these general guidelines. These numbers are assigned by FHWA and have no correlation to our numbering system.

Attachments:
#1 - Project Prefix Letters
#2 - Zone Map
#3 - Interstate Zones
#4 - Highway Numbers by Direction

Monty W. Fredrickson
Deputy Director-Engineering

Project Prefixes

Project Prefixes Federal-Aid Project Prefixes

Regular appropriation codes are shown for both the current (TEA-21) and previous (ISTEA) highway acts for reference.

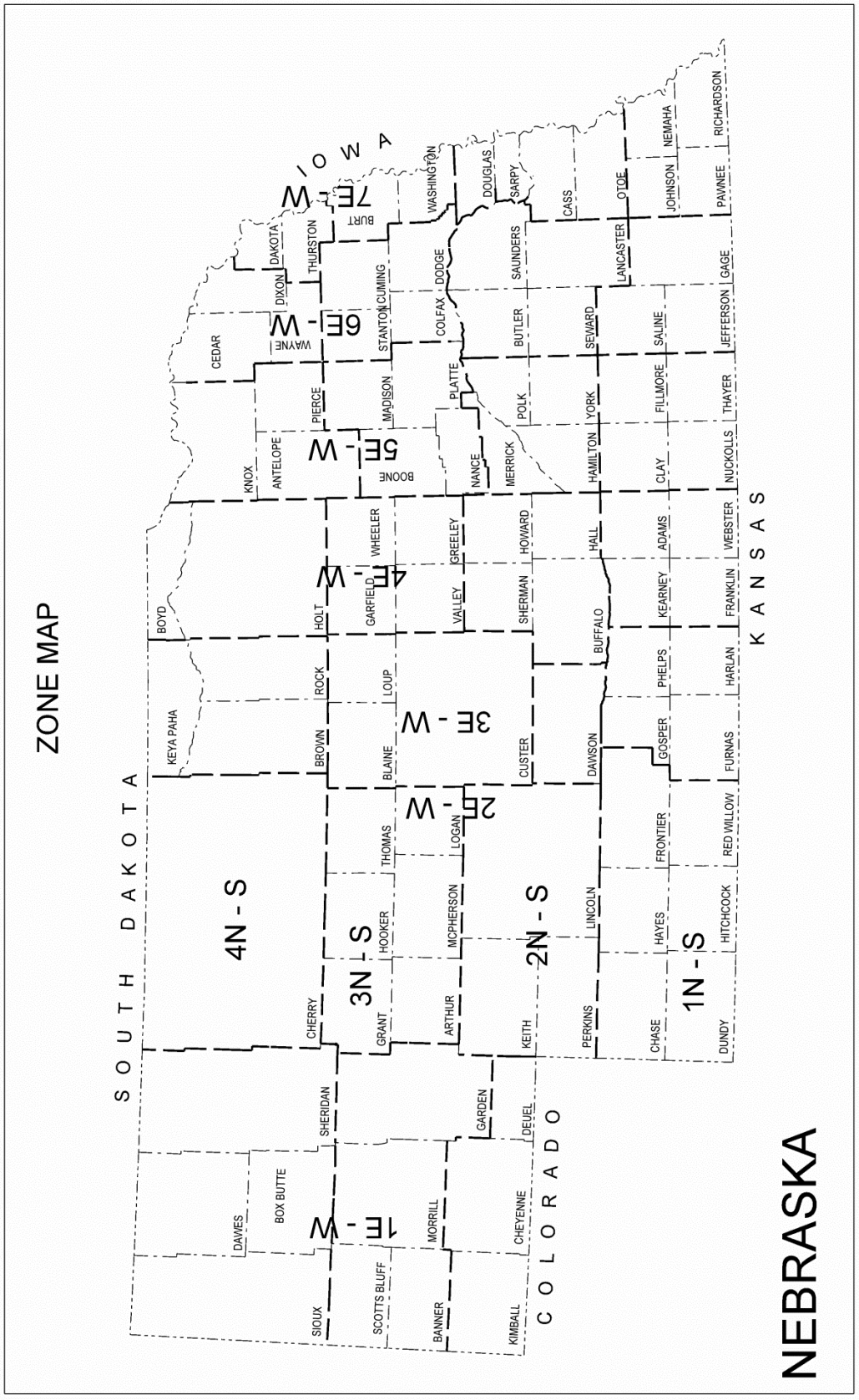
Appropriation Code					
Prefix	**Description**	**TEA-21 FY-98**	**ISTEA (FY92-97)**	**Advance Const. (EAC)**	**Federal Participation Rate**
IM	*Interstate Maintenance:* Resurfacing, rehabilitation or reconstruction of the interstate system. May *not* be used to add capacity.	Q01	04M	0AB	90%
NH	*National Highway System:* Used only on highways designated as part of the National Highway System, including the interstate.	Q05	315	0AC	80% (90% on the interstate if not used to add capacity)
BR BH	*Federal-Aid Bridge – On System:* Replacement (BR) or rehabilitation (BH) of bridges on the federal-aid highway system.	Q10 Q12	118 114	00F	80%
BRO BHO	*Federal-Aid Bridge – Off System:* Replacement (BRO) or rehabilitation (BHO) of off-system bridges.	Q11 Q12	117 114	00E	80%
Surface Transportation Program – Suballocations					
STPD	*Any area:* Generally used on federal-aid highways not on the NHS or interstate. (However, it can be used on those systems and any other systems for any of the purposes described in the following STP Suballocations.)	Q24	33D	0AW	80% (90% on the interstate if not used to add capacity)
STPP	*Safety – Hazard Elimination:* Safety improvements on any public road.	Q28	33P	0BC	80%
STPM	*Safety – Rail-Highway Crossings, Protective Devices:* Signals, gates, etc.	Q26	33M	0BA	80%
STPN	*Safety – Rail-Highway Crossings, Hazard Elimination:* Replacement of at-grade crossings with grade separation structures.	Q27	33N	0BB	80%
STPA	*Safety – Optional:* May be used for work described in any of the above three safety categories.	Q21	33A	0AR	80%
STPE	*Non-Urban Areas:* Allocated to counties for work on rural major and minor collector routes.	Q25	33E	0AX	80%
STPAA	*Urban Areas:* Allocated to first class cities (5,000 – 200,000 population.)	Q20	3AA	0BD	80%
STPC	*Urbanized Areas:* Allocated to cities with 200,000+ population.	Q23	33C	0AV	80%
STPB	*Transportation Enhancement:* Used for various enhancement activities, such as: --Providing pedestrian/bicycle/equestrian facilities --Acquisition of scenic/historic sites --Landscaping and other scenic beautification --Rehabilitation and operation of historic transportation buildings/structures --Preservation of abandoned railroad corridors --Archeological planning and research	Q22	33B	0AU	80%

Project Prefixes

Appropriation Code					
Prefix	**Description**	**TEA-21 FY-98**	**ISTEA (FY92-97)**	**Advance Const. (EAC)**	**Federal Participation Rate**
Other Miscellaneous Categories					
CM	*Congestion Mitigation and Air Quality:* Intended for use on projects to improve air quality and reduce congestion. Nebraska has no "non-attainment" areas, so it may be used for any STP or CM eligible project.	Q40	320	0AD	80%
IMD	*Interstate Maintenance Discretionary:* Special funds that may be allocated to states on a year-by-year basis. May be used for resurfacing, rehabilitating or reconstructing the interstate, including work that adds capacity.	Q02	31B		90%
B1A	*Bureau of Indian Affairs:* Projects on federal Indian reservations (Funds administrated by BIA)				80%
SPR	*State Planning and Research:* State planning and/or development and technology transfer (RD&T) activities.	Q55 Q56	081 086	0B5 0AP	80%
PL	*Metropolitan Planning:* Allocated to metropolitan planning areas to carry out the transportation planning process required by federal law.	Q45	085	0BE	80%
PLH FL	*Public Lands Highways – Discretionary and Forest Highways:* Projects within, adjacent to or providing access to areas served by public lands or forest highway.	413 414	19A		100%
DPS	*High Priority Projects:* Specific projects identified in the TEA-21.	Q90 Q92		0AG	80%
OM-AD	*Defense Access Roads:* Roads identified as needed for defense activities (missile roads.)	72__	72__		100%
ER	*Emergency Relief:* Emergency repairs and restoration of federal aid highways damaged by natural disasters.	098 099			80-100%
NCPD	*National Corridor Planning and Development Program:* Discretionary funds granted for planning, design and construction of corridors of national significance.				80%
SB	*Scenic Byways:* Planning, design and development of scenic byways programs.	Q97			80%

Project Prefixes

Federal-aid project prefixes used with previous highway acts		
Prefix	**Description**	**Appropriation Code**
TBCG	Timber Bridge Construction Grant	11P
DE, DPU	Demonstration Funds	362,363,366,367
F	Consolidated Primary	010
I	Interstate	042
IR	Interstate 4R	050
M	Urban System	W-32, W-36
RS	Rural Secondary	075
RRS	Rail-Highway Crossing – Hazard Elimination	138
RRP	Rail-Highway Crossing – Protective Devices	139
HES	Highway – Hazard Elimination	141
BWD	Bikeway Demonstration	633
RR	Railroad-Highway Crossing Demonstration	697
DP	Economic Growth Center	106
State Funded Project Prefixes		
Prefix	**Description**	**Comments**
5	Resurfacing, rehabilitation or reconstruction of state highways.	100% State Highway Cash Fund
SRR	Resurfacing, rehabilitation or reconstruction of roads into or within state parks and recreational areas.	100% SRR funds for roads within parks; 90% SRR, 10% county funds for exterior roads
NFG	State grade crossing funds used for crossing protective devices and closures.	100% NFG funds
TMT	*Train Mile Tax:* State tax on rail traffic used for constructing, rehabilitating, relocating or modifying railroad grade separation facilities.	Maximum 95% TMT funds to be used on any project
RD	Small projects of one or more of the following types: road profiling, armor coat, fog seal, maintaining municipal connecting links, joint and crack filling, asphalt and concrete patching.	100% State Highway Cash Fund
STR	Small projects involving structure work such as concrete box culvert construction, bridge deck repair and/or overlay, bridge structure repair and bridge deck preservation.	100% State Highway Cash Fund
MISC	Small projects involving such things as concrete slope protection, culvert repair, landscaping, intersection modification, channel structures, pedestrian walkways, scenic overlooks and minor grading.	100% State Highway Cash Fund
ELEC	Small electrical projects such as lighting, pedestrian signals and traffic signals.	100% State Highway Cash Fund



Attachment #2

INTERSTATE ZONES

Zone No.	Location	Interstate Route No.
1	Wyoming State Line – Sidney	80
2	Sidney – I-76	80
3	I-76 – North Platte	80,76
4	North Platte – Lexington	80
5	Lexington – Kearney	80
6	Kearney – Grand Island	80
7	Grand Island – York	80
8	York – West Lincoln	80
9	West Lincoln – Iowa State Line	80, 180, 480, 680
1	South Sioux City – Iowa State Line	129

HIGHWAY NUMBERS BY DIRECTION

Highway No.	Highway Direction	Highway No.	Highway Direction	Highway No.	Highway Direction
1	West-East	39	South-North	84	West-East
2	West-East	40	West-East	85	South-North
4	West-East	41	West-East	87	South-North
5	South-North	43	South-North	88	West-East
6	West-East	44	South-North	89	West-East
7	South-North	45	South-North	91	West-East
8	West-East	46	South-North	92	West-East
9	South-North	47	South-North	94	West-East
10	South-North	50	South-North	95	West-East
11	South-North	51	West-East	97	South-North
12	West-East	52	South-North	98	West-East
13	South-North	53	South-North	99	South-North
14	South-North	56	West-East	103	South-North
15	South-North	57	South-North	105	South-North
16	South-North	58	South-North	109	South-North
17	South-North	59	West-East	110	South-North
18	West-East	61	South-North	112	South-North
19	South-North	62	West-East	116	South-North
20	West-East	63	South-North	121	South-North
21	South-North	64	West-East	128	West-East
22	West-East	65	South-North	131	South-North
23	West-East	66	West-East	133	South-North
24	West-East	67	South-North	136	West-East
25	South-North	68	South-North	137	South-North
* 25A	South-North	69	South-North	138	South-North
26	West-East	70	West-East	159	West-East
27	South-North	71	South-North	183	South-North
29	South-North	73	South-North	250	South-North
30	West-East	74	West-East	275	West-East
31	South-North	75	South-North	275B	West-East
32	West-East	77	South-North	281	South-North
33	West-East	78	South-North	283	South-North
34	West-East	79	South-North	370	West-East
35	South-North	81	South-North	385	South-North
36	West-East	83	South-North		
38	West-East				

* Highway 25A will be considered as Highway 259 for programming purposes.

The last time **NDOT** established new project prefixes was with the passing of ISTEA in 1992. Some of the designations have not been carried into subsequent Highway Acts and will be updated. These prefixes will only be used on new projects as they are created, so there will be no need to revise agreements, plan sheets, etc. Here is a list of new prefixes and their corresponding appropriation codes:

Federally Funded Projects			
Former Prefix	New Prefix	Description	Appr Code
IM	IM	Interstate Maintenance	L010
NH	NH	National Highway System	L050
STPN/A	RRZ	Rail Highway Crossing Hazard Elimination	LS40
STPM	RRX	Rail Highway Protective Devices	LS50
	HRRR	HSIP-High Risk Rural Road	LS20
STPP	HSIP	Highway Safety Improvement Program	LS30
CM	CM	Congestion Mitigation	L400
PL	PL	Statewide Planning	L550
SPR	SPR	Statewide Plan Mandatory (Research)	L560
PL	PL	Metro Planning 1.25% Takedown	L450
BRO/BHO	BRO/BHO	Bridge Program - 15% Off	L110
BR/BH	BR/BH	Bridge Program 85% On/Off	L1C0/H1C0
	SRSP	Safe Routes to School Prog	LU10/HU10
	SRSI	Safe Routes to School Infr	LU20/HU20
	SRSP or SRSI	Safe Routes to School Either	LU30/HU30
STPB	ENH	STP-Enhancement	L220
STPC	LCLC	STP-Urbanized Areas > 200,000 (Lincoln)	L230
STPC	MAPA	STP-Urbanized Areas > 200,000 (MAPA)	L230
STPD	STP	STP-Flexible	L240
STPE	RUR	STP-Rural Areas < 5,000	L250
STPAA	URB	STP - < 200,000	L200
DPS/DPU	DPS/DPU	High Priority Projects (SAFETEA-LU)	HY10/HY20/LY10/LY20
	DPS/DPU	Transportation Improvements (SAFETEA-LU)	LY30
BRD	BRD	Bridge Discretionary	
IMD	IMD	Interstate Maintenance Discretionary	
State Funds Only			
Former Prefix	New Prefix	Description	
RD	RD	Maintenance Rehab (crack seal, joint seal, etc.)	
S	S	Other Miscellaneous Projects	
ELEC	ELEC	Lighting/Signal Projects	
SRR	SRR	State Rec Roads	
PM	PM	Preventive Maintenance	
PEP	PEP	Pavement Extension Program	

The information contained in Appendix B: Selected NDOT Operating Instructions (Formally Appendix F), dated July 2006, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this Appendix.

Nebraska Department of Transportation
Operating Instruction 45-1
February 15, 2000

UTILITY REHABILITATION NEGOTIATIONS

1. **Purpose:** To provide policy for negotiating the relocation and adjustment of utility facilities concerning the basis of payment to the utility and for requesting federal participation in the non-betterment costs. The office of primary responsibility for this DOT-OI is the Project Development Division. This DOT-OI supersedes DOT-OI 45-1 dated April 21, 1995.

2. Highway construction projects frequently require the revision and relocation of utilities. Reimbursable costs represent the eligible non-betterment expenditures of the utility required to accomplish these revisions and relocations. These expenditures may be paid on a lump sum or actual cost basis and with state funds only or, under certain conditions, federal participation may be requested. See Federal-Aid Policy Guides 23 CFR 645A, "Utility Relocations, Adjustments, and Reimbursement, and 23 CFR 645B, "Accommodation of Utilities."

3. Federal participation in utility agreements normally will be requested only under the following conditions, where:

A. Federal funds available to Nebraska would increase substantially. Generally, this would be the case if the federal appropriations type is one of the following: Interstate, Emergency Relief, Discretionary Bridge Replacement, Demonstration, or Defense Access.

B. Federal funds available to Nebraska are in danger of lapsing if not obligated.

C. A need exists to accelerate the obligation of federal funds to utilize obligation authority by administratively imposed deadlines.

D. Local contributors specifically request federal participation and would be required to provide a greater share of project costs if federal participation was not approved.

4. Subject to the approval of the Project Development Division Engineer, or the Roadway Design Division Engineer, the Utilities Engineer or Assistant Roadway Design Division Engineer may recommend the following actions:

A. Designation of various utility items as non-participating for federal funds on any project, regardless of appropriation type, when technical engineering and administrative difficulties indicate it would be impractical and uneconomical to request approval of federal participation, except when the use of state or local funds is illegal.

Operating Instruction 45-1

B. Negotiation of lump-sum agreements with utility companies when the non-betterment portion of the utility rehabilitation estimate is $25,000 or less and federal participation is not to be requested.

C. Negotiation of lump-sum agreements with utility companies in accordance with Federal-Aid Policy Guide 23 CFR 645.113 when the non-betterment portion of the utility rehabilitation estimate is $25,000 or less and federal participation is to be requested.

D. Processing actual cost agreement final billings of $25,000 or less as lump sum payments when federal participation is not to be requested (not requiring a contract audit).

Monty W. Fredrickson
Deputy Director-Engineering

Nebraska Department of Transportation
Operating Instruction 45-2
October 19, 1993

UTILITY AND RAILROAD PAYMENTS

1. **Purpose:** To provide policy for expediting payments to utility and railroad companies. The office of primary responsibility for this DOT-OI is the Project Development Division. This DOT-OI supersedes DOT-OI 45-2 dated April 17, 1991.

2. Highway construction projects frequently require the installation, revision, and relocation of utility and railroad facilities. Costs incurred are borne entirely by the companies until reimbursed by the state or other governmental subdivisions. This instruction is intended to minimize the time that company funds are tied-up in work related to department activities. Prompt partial and progress payments to utility and railroad companies will be made upon receipt of company billings. Retained amounts due on final billings will be paid promptly upon completion of applicable department or FHWA audit procedures.

3. **The Controller Division will:**

A. Make 90 to 95 percent partial payment to utility companies upon receipt of progress or final billings and a request from the Utilities Unit Engineer in the Roadway Design Division.

B. Make 90 to 95 percent partial payment to railroad companies upon receipt of progress or final billings and a request from the Railroad Liaison Engineer in the Intermodal Planning Division.

C. Make immediate and full payment to utility companies of "lump sum" type billings that are submitted in accordance with previously executed agreements or as recommended for payment by the Utilities Unit Engineer.

D. Forward a copy of each utility payment accounting coding document and a copy of each railroad final payment memorandum to the Project Development Division.

4. **The Project Development Division will:**

A. Advise the utility companies of their option of submitting periodic progress billings to avoid unnecessary tie-up of their funds pending submission of one final and complete bill.

B. Advise the railroad companies, but not necessarily as part of agreements, of their option of submitting progress bills to avoid unnecessary tie-up of their funds pending submission of final billings.

Operating Instruction 45-2

C. Include a requirement in agreements that railroads affix the following notice, or similar language, on all final billings: "This billing is rendered with the understanding that the proportionate shares of cost stated are complete and the final obligations of participants are subject to audit. Proportionate shares of audit citations will be promptly repaid to the participants by the railroad upon acceptance of final settlement offered by the Department of Roads."

Monty W. Fredrickson
Deputy Director-Engineering

Nebraska Department of Transportation
Operating Instruction 45-5
January 17, 2001

AGREEMENTS

1. **Purpose:** To provide policy for the preparation, distribution, and disposition of agreements between the department and an outside party. This DOT-OI supersedes DOT-OI 45-5 dated November 2, 1992. The office of primary responsibility is the Project Development Division.

2. Due to the extensive number of agreements, the variable nature of technical performance, and the governmental requirements originating in many different areas, the Project Development Division (PDD) will prepare, coordinate, distribute, monitor, and maintain departmental agreements, excluding those agreements associated with bid lettings, right-of-way acquisition, purchasing, and the contracts and bonds for highway construction. Those divisions which normally prepare their own agreements, or use a standard form of agreement, will submit prepared agreements to the PDD for review prior to execution by outside parties.

3. When necessary, managers will request that agreements be prepared by the PDD and will submit a DR Form 65, "Request for Agreement."

4. Agreements will be reviewed "in-house" by the Controller Division and PDD prior to execution by any party.

5. Except for standard agreements which have had prior review, all agreements prepared outside the PDD should be submitted to the PDD for review before negotiations are begun. When a standard agreement is revised, it should also be submitted for review.

6. The originating office is responsible for obtaining the signatures of parties outside the department. Following execution by an outside party, agreements will be **hand-carried** to the PDD for internal coordination.

7. Internal coordination will be accomplished by using a RDP Form 656-A, "Agreement Monitoring System - Agreement File Update." The originating office will complete the description and coordination portion of the form. The computer portion will be completed by the PDD.

8. Individuals to whom agreements are routed for coordination will promptly coordinate and have the agreement hand-carried to the next office indicated on the coordination sheet and immediately advise the PDD, via telephone, if he/she disagrees with the contents of the agreement or believes that further coordination with other offices is required.

9. Signatory responsibility for agreements is defined by DOT-OI 45-6.

Operating Instruction 45-5

10. Following execution by the department and approval (when necessary) of the FHWA, the PDD will coordinate with the originating office for the distribution of the agreements. The department's original, or a copy if the department is not a party to the agreement, will be retained in the PDD files. The PDD will then enter the basic data into the computerized agreement monitoring system.

11. Agreements retained in the PDD files will be microfilmed after ten years from the execution date. At that time, most originals will be destroyed. Agreement microfilm cards and a reader are available in the PDD for use by others.

12. The agreement number, which is a descriptive number indicating the originating office, agreement type, year, and sequence will be used by the PDD for filing purposes. Cross-reference listing by the agreement number, control number, and project number will be available in the PDD.

13. **Requirements for Agreement Preparation and Review:**

    A. **Offer, acceptance, and a "meeting of the minds":**

        (1) The preliminary definition of performance specifications is normally established through personal contact and written proposals.

        (2) Where federal financing is involved, it is imperative to caution against beginning work before receiving notice to proceed, since work performed before federal authorization is ineligible for federal reimbursement.

        (3) Failure of the contracting parties to interpret and understand all contract provisions identically tends to generate misunderstandings, disagreements, and legal problems. Accordingly, check each contract or agreement carefully for clarity and complete coverage of performance requirements as it affects each party to the contract.

        (4) A "closing conference" with all parties is highly recommended on agreements containing complex performance details to assure complete understanding before contract execution.

    B. **Cost Principles:** Managers will establish cost principles for use in determining the allowability of individual items of cost. These cost principles will be appropriately identified or referenced in each contractual document. If federal-aid is involved, cost principles will be those established by the applicable provisions of the governing Federal-Aid Highway Program Manual, grant agreement, Office of Management & Budget circular, other directives, and the contract cost principles and procedures set forth in the Federal Acquisition Regulations System (48 CFR, 1.31), as appropriate.

C. **Consideration:**

(1) Check each agreement to see if the following are clearly answered. What are the pay items? When will payment be made? How will the amount to be paid be determined? Who is to be paid and who pays? Form of payment, i.e., cash offset against cost sharing, etc.?

(2) In some cases, the requirement of consideration may be satisfied without monetary payment for work performance. An example of this would be obtaining covenants from counties, cities, and other political subdivisions to cause certain restrictions and to perform certain acts in consideration of the department making certain highway revisions either on its own behalf, or as an agent for the FHWA.

D. **Performance:**

(1) Extra care and attention in defining and describing the detailed work to be done will do much toward eliminating misunderstanding, extra correspondence, and the need for supplemental agreements. Check each agreement carefully to see if the following are clearly answered. What is to be done? When will it be done? Where will it be done? Who will do it? How will it be done?

(2) Attention should be directed to provisions in event of nonperformance.

(3) Where applicable, attention should be directed to provisions concerning the handling of credits for materials recovered.

E. **Authority:** Contracts and agreements should be thoroughly checked for accurate inclusion, reference, and compliance with applicable laws, rules, and regulations.

F. **Cost Sharing:** Contracts and agreements should be reviewed for clear definition of the participants, sharing formula, when participants contribute, and how participants contribute.

G. **Covenants:** Contracts and agreements should be reviewed for clear definition of stewardship, liability, inspection, audit permission, retention of records, Disadvantaged Business Enterprises, and nondiscrimination.

H. **Guidelines for Requesting Contract and Agreement Reviews from the Legal Counsel:**

(1) Agreements covering simple work performance and nominal amounts of consideration -- no review necessary.

(2) Standard agreements and contracts -- request a review once for form and legal sufficiency unless changed and after each state legislative session or issue/revision of applicable FHWA publications.

Operating Instruction 45-5

(3) Agreements and contracts involving complex provisions – review regardless of consideration amount.

(4) Formulation of policy is not a responsibility of the Legal Counsel. Questions involving policy will be taken to the applicable deputy director.

I. **Guidelines for Requesting Contract and Agreement Reviews by the Operational Analysis & Audit Division (OAAD):**

(1) Contracts exceeding $50,000 must be sent to the OAAD for a pre-award audit.

(2) Contracts not based on a firm, fixed price must go to the OAAD for a post-audit to determine the total allowable contract costs.

J. **General Guidelines:**

(1) Avoid indefinite or ambiguous language and be explicit. The terms "and/or" should never be used.

(2) Insure that each agreement includes all of the proper parties, but not more parties than necessary to perform the subject of the agreement.

(3) Do not automatically make the state a party to every agreement -- only when necessary.

(4) FHWA publications will be included by reference, as applicable.

Monty W. Fredrickson
Deputy Director-Engineering

Nebraska Department of Transportation
Operating Instruction 45-6
May 31, 2012

DELEGATION OF AUTHORITY

1. **Purpose:** To provide policy, delegate authority, and establish accountability for selected financial obligations and activities. This DOT-OI supersedes DOT-OI 45-6 dated September 10, 2009. The office of primary responsibility is the Controller Division.

2. **Annual Operating Budget:**

A. Division Heads and District Engineers, or their designee, are responsible for the preparation and management of their annual operating budget.

B. Deputy Directors are responsible for reviewing and approving the annual operating budgets for their respective areas of responsibility.

C. The Director – State Engineer will review and approve the Department's annual operating budget.

D. Any adjustments to the Division/District operating budgets must be approved by the Division Head/District Engineer and will be submitted to the Controller Division on an Allotment Change form BF-9. The Controller Division will request the approval of the Resource Manager, Deputy or Director for any adjustments deemed necessary.

3. **Six-Year Plan for Highway Construction:**

A. The Deputy Director-Engineering, in consultation with the State Highway Commissioners, District Engineers, and appropriate Division Heads, is responsible for annually updating the Nebraska Surface Transportation Program.

B. The Nebraska Surface Transportation Program and changes thereto must be submitted to the Director for approval.

4. **Computer Development Projects:**

Computer technology project ideas and proposals must be submitted to the Business Technology Support Division (BTSD) Project Management Officer (PMO) using the Business Technology Project Proposal form provided by BTSD. The PMO will assign a Project Manager and they will work with the submitter to fully understand the desired outcome of the project and develop preliminary estimates of time, cost and resources to complete the project. The project proposal will be forwarded to the Information Technology Management Team (ITMT) for their approval. The project sponsor(s) may be invited to a meeting to review the project proposal with the ITMT. The ITMT will then decide to either approve or reject the project proposal.

If the project proposal is approved, a BTSD Project Manager will begin working with the submitter to establish the project team, develop the project charter and begin collecting business requirements. Once the project charter has been completed, it must be approved by the project sponsor(s). If the project charter includes a major change or addition to the project scope as determined by the BTSD Management Team, it will be forwarded to the ITMT for their approval. The project sponsor(s) may be invited to a meeting to review the project charter with the ITMT. The ITMT will then decide to continue with the project, or go back to the original project scope or reject the project.

