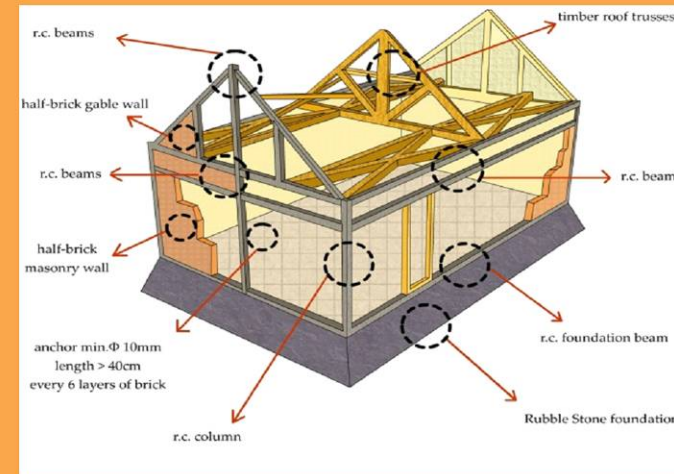
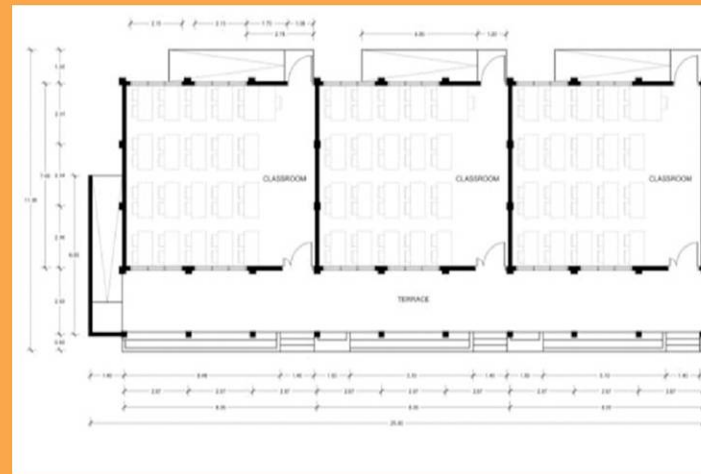




Handbook of typical school design



(general)
 2 classrooms and 3 classrooms



HANDBOOK OF TYPICAL SCHOOL DESIGN

(GENERAL)

2 CLASSROOMS AND 3 CLASSROOMS

Hari Darshan Shrestha

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Dyah Kusumastuti

Edwin Lim

Mission of Save the Children

To create lasting, positive change in the lives of children in need

Vision of Save the Children

A world in which every child is ensured the right to survival, protection, development and participation as set forth in the United Nations Convention on the Right of Children

This book is developed by Save the Children, Construction Quality & Technical Assistance (CQTA)

in collaboration with

Center for Disaster Mitigation - Institute of Technology Bandung (CDM –ITB)

PREFACE

Schools are institutions providing an education as well as a common place for community gatherings and meetings. They should be models in providing examples of quality education and the enhancement of the environment & physical facilities. Schools not only provide opportunities for formal education, but also for social development and personal growth.

Despite this, there are millions of schools around the world that are unsafe. There is an urgent need to create greater awareness of safer school construction in new schools, while at the same time making sure that the existing school buildings are safe. This can be done through the implementation of general practices of safe school construction and the retrofitting of existing school buildings.

Creating a culture of safe school construction is possible and need not be as complicated as some may seem. It can be implemented simply by establishing standards of design and construction of school buildings, developing a local building code and ensuring that the code and standards are met. The challenge is the thousands of unsafe existing school buildings around the globe where millions of children are at risk. Recent disasters such as the earthquake in Pakistan and China, the cyclone in Bangladesh and the infamous hurricane Katrina in the USA have caused the destruction of thousands of schools and with them the lives of many students and teachers. This shows the urgent need to make schools safer for everyone.

Save the Children initiated the creation of safe and child friendly school construction. Save the Children is conducting workshops and trainings as well as developing guidelines and manuals to support this initiative.

These documents are based on best practices in Indonesia, the most seismic prone country in the world. We believe these resources could be useful for other countries facing similar challenges as well as other organizations working on building the capacities of local authorities to effectively implement safe and child friendly school buildings.

We would like to thank Dr. Krishna Pribadi, Dr. Dyah Kusumastuti and Mr. Edwin Lim from the Center for Disaster Mitigation - Institute of Technology Bandung, and Mr. Hari Darshan Shrestha for their contributions on the development of this document.

Mike Novell

AVP, Asia Area office

Save the Children

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1. INTRODUCTION

Indonesia is located in an area that is very vulnerable to earthquake hazards. Geologically, Indonesia is located at the intersection of four earth-plates. Those are Eurasian plate, Indo-Australia Plate, Pacific Plate and Philippine Sea Plate. Sumatra Island, Java Island, Bali, Nusa Tenggara, Sulawesi, Maluku, Papua, and Borneo are some of the islands located near the intersection lines. Collision happened on the intersection of these plates often triggers tectonic earthquakes.

Recent earthquakes in Indonesia have caused major economic losses and fatalities/injuries due to damages on structures, including school building. In Indonesia, most of school buildings, the majority were built in the 1970s and 1980s, can be considered as non-engineered buildings due to very little or no involvement from engineers during design and construction stages. However, considering the function and usage of the facilities, school building should be considered as engineered building where the design and construction should be appropriate with engineering criteria from applicable building codes.

Unfortunately proper consultations from an engineer for design and construction of school buildings may be hampered due to financial aspects and other hindrances (time, distance, etc), especially for the remote areas. Thus, a manual or guideline can be seen as a viable solution to transfer knowledge and experience on building a school building based on design criteria and specifications from building codes. The development of this guideline on typical design of simple earthquake resistant school buildings is intended to assist all parties (owner, constructor, and school community) in constructing an earthquake resistant school building.

The typical design of school buildings with 2 classrooms and 3 classrooms presented in this handbook is based on analytical approach and follows requirements for obtaining earthquake resistant, hygiene, environmental friendly, disaster risk reduction as well as child safety features in school building design.

- The earthquake resistant features are design and construction according to latest code and compliance with earthquake regulations, simple rectangular and symmetric in plan and elevation, lightweight roof material, proper connection and detailing.
- The disaster risk reduction features are low hazard site location, community participations, door panel open outward with lateral push, stable study table, emergency escape door in each room and path.

- The child friendly features are the obtuse edge of the school tables, non-structural elements (cladding) and structural elements (column), special ramp for the disabled students, natural light and proper ventilation, wide terrace for outdoor activities, separate toilet blocks for girls and boys, safe play area and fencing around compound.
- The hygiene features include proper water sanitation and drainage system at the school as well as hand washing station
- Environmental-friendly features include small trees and plantation in area and in verandah

2. ASPECTS IN SCHOOL BUILDING DESIGNS

2.1. ARCHITECTURAL ASPECTS IN SCHOOL BUILDING DESIGNS

2.1.1. Location

School's site location selection plays an important role not only in building a proper simple earthquake resistant building but also in creating conducive learning environment. School sites should be evenly distributed to minimize students' travelling distance from their homes. The site is also preferably located adjacent to the sports facilities, parks, community centers, and other recreational facilities to enable use of these facilities. In the contrary, the site should not be located close to express way/major arterial roads, military camps and firing ground, a funeral parlor, a factory, a bus interchange, a market, or a large electrical substation. The noise generated from these places is considered to be disruptive to the learning activities within the site. The site for a low-rise school is preferably located on a relatively fair ground, without any significant level changes and excessive embankments, free of drainage, sewerage, or road reserves and service lines.

2.1.2. Building Layout



Figure 1 School's Siteplan

2.1.2.1. Building's Orientation

In the humid tropical climate, the building's layout and orientation must allow the air to flow through the buildings and the reflected sunlight to penetrate into the buildings without letting the heat and rain water to come into the building. An ideal buildings' site should enable the classroom blocks to be located with the longer facades facing north and south to minimize the penetration of direct sunlight through the buildings. Deep verandahs and wide overhangs are also usually used to provide shadings and better weather protection.

The school playing field and games court should have their longer axis along the north-south direction to avoid the glares from direct sunlight.



Figure 2 Building's Orientation

2.1.2.2. Massing Configuration

As an earthquake resistant building, the buildings blocks should be shaped as simple as possible. Also, the building's length is also preferred to be as short as can be. The massing configuration may be shaped a U, an L, a double L, or an O. With these configurations, the school complex may have an open space that can be used as parade square, sports field, and/or playing field.

The teachers must have a full visual access to the entire school corners to watch over the students. The massing configuration must not leave any undefined spaces between buildings to avert misuses of space by the students. Shown below is the example of an L massing configuration.

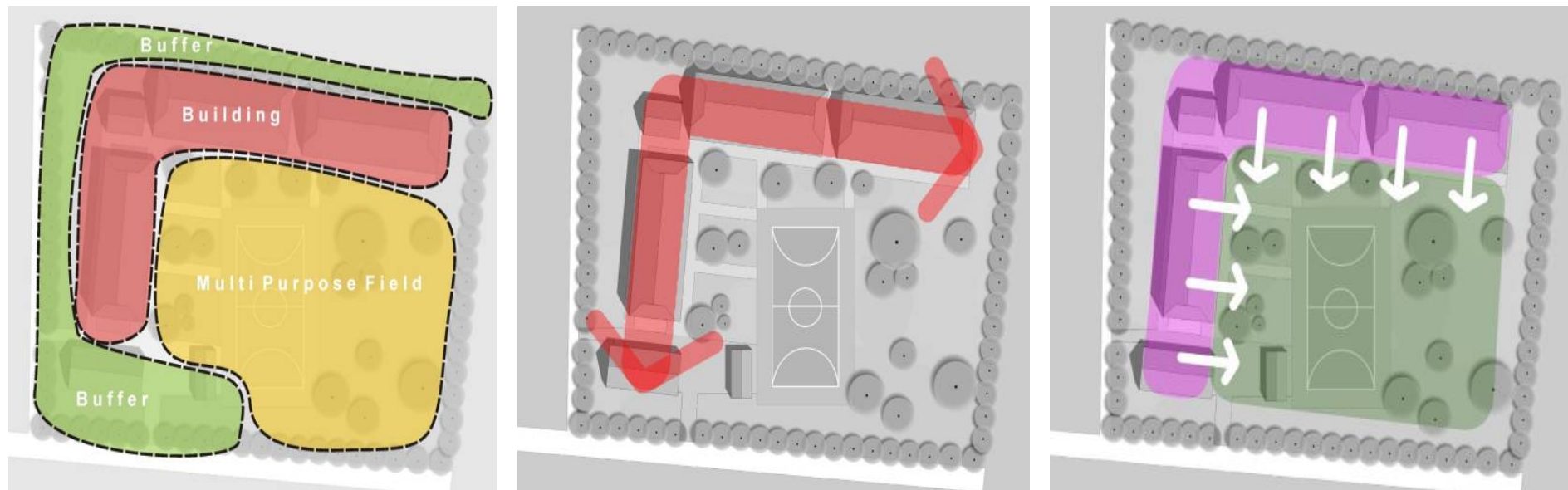


Figure 3 School Site's Zoning (left), Massing Configuration "L" Shaped Building Arrangement (middle), and Massing Configuration: Solid-Void Association (right)

2.1.2.3. Set Back

When planning the layout of a school, certain minimum building set back is set down to provide noise buffer for the school, and to provide privacy for the neighbors. Building setbacks may vary according to the environment's characteristics. When the school is facing local roads, the setbacks are likely to be narrower than when it is facing major arterial roads. The school field and bunch of trees can also be used as a buffer area from roads to the building.



Figure 4 Set Back as Buffer Area

2.2. INFRASTRUCTURES AND FACILITIES ASPECTS IN SCHOOL BUILDING DESIGNS

2.2.1. Facilities

A school building consists of at least class room, toilets, administration and teacher's room, library, multipurpose hall, and sports field. It is better if the rooms/facilities allow multipurpose usage of the rooms. For example, the sports field may also be used as playing field and parade square; or a large class room that may be divided into three and become three small class rooms. Also, the large class room may be used as a multipurpose hall as well. Those facilities are grouped into main building and other supporting facilities.



Figure 5 School's Ground Plan

2.2.1.1. Main Building

The school's main building facility consists of the classroom blocks and other learning facilities (library, laboratories, etc). Each classroom block comprises the terrace area, classroom area, and emergency exit area – which is equipped with ramps instead of stairs. The class' typical plan is 7.00 x 8.00 m in dimension with ceiling height of 3.50 m. The terrace is 2.50 m wide and the emergency ramps width are 1.40 m. Followings are the illustrations of classroom-block plan, including its measurement.

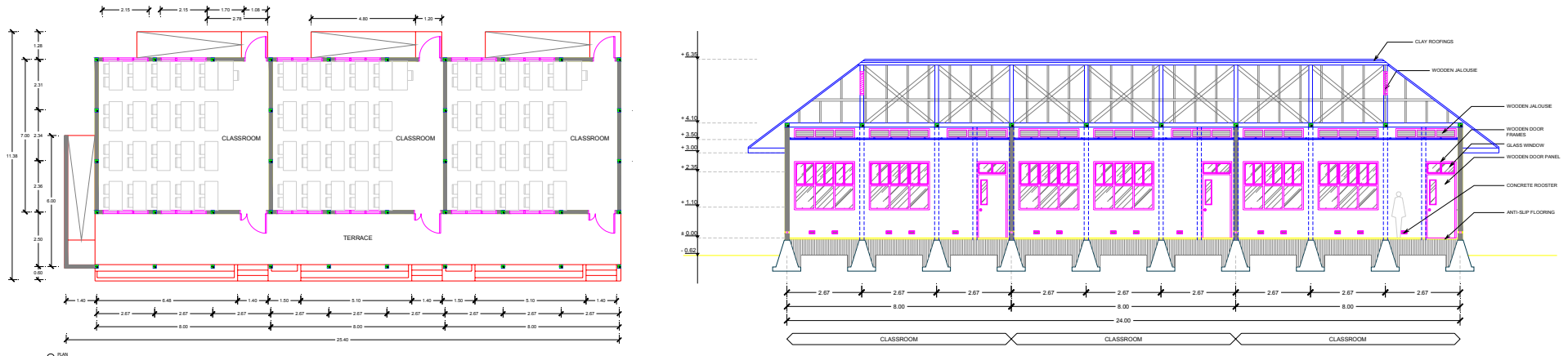


Figure 6 Classroom-Block Plan (left) and Classroom-Block Longitudinal Section (right)

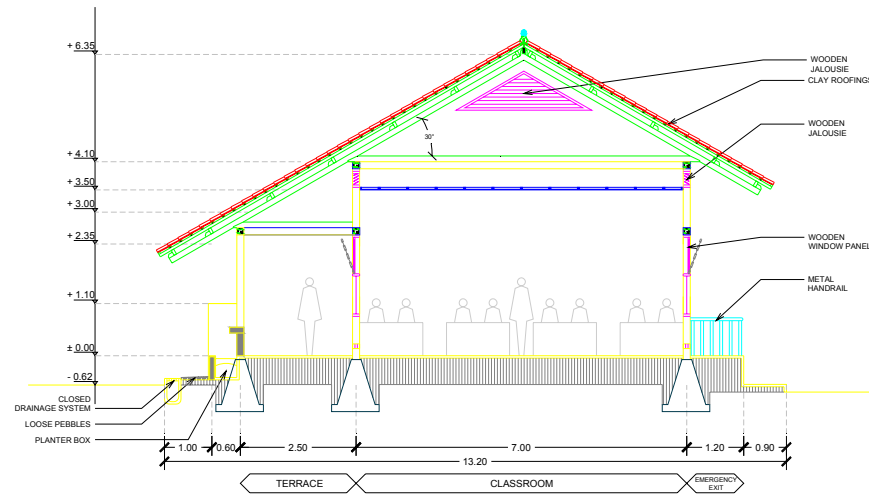


Figure 7 Classroom-Block Lateral Section

2.2.1.2. Other Supporting Facilities

School's supporting facilities consist of toilet area, hand-washing station, storage building, sports hall, and parking building. The toilet facility may be located attached or separated from the classroom block. If attached, it should be located far from the class rooms and must be equipped with sufficient air circulation. Below are the illustrations of separated toilet facility. Hand-washing facilities may be located attached to the classroom block at the terrace.

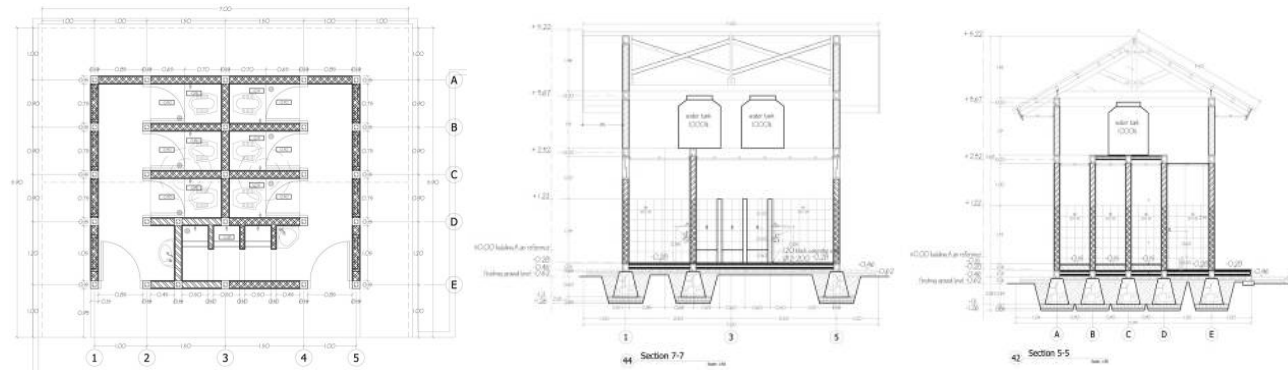


Figure 8 Toilet Plan and Toilet Section



Figure 9 Hand-washing Station

2.2.2. Drainage System

A proper drainage system is required to maintain the grey water from overflowing to roads and lawns. The site's drainage system is usually connected to greater system: city's drainage and waste water system. To maintain the safety within school-zone, school's drainage system must adopt a closed drainage channels system.

As Indonesia is granted by abundant rain water as much as sunlight, it can be maintained to be the alternative natural resource for water supply. The excessive rain water must be managed well to prevent flood and water overflow. Below is the schematic of rain water handling system. The main concept of the rain water handling system is to flow the water as soon as can be, both to be absorbed by the soils directly and to be flowed to the drainage system.



Figure 10 Closed Drainage System

In other hand, the rain water can also be harvested and reused as an alternative water resource. If managed well, the harvested rain water can be stored, treated, and used as well as the clean water supply for daily use. The rain water that is kept can be used for flushing the toilets, watering the plants, and even for washing. Below is the illustration of rain water harvesting concept.

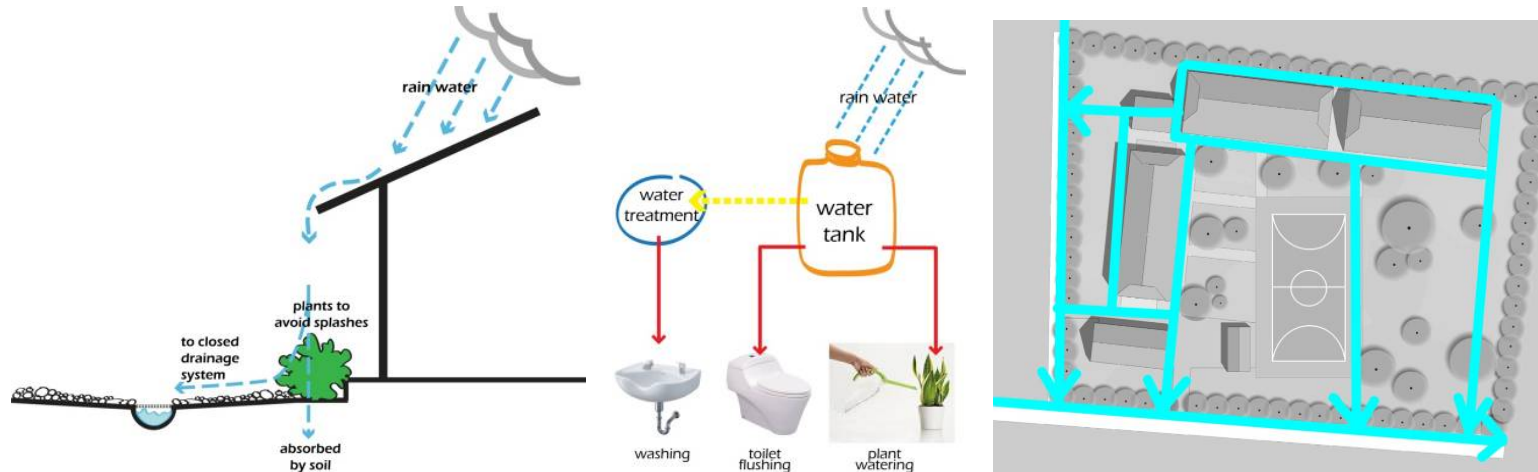


Figure 11 Rain Water Handling Concept (left), Rain Water Harvesting Concept Illustration (middle), Schematic: Site's Drainage system (right)

2.2.3. Road and Accessibility

The access to school should be carefully considered and must avoid busy traffic nodes. Bus turning circles and pick-up points require careful attention particularly in relation to safety aspects. Also, there should be a separation between vehicular and pedestrian access roads in school area. An adequate parking area is also necessary within the school area, both for cars and bicycles.

To preserve the soil's water-absorbing ability, the road may be covered by grass blocks, gravels, or paving blocks instead of asphalt and concrete blocks. This also means to reduce the heat-radiation caused by the sunlight exposure to the asphalt/concrete blocks. As a mean of disaster mitigation, each class in the building must be equipped with an emergency exit headed right away to open space. In a multi-storey school, emergency stairs also must be provided.

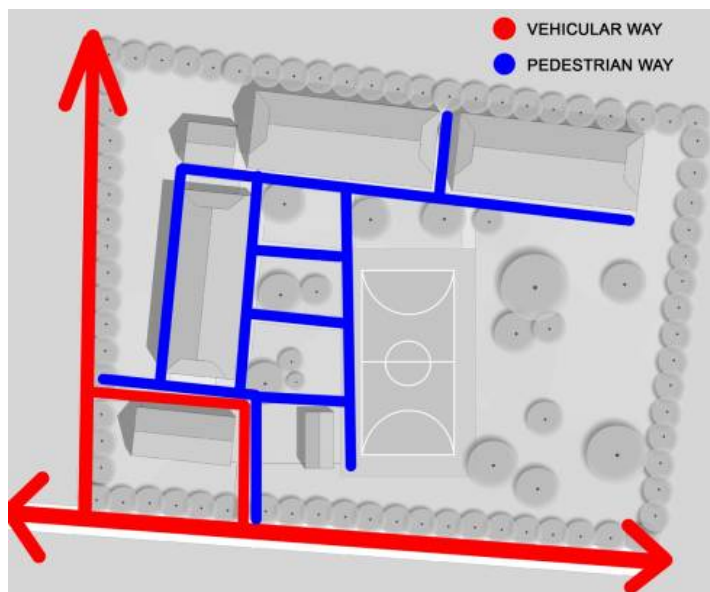


Figure 12 School's Accessibility (left), Non-Asphalt/Concrete Material Selection for Road Cover (middle and right)

2.2.4. Thermal Comfort

As it lies on the world's equatorial zone, Indonesia granted by abundant sunlight, heavy rainfall, and high level of humidity. Along with the climate state, Indonesian has a different level of thermal comfort compared to those in other 4-seasons-countries: approx. 23–25°C. Therefore, such treatments are needed to reach the thermal comfort level, especially inside a building.

2.2.4.1. Air Flow

The basic principle of natural air handling is the nature of hot air and cool air themselves. The pressure difference between the hot and cool air caused them to switch place. As the hot air is lighter than the cool air, it is always pushed to the higher areas. Thus, both sides of wall must have openings on its bottom and top areas to preserve natural air flow within the room. This air pressure difference caused the air to flow inside the building and generate wind that may reduce the humidity inside the building. Below is a schematic illustration of natural air flow handling within a room in the building.

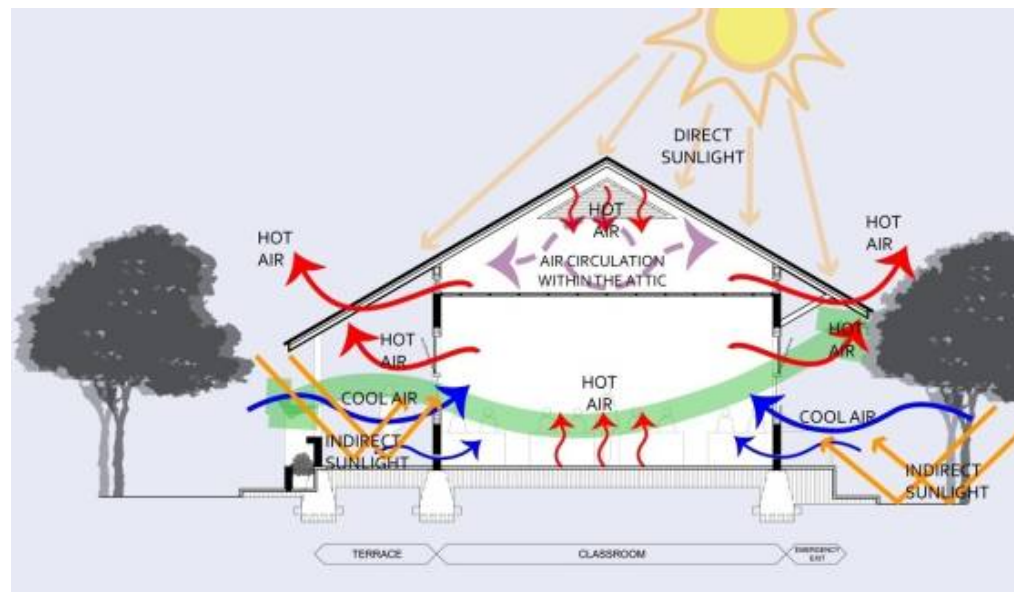


Figure 13 Schematic: Air Flow Within Building

2.2.4.2. Natural Lighting

Wall openings are made not only to maintain the quality of air flow but also to provide natural lighting into the room. The building blocks are preferably facing north-south to minimize penetration of direct sunlight into the room. With this arrangement, the room may receive adequate natural lighting from the daylight, but not the heat. If the buildings are facing east-west, some shading devices are needed to reduce the glare caused by direct sunlight.

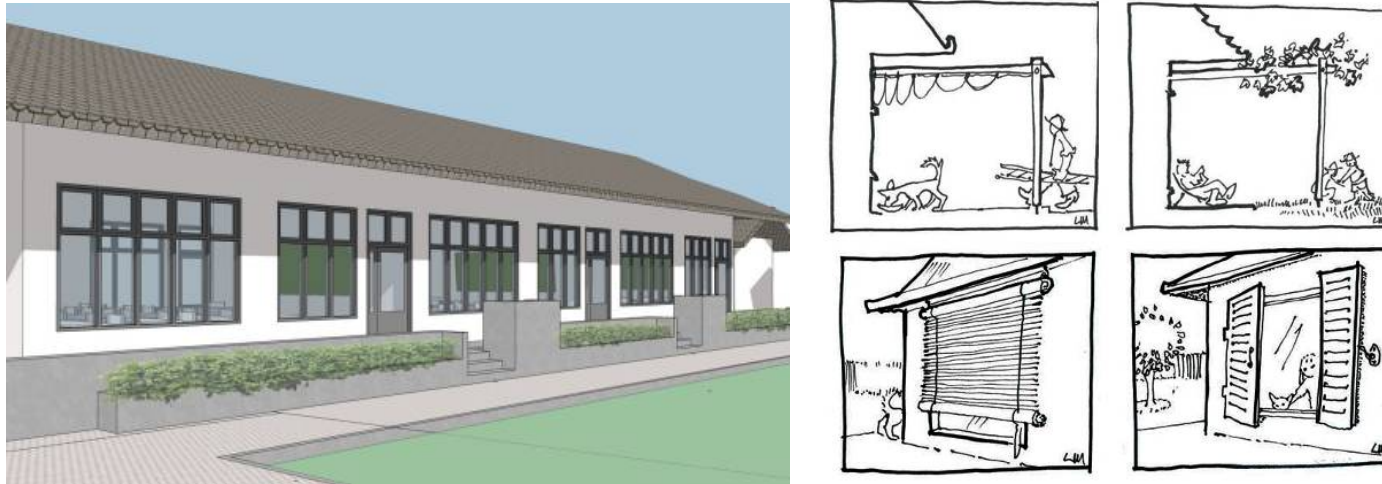


Figure 14 Wall Openings in Classroom Block (left) and Various Sun-Shading Devices (Pergolas, Blinds, Shutters) (source: <http://www.gawler.sa.gov.au/webdata/resources/images/Shading.jpg>) (right)

2.2.5. Lightings

Bright light coming through the windows and door opening was sometimes reflected from the white/blackboard and students sitting at the end of the front two rows in the classroom experienced reflected glare from the board. The solutions consist of inclining the boards with a 5-degree tilt and making the windows opaque for the distance of 1.8 m from the board. All teaching rooms may adopt an artificial lighting level of 500 lux and equipped with dimming facilities to facilitate audio-visual presentation.

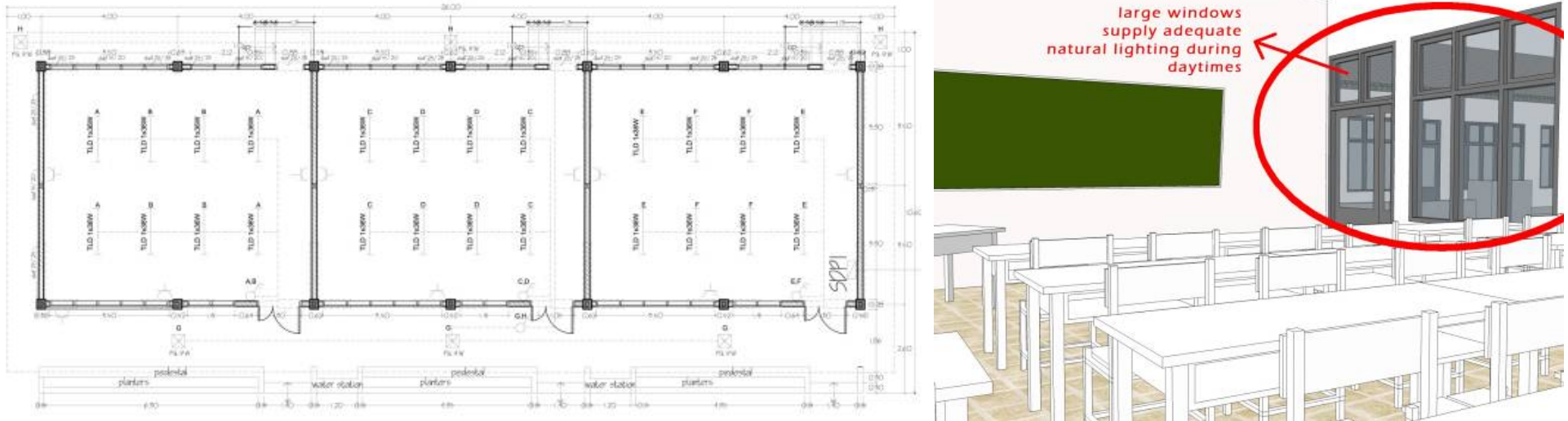


Figure 15 Classroom Lighting and Electrical Plan (left) and Classroom Interior Illustration (right)

2.2.6. Noise Control

There is currently no international standard for naturally-ventilated classrooms. Background noise level is typically 60 – 65 dBA and reverberation time is typically 1.0 second. The study makes specific recommendations to reduce the reverberation time to 0.5 – 0.8 seconds. This involves the use of acoustic ceiling tiles in teaching areas, 40% of which would be reflective tiles, and 60% absorptive tiles.

2.2.7. Access for Handicapped

The facilities provided for handicapped usually placed on the ground to the first floor to make it more accessible for the users. If it is located on the higher storey, ramps and/or elevators are required.



Figure 16 Ramps and Emergency Access From Classroom (left) and Ramps and Emergency Exit Area (right)

2.2.8. Building's Material

In designing a children friendly school, it is important to note that the building material selections are also play important part. Floor material selections may vary, but the main important check-list is that the material used for floorings is not slippery. For the classrooms, floor material is preferably also non-glossy material to prevent the undesired reflections from lightings.

For the mean of students' safety, it is recommended to use a "non-climbable" material, especially for handrails and balustrades. The conventional handrail and balustrade may be changed by aluminum metal sheets or parapets.

To maintain building's thermal comfort, it is suggested to use clay roofing for the building. Unlike metal sheets, clay is a heat isolator – it absorbs half of the heat and reflects the other. Thus, the temperature in the building can be reduced. In another hand, it should be noted that clay roofing is heavier than metal sheets. In earthquake resistant construction, it is suggested that the materials used for roofing system is as light as possible, in order to reduce the earthquake force. For doors and windows frames, woods are used. Although it has less fire-resistance compared to aluminums, woods is likely more un-rigid material.



(wooden frames)



(clay roofing)



(low reflection floorings)



(un-climbable balustrade)



(anti-slip flooring material)

Figure 17 Some Alternatives for Building Material Selection

2.3. STRUCTURAL ASPECTS IN SCHOOL BUILDING DESIGN

2.3.1 Basics of Earthquake Resistant Building

To produce a proper earthquake resistant building, the design and construction of the building should be well conducted. Following are the basic criteria of an earthquake resistant building:

- a) Adequate structural elements, with lateral load resisting system. Columns should be installed for area of wall maximum 10 m².
- b) Proper construction materials, including concrete and mortars mixtures.
- c) Good connectivity between structural elements to form integrity between the elements during earthquakes, including beam-foundation, beam-column, column-foundation, truss element, truss-beam, wall-column, and truss-column connections.

2.3.2 Site/Location

In selecting the location, the designer/building planner should choose low-hazard sites. The location should be safe from natural disasters such as land sliding, tsunami, flood, and other hazards. The following items give some guidance for site selection:

- a) Avoid constructing building on cohesion-less soil with more than 1m of thickness.
- b) Avoid constructing building on the slope
- c) Avoid constructing building on the edge of a steep slope
- d) Avoid constructing building near the coastal line.
- e) Choose a flat, firm and dry site.



Figure 18 Site Location (Courtesy of *Panduan Konstruksi dan Perkuatan Bangunan Sekolah Tahan Gempa*, CDM-ITB 2008)

2.3.3 Building's Layout

In designing the configuration of an earthquake resistant building, it is preferable that the following items are followed by the designer to obtain good behavior of the building in resisting earthquake forces:

- Building layout should be simple and symmetry (regular)
- Provide gaps if building layout is not symmetry
- Use less openings (windows and doors)
- Walls should form closed box shape
- Buildings should have adequate vertical elements
- Use lightweight materials for the roof system

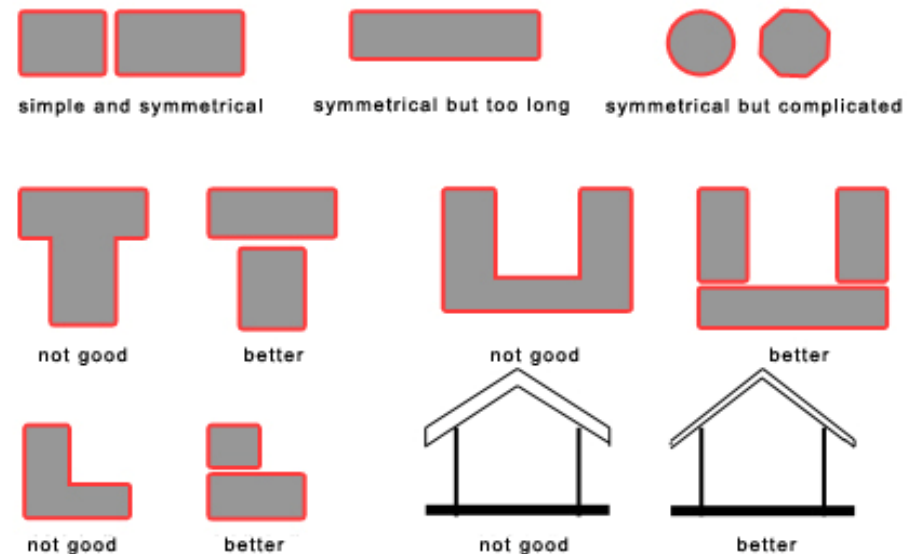


Figure 19 Building's Configuration (Courtesy of *Panduan Konstruksi dan Perkuatan Bangunan Sekolah Tahan Gempa*, CDM-ITB 2008)

2.3.4 Structural Requirements

The basic elements of building are foundation, columns, beams, walls, and roof system. The structure should have adequate structural elements to resist gravity and lateral loads. It should be noted that all of the structural element must be tied together to provide an integral unit, thus requires proper detailing for connections.

