

Enclosed Areas Below the Flood Protection Level

Enclosures

When solid walls fully enclose an area that is subject to flooding, those walls and the enclosure should be designed to resist damage from a flood. Of particular concern is the potential for solid walls to collapse from hydrostatic pressure if floodwaters get too deep outside of the building. Standards applicable to flood-prone enclosures apply to:

- Crawl spaces and other enclosed areas below the lowest floor of floodplain buildings;
- Structurally attached garages with the floor slab located below the flood protection level;
- Accessory structures with the floor below the flood protection level; and
- Existing structures for which increased flood resistance is desired.

*Enclosed areas that are sub-grade on all sides are considered **basements** and are not permitted in floodplain structures.*

Allowed Uses

For new construction or substantially improved structures (which must comply with floodplain development standards), enclosed areas below the flood protection level can only be used for parking of vehicles, building access, or storage. The interior portion shall not be partitioned, temperature-controlled, or finished into separate rooms. Because these areas are intended to flood, storage should be limited to items that have a low damage potential or can be easily moved to the elevated portion of the building if there is a flood.

Required Openings in Enclosure Walls



The walls of any enclosed area below the flood protection level must be designed to automatically equalize hydrostatic forces that result from the pressure of floodwaters against the structure. This is accomplished by installing openings, or flood vents, through which water can enter and exit the enclosure to maintain equal levels on both sides of the wall.

A “flood vent” is a permanent opening in a wall that allows the free passage of water automatically in both directions without human intervention.

Designs for flood vent openings must either (1) be certified by a licensed design professional or (2) meet or exceed the following requirements for non-engineered openings:

- The openings shall be installed on at least two walls of each enclosed area;
- The bottom of the openings must be no higher than one foot above the adjacent finished grade;
- The openings shall have a total net area of not less than one square inch for every square foot of enclosed area subject to flooding; and
- Openings shall be at least three inches in diameter.



Openings may be equipped with screens, louvers, valves, or other coverings or devices, provided that they permit the automatic entry and exit of floodwaters. However, the area occupied by any obstructions must be subtracted when determining the “net area” of the opening. Insect screens do not affect the net open area. The requirement that the opening be at least three inches in diameter applies to the hole in the wall, excluding any device that may be inserted.

If the floor of the enclosure is below the Base Flood Elevation (100-year flood height indicated in the Flood Insurance Study and on the flood hazard map), then only those portions of openings that are below the Base Flood Elevation can be counted toward the required net open area.

Crawl space ventilation vents are designed to facilitate the flow of air and generally do not meet the requirements for flood vents. However, in some circumstances it is possible to design permanent openings that satisfy the required criteria for flood openings as well as ventilation.

Windows, doors, and garage doors are not considered openings for flood venting purposes. However, openings that meet the flood vent standards can be installed in doors and windows.



Flood vents not meeting the above criteria are allowed only if a registered professional engineer or architect certifies that the design meets the requirement to automatically equalize hydrostatic forces on the exterior walls by allowing for the entry and exit of floodwaters. This certification should be attached to the Elevation Certificate.

Several manufacturers have developed products that meet the flood venting requirements. Some of these products are certified to enable equalization of water pressure with smaller openings.

If flood vent openings do not comply with National Flood Insurance Program requirements, the floor of the crawlspace, attached garage, or other enclosure becomes the “lowest floor” of the structure. This may result in significantly higher flood insurance premiums, which would be based on the elevation of the enclosure floor relative to the 100-year flood elevation.

Flood Resistant Materials

Since floodwaters are intended to enter the enclosure, it must be built of flood-resistant materials. This precludes the use of finishings such as carpeting, paneling, insulation (both cellulose and fiberglass) and gypsum wallboard (drywall or sheet rock). Any utilities, ducts, or electrical service must be located or designed to prevent damage from flooding. (Additional information and references concerning flood damage-resistant materials and methods is provided in *Floodplain Facts #9: Flood Resistant Design*.)

High Velocity Considerations

In riverine flood hazard areas where flow velocities are expected to exceed five feet per second, the recommended flood vent openings may not be sufficient to protect solid perimeter foundation walls from hydrodynamic loads and the potential for debris impact and scour. In these areas, it is recommended that buildings be elevated on fill or on open foundations, such as posts, columns, or pilings. All of the requirements for enclosed areas below such structures would apply.

Non-Conversion Agreement

Enclosed areas below the flood protection level are designed to be flooded and should not be converted to uses that are incompatible with the flood hazard. Conversion to finished living space, blockage of flood vents, or installation of unprotected equipment (appliances, heating/cooling equipment, plumbing fixtures, etc.) violates the conditions of the floodplain development permit. The municipality may require the owner to sign a non-conversion agreement to document their understanding of the limitations on construction and use of the enclosed area.

Additional Resources

- *Openings in Foundation Walls and Walls of Enclosures*, Technical Bulletin 1, FEMA FIA-TB-1 (2008), available at <http://www.fema.gov/library/viewRecord.do?id=1579>. This technical bulletin provides guidance for non-engineered and engineered flood openings.