The ITMT consists of the Deputies, Director and BTSD Manager.

The BTSD Management Team consists of the BTSD Manager, Project Management Officer and Technical Services Officer.

The BTSD Project Manager will be the person to manage the project based off of the BTSD Project Management Methodology and will be assigned by the BTSD Management Team.

5. **Contracts and Agreements:**

A. Agreements related to state highway projects with cities, counties, utilities, and irrigation districts shall be executed by the Division Head responsible for administering the agreement. District Engineers shall provide their concurrence for these agreements. Unusual or complicated agreements may be referred to the appropriate Deputy for signing. Relinquishment agreements will be executed by a Deputy Director in accordance with DOT-OI 60-13.

B. Agreements related to state highway projects with federal agencies, state agencies, and other states must be submitted to the Director, or appropriate Deputy Director in the Director's absence, for execution. **Exception:** A Deputy Director or the appropriate Division Head, responsible for administering the agreement, may execute routine agreements.

C. Other agreements (such as service, research, registered land surveying, underground fuel leak investigations, and consultant agreements) will be executed by the Division Head or District Engineer responsible for administrating the agreement.

D. Construction contracts awarded through the letting process will be executed by the Deputy Director-Engineering, Construction Engineer or Contract Lettings Engineer.

E. Construction contract progress estimates, final payments, tentative acceptance and as-built plans shall be approved by the District Engineer, the District Construction Engineer or Assistant District Construction Engineer in the absence of the District Engineer.

F. The below individuals shall have approval to execute construction project change orders and supplemental agreements for the following limited amounts:

(1) District Engineer or District Construction Engineer: $0.00 - $100,000

(2) Construction Engineer: $100,000 - $250,000

(3) Deputy Director – Operations or Deputy Director – Engineering: over $250,000

G. District Engineers, District Construction Engineers or District Operations and Maintenance Managers shall approve all NDOT let capital facilities project pay estimates, change orders and supplemental agreements.

H. The Local Projects Engineer shall approve the following requests, agreements and supplemental agreements:

(1) All Local Public Agency (LPA) Project Programming Requests, DR-530.

(2) All LPA project program agreements and supplemental project program agreements.

(3) Consultant agreements and supplemental agreements as to form, for preliminary engineering and NEPA services for LPA Federal-aid projects and for Recreation Road projects. Local Projects Division Sections Heads may approve these agreements in lieu of the Division Head.

(4) All NE-LTAP agreements with NDOT and FHWA. Design exceptions for LPA's and public interest letters (ROW conditional certifications, force account work, sole source purchases) for LPA's shall have final approval by the Deputy Director – Engineering.

I. The Construction Division Head or designee shall approve as to form consultant professional services agreement and supplemental agreements for construction engineering and design services during construction for LPA Federal-aid projects and for Recreation Road projects.

J. State Highway Improvement Programming Requests, DR-73, shall be approved by the Deputy Director – Engineering and the Program Management Engineer. Approval by the Deputy Director – Engineering may be delegated to specific Division Heads, as shown below, when the improvement request involves their functional areas.

(1) Resurfacing, Restoration and Rehabilitation (3R), new and reconstruction – Roadway Design Engineer.

(2) Maintenance – Materials and Research Engineer.

(3) Traffic Signals/Sign Projects – Traffic Engineer.

(4) Bridge Only Projects – Bridge Engineer.

(5) Railroad Upgrade/Circuitry/Warning Devices – Intermodal Planning Division Engineer.

(6) Right-of-Way Only Projects – Right of Way Manager.

(7) Intermodal Transportation System Projects – Operations Manager.

K. All State Transportation Improvement Program requests (STIP) shall be approved by the Program Management Engineer or the Highway Projects Funds Manager.

L. The following documents shall be approved by the Right-of-Way Manager or to a specific Section Head in the Right-of-Way Division such as the Right-of-Way Design Engineer, Chief Appraiser, Chief Negotiator/Relocation Supervisor, Highway Beautification Supervisor or Property Management Supervisor.

(1) Consultant Service Contracts

[a] Right-of-Way Design

[b] Title Search

[c] Appraisal and/or Appraisal Review

[d] Relocation Assistance

(2) Acquisition contracts for the purchase of right-of-way.

(3) Demolition contracts for the demolition of buildings/improvements in the right-of-way.

(4) Clearing/grubbing contracts let through the Right-of-Way Division for tree removal.

(5) Agreements for state services. *(Right-of-Way Division only)*

(6) Right-of-Way certificates

M. Approval authority for various Local Public Agency documentation shall be delegated to section heads in the Right-of-Way Division as follows, with one exception. Local Public Agency Right-of-Way certificates shall be approved by the Right-of-Way Division Manager.

(1) Right-of-Way Plan approval delegated to the Right-of-Way Design Engineer.

(2) Preliminary Right-of-Way Estimate approval delegated to the Chief Appraiser.

(3) Appraisal/Appraisal Review approval delegated to the Chief Appraiser.

Operating Instruction 45-6

(4) Relocation Assistance delegated to the Chief Appraiser/Relocation Supervisor.

(5) Acquisition approval delegated to the Chief Negotiator/Relocation Supervisor.

(6) Project Review delegated to the Right-of-Way Local Public Agency Coordinator.

6. **Miscellaneous:** The Project Concept Review (engineering review) for each state highway construction project must be approved by the District Engineer, the Roadway Design Engineer and the Deputy Director-Engineering.

Mostafa Jamshidi, P.E.
Deputy Director – Operations

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Nebraska Department of Transportation
Operating Instruction 60-9
April 24, 2012

CORRIDOR PROTECTION

1. **Purpose:** To provide policy for establishing corridor protection on state highways and notifying the public that corridor protection has been filed. The office of primary responsibility for this DOT-OI is the Right-of-Way Division. This DOT-OI supersedes T-OI 60-9 dated April 17, 2009.

2. Highways in areas having the potential to develop prior to a planned highway improvement will be reviewed for corridor protection as defined in Sections 39-1311 through 39-1311.05, Nebraska Statutes. If there is a need for corridor protection, a recommendation will be made by the Project Development Division, Roadway Design Division, Right-of-Way Division, or District Engineer.

3. The following are required before initiating corridor protection for a project on a **new alignment**: (a) a location public hearing, (b) if applicable, FHWA approval of the draft environmental impact statement, (c) a State Highway Commission recommendation, and (d) approval by the Governor. For a project on an **existing alignment**, the above requirements are unnecessary in order to initiate corridor protection.

4. The Project Development Division, Roadway Design Division, or Property Management Section of the Right-of-Way Division will write a letter to the Right-of-Way Division Manager, through the Deputy Director - Engineering, requesting that corridor protection procedures be initiated on the proposed project (see attachment). Copies of the letter will be sent to the Project Development Division, Roadway Design Division, District Engineer, Property Management Section, and Right-of-Way Design Section of the Right-of-Way Division.

5. For projects using an existing alignment for which it is deemed necessary to file corridor protection, a strip 300 feet wide will be designated on both sides of the existing right-of-way. In the case of projects on a new alignment, a strip 400 feet wide on both sides of the proposed centerline will be designated for corridor protection. These widths are guidelines and may vary depending on the terrain and design. Projects will have corridor protection procedures initiated after the project concept and alignment has been defined.

6. The Right-of-Way Design Section will begin title research and prepare corridor protection maps after the corridor centerline, length, and width have been established by joint action of the Project Development Division, Roadway Design Division, and Right-of-Way Division. After a corridor protection plan is completed by the Right-of-Way Design Section, said plan will be sent to the Property Management Section.

7. The Property Management Section will file the corridor protection plan with the appropriate city and/or county officials as outlined in Sections 39-1311 through 39-1311.05, Nebraska Statutes. A signed receipt will be obtained from the appropriate governmental official receiving the corridor protection plan, acknowledging that such plan has been received.

Operating Instruction 60-9

8. The Property Management Section shall send an annual notice to each zoning authority and all utility companies as listed with the Utilities Unit of the Roadway Design Division, where corridor protection is currently filed. This notice shall be prepared in April of each year.

9. After corridor protection has been filed, functional plans will be prepared to determine the right-of-way requirements. After the functional plans are completed, they will be reviewed to determine if an amended corridor protection plan should be filed. An amended corridor protection plan is filed in the same manner as an original filing.

10. The Property Management Section will forward copies of the corridor protection map and the signed filing receipt to the Project Development Division, Roadway Design Division, District Engineer, and Highway District Right of Way Permits Officer.

11. At appropriate locations along the proposed highway project, the district engineer will erect signs which are visible to the public and which state that corridor protection has been filed.

12. The Property Management Section shall obtain approvals for the release of a corridor protection project from the District Engineer, Roadway Design Engineer and the Project Development Engineer on an annual basis. Such requests for release shall be routed in January of each year.

13. The Property Management Section will promptly notify the appropriate city and/or county official of corridor protection release after receiving approval from the District Engineer, Roadway Design Engineer and the Project Development Engineer.

Attachment #1 of 1

Randall D. Peters, P.E.
Deputy Director-Engineering

Operating Instruction 60-9

DATE

TO Right-of-Way Division Manager

FROM Location Studies Section Engineer _____

THRU Project Development Division Engineer _____
Deputy Director-Engineering _____

SUBJECT Request for Corridor Protection
Project No.
Location:
C.N.

The design of the project (_____) will be along 1) the existing highway alignment, 2) on new alignment. Corridor protection is needed for the area annotated on the attached map. Notes: (that corridor protection has already been established along US-75 south of the N-2 junction.)

After concurrence by the deputy director, please initiate the process to provide corridor protection at this location. The Project Development Division will supply additional information as may be necessary.

GEK/60-9

Attachment

xc: Project Development Division
Roadway Design Division
District Engineer
Property Management Section
Right-of-Way Design Section

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Nebraska Department of Transportation
Operating Instruction 60-10
May 13, 2009

ADA ACCESSIBILITY REQUIREMENTS IN TRANSPORTATION PROJECTS

1. **Purpose:** The State of Nebraska, Department of Roads, (NDOT), will include accessibility features in applicable construction and maintenance projects or activities on the transportation systems for which it has jurisdictional responsibility as required by the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 (ADA) and as further defined and clarified in the Americans with Disabilities Act Accessibility Guidelines (ADAAG) https://www.access-board.gov/index.php. The office of primary responsibility is the Roadway Design Division. This DOT-OI supersedes DOT-OI 60-10 dated April 28, 2009.

2. **Scope:** This DOT-OI establishes policy for accessibility of pedestrian facilities on street or highway projects on the State Highway System, the National Highway System (NHS), and for local projects funded in whole or in part with state or federal highway funds. This DOT-OI shall be considered in conjunction with DOT-OI 60-11 which details the financial responsibilities of project participants.

   A. **Projects or Activities Subject to the Requirements of this Policy:**

      (1) New Construction projects (Section 3A)

      (2) Reconstruction projects (Section 3B)

      (3) Other construction projects that meet any of the following criteria (Section 3C):

         (a) Pavement overlays with a design thickness of 1.5 inches or greater

         (b) Pavement repair or patching that requires replacement of curb within a crosswalk that does not currently have a curb ramp

      (4) Traffic signal installation or reconstruction (Section 3D)

      (5) Construction Projects on Local Roads and Streets (Section 3E)

      (6) Roadway Maintenance Activities (Section 3F)

      (7) Construction Authorized by Right-of-Way Permits (Section 3G)

B. **Projects or Activities Excluded From the Requirements of this Policy:** The following projects or activities are excluded from the requirements of this policy provided that the work does not create an elevation difference greater than 0.5 inches at the gutter line in a crosswalk.

(1) Constructing chip seals, sand seals, microsurfacing, fog seals or armor coats

(2) Patching or repairing potholes

(3) Striping or re-striping roadways including crosswalks

(4) Maintaining, repairing, replacing or upgrading roadside safety devices such as guardrail or median barrier

(5) Maintaining and repairing traffic signals as further identified in Section 3D

(6) Maintaining, repairing, replacing or upgrading permanent traffic control signs and devices

(7) Constructing overlays by milling and resurfacing with a design thickness of less than 1.5 inches

(8) Placing overlays with a design thickness of less than 1.5 inches

(9) Pavement repair or patching that does not require replacement of curb within a crosswalk

(10) Maintaining or repairing roadside shoulders

(11) Sealing pavement joints and cracks

(12) Grinding or profiling pavement surface

(13) Patching or repairing of utility pavement cuts

(14) Constructing, maintaining, repairing, replacing or upgrading of roadway lighting

(15) Maintaining or repairing drainage systems

(16) Retrofitting pavement with dowel bars

(17) Repairing or replacing sidewalk panels

(18) Other work not specifically covered by Section 3

Although the above listed Projects or Activities are exempt from the requirements of this Policy, any Project or Activity that requires the closure of a sidewalk shall conform to the requirements of Section 4.

3. **Accessibility Policy for Applicable Projects or Activities:** The following shall apply to projects or segments of projects.

   A. **New Construction Projects** – New construction projects are constructed in a new location and are designed to meet the new and reconstructed requirements of the Nebraska Minimum Design Standards. Accessibility features will be included to the extent required by the AADAG.

   B. **Reconstruction Projects** – Reconstruction projects are projects designed to conform to the new and reconstructed requirements of the Nebraska Minimum Design Standards in an existing location of a roadway. Accessibility features will be included to the extent technically feasible as provided by the AADAG.

   C. **Other Pavement Projects** – Other pavement projects include:

      - Pavement overlays with a design thickness of 1.5 inches or greater
      - Pavement repair or patching that requires replacement of curb within a crosswalk that does not currently have a curb ramp

      The following subsections apply to other pavement projects:

      (1) **Curb Ramps** – Curb ramps will be constructed within project limits. Curb ramps should be constructed, or reconstructed when necessary, whenever an activity listed in Section 2.A. alters the pavement in a crosswalk. When an activity causes a differential in elevation in gutter line at a crosswalk with a curb ramp in excess of 0.5 inches, the differential must be eliminated.

      (2) **Landing Area of the Curb Ramp** – Whenever a new curb ramp is installed as a part of a project, the landing area on the sidewalk side of the curb ramp will be evaluated to identify and implement, if reasonable, other improvements to provide an open and useable landing area. For example, reasonable steps should be taken to relocate signs and other objects to a location outside of the landing area.

      (3) **Sidewalk** – New sidewalks will not ordinarily be installed and existing sidewalks will not ordinarily be replaced except as necessary to create a transition from the new curb or landing area to the adjacent sidewalk. Based on Neb. Rev. Stat. §§ 39-2105 and 39-1339, generally, cities and villages have the duty to construct, operate, and maintain sidewalks and curb ramps along the state highway system within the corporate limits.

      (4) **Driveways** – Ordinarily, driveways will not be replaced or reconstructed as a part of this policy.

D. **Installation or Reconstruction of Traffic or Pedestrian Signals** – The following shall apply when a traffic signal is installed or rebuilt and pedestrian or bicycle traffic is expected to be present within the next five years:

(1) Assess the need and install accessible pedestrian signals with the work when necessary.

(2) Install curb ramps necessary for the proper functioning of the traffic signal.

(3) Install sidewalks to connect the curb ramps to the existing pedestrian routes. If no connecting sidewalks currently exist within the limits of the project, the NDOT shall build sufficient sidewalk to access the pedestrian push button and enter into an agreement for the local entity to complete the sidewalks at a later time.

The following shall apply when a pedestrian or school crossing traffic signal is installed or reconstructed:

(1) Assess the need and install accessible pedestrian signals with the work when necessary.

(2) Install curb ramps necessary for the proper functioning of the traffic signal.

(3) Install sidewalks to connect the curb ramps to the existing pedestrian routes. If no connecting sidewalks currently exist within the limits of the project, NDOT shall enter into an agreement for the local entity to complete the sidewalks.

Traffic signal, pedestrian signal or school crossing signal installation or reconstruction completed by a municipality or as part of a right-of-way permit or agreement shall meet the requirements of this section. In addition, work that is performed by a developer as a part of a right-of-way permit shall include the construction of all necessary connecting sidewalks or trails.

When a signal is installed, or reconstructed, the need for accessible pedestrian signals shall be studied and if warranted integrated into the pedestrian push button to the extent required in Public Rights-of-Way Accessibility Guidelines (PROWAG).

For the purposes of this policy, reconstruction of a traffic signal shall not include routine maintenance, repair of the traffic signal, replacement of signal heads, replacement of any cabinet components, or replacement of poles, mast arms, signal components or controller cabinet.

Traffic signal installations at locations where pedestrians are not allowed to cross should have signs indicating no crosswalk. Traffic signal installations at locations where pedestrians are not expected within the next five years should not include the installation of pedestrian signals unless there is an engineering basis for such installation.

E. **Construction Projects on Roads and Streets Off the State Highway System** – Local street or road projects funded in whole or in part with federal or state funds or activities on the NHS regardless of funding must be designed and constructed in compliance with this policy.

(1) The local entity has a duty to ensure that the project plans and specifications comply with the applicable requirements. NDOT is authorized, but not required, to confirm the local entity's completion of its duty under this paragraph.

If the local entity declares it is not technically feasible to comply with a particular accessibility requirement, the local entity shall submit to the NDOT Local Projects Engineer documentation from a professional engineer licensed to practice in the State of Nebraska that describes how meeting the specific requirement is technically infeasible and a design plan showing how the local entity intends to make the facility accessible to the maximum extent feasible.

The Local Projects Engineer shall review and approve or deny the proposed design plan. Any deviations from the ADAAG must meet the test of technically infeasible.

(2) The NDOT will apply the requirements of this document in the following manner:

(a) Each agreement between NDOT and a local entity shall contain the following language:

"The local entity shall comply with the requirements of the Rehabilitation Act of 1973 and Title II of the Americans with Disabilities Act of 1990 (ADA), and applicable federal regulations and standards to the extent required by the policy "ADA Accessibility Requirements in Transportation Projects."

(b) The local entity shall not submit a project for letting unless it or its consultant has confirmed that the project is in compliance with the ADA and ADAAG.

(c) The local entity shall certify to NDOT that the project has been constructed in substantial compliance with the plans and specifications and that the completed construction complies with the requirements of Title II of the ADA, applicable federal regulations, and the ADAAG to the extent required by this policy.

F. **Roadway Maintenance Activities** – Generally, maintenance activities (Section 2B) are not alterations and are not subject to the requirements of this policy except to the extent specifically identified below.

(1) Curb ramps shall be installed when pavement repair or patching requires the replacement of a curb within a crosswalk that does not have existing curb ramps.

(2) The accessibility of a crosswalk will be restored to pre-activity conditions whenever surface maintenance of the highway causes a 0.5 inch differential in the surfacing within the crosswalk. The 0.5 inch differential will need to be eliminated either by tapering or grinding.

G. **Construction Authorized by Right-of-Way Permits** – Right-of-way permits issued or agreements entered into by NDOT including the construction or modification of pedestrian facilities shall contain the condition that the permittee will comply with the requirements of this policy, applicable federal regulations, and the ADAAG. Permits shall not be issued for work until an engineer, licensed to practice in the State of Nebraska, has certified to NDOT that the plans comply with this policy. NDOT is authorized, but not required to review the plans to confirm compliance with this policy. Traffic Impact Studies will be required to determine whether pedestrians are expected to be present at the site of the permitted construction and if so, what accessible pedestrian facilities are required. If the project is within the corporate limits of a municipality or its extra-territorial jurisdiction, the applicant should coordinate the need for constructing pedestrian facilities with the municipality. When accessible sidewalks or other pedestrian facilities are not constructed as part of a permitted project within the corporate limits of a municipality or its extra-territorial jurisdiction, the applicant shall enter into an agreement with the municipality stipulating the responsibility for completion of the accessible pedestrian facilities when required by this policy. The NDOT District Engineer or their designee has the right, but not the duty to verify through on-site inspection that the ADA facilities as constructed meet the requirements of the ADAAG and Public Rights-of-Way Accessibility Guidelines (PROWAG).

4. **Temporary Accessible Pedestrian Facilities:** Temporary accessible pedestrian facilities should be constructed when any primary accessible route or crossing will be blocked.

The person or entity in charge of the project or activity shall determine whether any of the pedestrian facilities within the limits of the project are used as a primary accessible route across the project or to an adjoining commercial, retail, medical or governmental property.

A primary accessible route or crossing is (a) a moderate to heavily used accessible crosswalk that serves as a connector between businesses with regular pedestrian traffic, or between parking areas and business, medical or governmental buildings dependent on such parking or (b) a public sidewalk used as a part of an accessible route to a business, when there is no reasonable alternate accessible route for customers traveling to that business.

In a business district, provision for one primary accessible crossing through the work zone shall be made at least every two blocks.

Temporary accessible pedestrian facilities should include accessibility features as practicable and reasonably consistent with the features present in the existing pedestrian facility.

Blocked sidewalks and re-designated accessible routes shall be marked in accordance with Section 6.D. of the MUTCD.

5. **Design Standards:** NDOT adopts the ADAAG as the design standard to be used when facilities are designed pursuant to this policy. NDOT will design to the standards of the Public Rights-of-Way Accessibility Guidelines (PROWAG) whenever the requirements of the PROWAG exceed the requirements of ADAAG. NDOT and FHWA anticipate that the PROWAG will be published as a final rule and be incorporated into the Federal Regulations. In the event the Federal Regulations are revised to establish PROWAG as a design standard, NDOT shall meet its requirements. FHWA has indicated in a memo dated January 23, 2006 that the PROWAG is the state of the practice and shall be used for design except when the ADAAG is more restrictive.

6. **Resolving Accessibility Complaints:** It is the District Engineer's responsibility to resolve complaints concerning the accessibility of pedestrian facilities on highway right-of-way. Complaints shall be handled in an expeditious manner to ensure the timely resolution of all complaints. Complaints received in offices outside the District Office will be sent to the attention of the District Engineer for investigation and resolution. When received in the District, a copy of the complaint will be forwarded to the State of Nebraska ADA Contact, 301 Centennial Mall South, Mall Level, P.O. Box 94905, Lincoln, NE 68509-4905, the NDOT Civil Rights Coordinator in the Human Resources Division and to the Roadway Design Engineer. The DAS Statewide Civil Rights Coordinator is responsible for monitoring the resolution of these complaints. The Roadway Design Division will function as a resource during resolution of the complaints. The NDOT Civil Rights Coordinator shall develop and update forms for the Pedestrian Accessibility Complaint Process and Request for Modification Process. These documents along with the State's ADA Complaint Procedure are available on the Department's web site or from the NDOT Civil Rights Coordinator.

7. **Technically Infeasible:** The ADA provides a limited exception to meeting the accessibility requirements for projects and activities altering an existing facility when it is technically infeasible to meet those requirements. Section 4.1.6 (1) (j) of the ADAAG states as follows:

   EXCEPTION: In alteration work, if compliance with Section 4.1.6 is technically infeasible, the alteration shall provide accessibility to the maximum extent feasible. Any elements or features of the building or facility that are being altered and can be made accessible shall be made accessible within the scope of the alteration.

Operating Instruction 60-10

'Technically infeasible' is defined in the ADAAG as follows:

Technically Infeasible. Means, with respect to an alteration of a building or a facility, that it has little likelihood of being accomplished because existing structural conditions would require removing or altering a load-bearing member which is an essential part of the structural frame; or because other existing physical or site constraints prohibit modification or addition of elements, spaces, or features which are in full and strict compliance with the minimum requirements for new construction and which are necessary to provide accessibility.

After exhausting all reasonable alternatives, it may sometimes be determined under this policy that strict adherence to all accessibility requirements may not be technically feasible. A design that does not meet the requirements may be allowed when consistent with this section.

A. The following is a nonexclusive list of situations when an exception may be considered:

   When ADAAG slope requirements cannot be met because of the difference in elevation between the highway and:

   (1) the floor elevation of existing buildings or structures;

   (2) the topography or geography of the area adjoining the project;

   (3) the elevation of intersecting streets and roads.

   When building the project in strict compliance with the ADAAG would cause:

   (1) the project to encroach on an environmentally sensitive or protected area;

   (2) the project to not conform with minimum design standards;

   (3) the project to negatively affect historic property, park lands, tribal lands or other similar properties;

   (4) an adverse effect on the safety of the traveling public.

B. In determining whether a finding of technical infeasibility under the ADAAG should be granted, the NDOT may consider the availability of a reasonable alternate accessible route.

C. When it is asserted that compliance with a particular standard is technically infeasible, documentation shall be submitted to the NDOT Roadway Design Engineer that describes why all the requirements cannot be met and providing a design complying to the fullest extent possible. The request for an exception shall provide all necessary facts showing that a design in strict adherence would qualify as technically infeasible. The request shall include a complete description of the work considered to be beyond the scope of the transportation improvement that would be required. Cost to make a facility accessible is a consideration but is not a determining factor.

D. The Roadway Design Engineer has the authority to approve or deny requests by NDOT and others for an exception based on a finding of technical infeasibility.

8. **Maintenance of Accessible Facilities:** Based on Neb. Rev. Stat. §§ 39-2105 and 39-1339, generally, cities and villages have the duty to construct, operate, and maintain new and existing sidewalks and curb ramps along the state highway system within the corporate limits. Construction, operation, and maintenance of facilities constructed outside the corporate limits shall be addressed by agreement with the local agency or the Sanitary Improvement District.

9. **Training:** The NDOT will provide training required to implement this policy.

10. **NDOT Publications:** The NDOT Roadway Design Manual and Standard/Special Plans, the NDOT Construction Manual, the NDOT Right-of-Way Manual and the NDOT Maintenance and Operations Manual shall be amended or supplemented by the Division responsible for each manual as appropriate to provide guidance for ADA accessibility issues.

11. **Documentation:** Documentation of project specific decisions related to accessibility shall be kept in the project records and archived as required by the records retention policy. Non-project related decision documents shall be retained in the appropriate file in the District and archived according to the records retention policy. All documentation shall be copied to the appropriate folder in the NDOT document management database.

Monty W. Fredrickson
Deputy Director-Engineering

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Nebraska Department of Transportation
Operating Instruction 60-11
December 3, 2013

MUNICIPAL COST SHARING

1. Purpose: To provide policy for the calculation of the municipal share of project costs for projects on **non-freeway** state highways located within or adjacent to the corporate limits of a municipality. Project costs include costs for preliminary engineering, eligible utility rehabilitation, construction, right-of-way and construction engineering. This policy applies to all **non-freeway** state highway projects including: "New and Reconstructed" projects, "Resurfacing, Restoration and Rehabilitation" (3R) projects, and "Maintenance" projects. This policy does not apply to projects determined by the Department to be "wants" or economic development projects. Projects classified as "wants" are projects that do not satisfy a state highway transportation need or that exceed the recognized need. Economic development projects are projects that are being built primarily to accommodate adjacent economic development. The office of primary responsibility for this DOT-OI is the Roadway Design Division. This DOT-OI supersedes DOT-OI 60-11 dated May 5, 2011. This policy is in compliance with and supplementary to Nebraska Revised Statutes.

2. Statutory References: Neb. Rev. Stat. §§ 39-1339 and 39-2105 (see Attachment A).

3. State Highways Abutting, Adjoining or Adjacent to the Municipal Corporate Limits:

A. In accordance with Sections 5, 6, and 7, a municipal corporation will be required to participate in the cost of the entire width of a project if:

(1) A portion of a state highway abuts, or adjoins the corporate limits of the municipality, or

(2) A portion of a state highway that is adjacent to the corporate limits when it appears to the Department that the state highway is being used by municipal traffic as if it were within the corporate limits of the municipality.

B. Apportionment of costs will be based upon the municipal corporate limits existing on the date that the department signs the municipal agreement.

4. Agreements:

A. Projects involving a municipal contribution: The Department and municipality shall enter into a written agreement establishing the scope of the project and a tentative construction schedule. It is the intent of the Department that the project be coordinated throughout the project term with the municipality.