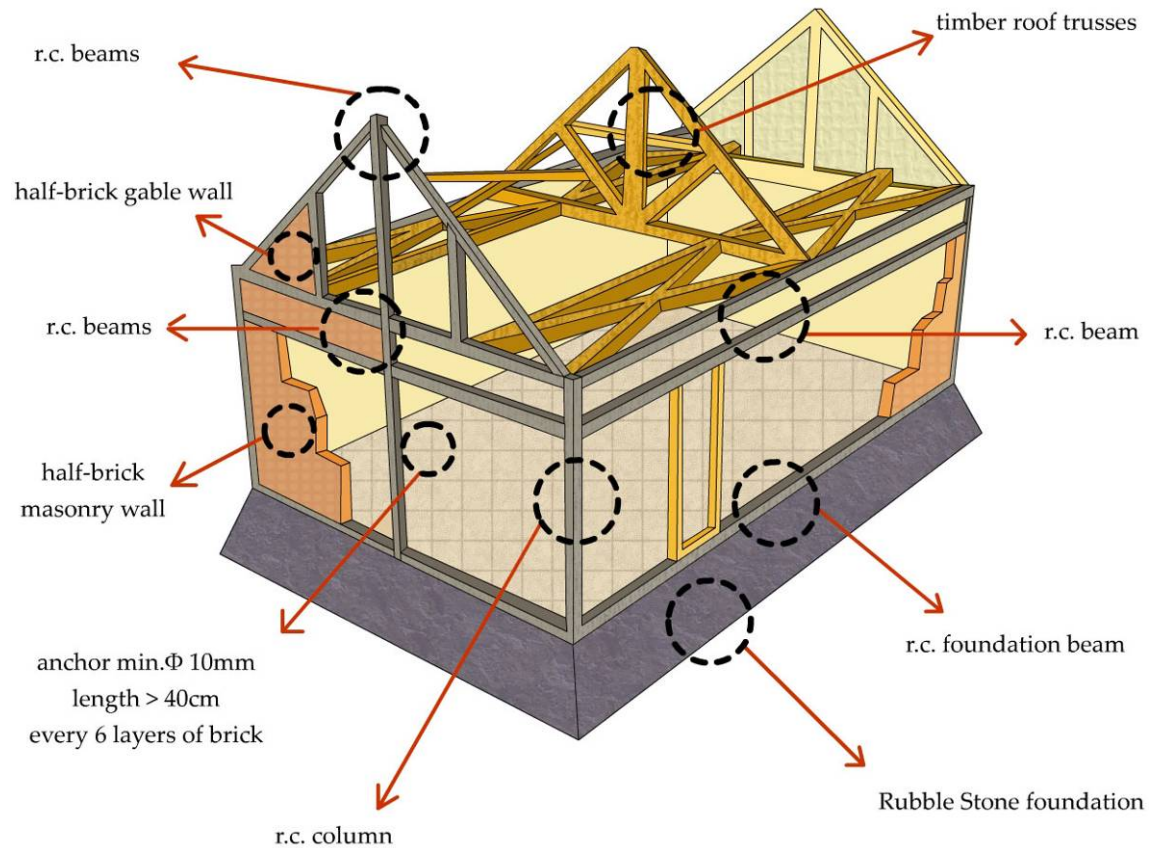


Figure 20 Structural Requirements (Courtesy of *Panduan Konstruksi dan Perkuatan Bangunan Sekolah Tahan Gempa*, CDM-ITB 2008)

2.3.5 Technical Specification of Materials

There are many materials available in the market for construction, such as sand, split/gravel, cement, bricks, concrete block, reinforcement bar, wood/timber, rubble stone, lightweight steel profile, etc. Special attention should be placed on the quality of all materials. Good quality of buildings needs good quality of materials.

Based on Indonesia National Standard-Standar Nasional Indonesia (SNI 03-1726-2002), minimum concrete strength of 17,5 MPa (K-215) must be used for buildings. For reinforcement bar, deformed bar must be used as main bars (longitudinal bars) and stirrups (confinement). For certain case, un-deformed bar may be allowed to be used for confinement.

2.3.6 Analysis and Design of the Structure

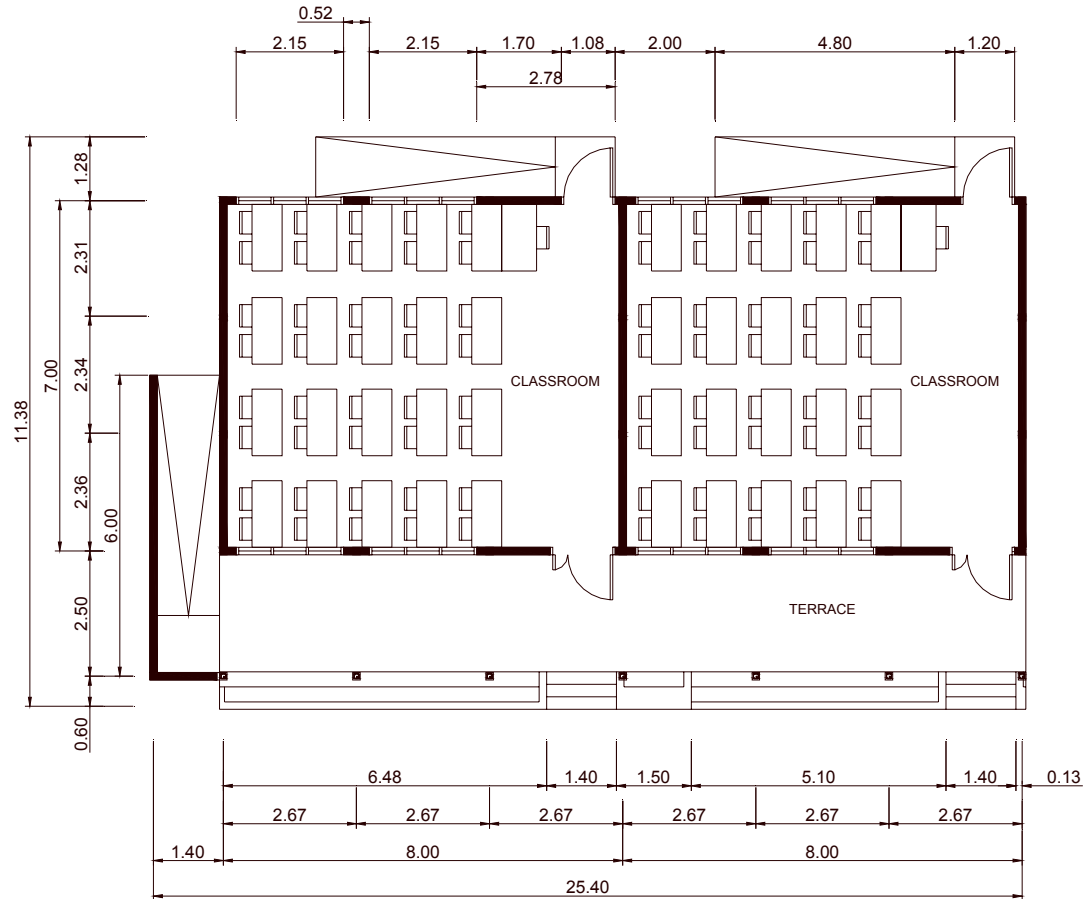
The analysis of the structure was conducted by modeling the structure as a confined masonry structure. For confined masonry structures, the contribution of the walls to the overall stiffness of the structures is taken into consideration. Therefore, the walls, columns, beams, and roof trusses were the structural elements. The load applied to the structure is based on the loading criteria stated on: *Peraturan Perencanaan dan Pembebanan untuk Rumah dan Gedung- 1983* (Indonesia Loading Standard), SNI 03-2847-2002 for design of the concrete element and loading combination, and SNI 03-1726-2002 for the earthquake load. The target performance level was to have minimum damage due to design earthquake, thus elastic analysis was carried out.

2.3.7 Design Notes

- In adopting this design, the school community should determine on how many rooms needed for the school. The design must be adopted as an integral unit (block) of 2 classrooms or 3 classrooms.
- This school is designed to meet the minimum criteria provided in *Standar Sarana dan Prasarana Sekolah/Madrasah Pendidikan Umum (Standard of Facilities in Public Education School/Madrasah)*.

3. TYPICAL DESIGN OF 2 ROOMS SCHOOL BUILDING

3.1 Architectural Drawings



Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

All dimensions presented must be followed

AR PLAN

Drawing no. AR-1 Plan

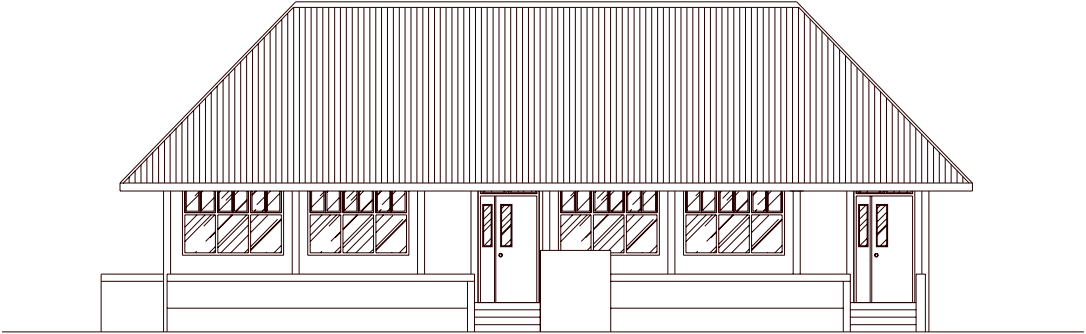
VPSCALE

Note:

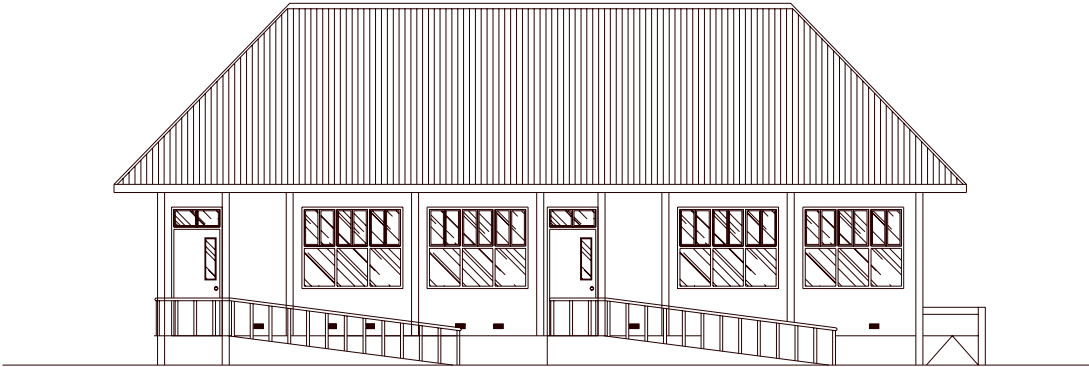
All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

All dimensions presented must be followed

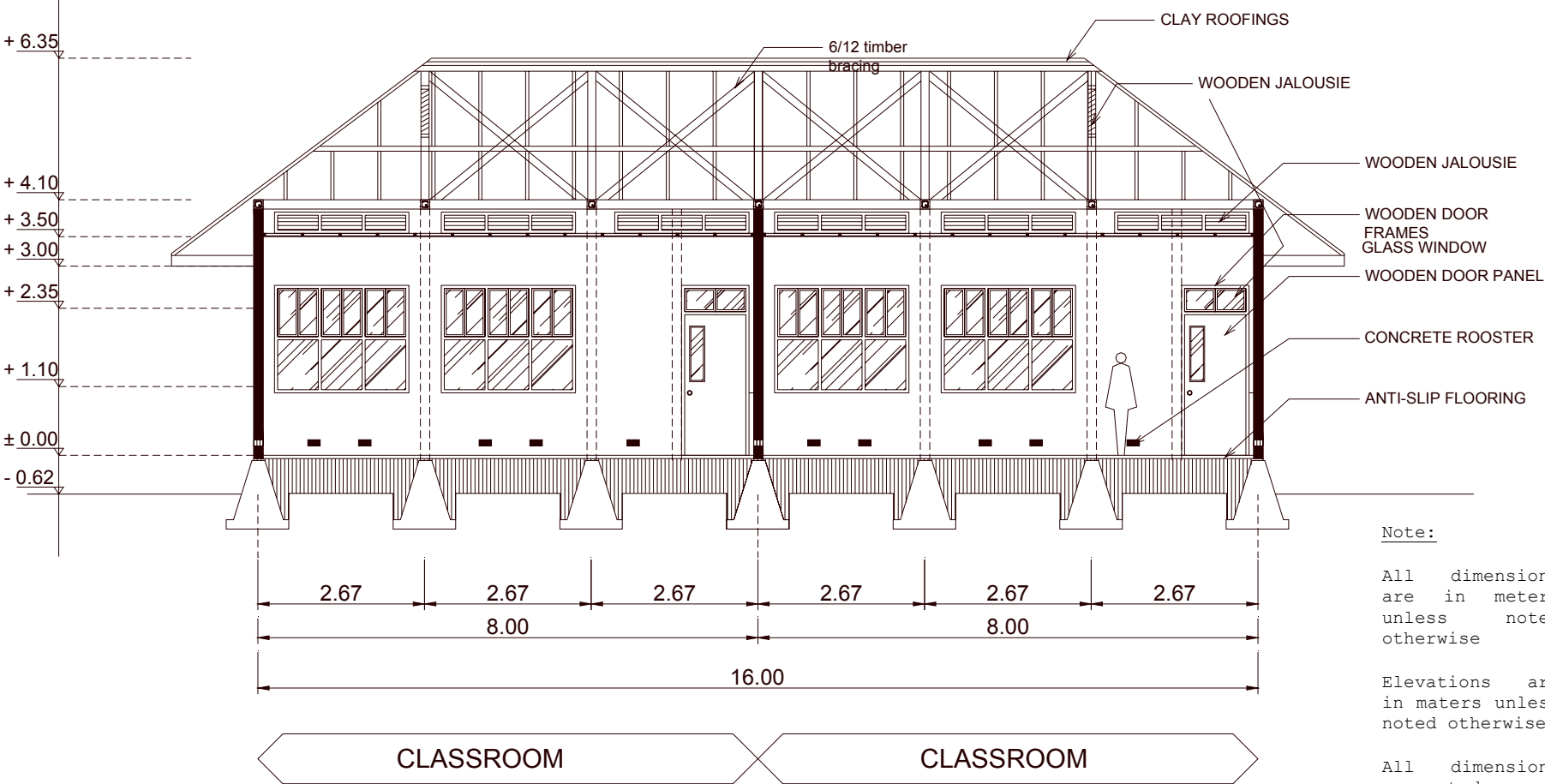


AR VIEW VPSCALE



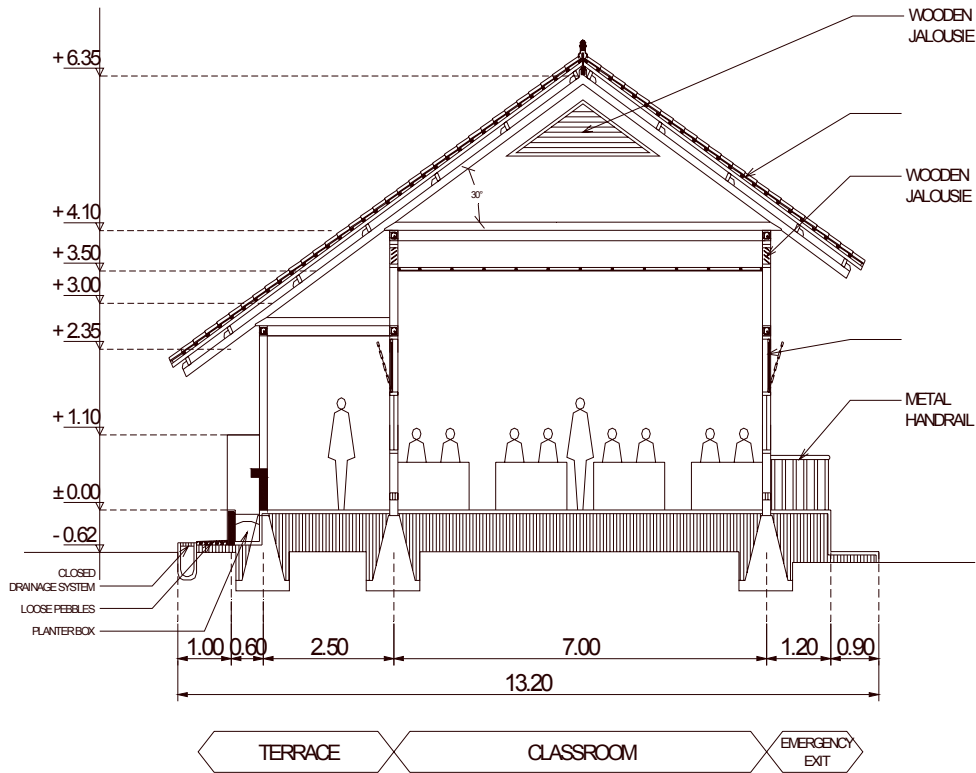
Drawing no. AR- 2 View

AR VIEW VPSCALE



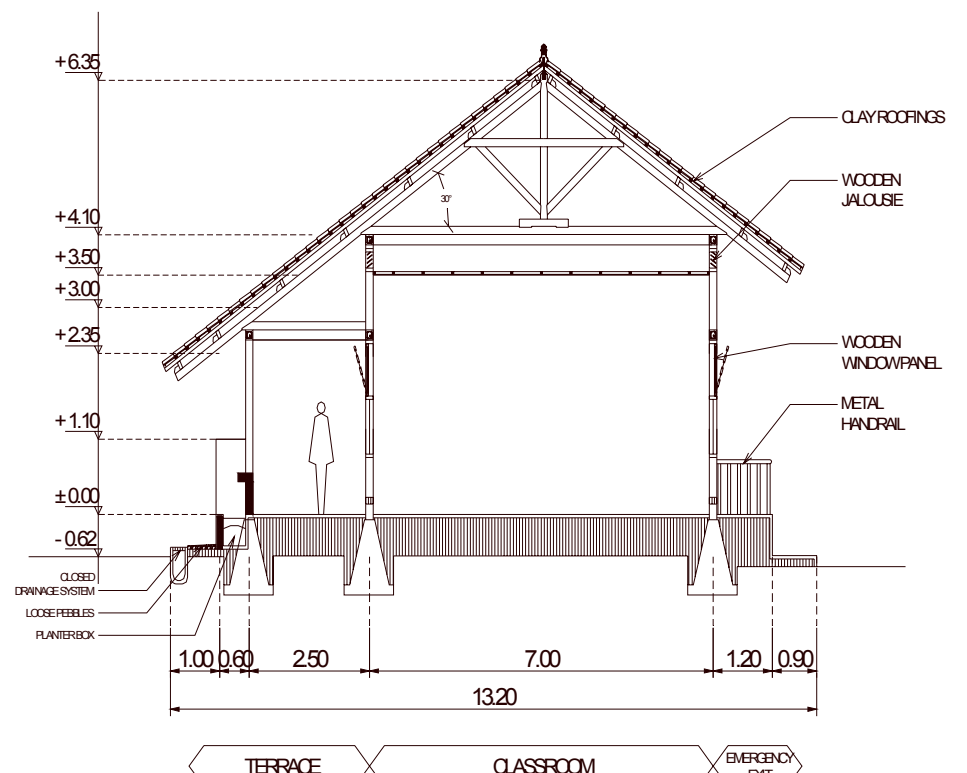
Note:
 All dimensions are in meters unless noted otherwise
 Elevations are in meters unless noted otherwise
 All dimensions presented must be followed

Drawing no. AR-3 Long Section



AR SECTION

VPSCALE



AR SECTION

VPSCALE

Note:

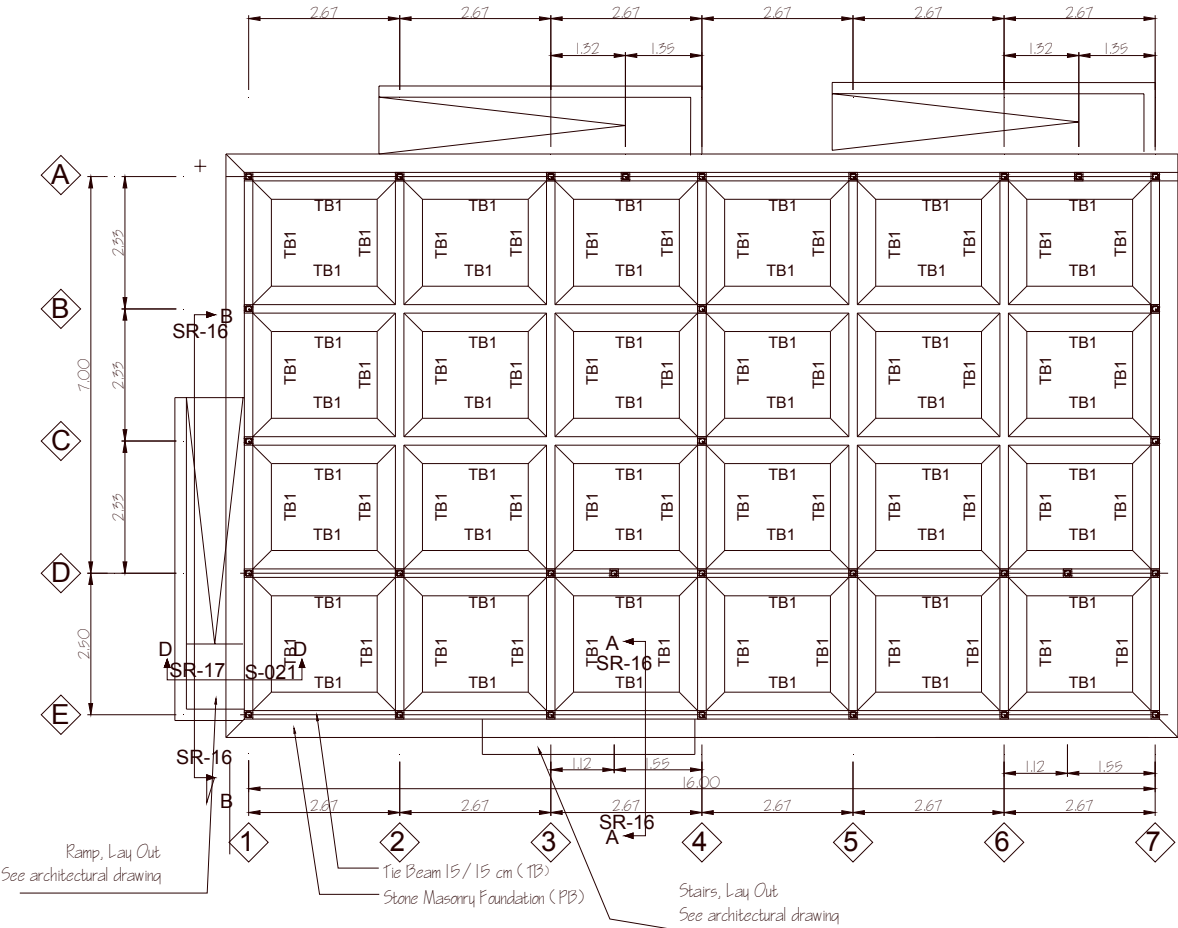
All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

All dimensions presented must be followed

Drawing no. AR-4 Cross Section View

3.2 Structural Drawings



Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

All dimensions presented must be followed

Concrete Strength: K-225

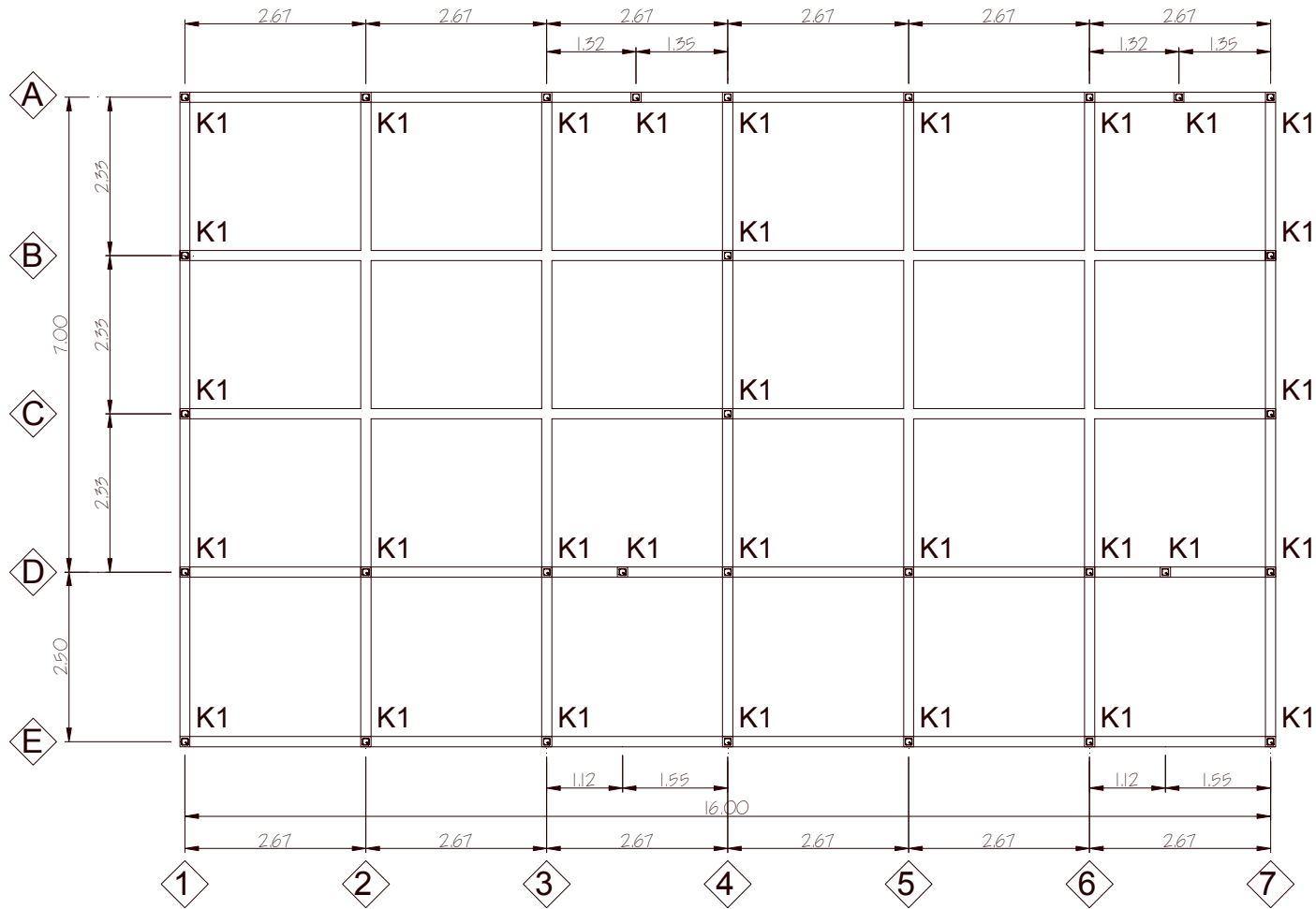
Reinforcement Bar:

$D \geq 10 \text{ mm}$, $f_y = 3200 \text{ kg/cm}^2$

$D < 10 \text{ mm}$, $f_y = 2400 \text{ kg/cm}^2$

① Foundation Plan (Elev. -1.95)

Drawing no. SR-1 Foundation Plan



Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

All dimensions presented must be followed

Concrete Strength: K-225

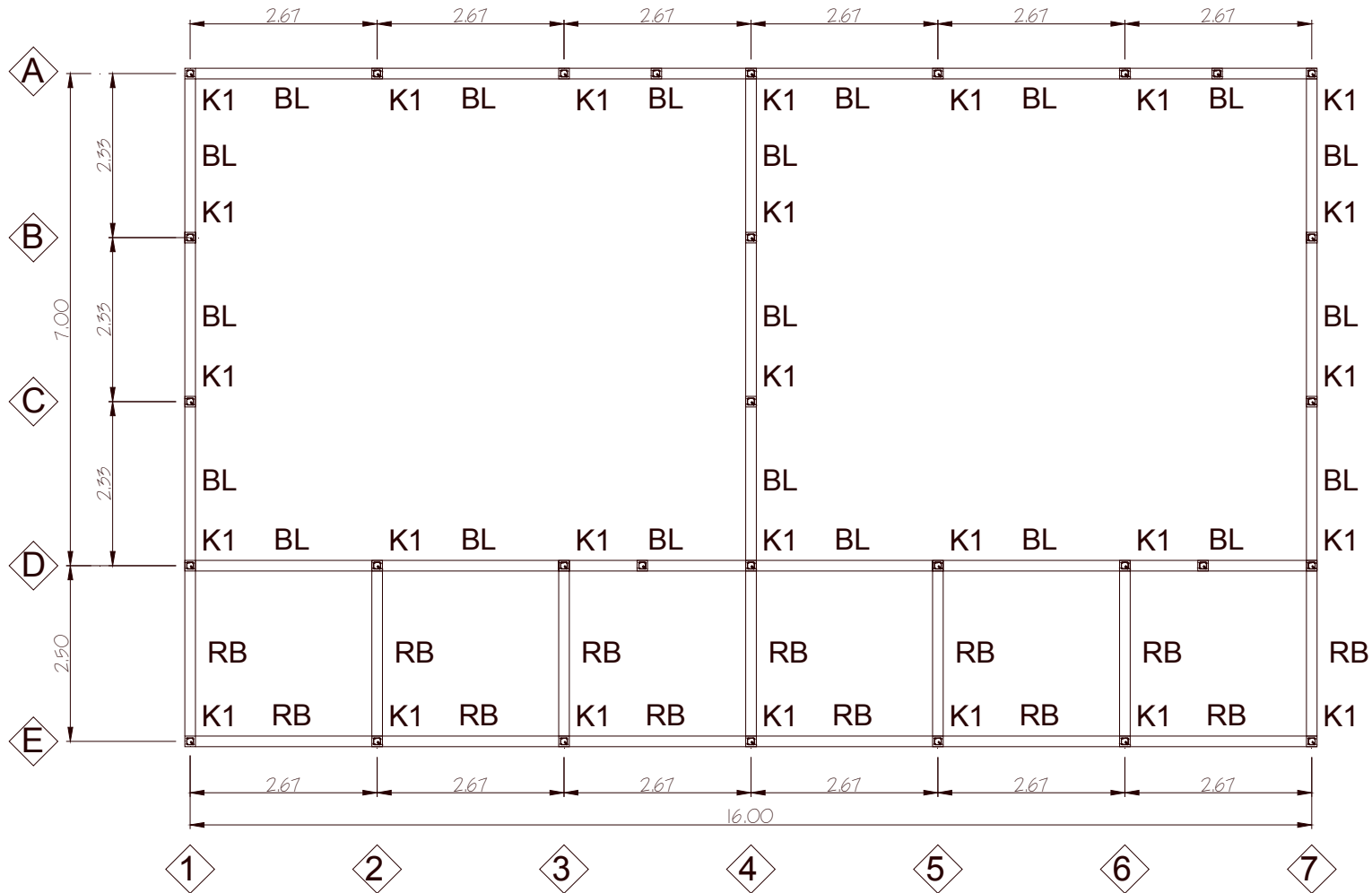
Reinforcement Bar:

$D \geq 10 \text{ mm}, f_y = 3200 \text{ kg/cm}^2$

$D < 10 \text{ mm}, f_y = 2400 \text{ kg/cm}^2$

② Practical Column Plan (Elev. ±0.00)

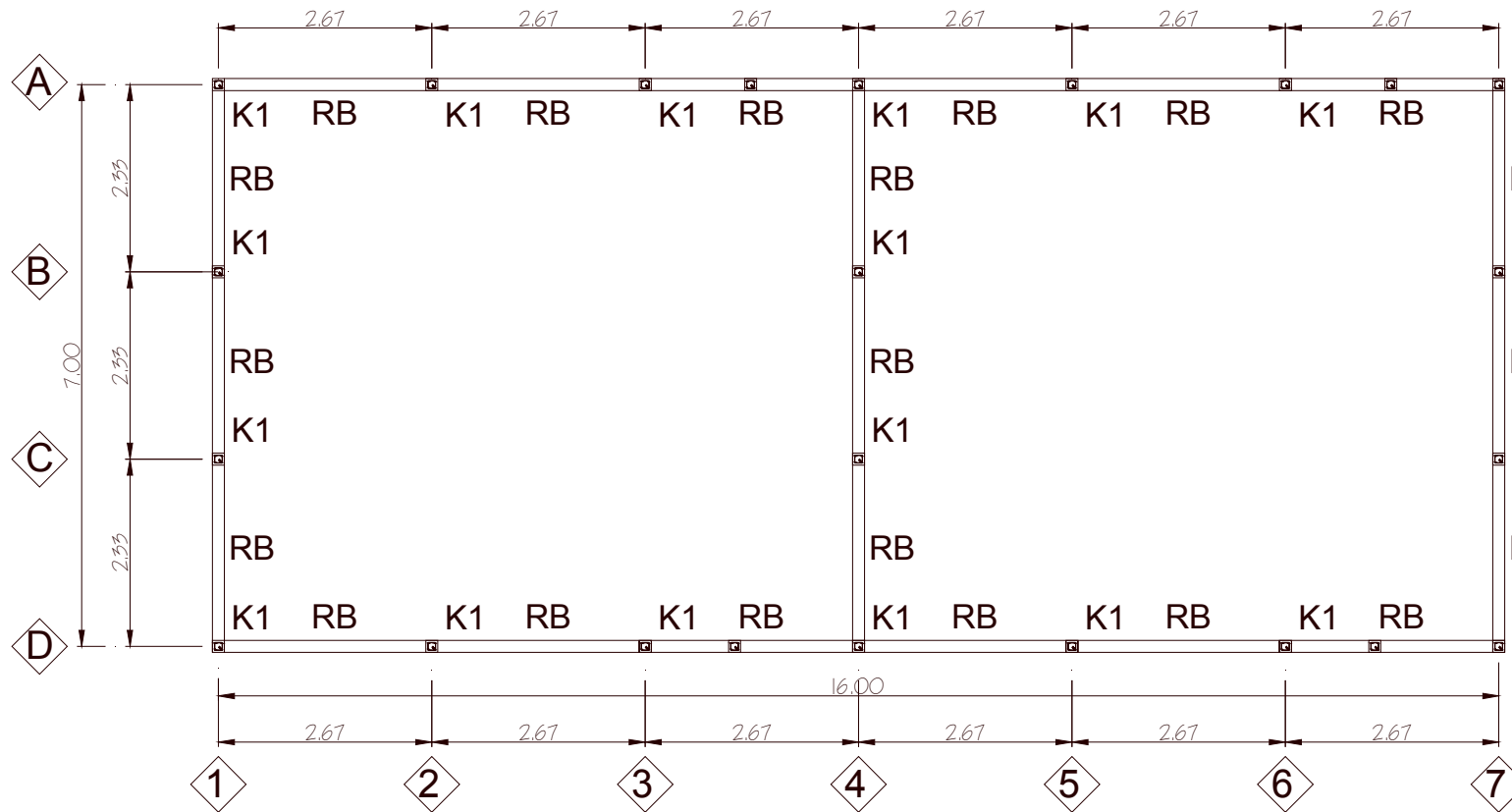
Drawing no. SR-2 Practical Column Plan



Note:
 All dimensions are in meters unless noted otherwise
 Elevations are in meters unless noted otherwise
 All dimensions presented must be followed
 Concrete Strength: K-225
 Reinforcement Bar:
 $D \geq 10 \text{ mm}, f_y = 3200 \text{ kg/cm}^2$
 $D < 10 \text{ mm}, f_v = 2400 \text{ kg/cm}^2$

③ Lintel Beam & Ring Beam Plan (Elev. +2.55)

