Foundations

FEMA

Purpose

To provide guidance on avoiding the ignition of foundations by windborne embers and convective and radiant heat in wildfire zones. Guidance pertains to both new and existing buildings.

Foundation Designs

Foundations can be open or closed. Homes normally have only one type of foundation, but some have both.

Closed Foundation

In a closed foundation, the foundation wall extends from the footing to the first floor around the perimeter of the building. The foundation wall is typically a bearing wall. The below-grade portion is typically constructed of concrete or masonry, but preservative-treated wood can also be used. The above-grade portion may also be constructed of concrete or masonry, or it may be a stud wall (commonly referred to as a "cripple wall"; see Figure 1). The foundation wall encloses a basement, a crawlspace, or the soil below a slab-on-grade.

Figure 1. A closed foundation with a cripple wall (FEMA field team).

Open Foundation

In an open foundation, the building is supported by piles or piers, and the bottom of the first-floor framing is several feet above-grade (see Figure 2). Piles and piers are constructed of concrete, masonry, timber, or steel. Some of the area below the first floor may be enclosed with walls for an elevator or to create a small storage area.[1] Wood lattice is also often placed between piles/piers to provide a privacy screen (for example, around cars parked under the building). Manufactured housing

Figure 2. An open foundation.

[1] If the home is in Flood Hazard Zone V, see Technical Fact Sheet 27, Enclosures and Breakaway Walls, in *Home Builder's Guide to Coastal Construction*, Technical Fact Sheet Series (FEMA 499). www.fema.gov/rebuild/mat/ mat_fema499.shtm.

is typically supported on an open foundation, but often a non-bearing wall (skirting) is installed around the perimeter of the home between grade and the floor.

Key Issues

Closed Foundation

- Direct flame, embers, or hot gases can enter through crawlspace vents or breached basement windows.
- The crawlspace wall or wall covering or the exposed portion of the basement wall or wall covering can be ignited by direct flame, embers, or hot gases. Once the wall is ignited, the fire can penetrate the crawlspace or basement and climb up the exterior wall.
- Combustible items stored in basements or crawlspaces (such as household goods in cardboard boxes) can become fuel in a fire.

Open Foundation

- The underside of the first floor can be ignited by direct flame, embers, or hot gases. When piles or piers are constructed of timber, the pile/pier is normally thick enough to resist ignition. See Fact Sheet #13, Decks and Other Attached Structures, for information on ignition resistance as a function of timber width.
- Wood lattice screens can be ignited by direct flame, embers, or hot gases. Lattice screens often trap combustible debris such as leaves and paper, increasing the potential for ignition. Ignition of a lattice screen can lead to ignition of the underside of the first floor.
- Walls and wall coverings around enclosures such as elevator shafts and storage areas can be ignited by embers or hot gases, leading to ignition of the underside of the first floor.
- Combustible debris or storage items (such as firewood or gas in a container) in an open foundation can be ignited, leading to ignition of the underside of the first floor.
- Skirting around the perimeter of manufactured homes can be ignited, leading to ignition of the underside of the floor and spread of a fire up the exterior wall.

Guidance for New Buildings

Closed Foundation

- See Fact Sheet #7, Exterior Walls, for guidance on walls and wall coverings.
- See Fact Sheet #8, Vents, for guidance on crawlspace vents.
- See Fact Sheet #10, Windows and Skylights, for guidance on windows.

Open Foundation

To avoid ignition of the first-floor framing members (joists) and floor decking, sheath the underside of the framing as follows:

- Attach 5/8-inch thick exterior type X gypsum board to the underside of the joists. For energy conservation, install batt insulation between the joists (see Figure 3).
- Attach fire-retardant-treated plywood, fiber-cement panels, or metal siding panels over the gypsum board.
- Do not install lattice screens. If screens are installed, use chain-link fencing with metal privacy slats instead of wood.
- For guidance on enclosure walls around storage areas and for skirting on manufactured homes, see Fact Sheet #7, Exterior Walls. For guidance on windows, see Fact Sheet #10, Windows and Skylights. For guidance on doors, see Fact Sheet #11, Exterior Doors.

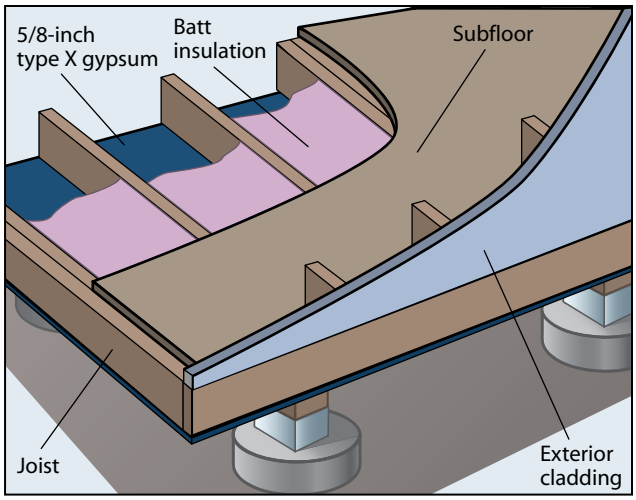

Figure 3. A 5/8-inch type X gypsum board attached to the underside of the joists.

Guidance for Existing Buildings

Closed Foundation

- See Fact Sheet #7, Exterior Walls, for guidance on walls and wall coverings.
- See Fact Sheet #8, Vents, for guidance on crawlspace vents.
- See Fact Sheet #10, Windows and Skylights, for guidance on windows.

Open Foundation

- If the first-floor framing members are timber members less than 3 inches thick (nominal) or if the floor decking is combustible, sheath the underside of the framing as described above.
- Evaluate floor beams and joists that are constructed of steel (not common in residential construction). Depending on a variety of conditions, it may be prudent to sheath the underside of the framing as described above or protect the steel with suitable fireproofing.
- Remove existing lattice screens or replace them with chain-link fencing with metal privacy slats.
- For guidance on enclosure walls around storage areas and for skirting on manufactured homes, see Fact Sheet #7, Exterior Walls. For guidance on windows, see Fact Sheet #10, Windows and Skylights. For guidance on doors, see Fact Sheet #11, Exterior Doors.

Considerations

- The homeowner should periodically remove combustible debris under buildings with open foundations.

- The homeowner should not store combustible items such as gas and firewood under buildings with open foundations.
- If a building is exposed to a wildfire, an engineer should evaluate the structural integrity of the foundation.
- In areas where dry rot is a concern, fire-retardant-treated plywood can be attached over the gypsum board on the underside of the floor joists, but plywood is affected more by weather elements than fiber-cement panels or metal siding panels.
- If the building is located in a floodplain, as designated by FEMA's National Flood Insurance Program, criteria set forth in Title 44 Code of Federal Regulations Part 60 should be considered.

Effectiveness

All measures listed in this Fact Sheet are effective in all Fire Severity Zones.

Resources

FEMA. 2005. *Home Builder's Guide to Coastal Construction Technical Fact Sheet Series*. FEMA 499. http://www.fema.gov/rebuild/mat/mat_fema499.shtm.

FEMA. 2006. *Recommended Residential Construction for the Gulf Coast: Building on Strong and Safe Foundations.* FEMA 550. www.fema.gov/library/viewRecord.do?id=1853.

Slack, P. 2000. *Firewise Construction Design and Materials*. Colorado State Forest Service.