B. Projects involving no municipal contribution: When a municipality is not required to make a financial contribution to a project, a written agreement for parking restrictions, encroachments, municipal-owned utilities, and other matters is required. If an existing municipal maintenance agreement adequately covers parking restrictions, encroachments, municipal-owned utilities, and other aspects of the project, and if no financial participation or change in participation is required, no new or modified agreement is necessary.

5. Municipal Share – all Municipalities:

A. A municipality will not be required to share in project costs if the estimated municipal share is $10,000 or less.

B. Unless addressed elsewhere herein, a municipality will pay 100 percent of the project costs of a project that is at the request of and for the sole benefit of the municipality.

C. A municipality will pay 100 percent of the costs of improvements constructed at the request of the municipality which are beyond the scope of and are not warranted by the highway project.

D. Relinquishment Projects: Municipalities will not normally share in the cost of projects accomplished as part of a relinquishment agreement. Improvements under these projects will be based upon DOT-OI 60-13, Relinquishment of Roads from the Highway System.

E. **Traffic operations and lighting systems:**

(1) The project costs for traffic signals and/or lighting systems, not part of a “New and Reconstructed”, “3R”, or “Maintenance” project, will be allocated 50 percent to the Department and 50 percent to the municipality. Project costs include the cost of all work required for the construction of the traffic signals and/or lighting systems, such as intersection geometric improvements.

(2) The municipality will pay 100 percent of the cost of operating, repairing and maintaining the traffic signal and/or lighting system.

(3) Roundabouts will be part of the project costs when the Department deems them necessary. The municipality will pay 100 percent of the difference in project costs when a roundabout is built at their request in lieu of the Department’s recommended design.

F. **Rail/highway grade crossing safety projects:**

(1) Project costs will be funded with a combination of state, federal, local and railroad funds. The cost sharing on specific projects will be determined by an agreement between the parties involved. Eligible project items may include preliminary and construction engineering, right-of-way, utilities, and construction costs.

(2) Railroad companies require that the construction of all pedestrian viaducts must incorporate a chain link fence as part of a rail safety project. The chain link fence must be a minimum of six (6) feet high and extend along the railroad track right-of-way for a minimum of 500 feet in each direction from the pedestrian viaduct, on both sides of the track. NDOT agrees to participate in a one-time maximum payment of $40,000 to the municipality for fence construction. NDOT assumes no other liability or involvement beyond said financial participation. Municipalities will be responsible for 100% of the cost of obtaining all necessary right-of-way, construction, and maintenance of said fence, as well as any necessary reconstruction costs. These terms will be included in the project agreement with the municipality.

G. **Highway and Municipal Drainage Facilities:**

(1) Definitions:

Highway drainage facilities are the facilities designed to collect and drain waters from the highway, the right-of-way and adjoining lands. These highway drainage facilities are usually located within the highway right-of-way.

Municipal drainage facilities are the facilities used by the municipality for the drainage of waters including waters draining from the highway drainage facilities. These municipal drainage facilities are usually located outside of highway right-of-way.

Additional drainage waters are the increased waters reaching the drainage facilities due to the project being built.

(2) Apportionment of costs:

Highway drainage facilities: Costs will be shared as a project cost.

Municipal drainage facilities: The municipality will pay all costs associated with the upgrade of municipal drainage facilities.

(3) Drainage design – No additional drainage waters:

The Department will design its highway drainage facilities to collect and discharge storm water based on the design guidelines set out in the Roadway Design Division's "Drainage Design Manual", if feasible, based on all applicable considerations. When the highway drainage facilities connect or drain into the municipal drainage facilities, the Department will calculate and notify the municipality of the capacity of the municipal drainage facilities necessary to convey waters away from the highway. When the capacity of the municipal drainage facilities does not comply with the Department's design guidelines, the Department will notify the municipality that it should upgrade its municipal drainage facilities. The Department will request, for safety and liability reasons, that the municipality commit to one of the plans for upgrading their municipal drainage facilities as described below:

(a) The municipality provides the Department with reasonable written assurances of a present plan for a future upgrade of its municipal drainage facilities. The municipality shall provide the Department with the details of its proposed improvements that will convey the design hydraulic event determined by the Department.

(b) The municipality requests that the project include an upgrade of its municipal drainage facilities to be paid for solely by the municipality, and the municipality shall enter into an agreement with the Department concerning this upgrade of its facilities prior to the Department beginning the design of the project.

If the Department determines that significant additional drainage waters will be conveyed to the municipal drainage facilities because of the design of the project, the Department will determine, on a case-by-case basis, whether the municipal drainage facilities will be upgraded and whether the Department will share in any portion of the cost of such upgrade. The extent of the upgrade to the municipal drainage facilities and the division of cost for such upgrade will be a matter of negotiation to be resolved and set forth in an agreement with the municipality.

H. **Municipal Utility Reimbursement Policy:**

(1) Non-betterment relocation of municipality-owned utilities made necessary by the construction or reconstruction of state highways within the municipal corporate limits are eligible as a project cost. The relocated municipality-owned utilities shall meet all applicable standards or codes that govern the installation, operation, and maintenance of said facilities.

(2) All relocation of municipality-owned utilities made necessary by the construction or reconstruction of state highways outside the corporate limits and located within the state right-of-way are not eligible for reimbursement by the Department.

(3) Non-betterment relocation of municipality-owned utilities due to construction or reconstruction of state highways which are located outside the corporate limits and outside the state right-of-way are eligible as a project cost for reimbursement by the Department. The relocated municipality-owned utilities shall meet all applicable standards or codes that govern the installation, operation, and maintenance of said facilities.

(4) Any municipality-owned utility cost that is eligible as a project cost will be included in the project cost sharing. When it is determined that a municipality is required to participate in the cost of a project, the cost sharing will be in accordance with Sections 5, 6, and 7.

I. **Americans with Disabilities Act (ADA) Compliance:** The municipality will be responsible for 100 percent of the costs for upgrading existing sidewalks and curb ramps to meet ADA accessibility guidelines, which are outside the normal scope of the project and are at the request of the municipality.

6. Municipal Share – Municipalities with a Population of 5,000 or Less:

A. Except as provided in this section, the municipality with a population of 5,000 or less will not ordinarily be required to participate in the cost of a project.

B. **On Highway Parking Areas:** The municipality will pay 100 percent of the costs of constructing additional parking areas and the reconstruction of existing parking areas, which are at the request of the municipality. One hundred percent of the costs of resurfacing existing parking areas will be the responsibility of the Department.

C. **Federal-Aid Safety Projects:** The municipal share is 10 percent of the total cost of a federal-aid safety project for projects on streets or roads that are not on the state highway system. No municipal contribution is required for a federal-aid safety project on the state highway system.

D. **Americans with Disabilities Act (ADA) Upgrades – Sidewalks and Curb Ramps:**

(1) **"New and Reconstructed" Projects:** The municipality will not be required to share in the costs of constructing or reconstructing sidewalks and curb ramps when included in the normal scope of a "New and Reconstructed" project.

(2) **"3R" or "Maintenance" Projects:**

(a) Sidewalks will not ordinarily be reconstructed as a part of a "3R" or "Maintenance" project, unless the municipality requests that sidewalks be reconstructed, at its sole cost, as a part of the project.

(b) Curb ramps will be constructed or reconstructed to meet federal and state accessibility guidelines under "3R" and "Maintenance" projects at no cost to the municipality. The cost of constructing or reconstructing sidewalk required to blend these curb ramps into the adjoining sidewalk will also be performed at no cost to the municipality.

7. Municipal Share – Municipalities with a Population Over 5,000:

A. Municipalities with a population over 5,000 may be required to participate in the cost of a project within, or in some instances, adjacent to the corporate limits of the municipality.

B. **Computation of Total Cost for "New and Reconstruction" Projects:**

A municipality's project cost share shall be based on the number of thru-traffic lanes as described below. Where the number of lanes is in transition, the start and end points for the differing number of lanes shall be at the mid-point of each transition. Turn lanes, medians, parking areas and surfaced shoulders shall not be considered to be thru-traffic lanes.

(1) **Projects including no more than two thru-traffic lanes:** Except as provided in Section 5 of this DOT-OI, the municipality will not be required to share in the cost of a project that includes no more than two thru-traffic lanes.

(2) **Projects including no more than four thru-traffic lanes:** Except as provided in Section 5 of this DOT-OI, the municipality will pay 20 percent of the project cost attributable to any portion of the project that includes four thru-traffic lanes.

(3) **Projects including more than four thru-traffic lanes:** Except as provided in Section 5 of this DOT-OI, the municipality will pay a share of the cost of the project attributable to any portion of the project that includes more than four thru-traffic lanes. The municipality's share will be based upon the number of thru-traffic lanes in excess of the lesser number of lanes entering or leaving the municipality, however, the municipality's minimum share will be 20 percent.

Example one: If the highway enters the municipality with two thru-traffic lanes and leaves the municipality with four thru-traffic lanes and the project has a two thru-traffic lane segment, a four thru-traffic lane segment and a six thru-traffic segment, the municipal cost share is 0 percent of the cost of the two thru-traffic lane segment, 20 percent of the cost of the four thru-traffic lane segment and 66.67 percent of the cost of the six thru-traffic lane segment of the project.

Example two: If the highway enters and leaves the municipality with four thru-traffic lanes and the project has a four thru-traffic lane segment and a six thru-traffic lane segment, the municipal cost share is 20 percent of the cost of the four thru-traffic lane segment and 33.33 percent of the cost of the six thru-traffic lane segment of the project.

Example three: If the highway enters and leaves the municipality with six thru-traffic lanes and the project has a six thru-traffic lane segment and an eight thru-traffic lane segment, the municipal cost share is 20 percent of the six thru-traffic lane segment and 25 percent of the cost of the eight thru-traffic lane segment of the project.

C. **Computation of Total Cost for "3R" and Maintenance" Projects:**

A municipality's project cost share shall be based on the number of thru-traffic lanes as described below. Where the number of lanes is in transition, the start and end points for the differing number of lanes shall be at the mid-point of each transition. Turn lanes, medians, parking areas and surfaced shoulders shall not be considered to be thru-traffic lanes.

(1) The municipality's share will be the cost of the number of thru-traffic lanes in excess of the lesser number of thru-traffic lanes entering or leaving the municipality.

Example one: If the highway enters and exits the municipality with two thru-traffic lanes and the project has a two thru-traffic lane segment and a four thru-traffic lane segment, the municipal cost share is 0 percent of the cost of the two thru-traffic lane segment and 50 percent of the cost of the four thru-traffic lane segment of the project.

Example two: If the highway enters and exits the municipality with four thru-traffic lanes and the project has a four thru-traffic lane segment and a six thru-traffic lane segment, the municipal cost share is 0 percent of the cost of the four thru-traffic lane segment and 33.33 percent of the cost of the six thru-traffic lane segment of the project.

Example three: If the highway enters the municipality with two thru-traffic lanes and exits the municipality with four thru-traffic lanes and the project has a two thru-traffic lane segment, a four thru-traffic segment and a six thru-traffic lane segment, the municipal cost share is 0 percent of the cost of the two thru-traffic lane segment, 50 percent of the cost of the four thru-traffic lane segment and 66.67 percent of the cost of the six thru-traffic lane segment of the project.

Example four: If the highway enters the municipality with four thru traffic lanes and exits the municipality with six thru-traffic lanes and the project has a four thru-traffic lane segment, a six thru-traffic lane segment and an eight thru-traffic lane segment, the municipal cost share is 0 percent of the cost of the four thru-traffic lane segment, 33.33 percent of the cost of the six thru-traffic lane segment and 50 percent of the cost of the eight thru-traffic lane segment of the project.

(2) Municipalities will not normally share in the cost of resurfacing projects accomplished as part of a relinquishment agreement.

(3) Because funding is limited and because many municipalities have their own annual resurfacing programs, District Engineers may elect to allow the municipality to design, let, and construct municipal resurfacing projects. In such cases, the preliminary and construction engineering costs are 100 percent the responsibility of the municipality. Resurfacing projects on the highway system let by the municipality shall include elimination of barriers to access as defined under the Americans with Disabilities Act and subsequent Federal regulations or technical guidance.

D. **Bridges:**

(1) The municipal share of the total cost of new construction, replacement, rehabilitation, redecking, widening and placing a structural overlay, and adding sidewalks to bridges will be determined pursuant to Section 7.B. Construction of additional width for lanes or sidewalks beyond that which is existing or under contract by the municipality shall be constructed at the municipalities cost.

Example: If the Department is replacing a two-lane bridge with an existing sidewalk on one side and the municipality requests that the new bridge accommodate a planned but not contracted three lane section with a shared use path on one side and a sidewalk on the other, the additional costs associated with the additional lane and the additional width of walkway would be 100% municipal cost.

(2) In general, bridge maintenance work will not require municipal cost participation (i.e. polymer deck overlays, abutment repair, pier repair, deck repair, joint repair, curb repair, curb replacement, and approach slab repair).

E. **Americans with Disabilities Act (ADA) Compliance – Sidewalks and Curb Ramps:**

(1) **"New and Reconstructed" Projects:** The municipality will share in the costs of constructing or reconstructing sidewalks and curb ramps to meet state and federal accessibility regulations and technical guidance when included in any "New and Reconstructed" project as a project cost.

(2) **"3R" or "Maintenance" Projects:**

(a) Sidewalks will not ordinarily be reconstructed as a part of a "3R" or "Maintenance" project, unless the municipality requests that sidewalks be reconstructed, at its sole cost, as a part of the project.

(b) Elimination of barriers to access including the construction of curb ramps will be constructed or reconstructed to meet state and federal accessibility regulations and technical guidance under "3R" and "Maintenance" projects with resurfacing of any thickness. The municipality will share in the cost of eliminating barriers to access including constructing or reconstructing curb ramps, and sidewalk construction or reconstruction required to blend these curb ramps into the adjoining sidewalk as a project cost.

F. **On Highway Parking Areas:** The municipality will be responsible for 100 percent of the costs of constructing additional parking areas and/or the reconstruction or resurfacing of existing parking areas, which are at the request of the municipality.

G. **Federal-Aid Safety Projects:** The municipal share of a federal-aid safety project either **on** or **off** the state highway system is 10 percent of the total cost of the project.

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H. **Traffic Signals and Lighting Systems:** For the purpose of determining the municipal share of traffic signals and/or lighting systems installed as part of a "New and Reconstructed", "3R", or "Maintenance" project, the costs are considered a project cost. The municipality will pay 100 percent of the cost of operating, repairing and maintaining the traffic signal and/or lighting system. The municipal agreement will detail the municipality's duties and responsibilities related to operation, maintenance and repair of the traffic signal or street lighting systems.

Khalil Jaber, P.E.
Deputy Director-Engineering

Operating Instruction 60-11

ATTACHMENT "A"

Neb. Rev. Stat. § 39-1339
State highway system; connecting links, defined; duty of Department of Roads. Except as provided in section 39-1372, the responsibility of the department for the maintenance of connecting links on the state highway system shall be determined in accordance with the following provisions:

(1) The department shall be liable for the cost of surface maintenance of the traveled way of connecting links, not including the parking lanes thereon, in cities of the metropolitan, primary, and first classes; PROVIDED, such connecting links were constructed under the authority of the department and construction costs were paid in whole or in part with county, state or federal-aid funds. The department shall not be responsible for the maintenance of any connecting link or portion thereof, which was not built in whole or in part with county, state or federal-aid funds;

(2) The department shall be liable for all of the surface maintenance of the traveled way of connecting links, including parking lanes thereon, in cities of the second class and villages; PROVIDED, such connecting links were constructed under the authority of the department and construction costs were paid in whole or in part with county, state or federal-aid funds. The department shall not be responsible for the maintenance of any connecting link or portion thereof which was not built with county, state or federal-aid funds;

(3) The responsibility of the department for the maintenance of the connecting links, described in subdivisions (1) and (2) of this section, shall be limited to such things as are caused either by wear and tear of travel on such connecting links or by acts of God. Maintenance shall not be construed to include (a) snow removal, (b) maintenance caused by constructing, placing, replacing, repairing, or servicing water mains, sewers, gas lines, pipes, utility equipment, or other similar things placed beneath, across, or upon the surface of any portion of a connecting link, or (c) repairs or reconstruction going beyond the scope or normal surface maintenance or wear and tear of travel;

(4) The maintenance of structures, on the connecting links described in subdivisions (1) and (2) of this section, shall not be limited to the traveled way but shall include the entire structure; PROVIDED, the department shall have no responsibility for the maintenance of appurtenances to such connecting links and the structures thereon, except by special agreement with the city or village in which the connecting link is situated. Appurtenances shall include, but are not limited to, sidewalks, storm sewers, guardrails, handrails, steps, curb or grate inlets, driveways, fire plugs, or retaining walls;

(5) The department shall maintain and keep in repair all public bridges and the approaches thereto when located in cities of the first class and on connecting links, which were constructed under the authority of the department and construction costs were paid in whole or in part with state or federal funds;

(6) Nothing contained in this section shall be construed to prevent the department from entering into special agreements with cities or villages regarding the reconstruction and maintenance of connecting links in such cities and villages; and

(7) As used in this section, unless the context otherwise requires, connecting link shall mean a street now designated as a state highway.

Neb. Rev. Stat. § 39-2105
Functional classifications; jurisdictional responsibility

Jurisdictional responsibility for the various functional classifications of public highways and streets shall be as follows:

(1) The state shall have the responsibility for the design, construction, reconstruction, maintenance, and operation of all roads classified under the category of rural highways as interstate, expressway, and major arterial, and the municipal extensions thereof, except that the state shall not be responsible for that portion of a municipal extension which exceeds the design of the rural highway leading into the municipality. When the design of a rural highway differs at the different points where it leads into the municipality, the state's responsibility for the municipal extension thereof shall be limited to the lesser of the two designs. The state shall be responsible for the entire interstate system under either the rural or municipal category, and for connecting links between the interstate and the nearest existing state highway system in rural areas: PROVIDED, if such a connecting link has not been improved and sufficient study by the Department of Roads results in the determination that a link to an alternate state highway would provide better service for the area involved, the department shall have the option of providing the alternate route, subject to satisfactory local participation in the additional cost of the alternate route;

(2) The various counties shall have the responsibility for the design, construction, reconstruction, maintenance, and operation of all roads classified as other arterial, collector, local, and minimum maintenance under the rural highway category;

(3) The various incorporated municipalities shall have the responsibility for the design, construction, reconstruction, maintenance, and operation of all streets classified as expressway, which are of a purely local nature, that portion of municipal extensions of rural expressways and major arterials which exceeds the design of the rural portions of such systems, and responsibility for those streets classified as other arterial, collector, and local within their corporate limits; and

(4) Jurisdictional responsibility for all scenic-recreation roads and highways shall remain with the governmental subdivision, which had jurisdictional responsibility for such road or highway prior to its change in classification to scenic-recreation made pursuant to Neb. Rev. Stat. §§ 39-2103, 39-2105, 39-2109, and 39-2113.

Note – The Department has defined the phrase “exceeds the design”, as used in the Statutes, to apply to the overall design of the roadway including the number of thru-traffic lanes entering or leaving the municipality. Because a municipal design and a rural design differ as far as appurtenances and drainage, the Department has established 20% as the minimum participation for new and reconstruction projects with four thru lanes within cities of the first class. Further refinement of the municipal participation rate will be based upon the actual number of thru-traffic lanes built with the project compared to the number of thru lanes entering or leaving the municipality. The test of “excess” in design applies to any point where the highway enters and/or leaves the municipality and not necessarily at the site of the improvement. Department policy defines the point where the highway enters and/or leaves the municipality to be the corporate limits of the municipality.

Website for Chapter 39 Nebraska Highway and Bridge Law State Statutes
http://uniweb.legislature.ne.gov/laws/browse-chapters.php?chapter=39

Nebraska Department of Transportation
Operating Instruction 60-13
April 12, 2007

RELINQUISHMENT OF ROADS FROM THE HIGHWAY SYSTEM

1. **Purpose:** To provide policy for the relinquishment of roads, by preparation, distribution, and disposition of relinquishment agreements between the Nebraska Department of Transportation and an outside party. The office of primary responsibility for this DOT-OI is the Project Development (PDD) Division. This DOT-OI supersedes DOT-OI 60-13 dated February 15, 2002.

2. **General:**

When a segment of highway is relocated, the functional classification of the old highway will be changed. The Department will offer to relinquish to the political or governmental subdivision(s) or public corporation(s), any portion of the old state highway that has been relocated. If an offer to relinquish a highway segment is not accepted by the local jurisdiction(s), the State may abandon it as provided by law (See Section 8 "Abandonment of Roadway"). The Department will relinquish the highway to the local agency after following the approved policy for relinquishment of highways.

Before relinquishment, the Department may improve the surface of existing highways if the roadway has a Nebraska Serviceability Index (NSI) or Present Serviceability Index (PSI) less than or equal to:

	NSI	**PSI**
Bituminous Pavements	70	2.5
Composite (overlay) Pavements	60	2.5
Portland Cement Concrete Pavements	50	2.5

Other than surface rehabilitation, improvements to the roadway will not be made. At the time of relinquishment, the Nebraska Department of Transportation (NDOT) will assess the adequacy of structures and determine if any reparation or corrective action is required. It is the intent of the State to relinquish only those structures which are structurally and functionally adequate for the purpose for which they will be used.

In any relinquishment or closure proceeding where the NDOT owns fee simple title to the underlying land, ownership should be reserved by the NDOT. However, the land may be sold according to Nebraska Statute Sec. 39-1325. If sold, the contract must guarantee that utility companies have a perpetual right to utilize the former state right of way.

Whenever a public hearing for a highway project is held, the Department of Roads' presentation will include a statement explaining the proposed changes in the highway system and the proposed segments of the existing highway to be relinquished to local jurisdiction.

A highway may be automatically relinquished by the state when its functional classification changes. However, it is preferable to acquire a signed relinquishment agreement with the County or City prior to highway removal or location approval.

The relinquishment or abandonment of a highway segment must be recommended by the NDOT and the Highway Commission and approved by the Governor. This action should take place at the location approval stage.

3. **Procedure for Completing Agreements:**

PPD, Agreements Engineer, is the activity manager for relinquishment activities in the Project Scheduling System (Clarity), and will initiate all agreements pertaining to relinquishments and changes in classification and jurisdictional responsibility. The development of the agreement will be according to the time frame defined in Clarity.

The activity manager will coordinate this effort with Roadway Design, PPD, Right of Way, and the District Engineer (DE). Throughout this entire process, Clarity will be updated by the activity manager to reflect the progress of the relinquishment activity for each applicable project.

PPD, Agreements Engineer will attend dry-run hearings to review projects with relinquishments.

4. **Covenant Agreement Process:**

A. Expressway Projects

Alignment concepts are studied by PPD. Example projects are expressway studies and could include, new railroad viaduct construction, major river crossings or city bypass routes.

(1.) During the course of such studies, PPD will discuss the possibility of relinquishment with the governmental entity affected. Whenever possible, a commitment in the form of a resolution or letter of intent to accept the relinquishment will be obtained from each governmental entity involved.

a. When potential changes in the National and/or State Functional Classification of roadways is an issue, Materials & Research, Functional Classifications Section staff will be a part of the discussion with Local entities.

(2.) Once an alignment is selected as the preferred route, a location hearing is normally conducted. Relinquishment information is provided in the engineering presentation and public comment is received.

(3.) The Agreements Engineer will be notified when a relinquishment agreement is needed, and will be advised of any special or specific information necessary to accurately define any previously agreed upon circumstances.

(4.) The Agreements Engineer will prepare a covenant agreement covering the proposed relinquishments. The draft review process will include PPD, Roadway Design, Roadway Asset Management Engineer, and the respective DE.

(5.) If a petition or resolution has not been received from the local jurisdiction, then the relinquishment agreement will contain a paragraph stating that by signing the agreement, the governmental entity is petitioning the State to relinquish said State Highway, according to Nebraska Statute Section 39-1314.

(6.) The Agreements Engineer will be advised of any subsequent revision(s) or supplementals to the relinquishment(s), by the initiating division, and will prepare the necessary Supplemental Document(s).

(7.) The Agreements Engineer will send the agreement(s) to the appropriate DE to obtain the local signatures and certification.

B. Non-Expressway Projects

(1.) The PPD Division or the Roadway Design Division will notify the Agreements Engineer when a Relinquishment agreement is needed.

(2.) Whenever possible, a commitment, in the form of a resolution or letter of intent to accept the relinquishment, will be obtained from each governmental entity involved.

(3.) If Clarity calls for action, the Agreements Engineer will notify Roadway Design that project details are needed to start the relinquishment process.

(4.) The Agreements Engineer will prepare a covenant agreement covering the proposed relinquishments. The draft review process will include PPD, Roadway Design, Roadway Asset Management Engineer and the respective DE.

(5.) The Agreements Engineer will be advised of any subsequent revision(s) or supplementals to the relinquishment(s), by the initiating division and will prepare the necessary Supplemental Document(s).

(6.) The Agreements Engineer will send the agreement(s) to the appropriate DE to obtain the local signatures and certification.

C. Expressway and Non-Expressway Projects

(1.) The DE will receive agreement(s) from the Agreements Engineer and will obtain signatures from representatives of local jurisdiction(s).

(2.) The DE will return signed agreements to the Agreements Engineer.

(3.) The Agreement Monitoring System will be initiated and updated by the Agreements Engineer.

(4.) The Agreements Engineer will file one completely executed agreement and will send other(s) to the District Engineer along with a copy in the District's file.

(5.) The DE will return the fully executed agreement(s) to the local jurisdiction(s).

(6.) The Agreements Engineer will be advised of any subsequent revision(s) or supplementals to the relinquishment(s), by the initiating division, and will prepare the necessary Supplemental Document(s).

5. **Final/Supplemental Agreement Process:**

A. For all projects, if a covenant agreement exists, the Agreements Engineer will furnish a copy of the agreement to the Roadway Design Division for review and definition of reference points describing final areas of relinquishment. The Roadway Design Division will furnish the required geometric details to the Agreements Engineer for incorporation into the agreement.

B. The Agreements Engineer will review all information with the applicable Division(s) to finalize the agreement.

C. If not previously stated in the covenant agreement, and no petition of relinquishment exists, the agreement will contain a paragraph stating that by signing the agreement, the County or City is petitioning the State to relinquish said State Highway, according to Nebraska Statute Section 39-1314.

D. A draft agreement will be sent to the: Roadway Asset Management Engineer; Roadway Design Division and the respective DE for review. If significant changes or additions are made during this review process, another review may be necessary.

E. Appropriate changes will be made only with consensus, and will be accomplished by the Agreements Engineer.

F. After final review, agreements will be provided to the DE by the Agreements Engineer.

G. The DE will obtain signatures from representatives of local jurisdiction(s).

H. The DE will return signed agreements to the Agreements Engineer.

I. The Agreement Monitoring System will be initiated and updated by the Agreements Engineer.

J. The Agreements Engineer will file one completely executed agreement and will send the other(s) to the DE along with a copy for the District's file.

K. The DE will return the fully executed agreement(s) to the local jurisdiction(s).

L. The Agreements Engineer will be advised of any subsequent revision(s) to the relinquishment(s), and prepare the necessary Supplemental Document(s).

6. **Internal Distribution:**

After the agreements are signed the following distribution will be made by the Agreements Engineer within the Department:

(1.) Roadway Design

(2.) Traffic Engineering

(3.) Right of Way

(4.) Controller: Maintenance Unit

(5.) District Engineer

(6.) Project Development: Location Studies-Urban, Traffic Analysis Unit

(7.) Materials & Research: Roadway Asset Management Engineer

(8.) Logistics

(9.) BTSD: Mapping Section

7. **Document Recording and Final Disposition:**

When the Right of Way Division receives notice of the executed agreement, they will file all necessary legal documents, for the relinquishment, at the appropriate County Office and notify the DE and the Agreements Engineer when the relinquishment was recorded.

The DE shall notify the appropriate local officials, in writing, with copies to: the Agreements Engineer, Roadway Asset Management Engineer, Director, all Deputy Directors, the appropriate Highway Commissioner, and all appropriate Division Heads, of the effective date of change of jurisdictional responsibility.