Drawing no. SR-3 Lintel Beam and Ring Beam



Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

All dimensions presented must be followed

Concrete Strength: K-225

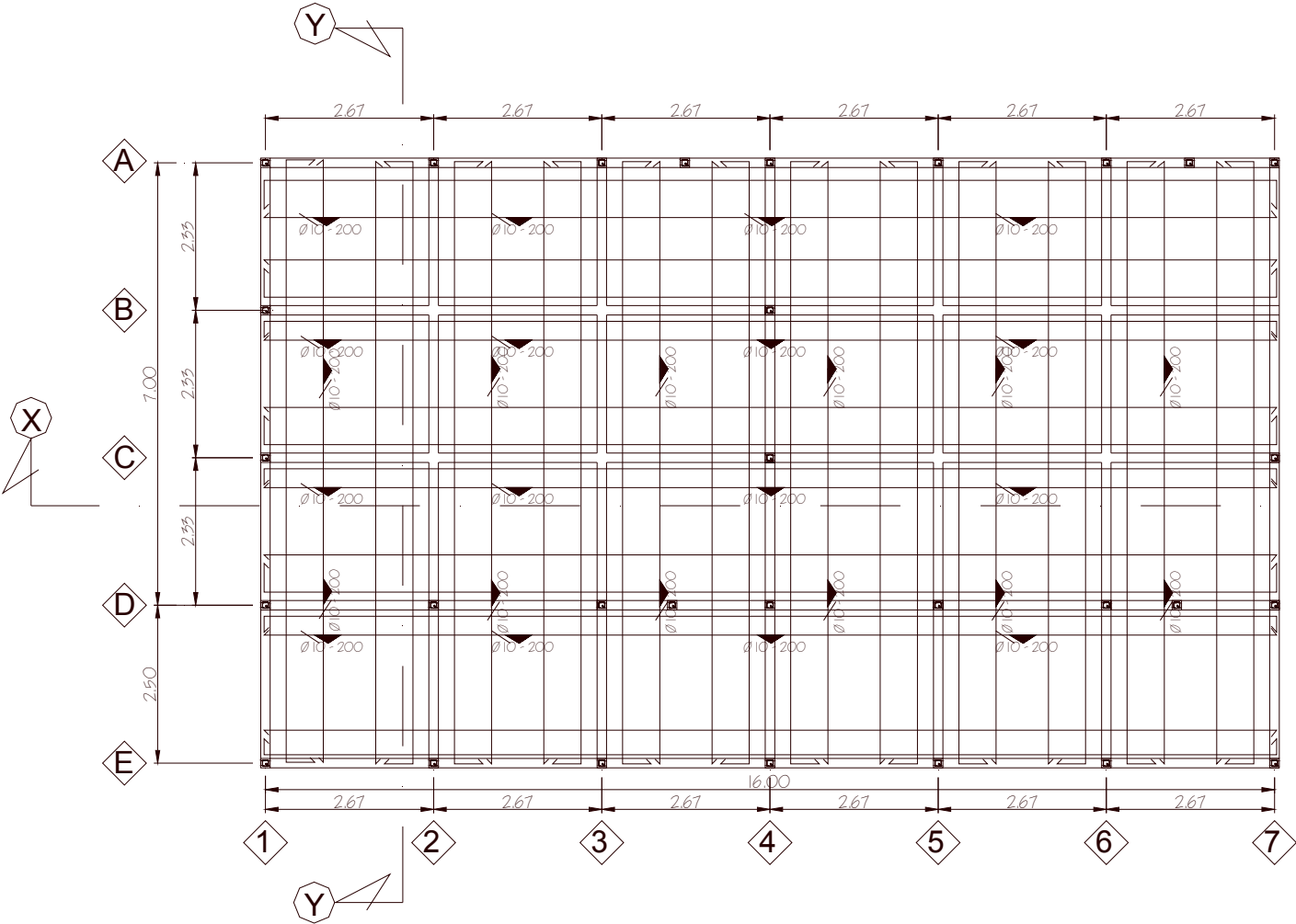
Reinforcement Bar:

$D \geq 10 \text{ mm}, f_y = 3200 \text{ kg/cm}^2$

$D < 10 \text{ mm}, f_y = 2400 \text{ kg/cm}^2$

④ Ring Beam Plan (Elev. +3.71)

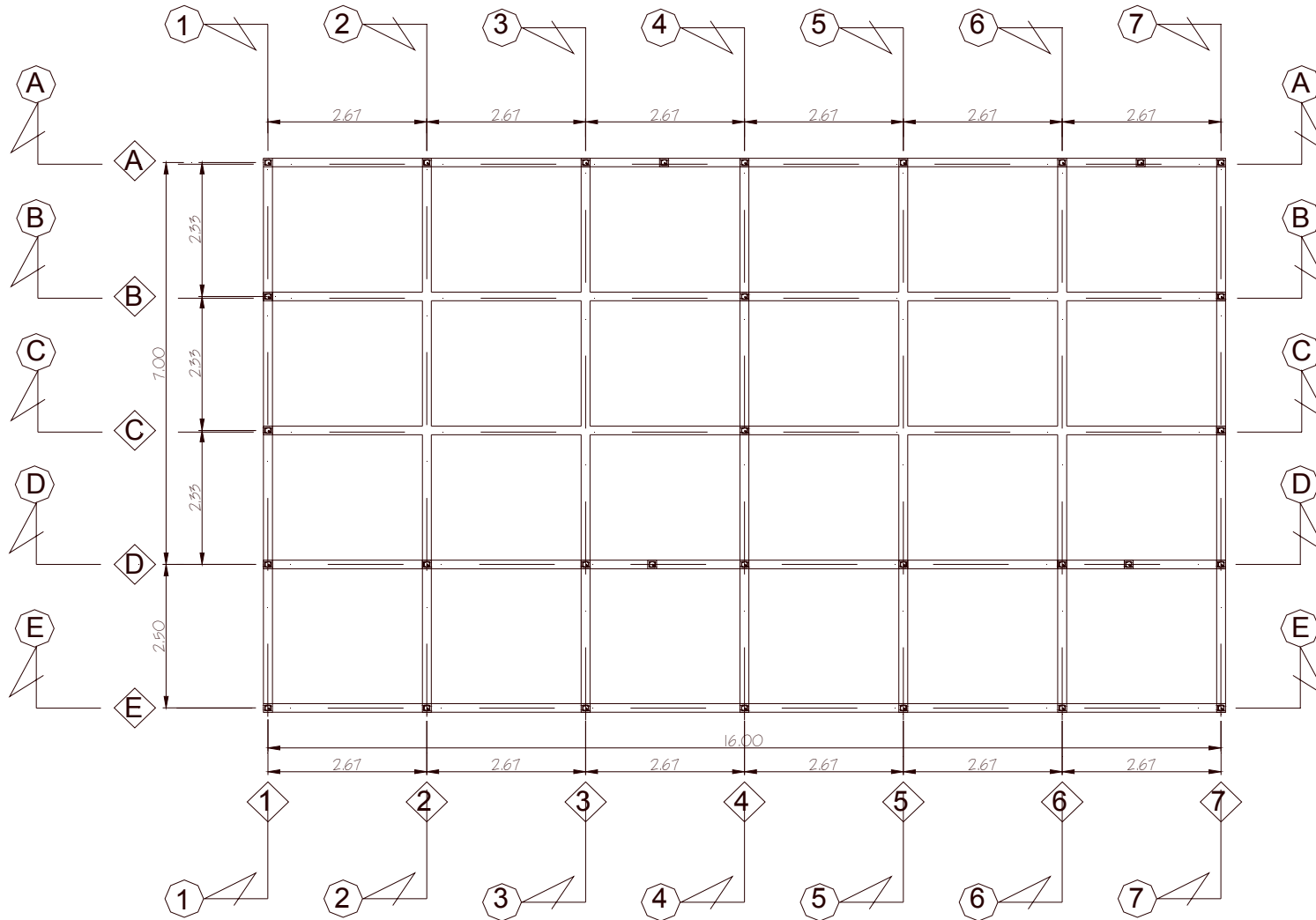
Drawing no. SR-4 Ring Beam Plan



Note:
 All dimensions are in meters unless noted otherwise
 Elevations are in meters unless noted otherwise
 All dimensions presented must be followed
 Concrete Strength: K-225
 Reinforcement Bar:
 $D \geq 10 \text{ mm}, f_y = 3200 \text{ kg/cm}^2$
 $D < 10 \text{ mm}, f_v = 2400 \text{ kg/cm}^2$

5 Slab Reinforcement (Elev. ± 0.00)

Drawing no. SR-5 Slab Reinforcement



Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

All dimensions presented must be followed

Concrete Strength: K-225

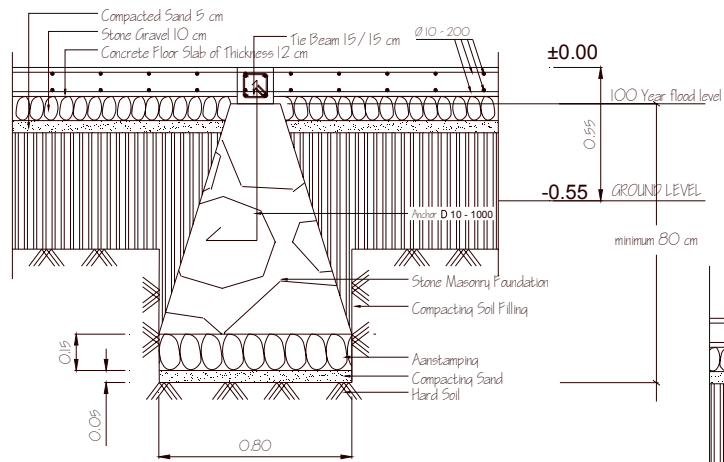
Reinforcement Bar:

$D \geq 10 \text{ mm}$, $f_y = 3200 \text{ kg/cm}^2$

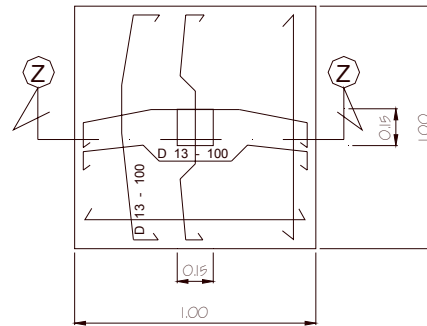
$D < 10 \text{ mm}$, $f_y = 2400 \text{ kg/cm}^2$

6 Reinforcement Plan

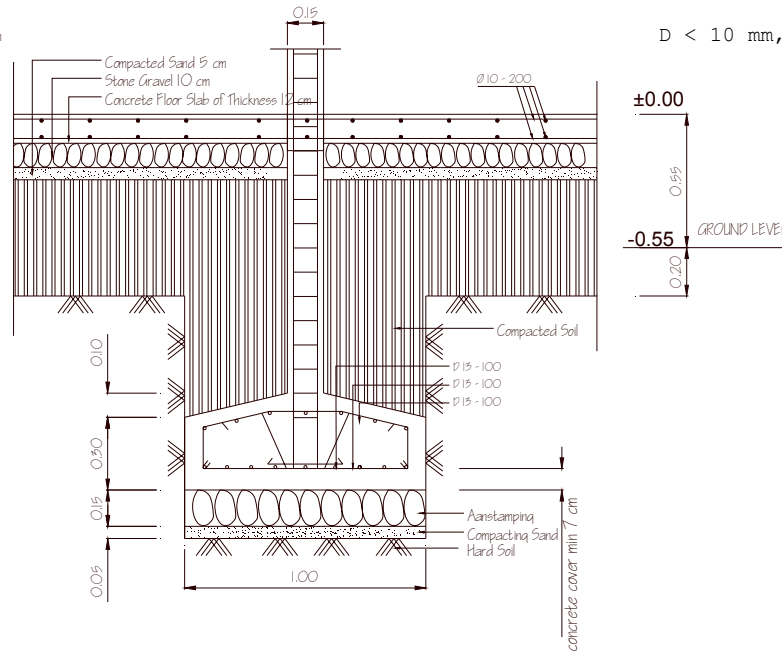
Drawing no. SR-6 Reinforcement Plan



9 Stone Masonry Foundation - Detail (PB)



7 Foot Plate Foundation Plan



8 Local Footings (needed to meet deep hard soil level)

Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

All dimensions presented must be followed

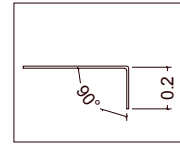
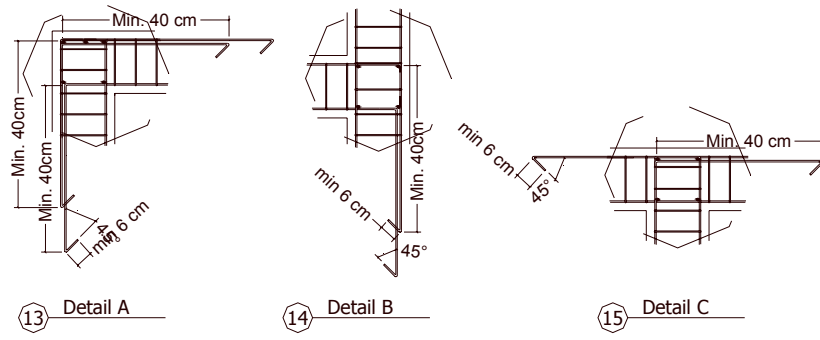
Concrete Strength: K-225

Reinforcement Bar:

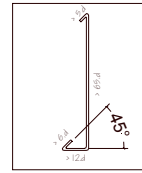
$D \geq 10 \text{ mm}, f_y = 3200 \text{ kg/cm}^2$

$D < 10 \text{ mm}, f_y = 2400 \text{ kg/cm}^2$

Drawing no. SR-7 Foundation



10 Detail Wall Anchor Ø8-1000 mm



11 Detail Foundation Anchor D10-1000 mm

Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

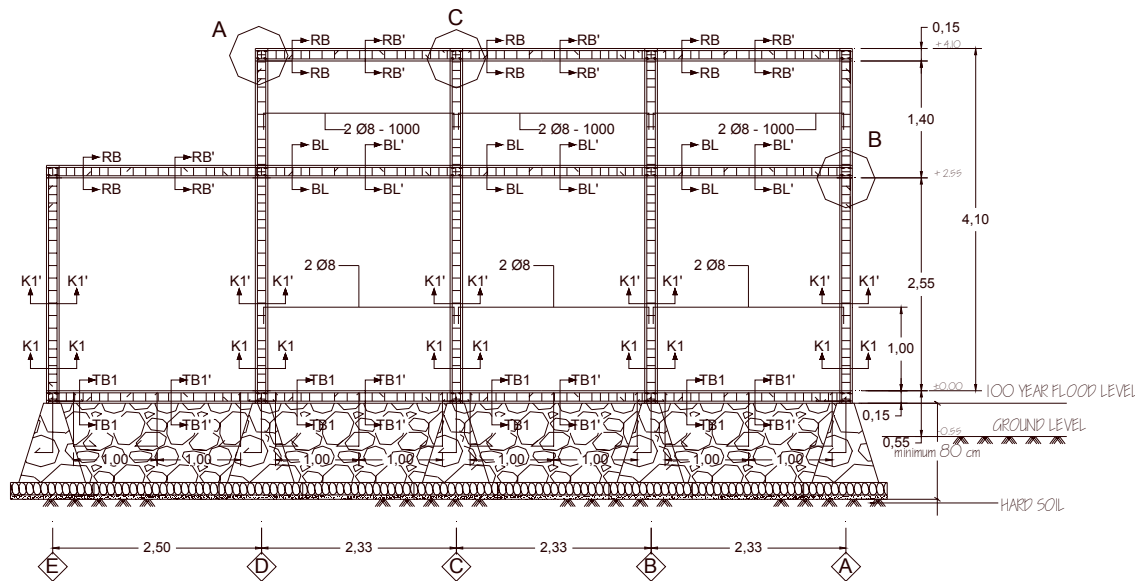
All dimensions presented must be followed

Concrete Strength: K-225

Reinforcement Bar:

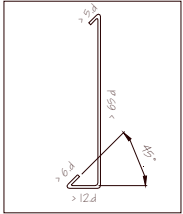
$D \geq 10 \text{ mm}, f_y = 3200 \text{ kg/cm}^2$

$D < 10 \text{ mm}, f_y = 2400 \text{ kg/cm}^2$



12 Reinforcement Grid 1, 4 & 7

Drawing no.SR-8 Reinforcement grid 1, 4 & 7



16 Detail Foundation Anchor D10-1000 mm

Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

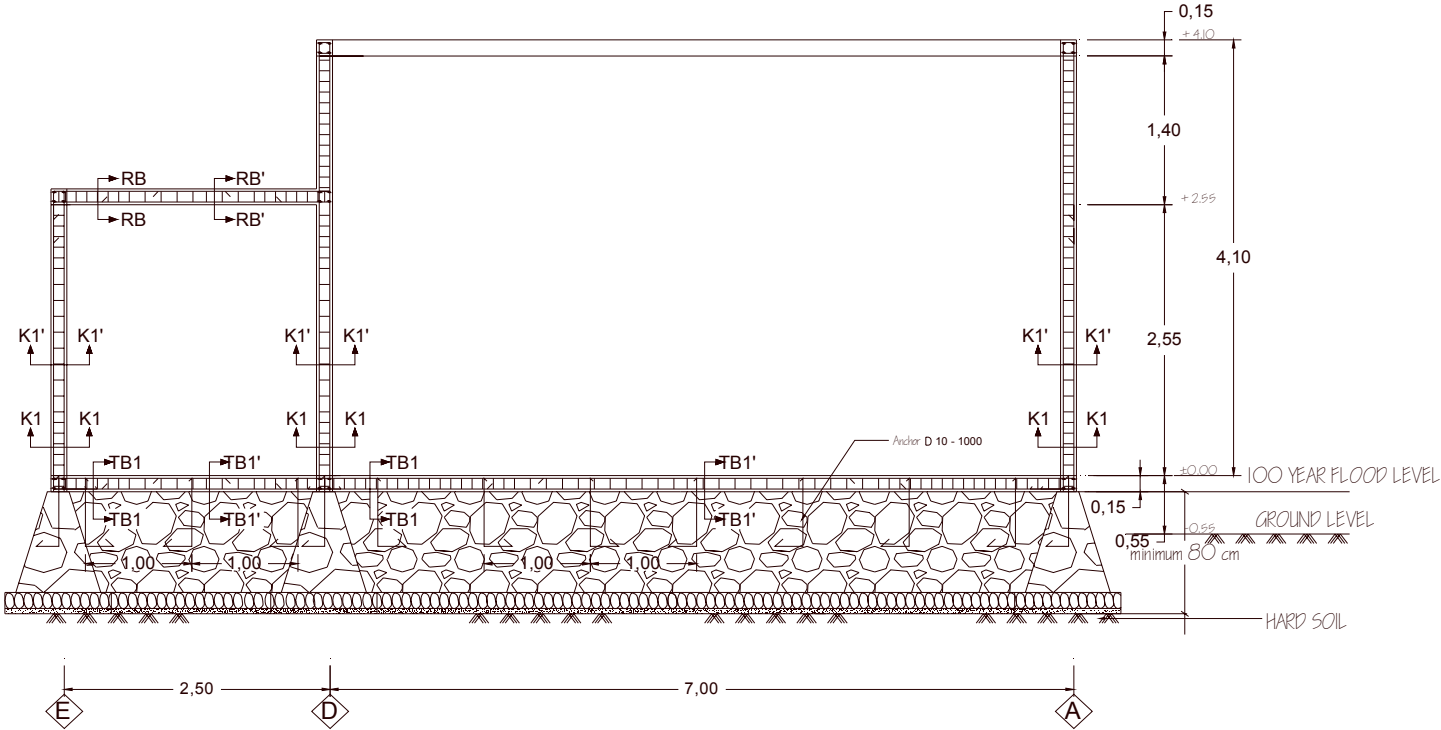
All dimensions presented must be followed

Concrete Strength: K-225

Reinforcement Bar:

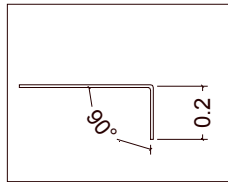
$D \geq 10 \text{ mm}, f_y = 3200 \text{ kg/cm}^2$

$D < 10 \text{ mm}, f_y = 2400 \text{ kg/cm}^2$

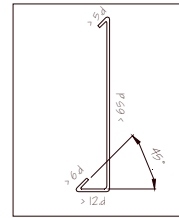


17 Reinforcement Grid 2,3,5 & 6

Drawing no. SR-9 Reinforcement grid 2,3,5 &



18 Detail Wall Anchor Ø8-1000 mm



19 Detail Foundation Anchor D10-1000 mm

Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

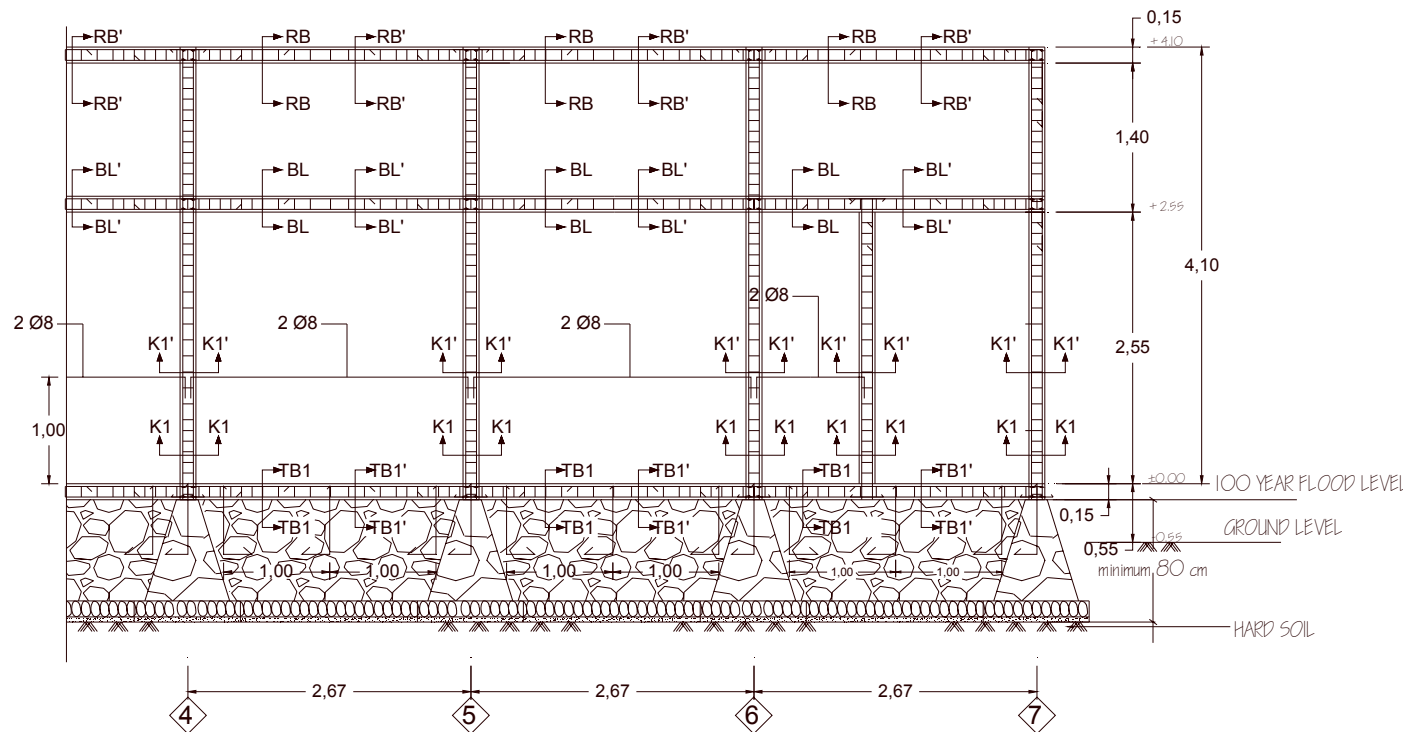
All dimensions presented must be followed

Concrete Strength: K-225

Reinforcement Bar:

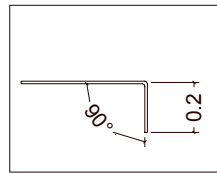
$D \geq 10$ mm, $f_y = 3200$ kg/cm²

$D < 10$ mm, $f_v = 2400$

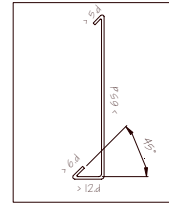


20 Reinforcement Grid A & D (Continue)

Drawing no. SR-10 Reinforcement grid A & D (Continue)



21 Detail Wall Anchor Ø8-1000 mm



22 Detail Foundation Anchor D10-1000 mm

Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

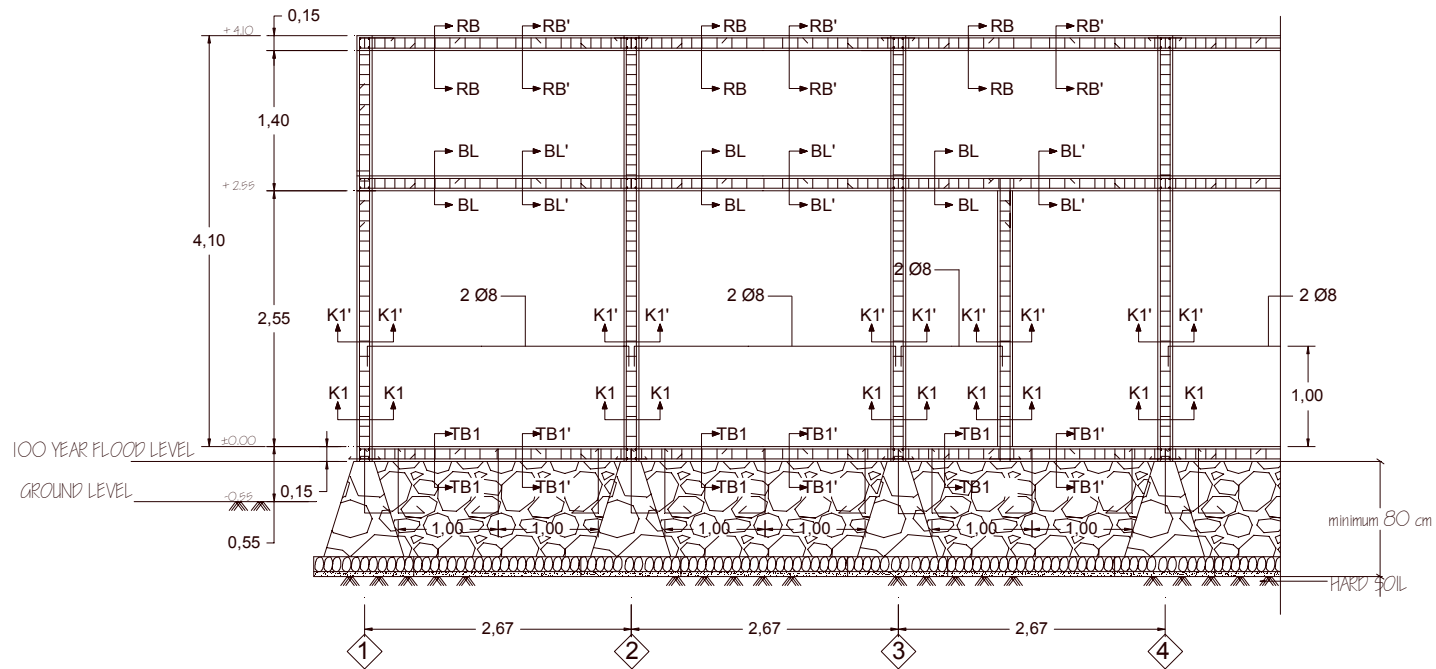
All dimensions presented must be followed

Concrete Strength: K-225

Reinforcement Bar:

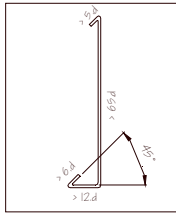
$D \geq 10 \text{ mm}$, $f_y = 3200 \text{ kg/cm}^2$

$D < 10 \text{ mm}$, $f_y = 2400 \text{ kg/cm}^2$



23 Reinforcement Grid A & D

Drawing no. SR-11 Reinforcement grid A & D



24 Detail Foundation Anchor D10-1000 mm

Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

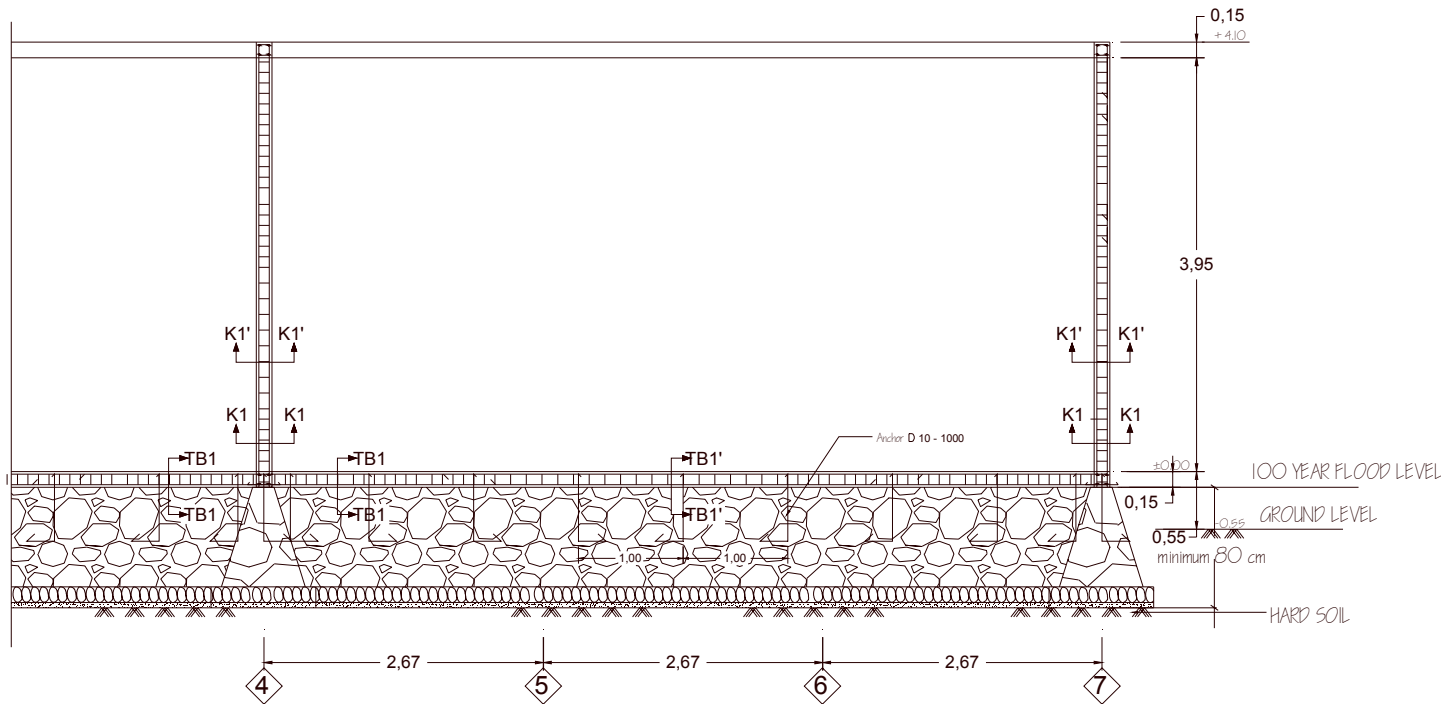
All dimensions presented must be followed

Concrete Strength: K-225

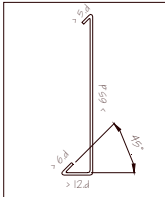
Reinforcement Bar:

$D \geq 10$ mm, $f_y = 3200$ kg/cm²

$D < 10$ mm, $f_y = 2400$ kg/cm²



25 Reinforcement Grid B & C (Continue) Drawing no. SR-12 Reinforcement grid B & C



26 Detail Foundation Anchor D10-1000 mm

Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

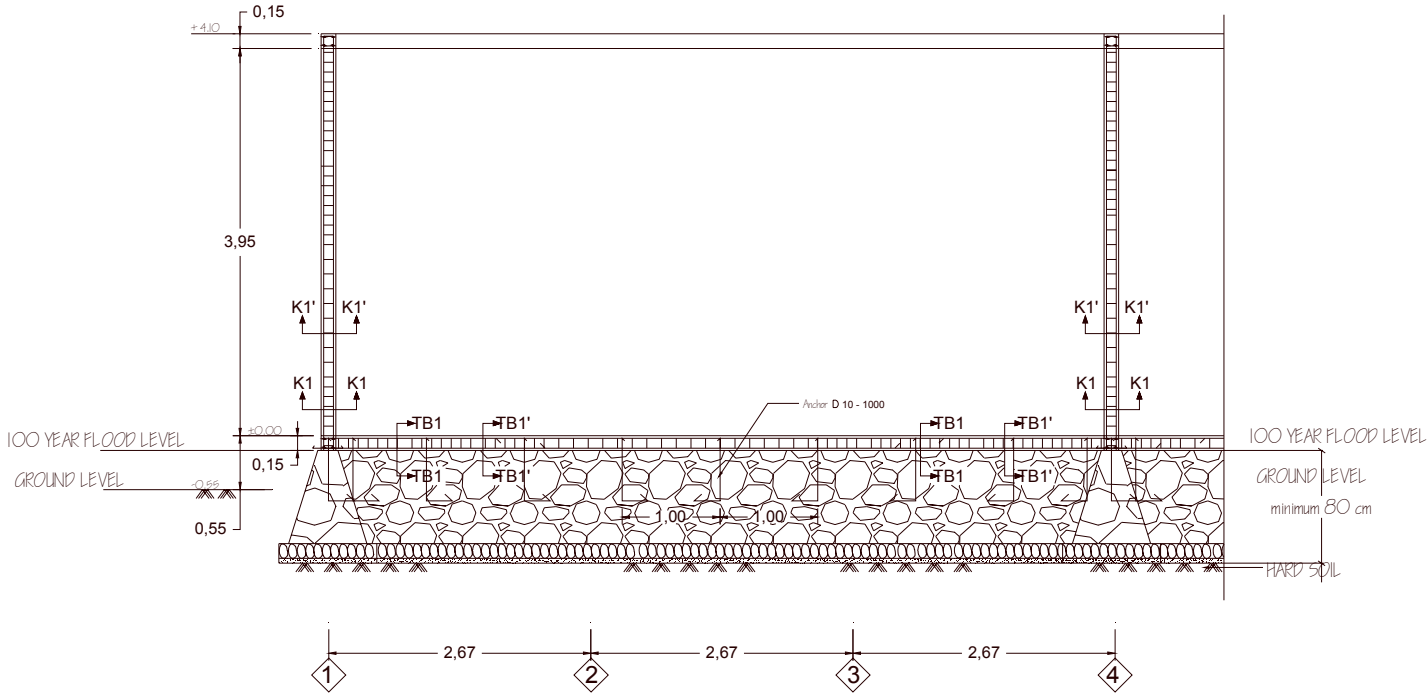
All dimensions presented must be followed

Concrete Strength: K-225

Reinforcement Bar:

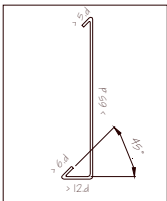
$D \geq 10 \text{ mm}, f_y = 3200 \text{ kg/cm}^2$

$D < 10 \text{ mm}, f_y = 2400 \text{ kg/cm}^2$



27 Reinforcement Grid B & C

Drawing no. SR-13 Reinforcement grid B & C



28 Detail Foundation Anchor D10-1000 mm

Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

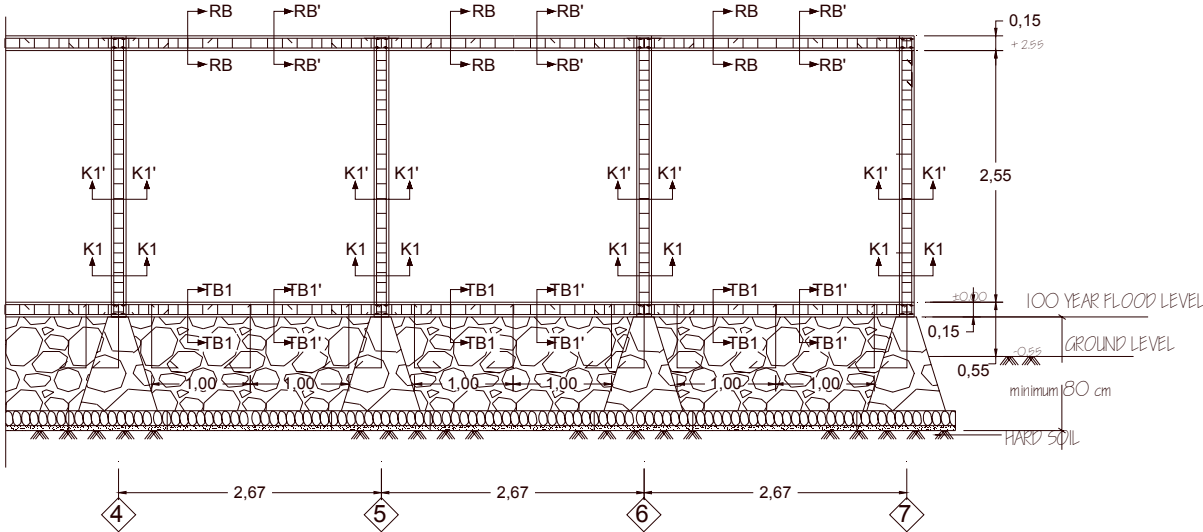
All dimensions presented must be followed

Concrete Strength: K-225

Reinforcement Bar:

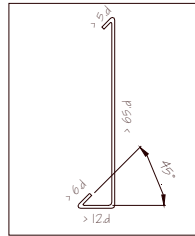
$D \geq 10 \text{ mm}, f_y = 3200 \text{ kg/cm}^2$

$D < 10 \text{ mm}, f_y = 2400 \text{ kg/cm}^2$



29 Reinforcement Grid E (Continue)

Drawing no. SR-14 Reinforcement grid E (continue)