Operating Instruction 60-13

Roadway Asset Management Engineer will make the final Functional Classification submittal to the Federal Highway Administration, perform all the necessary documentary changes in functional classifications, update the official state highway and local road/street Functional Classification maps and make submittal action to the American Association of State Highway and Transportation Officials (AASHTO) for Route Number changes when necessary.

If necessary the Traffic Engineer will issue a highway route revision informing all concerned officials of the new highway location, number, and identify the old highway.

8. **Abandonment of Roadway:**

Projects should not progress to the design hearing stage without a signed agreement covering all relinquishments of highways affected by the project.

If the local government refuses to accept the relinquishment, the Department of Roads will delay the project until an agreement with the local jurisdictions can be reached. If an agreement is not obtainable, the Department may abandon the segment as a public road, as provided by Section 39-1314 of State Statute, so the project may continue.

Monty W. Fredrickson
Deputy Director – Engineering

Nebraska Department of Transportation
Operating Instruction 60-16
April 14, 2010

POLICY FOR PHASE CONSTRUCTED 3R PROJECTS

*** 1. **Purpose:** To provide policy for projects when construction is phased due to the condition of the pavement and time constraints necessary to develop a 3R project. The office of primary responsibility for this DOT-OI is the Roadway Design Division. This is a new DOT-OI.

*** 2. **Scope:**

A significant level of project development is required for "3R" projects in order to prepare them for letting. Occasionally the project development timeframe exceeds the remaining life of the pavement. In these cases, pavement condition and ability of the State maintenance forces to maintain the rapidly deteriorating roadway surface dictate that the rehabilitation of the surfacing occur prior to the projected letting of the project. This policy will allow for the phasing of the construction of the project to complete the surface rehabilitation as soon as possible and concurrently pursue the development of the remaining features necessary to meet the 3R standards such as culvert modification, widening, property acquisition, etc.

*** 3. **Policy:**

It is the policy of the NDOT that when the construction of a project is phased due to the condition of the asset, a follow-up project addressing those design features requiring development to meet the design standards shall be let as soon as project development allows. The funds necessary to build the follow-up or "phase 2" project shall be set aside from the District's allocation at the time the phase 1 project is awarded. These funds will not be redirected to a different purpose without the approval of the Deputy Director – Engineering.

The decision to construct a project in phases will be made by the Roadway Design Engineer following a request by the District Engineer and with the concurrence of the Program Management Engineer, the Materials and Research Engineer, and when appropriate, the Bridge Engineer.

Randall D. Peters, P.E.
Deputy Director – Engineering

Subject: PUBLIC INTEREST LETTERS

MEMORANDUM OF UNDERSTANDING

This MOU implements the provisions of 23CFR635.309(b), (c), (g) and (h) for State Highway Projects. The statements required in these paragraphs are contained in a document called the Right of Way certificate (certificate), and need to be prepared prior to any bid advertisement. The certificate will be certified by the Right of Way Division's Property Management Supervisor and will be approved by the Right of Way Division Manager.

The Monthly Project Scheduling Team is responsible for reviewing individual projects to determine if the provisions of (c)(3) are applicable. When the team decides that those provisions are applicable a letter will be prepared justifying why it is in the publics interest to proceed with advertising the project. The letter will be signed by the Roadway Design Engineer and will include a brief description of each unacquired tract sufficient to form a reasonable conclusion of the significance of the tract.

The Deputy Director-Engineering will review the public interest letter and give consideration to the following factors in determining if advertising the project is in the public interest.

1. The proposed starting date of the contract
2. The feasibility of moving the project to another letting
3. The number and significance of the remaining unacquired tracts
4. The exact status in the acquisition process of the unacquired tracts
5. The overall justification of exactly why it is in the public interest to have the project in a particular letting.

On those projects not involving residential or business displacees still in occupancy the Deputy Director's decision will be final. No approval is required by the FHWA.

The Contracts Section of the Construction Division will provide an information copy of all ROW certificates and public interest letters to the FHWA prior to each letting.

If a Residential or business displacee is still in occupancy the above-described letter will be presented to the FHWA for approval.

ORIGINAL SIGNED BY:

Allan L. Abbott	Bruce Lind
Director-State Engineer	Division Administrator
Nebraska Department of Transportation	Federal Highway Administration

12/07/1998

U.S. Department of Transportation
Federal Highway Administration
1200 New Jersey Avenue, SE
Washington, DC 20590
202-366-4000

Civil Rights

Civil Rights

U.S. Department of Justice
Civil Rights Division
Disability Rights Section

U.S. Department of Transportation
Federal Highway Administration

Department of Justice/Department of Transportation Joint Technical Assistance[1] on the Title II of the Americans with Disabilities Act Requirements to Provide Curb Ramps when Streets, Roads, or Highways are Altered through Resurfacing

Title II of the Americans with Disabilities Act (ADA) requires that state and local governments ensure that persons with disabilities have access to the pedestrian routes in the public right of way. An important part of this requirement is the obligation whenever streets, roadways, or highways are *altered* to provide curb ramps where street level pedestrian walkways cross curbs.[2] This requirement is intended to ensure the accessibility and usability of the pedestrian walkway for persons with disabilities.

An alteration is a change that affects or could affect the usability of all or part of a building or facility.[3] Alterations of streets, roads, or highways include activities such as reconstruction, rehabilitation, *resurfacing*, widening, and projects of similar scale and effect.[4] Maintenance activities on streets, roads, or highways, such as filling potholes, are not alterations.

Without curb ramps, sidewalk travel in urban areas can be dangerous, difficult, or even impossible for people who use wheelchairs, scooters, and other mobility devices. Curb ramps allow people with mobility disabilities to gain access to the sidewalks and to pass through center islands in streets. Otherwise, these individuals are forced to travel in streets and roadways and are put in danger or are prevented from reaching their destination; some people with disabilities may simply choose not to take this risk and will not venture out of their homes or communities.

Because resurfacing of streets constitutes an alteration under the ADA, it triggers the obligation to provide curb ramps where pedestrian walkways intersect the resurfaced streets. See *Kinney v. Yerusalim*, 9 F 3d 1067 (3rd Cir. 1993). This obligation has been discussed in a variety of technical assistance materials published by the Department of Justice beginning in 1994.[5] Over the past few years, state and local governments have sought further guidance on the scope of the alterations

requirement with respect to the provision of curb ramps when streets, roads or highways are being resurfaced. These questions have arisen largely due to the development of a variety of road surface treatments other than traditional road resurfacing, which generally involved the addition of a new layer of asphalt. Public entities have asked the Department of Transportation and the Department of Justice to clarify whether particular road surface treatments fall within the ADA definition of alterations, or whether they should be considered maintenance that would not trigger the obligation to provide curb ramps. This Joint Technical Assistance addresses some of those questions.

Where must curb ramps be provided?

Generally, curb ramps are needed wherever a sidewalk or other pedestrian walkway crosses a curb. Curb ramps must be located to ensure a person with a mobility disability can travel from a sidewalk on one side of the street, over or through any curbs or traffic islands, to the sidewalk on the other side of the street. However, the ADA does not require installation of ramps or curb ramps in the absence of a pedestrian walkway with a prepared surface for pedestrian use. Nor are curb ramps required in the absence of a curb, elevation, or other barrier between the street and the walkway.

When is resurfacing considered to be an alteration?

Resurfacing is an alteration that triggers the requirement to add curb ramps if it involves work on a street or roadway spanning from one intersection to another, and includes overlays of additional material to the road surface, with or without milling. Examples include, but are not limited to the following treatments or their equivalents: addition of a new layer of asphalt, reconstruction, concrete pavement rehabilitation and reconstruction, open-graded surface course, micro-surfacing and thin lift overlays, cape seals, and in-place asphalt recycling.

What kinds of treatments constitute maintenance rather than an alteration?

Treatments that serve solely to seal and protect the road surface, improve friction, and control splash and spray are considered to be maintenance because they do not significantly affect the public's access to or usability of the road. Some examples of the types of treatments that would normally be considered maintenance are: painting or striping lanes, crack filling and sealing, surface sealing, chip seals, slurry seals, fog seals, scrub sealing, joint crack seals, joint repairs, dowel bar retrofit, spot high -friction treatments, diamond grinding, and pavement patching. In some cases, the combination of several maintenance treatments occurring at or near the same time may qualify as an alteration and would trigger the obligation to provide curb ramps.

What if a locality is not resurfacing an entire block, but is resurfacing a crosswalk by itself?

Crosswalks constitute distinct elements of the right-of-way intended to facilitate pedestrian traffic. Regardless of whether there is curb-to-curb resurfacing of the street or roadway in general, resurfacing of a crosswalk also requires the provision of curb ramps at that crosswalk.

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1 The Department of Justice is the federal agency with responsibility for issuing regulations implementing the requirements of title II of the ADA and for coordinating federal agency compliance activities with respect to those requirements. Title II applies to the programs and activities of state and local governmental entities. The Department of Justice and the Department of Transportation share responsibility for enforcing the requirements of title II of the ADA with respect to the public right of way, including streets, roads, and highways.

2 *See* 28 CFR 35.151(*i*)(1) (Newly constructed or altered streets, roads, and highways must contain curb ramps or other sloped areas at any intersection having curbs or other barriers to entry from a street level pedestrian walkway) and 35.151(i)(2) (Newly constructed or altered street level pedestrian walkways must contain curb ramps or other sloped areas at intersections to streets, roads, or highways).

3 28 CFR 35.151(b)(1).

4 2010 ADA Accessibility Standards, section 106.5.

5 See 1994 Title II Technical Assistance Manual Supplement, Title II TA Guidance: The ADA and City Governments: Common Problems; and ADA Best Practices Tool Kit for State and Local Governments: Chapter 6, Curb Ramps and Pedestrian Crossings under Title II of the ADA, available at *ada.gov*.

Page last modified on February 3, 2013.

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Civil Rights

Civil Rights

Glossary of Terms for DOJ/FHWA Joint Technical Assistance on the ADA Title II Requirements to Provide Curb Ramps When Streets Roads or Highways are Altered Through Resurfacing

This glossary is intended to help readers understand certain road treatments referenced on page 2 of the DOJ/FHWA Joint Technical Assistance on the ADA Title II Requirements to Provide Curb Ramps When Streets Roads or Highways are Altered Through Resurfacing. The definitions explain the meaning of these terms from an engineering perspective and are provided in the order in which they appear in the Technical Assistance document.

Treatments that are considered alterations of the road surface

Reconstruction – Reconstruction refers to removing all or a significant portion of the pavement material and replacing it with new or recycled materials. This may include full-depth reclamation, where the pavement surface is demolished in place and new pavement surface is applied. In addition, reconstruction may also include grinding up a portion of the pavement surface, recycling it and placing it back, and then adding a wearing surface, such as in cold in-place asphalt recycling. Reconstruction often includes widening or geometrical changes to the roadway profile.

Rehabilitation – Rehabilitation refers to significant repairs made to a road or highway surface, including activities such as full slab replacement, filling voids under slabs (slabjacking), widening, and adding additional structural capacity.

Open-graded surface course – Open-graded surface course, also known as "open-graded friction course," involves a pavement surface course that consists of a high-void, asphalt concrete mix that permits rapid drainage of rainwater through the course and off the shoulder of the road. The mixture consists of either Polymer-modified or rubber-modified asphalt binder, a large percentage of one-sized coarse aggregate, and a small amount of fibers. This treatment prevents tires from hydroplaning and provides a skid-resistant pavement surface with significant noise reduction.

Microsurfacing – Microsurfacing involves spreading a properly proportioned mixture of polymer modified asphalt emulsion, mineral aggregate, mineral filler, water, and other additives, on a paved surface. Microsurfacing differs from slurry seal in that it can be used on high volume roadways to correct wheel path rutting and provide a skid resistant pavement surface.

Thin lift overlays – Thin lift overlays are thin applications of mixtures of hot mix asphalt. Thin lift overlays may also require some milling along curbs, manholes, existing curb cuts, or other road structures to assure proper drainage and cross slopes.

Cape seal – A cape seal is a thin surface treatment constructed by applying a slurry seal or microsurfacing to a newly constructed chip seal. It is designed to be an integrated system where the primary purpose of the slurry is to fill voids in the chip seal.

In-place asphalt recycling – In-place asphalt recycling is a process of heating and removing around 1-2 inches of existing asphalt and remixing the asphalt with the addition of a binder additive and possible aggregate to restore the wearing surface for placement and compaction. All of this is performed in a train of equipment.

Treatments that are considered maintenance of the road surface

Crack filling and sealing – Crack filling and sealing involves placing elastomeric material directly into cracks in pavement.

Surface sealing – Surface sealing involves applying liquid sealant to pavement surface in order to stop water penetration and/or reduce oxidation of asphalt products. Sand is sometimes spread over liquid to absorb excess material.

Chip seals – Chip Seals involve placing graded stone (chips) on liquid emulsified asphalt sprayed on pavement surface. The surface is rolled to enable seating of chips.

Slurry seal – Slurry seals involve spraying a mixture of slow setting emulsified asphalt, well graded fine aggregate, mineral filler, and water on the pavement surface. It is used to fill cracks and seal areas of old pavements, to restore a uniform surface texture, to seal the surface to prevent moisture and air intrusion into the pavement, and to improve skid resistance.

Fog seals – Fog seals are a type of surface sealing.

Scrub sealing – Scrub sealing is type of surface sealing

Joint crack seals – Joint crack seals are usually associated with concrete pavement. This work consists of routing and cleaning existing cracks and joints and resealing to prevent water and non-compressibles from entering into the pavement joints and subgrade materials.

Joint repairs – Joint repairs are usually associated with concrete pavement. This work consists of selectively repairing portions of the pavement where the slabs are generally in good condition, but corners or joints are broken. The depth of the patch could be full depth or partial depth.

Dowel retrofit – Dowel retrofits are usually associated with concrete pavement. This work involves the installation of dowel bars connecting slabs in existing pavements. Pavement with dowel bar retrofits can have life extensions of as much as 20 years. Its application is almost exclusively on high-speed Interstate highways.

Spot high-friction treatments – Spot high-friction treatments involve using epoxy based resin liquids as a binder for an aggregate with high-friction properties. These are used in locations where drivers are frequently braking and the pavement surface has less resistance to slipping.

Diamond grinding – Diamond grinding involves using a gang saw to cut grooves in the pavement surface to restore smoothness and eliminate any joint faulting.

Pavement patching – Pavement patching involves selectively repairing portions of the pavement where the slabs are generally in good condition, but corners or joints are broken. The depth of the patch could be full depth or partial depth.

Page last modified on February 3, 2013.

UPGRADING RURAL INTERCHANGES ON I-80 IN NEBRASKA

The following is a guide for upgrading I-80 interchange bridges and approaches in rural areas. These guidelines are based on economic analyses that compare the benefits derived from accident cost reduction to the cost of the improvement. This should be used for interchange projects and projects involving intersecting highways at an interchange.

1. Crossroads with a design year ADT of less than 3000:

   A. If the bridge width meets "Needs Study" criteria and the structural condition is sufficient to use in place, repair the bridge as needed. Upgrade the guardrail and bridge rail, use the existing gradeline in place, and upgrade the pavement surface as needed. Sign the roadway for reduced speed, if necessary.

   B. If the bridge width does not meet "Needs Study" criteria or if the bridge has major structural deficiencies, replace the bridge to "New and Reconstructed" standards. The clear roadway width on the new bridge must meet minimum design standards and should match the width of the approach roadway plus shoulders. The new bridge should be a two-span structure providing adequate lateral clearance for the outside travel lanes on I-80. Retaining walls should be considered where it is possible to use a shorter bridge length. Upgrade the guardrail.

   C. Use the existing gradeline in place if it meets "Needs Study" criteria (max. allowable speed for crest vertical curves: 40 mph below 400 ADT and 45 mph at and above 400 ADT) and upgrade the pavement surface as needed. Sign the roadway for reduced speed, if necessary.

2. Crossroads with a design year ADT of 3000 or greater:

   A. If the bridge width meets "Needs Study" criteria and the structural condition is sufficient to use in place, repair the bridge as needed. If the existing gradeline meets "Needs Study" criteria, use the gradeline in place, widen the roadway at the ramp terminals to provide left-turn lanes if justified by the Traffic Engineering Division, upgrade the pavement surface as needed, upgrade the guardrail, and sign the roadway for reduced speed, if necessary. Further study may be needed to determine if the bridge should be widened or replaced to accommodate left-turn-lane storage.

   B. If the bridge width does not meet "Needs Study" criteria or if the bridge has major structural deficiencies, replace the bridge to meet "New and Reconstructed" standards. The new bridge should be a two-span structure providing adequate lateral clearance for the outside travel lanes on I-80. Retaining walls should be considered where it is possible to use a shorter bridge length.

   C. Rebuild the crossroad if the existing vertical alignment does not meet "New and Reconstructed" standards. However, if the impact to adjacent property is significant, consider design features closer to minimum or lower design speeds. If the vertical alignment is sufficient, upgrade the pavement surface as needed.

ORIGINAL SIGNED BY:

Approved _____ Date: 6-19-96
Monty W. Fredrickson
Deputy Director – Engineering

SUPPLEMENT TO THE
I-80 RURAL INTERCHANGE STUDY

This supplement describes the economic analyses that provide the guidelines contained in "**UPGRADING RURAL INTERCHANGES ON I-80 IN NEBRASKA**". The information that helped develop the guidelines came from a 1995 study of rural I-80 interchanges.

BACKROUND

In Nebraska, I-80 was built between 1957 and 1974. Many of its rural interchanges have four-span bridges and vertical geometrics that do not meet modern "New and Reconstructed" standards.

The four-span bridges, typically, have piers located three to four meters from the edge of the driving lane of I-80. This does not meet the DR-1 lateral obstacle clearance of 11 meters. New two-span bridges provide the required lateral clearance.

Roadway approaches of the crossroad were originally designed to provide minimum stopping sight distances for 80 km/h (50 mph). Under modern criteria, many of these vertical alignments now have minimum stopping sight distances for only about 70 km/h (45 mph).

ACCIDENTS

A review of accidents occurring during the five-year period from June 1989 to May 1994 revealed a significant increase in the number of accidents on the crossroad over I-80 when current ADT exceeds 2,500. Most of these accidents occurred near the ramp terminals where slowing, stopping, and turning maneuvers occur.

Interchanges where the crossroad carries less than 2,500 current ADT have less than one accident per year on the average. Major improvements, such as reconstruction of the gradeline, may not be cost effective since the potential for reducing accidents is low.

Because the current ADT of 2,500 appeared to be the dividing line for accidents, a design year ADT of 3,000 is used in the recommendations.

Some accidents may be attributed to sight distance. As stated above, many of these crossroads have only 70 km/h (45 mph) speeds for minimum stopping sight distance for crest vertical curves. Stopping sight distance at the ramp terminals will generally be higher for a passenger vehicle.

Sight distance for vehicles turning onto the crossroad from the ramp was evaluated. Vehicles on the crossroad would normally have to slow down to less than 85 percent of the mainline speed of 90 km/h (55 mph) when a passenger vehicle pulls out from a stop condition at the ramp terminal, turns either left or right, and proceeds. Sight distance requirements are met for a 90 km/h (55 mph) design speed to allow a passenger vehicle to turn left onto the crossroad and not interfere with a passenger vehicle approaching from the left.

Accidents on I-80 near interchanges are relatively few. Most occur at a grade separation, normally hitting the guardrail and occasionally the piers.

GEOMETRIC DEFICIENCIES

Three primary geometric deficiencies exist at many of the interchanges. First, there is the lateral obstacle clearance deficiency for through-traffic lanes on I-80 because of pier location. Second, there is a bridge width deficiency for the crossroad over I-80. Third, there is also less than a 90 km/h (55 mph) minimum sight distance on the crossroad. Replacing the bridge with a two-span structure which meets "New and Reconstructed" standards would correct the first of these deficiencies, but not the third.

A substantial investment went into constructing the I-80 interchanges and justification for correcting the current deficiencies should be based on an effective cost analysis. A benefit/cost analysis compares the reduction in accident costs derived from a safety improvement to the cost of the improvement.

Depending on the pavement history, the guardrail would normally be replaced three times (minimum) or four times (maximum) over a 50-year period. The benefit/cost analysis considers both possibilities.

BRIDGE WIDTH

For new or reconstructed bridges on state highways, the clear roadway width must meet minimum design standards and should match the width of the approach roadway plus shoulders. The width of most bridge approaches is 44' (24' roadway and 10' shoulders).

CALCULATIONS AND CONCLUSIONS

1. If bridge widening is required, it is more cost effective to replace the existing four-span bridge with a two-span bridge that meets "New and Reconstructed" standards, than to widen and redeck the existing bridge.

   A. Assuming an average bridge length of 235' and a crossroad approach of 44', the cost of widening and redecking an existing bridge to 46.4' (44' plus 2.4' for width of rails) is $501,584.

      235' x 46.4' x $46 / sf = $501,584

   B. Assuming that the average bridge could be shortened by 35' using retaining walls, the latter costing $115,000, the cost of replacing an existing bridge with a new structure is $642,104.

      200' x 46.4' x $56.80 / sf = $527,104
      $527,104 + $115,000 = $642,104

   C. A life-cycle, 50-year, cost analysis of upgrading the guardrail three or four times to protect the outside piers of an existing four-span bridge indicates the following <u>additional cost</u> for widening an existing bridge. The costs of installation, maintenance, and accidents are included.

	Three Guardrail <u>Upgrades</u>	Four Guardrail <u>Upgrades</u>
Low volume traffic	$130,170	$148,175
Medium volume traffic	$175,878	$193,878
High volume traffic	$218,196	$236,196

<u>Note:</u> "Low volume traffic" refers to western I-80, Wyoming border to I-76 (5,800 ADT). "Medium volume traffic" refers to central I-80, I-76 to Grand Island (12,460 ADT). "High volume traffic" refers to eastern I-80, Grand Island to Seward (17,680 ADT).

D. Therefore, the total cost of widening and redecking an overpass bridge is:

Three Guardrail Upgrades

Low volume traffic	$501,584 + $301,170 = $631,754
Medium volume traffic	$501,584 + $175,878 = $677,462
High volume traffic	$501,584 + $218,196 = $719,780

Four Guardrail Upgrades

Low volume traffic	$501,584 + $148,175 = $649,759
Medium volume traffic	$501,584 + $193,878 = $695,462
High volume traffic	$501,584 + $236,196 = $737,780

E. Comparing the cost to replace an overpass bridge ($642,104) to the figures in paragraph D above, it is more cost effective to replace a bridge than to widen and redeck it. Note that for low volume, three guardrail upgrades, the life-cycle cost is slightly less than the cost of replacement. The difference is less than two percent and, therefore, is considered adequate justification for replacement.

2. Along I-80, it is cost effective to remove the outside guardrail at pier locations and provide adequate lateral obstacle clearance. This is true for both low-volume and high-volume traffic sections. The clearance would be provided if the four-span bridges were replaced with two-span bridges. For two-span bridges, the center pier still requires guardrail. This conclusion supplements the cost effectiveness of paragraph one above.

3. On low-volume crossroads (under 3,000 design year ADT), it is not cost effective to build short left-turn lanes between the ramp terminals and the overpass bridge. The cost to add short left-turn lanes at the ramp terminals is about $180,000. Evaluating the accident report information indicated that there are very few cases where a separate left-turn lane would have prevented the accident. However, for design year ADT's exceeding 3,000, accidents prevented using left-turn lanes may actually be cost effective where sight distance is restricted.

The information contained in Appendix F: Plan Accuracy (Formally Appendix K), dated July 2006, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this Appendix.

SURVEY / PLAN ACCURACY

DESCRIPTION	(feet)
Alignment (PI's, PC's, PT's, equations	0.01
Project Stationing) Begin/End of Project	1
Farmstead Drives (Stationing)	1
Field Entrances (Stationing)	1
County Roads (Stationing)	0.1
Build note to the nearest foot	1
Intersecting Hwy / **Streets** (Stationing)	0.1
Build note to the nearest foot	1
Tel Poles / **Power Poles** (Sta./Offset)	1
Drainage Pipes (Stationing)	1
(Length of Pipe)	1
(Skew Angle)	Nearest Degree
(Flow Line Elevation)	0.01
Drainage Box Culverts (Stationing)	1
Build Note to the nearest foot	1
(Length of Box)	0.1
(Skew Angle)	Nearest Degree
(Flow Line Elevation)	0.01
Bridges (Stationing & Approach Slabs)	0.01
Paving Sections	Even foot from end of Bridge
Bridge Exceptions for Typ. Sections	1
(Example: Approach & Paving Sections are built from Sta. 103 + 10.56 to 110 + 42.21, The exception is from Sta. 103 + 10 to 110 + 43)	
Wells (Stationing / Offset)	1
ROW Markers (Coordinate Survey)	Not Required
Control Points (Coordinate Survey)	Not Required
(Surveyed by Station & Offset)	0.01
Bench Marks (Coordinate Survey)	Not Required
(Surveyed by Station & Offset)	0.01
Hard Surface Grades	0.01
(Top of Curb)	0.01
Build Notes (Stationing & Offset)	1
Cross-Sections	
(Everything, including Culvert Cross-Sections)	1

Degree	Radius (ft.)	Degree	Radius (ft.)	Degree	Radius (ft.)
0° 15’	22,918.312	8° 15’	694.494	16° 15’	352.589
0° 30’	11,459.156	8° 30’	674.068	16° 30’	347.247
0° 45’	7639.437	8° 45’	654.809	16° 45’	342.064
1° 00’	5729.578	9° 00’	636.620	17° 00’	337.034
1° 15’	4583.662	9° 15’	619.414	17° 15’	332.149
1° 30’	3819.719	9° 30’	603.113	17° 30’	327.404
1° 45’	3274.045	9° 45’	587.649	17° 45’	322.793
2° 00’	2864.789	10° 00’	572.958	18° 00’	318.310
2° 15’	2546.479	10° 15’	558.983	18° 15’	313.549
2° 30’	2291.831	10° 30’	545.674	18° 30’	309.707
2° 45’	2083.483	10° 45’	532.984	18° 45’	305.577
3° 00’	1909.859	11° 00’	520.871	19° 00’	301.557
3° 15’	1762.947	11° 15’	509.296	19° 15’	297.640
3° 30’	1637.022	11° 30’	498.224	19° 30’	293.825
3° 45’	1527.887	11° 45’	487.624	19° 45’	290.105
4° 00’	1432.394	12° 00’	477.465	20° 00’	286.479
4° 15’	1348.136	12° 15’	467.721	20° 30’	279.492
4° 30’	1273.240	12° 30’	458.366	21° 00’	272.837
4° 45’	1206.227	12° 45’	449.379	21° 30’	266.492
5° 00’	1145.916	13° 00’	440.737	22° 00’	260.435
5° 15’	1091.348	13° 15’	432.421	22° 30’	254.648
5° 30’	1041.741	13° 30’	424.413	23° 00’	249.112
5° 45’	996.448	13° 45’	416.697	23° 30’	243.812
6° 00’	954.930	14° 00’	409.256	24° 00’	238.732
6° 15’	916.732	14° 15’	402.076	24° 30’	233.860
6° 30’	881.474	14° 30’	395.143	25° 00’	229.183
6° 45’	848.826	14° 45’	388.446	25° 30’	224.689
7° 00’	818.511	15° 00’	381.972	26° 00’	220.368
7° 15’	790.287	15° 15’	375.710	26° 30’	216.210
7° 30’	763.944	15° 30’	369.650	27° 00’	212.207
7° 45’	739.300	15° 45’	363.783	27° 30’	208.348
8° 00’	716.197	16° 00’	358.099	28° 00’	204.628

Degree of Curve = 5729.578 ÷ Radius

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1. THE CONTROLLING DESIGN CRITERIA

Through research and practical experience, minimum guidance has been established for the geometric design elements of a roadway project. The minimum values for the design criteria are based on such parameters as design speed, roadway location, functional classification of the roadway, traffic volume, and the design vehicle. The Federal Highway Administration (**FHWA**) has adopted the American Association of State Highway and Transportation Officials (**AASHTO**) publication A Policy on Geometric Design of Highways and Streets (*Green Book*) as their source of roadway design guidance.

The **FHWA** has identified ten elements of roadway geometry on all Interstate and freeway projects and for high-speed roadways (≥ 50 mph) and two design elements on low-speed roadways (< 50 mph) as being of such importance that when the minimum design standard cannot be attained for a project on the National Highway System (NHS) a design exception will be required. This same rationale was used in the creation of the Minimum Design Standards (*MDS*); if a design criterion on a non-NHS highway project cannot meet the minimum design standard, a relaxation of the *MDS* (design relaxation) will be required.

The FHWA Controlling Design Elements for Interstate, Freeway, and High-Speed (≥ 50 mph) Roadways		
	Element	**Definition**
1	**Design Speed**	The speed selected to control the geometric features of the project
2	**Lane Width**	The appropriate width to be used for the through travel lanes
3	**Shoulder Width**	The appropriate shoulder width for the roadway
4	**Horizontal Curve Radius**	The horizontal curvature of the roadway
5	**Superelevation Rate**	The appropriate cross slope of the roadway through a horizontal curve
6	**Maximum Grade**	The rate of change in the elevation of a roadway, expressed as a percentage
7	**Stopping Sight Distance**	The distance required by a driver to see an object on the roadway and to bring the vehicle to a safe stop before colliding with that object
8	**Cross Slope**	The cross slope aids in draining the roadway and shoulder
9	**Vertical Clearance**	The clear distance required between the top of the pavement and an overhead object
10	**Structural Capacity**	The load carrying capacity of a bridge or bridge sized structure

The FHWA Controlling Design Elements for Low-Speed (< 50 mph) Roadways		
	Element	**Definition**
1	**Design Speed**	The speed selected to control the geometric features of the project
2	**Structural Capacity**	The load carrying capacity of a bridge or bridge sized structure

The Nebraska Department of Transportation (**NDOT**) has added four controlling design criteria to the *MDS*:

11	**Vertical Alignment**	The vertical curvature of the roadway
12	**Horizontal Clear Zone / Fixed Obstacle Clearance**	Does the project meet the *MDS* recommended distance?
13	**Lateral Offset to Obstruction**	The distance from the edge of the traveled way to a vertical roadside object; lateral offset to obstruction should not be confused with the roadway clear zone
14	**Bridge Width**	The width of the lanes and shoulders carried across the bridge, measured from bridge rail to bridge rail or curb to curb

The 14 controlling design criteria in the *MDS* will apply to all roadway classifications and design speeds.

These items are not **FHWA** design criteria; inability to meet the minimum standard will not require a design exception from the **FHWA** but will require a relaxation of the *MDS* (See Section 2.B).

Three additional items have been determined by the **NDOT** to be important to the design of a roadway while not rising to the level of a controlling criterion. These non-controlling items are:

1. **Barrier Crashworthiness:** Do the roadside barriers (e.g. guardrail, bridge rail) meet current standards? Are they NCHRP 350 / MASH compliant?
2. **Hydraulic Design:** Are the components of the drainage system (e.g. culverts, storm sewers, roadway ditches) designed to the appropriate **NDOT** Design Storm Frequency? (See the Drainage Design and Erosion Control Manual, page 1-12)
3. **Pavement Design:** Is the projected life expectancy of the pavement less than the project design year?

An inability to meet the minimum guidance for these items will require written **Unit Head** approval and justification to the project file.

2. DEPARTURE FROM STANDARDS

If the minimum design standards cannot be attained, a design exception for Projects of Division Interest (PoDI) and/or a relaxation of the *MDS* will be required, unless the project is classified as a maintenance resurfacing project. The design exception and/or relaxation documentation will be included in the project file.

2.A Design Exceptions for Projects of Division Interest

2.A.1 Oversight Authority for Departure from Standards

FHWA PROJECT APPROVAL AUTHORITY: The **FHWA** retains full oversight and approval authority for design exceptions to the controlling design criteria for any project on the NHS which has been designated as a PoDI.

The designer should check Clarity© to determine if a project is a PoDI.

NDOT PROJECT APPROVAL AUTHORITY: Under the terms of the NDOT/FHWA Stewardship & Oversight Agreement (http://roads.nebraska.gov/media/6796/steward-oversight-agr.pdf), the **NDOT** assumes oversight and approval authority for design exceptions to the controlling design criteria for any project which is designated as a PoDI which is not on the NHS.

2.A.2 Design Exception Documentation for PoDIs

PoDIs Which Are On The NHS: For projects that do not meet the guidance found in the "AASHTO Minimum Design Guidance" (pg. H-8), the *Green Book*, or the *I-State Green Book* a design exception document will be prepared for formal **FHWA** approval following the **FHWA** design exception format (See Mitigation Strategies for Design Exceptions, (http://safety.fhwa.dot.gov/geometric/pubs/mitigationstrategies/fhwa_sa_07011.pdf)). If the project also does not meet the design standards found in the *MDS* the designer will request a design relaxation of the *MDS* as detailed in Section 2.B *after* obtaining **FHWA** approval.

PoDIs Which Are Not On The NHS: For projects which are not on the NHS that do not meet the guidance found in the "AASHTO Minimum Design Guidance" (pg. H-8), the *Green Book*, or the *I-State Green Book* a design exception document will be prepared following the **FHWA** design exception format (See Mitigation Strategies for Design Exceptions) for both the project file and for approval by the **Deputy Director-Engineering**. This documentation does not need to be submitted to the **FHWA** for formal approval but will be transmitted to the appropriate **FHWA Transportation Engineer** for review and comment. If the project also does not meet the design standards found in the *MDS* the designer will request a design relaxation as detailed in Section 2.B.

PoDIs Which Meet the Minimum Standards: A document will be placed in the project file stating that "This project meets the controlling design criteria."

2.B Design Relaxations of the Nebraska Minimum Design Standards (*MDS*)

Requests for relaxation of the *MDS* will be prepared in the same format as a **FHWA** design exception (See Mitigation Strategies for Design Exceptions). The relaxation request will be routed through the appropriate **Division Head** and **District Engineer** and requires the approval of the **Deputy Director-Engineering**. After this approval is obtained, the request will be sent to the **Secretary of the Board of Public Roads Classifications and Standards** at least ten working days prior to the board meeting where it will be presented to the **Board of Public Roads** for their approval.

A design relaxation request letter will have the following attachments:

- The existing typical section
- The proposed typical section
- The typical section required by the *MDS*
- Crash history and analysis, stamped as "Confidential, for NDOT use only" (The analysis should include location or identifying hazardous locations, accident clusters, or accident trends within the project limits).

The request for a relaxation of the *MDS* will be presented to the **Board of Public Roads Classifications and Standards** in a power point format. The power point presentation will include location maps, aerial views of the locations, pictures of the sites or project, typical sections of the existing, proposed, and standard sections, slides concerning crashes (not protected information), costs to obtain standards, environmental impacts, etc. A meeting will be scheduled at least two weeks in advance of the board meeting to present the power point to the **Roadway Design Engineer**.

2.C Procedure for When Desirable Conditions Cannot be Attained

In those instances where it is not possible to meet the desirable design condition (see pg. H-31), a decision document will be created (the "Design Decision Documentation Sheet", Form DR-335, may be used for this purpose). This document should be reviewed and signed by the affected Divisions (e.g. **Project Development**, **Traffic Engineering**) and by the appropriate level of supervision (such as the **Unit Head** or the **Assistant Design Engineer**) and placed in the project file. For example: where it is not possible to design a temporary roadway to a design speed 10 mph less than the existing posted speed limit, the designer will detail the reasons why a lower design speed is necessary, obtain approval from the **Unit Head**, and have **Traffic Engineering** review and sign the letter. This does not need to be a routed letter; an e-mail from **Traffic Engineering** stating that the design has been reviewed and approved would suffice.

3. INSTRUCTIONS FOR COMPLETING FORM DR-76:

3.A Sources

1. **Design Guidance from the *MDS***. The designer should use the *MDS* to obtain the minimum design values for all projects.

2. **AASHTO Minimum Design Guidance** (pg. H-8). This guidance has been consolidated from A Policy on Geometric Design of Highways and Streets (2011), A Policy on Design Standards Interstate System (2005), and Special Report 214: Designing Safer Roads – Practices for Resurfacing, Restoration, and Rehabilitation (1987). Some items in the "AASHTO Minimum Design Guidance" may be less restrictive than the guidance found in the *MDS*, the designer may use the design guidance for these items to avoid requesting a design exception on NHS projects and as a justification for using a lower standard when requesting a design relaxation on non-NHS and state projects.

3. **Nebraska Desirable Design Guidance** (pg. H-31). This is design guidance from the Nebraska Roadway Design Manual and from Roadway Design Division Policy Letters. This listing gives the **NDOT** preferred guidance for certain design categories. This is the design value to be used on all projects, where possible.

3.B Instructions

Prior to filling out Form DR-76, the designer must determine whether the project is a PoDI and if it is on the NHS. The designer may view maps showing the NHS routes in Nebraska at http://www.fhwa.dot.gov/planning/national_highway_system/nhs_maps/nebraska/. PoDIs will require a design exception from the **FHWA** or approval by the **Deputy Director - Engineering** (See Section 2.A.2) if the **AASHTO** minimum design guidance cannot be attained. All other projects will require a relaxation of the *MDS* from the **Board of Public Roads Classifications and Standards** when the minimum design value cannot be met.

Form DR-76 will be completed using the same format for all projects regardless of the level of approval authority.

The designer, in consultation with the **Unit Head**, will determine the design values to be used on a project for each of the controlling design criteria. Placing a design value which is less than the minimum design value in Form DR-76 will require written **Unit Head** approval and justification to the project file. The applicable minimum design value will be entered in Form DR-76, in parenthesis, after the chosen design value. This will highlight any departure from the minimum design guidance requiring a design exception and/or relaxation.

PoDIs on the NHS: The designer should use the design values from the *MDS* as the minimum condition. By exceeding or meeting these values the designer will not need to request either a design exception or relaxation. If the designer cannot meet the minimum *MDS* value for a design element, the "AASHTO Minimum Design Guidance" (pg. H-8) should be reviewed to see if that value may be used. If using the **AASHTO** value, the designer is responsible for ascertaining whether the design value from the *MDS* has been met or if a design relaxation will be required.

PoDIs not on the NHS and State Highway Projects: The designer will use the design guidance from the *MDS* as the minimum condition. If the minimum design values cannot be attained, the designer will need to request a relaxation of the *MDS*. A copy of the approval of a design relaxation for non-NHS PoDIs will be transmitted to the appropriate **FHWA Transportation Engineer** for review and comment.

Note: When entering the appropriate minimum values into Form DR-76, the source of the guidance should be given. The designer will enter the following abbreviations on the form:

- "Minimum Design Standards" = (*MDS*)
- "AASHTO Minimum Design Guidance" = (*GB*)

All projects: When choosing the design values to be used on a project, the designer and **Unit Head** should refer the "Nebraska Desirable Design Guidance" (pg. H-31), the Roadway Design Manual, and the "Roadway Design Division Policy Letters" for additional guidance. Deviation from these guidelines will require approval from the appropriate **Roadway Design Division** level of authority.

AASHTO MINIMUM DESIGN GUIDANCE
STATE FUNCTIONAL CLASSIFICATION
[NATIONAL FUNCTIONAL CLASSIFICATION]

NEW AND RECONSTRUCTED RURAL PROJECTS

Interstate
[Principal Arterial – Interstate] **H-9**
Expressway (Access Only at Interchanges)
[Principal Arterial - Other Freeways & Expressways] **H-10**
Expressway
[Principal Arterial - Other Freeways & Expressways] **H-11**
Major Arterial
[Arterial] **H-12**
Major Arterial
[Collector/Local] **H-13**
Major Arterial – Scenic Recreation
[Arterial/Collector] **H-14**

NEW AND RECONSTRUCTED MUNICIPAL PROJECTS

Interstate
[Principal Arterial – Interstate] **H-15**
Expressway (Access Only at Interchanges)
[Principal Arterial – Other Freeways & Expressways] **H-16**
Expressway
[Principal Arterial – Other Freeways & Expressways] **H-17**
Major Arterial
[Arterial] **H-18**
Major Arterial
[Collector] **H-19**

RESURFACING, RESTORATION AND REHABILITATION (3R) RURAL PROJECTS

Interstate
[Principal Arterial – Interstate] **H-20**
Expressway (Access Only at Interchanges)
[Principal Arterial - Other Freeways & Expressways] **H-21**
Expressway
[Principal Arterial - Other Freeways & Expressways] **H-22**
Major Arterial
[Arterial] **H-23**
Major Arterial
[Collector/Local] **H-24**
Major Arterial – Scenic Recreation
[Arterial/Collector] **H-25**

RESURFACING, RESTORATION AND REHABILITATION (3R) MUNICIPAL PROJECTS

Interstate – Municipal
[Principal Arterial – Interstate] **H-26**
Expressway (Access Only at Interchanges)
[Principal Arterial - Other Freeways & Expressways] **H-27**
Expressway
[Principal Arterial - Other Freeways & Expressways] **H-28**
Major Arterial
[Arterial] **H-29**
Major Arterial
[Collector] **H-30**

NEW AND RECONSTRUCTED RURAL STATE HIGHWAYS AASHTO CLASSIFICATION: INTERSTATE STATE FUNCTIONAL CLASSIFICATION: INTERSTATE NATIONAL FUNCTIONAL CLASSIFICATION: PRINCIPAL ARTERIAL – INTERSTATE	
Design Speed	70 mph
Lane Width	12 ft.
Shoulder Width	Right = 10 ft. 4-Lane: Left = 4 ft. ≥ 6-Lane: Left = 10 ft. Truck Traffic > 250 DDHV: Right & Left = 12 ft. (Note: All shoulder widths are paved).
Horizontal Alignment	
Superelevation	e_{max} = 8%
Minimum Radius (Based on Maximum Superelevation)	1,810 ft.
Vertical Alignment	
Crest K Value	247
Sag K Value	181
Maximum Grade	3% Level 4% Rolling
Stopping Sight Distance	730 ft.
Cross Slope	
Lane	1.5% (A)
Shoulder	2% to 6% paved (B)
Lateral Offset to Obstruction	The paved shoulder width.
Vertical Clearance (1)	16 ft. Sign trusses: Structure clearance + 1 ft.
Bridge Width	Full width of the approach roadway including paved shoulders. Bridge L > 200 ft.: Offsets to parapet, rail or barrier from the edge of the nearest traffic lane shall be at least 4 ft.
Structural Capacity	HL93

For additional information see A Policy on Design Standards Interstate System, January 2005 and A Policy on Geometric Design of Highways and Streets, 2011

(1) Over the entire roadway, including the width of paved shoulders.

(A) On roadways where there are more than two lanes inclined in the same direction, the cross slope may be increased by 0.5% to 1% for each additional lane, up to a maximum of 3%.

(B) The surfaced shoulder cross slope should not be less than the cross slope of the adjacent lane.

NEW AND RECONSTRUCTED RURAL STATE HIGHWAYS AASHTO CLASSIFICATION: RURAL FREEWAY STATE FUNCTIONAL CLASSIFICATION: EXPRESSWAY (ACCESS ONLY AT INTERCHANGES) NATIONAL FUNCTIONAL CLASSIFICATION: PRINCIPAL ARTERIAL – OTHER FREEWAYS AND EXPRESSWAYS	
Design Speed	50 mph
Lane Width	12 ft.
Shoulder Width	Right = 10 ft. 4-Lane: Left = 4 ft. ≥ 6-Lane: Left = 10 ft. Truck Traffic > 250 DDHV: Right & Left = 12 ft. (Note: All shoulder widths are paved).
Horizontal Alignment	
Superelevation	e_{max} = 8%
Minimum Radius (Based on Maximum Superelevation)	758 ft.
Vertical Alignment	
Crest K Value	84
Sag K Value	96
Maximum Grade	4% Level 5% Rolling
Stopping Sight Distance	425 ft.
Cross Slope	
Lane	1.5% to 2% (A)
Shoulder	2% to 6% paved (C)
Lateral Offset to Obstruction	The normal shoulder width.
Vertical Clearance (2)	16 ft. Sign trusses: Structure clearance + 1 ft.
Bridge Width	Full width of the approach roadway.
Structural Capacity	HL93

For additional information see A Policy on Geometric Design of Highways and Streets, 2011

(2) Over the entire roadway, including usable shoulders.

(A) On roadways where there are more than two lanes inclined in the same direction, the cross slope may be increased by 0.5% to 1% for each additional lane, up to a maximum of 3%.

(C) The surfaced shoulder cross slope should not be less than the cross slope of the adjacent roadway lane and can be at least 1% greater.

NEW AND RECONSTRUCTED RURAL STATE HIGHWAYS AASHTO CLASSIFICATION: RURAL DIVIDED ARTERIAL STATE FUNCTIONAL CLASSIFICATION: EXPRESSWAY NATIONAL FUNCTIONAL CLASSIFICATION: PRINCIPAL ARTERIAL	
Design Speed	50 mph
Lane Width	12 ft. (11 ft. may be retained based on alignment and crash history)
Shoulder Width	8 ft. Right / 4 ft. Left (both paved)
Horizontal Alignment	
Superelevation	e_{max} = 8%
Minimum Radius (Based on Maximum Superelevation)	758 ft.
Vertical Alignment	
Crest K Value	84
Sag K Value	96
Maximum Grade (3)	4% Level 5% Rolling
Stopping Sight Distance	425 ft.
Cross Slope	
Lane	1.5% to 2% (A)
Shoulder	2% to 6% paved (B) 6% to 8% turf
Lateral Offset to Obstruction	The greater of the paved shoulder width or 4 ft. from the edge of the travelled way.
Vertical Clearance (2)	16 ft. (14 ft. may be retained if allowed by local statute). Sign trusses: Structure clearance +1 ft.
Bridge Width	Full width of the approach roadway including paved shoulders. Bridge L > 200 ft.: Offsets to parapet, rail or barrier from the edge of the nearest traffic lane shall be at least 4 ft.
Structural Capacity	HL93

For additional information see A Policy on Geometric Design of Highways and Streets, 2011

(2) Over the entire roadway, including usable shoulders.

(3) Grade may be up to 1% steeper for tangent length less than 500 ft.

(A) On roadways where there are more than two lanes inclined in the same direction, the cross slope may be increased by 0.5% to 1% for each additional lane, up to a maximum of 3%.

(B) The surfaced shoulder cross slope should not be less than the cross slope of the adjacent lane.

NEW AND RECONSTRUCTED RURAL STATE HIGHWAYS AASHTO CLASSIFICATION: RURAL ARTERIAL STATE FUNCTIONAL CLASSIFICATION: MAJOR ARTERIAL NATIONAL FUNCTIONAL CLASSIFICATION: ARTERIAL	
Design Speed	50 mph
Lane Width	ADT ≥ 400 VPD: 12 ft. ADT < 400 VPD: 11 ft.
Shoulder Width	ADT ≥ 2,000 VPD: 8 ft. ADT 400 – 1,999 VPD: 6 ft. ADT < 400 VPD: 4 ft.
Horizontal Alignment	
Superelevation	e_{max} = 8%
Minimum Radius (Based on Maximum Superelevation)	758 ft.
Vertical Alignment	
Crest K Value	84
Sag K Value	96
Maximum Grade (3)	4% Level 5% Rolling
Stopping Sight Distance	425 ft.
Cross Slope	
Lane	1.5% to 2% (A)
Shoulder	2% to 6% paved (B) 6% to 8% turf
Lateral Offset to Obstruction	The greater of the paved shoulder width or 4 ft. from the edge of the travelled way.
Vertical Clearance (2)	16 ft. (14 ft. may be retained if allowed by local statute). Sign Trusses: Structure clearance + 1 ft.
Bridge Width	Full width of the approach roadway including paved shoulders. Bridge L > 200 ft.: Offsets to parapet, rail or barrier from the edge of the traffic lane shall be at least 4 ft.
Structural Capacity	HL93

For additional information see A Policy on Geometric Design of Highways and Streets, 2011

(2) Over the entire roadway, including usable shoulders.

(3) Grade may be up to 1% steeper for tangent length less than 500 ft.

(A) On roadways where there are more than two lanes inclined in the same direction, the cross slope may be increased by 0.5% to 1% for each additional lane, up to a maximum of 3%.

(B) The surfaced shoulder cross slope should not be less than the cross slope of the adjacent lane.

NEW AND RECONSTRUCTED RURAL STATE HIGHWAYS AASHTO CLASSIFICATION: RURAL COLLECTOR STATE FUNCTIONAL CLASSIFICATION: MAJOR ARTERIAL NATIONAL FUNCTIONAL CLASSIFICATION: COLLECTOR / LOCAL				
	ADT > 2,000	**ADT 1,500 – 1,999**	**ADT 400 – 1,499**	**ADT < 400**
Design Speed	50 mph	40 mph	40 mph	30 mph
Lane Width	12 ft.	11 ft.	11 ft.	10 ft.
Shoulder Width	8 ft.	6 ft.	5 ft.	2 ft.
Horizontal Alignment				
Superelevation	e_{max} = 8%	e_{max} = 8%	e_{max} = 8%	e_{max} = 8%
Minimum Radius (Based on Max. Superelevation)	758 ft.	444 ft.	444 ft.	214 ft.
Vertical Alignment				
Crest K Value	84	44	44	19
Sag K Value	96	64	64	37
Maximum Grade (4)	6% Level 7% Rolling	7% Level 8% Rolling	7% Level 8% Rolling	7% Level 9% Rolling
Stopping Sight Distance	425 ft.	305 ft.	305 ft.	200 ft.
Cross Slope				
Lane	1.5% - 2%	1.5% - 2%	1.5% - 2%	1.5% - 2%
Shoulder	2% - 6% paved (B) 6% - 8% turf	2% - 6% paved (B) 6% - 8% turf	2% - 6% paved (B) 6% - 8% turf	2% - 6% paved (B) 6% - 8% turf
Lateral Offset to Obstruction	The greater of the shoulder width or 4 ft. from the edge of the travelled way.	The greater of the shoulder width or 4 ft. from the edge of the travelled way.	The greater of the shoulder width or 4 ft. from the edge of the travelled way.	The greater of the shoulder width or 4 ft. from the edge of the travelled way.
Vertical Clearance (2)	14 ft. Sign Trusses: Structure clearance + 1 ft.	14 ft. Sign Trusses: Structure clearance + 1 ft.	14 ft. Sign Trusses: Structure clearance + 1 ft.	14 ft. Sign Trusses: Structure clearance + 1 ft.
Bridge Width	Full width of the approach roadway. Bridge L > 100 ft.: Traveled way + 3 ft. on each side.	Traveled way + 4 ft. on each side. Bridge L > 100 ft.: Traveled way + 3 ft. on each side.	Traveled way + 3 ft. on each side.	Traveled way + 2 ft. on each side.
Structural Capacity	HL93	HL93	HL93	HL93

For additional information see A Policy on Geometric Design of Highways and Streets, 2011

(2) Over the entire roadway, including usable shoulders.

(4) Grade may be up to 2% steeper for tangent length less than 500 ft.

(B) The surfaced shoulder cross slope should not be less than the cross slope of the adjacent lane.

NEW AND RECONSTRUCTED RURAL STATE HIGHWAYS

STATE FUNCTIONAL CLASSIFICATION: MAJOR ARTERIAL – SCENIC RECREATION
NATIONAL FUNCTIONAL CLASSIFICATION: COLLECTOR / LOCAL

THERE IS NO AASHTO GUIDANCE FOR SCENIC RECREATION.
USE THE DESIGN STANDARDS FOUND IN THE NEBRASKA MINIMUM DESIGN STANDARDS.

NEW AND RECONSTRUCTED MUNICIPAL STATE HIGHWAYS AASHTO CLASSIFICATION: INTERSTATE STATE FUNCTIONAL CLASSIFICATION: INTERSTATE NATIONAL FUNCTIONAL CLASSIFICATION: PRINCIPAL ARTERIAL – INTERSTATE	
Design Speed	50 mph
Lane Width	12 ft.
Shoulder Width	Right = 10 ft. 4-Lane: Left = 4 ft. ≥ 6-Lane: Left = 10 ft. Truck Traffic > 250 DDHV: Right & Left = 12 ft. (Note: All shoulder widths are paved).
Horizontal Alignment	
Superelevation	e_{max} = 8%
Minimum Radius (Based on Maximum Superelevation)	758 ft.
Vertical Alignment	
Crest K Value	84
Sag K Value	96
Maximum Grade	4% Level 5% Rolling (Grades may be up to 1% steeper)
Stopping Sight Distance	425 ft.
Cross Slope	
Lane	1.5% (A)
Shoulder	2% to 6% paved (B)
Lateral Offset to Obstruction	The paved shoulder width.
Vertical Clearance (1)	16 ft. for at least one route and 14 ft. for other routes (including paved shoulders). Sign trusses and pedestrian overpasses: Structure clearance + 1 ft.
Bridge Width	Full width of the approach roadway including paved shoulders. Bridge L > 200 ft.: Offsets to parapet, rail or barrier from the edge of the nearest traffic lane shall be at least 4 ft.
Structural Capacity	HL93

For additional information see A Policy on Design Standards Interstate System, January 2005 and A Policy on Geometric Design of Highways and Streets, 2011

(1) Over the entire roadway, including the width of paved shoulders

(A) On roadways where there are more than two lanes inclined in the same direction, the cross slope may be increased by 0.5% to 1% for each additional lane, up to a maximum of 3%.

(B) The surfaced shoulder cross slope should not be less than the cross slope of the adjacent lane.

NEW AND RECONSTRUCTED MUNICIPAL STATE HIGHWAYS AASHTO CLASSIFICATION: URBAN FREEWAY STATE FUNCTIONAL CLASSIFICATION: EXPRESSWAY (ACCESS ONLY AT INTERCHANGES) NATIONAL FUNCTIONAL CLASSIFICATION: PRINCIPAL ARTERIAL – OTHER FREEWAYS AND EXPRESSWAYS	
Design Speed	50 mph
Lane Width	12 ft.
Shoulder Width	Right = 10 ft. 4-Lane: Left = 4 ft. ≥ 6-Lane: Left = 10 ft. Truck Traffic > 250 DDHV: Right & Left = 12 ft. (Note: All shoulder widths are paved).
Horizontal Alignment	
Superelevation	e_{max} = 8%
Minimum Radius (Based on Maximum Superelevation)	758 ft.
Vertical Alignment	
Crest K Value	84
Sag K Value	96
Maximum Grade	4% Level 5% Rolling (Grades 1% steeper may be provided)
Stopping Sight Distance	425 ft.
Cross Slope	
Lane	1.5% to 2% (A)
Shoulder	2% to 6% paved (C)
Lateral Offset to Obstruction	The normal shoulder width.
Vertical Clearance (2)	16 ft. for at least one route and 14 ft. for other routes (including auxiliary lanes and paved shoulders). Sign trusses and pedestrian overpasses: Structure clearance + 1 ft.
Bridge Width	Full width of the approach roadway.
Structural Capacity	HL93

For additional information see A Policy on Geometric Design of Highways and Streets, 2011

(2) Over the entire roadway, including usable shoulders.

(A) On roadways where there are more than two lanes inclined in the same direction, the cross slope may be increased by 0.5% to 1% for each additional lane, up to a maximum of 3%.

(C) The surfaced shoulder cross slope should not be less than the cross slope of the adjacent roadway lane and can be at least 1% greater.