30 Detail Foundation Anchor D10-1000 mm

Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

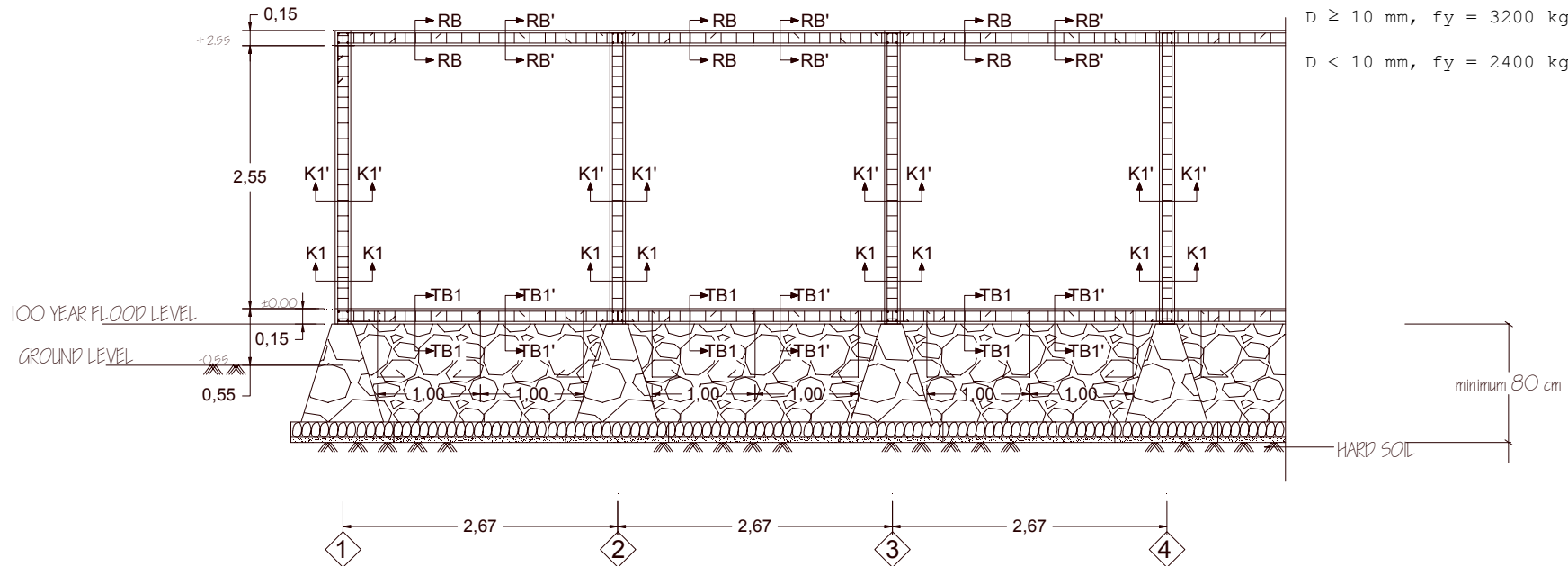
All dimensions presented must be followed

Concrete Strength: K-225

Reinforcement Bar:

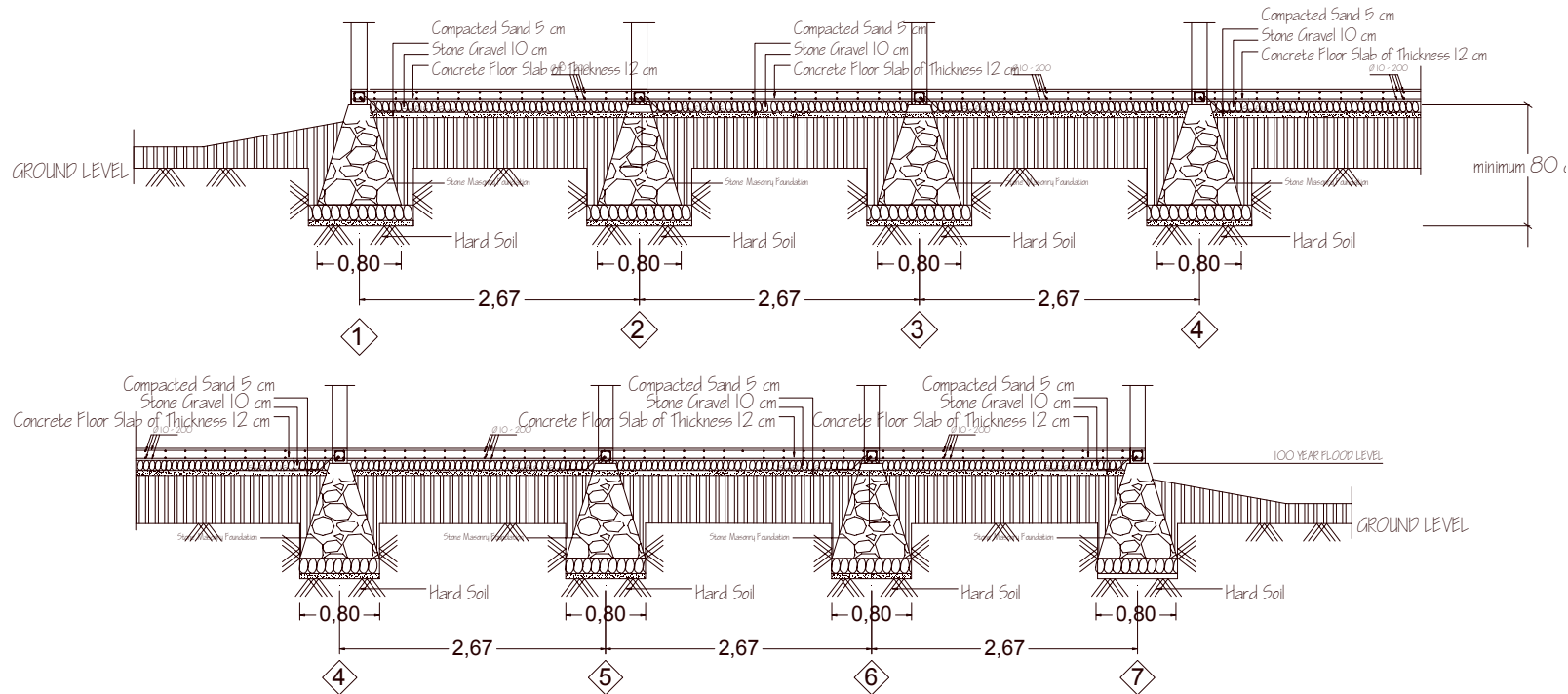
$D \geq 10 \text{ mm}, f_y = 3200 \text{ kg/cm}^2$

$D < 10 \text{ mm}, f_y = 2400 \text{ kg/cm}^2$



31 Reinforcement Grid E

Drawing no. SR-15 Reinforcement grid E



Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

All dimensions presented must be followed

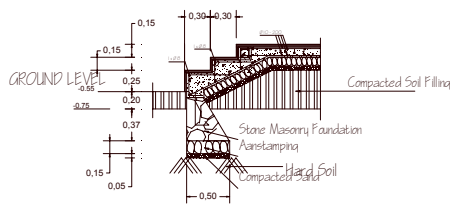
Concrete Strength: K-225

Reinforcement Bar:

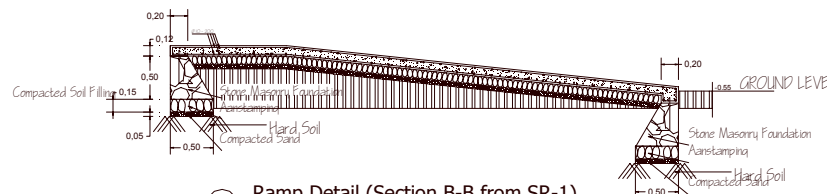
$D \geq 10$ mm, $f_y = 3200$ kg/cm²

$D < 10$ mm, $f_y = 2400$ kg/cm²

32 Floor Reinforcement Section X-X (Elev. -0.03)

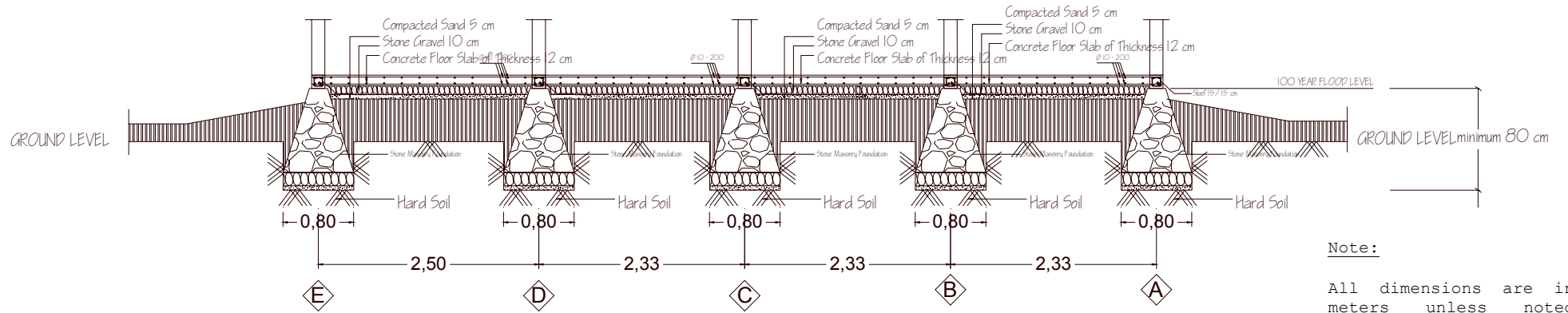


33 Stairs Detail (Section A-A from SR-1)



34 Ramp Detail (Section B-B from SR-1)

Drawing no. SR-16 Floor Reinforcement Sec X-X



36 Floor Reinforcement Section Y-Y (Elev. - 0.03)

Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

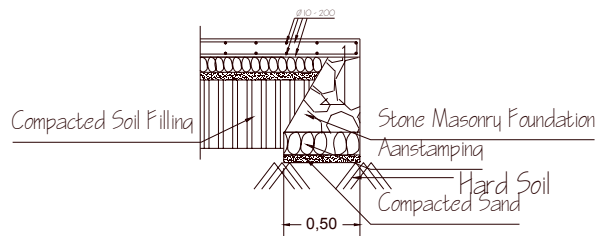
All dimensions presented must be followed

Concrete Strength: K-225

Reinforcement Bar:

$D \geq 10$ mm, $f_y = 3200$ kg/cm²

$D < 10$ mm, $f_y = 2400$ kg/cm²



37 Stairs Detail (Section D-D from SR-1)

Drawing no. SR-17 Floor Reinforcement Sec Y-Y

LIST OF TIE BEAM		
NOTATION	TB1	TB1'
POSITION	END	MID
SECTION		
B x D	15 x 15 cm	
TOP BAR	2 D 10 mm	2 D 10 mm
BOTTOM BAR	2 D 10 mm	2 D 10 mm
STRIRRUP	Ø 8 - 100 mm	Ø 8 - 150 mm
WEB BAR		
NOTE		

LIST OF RING BEAM		
NOTATION	RB	RB'
POSITION	END	MID
SECTION		
B x D	15 x 15 cm	
TOP BAR	2 D 10 mm	2 D 10 mm
BOTTOM BAR	2 D 10 mm	2 D 10 mm
STRIRRUP	Ø 8 - 100 mm	Ø 8 - 150 mm
WEB BAR		
NOTE		

Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

All dimensions presented must be followed

Concrete Strength: K-225

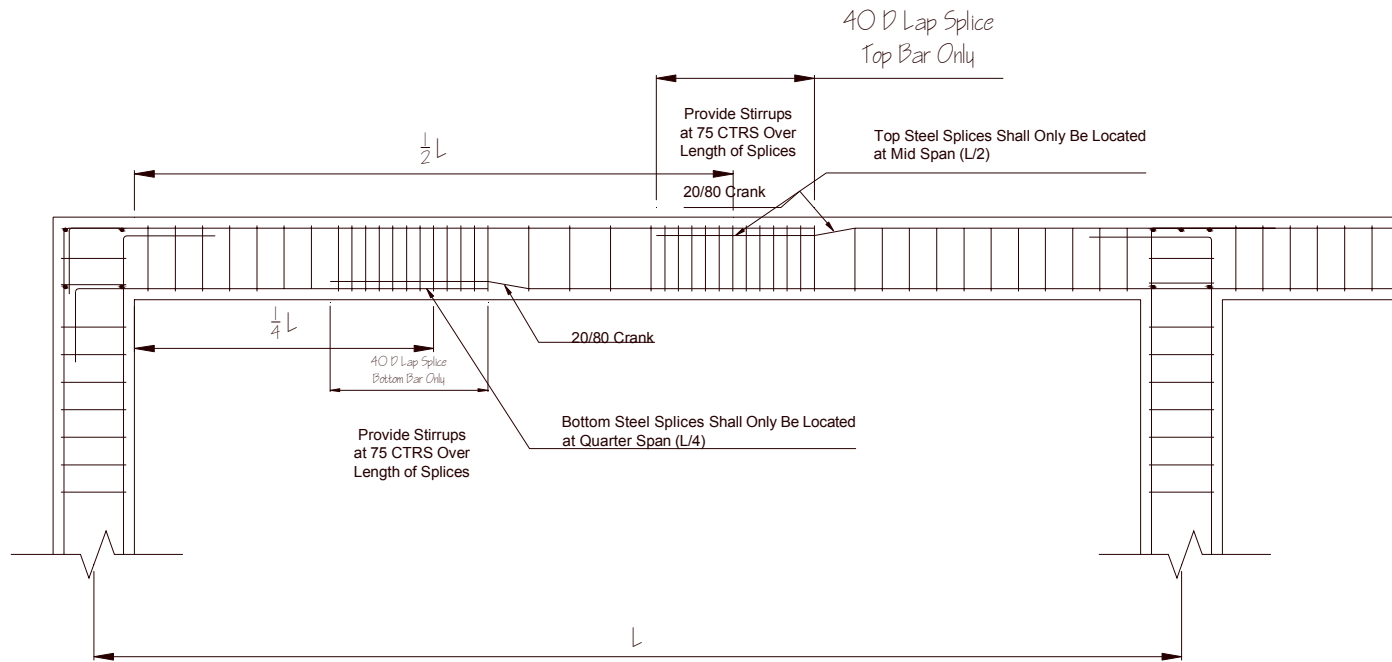
Reinforcement Bar:

$D \geq 10$ mm, $f_y = 3200$ kg/cm²

$D < 10$ mm, $f_y = 2400$ kg/cm²

LIST OF PRACTICAL COLUMN		
NOTATION	K1	K1'
POSITION	END	MID
SECTION		
B x D	15 x 15 cm	
MAIN BAR	4 D 10 mm	4 D 10 mm
STRIRRUP	Ø 8 - 100 mm	Ø 8 - 150 mm
NOTE		

LIST OF LINTEL BEAM		
NOTATION	BL	BL'
POSITION	END	MID
SECTION		
B x D	15 x 15 cm	
TOP BAR	2 D 10 mm	2 D 10 mm
BOTTOM BAR	2 D 10 mm	2 D 10 mm
STRIRRUP	Ø 8 - 100 mm	Ø 8 - 150 mm
WEB BAR		
NOTE		



Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

All dimensions presented must be followed

Concrete Strength: K-225

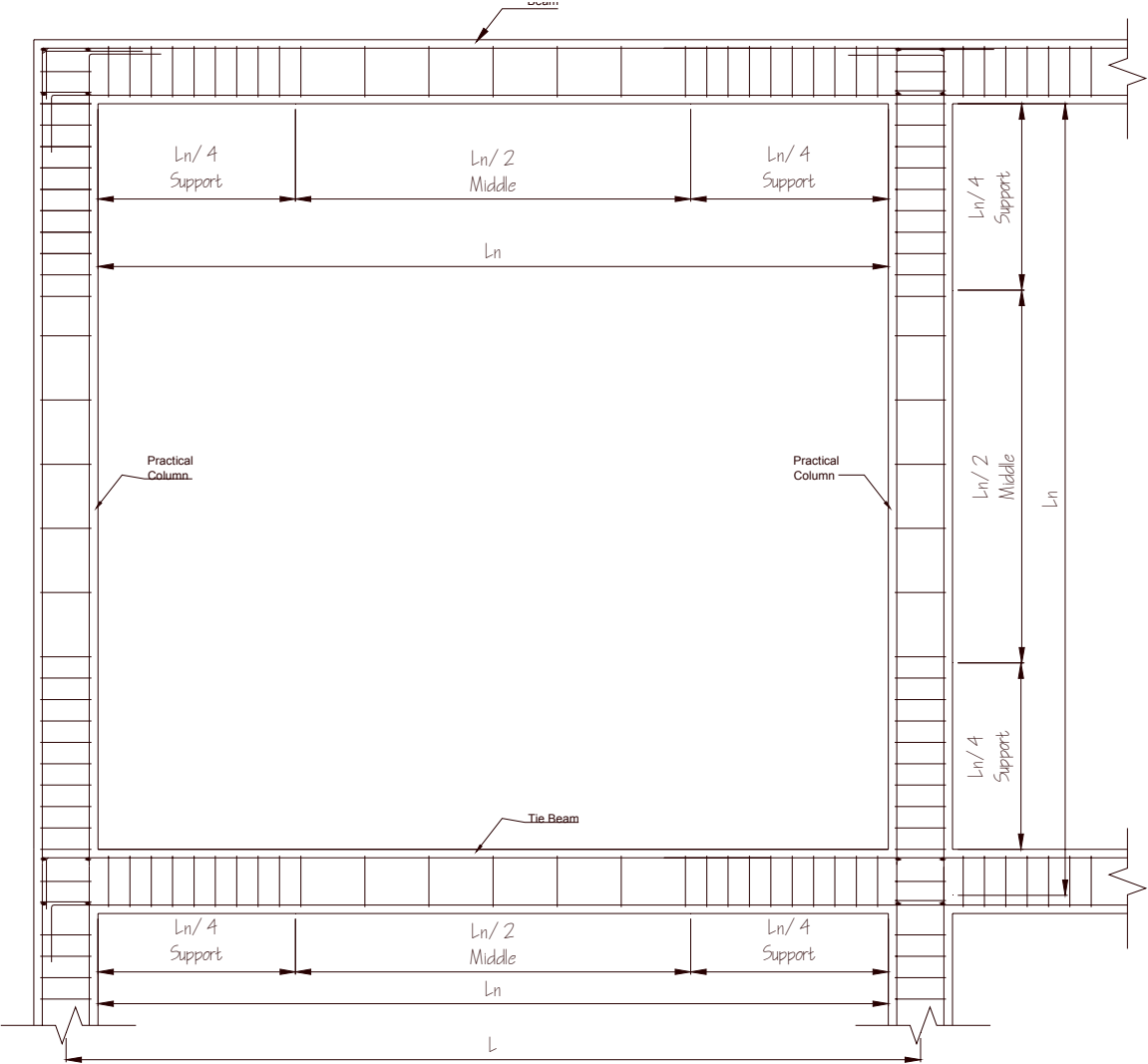
Reinforcement Bar:

$D \geq 10$ mm, $f_y = 3200$ kg/cm²

$D < 10$ mm, $f_y = 2400$ kg/cm²

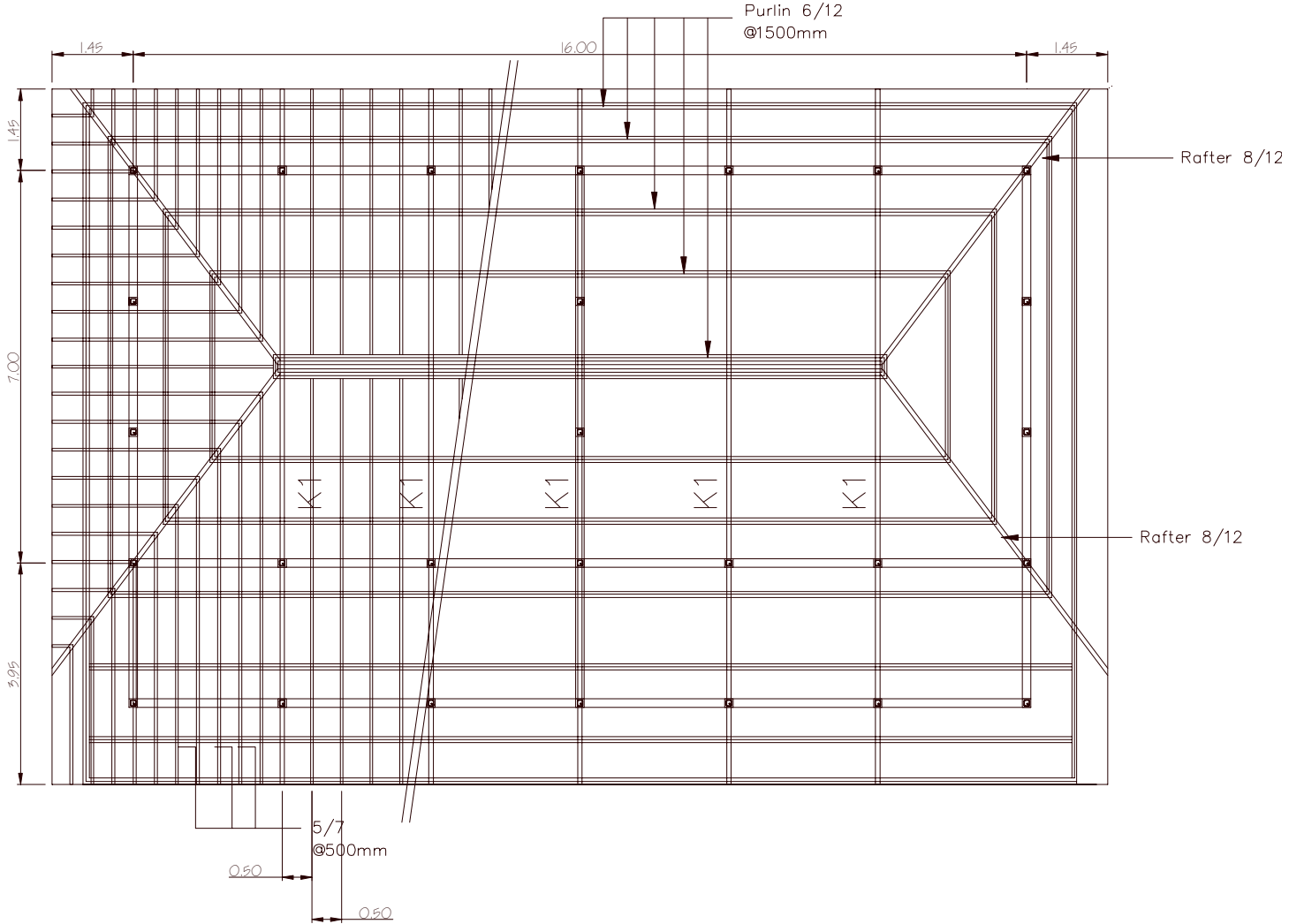
40 Permissible Beam Splice locations

Drawing no. SR-19 Permissible Beam Splice Locations



Note:
 All dimensions are in meters unless noted otherwise
 Elevations are in meters unless noted otherwise
 All dimensions presented must be followed
 Concrete Strength: K-225
 Reinforcement Bar:
 $D \geq 10 \text{ mm}, f_y = 3200 \text{ kg/cm}^2$
 $D < 10 \text{ mm}, f_y = 2400 \text{ kg/cm}^2$

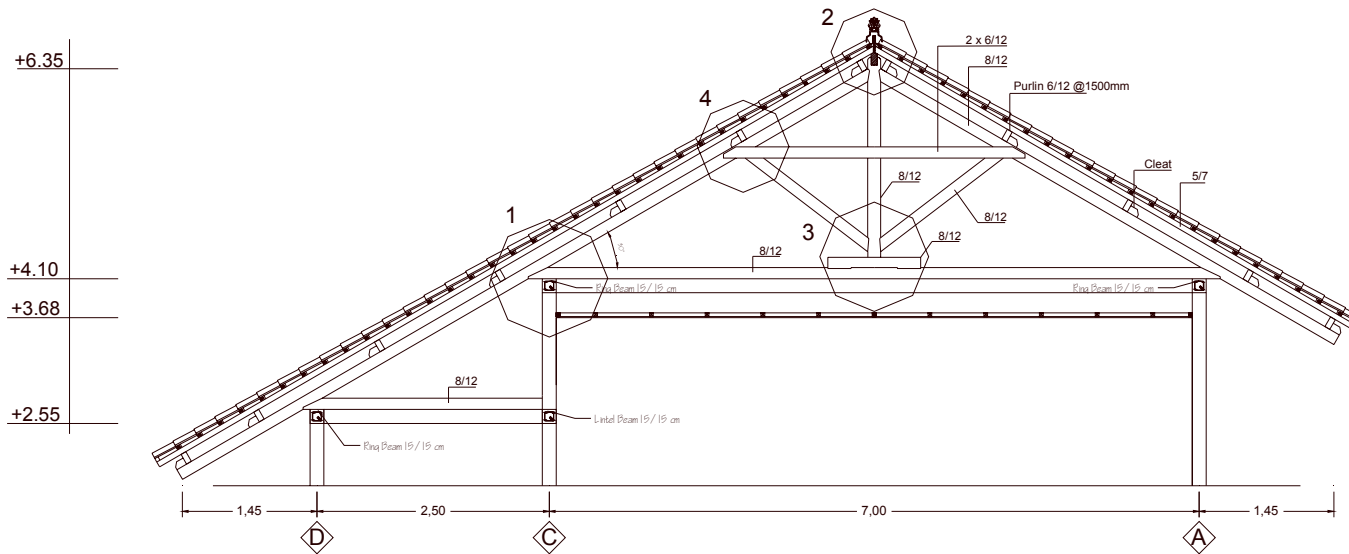
41 Permissible Beam & Column Stirrup locations
 Drawing no. SR-20 Permissible Beam and Column Stirrup Locations
 Scale: 1:10



Note:
 All dimensions are in meters unless noted otherwise
 Elevations are in meters unless noted otherwise
 All dimensions presented must be followed

49 Roof Truss Plan

Drawing no. SR-21 Roof Truss Plan



Note:

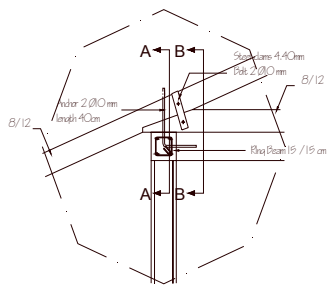
All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

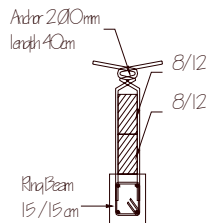
All dimensions presented must be followed

Refer to AR-3 for roof truss bracing

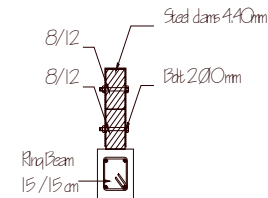
43 Roof Truss Detail - K1



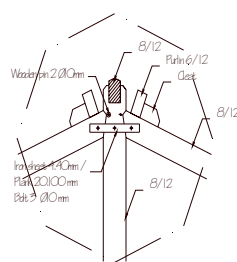
44 Section 1



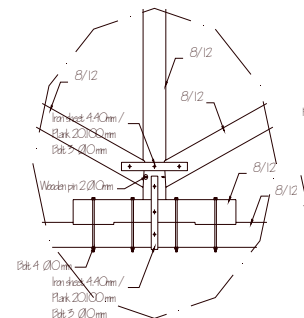
45 Section A - A



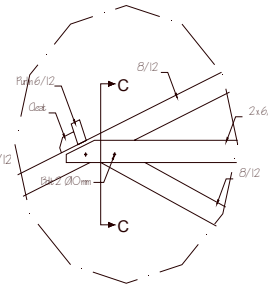
46 Section B - B



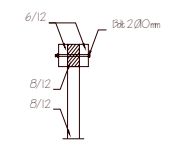
47 Section 2



48 Section 3

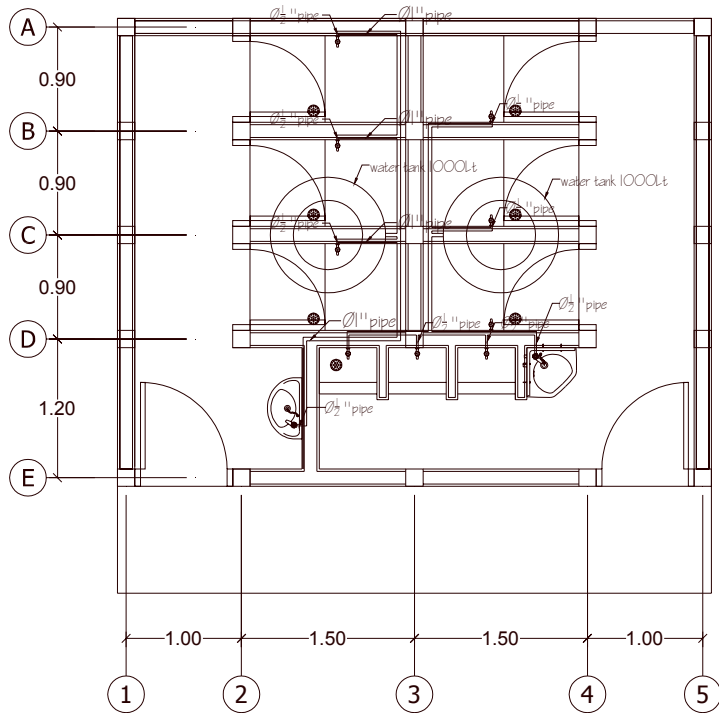


49 Section 4

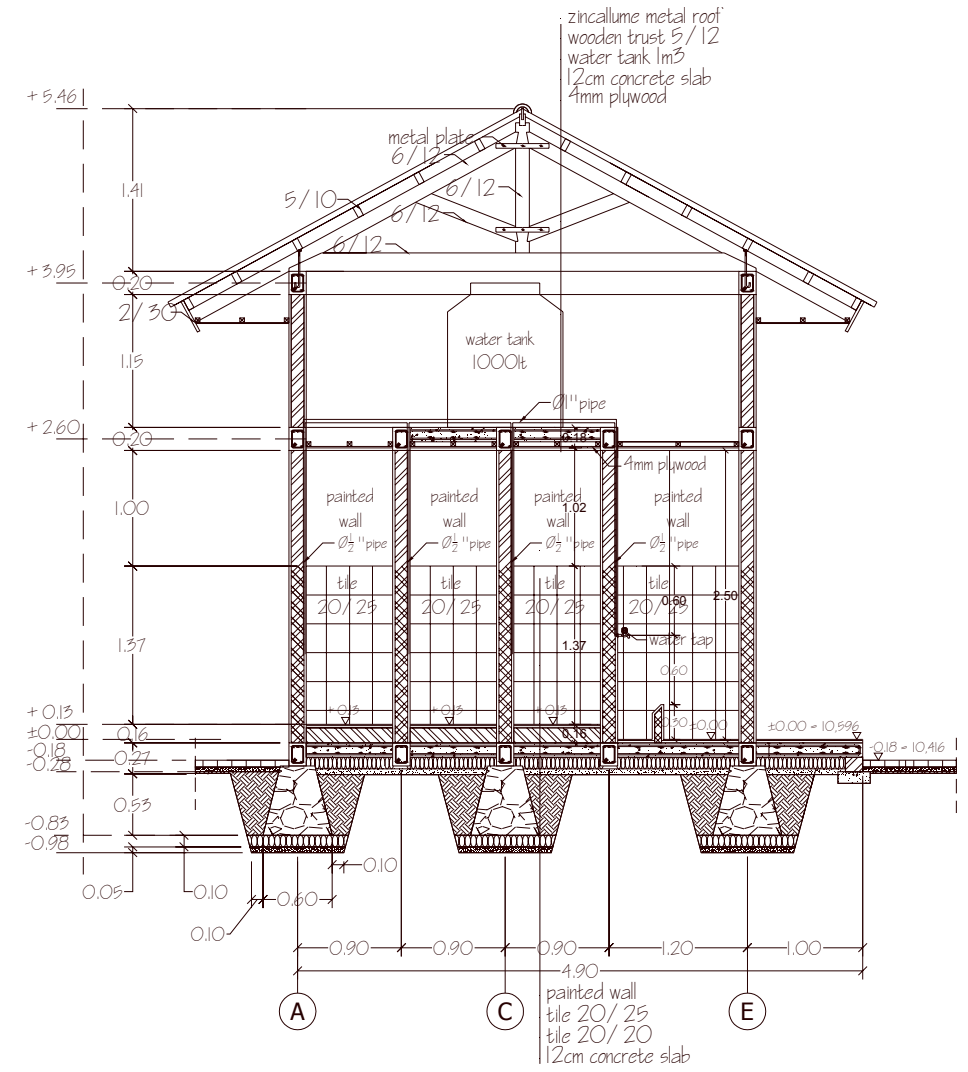


50 Section C - C

Drawing no. SR-22 Roof Truss Detail

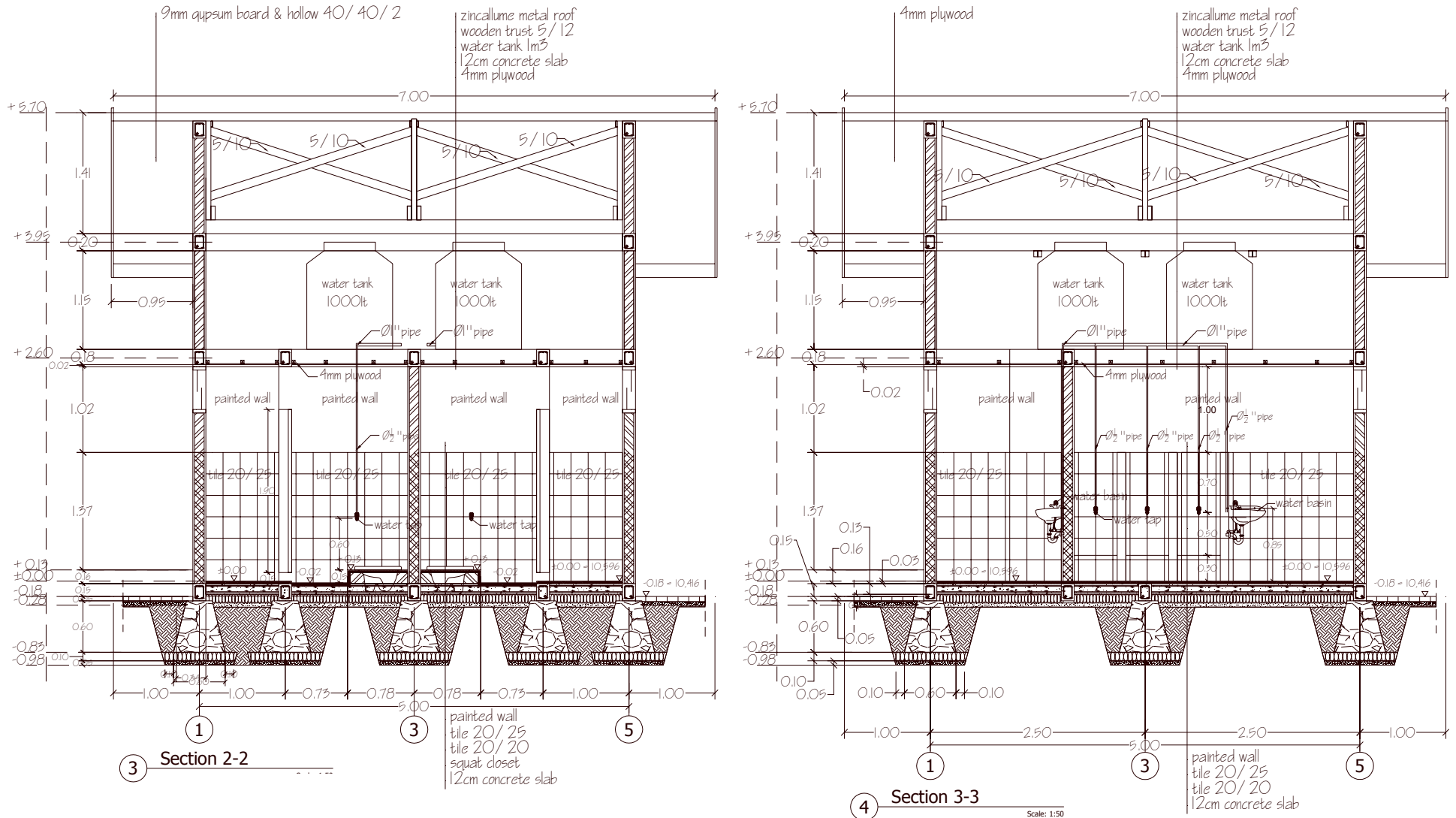


1 Ceiling Piping Plan
Scale: 1:50

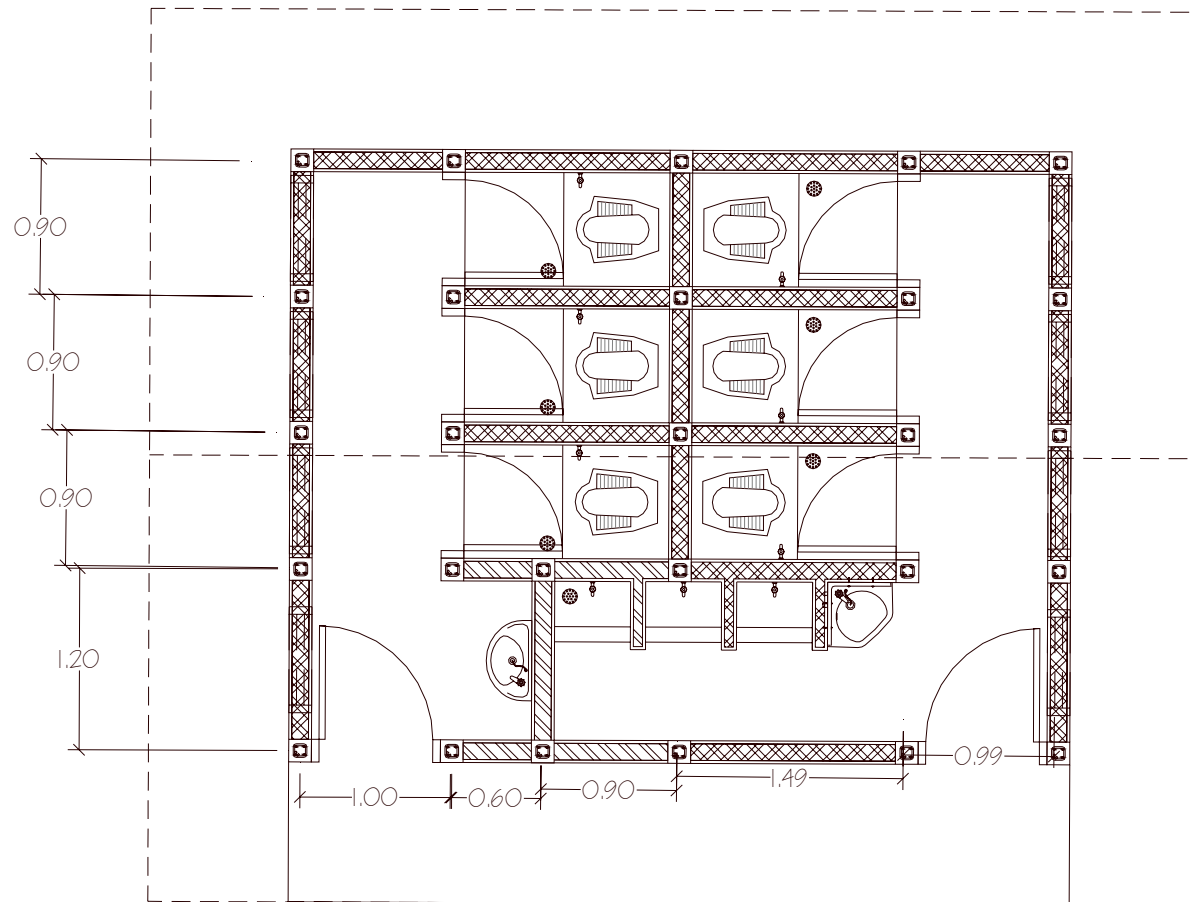


2 Section 1-1
Scale: 1:50

Drawing no. WS-1 Ceiling Piping Plan and Section 1-1



Drawing no. WS-2 Section 2-2 & 3-3



5 Toilet Plan

Drawing no. WS-3 Toilet Plan

3.4 Bill of Quantities

BOQ Typical 2 Classrooms School Designs

No	Items of Works	Unit	Quantities	Unit Rate	Total Amount
A	Substructure works				
A.1	Excavation works:				
a	Class room and terrace	m3	102.36		
b	Stair	m3	1.09		
c	Ramp	m3	8.52		
A.2	Compacted fill works:				
d	Class room and terrace	m3	81.56		
e	Stair	m3	0.38		
f	Ramp	m3	10.35		
A.3	Sand bed 50 mm consolidated thickness under floor				
g	Class room and terrace	m3	6.58		
h	Stair	m3	0.14		
i	Ramp	m3	1.31		
A.4	Compacted gravel t =100 mm under floor for leveling				
j	Class room and terrace	m3	15.99		
k	Stair	m3	0.17		
l	Ramp	m3	2.52		
B	Foundation Works				
B.1	Aanstamping+sand t = 150 mm masonry erection under foundation				
a	Classroom	m3	12.12		
b	Verandah	m3	4.98		
c	Stair	m3	0.67		
d	Ramp	m3	1.01		
e	Water Station & Parapets	m3	2.78		
B.2	Stone masonry foundation to:				