NEW AND RECONSTRUCTED MUNICIPAL STATE HIGHWAYS AASHTO CLASSIFICATION: URBAN ARTERIAL STATE FUNCTIONAL CLASSIFICATION: EXPRESSWAY NATIONAL FUNCTIONAL CLASSIFICATION: PRINCIPAL ARTERIAL – OTHER FREEWAYS AND EXPRESSWAYS	
Design Speed	30 mph
Lane Width	11 ft.
Shoulder Width	Curbed: Not Applicable 8 ft. Right / 4 ft. Left (both paved)
Horizontal Alignment	
Superelevation	e_{max} = 8%
Minimum Radius (Based on Maximum Superelevation)	214 ft.
Vertical Alignment	
Crest K Value	19
Sag K Value	37
Maximum Grade (3)	8% level 9% Rolling
Stopping Sight Distance	200 ft.
Cross Slope	
Lane	1.5% to 2% (A)
Shoulder	2% to 6% paved (B) 6% to 8% turf
Lateral Offset to Obstruction	Curbed: 1.5 ft. from face of the curb (3 ft. at intersections). Non-curbed: The greater of the paved shoulder width or 4 ft. from the edge of the travelled way.
Vertical Clearance (2)	16 ft. for one route & 14 ft. for other routes (including auxiliary lanes & paved shoulders). Sign Trusses and pedestrian overpasses: Structure clearance + 1 ft.
Bridge Width	Curb to curb width of street, including sidewalks and bike lanes. Bridge L > 200 ft.: Offsets to parapet, rail or barrier from the edge of the nearest traffic lane shall be at least 4 ft.
Structural Capacity	HL93

For additional information see A Policy on Geometric Design of Highways and Streets, 2011

(2) Over the entire roadway, including usable shoulders.

(3) Grade may be up to 1% steeper for tangent lengths less than 500 ft.

(A) On roadways where there are more than two lanes inclined in the same direction, the cross slope may be increased by 0.5% to 1% for each additional lane, up to a maximum of 3%.

(B) The surfaced shoulder cross slope should not be less than the cross slope of the adjacent lane.

NEW AND RECONSTRUCTED MUNICIPAL STATE HIGHWAYS AASHTO CLASSIFICATION: URBAN ARTERIAL STATE FUNCTIONAL CLASSIFICATION: MAJOR ARTERIAL NATIONAL FUNCTIONAL CLASSIFICATION: ARTERIAL	
Design Speed	30 mph
Lane Width	11 ft.
Shoulder Width	Curbed: Not Applicable ADT ≥ 2,000 VPD: 8 ft. ADT 400 – 1,999 VPD: 6 ft. ADT < 400 VPD: 4 ft.
Horizontal Alignment	
Superelevation	e_{max} = 8%
Minimum Radius (Based on Maximum Superelevation)	214 ft.
Vertical Alignment	
Crest K Value	19
Sag K Value	37
Maximum Grade (3)	8% level 9% Rolling
Stopping Sight Distance	200 ft.
Cross Slope	
Lane	1.5% to 3% (A)
Shoulder	2% to 6% paved (B) 6% to 8% turf
Lateral Offset to Obstruction	Curbed: 1.5 ft. from face of the curb (3 ft. at intersections). Non-curbed: The greater of the paved shoulder width or 4 ft. from the edge of the travelled way.
Vertical Clearance (2)	16 ft. for one route & 14 ft. for other routes (including auxiliary lanes & paved shoulders). Sign Trusses and pedestrian overpasses: Structure clearance + 1 ft.
Bridge Width	Curb to curb width of street, including sidewalks and bike lanes. Bridge L > 200 ft.: Offsets to parapet, rail or barrier from the edge of the nearest traffic lane shall be at least 4 ft.
Structural Capacity	HL93

For additional information see A Policy on Geometric Design of Highways and Streets, 2011

(2) Over the entire roadway, including usable shoulders.

(3) Grade may be up to 1% steeper for tangent lengths less than 500 ft.

(A) On roadways where there are more than two lanes inclined in the same direction, the cross slope may be increased by 0.5% to 1% for each additional lane, up to a maximum of 3%.

(B) The surfaced shoulder cross slope should not be less than the cross slope of the adjacent lane.

NEW AND RECONSTRUCTED MUNICIPAL STATE HIGHWAYS AASHTO CLASSIFICATION: URBAN COLLECTOR STATE FUNCTIONAL CLASSIFICATION: MAJOR ARTERIAL NATIONAL FUNCTIONAL CLASSIFICATION: COLLECTOR	
Design Speed	30 mph
Lane Width	10 ft.
Shoulder Width	Curbed: Not Applicable ADT ≥ 2,000 VPD: 8 ft. ADT 1,500 – 1,999 VPD: 6 ft. ADT 400 – 1,499 VPD: 5 ft. ADT < 400 VPD: 2 ft.
Horizontal Alignment	
Superelevation	e_{max} = 6%
Minimum Radius (Based on Maximum Superelevation)	231 ft.
Vertical Alignment	
Crest K Value	19
Sag K Value	37
Maximum Grade (4)	9% level 11% Rolling
Stopping Sight Distance	200 ft.
Cross Slope	
Lane	1.5% to 3% (A)
Shoulder	2% to 6% paved (B) 6% to 8% turf
Lateral Offset to Obstruction	Curbed: 1.5 ft. from face of the curb (3 ft. at intersections). Non-curbed: The greater of the paved shoulder width or 4 ft. from the edge of the travelled way.
Vertical Clearance (2)	14 ft. Sign Trusses and pedestrian overpasses: Structure clearance + 1 ft.
Bridge Width	Curb to curb width of street or the full width of the approach roadway (including shoulders and sidewalks). Non-curbed: The full width of the approach roadway.
Structural Capacity	HL93

For additional information see A Policy on Geometric Design of Highways and Streets, 2011

(2) Over the entire roadway, including usable shoulders.

(4) Grade may be up to 2% steeper for tangent length less than 500 ft.

(A) On roadways where there are more than two lanes inclined in the same direction, the cross slope may be increased by 0.5% to 1% for each additional lane, up to a maximum of 3%.

(B) The surfaced shoulder cross slope should not be less than the cross slope of the adjacent lane.

RESURFACING, RESTORATION AND REHABILITATION (3R) PROJECTS ON RURAL STATE HIGHWAYS	
AASHTO CLASSIFICATION: INTERSTATE STATE FUNCTIONAL CLASSIFICATION: INTERSTATE NATIONAL FUNCTIONAL CLASSIFICATION: PRINCIPAL ARTERIAL	
Design Speed	Posted Speed Limit
Lane Width	AASHTO standards in effect at time of latest New or Reconstructed project on the section of the Interstate.
Shoulder Width	AASHTO standards in effect at time of latest New or Reconstructed project on the section of the Interstate.
Horizontal Alignment	
Superelevation	e_{max} = 8%
Minimum Radius (Based on Maximum Superelevation)	AASHTO standards in effect at time of latest New or Reconstructed project on the section of the Interstate.
Vertical Alignment	AASHTO standards in effect at time of latest New or Reconstructed project on the section of the Interstate.
Grade	AASHTO standards in effect at time of latest New or Reconstructed project on the section of the Interstate.
Stopping Sight Distance	AASHTO standards in effect at time of latest New or Reconstructed project on the section of the Interstate.
Cross Slope	
Lane	1.5% to 2.5% (A)
Shoulder	Paved shoulder = 2% to 6% (B)
Lateral Offset to Obstruction	The paved shoulder width.
Vertical Clearance (1)	16 ft. 17 ft. clearance for sign trusses and pedestrian overpasses
Bridge Width	Bridge may remain in place if the cross section consists of 12 ft. lanes, a 10 ft. shoulder right, and a 3.5 ft. shoulder left. For long bridges the minimum width is from the outside edge of travel lane to the outside edge of travel lane plus 3.5 ft. on each side.
Structural Capacity	A bridge can remain in place if the operating capacity can safely service the system for an additional 20 years.

For additional information see A Policy On Design Standards Interstate System, January 2005 and Special Report 214: Designing Safer Roads – Practices for Resurfacing, Restoration, and Rehabilitation as cited in A Policy on Geometric Design of Highways and Streets, 2011

(1) Over the entire roadway, including the width of paved shoulders.

(A) On roadways where there are more than two lanes inclined in the same direction, the cross slope may be increased by 0.5% to 1% for each additional lane, up to a maximum of 3%.

(B) The surfaced shoulder cross slope should not be less than the cross slope of the adjacent lane.

RESURFACING, RESTORATION AND REHABILITATION (3R) PROJECTS ON RURAL STATE HIGHWAYS
AASHTO CLASSIFICATION: RURAL FREEWAY STATE FUNCTIONAL CLASSIFICATION: EXPRESSWAY (ACCESS ONLY AT INTERCHANGES) NATIONAL FUNCTIONAL CLASSIFICATION: PRINCIPAL ARTERIAL – OTHER FREEWAYS AND EXPRESSWAYS

THERE ARE NO 3R STANDARDS FOR FREEWAYS.
USE THE DESIGN STANDARDS FOR NEW AND RECONSTRUCTED PROJECTS.

RESURFACING, RESTORATION AND REHABILITATION (3R) PROJECTS ON RURAL STATE HIGHWAYS
AASHTO CLASSIFICATION: RURAL DIVIDED ARTERIAL STATE FUNCTIONAL CLASSIFICATION: EXPRESSWAY NATIONAL FUNCTIONAL CLASSIFICATION: PRINCIPAL ARTERIAL - OTHER FREEWAYS AND EXPRESSWAYS

THERE IS NO AASHTO 3R GUIDANCE FOR EXPRESSWAY.
USE THE 3R DESIGN STANDARDS FOUND IN THE NEBRASKA MINIMUM DESIGN STANDARDS.

RESURFACING, RESTORATION AND REHABILITATION (3R) PROJECTS ON RURAL STATE HIGHWAYS	
AASHTO CLASSIFICATION: RURAL ARTERIAL STATE FUNCTIONAL CLASSIFICATION: MAJOR ARTERIAL NATIONAL FUNCTIONAL CLASSIFICATION: ARTERIAL	
Design Speed	Posted Speed Limit
Lane Width	ADT > 750 VPD: ≥ 10% Trucks = 12 ft. < 10% Trucks = 11 ft. ADT ≤ 750 VPD: 10 ft.
Shoulder Width	ADT > 2,000 VPD = 6 ft. ADT 751 – 2,000 VPD = 3 ft. ADT ≤ 750 VPD = 2 ft.
Horizontal Alignment	
Superelevation	Increase the superelevation when the design speed is below the running speed and the existing superelevation is less than the maximum from the *Green Book*.
Minimum Radius (Based on Maximum Superelevation)	Evaluate reconstruction when the design speed is more than 15 mph below the running speed and the ADT is > 750.
Vertical Alignment	Evaluate reconstructing hill crests when: the crest hides major hazards, the ADT > 1500, and the design speed is more than 20 mph below the running speed.
Grade	Existing
Stopping Sight Distance	Evaluate reconstructing hill crests when: the crest hides major hazards, the ADT > 1500, and the design speed is more than 20 mph below the running speed.
Cross Slope	
Lane	1.5% to 2% (A)
Shoulder	2% to 6% paved (B) 6% to 8% turf
Lateral Offset to Obstruction	The greater of the paved shoulder width or 4 ft. from the edge of the travelled way.
Vertical Clearance (2)	14 ft. if allowed by local statute. Sign Trusses: Structure clearance + 1 ft.
Bridge Width	ADT > 4,000 VPD: Width of approach lanes + 3 ft. clearance / side. ADT 2,000 – 3,999 VPD: Width of approach lanes + 2 ft. clearance / side. ADT 751 – 1,999 VPD: Width of approach lanes + 1 ft. clearance / side. ADT ≤ 750 VPD: Width of approach lanes.
Structural Capacity	Use in Place: Existing. (D) Rehabilitated: H15 with a service life of 15 years or more. (E)

For additional information see Special Report 214: Designing Safer Roads – Practices for Resurfacing, Restoration, and Rehabilitation as cited in A Policy on Geometric Design of Highways and Streets, 2011

(2) Over the entire roadway, including usable shoulders.

(A) On roadways where there are more than two lanes inclined in the same direction, the cross slope may be increased by 0.5% to 1% for each additional lane, up to a maximum of 3%.

(B) The surfaced shoulder cross slope should not be less than the cross slope of the adjacent lane.

(D) "Use in Place" includes any bridge work short of razing the entire superstructure (e.g. overlay, new railing, redecking, widening, girder replacement in kind, etc.)

(E) Rehabilitation is the replacement of the existing deck and superstructure and can include repairs to the existing substructure.

RESURFACING, RESTORATION AND REHABILITATION (3R) PROJECTS ON RURAL STATE HIGHWAYS		
AASHTO CLASSIFICATION: RURAL COLLECTOR STATE FUNCTIONAL CLASSIFICATION: MAJOR ARTERIAL NATIONAL FUNCTIONAL CLASSIFICATION: COLLECTOR / LOCAL		
Design Speed	Posted Speed Limit	
Lane Width	Design Speed ≥ 50 mph: ADT > 750 VPD: ≥ 10% Trucks = 12 ft. < 10% Trucks = 11 ft. ADT ≤ 750 VPD: 10 ft.	Design Speed < 50 mph: ADT > 2,000 VPD: ≥ 10% Trucks = 12 ft. < 10% Trucks = 11 ft. ADT 751 – 2,000 VPD: ≥ 10% Trucks = 11 ft. < 10% Trucks = 10 ft. ADT ≤ 750 ADT: ≥ 10% Trucks = 10 ft. < 10% Trucks = 9 ft.
Shoulder Width	Design Speed ≥ 50 mph: ADT > 2,000 VPD = 6 ft. ADT 751 – 2,000 VPD = 3 ft. ADT ≤ 750 VPD = 2 ft.	Design Speed < 50 mph: ADT > 2,000 VPD = 6 ft. ADT ≤ 2,000 VPD = 2 ft.
Horizontal Alignment		
Superelevation	Increase the superelevation when the design speed is below the running speed and the existing superelevation is less than the maximum from the *Green Book*.	
Minimum Radius (Based on Maximum Superelevation)	Evaluate reconstruction when the design speed is more than 15 mph below the running speed and the ADT is > 750.	
Vertical Alignment	Evaluate reconstructing hill crests when: the crest hides major hazards, the ADT > 1500, and the design speed is more than 20 mph below the running speed.	
Grade	Existing	
Stopping Sight Distance	Evaluate reconstructing hill crests when: the crest hides major hazards, the ADT > 1500, and the design speed is more than 20 mph below the running speed.	
Cross Slope		
Lane	1.5% to 2%	
Shoulder	2% to 6% paved (B) 6% to 8% turf	
Lateral Offset to Obstruction	The greater of the paved shoulder width or 4 ft. from the edge of the travelled way.	
Vertical Clearance (2)	14 ft. if allowed by local statute. Sign Trusses: Structure clearance + 1 ft.	
Bridge Width	ADT > 2,000 VPD: 28 ft. ADT 1,500 – 1,999 VPD: 24 ft. ADT < 1,500 VPD: 22 ft.	
Structural Capacity	Use in Place: Existing. (D) Rehabilitated: H15 with a service life of 15 years or more. (D)	

For additional information see Special Report 214: Designing Safer Roads – Practices for Resurfacing, Restoration, and Rehabilitation as cited in A Policy on Geometric Design of Highways and Streets, 2011

(2) Over the entire roadway, including usable shoulders.

(B) The surfaced shoulder cross slope should not be less than the cross slope of the adjacent lane.

(D) "Use in Place" includes any bridge work short of razing the entire superstructure (e.g. overlay, new railing, redecking, widening, girder replacement in kind, etc.)

(D) Rehabilitation is the replacement of the existing deck and superstructure and can include repairs to the existing substructure.

NEW AND RECONSTRUCTED RURAL STATE HIGHWAYS
STATE FUNCTIONAL CLASSIFICATION: MAJOR ARTERIAL – SCENIC RECREATION NATIONAL FUNCTIONAL CLASSIFICATION: COLLECTOR / LOCAL

THERE IS NO AASHTO 3R GUIDANCE FOR SCENIC RECREATION.
USE THE 3R DESIGN STANDARDS FOUND IN THE NEBRASKA MINIMUM DESIGN STANDARDS.

RESURFACING, RESTORATION AND REHABILITATION (3R) PROJECTS ON MUNICIPAL STATE HIGHWAYS	
AASHTO CLASSIFICATION: INTERSTATE STATE FUNCTIONAL CLASSIFICATION: INTERSTATE NATIONAL FUNCTIONAL CLASSIFICATION: PRINCIPAL ARTERIAL – INTERSTATE	
Design Speed	Posted Speed Limit
Lane Width	AASHTO standards in effect at time of latest New or Reconstructed project on the section of the Interstate.
Shoulder Width	AASHTO standards in effect at time of latest New or Reconstructed project on the section of the Interstate.
Horizontal Alignment	
Superelevation	e_{max} = 8%
Minimum Radius (Based on Maximum Superelevation)	AASHTO standards in effect at time of latest New or Reconstructed project on the section of the Interstate.
Vertical Alignment	AASHTO standards in effect at time of latest New or Reconstructed project on the section of the Interstate.
Grade	AASHTO standards in effect at time of latest New or Reconstructed project on the section of the Interstate.
Stopping Sight Distance	AASHTO standards in effect at time of latest New or Reconstructed project on the section of the Interstate.
Cross Slope	
Lane	1.5% to 2.5% (A)
Shoulder	Paved shoulder = 2% to 6% (B)
Lateral Offset to Obstruction	The paved shoulder width.
Vertical Clearance (1)	16 ft. for at least one route and 14 ft. for other routes. Sign Trusses: Structure clearance + 1 ft.
Bridge Width	Bridge may remain in place if the cross section consists of 12 ft. lanes, a 10 ft. shoulder right, and a 3.5 ft. shoulder left. For long bridges the minimum width is from the outside edge of travel lane to the outside edge of travel lane plus 3.5 ft. on each side.
Structural Capacity	A bridge can remain in place if the operating capacity can safely service the system for an additional 20 years.

For additional information see A Policy On Design Standards Interstate System, January 2005 and Special Report 214: Designing Safer Roads – Practices for Resurfacing, Restoration, and Rehabilitation as cited in A Policy on Geometric Design of Highways and Streets, 2011

(1) Over the entire roadway, including the width of paved shoulders.

(A) On roadways where there are more than two lanes inclined in the same direction, the cross slope may be increased by 0.5% to 1% for each additional lane, up to a maximum of 3%.

(B) The surfaced shoulder cross slope should not be less than the cross slope of the adjacent lane.

RESURFACING, RESTORATION AND REHABILITATION (3R) PROJECTS ON MUNICIPAL STATE HIGHWAYS
AASHTO CLASSIFICATION: URBAN FREEWAY STATE FUNCTIONAL CLASSIFICATION: EXPRESSWAY (ACCESS ONLY AT INTERCHANGES) NATIONAL FUNCTIONAL CLASSIFICATION: PRINCIPAL ARTERIAL – OTHER FREEWAYS AND EXPRESSWAYS

THERE ARE NO 3R STANDARDS FOR FREEWAYS.
USE THE DESIGN STANDARDS FOR NEW AND RECONSTRUCTED PROJECTS.

NEW AND RECONSTRUCTED MUNICIPAL STATE HIGHWAYS
STATE FUNCTIONAL CLASSIFICATION: EXPRESSWAY NATIONAL FUNCTIONAL CLASSIFICATION: PRINCIPAL ARTERIAL – OTHER FREEWAYS AND EXPRESSWAYS

THERE IS NO AASHTO 3R GUIDANCE FOR MUNICIPAL EXPRESSWAY.
USE THE 3R DESIGN STANDARDS FOUND IN THE NEBRASKA MINIMUM DESIGN STANDARDS.

RESURFACING, RESTORATION AND REHABILITATION (3R) PROJECTS ON MUNICIPAL STATE HIGHWAYS		
AASHTO CLASSIFICATION: URBAN ARTERIAL STATE FUNCTIONAL CLASSIFICATION: MAJOR ARTERIAL NATIONAL FUNCTIONAL CLASSIFICATION: ARTERIAL		
Design Speed	Posted Speed Limit	
Lane Width	Design Speed ≥ 50 mph: ADT > 750 VPD: ≥ 10% Trucks = 12 ft. < 10% Trucks = 11 ft. ADT ≤ 750 VPD: 10 ft.	Design Speed < 50 mph: ADT > 2,000 VPD: ≥ 10% Trucks = 12 ft. < 10% Trucks = 11 ft. ADT 751 – 2,000 VPD: ≥ 10% Trucks = 11 ft. < 10% Trucks = 10 ft. ADT ≤ 750 ADT: ≥ 10% Trucks = 10 ft. < 10% Trucks = 9 ft.
Shoulder Width	Curbed: Not Applicable	
	Design Speed ≥ 50 mph: ADT > 2,000 VPD = 6 ft. ADT 751 – 2,000 VPD = 3 ft. ADT ≤ 750 VPD = 2 ft.	Design Speed < 50 mph: ADT > 2,000 VPD = 6 ft. ADT ≤ 2,000 VPD = 2 ft.
Horizontal Alignment		
Superelevation	Increase the superelevation when the design speed is below the running speed and the existing superelevation is less than the maximum from the *Green Book*.	
Minimum Radius (Based on Maximum Superelevation)	Evaluate reconstruction when the design speed is more than 15 mph below the running speed and the ADT is > 750.	
Vertical Alignment	Evaluate reconstructing hill crests when: the crest hides major hazards, the ADT > 1500, and the design speed is more than 20 mph below the running speed.	
Grade	Existing	
Stopping Sight Distance	Evaluate reconstructing hill crests when: the crest hides major hazards, the ADT > 1500, and the design speed is more than 20 mph below the running speed.	
Cross Slope		
Lane	1.5% to 3%	
Shoulder	2% to 6% paved (B) 6% to 8% turf	
Lateral Offset to Obstruction	Curbed: 1.5 ft. from the edge of the curb (3 ft. at intersections). Non-curbed: The greater of the paved shoulder width or 4 ft. from the edge of the travelled way.	
Vertical Clearance (2)	14 ft. if allowed by local statute. Sign Trusses: Structure clearance + 1 ft.	
Bridge Width	ADT > 4,000 VPD: Width of approach lanes + 3 ft. clearance / side. ADT 2,000 – 3,999 VPD: Width of approach lanes + 2 ft. clearance / side. ADT 751 – 1,999 VPD: Width of approach lanes + 1 ft. clearance / side. ADT ≤ 750 VPD: Width of approach lanes.	
Structural Capacity	Use in Place: Existing. (D) Rehabilitated: H15 with a service life of 15 years or more. (D)	

For additional information see Special Report 214: Designing Safer Roads – Practices for Resurfacing, Restoration, and Rehabilitation as cited in A Policy on Geometric Design of Highways and Streets, 2011

(2) Over the entire roadway, including usable shoulders.

(B) The surfaced shoulder cross slope should not be less than the cross slope of the adjacent lane.

(D) "Use in Place" includes any bridge work short of razing the entire superstructure (e.g. overlay, new railing, redecking, widening, girder replacement in kind, etc.)

(E) Rehabilitation is the replacement of the existing deck and superstructure and can include repairs to the existing substructure.

RESURFACING, RESTORATION AND REHABILITATION (3R) PROJECTS ON MUNICIPAL STATE HIGHWAYS		
AASHTO CLASSIFICATION: URBAN COLLECTOR STATE FUNCTIONAL CLASSIFICATION: MAJOR ARTERIAL NATIONAL FUNCTIONAL CLASSIFICATION: COLLECTOR		
Design Speed	Posted Speed Limit	
Lane Width	Design Speed ≥ 50 mph: ADT > 750 VPD: ≥ 10% Trucks = 12 ft. < 10% Trucks = 11 ft. ADT ≤ 750 VPD: 10 ft.	Design Speed < 50 mph: ADT > 2,000 VPD: ≥ 10% Trucks = 12 ft. < 10% Trucks = 11 ft. ADT 751 – 2,000 VPD: ≥ 10% Trucks = 11 ft. < 10% Trucks = 10 ft. ADT ≤ 750 ADT: ≥ 10% Trucks = 10 ft. < 10% Trucks = 9 ft.
Shoulder Width	Curbed: Not Applicable	
	Design Speed ≥ 50 mph: ADT > 2,000 VPD = 6 ft. ADT 751 – 2,000 VPD = 3 ft. ADT ≤ 750 VPD = 2 ft.	Design Speed < 50 mph: ADT > 2,000 VPD = 6 ft. ADT ≤ 2,000 VPD = 2 ft.
Horizontal Alignment		
Superelevation	Increase the superelevation when the design speed is below the running speed and the existing superelevation is less than the maximum from the *Green Book*.	
Minimum Radius (Based on Maximum Superelevation)	Evaluate reconstruction when the design speed is more than 15 mph below the running speed and the ADT is > 750.	
Vertical Alignment	Evaluate reconstructing hill crests when: the crest hides major hazards, the ADT > 1500, and the design speed is more than 20 mph below the running speed.	
Grade	Existing	
Stopping Sight Distance	Evaluate reconstructing hill crests when: the crest hides major hazards, the ADT > 1500, and the design speed is more than 20 mph below the running speed.	
Cross Slope		
Lane	1.5% to 2%	
Shoulder	2% to 6% paved (B) 6% to 8% turf	
Lateral Offset to Obstruction	Curbed: 1.5 ft. from the edge of the curb (3 ft. at intersections). The greater of the paved shoulder width or 4 ft. from the edge of the travelled way.	
Vertical Clearance (2)	14 ft. if allowed by local statute. Sign Trusses: Structure clearance + 1 ft.	
Bridge Width	ADT > 2,000 VPD: 28 ft. ADT 1,500 – 1,999 VPD: 24 ft. ADT < 1,500 VPD: 22 ft.	
Structural Capacity	Use in Place: Existing. (D) Rehabilitated: H15 with a service life of 15 years or more. (E)	

For additional information see Special Report 214: Designing Safer Roads – Practices for Resurfacing, Restoration, and Rehabilitation as cited in A Policy on Geometric Design of Highways and Streets, 2011

(2) Over the entire roadway, including usable shoulders.

(B) The surfaced shoulder cross slope should not be less than the cross slope of the adjacent lane.

(D) "Use in Place includes any bridge work short of razing the entire superstructure (e.g. overlay, new railing, redecking, widening girder replacement in kind, etc.)

(E) Rehabilitation is the replacement of the existing deck and superstructure and can include repairs to the existing substructure.

NEBRASKA DESIRABLE DESIGN GUIDANCE

(For additional information see the Roadway Design Manual (*RDM*) and the Roadway Design Division Policy Letters)

NEW AND RECONSTRUCTED PROJECTS

Design Speed: "The desirable design speed for a roadway project is 5 mph greater than the anticipated posted speed limit for the roadway." (See the *RDM*, Chapter One: Design Standards, Section 6.B).

Superelevation: The desirable maximum superelevation for rural roadways and for bridges is 6%; the use of 8% requires **Assistant Design Engineer** approval. (See the *RDM*, Chapter Three: Roadway Alignment, Section 2.B and EXHIBIT 3.2).

Vertical Alignment and Stopping Sight Distance: The desirable K values for crest and sag vertical curves and the desirable stopping sight distance includes intersection sight distance (See the *RDM*, Chapter Three: Roadway Alignment, Sections 3.B.2, 3.C, and 3.D and EXHIBITS 3.9 AND 3.14). The use of less than the desirable K value or stopping sight distance requires **Unit Head** approval..

Vertical Clearance: "It is desirable to include 0.50 feet allowance for future resurfacing." (See the *RDM*, Chapter Ten: Miscellaneous Design Issues, EXHIBIT 10.4).

3R PROJECTS

(See the *RDM*, Chapter Seventeen: Resurfacing, Restoration and Rehabilitation (3R) Projects, Section 2)

Design Speed: "The design speed to be used is the speed limit determined by **Traffic** to be posted at the completion of the project."

Superelevation:

- The designer should check the existing superelevation using the as-built e_{max}. In the event no as-built information is available, the e_{max} = 6% table (*RDM* Chapter Three, EXHIBIT 3.3c) can be used and, if necessary, the existing superelevation should be corrected to match the table. If the existing superelevation rate is over 6%, the existing superelevation should be checked using the e_{max} = 8% table (**TABLE 3-10b** of the *Green Book*). An 8% superelevation will not be exceeded without the approval of the **Roadway Design Engineer**.
- For low-speed urban applications (V ≤ 45 mph) the designer should check the superelevation using the e_{max} = 4% table (*RDM* Chapter Three, EXHIBIT 3.3d & **TABLE 3-13b** of the *Green Book*).