f	Classroom	m3	55.55		
g	Verandah	m3	22.83		
h	Stair	m3	2.24		
i	Ramp	m3	1.47		
j	Water Station & Parapets	m3	4.05		
C	Anchorage				
a	Anchorage between tie beams and foundation Φ 10-1000, Classroom	kg	147.21		
b	Anchorage between tie beams and foundation Φ 10-1000, Verandah	kg	29.98		
c	Anchorage between tie beams and foundation Φ 10-1000, Stair	kg	5.33		
d	Anchorage between tie beams and foundation Φ 10-1000, Ramp	kg	7.99		
e	Anchorage between column and brick 2 Φ 8, classroom	kg	67.44		
D	Vibrated reinforced concrete works K-225				
D.1	Column 150/150				
a	Concrete	m3	2.81		
b	Reinforcement bar	kg	429.21		
c	formwork	m2	76.64		
D.2	Ring Beam 150/150				
d	Concrete	m3	1.95		
e	Reinforcement bar	kg	264.87		
f	formwork	m2	49.78		
D.3	Tie Beam 150/150				
g	Concrete	m3	3.29		
h	Reinforcement bar	kg	661.53		
i	formwork	m2	84.30		
D.4	Lintel Beam 150/150				
j	Concrete	m3	1.19		
k	Reinforcement bar	kg	244.50		
l	formwork	m2	30.50		
D.5	Concrete floor slab t = 120 mm				

m	Concrete	m3	18.24		
n	Reinforcement bar	kg	1,899.50		
o	formwork	m2	5.79		
D.6 Concrete stair					
p	Concrete	m3	0.55		
q	Reinforcement bar	kg	24.96		
r	formwork	m2	1.87		
D.7 Concrete ramp					
s	Concrete	m3	3.02		
t	Reinforcement bar	kg	308.88		
u	formwork	m2	6.22		
D.8 Beam on parapet wall					
v	Concrete	m3	0.36		
w	Reinforcement bar	kg	55.95		
x	formwork	m2	6.45		
D.9 Slab concrete t= 120 mm at water station					
y	Concrete	m3	0.22		
z	Reinforcement bar	kg	7.60		
aa	formwork	m2	1.18		
E Wall + wall finishing:					
E.1 Brickwork in cement and sand (1:4) for construct :					
a	Class room	m2	127.65		
b	Parapet wall and water station	m2	20.41		
E.2 Plaster to brick wall, smooth finish with cement coating to :					
c	Class room	m2	255.29		
d	Parapet wall and water station	m2	40.83		
E.3 Internal wall painting with apply one coat primer and two coats of approved paint to:					
e	Class room	m2	151.55		
E.4 External wall painting with apply one coat primer and two coats of approved paint to:					

f	Class room	m2	87.88		
g	Parapet wall and water station	m2	58.69		
F	Floor finishing				
	Non slippery Ceramic tiles 300 mm x 300 mm,				
a	Class room	m2	112.00		
b	Verandah, stair and ramp	m2	48.26		
c	finishing patterns to form ramp surface	m2	20.16		
G	Door frames, window frames and jalousie				
a	door (5/7)	m3	0.10		
b	window (5/7)	m3	0.36		
c	jalousie (5/7)	m3	0.26		
d	Jalousie grid (1/7)	m3	0.12		
H	Door, windows and concrete rooster				
a	Front doors, as specified in architectural drawings	unit	2.00		
b	windows glass (650x800 mm), included the frames and hinges if needed, refer to drawings	unit	24.00		
c	window glass (270x710 mm), included the frames and hinges if needed, refer to drawings	unit	48.00		
d	window glass (310x430 mm), included the frames and hinges if needed, refer to drawings	unit	8.00		
e	window glass (200x850 mm), included the frames and hinges if needed, refer to drawings	unit	4.00		
f	concrete rooster	unit	20.00		
g	backdoors, as specified in architectural drawings	unit	2.00		
I	Roofing works and Ceilings				
I.1	Roof Trusses				
a	main chord (8/12)	m3	1.32		
b	stiffener (6/12)	m3	0.23		
c	purlin (6/12)	m3	0.50		
d	Kasau (timber element) (5/7)	m3	1.19		
e	timber bracing (6/12)	m3	0.22		
f	cleat (5/7)	m3	0.01		
I.2	Roof Cover				

g	Galvanized iron sheet roof & screw	m2	355.33		
h	fascia board (2/25)	m'	34.21		
i	Board painted triplex	m2	137.60		
I.3	Ceilings				
j	hanger (6/12)	m3	1.50		
k	plafond (5/7)	m3	0.65		
l	ceilings boards (9mm thick)	m2	108.93		
m	cornice	m'	58.80		
J	Railing works				
	Black steel pipe of balustrade 1 " and hand rails 2" with welded and bolted connection:				
a	Ramp	m'	22.20		
K	Water station area works				
a	Water foucet T 23 B13V7N	unit	3.00		
b	Floor trap TX 1 AVI	unit	2.00		
c	PVC pipe 2 1/2" for grey water	m'	2.20		
d	Ceramic at Water station area	m2	4.17		

- Note:
1. Assumption depth of foundation = 1m
 2. Assumption existing ground level = -0.55 m (refer to drawings)
 3. Mechanical and electrical appliances are not included

4. TYPICAL DESIGN OF 3 ROOMS SCHOOL BUILDING

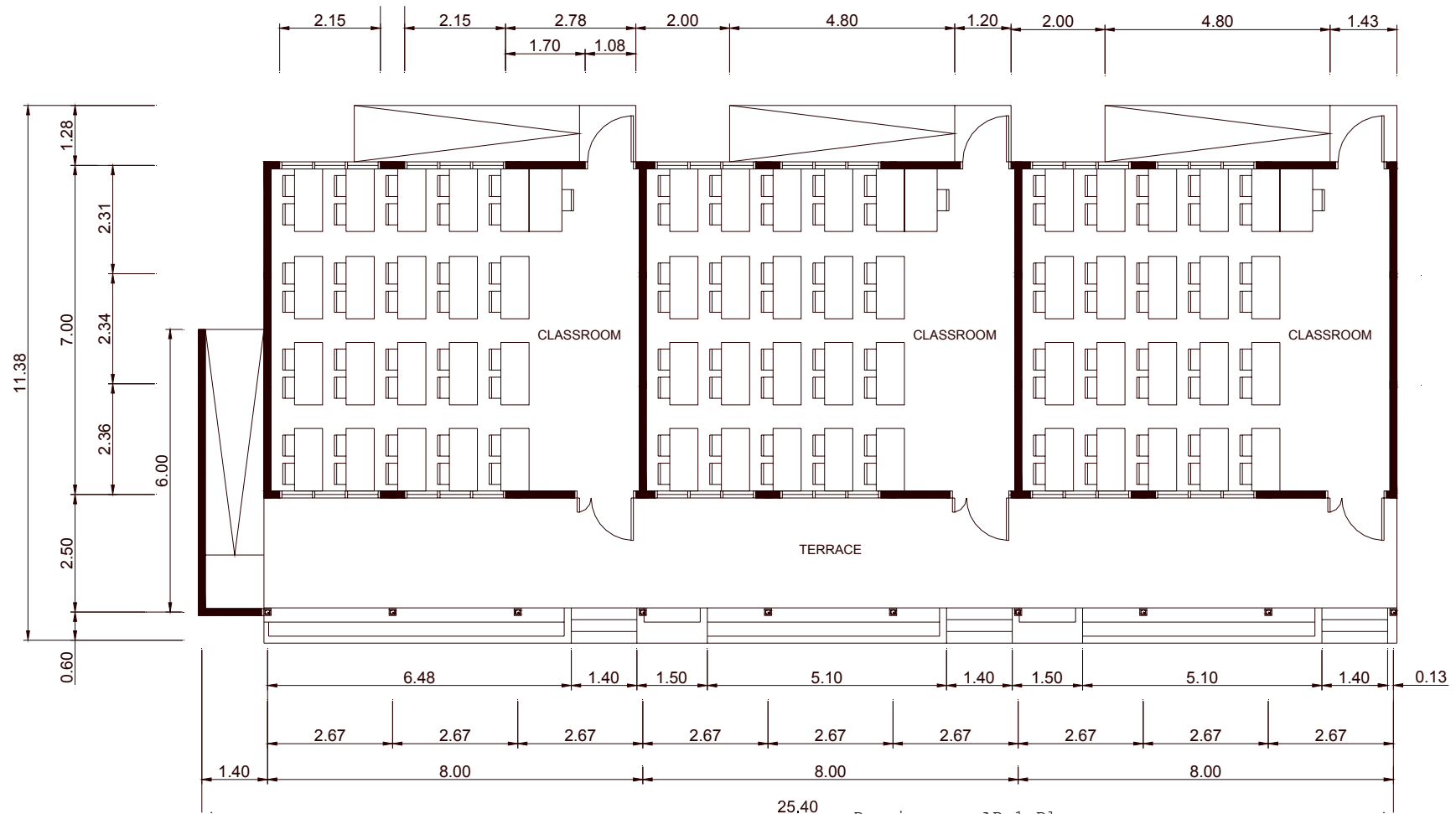
4.1 Architectural Drawings

Note:

All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

All dimensions presented must be followed



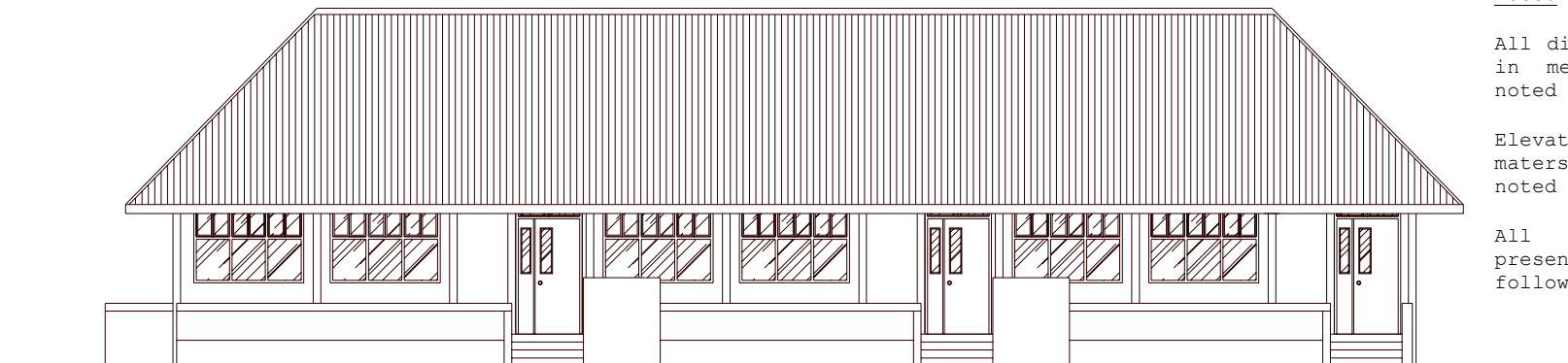
Drawing no. AR-1 Plan

Note:

All dimensions are in meters unless noted otherwise

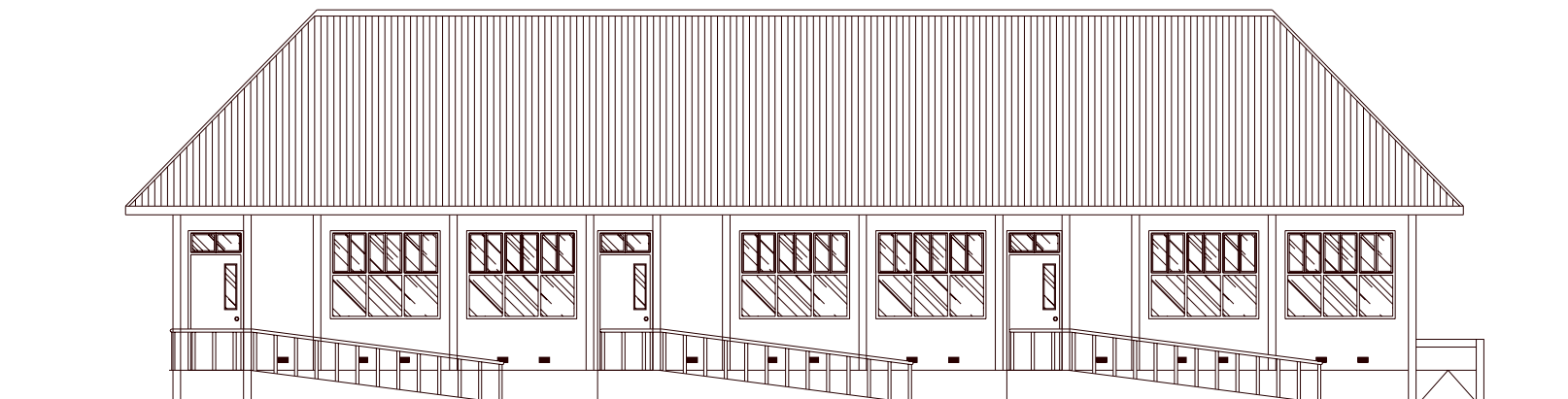
Elevations are in meters unless noted otherwise

All dimensions presented must be followed



AR VIEW

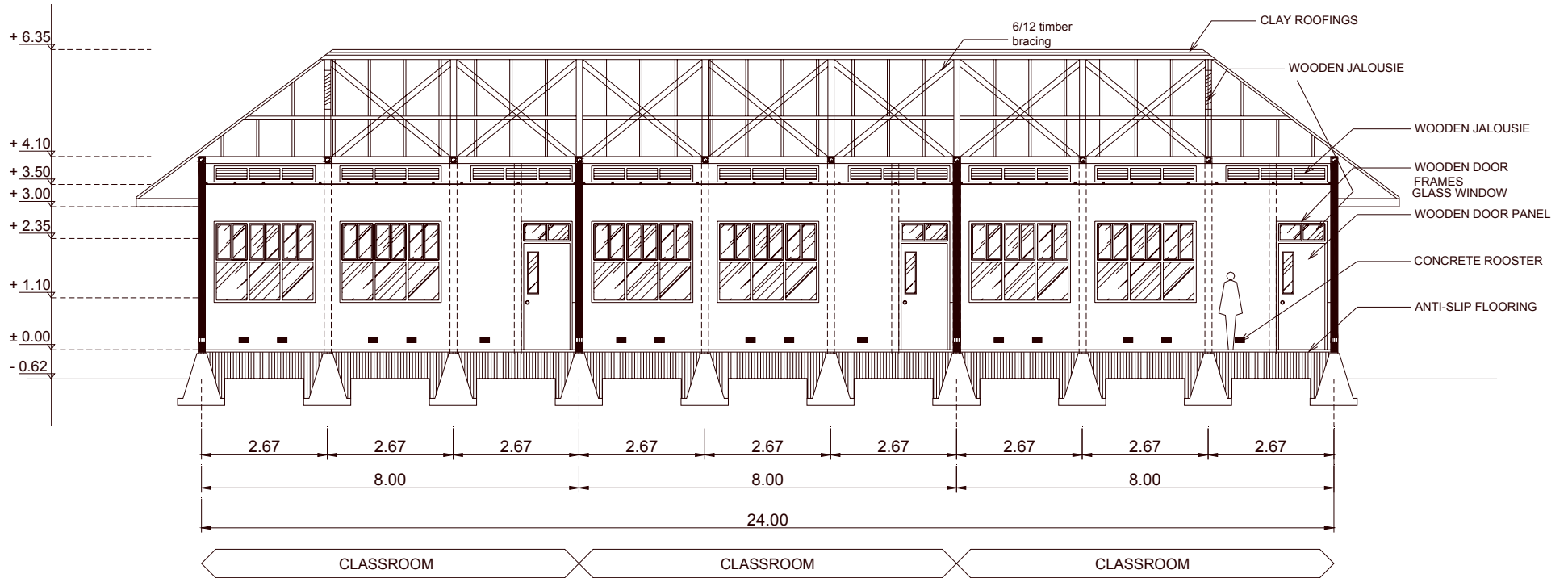
VPSCALE



AR VIEW

VPSCALE

Drawing no. AR-2 View



AR SECTION

VPSCALE

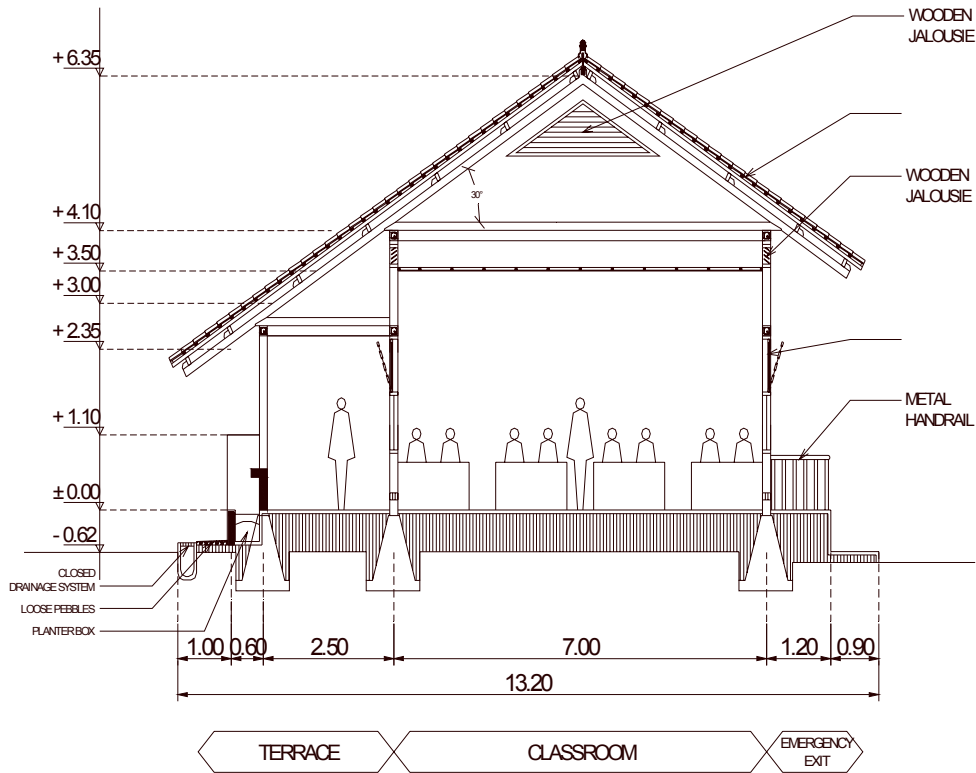
Drawing no. AR-3 Long Section

Note:

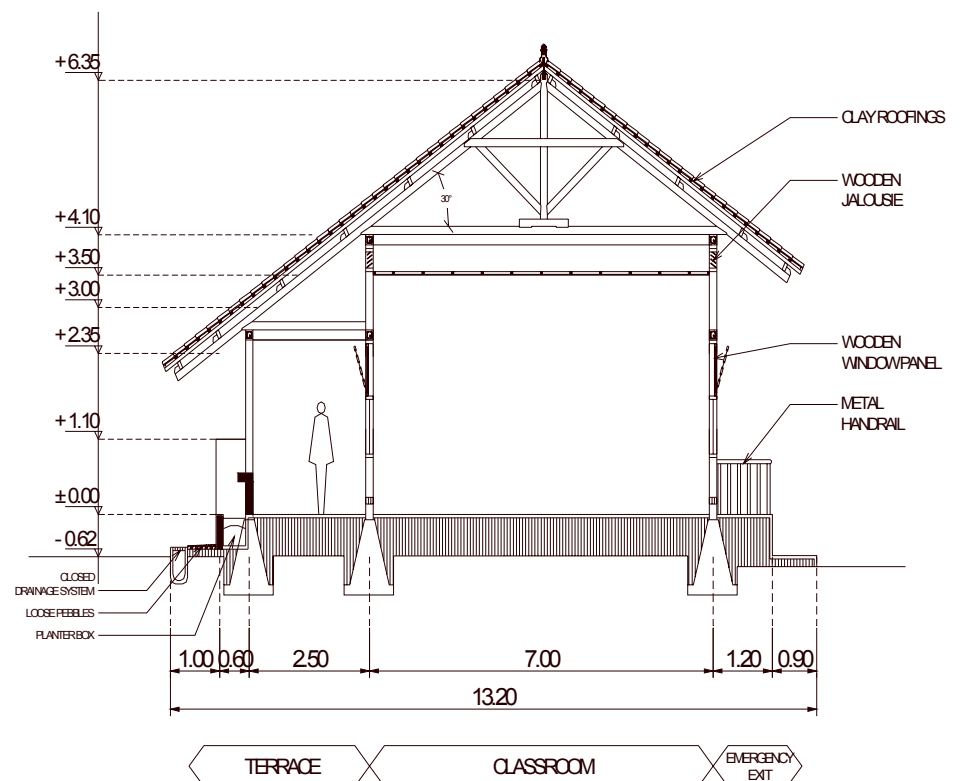
All dimensions are in meters unless noted otherwise

Elevations are in meters unless noted otherwise

All dimensions presented must be followed



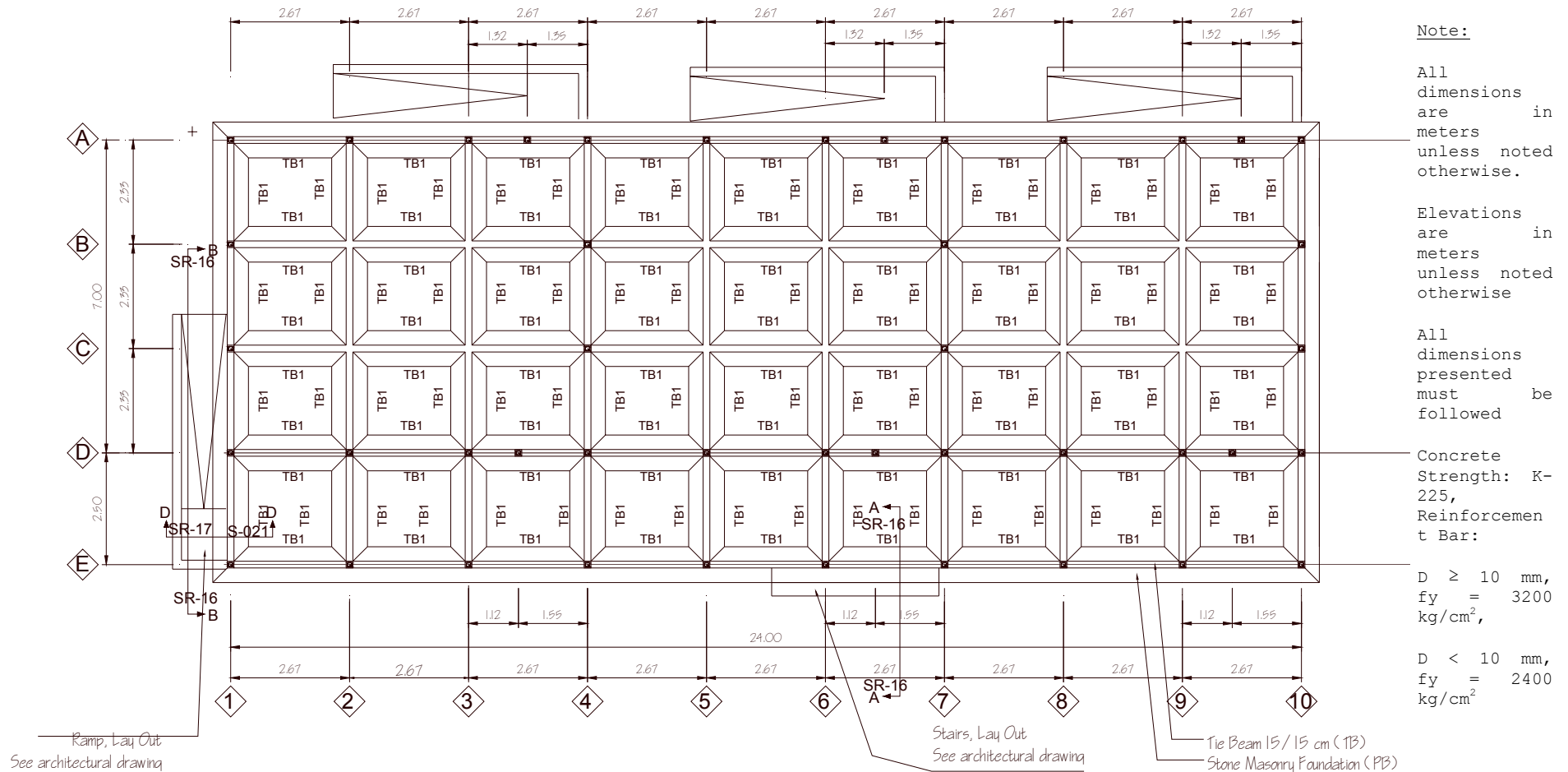
AR SECTION
VPSCALE



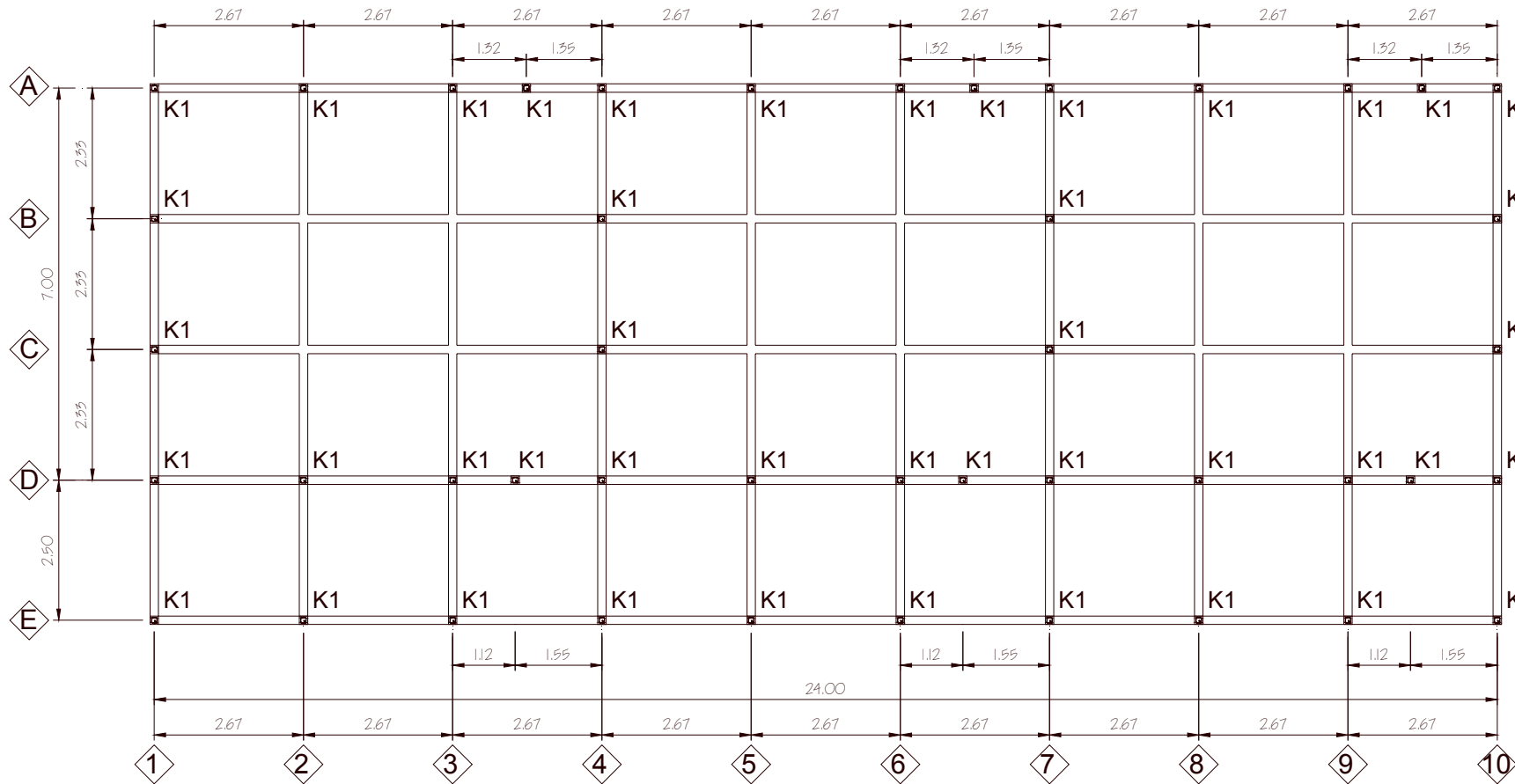
AR SECTION
VPSCALE
Note:
All dimensions are in meters unless noted otherwise
Elevations are in meters unless noted otherwise
All dimensions presented must be followed

Drawing no. AR-4 Cross Section

4.2 Structural Drawings



Drawing no. SR-1 Foundation Plan



Note:

All dimensions are in meters unless noted otherwise.

Elevations are in meters unless noted otherwise

All dimensions presented must be followed

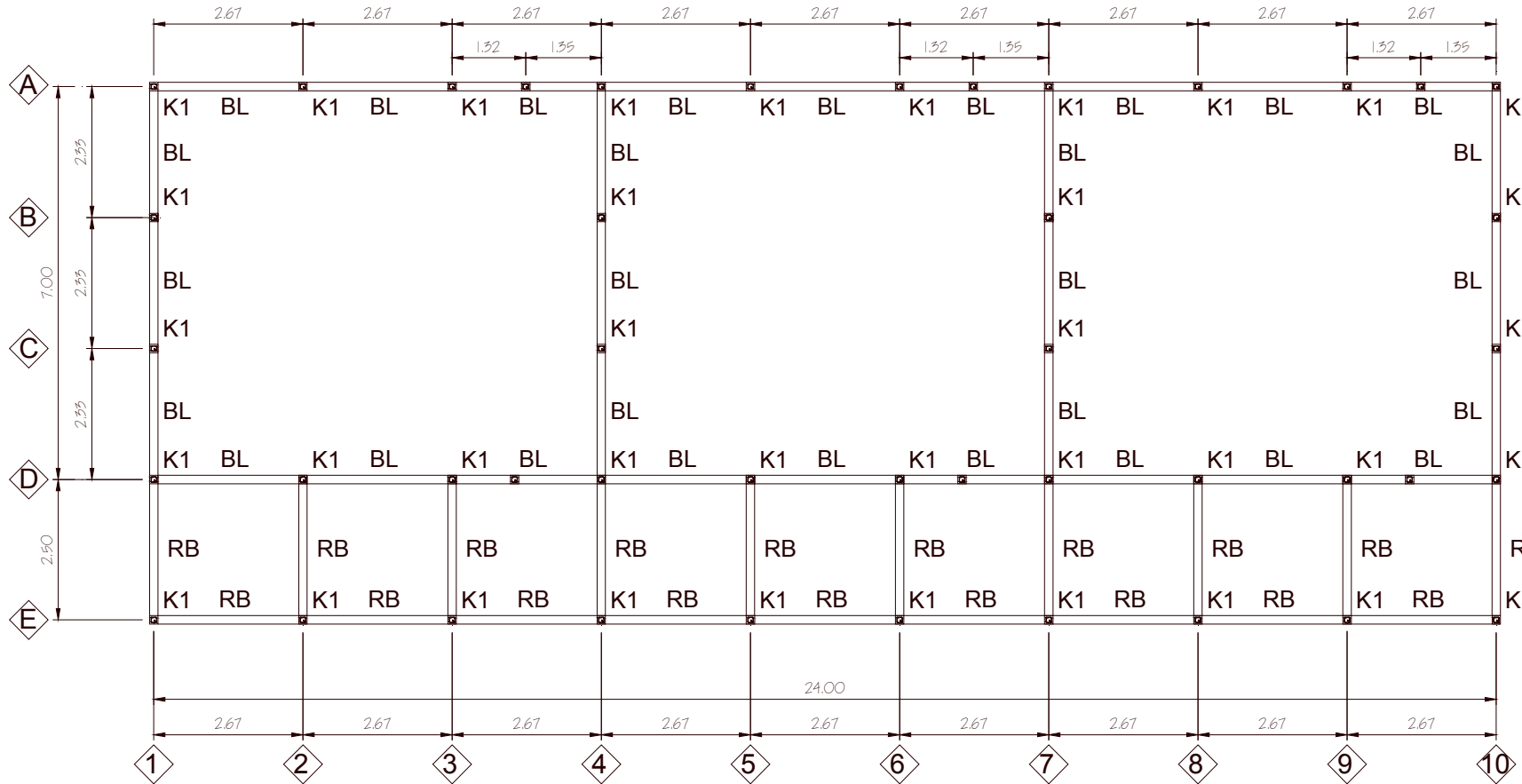
Concrete Strength: K-225,
Reinforcement Bar:

$D \geq 10 \text{ mm}$, $f_y = 3200 \text{ kg/cm}^2$,

$D < 10 \text{ mm}$, $f_y = 2400 \text{ kg/cm}^2$

2 Practical Column Plan (Elev. ±0.00)

Drawing no. SR-2 Practical Column



Note:

All dimensions are in meters unless noted otherwise.

Elevations are in meters unless noted otherwise

All dimensions presented must be followed

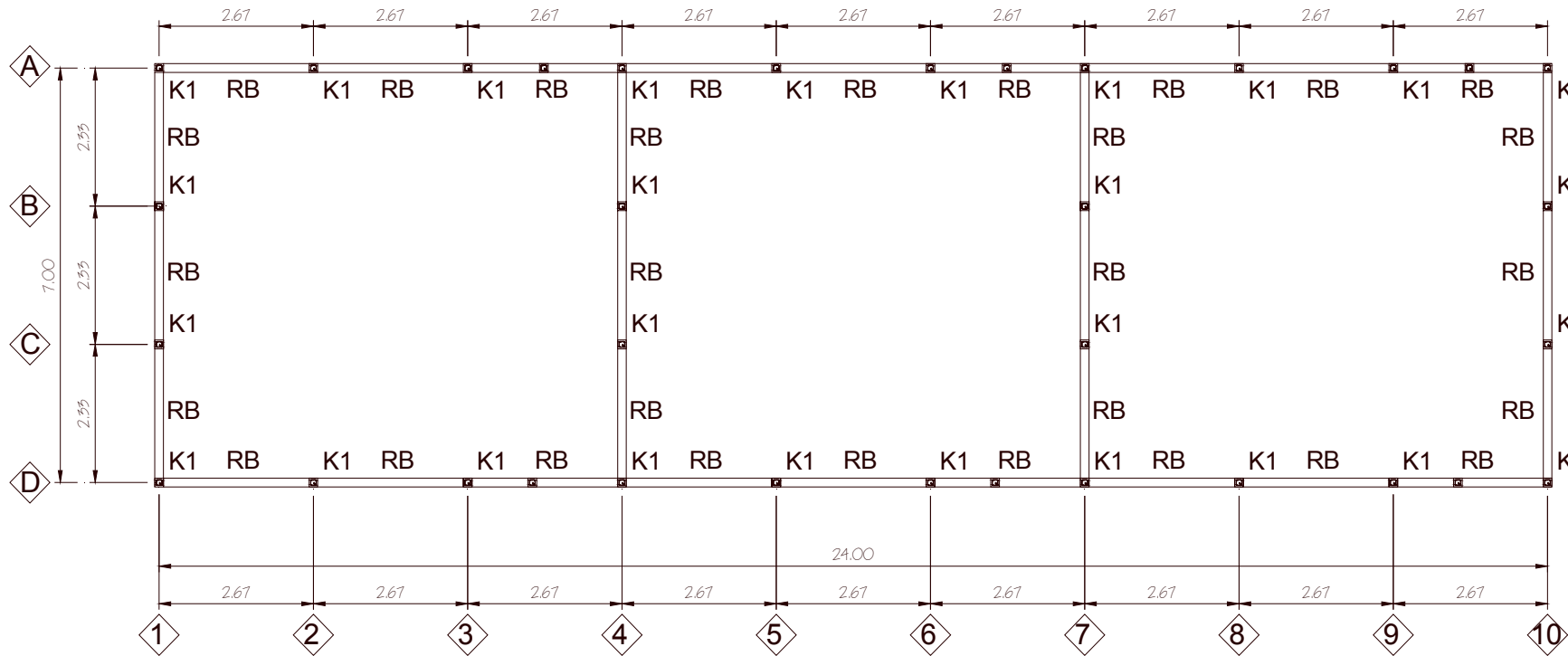
Concrete Strength: K-225,
Reinforcement Bar:

$D \geq 10 \text{ mm}, f_y = 3200 \text{ kg/cm}^2,$

$D < 10 \text{ mm}, f_y = 2400 \text{ kg/cm}^2$

3 Lintel Beam & Ring Beam Plan (Elev. +2.55)

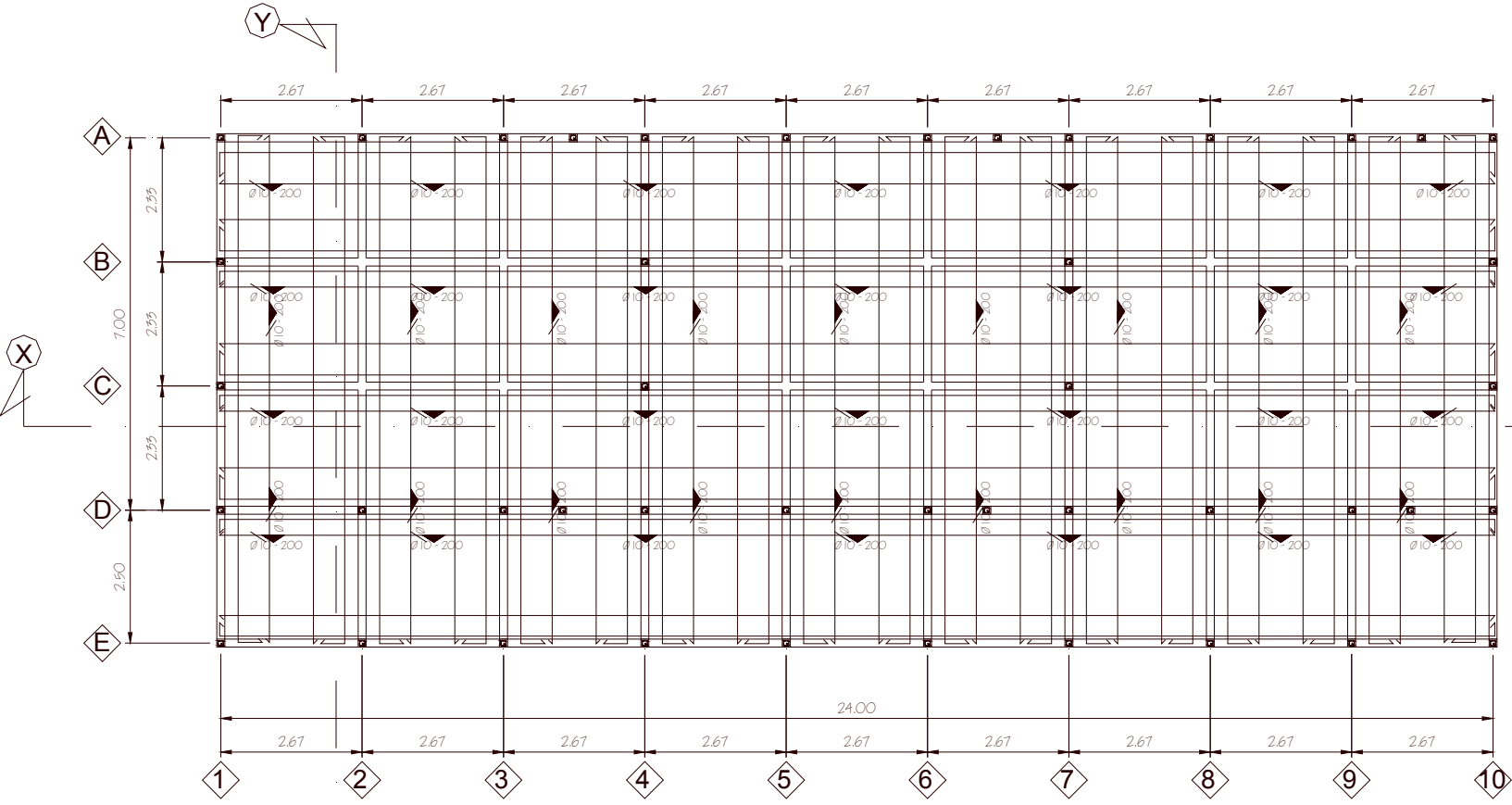
Drawing no. SR-3 Lintel Beam & Ring Beam Plan



Note:
 All dimensions are in meters unless noted otherwise.
 Elevations are in meters unless noted otherwise.
 All dimensions presented must be followed.
 Concrete Strength: K-225,
 Reinforcement Bar:
 $D \geq 10 \text{ mm}, f_y = 3200 \text{ kg/cm}^2,$
 $D < 10 \text{ mm}, f_y = 2400 \text{ kg/cm}^2$

4 Ring Beam Plan (Elev. +3.71)

Drawing no. SR-4 Ring Beam Plan



Note:

All dimensions are in meters unless noted otherwise.

Elevations are in meters unless noted otherwise

All dimensions presented must be followed

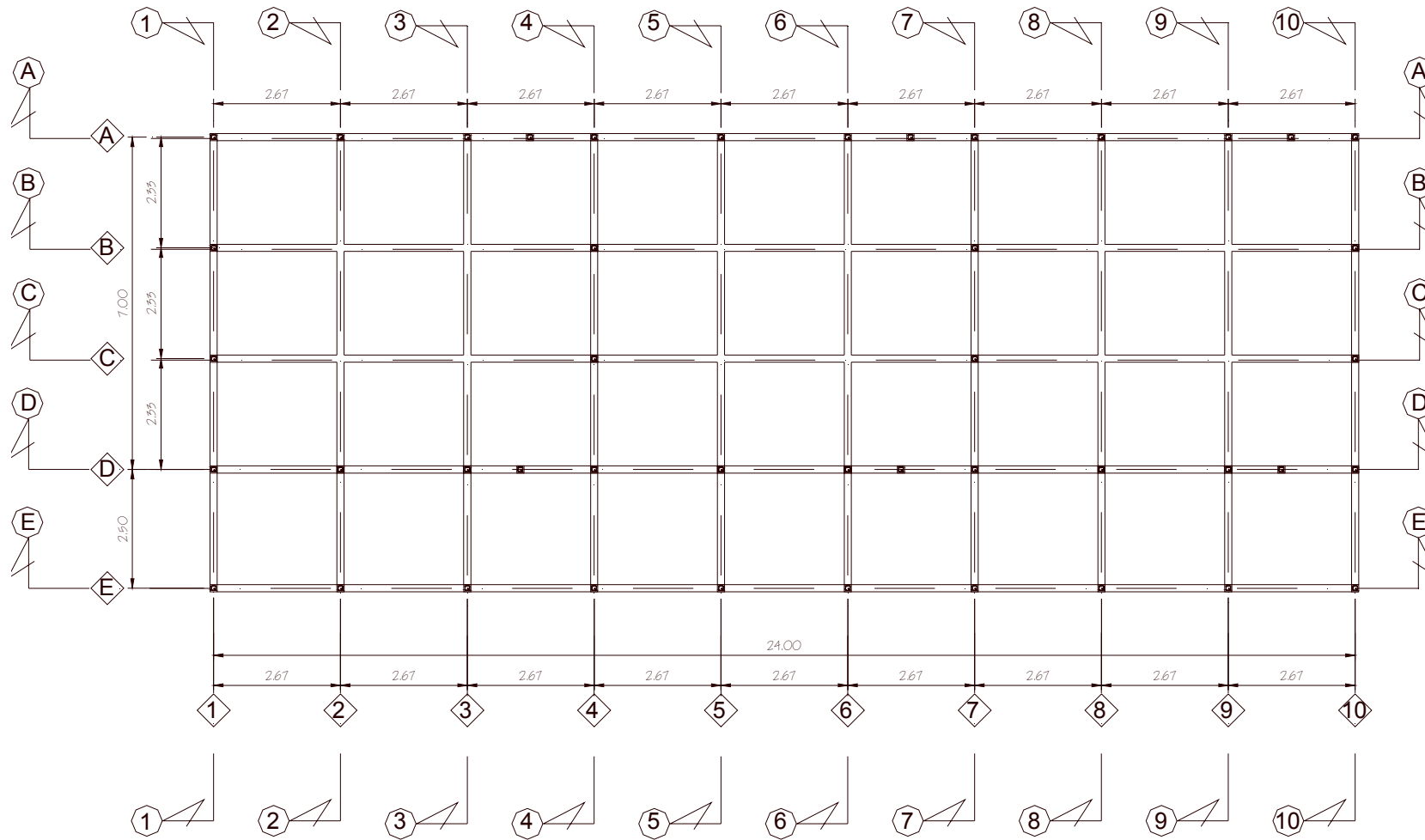
Concrete Strength: K-225, Reinforcement Bar:

$D \geq 10$ mm, $f_y = 3200$ kg/cm²,

$D < 10$ mm, $f_y = 2400$ kg/cm²

5 Slab Reinforcement (Elev. ± 0.00)

Drawing no. SR-5 Slab Reinforcement



Note:

All dimensions are in meters unless noted otherwise.

Elevations are in meters unless noted otherwise

All dimensions presented must be followed

Concrete Strength: K-225, Reinforcement Bar:

$D \geq 10 \text{ mm}$, $f_y = 3200 \text{ kg/cm}^2$,

$D < 10 \text{ mm}$, $f_y = 2400 \text{ kg/cm}^2$

6 Reinforcement Plan

Drawing no. SR-6 Reinforcement Plan

Note:

All dimensions are in meters unless noted otherwise.

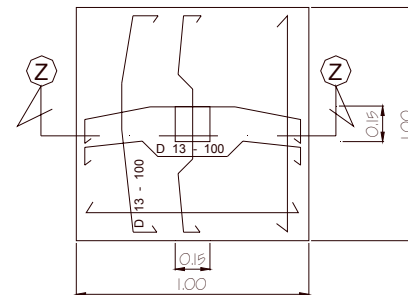
Elevations are in meters unless noted otherwise

All dimensions presented must be followed

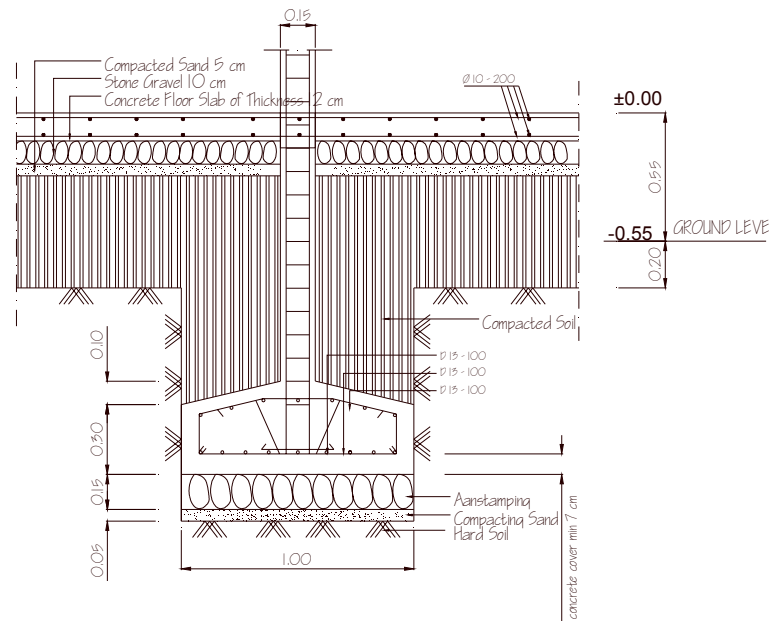
Concrete Strength: K-225, Reinforcement Bar:

$D \geq 10 \text{ mm}$, $f_y = 3200 \text{ kg/cm}^2$,

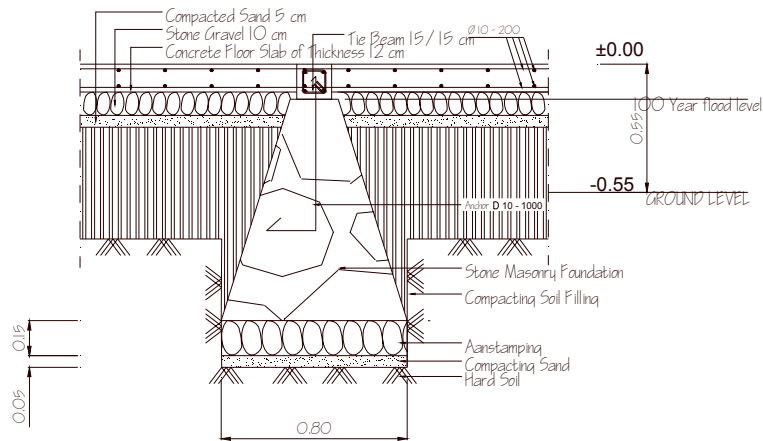
$D < 10 \text{ mm}$, $f_y = 2400 \text{ kg/cm}^2$



7 Foot Plate Foundation Plan

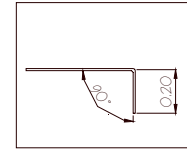
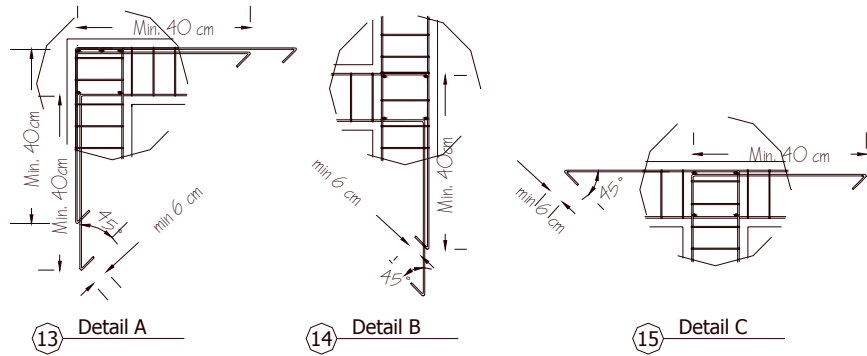


8 Local Footings (needed to meet deep hard soil level)

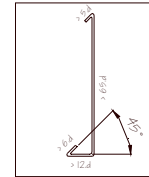


9 Stone Masonry Foundation - Detail (PB)

Drawing no. SR-7 Foundation Detail



10 Detail Wall Anchor Ø8-1000mm



11 Detail Foundation Anchor D10-1000mm

Note:

All dimensions are in meters unless noted otherwise.

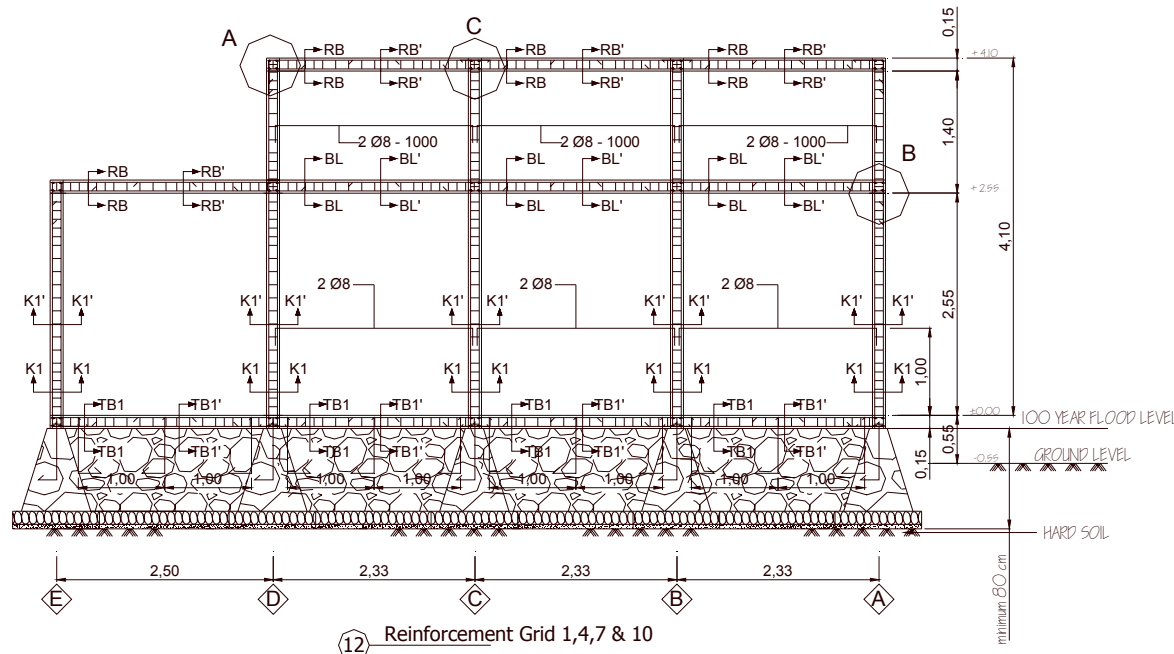
Elevations are in meters unless noted otherwise

All dimensions presented must be followed

Concrete Strength: K-225,
Reinforcement Bar:

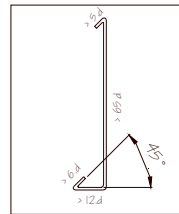
$D \geq 10 \text{ mm}$, $f_y = 3200 \text{ kg/cm}^2$,

$D < 10 \text{ mm}$, $f_y = 2400 \text{ kg/cm}^2$



12 Reinforcement Grid 1, 4, 7 & 10

Drawing no. SR8 Reinforcement Grid 1, 4, 7 & 10



16 Detail Foundation Anchor D10-1000mm

Note:

All dimensions are in meters unless noted otherwise.

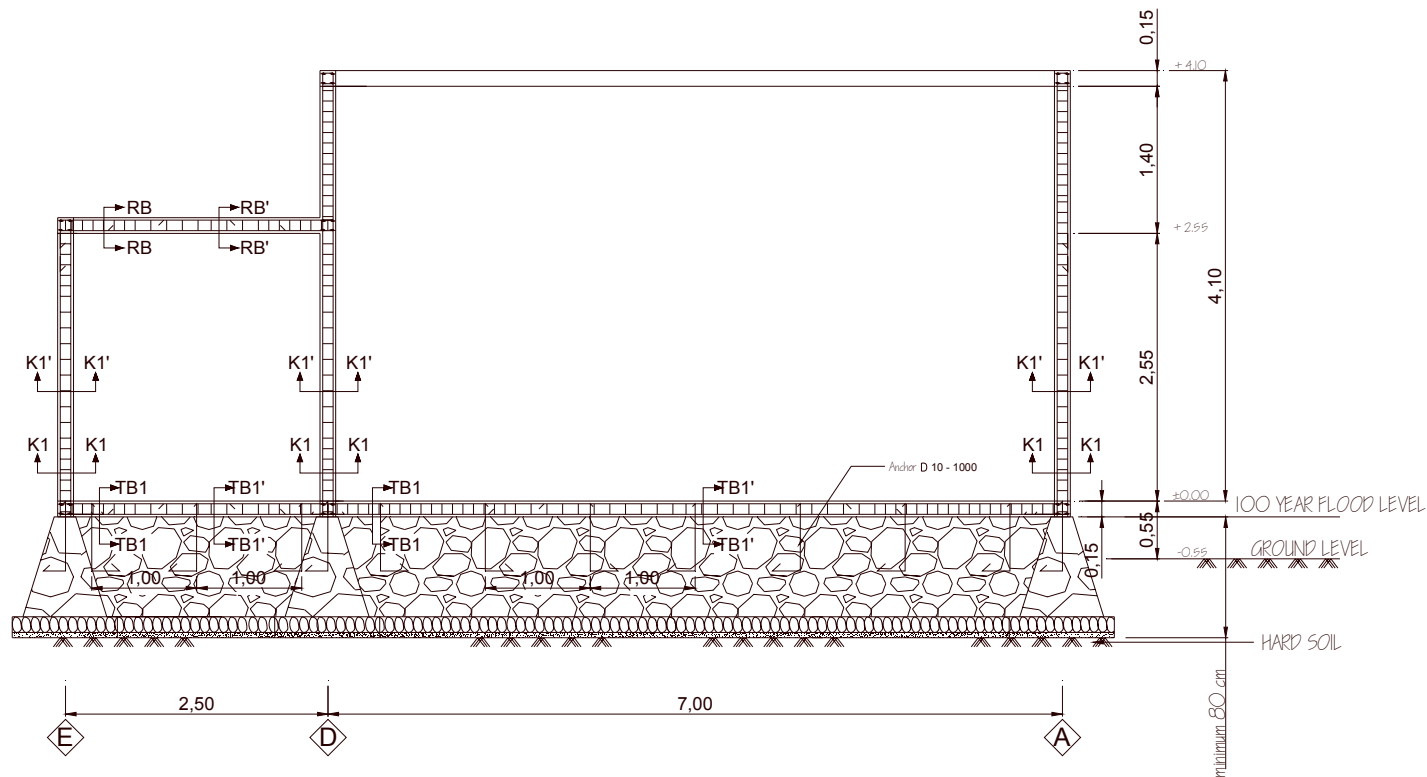
Elevations are in meters unless noted otherwise

All dimensions presented must be followed

Concrete Strength: K-225,
Reinforcement Bar:

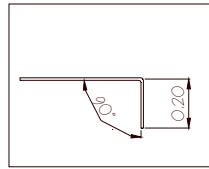
$D \geq 10 \text{ mm}, f_y = 3200 \text{ kg/cm}^2,$

$D < 10 \text{ mm}, f_y = 2400 \text{ kg/cm}^2$

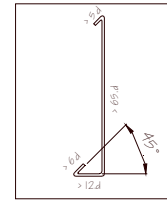


17 Reinforcement Grid 2,3,5,6,8 & 9

Drawing no. SR-9 Reinforcement Grid 2, 3, 5, 6, 8, & 9



18 Detail Wall Anchor Ø8-1000mm



19 Detail Foundation Anchor D10-1000mm

Note:

All dimensions are in meters unless noted otherwise.

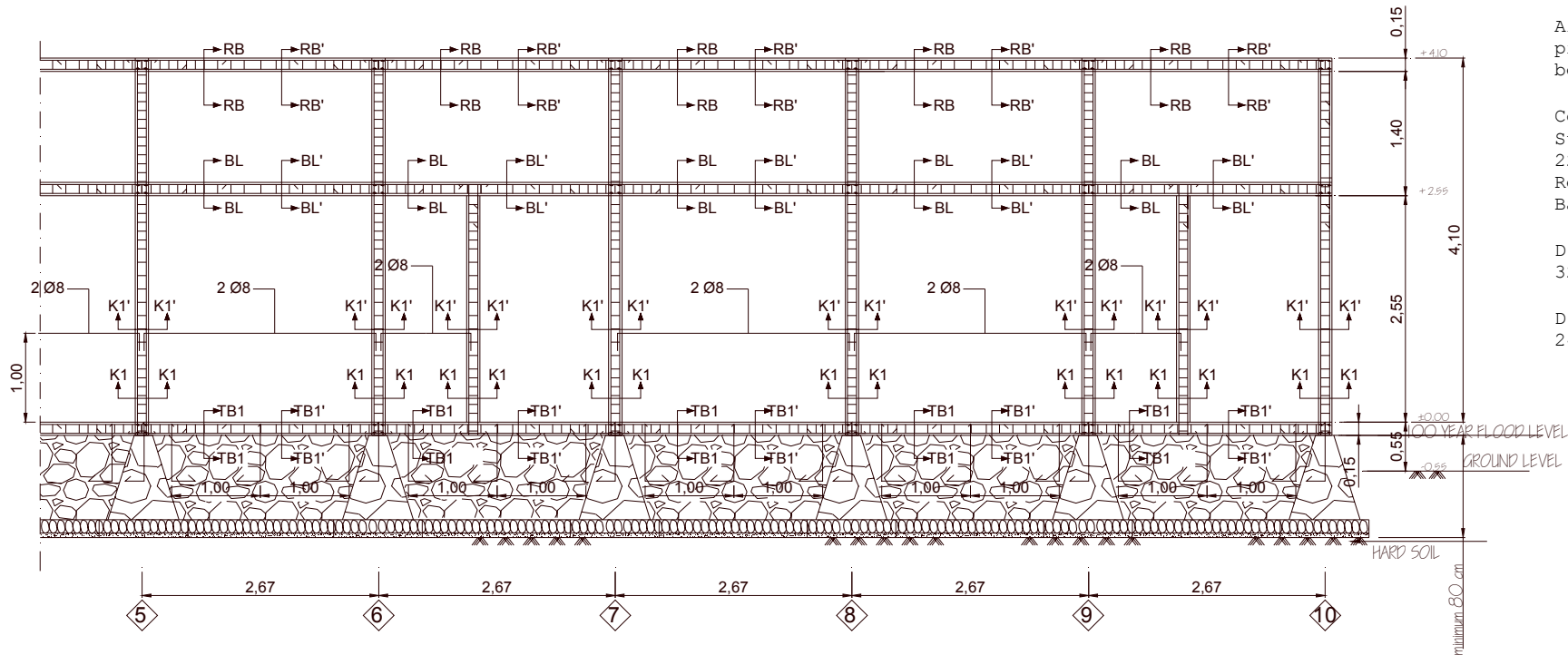
Elevations are in meters unless noted otherwise

All dimensions presented must be followed

Concrete Strength: K-225,
Reinforcement Bar:

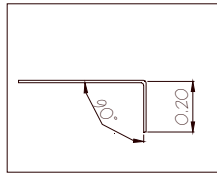
$D \geq 10 \text{ mm}, f_y = 3200 \text{ kg/cm}^2,$

$D < 10 \text{ mm}, f_y = 2400 \text{ kg/cm}^2$

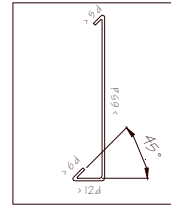


20 Reinforcement Grid A & D (Continue)

Drawing no. SR-10 Reinforcement Grid A & D (Continue)



21 Detail Wall Anchor Ø8-1000mm



22 Detail Foundation Anchor D10-1000mm

Note:

All dimensions are in meters unless noted otherwise.

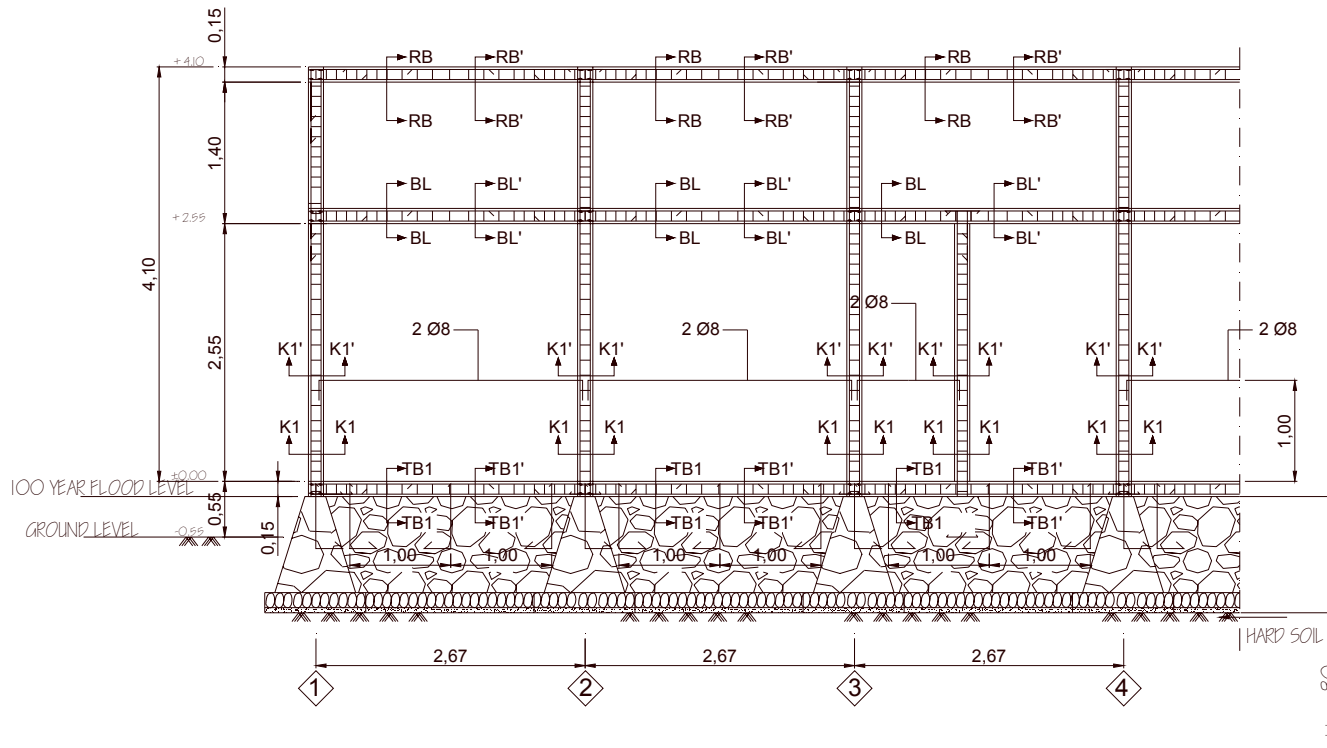
Elevations are in meters unless noted otherwise

All dimensions presented must be followed

Concrete Strength: K-225,
Reinforcement Bar:

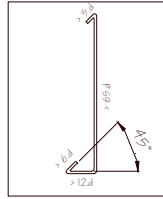
$D \geq 10 \text{ mm}$, $f_y = 3200 \text{ kg/cm}^2$,

$D < 10 \text{ mm}$, $f_y = 2400 \text{ kg/cm}^2$



23 Reinforcement Grid A & D

Drawing no. SR-11 Reinforcement Grid A & D



24 Detail Foundation Anchor D10-1000mm

Note:

All dimensions are in meters unless noted otherwise.

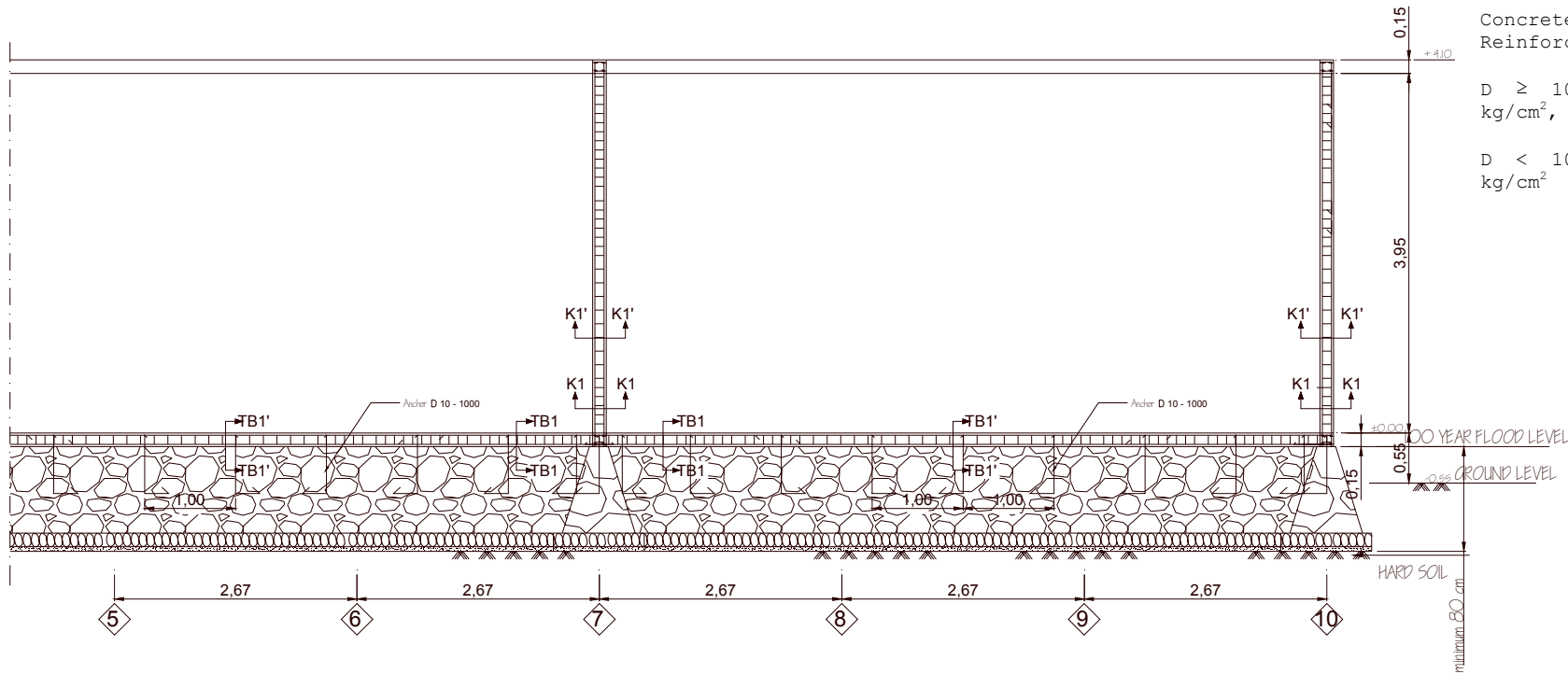
Elevations are in meters unless noted otherwise

All dimensions presented must be followed

Concrete Strength: K-225,
Reinforcement Bar:

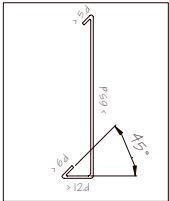
$D \geq 10 \text{ mm}$, $f_y = 3200 \text{ kg/cm}^2$,

$D < 10 \text{ mm}$, $f_y = 2400 \text{ kg/cm}^2$

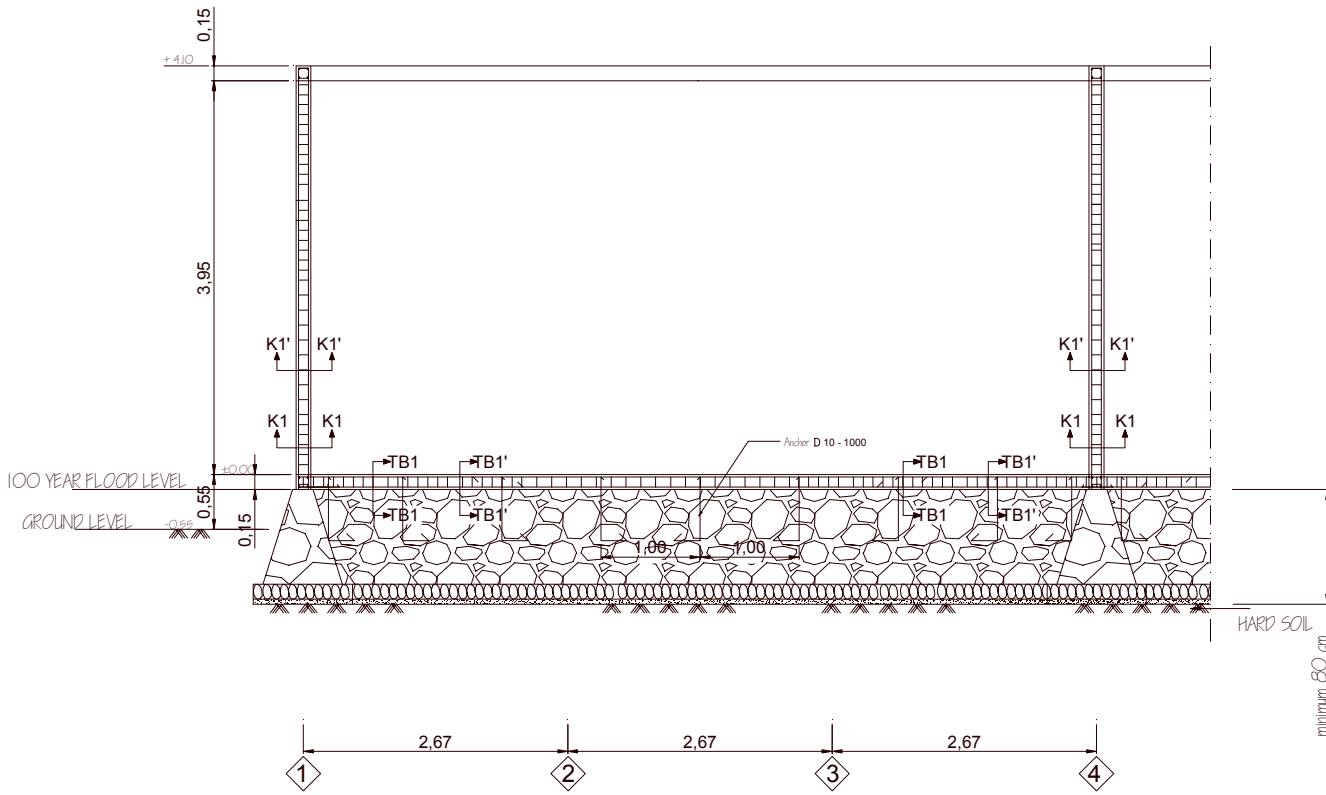


25 Reinforcement Grid B & C (Continue)

Drawing no. SR-12 Reinforcement Grid B & C (Continue)



26 Detail Foundation Anchor D10-1000mm



27 Reinforcement Grid B & C

Drawing no. SR-13 Reinforcement Grid B & C

Note:

All dimensions are in meters unless noted otherwise.