Installation of the Beveled Edge

The beveled edge is a mitigation measure for roadway departure crashes, intended to allow a smoother recovery to the roadway for an errant vehicle that has departed the roadway hard surfacing. The beveled edge, a sloping finish to the edge of pavement, is an effective measure, recommended by the Federal Highway Administration (FHWA), to reduce the frequency and severity of run-off-the-road crashes by reducing tire scrubbing and allowing for a smooth re-entry of errant vehicles to the travelled way.

This treatment of the pavement edge is a recognized and recommended crash mitigation measure by the FHWA; therefore, if the average roadway departure crash rate for rural two-lane roads shows the addition of a beveled edge to be safety beneficial, Federal-aid Highway Safety Improvement Program (HSIP) funds may be used for that purpose. This may be done on individual projects or on a system-wide basis. Additionally, per 23 CFR 924.5(c), “Other Federal-aid funds are eligible to support and leverage the safety program. Improvements to safety features that are routinely provided as part of a broader Federal-aid project should be funded from the same source as the broader project.” A project specific benefit-cost calculation will not be required. The beveled edge will be installed on projects or segments of projects where the following conditions are met:

1. Rural, high speed (posted speed > 45 mph) segments of the State Highway System.
2. Asphalt concrete and Portland Cement Concrete pavements.
3. 3R, reconstruction and new projects with at least two inches of surfacing placement (the beveled edge will not be used on resurfacing projects where less than two inches of surfacing is placed).
4. Surfaced shoulders less than six feet in width; not including segments of erosion control curbed shoulders.
5. Non-curbed roadways.
6. Other projects in locations identified by Traffic Engineering as a mitigation measure for a crash history.

The beveled edge may be used in conjunction with rumble stripes (8 inches strip embedded in the pavement marking).

The information contained in the Glossary, dated July 2006, has been updated to reflect the July 2017 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of the Glossary.

1. GLOSSARY

A. Acronyms, Abbreviations and Symbols

2-A	Aerial photo plan sheets
2-H	Horizontal alignment and control points plan sheets
2-K	Summary of soil and materials survey information plan sheets
2-L	Large scale plan sheets
2-N	General information plan sheets
2-S	Summary of quantities plan sheets
2-T	Typical cross-section plan sheets
2-W	Wetlands plan sheets
3C	Continuing, cooperative, comprehensive planning process
3R	Resurfacing, restoration and rehabilitation projects
AASHTO	**American Association of State Highway and Transportation Officials**
ADA	Americans with Disabilities Act
ADT	Average daily traffic
BCT	Breakaway cable terminals
CA	Certification acceptance program agreement
CADD	Computer-aided drafting and design
CE	Categorical exclusion
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CRT	Controlled releasing terminals
DA	Diameter of culvert
DEA	Draft environmental assessment
DEIS	Draft environmental impact statement
DHV	Design hourly volume
DR Form 73	Highway Improvement Planning Request Form
DR Form 342	Project Information Sheet
DR Form 334	Project Data Revision Sheet
DR Form 335	Request for Project Authorization Form
EA	Environmental assessment
EIS	Environmental impact statement

EPA	**Environmental Protection Agency**
ESAL	Equivalent single axle load
e	Superelevation rate
e_{max}	Maximum superelevation rate
f	Side friction factor
f_{max}	Limiting side friction factor
FEMA	**Federal Emergency Management Agency**
FHWA	**Federal Highway Administration**
FONSI	Finding of no significant impact
H rating	**AASHTO** bridge live load rating corresponding to weight of a two-axle truck or lane loading (a uniformly distributed and concentrated load)
HS Rating	**AASHTO** bridge live load rating representing a tractor truck with semitrailer, or the corresponding lane loading
HW	Headwater
IES	**Illuminating Engineering Society**
K	Rate of vertical curvature, the length of vertical curve per percentage change in the algebraic difference between two tangent grades
L	Length of curve, distance from the PC to PT along a curve
L_r	Superelevation runoff length
L_{min}	Minimum superelevation runoff length
MELT	Modified eccentric loader terminals
mph	Miles per hour
MPO	Metropolitan planning organization
MSE	Mechanically stabilized earth
MUTCD	The Manual of Uniform Traffic Control Devices
NC	Normal crown section
NCHRP	**National Cooperative Highway Research Program**
NDEQ	**Nebraska Department of Environmental Quality**
NDOT	**Nebraska Department of Transportation**
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NWP	Nationwide permits
OI	Nebraska Department of Transportation Operating Instruction
OSHA	**Occupational Safety and Health Administration**
P	Any point on a curve
P_o	The high or low point of the curve
PC	Point of curvature for a horizontal curve
PCC	Point of compound curvature

PI	Point of intersection of tangents for a horizontal curve
PRC	Point of reverse curvature
PROWAG	The 2011 Draft Public Rights-of-Way Accessibility Guidelines
PS&E	**Plans, Specifications and Estimates Section** in the **Construction Division**
PSI	Pavement serviceability index
PSS	Preconstruction Scheduling System
PT	Point of tangency for a horizontal curve
PVC	Point of curvature for a vertical curve
PVI	Point of intersection of tangents for a vertical curve
PVT	Point of tangency for a vertical curve
Q	Culvert capacity
Q_{design}	Overtopping frequency or the frequency based on the allowable water surface elevation, whichever is more critical
R	Radius of a horizontal curve
R-*	Right-of-way plan sheets
RCRA	Resource Conservation and Recovery Act
ROW	Right-of-way
RR	Railroad
SCS	**Soil Conservation Service**
SEE	Social, economic and environmental review
SHPO	**State Historic Preservation Officer**
SPUI	Single point urban interchange
STP	Surface Transportation Program
T	Tangent length, distance from PC or PT to PI
TCP	Traffic control plan
TR	Tangent runout length
TRB	**Transportation Research Board**
TWLTL	Two-way left turn lane
USDOT	**United States Department of Transportation**
USGS	**U.S. Geologic Survey**
VC	Vertical curves
X-*	Roadway cross-section sheets

B. Terms and Definitions

Abandonment	The act of abandoning an existing roadway and right-of-way when the road is not needed on the state highway system.
Access	A means of ingress or egress between a highway and abutting property or an intersecting local public road or street.
Access Control	Restriction of the number and location of access points along the highway; it varies by the functional classification of the roadway.
Accessible Route	A continuous and unobstructed pedestrian circulation path in the public right-of-way, the various components of which adhere to the guidance found in *PROWAG*.
Accessibility	A measure of the ability of users to utilize the transportation system.
ADA	The Americans with Disabilities Act of 1990 which provides comprehensive civil rights protection to individuals with disabilities in the areas of employment, transportation, public accommodations, state and local government services, and telecommunications.
Adjusted Embankment	The volume of embankment that results from the balance factor being multiplied by the measured embankment.
Alignment Book	A construction book that provides a listing of alignment information for referencing and relocating the centerline.
Allocation	Assigning funds to particular uses.
Alteration	Defined by *PROWAG* as "A change to a facility in the public right-of-way that affects or could affect pedestrian access, circulation, or use. Alterations include, but are not limited to, resurfacing, rehabilitation, reconstruction, historic restoration, or changes or rearrangement of structural parts or elements of a facility."
Ambient Air Quality	The quality of the surrounding air measured in terms of presence of ozone, hydrocarbons, nitrogen oxide, and carbon monoxide based on national standards.
Annual General Stormwater Runoff Permit	A permit obtained annually by the **Construction Division** relative to stormwater discharge.
Archeological Resources	Prehistoric cultural assets.
Armor Coat	A surface treatment consisting of sequential applications of asphalt and stone chips which may be made either in one or more layers to build up a structure roughly one inch or more in thickness.
Arterial Highway	Defined by **AASHTO** as "A highway primarily for through traffic, usually on a continuous route."

At-Grade Intersections	Locations where two or more roadways or entrances cross and/or meet each other at the same elevation.
Auxiliary Lanes	Lanes that are not considered through travel lanes that are intended for use by vehicular traffic for specific functions, such as left and right turns, climbing/passing, acceleration/ deceleration, weaving, etc.
Average Daily Traffic	The average of 24 hr traffic counts collected over a number of days greater than one but less than a year.
Backslope	A cut slope, the segment of the roadside geometry that slopes up from the outside edge of a ditch to intersect with the existing ground.
Balance	When the amount of available excavation equals the amount of needed embankment.
Balance Points	A location along a roadway where an earthwork balance occurs.
Balance Factors	Multipliers applied to embankment volumes to adjust for shrinkage or swell of the soils used for embankment.
Barrier	A structure used to protect traffic from hazardous conditions along the roadside or medians.
Barrier Curb	Steep-face curb design to inhibit encroachment on state right-of-way.
Base Course	The layer or layers of specified or selected material of designed thickness placed on a subbase or a subgrade to support a pavement surface course.
Benefit-Cost Comparison	An economic evaluation to determine if a given design is warranted and justified based on the costs and benefits associated with it.
Bid	A contractor's written offer to construct a project based on the contract documents (plans, specifications, special provisions, etc.) at a specified price.
Bicycle Facilities	Defined by *MUTCD* as "A general term denoting improvements and provisions that accommodate or encourage bicycling, including parking and storage facilities, and shared roadways not specifically defined for bicycle use."
Bicycle Lane	Defined by *MUTCD* as "A portion of a roadway that has been designated for preferential or exclusive use by bicyclists by pavement markings and, if used, signs."
Bicycle Path	A facility physically separated from motorized traffic facilities, either within a highway right-of-way or on another alignment, for either the preferential or exclusive use by bicyclists.

Bikeway	Defined by *MUTCD* as "A generic term for any road, street, path or way that in some manner is specifically designated for bicycle travel, regardless of whether such facilities are designated for the exclusive use of bicycles or are to be shared with other transportation modes."
Blended Transition	Defined by *PROWAG* as "A raised pedestrian street crossing, depressed corner, or similar connection between the pedestrian access route at the level of the sidewalk and the level of the pedestrian street crossing that has a grade of 5 percent or less."
Blue Top Book	A construction book that provides a format for finish stake (blue top) notes to be recorded. Stations and subgrade elevations at the centerline, edge of surface and edge of subgrade shoulder are the information provided.
Borrow	Additional material required when the amount of embankment needed exceeds the amount of excavation available.
Borrow Pit	Areas that are approved by the state for the source of borrow; they can be either contractor-furnished or state-furnished.
Borrow Restoration	Upon completion of removal of borrow from a site, the pit is to be scarified and then stockpiled topsoil replaced and seeded.
Breakaway Support	A support used for traffic signs, traffic signals, streetlights, etc. that is designed to breakaway or bend on impact with an errant vehicle.
Bridge	A structure for carrying traffic erected over a depression or an obstruction and having an opening greater than 20 feet as measured along the centerline of the roadway.
Bridge Approach Section	A transition section from guardrail to a bridge rail.
Broken Back Curve	A curve consisting of two consecutive curves deflecting in the same direction joined by a short tangent section.
Budgeting	The process of outlining future funding needs based on anticipated highway projects.
Bullnose Guardrail	A guardrail configuration in which the guardrail is curved around a hazard, forming a "nose". It is often used in medians to shield a hazard from traffic in both directions.
Cable Guardrail	Guardrail constructed of multiple steel cables stretched between support posts.
CADD Coordination Policy	A schedule of required drafting activities for roadway design.

Capacity	The maximum flow in vehicles per hour that can be reasonably expected on a segment of highway during a given time period under prevailing roadway, traffic and control conditions.
Capacity Analysis	Study that estimates the amount of traffic that can be accommodated by a given facility while maintaining a predetermined level of service.
Categorical Exclusion	An environmental classification for a project indicating that no significant environmental impacts are anticipated (Class II project).
Center Of Gravity	The location where a vertical line divides an area of cut or fill into two equal areas; the area left of the center of gravity equals the area right of the center of gravity.
Center Pivot	A structure that pumps water from the ground to an aerial sprinkler system that rotates about the structure; used for crop irrigation.
Changes In Concept	Alterations in the original project idea during the planning and/or design stages.
Changes In Scope	Modifications in the extent or size of the project.
Change Order	A written order to the contractor covering changes in the contract.
Channelization	The physical separation of vehicular and/or pedestrian traffic movements to regulate conflicting movements.
Channelized Intersection	An intersection at which various traffic movements are separated by auxiliary lanes, medians, islands, etc.
Clarity	A computerized system that programs, schedules and monitors projects through preconstruction stages. The **Project Scheduling Section** of the **Program Management Division** manages it.
Class I Project	A project that may significantly impact the environment and for which an environmental impact statement is required.
Class II Project	A project that has been determined will not significantly affect the environment.
Class III Project	A project on which the environmental impact must be determined and for which an environmental assessment must be prepared.
Clean Air Act	A federal law passed to protect and enhance the quality of the nation’s air resources.
Clean Water Act	A federal law passed in 1977 to protect the quality of the nation’s water resources.

Clear Zone	The total roadside border area, starting at the edge of the traveled way, available for use by errant vehicles. This area may consist of a shoulder, a recoverable slope, a non-recoverable slope, and/or a clear run-out area. The desired width depends on the traffic volumes and speeds, and on the roadside geometry. Also called the recovery area or lateral obstacle clearance distance.
Climbing Lanes	Additional lane(s) provided on crest vertical curves to accommodate slow moving vehicles.
Cloverleaf Interchange	Four-leg interchanges with loop ramps to accommodate left turn movements. A full cloverleaf has loops in all quadrants.
Collector-Distributor Roads	An auxiliary road system parallel to but separate from a freeway/interstate that collects and distributes local traffic with the intent of limiting the number of entrance and exit points on a freeway while satisfying the demand for access to the freeway. Similar to frontage roads but collector-distributor roads do not provide access to abutting properties.
Comfort Criteria	Design consideration of motorists' willingness and/or ability to accept discomfort while traversing a roadway.
Complex Interchanges	A combination of two or more interchange configurations, within very limited spacing, connecting several different roadways.
Compound Curve	Two curves which join on the same side of a common tangent with no tangent length between the curves.
Comprehensive Plan	A plan developed for a local, regional or statewide area that considers social, economic, cultural, transportation, environment, and other concerns.
Condemnation	A legal proceeding **NDOT** pursues when an agreement cannot be reached with a landowner on the purchase of right-of-way.
Consolidation	The settling of existing ground under the weight of embankment, causing the embankment to settle.
Construction Joint	A joint made necessary by a prolonged interruption in the placing of concrete.
Construction Sequencing	The construction of a roadway in different phases so that the project may be built while maintaining through traffic and/or access to local residences or businesses.
Contaminated Soils	Soil that has unacceptable impurities in it.
Contour Grading Plans	Plans that show proposed contour lines for the areas adjacent to the roadway surfaces for use in construction.
Contract Plans	Plans used to bid on and construct a project.
Contraction Joint	A joint normally placed at recurrent intervals in a rigid slab to control transverse cracking.

Controlled Access Facility	A facility designed for through traffic and upon which **NDOT** may regulate, restrict or prohibit access for efficient traffic flow and the reduction of areas of traffic conflict.
Corridor Protection	A procedure whereby **NDOT** notifies appropriate local governmental agencies and the general public of the intent to acquire right-of-way along a highway corridor in order to restrict the amount of development which may occur adjacent to the intended improvement minimizing acquisition costs and design complexity.
Corridor Protection Plans	Plans, often aerial sheets, filed with the local government showing property ownership and the corridor width to be protected.
Corridor Studies	Studies of projects that may involve some relocation and/or community bypass. Study results usually are published in report form and include alignment location factors and cost estimates. Plan and profile sheets may also be included.
Cost Estimate	The anticipated cost of a project at different stages of planning and design.
Cost Sharing	The division of project expenses among governmental (and possibly other) entities involved in the project.
Covenant Agreement	A written agreement or contract between the state and local cities, towns or villages that outlines the respective responsibilities in planning, designing, constructing or maintaining a highway or their associated facilities, such as roadway lighting, traffic signals, etc.
Covenant Relinquishment Agreements	Agreements prepared prior to public hearings in which the provisions of relinquishment of roadway maintenance and operation functions to a local government are described.
Crash Cushions	A protective system that prevents errant vehicles from impacting roadside obstacles by decelerating the vehicle to a stop when the cushion is hit head on or redirecting the vehicle away from the obstacle when the cushions are hit from the side.
Critical Length Of Grade	The maximum length of a designated upgrade on which a loaded truck can operate without an unreasonable reduction in speed.
Critical Path	Tasks and activities that must be completed prior to the start of other activities.
Critical Slope	A slope that is considered non-recoverable, non-traversable and one on which a vehicle is likely to overturn. A slope steeper than 1:3.
Cross Slope (Roadway)	The slope across traffic lanes and shoulders perpendicular to the flow of traffic.
Cross Slope (Sidewalk)	Defined by *PROWAG* as “The grade that is perpendicular to the direction of pedestrian travel.”

Crossover Temporary pavement constructed on divided highways to temporarily route traffic across the median to the opposite lanes so that construction can occur on the vacated side.

Crosswalk The Nebraska Revised Statutes, Chapter 60 Motor Vehicles defines a crosswalk as:

1. "That part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of such roadway measured from the curbs or, in the absence of curbs, from the edge of the roadway; or
2. Any portion of a roadway at an intersection or elsewhere distinctly designated by competent authority and marked for pedestrian crossing by lines, signs, or other devices."

Crowned Typical Section A cross-section of roadway that has the high point of the pavement located at the center of the traveled way and slopes to both shoulders.

Cul-De-Sacs A turning area provided at the closed end of a street opened at one end only.

Culvert A structure under the roadway with a clear opening of less than 20 feet as measured along the center of the roadway.

Curb Cut A depression in the curb that is provided at curb ramps and entrances.

Curb Ramp A connection between the pedestrian access route at the level of the sidewalk and the level of the pedestrian street crossing that has a grade which is between 5 percent and 8.3 percent inclusive in the direction of pedestrian travel. Curb ramps can be perpendicular or parallel, or a combination of parallel and perpendicular ramps."

Cut Slope A positive grade side-slope generally going upward and outward from the shoulder edge or ditch bottom to intersect the natural ground.

Daylighting Flattening the roadway backslope to intersect with the natural ground at a lower elevation than the typical backslope. This is done to gain excavation or to improve sight distance.

Decision Sight Distance The distance required for a driver to complete the following actions: 1) detect an unexpected or otherwise difficult-to-perceive information source or obstacle in a roadway environment; 2) recognize the obstacle or its threat potential; 3) select an appropriate speed and path; and 4) initiate and complete the required maneuver.

Deed A signed legal document to convey or transfer rights, ownership, etc.

Delineators Retroreflective devices mounted at the side of the roadway used to guide traffic, especially at night.

Depressed Median	A median that is constructed at a lower elevation than the travel lanes. They are typically used on freeways and other divided arterials.
Design Checklist	A list of tasks associated with roadway design activities.
Design Hourly Volume	The two-way design hourly volume in number of vehicles during the thirtieth highest hour for the design year.
Design Process Outline	An outline of regular roadway design activities.
Design Relaxation or Exception	A deviation from the design standards requiring approval by the appropriate state and/or federal officials.
Design Speed	The maximum speed that can be maintained over a specified section of highway when conditions are so favorable that the design features of the highway govern. Limits of curvature, sight distance, roadway clearance, maximum gradient and other geometric features are a function of design speed.
Design Vehicle	A theoretical motor vehicle whose weight, dimensions and operating characteristics are used to establish highway design controls such as radius returns and turning roadways.
Design Year	The year 20 years after the initial construction of a new/reconstructed project. For 3R projects use 20 years for Portland Cement Concrete surfacing and 10 years for hot mixed asphalt surfacing.
Detour	A signed alternate route within an existing roadway system that guides traffic around a construction zone outside of the project right-of-way instead of through the construction zone.
Diamond Interchange	A simple interchange with four ramps configured similarly to a diamond and having a stop condition on the side road.
Directional Island	Raised, flush or painted medians used to guide and protect traffic during turning movements. Also, known as channeling islands.
Directional Interchange	An interchange that provides continuous high-speed free-flow operations for both through and turning movements.
Distribution Analysis	An analysis of the volumes of excavation and embankment by station for the purpose of determining if the project earthwork will be balanced, borrow or waste.
Dowel	A load transfer device in a rigid slab, usually consisting of a plain round steel bar.
Driver Expectancy	A drivers' memory of previous roadway experiences that he/she relies on when responding to new situations.
Driveways	Access openings to adjoining properties from roadways.
Dry Run	Rehearsal for public hearing.

Easement	A legal right afforded a person, agency, etc. to make limited use of another's land usually for specific purposes, such as construction, utility, access, etc. Easements may be permanent or temporary.
Embankment	Material that must be filled or placed to construct the proposed roadway and its associated components.
Embankment Foundation Report	A report by the **Soils Mechanics Unit** recommending steps to minimize settlement and slope stability problems in areas of poor foundation soils.
End Areas	The areas of cut and fill computed between cross-sections from which total volumes of embankment and excavation may be made for the entire project.
Endangered Species	A species that is in danger of extinction throughout all or any portion of its range.
Endangered Species Act	A federal law passed in 1973 to insure that actions authorized, funded or carried out by state or federal agencies do not jeopardize, destroy or critically modify the continued existence of endangered or threatened species and their habitat.
Engineering Review	A process by the **Project Development Division Location Studies Section** early in the project to establish the concept of work to be performed and the initial itemized cost estimate for major, non-interstate projects. The review summarizes the existing highway conditions, traffic, classification, adjacent sections, alignment, and environmental conditions. It is sometimes completed by the **Roadway Design Division** for smaller projects.
Enhancement Projects	Transportation infrastructure projects by local, regional and state governments that are not eligible for funding from other programs, e.g., historic preservation, trails and scenic byways projects.
Entrance Ramp	A ramp that provides access onto an expressway or interstate.
Environmental Assessment	A study required for environmental Class III projects for which the significance of environmental effects of a proposed project must be determined. If it is determined that the project will have no significant environmental impacts, it remains a Class III project and a finding of no significant impact (FONSI) statement is prepared. If significant effects are possible, the project is reclassified as a Class I project.
Environmental Classification	Federal designation of a project based on its potential impact on the environment.
Environmental Impacts	The possible effects of projects on the quality of the social, cultural or natural environment.

Environmental Impact Statement	A statement that describes the anticipated social, economic and environmental impacts of a Class I project (projects that may have significant impact on the environment).
Environmental Summary Sheet	A form from the **Project Development Division** that outlines the measures to be taken to mitigate the effects of a project on the environment, the applicable permits, etc.
Equivalent Single Axle Loads	Summation of equivalent 18,000-pound single axle loads used to combine mixed traffic to design pavement for traffic in the design period.
Erosion	A process in which soil and/or rock is loosened from its resting place and is carried by wind and/or runoff and deposited elsewhere.
Erosion Control	A program to control the displacement of soil particles by water, wind or other agents.
Erosion Control Permit	A part of the Section 404 permit process related to controlling water and siltation due to runoff into any water body including wetlands.
Established Quantities	Quantities of earthwork material determined from cross-sections by Design and used for the payment of earthwork.
Estimate Checklist	A listing of items required for a cost estimate.
Excavation	Material that must be cut to construct the proposed roadway, ditches, channels, entrances, etc.
Exempt Projects	Projects exempt from **FHWA** oversight, e.g., new/reconstructed or 3R NHS projects estimated at less than $5 million or off-NHS projects.
Exit Ramp	A ramp that provides egress from an expressway or interstate.
Expansion Joint	A joint located to provide for the expansion of a rigid slab, without damage to itself, adjacent slabs or structures.
Exposure Factor	A factor used to evaluate whether grade separation of a railroad/roadway crossing is necessary based on the number of vehicles times the number of trains per day. If this factor is 50,000 or greater, a grade separation should be considered.
Expressway	A divided highway for through traffic with full or partial control of access with interchanges at major intersections and at-grade intersections at designated minor public road intersections. It serves urban centers of 15,000 population or more not served by the interstate system.
Federal Aid Projects	Projects that are partially or entirely funded by the federal government. They must comply with federal regulations, including environmental regulations.

Federal Funding	Funds provided by the federal government from various funding appropriation sources for transportation-related projects. Depending on the appropriation restrictions, some portions of projects may be participating (federal funds may be used for those items) or nonparticipating (items are not eligible for those particular federal funds).
Fill Slope	A downward embankment slope connecting the graded shoulder at the hinge point to the ditch bottom or natural ground.
Final Plans	Contract plans used by contractors, inspectors, etc. to construct the project.
Flare Rate	The allowable variable offset distance of a barrier to move the barrier end further from the traveled way.
Floodplain	The area adjoining a watercourse or drainage way that has been or may be covered by floodwaters.
Floodway	The channel of a watercourse or drainage way and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a reasonable height.
Flush Median	A median that is on the same plane as the travel lanes, it is usually delineated by paint stripping on the pavement.
Fog Seal	A surface application of dilute emulsion with no aggregate that seals the pavement surface and generally provides a very distinct delineation between the mainline pavement and the shoulder.
Foreslope	The segment of the roadway cross-section from the hinge point sloping downward to the inside edge of the ditch.
Foundation Course	The graded portion of a highway prepared as the foundation for the pavement structure and shoulder.
Foundation Report	A report that summarizes field investigations of foundation soils and makes recommendations to minimize settlement and slope stability problems.
Freeway	An arterial highway with full control of access.
Frontage Roads	Restricted access roads, paralleling the mainline, to maintain capacity on the mainline and provide access to adjoining property.
Functional Classification	The grouping of highways and roads by the primary service they provide, access, mobility or a combination of access and mobility. It is used to determine the design standards to be used.
Functional Design	The stage of design after the plan-in-hand inspection and prior to the public hearing.

Future Access	A future means of ingress or egress between a highway and abutting property or an intersecting local public road or street that will not be built by **NDOT** but will be built by the owner at some future date when the development of the property requires construction of the driveway.
Gore	The area between a through roadway and an exit/entrance ramp.
Gore Neutral Area	The triangular area between the gore nose and the physical nose and the triangular area between the physical nose and the painted nose.
Gore Nose	A point, having some dimensional width separating the shoulders of the through traveled way and the ramp, upstream from the gore area.
Grade Separation	The separation of traffic at an intersection of two or more roadways by constructing the roadways at different elevations; provides for free flow of traffic on all highways through the intersection but does not provide for access for turning traffic.
Granular Subdrain	A drain that is constructed of a porous, granular material designed to drain water from the foundation of the pavement.
Guardrail	A longitudinal barrier that shields roadside hazards from vehicles that may leave the traveled way.
Habitat	The place(s) a given species of animal or plant naturally lives or grows that has the necessary food, cover, water and other species-specific conditions essential to well-being.
Haul	The distance that excavated material is moved, as shown on the plans, from the location where the material is obtained to the location where the material is to be deposited.
Headwater	The depth of water impounded upstream of a culvert due to the influence of the culvert construction, friction and configuration.
Height Of Eye	The height of driver's eye above the road surface used for calculating sight distances. For stopping and passing sight distances, passenger vehicle height of eye is 3.5 feet.
Height Of Object	The height of an object within the roadway used for calculating sight distances.
Highway Commission Statement	An official communication from **Roadway Design** to the **Highway Commission** regarding a proposed project.
Hinge Point	The point where the rate of slope either continues at 1:6 or changes to a steeper slope based on the difference in elevation between the edge of the finished shoulder and the end of the foreslope.
Horizontal Alignment	The line of roadway curvature as related to the horizontal direction.