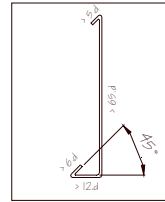
Elevations are in meters unless noted otherwise

All dimensions presented must be followed

Concrete Strength: K-225,
Reinforcement Bar:

$D \geq 10 \text{ mm}, f_y = 3200 \text{ kg/cm}^2,$

$D < 10 \text{ mm}, f_y = 2400 \text{ kg/cm}^2$



Note:

All dimensions are in meters unless noted otherwise.

Elevations are in meters unless noted otherwise

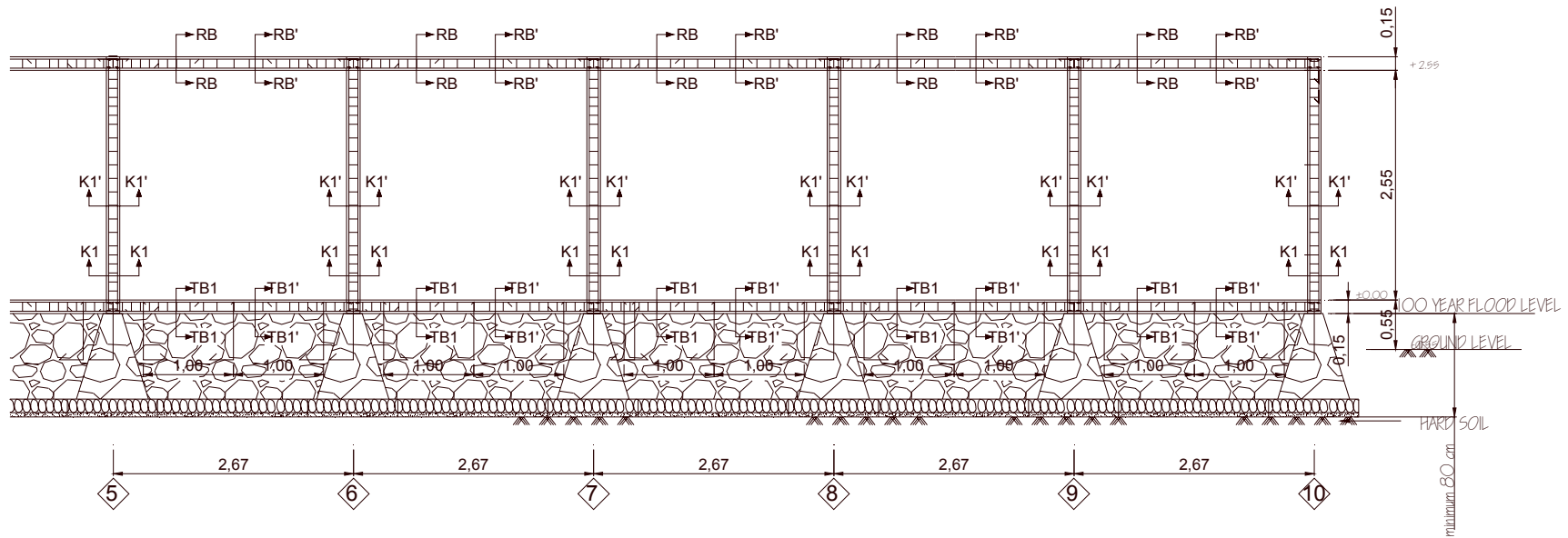
All dimensions presented must be followed

Concrete Strength: K-225, Reinforcement Bar:

$D \geq 10 \text{ mm}$, $f_y = 3200 \text{ kg/cm}^2$,

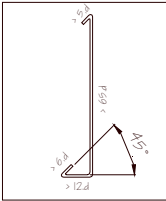
$D < 10 \text{ mm}$, $f_y = 2400 \text{ kg/cm}^2$

28 Detail Foundation Anchor D10-1000mm



29 Reinforcement Grid E (Continue)

Drawing no. SR-14 Reinforcement Grid E(Continue)



30 Detail Foundation Anchor D10-1000mm

Note:

All dimensions are in meters unless noted otherwise.

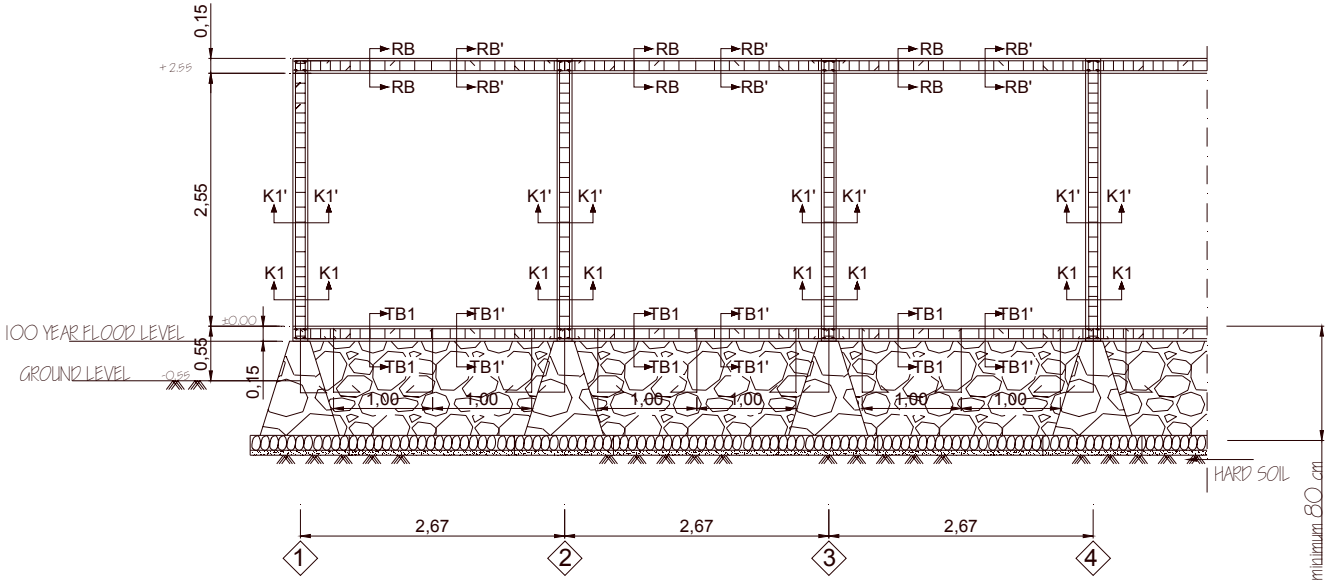
Elevations are in meters unless noted otherwise

All dimensions presented must be followed

Concrete Strength: K-225,
Reinforcement Bar:

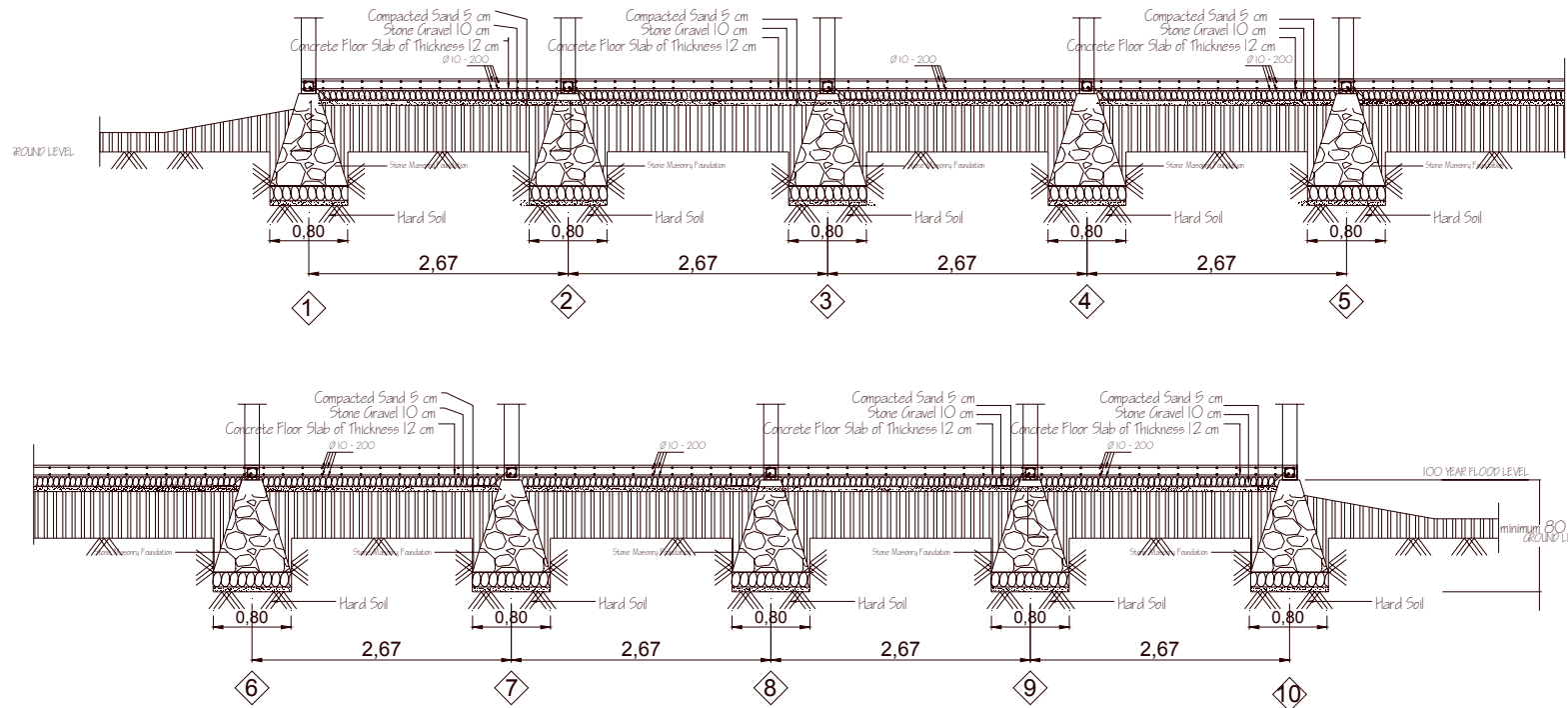
$D \geq 10 \text{ mm}, f_y = 3200 \text{ kg/cm}^2,$

$D < 10 \text{ mm}, f_y = 2400 \text{ kg/cm}^2$



31 Reinforcement Grid E

Drawing no. SR-15 Reinforcement Grid E



Note:

All dimensions are in meters unless noted otherwise.

Elevations are in meters unless noted otherwise

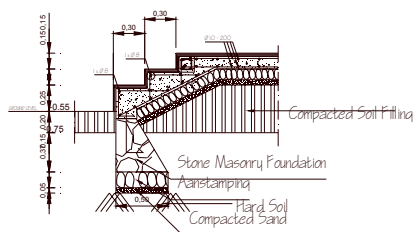
All dimensions presented must be followed

Concrete Strength: K-225, Reinforcement Bar:

$D \geq 10 \text{ mm}$, $f_y = 3200 \text{ kg/cm}^2$,

$D < 10 \text{ mm}$, $f_y = 2400 \text{ kg/cm}^2$

32 Floor Reinforcement Section X-X (Elev. -0.03)

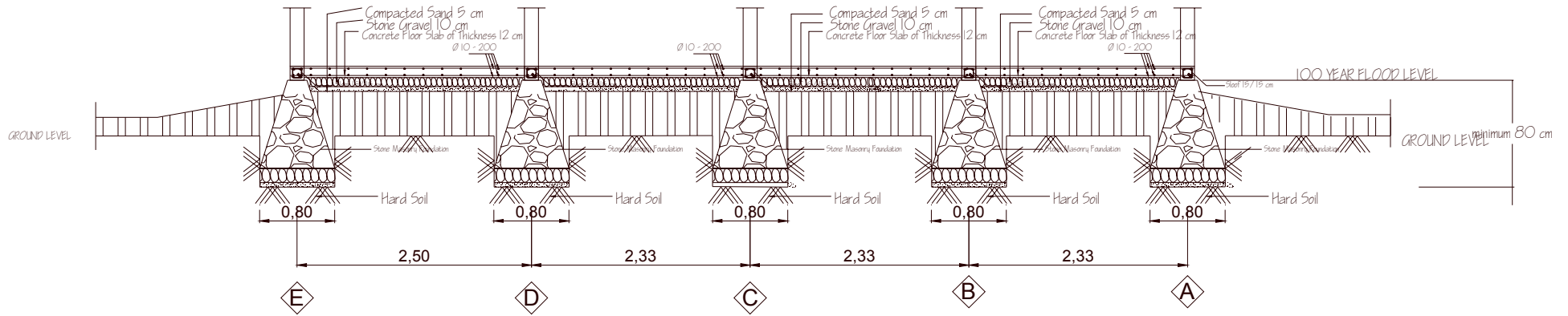


33 Stairs Detail (Section A-A from SR-1)



34 Ramp Detail (Section B-B from SR-1)

Drawing no. SR-16 Floor Reinforcement Section X-X



36 Floor Reinforcement Section Y-Y (Elev. - 0.03)

Note:

All dimensions are in meters unless noted otherwise.

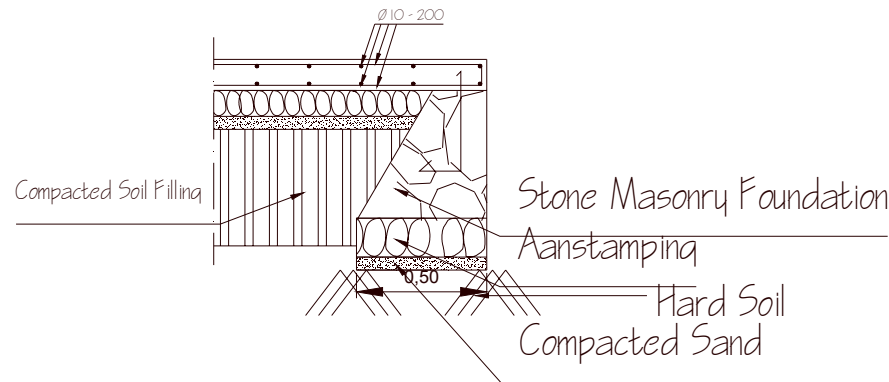
Elevations are in meters unless noted otherwise

All dimensions presented must be followed

Concrete Strength: K-225,
Reinforcement Bar:

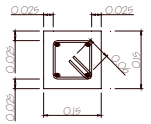
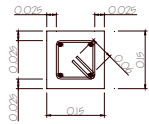
$D \geq 10 \text{ mm}$, $f_y = 3200 \text{ kg/cm}^2$,

$D < 10 \text{ mm}$, $f_y = 2400 \text{ kg/cm}^2$

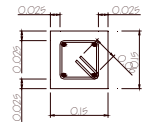
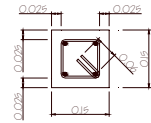


Drawing no.SR-17 Floor Reinforcement Section Y-Y

LIST OF TIE BEAM

NOTATION	TB1	TB1'
POSITION	END	MID
SECTION		
B x D	15 x 15 cm	
TOP BAR	2 D 10 mm	2 D 10 mm
BOTTOM BAR	2 D 10 mm	2 D 10 mm
STRIRRUP	Ø 8 - 100 mm	Ø 8 - 150 mm
WEB BAR		
NOTE		

LIST OF RING BEAM

NOTATION	RB	RB'
POSITION	END	MID
SECTION		
B x D	15 x 15 cm	
TOP BAR	2 D 10 mm	2 D 10 mm
BOTTOM BAR	2 D 10 mm	2 D 10 mm
STRIRRUP	Ø 8 - 100 mm	Ø 8 - 150 mm
WEB BAR		
NOTE		

Note:

All dimensions are in meters unless noted otherwise.

Elevations are in meters unless noted otherwise

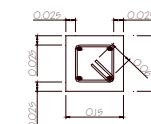
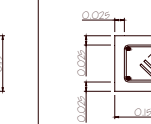
All dimensions presented must be followed

Concrete Strength: K-225,
Reinforcement Bar:

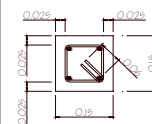
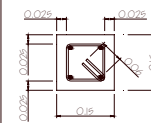
D ≥ 10 mm, $f_y = 3200 \text{ kg/cm}^2$,

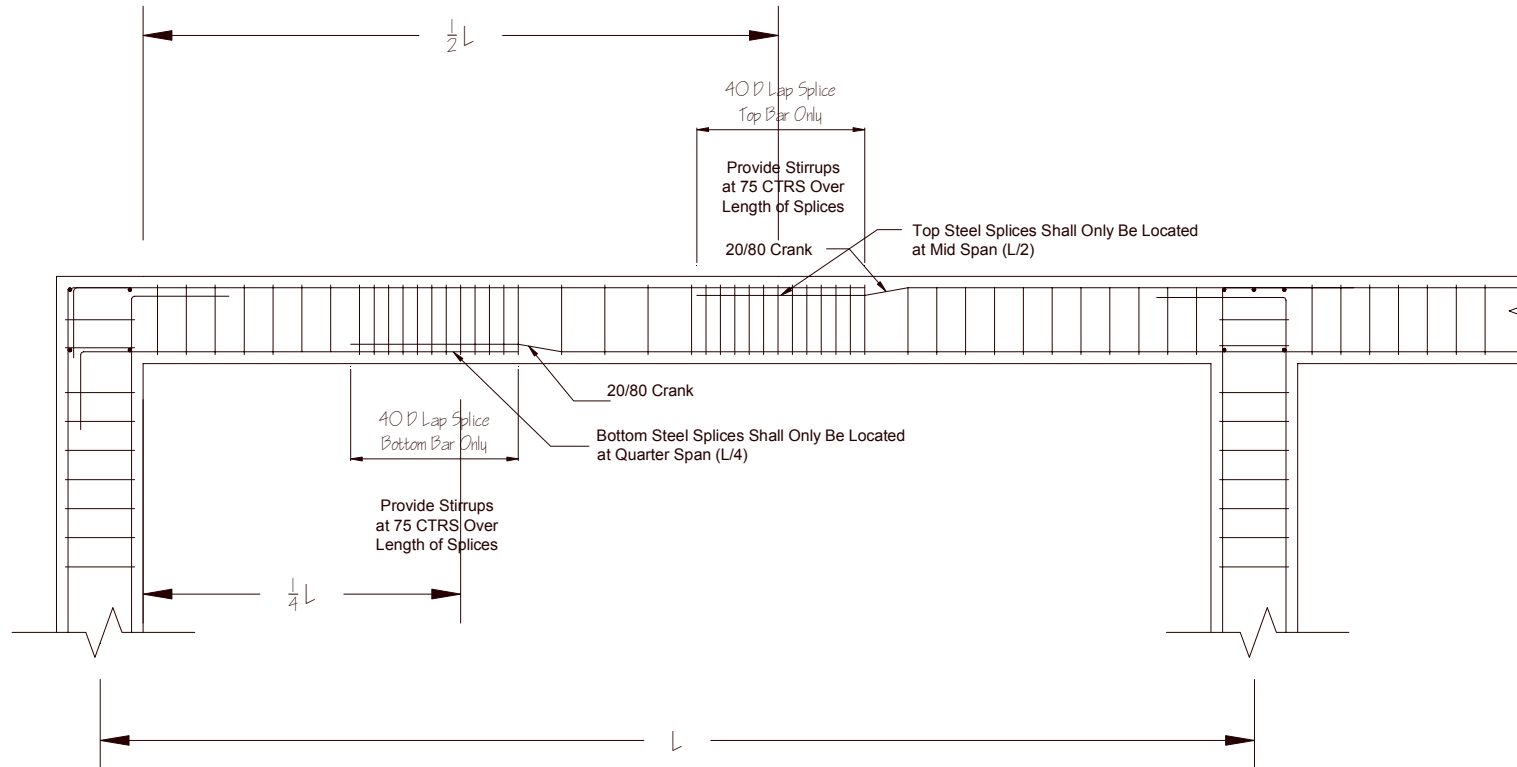
D < 10 mm, $f_y = 2400 \text{ kg/cm}^2$

LIST OF PRACTICAL COLUMN

NOTATION	K1	K1'
POSITION	END	MID
SECTION		
B x D	15 x 15 cm	
MAIN BAR	4 D 10 mm	4 D 10 mm
STRIRRUP	Ø 8 - 100 mm	Ø 8 - 150 mm
NOTE		

LIST OF LINTEL BEAM

NOTATION	BL	BL'
POSITION	END	MID
SECTION		
B x D	15 x 15 cm	
TOP BAR	2 D 10 mm	2 D 10 mm
BOTTOM BAR	2 D 10 mm	2 D 10 mm
STRIRRUP	Ø 8 - 100 mm	Ø 8 - 150 mm
WEB BAR		
NOTE		



Note:

All dimensions are in meters unless noted otherwise.

Elevations are in meters unless noted otherwise

All dimensions presented must be followed

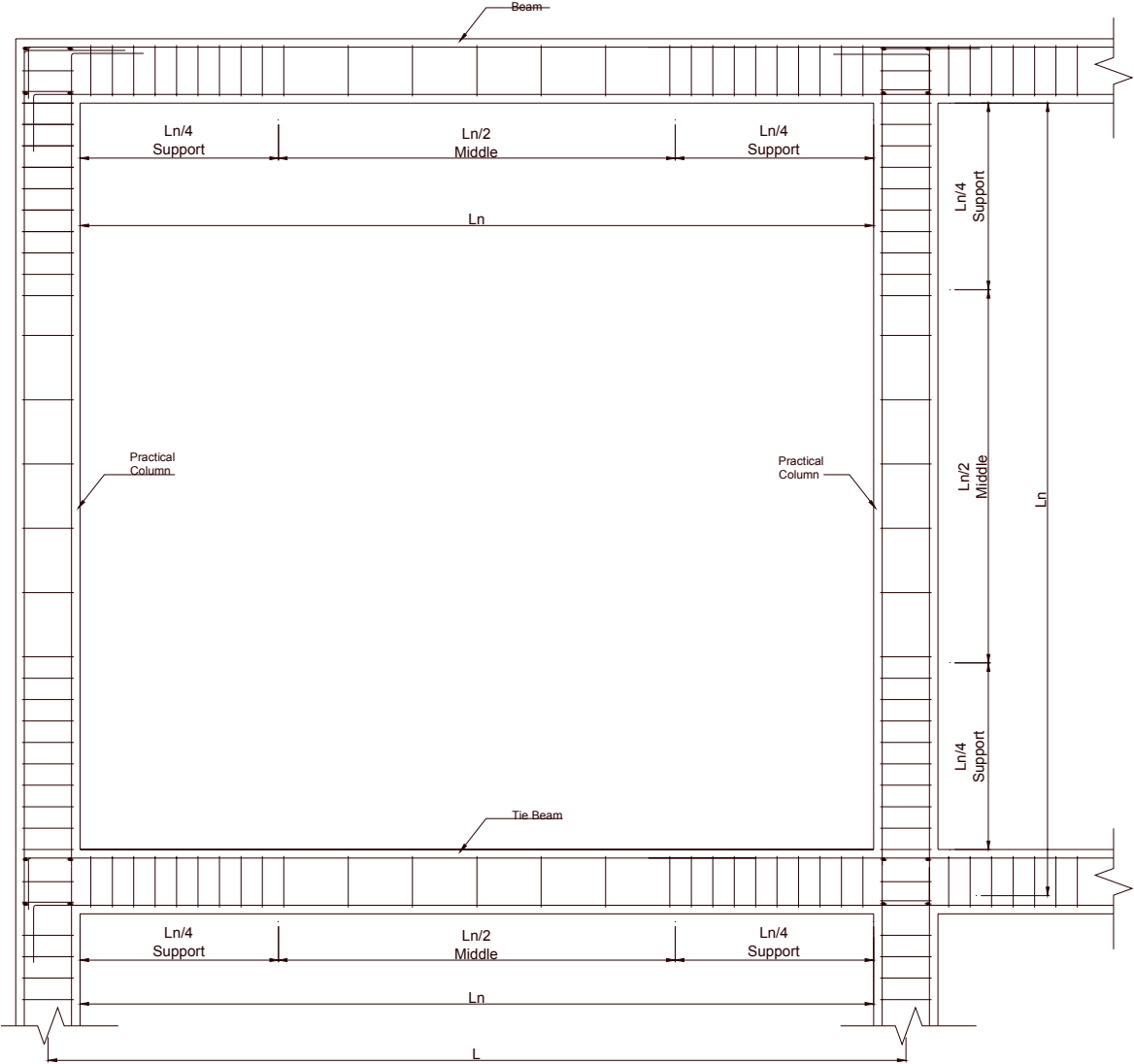
Concrete Strength: K-225, Reinforcement Bar:

$D \geq 10 \text{ mm}$, $f_y = 3200 \text{ kg/cm}^2$,

$D < 10 \text{ mm}$, $f_y = 2400 \text{ kg/cm}^2$

40 Permissible Beam Splice locations

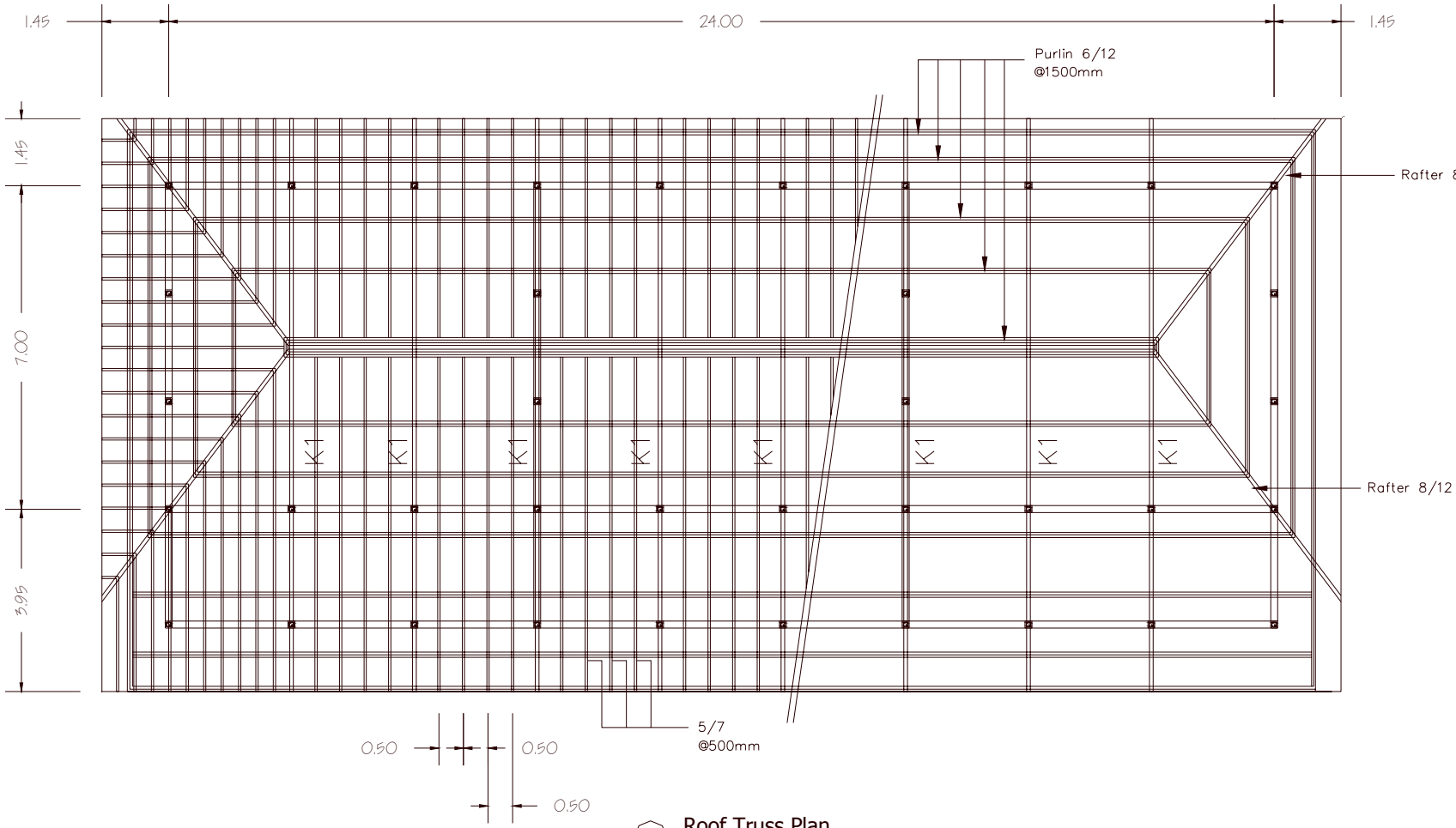
Drawing no. SR-19 Permissible Beam Splice Locations



Note:
 All dimensions are in meters unless noted otherwise.
 Elevations are in meters unless noted otherwise
 All dimensions presented must be followed
 Concrete Strength: K-225,
 Reinforcement Bar:
 $D \geq 10 \text{ mm}, f_y = 3200 \text{ kg/cm}^2,$
 $D < 10 \text{ mm}, f_y = 2400 \text{ kg/cm}^2$

41 Permissible Beam & Column Stirrup locations

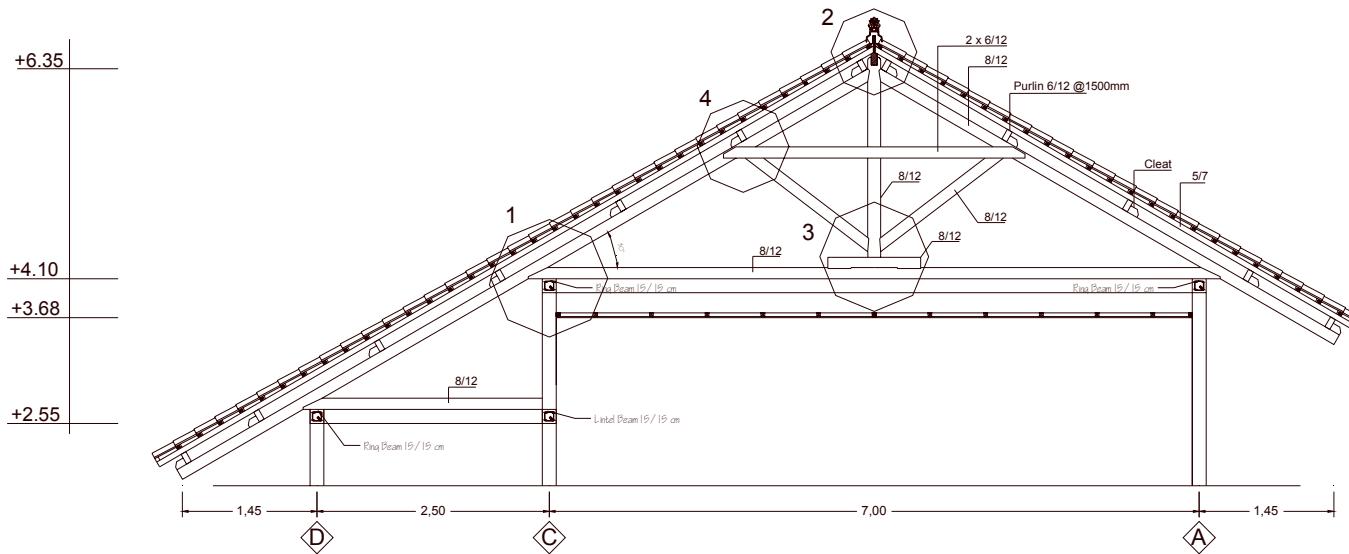
Drawing no. SR-20 Permissible Beam & Column Stirrups Locations



Note:
 All dimensions are in meters unless noted otherwise.
 Elevations are in meters unless noted otherwise.
 All dimensions presented must be followed.

49 Roof Truss Plan

Drawing no. SR-21 Roof Truss Plan



Note:

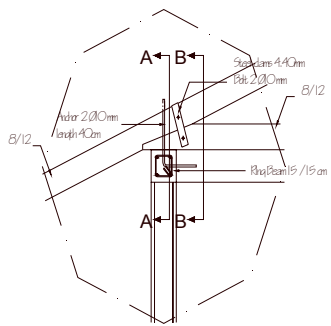
All dimensions are in meters unless noted otherwise.