Horizontal Sight Distance	The clearance required from the center of the inside lane to an obstruction located off the pavement area on the inside of a horizontal curve. The straight-line distance a driver can look through a horizontal curve to the road ahead.
Impact Attenuators	Barriers designed to act as cushions, absorbing most of the energy from errant vehicles that leave the roadway before striking a roadside hazard.
Inertial Barriers	Impact attenuators that are modules filled with sand used for protection of poles, column bases, lighting supports, etc.
Intercepting Dikes	Small dikes constructed at the top of cut slopes that prevent stormwater from flowing down the cut slopes by intercepting the runoff and redirecting the flow to where it can be discharged into a ditch, creek, stream, etc.
Interchange	A combination of ramps and grade separations designed to increase capacity, reduce or eliminate traffic conflicts, and reduce the potential for crashes at the junction of two or more roadways. They separate the through traffic movements and also provide for turning traffic movements.
Intergovernmental Agreements	Agreements prepared by the **Agreements Section** in the **Project Development Division** that outline the scope and participation of the governmental parties involved in a project and are executed for projects involving other units of government.
Intersection Sight Distance	The unobstructed sight distance along both road approaches at an intersection and across their included corners for a distance that will allow vehicle operators, approaching simultaneously, to see each other in time to prevent collisions.
Interstate	A national defense highway system established to connect most cities of 50,000 or more population in the U.S., with complete access control and a minimum of two 12 feet wide lanes in each direction, divided in most instances by wide medians.
Interval	A discrete portion of a traffic signal cycle during which signal indications do not change.
Island	A flush or raised channelizing device.
Joint Access	A single access provided to two or more properties.
Land Water Conservation Fund Act	An act administered by the **National Park Service** to preserve public parklands. The Act provides funds to purchase and develop public parklands, and to preserve those lands from conversion to other uses.
Landscaping	Plantings, scenic view development, retaining walls, median treatments, slope rounding or berms, aesthetic treatment, etc. for environmental, functional or aesthetic purposes.

Lane Balance	A condition in which there is a balance in the number of traffic lanes on a freeway and the number of lanes on ramps to provide for efficient traffic operations through and beyond interchanges. The number of lanes and the rate that lanes are added and dropped at interchanges are appropriate for the interchange.
Lateral Extent Of Hazard	The distance from the edge of the traveled way to the far side of a hazard, if the hazard is a fixed object, or to the outside edge of the clear zone if the hazard is an embankment or fixed object that extends beyond the clear zone.
Lateral Obstacle Clearance Distance	The unobstructed, relatively flat area provided beyond the edge of the travel way for the recovery of errant vehicles. The width depends on the traffic volumes, design speed and side slopes of roadway section. Also known as the recovery area or clear zone.
Level Of Service	A rating system from A to F that classifies roads or highways according to the operating conditions of the roadway given the design traffic volumes, A being a roadway providing an optimum level of service and F being a roadway providing a very poor level of service. The operating conditions that characterize levels of service are described in terms of density, average travel speeds, volume to capacity ratios, and stop delays at intersections.
Life Cycle Cost Analysis	The economic analysis of pavement design alternatives based on initial construction costs, maintenance costs, salvage values at the end of the life of the pavement and replacement costs.
Limits Of Construction Plans	Design plans, developed after the public hearing, showing the extent of the area required for the construction of the project. They include culverts, driveways, intersections, dikes, etc. for use in right-of-way design.
Living Snow Fence	A barrier of trees and shrubs planted to reduce snow drifting along a highway, usually at or near the right-of-way line.
Load Transfer Device	Devices, e.g., steel dowel bars, used at transverse joints to properly distribute load stresses without offering resistance to longitudinal movement at the joint.
Local Roads	Rural roads not classified otherwise except minimum maintenance roads.
Location Studies	Studies to address social, economic, environmental and other issues associated with alternative project locations for specific "spot" projects or for longer corridors.
Longitudinal Slope	The slope of the travel lane along the length of the travel lane.
Longitudinal Joint	A joint normally placed between traffic lanes in rigid pavements to control longitudinal cracking.

Loop	A curved ramp that has a less direct travel path and distance than normal ramps and often will redirect the path of a vehicle almost 290°.
Lump Sum Funding Splits	A method of allocating funds from several funding sources by dividing the total costs on a pro rata basis.
Mailbox Turnout	A designated area, outside the travel lanes, provided for the use of vehicles accessing mailboxes.
Major Arterials	Roadways linking cities, towns and other traffic generators, that are capable of carrying long distance travel and form a network with higher systems to provide interstate and inter-county service.
Major Collectors	Roadways that serve the dual function of property access and feeding arterials; they generally consist of shorter trip lengths.
Markings	Traffic control devices, such as pavement markings, object markings or delineators, used to channelize traffic into proper lane position on the roadway. They may either supplement regulatory and warning signs or independently warn or regulate traffic.
Mass Diagram	A graphical representation of the amount of embankment and excavation on a project and the way in which the earth is to be moved. It shows balance point locations, direction of haul and amounts of earth taken from or to each location.
Mass Ordinate	The cumulative algebraic sums of volumes of cut and fill by station.
Medians	The portion of a divided highway separating the traveled ways for traffic in opposite directions.
Median Barrier	A longitudinal barrier placed on the left side of traffic lanes of a divided highway designed to redirect vehicles striking either side of the barrier.
Median Openings	A gap in a median provided for crossing and turning traffic.
Median Width	The distance between the inside edges of the inside travel lanes of a multi-lane divided highway.
Metropolitan Planning Organization (MPO)	Transportation planning organization composed of state and local government officials and citizens responsible for continuing, cooperative and comprehensive planning process in metropolitan areas.
Milling	A process in which asphalt is removed from the roadway by a machine that “scrapes” off the top layer of asphalt.
Minimum Maintenance Roads	Rural roads used occasionally by limited numbers of people as alternative access roads.
Maintenance Resurfacing Standards	Maintenance for each functional classification of roadway type as established by **the Board of Public Roads Classifications and Standards**.

Minor Arterials	Routes to provide linkage of cities, towns and other traffic generators, integrating interstate and inter-county service.
Mitigation	Measures taken to offset or minimize the impact of construction on the environment.
Mobilization	The costs associated with startup activities such as movement of personnel, equipment, supplies and other incidentals to the project site.
Moisture Content	The amount of water in the soil which impacts compaction.
Mountable Curb	A curb designed so that errant vehicles can cross them easily.
Mow Strip	A 2 feet surfaced section between the curb and a turf median or around area inlets.
MSE Wall	A mechanically stabilized earth retaining wall of blocks or panels.
Multi-Leg Intersections	Intersections having five or more legs.
National Highway System	An interconnected system of principal arterial routes which will serve major population centers, international border crossings, ports, airports, public transportation facilities, other intermodal transportation facilities and other major travel destinations.
National Register Of Historic Places	A federal listing of places with significant historic value.
Nationwide Permits	A type of permit issued by the **U.S. Army Corps of Engineers** for projects that have minimal environmental impacts.
Needs Assessment	An annual review of the condition of existing roadways throughout the state conducted by the **Classification, Needs, and Pavement Management Unit** in the **Materials and Research Division**. A summary of the results are published in the State Highway Inventory Report.
New Jersey Barriers	Concrete rigid barriers generally used as median barriers and as barriers in work zones.
Noise	Unwanted sound.
Noise Abatement	Measures taken to reduce noise through design features or location of a project.
Noise Barriers	Devices installed beyond the lateral obstacle clearance distance to reduce the effects of noise on nearby noise sensitive areas.
Nonparticipating	That portion of a project that a particular federal fund does not cover, e.g., federal bridge funds may not be used for mainline construction.
Nonpoint Source Pollution	Pollution that cannot be attributed to a specific source.

Non-Recoverable Slope	A slope on which a motorist will not be able to stop his/her vehicle or return to the roadway but generally will reach the bottom of the slope without overturning; a slope between 1:4 and 1:3.
No Passing Zones	Segments of two-lane, two-way highways that do not have sufficient passing sight distance for motorists to pass slower moving vehicles. Pavement markings and warning signs are used to inform drivers of no passing zones.
Object Markers	Traffic control devices that warn motorists of physical obstructions or roadside conditions within or adjacent to the roadway that pose a hazard to motorists. They are considered a maintenance item and are not included in roadway quantities and cost estimates.
Off-Street Parking	A parking facility, parking lot or garage that is provided outside of the roadway right-of-way and is not considered a part of the roadway.
Off-System County Roads	County roads that are not part of the federal or state highway system.
Off-System Rural Projects	Projects on rural roads for which local road standards have been developed.
Off-System Urban Projects	Urban transportation projects in cities of the first class that are eligible for specific federal funding.
On-Street Parking	Parking that is provided adjacent to the traveled way of a roadway within the roadway right-of-way; it is considered a part of the roadway.
Operating Speed	The highest overall speed at which a driver can travel on a given highway under favorable weather conditions and under prevailing traffic conditions without exceeding the design speed on a section-by-section basis.
Outer Separation	The area between the traveled way of a roadway for through traffic and a frontage road or street.
Overlay	The resurfacing of an existing pavement to a specified depth to extend the structural life of the pavement.
Painted Gore Nose	A point, having no dimensional width, occurring at the separation of the pavements at a ramp.
Parallel Fill Slope	A fill slope that parallels the roadway.
Partial Cloverleaf Interchange (Parclo)	A cloverleaf interchange with loops in some but not all quadrants.
Passing Sight Distance	The distance required for an overtaking vehicle to pass another vehicle on a two-lane, two-way roadway.
Pavement Markings	Traffic devices in the form of line markings, symbols, arrows, raised reflective markers, etc. that are on the roadway pavement to channelize the traffic and to warn motorists.

Pavement Structure	A combination of subbase, base course and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.
Pavement Serviceability Index	A numerical value derived by formula from measurements of certain physical features of the pavement.
Pavement Subdrain	Subgrade drainage treatments, which vary depending on the subgrade soils plasticity index.
Pedestrian	Defined by *MUTCD* as " A person on foot, in a wheelchair, on skates, or on a skateboard."
Pedestrian Crossing	A pedestrian crossing facilitates the movement of the non-motorized public (e.g. pedestrians, bicyclists) across highways, railroad tracks, and rivers or streams.
Pedestrian Ramp	A part of an accessible route that has a running slope which is between 5% and 8.3% inclusive in the direction of pedestrian travel.
Pedology	Study of the genesis and classification of soils.
Permanent Easement	A property easement in which **NDOT** has the use of or access to land that remains in private ownership. The owner may do as he/she chooses with the property as long as it does not conflict with the purpose of the easement.
Phasing	The division of a construction project into several stages over time.
Physical Gore Nose	A point, having a dimensional width separating the pavements, upstream of the gore area.
Pivot Irrigation System	Custom irrigation systems varying in size and configuration that consist of center pivot structure and a boom that holds the sprinkler heads and rotates around the center pivot.
Plan-In-Hand	A field inspection of the proposed project, after preliminary design, by **NDOT** representatives and others as appropriate.
Planning	Advance consideration, development and description of anticipated projects, activities and scheduling.
Point Of Convergence	The point of intersection of a ramp and the through travel lane.
Posted Speed	The speed limit on advisory signs posted on the roadway; usually the 85th percentile speed.
Preliminary Design	The initial design of a project following the engineering review.
Preliminary Plans	Plans developed prior to preliminary design, from a survey or as-built plans, showing existing features only.
Principal Arterials	Roadways that provide corridor movement with trip length and density compatible with significant statewide or interstate travel.

Priority Commercial System	A roadway designation for routes that carry heavy traffic volumes and/or large volumes of commercial vehicles.
Profile	The grade line of a roadway, usually along the roadway centerline.
Project Numbering	The assignment of a unique number to a transportation project which identifies the funding source, type of project, and project location.
Public Hearing	A formal process presided over by a **Highway Commissioner** to present the proposed project to the public and to obtain public input. Hearing guidelines must be followed for notice of hearing, information presented and hearing procedures. The hearing is recorded and a transcript is made of the verbal testimony.
Public Information Meetings	Informal meetings held to inform the public of the proposed project location and /or design, to obtain public input and to answer questions from the public. They are usually held for major relocations and location studies, right-of-way appraisal, design and scope changes and sometimes for engineering review.
Radius Return	The turning radius of an intersection.
Public Right-of-Way	Defined by *PROWAG* as “Public land or property, usually in interconnected corridors, that is acquired for or dedicated to transportation purposes.”
Raised Median	A median that is elevated above the travel lanes to control access and left turns on urban highways and streets.
Ramp Angle	The angle the ramp makes with the mainline highway.
Ramps	Any type, arrangement and size of turning roadway that connects two or more legs at an interchange.
Ramp Terminal	The portion of a ramp adjacent to the through traveled way, including speed change lanes, tapers and islands.
Reconstructed Bridges	An existing bridge that is to be either widened, significantly remodeled or rehabilitated.
Recoverable Slope	A slope on which a motorist can stop his/her vehicle or slow it and then return to the roadway; a slope of 1:4 or flatter.
Recovery Taper	The taper downstream of a weaving section that enables motorists to merge with the traffic on the expressway.
Reimbursable Costs	The eligible non-betterment expenditures a utility owner incurs in relocating utilities to accommodate a proposed project.
Relinquishment	A process by which **NDOT** maintains ownership of right-of-way for utility easement purposes but cedes responsibility for maintenance and operation of the roadway to a local government.

Relocation Assistance	Financial assistance provided to residents and business entities that are relocated due to right-of-way acquisition.
Reverse Curves	Two curves on opposite sides of a common tangent with a relatively short tangent length between the curves.
Right-Of-Way	Land, property or interest therein, usually in strip, dedicated for transportation purposes.
Right-Of-Way Appraisal Plans	R.O.W. Ownership plans with the addition of limits of construction, construction details, right-of-way design, permanent and/or temporary easements, access control and summary of areas.
Right-Of-Way Certification	Certificate stating that the right-of-way is available to the contractor and clear of improvements or the estimated date when the non-complying tracts will be clear and available.
Right-Of-Way Costs	Costs associated with acquisition of right-of-way including real property, relocation assistance, fencing, improvements, etc.
Right-Of-Way Marker	A concrete monument, iron pipe, or pin marker used to indicate the location of a highway's right-of-way, where the right-of-way changes width or where a curve in the right-of-way begins or ends.
Right-Of-Way Negotiation Plans	Right-of-way plans that reflect right-of-way contracts and changes made during negotiations.
Right-Of-Way Ownership Plans	Right-of-way plans showing plotted section and quarter section lines, surveyed centerline, topography, property lines, existing R.O.W. boundaries, and ownership data.
Right-Of-Way Survey	A survey conducted to establish section corners, quarter-section corners and lot corners.
Rivers And Harbors Act	A federal act originally passed in 1899 to regulate structures or work affecting navigable waters of the U.S.
Roadside Geometry	The area outside of the hinge points; it is comprised of sideslopes, foreslopes, backslopes, ditch bottoms, benches, etc.
Roadway Lighting	Lighting which is provided along a roadway or highway to improve nighttime visibility.
Rollover Rate	The algebraic difference in rate of cross slope between adjacent lanes.
Route Continuity	Providing a continuous through route on which the motorist is not expected to change lanes or "exit" a roadway. Route continuity of minor roadways should yield to preserve road continuity of major roadways.
Running Slope	Defined by *PROWAG* as "The grade that is parallel to the direction of pedestrian travel."

Running Speed	The actual speed of a vehicle over specified section of highway; the distance traveled divided by the time the vehicle is in motion (running time).
Runout Length	The theoretical distance needed for an errant vehicle that has left the roadway to come to a stop.
Rural Area	An area where property abutting the roadway is predominately used for agricultural purposes and lies outside municipal boundaries. It may include isolated tracts devoted to light industrial purposes.
Safe Drinking Water Act	Federal regulations of potable water supply.
Safety Improvement Project	A project that is generally small in size and located at specific high accident sites.
Scenic Byways	A road or byway with roadsides or corridors of aesthetic, cultural or historic value.
Scoping	The initial estimation of project magnitude once a DR 73 form has been initiated.
Section 4(f)	A portion of the 1966 Transportation Act which limits use of publicly owned parks, recreation areas, wildlife/waterfowl refuges, and lands having historic sites of national, state or local significance.
Section 6(f)	A portion of the Land and Water Conservation Fund Act restricting use of public park land funded with Section 6(f) monies.
Section 10 Permits	Permits for construction activity that impacts navigable waterways.
Section 401 Permits	Permits from the **Nebraska Dept. of Environmental Quality** for activities involving waters of Nebraska, including wetlands. This permit is generally acquired in conjunction with Section 404 individual permits.
Section 402 Permits	Permits required for projects with point source discharge, e.g., rest areas.
Section 404 Permits	Permits from the **U.S. Army Corps of Engineers** for activities involving waters of the U.S., including wetlands.
Segregation Damages	Damages that may occur to a landowner when property is split by the construction of a highway.
Select Placement	The setting aside of certain excavated soils and/or materials during earthwork construction for a specific placement within the limits of the project. For example, topsoil will often be excavated and separated from other soils for final placement in the top four inches within the construction area.
Semi-Directional Interchange	An interchange that has some high-speed free-flow connections but has one or more connections that are indirect in alignment yet more direct than loops.

Serviceability	The ability, at the time of observation, of a pavement to serve the traffic (autos and trucks) that uses the facility.
Service Volumes	The number of vehicles traveling in a lane for a given time period. The number of vehicles "served" by a traffic lane for a given time period.
Service Ramps	Ramps, usually low-speed (≤ 45 mph), that transfer traffic between an Interstate or expressway and an arterial.
Shared Roadway	Defined by *MUTCD* as "A roadway that is officially designated and marked as a bicycle route, but which is open to motor vehicle travel and upon which no bicycle lane is designated."
Shared-Use Path	Defined by *MUTCD* as "A bikeway outside the traveled way and physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent alignment. Shared-use paths are also used by pedestrians (including skaters, users of manual and motorized wheelchairs, and joggers) and other authorized motorized and non-motorized users."
Shear Lines	Lines used for simplifying earthwork calculations at intersections and other locations where irregularly shaped excavations or embankments may be encountered due to channel changes, etc.
Shop Plans	Plans developed by the contractor to show how the contractor intends to construct specific structures, such as bridges, retaining walls, etc.
Shoulder	The area adjacent to the travel lanes for rural cross-sections or the area behind the curb and gutter for urban cross-sections.
Shrinkage	The decrease in volume of soil when it is excavated, hauled and compacted into an embankment.
Sidewalk	Defined by *MUTCD* as "That portion of a street between the curb line, or the lateral line of a roadway, and the adjacent property line or on easements of private property that is paved and intended for use by pedestrians."
Sight Distance	The length of roadway ahead that is visible to the driver.
Signalized Intersection	An intersection where traffic movement is controlled by traffic signals.
Single Axle Load	The total load transmitted by all wheels whose centers may be included between two parallel transverse vertical planes 40 inches apart, extending across the full width of the vehicle.
Single Point Urban Interchange	An interchange configuration where all legs of the interchange intersect at a single point.
Skew Angle	The degree of deviation from a 90° intersection.

Slope Stake Book	A construction notebook that provides elevation and distance information necessary for the construction of back slopes, fore slopes and side slopes.
Slurry Seal	An application of diluted asphalt emulsion mixed with sand-size aggregate and then squeegeed onto the pavement surface. It is generally less than 3/8-inch in depth.
Snowshots	Cut stations where the toe of the backslope is less than 60 feet from the centerline and the backslope elevation is greater than the centerline elevation.
Soil Horizon	The underlying formations of soil layers.
Soil Profile	The combined horizons or layers of soil.
Soil Survey	Research of the soil characteristics and water table condition provided by the **Materials and Research Division**.
Soil And Situation Report	A report of the results of the soil survey.
Spacing	The number of access locations to the mainline per mile between each mile road or county road.
Special Investigations	Research about specific topics for a proposed project (e.g. accident records, traffic counts).
Special Plans	Plans used for items subject to frequent change, e.g., guardrail.
Special Provisions	A document that outlines unique construction items or procedures not covered in the Standard Specifications.
Speed-Change Lane	An auxiliary lane, including taper, used primarily for the acceleration or deceleration of vehicles entering or exiting the through traffic lanes.
Spot Speed Studies	A traffic study that measures the individual speeds of a sample of vehicles passing a given point (spot) on a roadway.
Spread	The width of stormwater from the curb onto the roadway that flows along the pavement.
Stage Construction	The phasing of an entire construction project over several time periods.
Standard Details	Details not large enough to warrant a special plan or standard plan or details of items that are not paid for directly.
Standard Items	Construction and other items, as defined by **NDOT** that are common project materials or activities.
Standard Plans	Plans that have been developed for common construction items and have been approved by the **Standard Plans Committee**.
Standard Specifications	The definition and delineation of how activities, materials, etc. are to be provided for **NDOT** projects.

State-Funded Projects	Projects that are partially or entirely funded by state agencies. They are not required to comply with all federal regulations, but must address environmental concerns.
State Highway Commission	A group of individuals appointed by the **Governor** to conduct studies, advise the public, and hold public hearings regarding Nebraska highways and the activities of **NDOT**.
State Highway Inventory Report	A summary of results from the needs assessment.
Station Funding Definition	The identification of limits of funding source coverage by station location.
Stopping Sight Distance	The minimum length of roadway ahead visible to the driver that is long enough to enable a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path. Stopping sight distance is the sum of the distance traversed by the vehicle from the instant the driver sights an object necessitating a stop to the instant that the brakes are applied and the distance required to stop the vehicle from the instant brake application begins.
Storage Area	The portion of a turn lane used for vehicle queuing.
Storage Length	The length of lane needed to store vehicles for a given time period.
Structural Snow Fence	Temporary or permanent fencing panels installed along a highway to reduce the snow drifting along a highway.
Subbase	The layer or layers of specified or selected material of designed thickness placed on a subgrade to support a base course (or in the case of rigid pavements, the Portland cement concrete slab).
Subgrade	The top surface of a roadbed on which the pavement structure and shoulders are constructed.
Subgrade Survey	A survey conducted for projects to surface previously graded roads to identify soil sections, stability, and other conditions.
Subgrade And Situation Report	A report issued when there is a period of time between grading and preparation of paving plans. The report describes existing surface conditions, foundation course requirements, existing topography and pedology, drainage, compaction requirements, etc.
Subsidiary Earthwork	Earthwork that is not paid for directly but is included in other earthwork or other construction pay items.
Subsoil	Soils beneath the topsoil that vary in thickness from a few inches to three or more feet. They are characterized by the presence of additional clay and soluble material that has been removed from the topsoil.

Substructure	The part of a structure below the bearings of simple and continuous spans, skewbacks or arches and the top of footings of rigid frames including backwalls, wingwalls, and wing protection railings.
Superelevation	Raising the outer edge of a curve to offset the tendency for vehicles to slip on the outward sloping of a crowned roadway, allowing the driver to maintain average speed through the curve without having to overcorrect steering.
Superelevation Runoff Length	The length of highway needed to accomplish the change in cross slope from a section with adverse crown removed to a fully superelevated section, or vice versa.
Superstructure	The part of a structure above the bearings of simple and continuous spans, skewbacks of arches and top of footings of rigid frames, excluding backwalls, wingwalls and wing protection railings.
Surcharge	The placement of additional embankment on top of a fill to account for settlement or to speed up settlement.
Surcharge Loading	The loading or forces a retaining wall may experience from embankment and traffic.
Surface Transportation Program	A federal funding program which includes public roads not on the NHS and not functionally classified as minor rural collectors or local roads or streets.
Swell	The increase in volume of rock when it is excavated, broken and placed into the embankment.
System Ramps	High-speed ramps that transfer traffic from freeway to freeway and /or interstate to interstate.
Tangent Runout	The distance required to transition a roadway from a normal crown section to a section with the adverse crown removed, or vice versa.
Tangent Section	A segment of roadway that has a “straight” horizontal alignment with no curvature.
Tangent Typical Section	A cross-section of a roadway that has the high point of the pavement on the inside shoulder and slopes continuously from the inside shoulder to the outside shoulder.
Taper Ramp	A ramp that only consists of a taper either before or after the point of convergence depending on whether it is an exit or entrance ramp, respectively. On taper entrance ramps, acceleration occurs before the point of convergence. On taper exit ramps, deceleration occurs after the point of convergence.

Technically Infeasible	Defined by the Department of Justice in the 2010 ADA Standards for Accessible Design as " … or because other existing physical or *site* constraints prohibit modification or *addition of elements, spaces*, or features that are in full and strict compliance with the minimum requirements." (emphasis original to DOJ) A finding of "technically infeasible" still requires that the element of the pedestrian path in question be built to the minimum applicable standards to the maximum extent possible.
Temporary Easements	Easements that permit the use of private property for a time period not to exceed the duration of the project and for specific purposes such as channel cleanout.
Temporary Road	Temporary detours within the project right-of-way, generally on temporary embankments, to bypass a construction site.
Threatened Species	A species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its habitat.
Thrie Beam Guardrail	A roadside barrier system similar to W-beam but with an additional rib in the rail to accommodate a wider range of vehicle sizes.
Tie Bar	A deformed steel bar or connector embedded across a joint in a rigid slab to prevent separation of abutting slabs.
Title	Legal evidence of right to property or the right itself.
Title Research	A search conducted by right-of-way agent of records for property ownership, existing easements, encumbrances and other interests. Provides information for plotting property lines and identifying ownership.
Toe Of Slope	The intersection of the foreslope with level ground or with a backslope, forming a ditch.
Topsoil	Soil, usually dark in color, that extends from the surface of the ground to a depth of as much as two feet.
Traffic Control Device	A sign, signal, marking or other device on or adjacent to a roadway to regulate, warn or guide traffic.
Traffic Control Plan	An essential part of the overall design of the roadway that provides for the routing of traffic through and/or around the construction zone while providing an adequate working area for the contractor.
Traffic Signals	Traffic control devices used to direct conflicting movements of vehicles and/or pedestrians by assigning the right-of-way to various movements at different times.
Transit	A public transportation service.
Transition Length	The distance required transitioning a roadway from a normal crown section to full superelevation. It consists of the tangent runout and the superelevation runoff length.

Transition Section	A section of roadway that provides a gradual change between different typical cross-sections.
Transverse Contraction Joint	Contraction joints in concrete pavement placed either perpendicular to the centerline with load transfer devices across the joint or skewed from the perpendicular for noise reduction and riding comfort.
Transverse Construction Joint	Joints placed at the end of each day's work or when paving ceases for over 30 minutes. They are placed perpendicular to the centerline.
Transverse Fill Slope	A fill slope that is perpendicular to the roadway and is associated with cross roads, entrances, median crossings or ditch plugs, etc. It is generally more critical to vehicles than parallel fill slopes because errant vehicles tend to run into the transverse slope head on.
Trumpet Interchange	An interchange configuration used where there are only three approaches to be served.
Turning Roadways	Channelized turn lanes at at-grade intersections to provide free flow turn movements.
Unchannelized Intersection	An at-grade intersection consisting of two crossing roadways connected by radius returns, without channelizing devices.
Underdrain Pipe	A pipe in a granular trench, that parallels the edge of pavement and base course, designed to intercept water that gets into the base and subgrade and carry it away from the pavement structure.
Unsuitable Material	Materials (soil, rock, muck, debris, etc.), which are inappropriate for use in the embankment.
Urban Area	A built-up area located adjacent to or within municipal boundaries.
Utility	A privately, publicly or cooperatively owned line, facility or system for producing, transmitting or distributing communications, cable television, electricity, light, heat, gas, oil, crude products, water, steam, waste, stormwater not connected with highway drainage, or other similar commodity including a fire or police signal system or street lighting system.
Valley Gutter	A depressed pavement area that is constructed across a side road at an intersection to carry runoff across the side road.
Vertical Alignment	The line of the roadway curvature as related to the vertical direction.
Vertical Clearance	The clearance provided above the roadway to allow vehicles to successfully pass under a structure.
Vertical Sight Distance	The distance a driver can see through a vertical curve to the roadway ahead.

Visual Impacts	Impacts of the proposed project on potential viewers of and from the project.
Volume Studies	Traffic studies conducted to determine the levels of traffic during specified time periods, e.g., average daily traffic (ADT), peak hour traffic, etc.
W-Beam Guardrail	A roadside barrier system with railing that is W-shaped.
Waste	The situation where the amount of available excavation exceeds the amount of needed embankment.
Waste Sites	Areas established for the disposal of excess excavation or unsuitable materials.
Waterway Permit Data Sheet	A data form from the **Environmental Permits Unit** that includes information about waterway permits, historic bridges and other environmental issues.
Weaving Sections	Highway segments where the pattern of traffic entering and leaving at contiguous points of access/egress result in vehicle paths crossing each other.
Wetlands	Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

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