Elevations are in meters unless noted otherwise

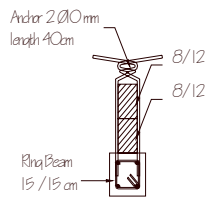
All dimensions presented must be followed

Refer to AR-3 for Roof Truss Bracing

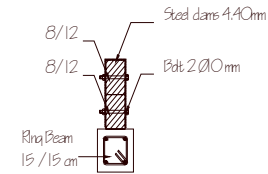
43 Roof Truss Detail - K1



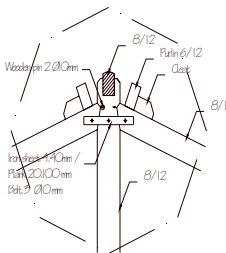
44 Section 1



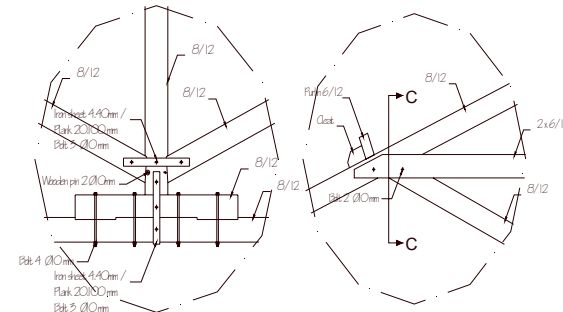
45 Section A - A



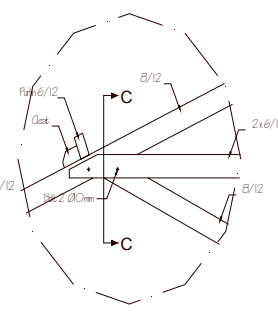
46 Section B - B



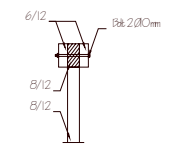
47 Section 2



48 Section 3



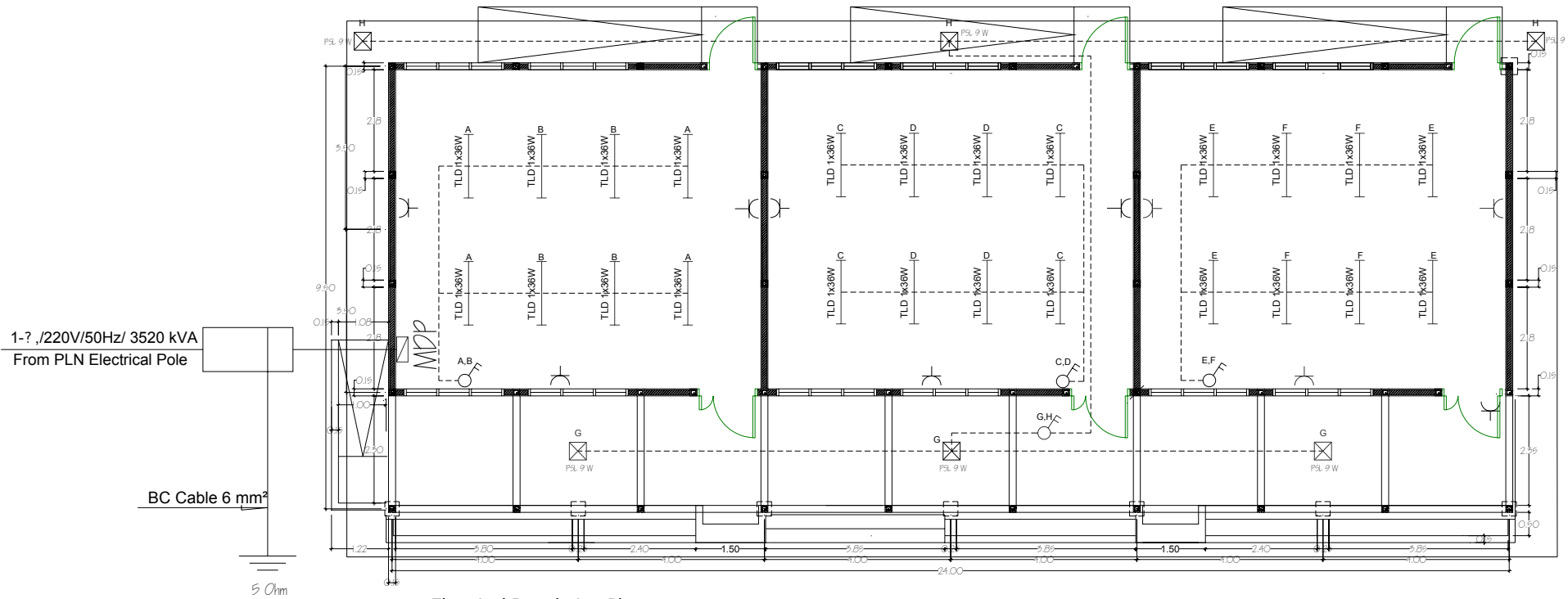
49 Section 4



50 Section C - C

Drawing no. SR-22 Roof Truss Detail








4.3 Lighting and Water Sanitation

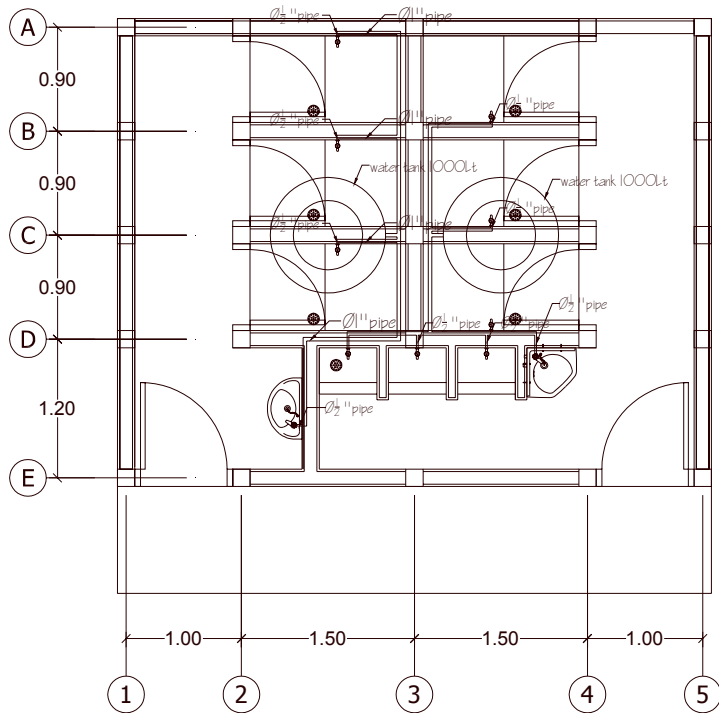


1 Electrical Instalation Plan

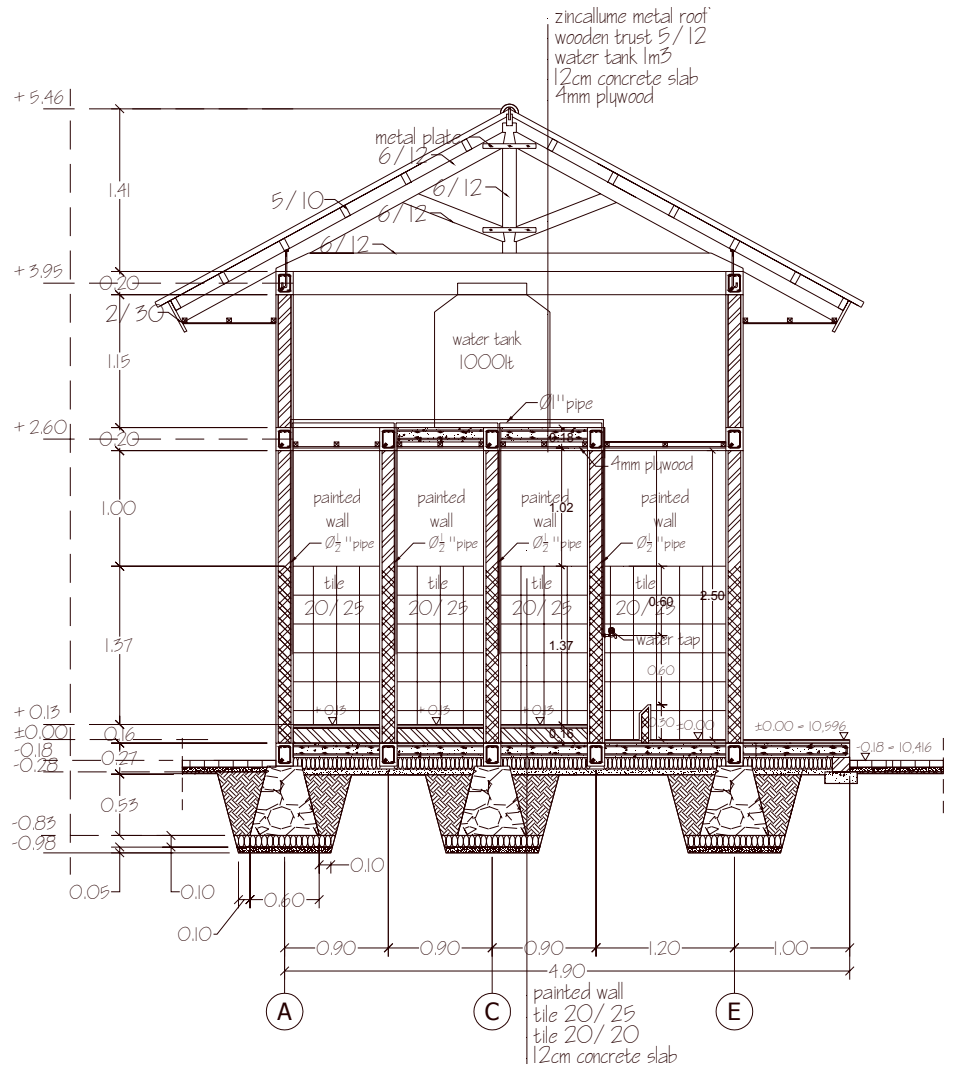
Drawing no. E-1 Electrical Plan

Note:

-  tubelamp 2x40w
-  socket
-  T dos
-  switch
-  MCB box
-  KWH meter
-  PSL 9w

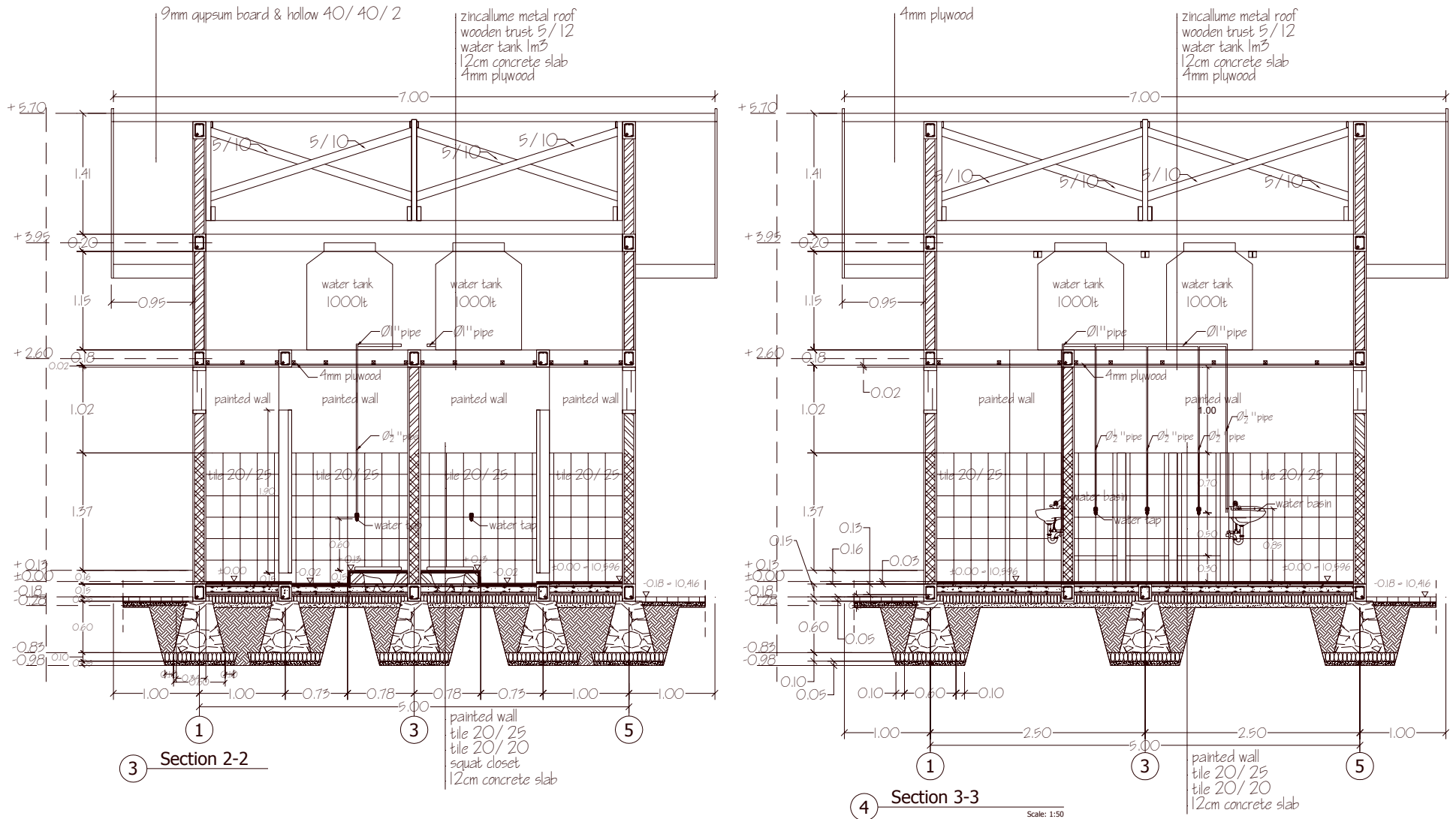


1 Ceiling Piping Plan
Scale: 1:50

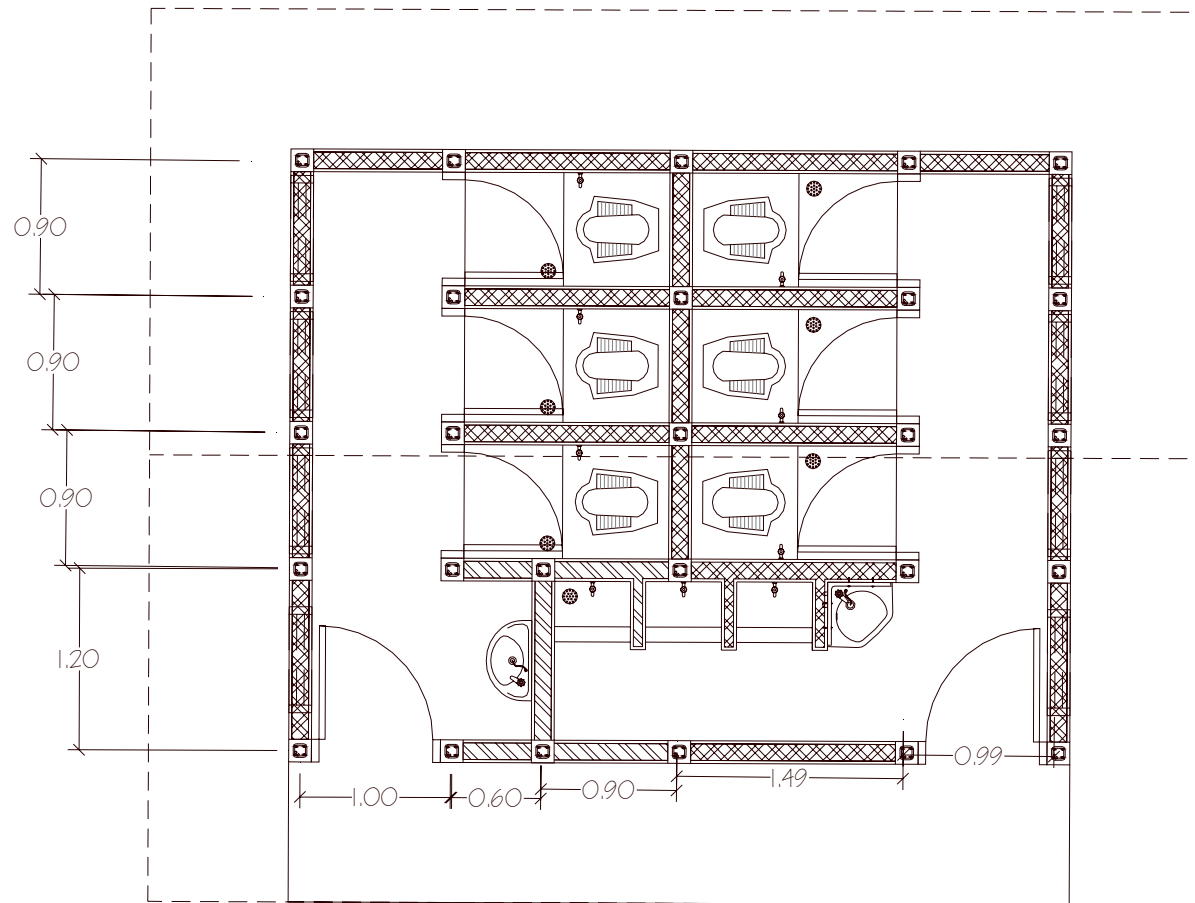


2 Section 1-1
Scale: 1:50

Drawing no. WS-1 Ceiling Piping Plan & Section 1-1



Drawing no. WS-2 Section 2-2 & Section 3-3



5 Toilet Plan

Drawing no. WS-3 Toilet Plan

4.4 Bill of Quantities

BOQ Typical 3 Classrooms School Designs

No	Items of Works	Unit	Quantities	Unit Rate	Total Amount
A	Substructure works				
A.1	Excavation works:				
a	Class room and terrace	m3	148.35		
b	Stair	m3	1.89		
c	Ramp	m3	13.06		
A.2	Compacted fill works:				
d	Class room and terrace	m3	119.44		
e	Stair	m3	0.58		
f	Ramp	m3	13.80		
A.3	Sand bed 50 mm consolidated thickness under floor				
g	Class room and terrace	m3	9.87		
h	Stair	m3	0.21		
i	Ramp	m3	1.75		
A.4	Compacted gravel t =100 mm under floor for leveling				
j	Class room and terrace	m3	23.98		
k	Stair	m3	0.25		
l	Ramp	m3	3.36		
B	Foundation Works				
B.1	Aanstamping+ sand t = 150 mm masonry erection under foundation				
a	Classroom	m3	18.48		
b	Verandah, water station & parapets	m3	11.32		
c	Stair	m3	1.01		
d	Ramp	m3	1.34		
B.2	Stone masonry foundation to:				
e	Classroom	m3	84.70		

f	Verandah, water station & parapets	m3	39.39		
g	Stair	m3	3.36		
h	Ramp	m3	1.96		
C	Anchorage				
a	Anchorage between tie beams and foundation Φ 10-1000, Classroom	kg	201.17		
b	Anchorage between tie beams and foundation Φ 10-1000, Verandah	kg	44.63		
c	Anchorage between tie beams and foundation Φ 10-1000, Stair	kg	7.99		
d	Anchorage between tie beams and foundation Φ 10-1000, Ramp	kg	10.66		
e	Anchorage between column and brick 2 Φ 8, classroom	kg	85.47		
D	Vibrated reinforced concrete works K-225				
D.1	Column 150/150				
a	Concrete	m3	3.95		
b	Reinforcement bar	kg	637.51		
c	formwork	m2	107.69		
D.2	Ring Beam 150/150				
d	Concrete	m3	2.81		
e	Reinforcement bar	kg	574.12		
f	formwork	m2	71.94		
D.3	Tie Beam 150/150				
g	Concrete	m3	4.84		
h	Reinforcement bar	kg	989.22		
i	formwork	m2	123.72		
D.4	Lintel Beam 150/150				
j	Concrete	m3	1.71		
k	Reinforcement bar	kg	350.63		
l	formwork	m2	43.73		
D.5	Concrete floor slab t = 120 mm				
m	Concrete	m3	27.36		
n	Reinforcement bar	kg	2,849.25		

	o	formwork	m2	8.68		
D.6	Concrete stair					
	p	Concrete	m3	0.82		
	q	Reinforcement bar	kg	37.44		
	r	formwork	m2	2.80		
D.7	Concrete ramp					
	s	Concrete	m3	4.03		
	t	Reinforcement bar	kg	411.84		
	u	formwork	m2	8.29		
D.8	Beam on parapet wall					
	v	Concrete	m3	0.54		
	w	Reinforcement bar	kg	83.93		
	x	formwork	m2	9.68		
D.9	Slab concrete t= 120 mm at water station					
	y	Concrete	m3	0.32		
	z	Reinforcement bar	kg	11.39		
	aa	formwork	m2	1.76		
E	Wall + wall finishing:					
E.1	Brickwork in cement and sand (1:4) for construct :					
	a	Class room	m2	193.11		
	b	Parapet wall and water station	m2	30.62		
E.2	Plaster to brick wall, smooth finish with cement coating to :					
	c	Class room	m2	386.21		
	d	Parapet wall and water station	m2	61.24		
E.3	Internal wall painting with apply one coat primer and two coats of approved paint to:					
	e	Class room	m2	230.44		
E.4	External wall painting with apply one coat primer and two coats of approved paint to:					
	f	Class room	m2	140.17		
	g	Parapet wall and water station	m2	88.04		

F	Floor finishing				
	Non slippery Ceramic tiles 300 mm x 300 mm, bedded and jointed in cement mortar, pointed in coloured cement as specified, including all necessary fixing accessories, laid as pattern ; all as described to the following:				
a	Class room	m2	168.00		
b	Verandah, stair and ramp	m2	71.55		
c	finishing patterns to form ramp surface	m2	26.88		
G	Door frames, window frames and jalousie				
a	door (5/7)	m3	0.16		
b	window (5/7)	m3	0.53		
c	jalousie (5/7)	m3	0.37		
d	Jalousie grid (1/7)	m3	0.17		
H	Door, windows and concrete rooster				
a	Front doors, as specified in architectural drawings	unit	3.00		
b	windows glass (650x800 mm), included the frames and hinges if needed, refer to drawings	unit	36.00		
c	window glass (270x710 mm), included the frames and hinges if needed, refer to drawings	unit	72.00		
d	window glass (310x430 mm), included the frames and hinges if needed, refer to drawings	unit	12.00		
e	window glass (200x850 mm), included the frames and hinges if needed, refer to drawings	unit	6.00		
f	concrete rooster	unit	30.00		
g	back doors, as specified in architectural drawings	unit	3.00		
I	Roofing works and Ceilings				
I.1	Roof Trusses				
a	main chord (8/12)	m3	2.11		
b	stiffener (6/12)	m3	0.37		
c	purlin (6/12)	m3	0.81		
d	kasau (timber element) (5/7)	m3	1.90		
e	timber bracing (6/12)	m3	0.35		
f	cleat (5/7)	m3	0.02		
I.2	Roof Cover				
g	Galvanized iron sheet roof & screw	m2	533.00		

	h	fascia board (2/25)	m'	51.32		
	i	Board painted triplex	m2	206.40		
I.3		Ceilings				
	j	hanger (6/12)	m3	2.25		
	k	plafond (5/7)	m3	0.98		
	l	ceilings boards (9mm thick)	m2	163.40		
	m	cornice	m'	88.20		
J		Railing works				
		Black steel pipe of balustrade 1 " and hand rails 2" with welded and bolted connection:				
	a	Ramp	m'	29.60		
K		Water station area works				
	a	Water foucet T 23 B13V7N	unit	4.00		
	b	Floor trap TX 1 AVI	unit	2.00		
	c	PVC pipe 2 1/2" for grey water	m'	3.30		
	d	Ceramic at Water station area	m2	6.25		

- Note:
1. Assumption depth of foundation = 1m
 2. Assumption existing ground level =-0.55 m (refer to drawings)
 3. Mechanical and electrical appliances are not included

5. TECHNICAL SPECIFICATION

SECTION A - EARTHWORKS

A.1 GENERAL

A.1.1 Types of earthworks

The earthwork consists of filling and excavation work, as shown on the drawing.

A.1.2 Site clearing

The constructor shall execute the site clearing before commencing the filling works, the area shall be cleaned from grass, trees, debris, wood, or other organic waste, etc.

A.1.3 Material for filling

Material to be used is excavated soil and shall be cleaned from grass, trees, debris, wood, or other organic waste, etc and shall be mechanically compacted.

A.2 CONFORMITY WITH DRAWINGS

Earthworks shall be finished to conform within the following limits to the levels, lines, and cross sections specified or shown on the drawings or directed by the Engineer.

A.2.1 Dimensions measured of earth work/filling work are the widths, length and level measured from specified edge shown in drawings. The top level shall not deviate by more than 10 mm from levels shown on the drawings. The top level of the foundation measured must be taken to 100 year flood level as shown on the drawings.

A.2.2 Before filling the excavation for foundation with approved material, the pit shall be cleared from retaining water, debris.

A.3 EXCAVATION

A.3.1 Common excavation

Common excavation shall refer to excavation in materials, in which the material to be excavated is common soil

A.3.2 Suitable material

Suitable material shall comprise all that are acceptable in accordance with the requirements of the material of filling work

A.2.3 Unsuitable material

Unsuitable material shall comprise:

- (a) Materials from swamps, marshes or bogs, running silt peat, logs, perishable material, slurry or mud; mining slime; or
- (b) Any materials which are of construction and demolition debris

SECTION B – RUBBLE FOUNDATION

- B.1 The composition of mortar for bedding and connecting in rubble foundation is of 1:4 of cement and sand.
- B.2 Before installing the dimension and elevation of the pit, it shall be cleaned from standing water, debris, and all unnecessary things.
- B.3 Maximum diameter of rubble used for the foundations shall be not more than 30 cm, and the rubble shall be free from dust, mud, or other soil and it must have a rough surface.
- B.4 The depth of the foundation must reach the hard soil or minimum of 80 cm. The width of the foundation must be at least 80 cm
- B.5 The arrangement of the rubbles in the foundation must not follow a straight line for good connectivity.
- B.6 Local foundations/footings must be provided if the level of hard soil is too deep.

SECTION C - WALL

C.1 BRICK BLOCK

- C.1.1 The brick shall be clay brick. All bricks shall have uniform dimension of 5 x 10 x 20 cm. It should be completely burnt and flat. It should not break easily and the corners should not have damage.

- C.1.2 All bricks should be soaked in water, prior to laying.

C.2 MORTAR

Mortar mix for wall construction should be in composition of 1 : 4 (cement : sand) with appropriate amount of water. Maximum thickness of the mortar used in wall construction is 15 mm, and the minimum is 8 mm.

C.3 WALLS

The arrangement of the brick must overlap each other and neat. Anchorage should be installed as in the drawings

SECTION D – REINFORCED CONCRETE WORKS

D.1 CEMENT

The cement used in the concrete works must be portland cement. It should not harden. It should be dry and have uniform color. It should be free from other materials.

D.2 AGGREGATES

- D.2.1 Fine aggregate should be clean from mud and organic materials. It should be taken from rivers/ quarries

D.2.2 Coarse aggregates should be free from mud and organic materials. It should be taken from rivers/quarries and the size should be approximately 1- 2 cm.

D.3 WATER

The water used in the concrete works should comply on these conditions:

- It should be clean
- It should be clear and have no odor
- It should be free from oil, acid, salt, organic material, etc, that can affect reinforcement bars

D.4 STEEL REINFORCEMENT

D.4.1 General

Steel Reinforcement used is steel bar of type U-32 for deformed bar BJTD-32 ($f_y = 3200 \text{ kg/cm}^2$) and type U-24 for undeformed bar BJTP-24 ($f_y = 2400 \text{ kg/cm}^2$). For steel bar with diameter $\geq 10 \text{ mm}$, deformed bar BJTD-32 should be used. For steel bar with diameter $< 10 \text{ mm}$ undeformed bar BJTP-24 may be used.

D.4.2 Condition

The reinforcement bar used should have uniform size and straight. It should be clean and have no rust. The diameter used must follow with the required diameter presented in the drawings.

D.4.3 Binding Wire

The binding wire for steel reinforcement shall be of 16 SWG soft pliable annealed steel wires.

D.5 MIX DESIGN

The concrete used in the construction works must have a minimum concrete strength of 17.5 MPa (1 cement: 2 sand: 3 gravel). All mix design standards must comply with SNI 03-1726-2002 "Guideline on Reinforced Concrete Design for Building- *Tata Cara Perencanaan Struktur Beton Untuk Bangunan Gedung*"

D.6 MIXING OF CONCRETE

- The mixing plant shall be operated at clear space and the machine has to stand on a stable position, safe, and has good accessibility. The concrete shall be mixed up to a uniform color and consistency.
- Mixers, which have been out of use for more than 30 minutes, shall be thoroughly cleaned before any fresh concrete is mixed.
- The mixer shall be kept on clean condition by washing the mixer immediately after finishing the work.
- Hand mixing of concrete should not be allowed normally, but if the quantity of concrete is small, and at the absolute discretion of the engineer, hand mixing may be permitted.
- Hand mixing of concrete shall be carried out on a hard, even and impervious surface of adequate size.

- In mixing the concrete the gravel and sand should be properly mixed first, then cement can be poured subsequently. Last, provide a depression in the center, add an appropriate amount of water and mix all materials.

D.7 TESTING MIXING

In testing the mixing consistency, place the concrete on the hand and check for the shape. If the concrete tends to spill or run over, it means that there is too much water in the mixture.

D.8 TRANSPORTING AND PLACING

D.8.1 Transporting

The concrete shall be discharged from the mixer and transported to the concrete pouring position. The concrete transported or otherwise exposed during wet weather shall be covered to prevent washing out by rain, or an undue increase in water content in severe cases.

D.8.2 Placing

The concrete shall be placed in positions with the sequence as indicated on the drawings, in the specifications, or as directed by the engineer. It shall be deposited as close as possible to its final position.. It shall be placed in such manner to avoid segregation of the concrete or displacement of the reinforcement and other embedded items or formwork. Fresh concrete shall not be placed against in situ concrete, which has been in position for more

than 3 minutes, unless a construction joint has been formed. Club hammer and steel rod can be used for compaction.

D.9 JOINT CONSTRUCTION

D.9.1 Position

Concreting shall be carried out continuously up to construction joint. The position and arrangement of the joints shall be as indicated on the drawings.

D.9.2 Preparation of joint

When work has to resume on a surface which has hardened, the whole surface shall be thoroughly chipped, all laitance removed, swept clean, wetted and covered with a layer of a minimum thickness of 3 mm of mortar composed of cement and sand with the same ratio as in the concrete mixture. The mortar shall be freshly mixed and placed immediately before the placing of the concrete. The procedure shall be as such to avoid the formation of bands. The prepared joint surfaces shall be inspected and approved by the engineer before commencement of concreting.

D.10 CURING AND PROTECTION

Concrete shall be protected during the first stage of hardening from the harmful effects of sunshine, drying winds, rain or running water. The protection shall be applied as soon as practicable after completion of placing using one or more of the following methods:

- (a) The concrete shall be covered with a wet layer of sacking or similar absorbent material for approximately 7 days.
- (b) Before and after the formwork is removed, spray the concrete routinely.

D.11 FORMWORK

Plywood may be used as the material for formwork. Prior to concreting, the formwork shall be cleaned from adhering concrete and the bottom part should be free from debris.

Additional support to formwork may be needed to maintain the shape of formwork and to retain compressive forces generated in concrete placement.

D.12 DEFECTIVE CONCRETE FINISHES

D.12.1 General

Any concrete found to have a defective finish shall be reformed by skilled workers using methods approved by the engineer.

D.12.2 Prompt remedial measures

Unless approved by the engineer, the repair of imperfection in the formed concrete shall be carried out immediately after the removal of formwork.

D.12.3 Damage and defect of concrete

Concrete that is damaged by any cause, concrete that shows honey-comb, cracks or other defects, and concrete which has excessive surface depressions

beyond accepted tolerances must be cut out and built up to bring the surface to the prescribed lines. Minor bulges and abrupt irregularities beyond the specified limits shall be reduced by grinding to the approved tolerances. All materials, procedures, and operations used in the repair of concrete shall be subjected to the approval of the engineer.

D.12.4 Fittings

All fittings shall be bonded tightly to the surface of the structure and be free from shrinkage cracks. Repair of concrete shall be carried out by one or more of the following methods:

- (a) Concrete replacement
- (b) Hand placed cement mortar
- (c) Pneumatically placed cement mortar
- (d) Dry pack
- (e) Epoxy mortar

The type and methods of repair to be used in any particular case shall be subjected to the approval of the engineer.

D.13 STRIKING AND REMOVAL OF FORMWORK

All forms shall be removed without damaging the concrete. Before removing the forms, the concrete shall be exposed by removing of the side forms or otherwise as required by the engineer in order to ensure that it has sufficiently hardened.

D.14 CONDITION, BENDING, FIXING OF REINFORCEMENT BARS

D.14.1 Condition

The reinforcement bars shall be free from rust, oil or other coating, which is liable to weaken the bonding between the concrete and steel, before being placed in the forms. Any bars that are pitted with rust shall be rejected.

D.14.2 Bending

The bending dimensions and tolerances and the dimensions of end anchorage, seismic hooks, stirrups, and development lengths shall be in accordance with SNI 03-1726-2002. All steel reinforcements shall be fabricated to the forms and dimensions as shown by the drawings. It also should be placed appropriately as shown in the drawings.

D.14.3 Fixing

The reinforcement shall be fixed in the formwork and held firm against displacement by approved cover blocks and binding wires to ensure that the meshwork or reinforcing bars will retain their designed form and exact positions in the formwork during the process of placing and compacting concrete. Bars intended to be in contact when passing each other shall be securely held together at intersections with binding wires.

No concrete shall be placed until all formwork, installation of reinforcing bars and preparation of surfaces involved in the placing have been completely prepared by the constructor and the completion has been inspected and approved by the engineer.

D.14.5 Laps, seismic hooks and length of development

Lap lengths of the reinforcing bars shall be calculated on the permissible stresses for the full tensile stresses in the bars. Laps in the reinforcement shall be suitably staggered. The length of lapped joints shall normally be not less than 40 times the bar diameter or minimal 60 cm.

Seismic hooks must be provided in every stirrups provided in the beam and column. Minimum 40 d length development must be provided in the connection of beam and column (refer to drawings).

SECTION E – PLASTER WORKS

E.1 GENERAL

E.1.1 Mortar used for plaster works is the mixture of portland cement and sand with addition of sufficient water in it. The materials for plaster mortars must be accurately gauged.

E.1.2 All plaster work should be conducted by skilled workers to get proper result.

E.2 EXECUTION OF WORKS

E.2.1 The wall shall be watered and cleaned before plastering and it should be applied to all surface of wall (exposed or unexposed)

E.2.2 Exposed concrete and foundation surfaces shall be plastered for finishing. The surface shall be scraped or chipped before plastering.

E.2.3 Composition of mixed mortar and the place to be plastered work is 1 cement and 4 sand.

E.2.4 The surface of the wall should be smoothened after plastering works using cement and water mixture.

SECTION F – WOODEN WORK

F.1 CODES / STANDARDS

Unless mentioned in further requirements, the constructor must follow:

- Indonesian Material Standard (PUBI - 1982)
- Peraturan Konstruksi Kayu Indonesia

F.2 WOODEN MATERIAL

The constructor shall provide the materials in dry condition (small water content), straight, smooth, has no defect, etc.

F.2.1. Material used for *list-plank* and wooden ventilation is of good quality of wood, straight, with no defect, and no crack.

F.2.2. Material used for roof frame/truss structures shall be from strong wood, or of second class or first class based on codes.

F.2.3. Conformity to structural drawings, locations, dimensions and structural sufficiency during handling/erection must be considered in construction.

F.3 WOODEN CONSTRUCTION

F.3.1. Use minimum Φ 10 mm bolts and 4.40 iron sheet/ 20.100 mm plank to connect the main chord in roof trussing system.

F.3.2. Nail only can be used for connecting wooden elements in the case where the elements are not main chord of roof truss elements or the elements are not structural elements (windows, doors, etc).

F.3.3. Detailing should be provided as presented in the drawings.

SECTION G – ROOFING AND CEILING WORKS

G.1 ROOF COVERING

G.1.1 Use light weight and easy to install materials for roof covering, such as galvanized iron sheet

G.1.2 Provide screw and washer to connect the roof materials to the purlin.

G.1.3 Provide cleat to support and maintain the position of purlin

G.1.4 Provide fascia 2/25 cm (*list-plank*) at the end of the roof trusses

G.2 CEILING ROOF WORKS

G.2.1 Material Requirement

- Gypsum boards for the ceiling shall be of the best quality and moisture resistant.
- Minimum thickness of gypsum board used is 9 mm.
- The board should be unwrapped and sufficiently hard.
- The smooth surface shall be free from defects.

G.2.2 Installation

- Before installing the ceiling, the engineer shall inspect the framework which must be suitable to the leveling, patterns, and dimensions shown on the drawings.
- The cutting of the gypsum (in accordance with the dimensions) to the exact length shall be in a perfect finish condition.
- The gypsum sheets shall be screwed carefully to the framework.

6. CLOSURE

This guideline is developed to provide an alternative design for the person in charge in school committee and to assist the school community in constructing an earthquake resistant school building. The guideline may be used without engineering consultancy, but it is recommended that the school committee/teachers consult an engineer regarding the design parameters and construction methods, to obtain a proper result.

Several design factors that must be noted by the person in charge are:

- 1) The level of the hard soil is not specified in the drawings. It means that depth of foundation must suitable with the local condition for hard soil level.
- 2) The 100 year flood level is not specified in the drawings. It means that the level of the rubble foundation must suitable with the local 100 year flood level.
- 3) No local footing is presented in the drawings for the typical design. However, a detailing of local footings is provided in the case where the local hard soil depth is beyond the depth of an ordinary rubble foundation.
- 4) The BOQ presented in this guideline is calculated using some assumptions, as noted in the BOQ section.
- 5) All changes in the design must be consulted to an engineer/building consultant in the area.

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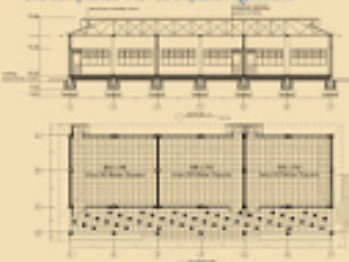


Save the Children®

Safe and Child-Friendly School Initiative

Earthquake Resistant Features

- Design and construction according to latest code and compliance with earthquake regulations



- Single rectangular and symmetric in plan and elevation
- Limit to single story and 3 classrooms maximum
- No gable wall and free-standing wall



- Lightweight roof structure
- No overhanging element



- Proper connection and bond
- Proper fixing and layout of non-structural element



Disaster Risk Reduction Features



- Low-hazard site location
- Community Participation
- Door panel opens with lateral push
- Stable study table
- Emergency escape door in each room and path

Child Friendly Features

- Design with risk friendly parameters



- Natural light and proper ventilation



- Wide verandah for outdoor activities (not cinema)



- Separate toilet block for girls & boys
- Sliding window opening



- Safe play area
- Fencing around compound

Hygiene and Nutrition Features



- Handwashing platform in verandah front of every classroom
- Proper water sanitation & drainage system

Environmentally Friendly Features



- Small area and flowers in area
- Flower base in verandah