Accessory Structures *(Detail courtesy of RCQuinn Consulting, Inc.)*

Taking the Mystery Out of **Flood Openings**

As the Floodplain Manager for the City of Augusta, I see a lot of Elevation Certificates come across my desk. The Elevation Certificate (EC) is a FEMA form designed to gather information on the compliance of an existing structure, or a new structure, with the requirements of the National Flood Insurance Program (NFIP) and is also used for rating flood insurance premiums. Our local surveyors do a fairly decent job of filling out ECs within compliance of the NFIP regulations, but at least once a month I get an Elevation Certificate where the house is not in compliance because there are not enough (or any) compliant flood openings, as required by the National Flood Insurance Program (NFIP) and the Building Code, or where the EC is not in compliance, because the net area of the flood openings, as installed in the structure, have been calculated incorrectly.

Flood Openings Defined

Flood openings are defined by FEMA as openings in the walls of enclosed structures that allow floodwaters to automatically enter and exit the enclosure.

Flood openings are required in enclosed areas below elevated buildings in flood zones designated Zone A (including A, AE, A1-30, AO, AH). (An area is considered "enclosed" if it has walls on all sides.) Flood openings are also required in crawlspaces, attached garages, solid perimeter walls on which manufactured homes are installed, and accessory structures, to include detached garages and storage buildings. in flood zones designated Zone A (including A, AE, A1-30, AO, AH).

If flood openings are not provided in the walls of enclosed areas, then the hydrostatic loads of slow moving or standing floodwaters, during a flood event, may damage, move, or collapse the foundation walls, and ultimately cause failure of the

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structure they are supporting. For this reason, the National Flood Insurance Program (NFIP) requires flood openings that allow for the free and automatic passage of floodwaters in to and out of the enclosed area. Flood openings are required at a rate of one square inch of net opening per one square foot of enclosed area for non-engineered openings. Engineered opening are permitted, as well; these openings are designed and certified as meeting a specific performance expectation. Flood openings allow for equal levels (and equal hydrostatic pressures) of floodwaters on either side of the enclosure wall; thereby, minimizing the potential for damage or collapse of the walls. For that reason, there must be a minimum of two flood openings, preferably on opposing walls, and preferably parallel to the flow pattern, and the bottom of those flood openings must be no higher than 12" above the higher of the existing interior floor or exterior grade, at the flood opening. Therefore, it is important to know the interior finished grade adjacent to the flood opening, as well as the exterior grade adjacent to the flood opening.

Too often surveyors, think that foundation ventilation openings, which facilitate air flow, and which are usually near the top of crawlspace walls, will count as the flood openings. Sometimes, that may be the case, but only if the enclosed area is no more than about 12–18" off of the existing grade on all sides. In more cases than not, these ventilation air vents will be too high above grade to satisfy the requirements for flood openings.

Further, if installed to serve as flood openings, foundation ventilation vent devices may contain louvers, valves or other coverings such as screening, and must be disabled in the open position; otherwise human intervention would be required during a flood event to manually open these vents. In short, these flood openings must allow for the "automatic entry and exit of floodwaters".

Freeboard—An additional amount of height above the Base Flood Elevation used as a factor of safety in determining the level at which a structure's lowest floor must be elevated or floodproofed to be in accordance with the State or community floodplain management regulations.

Common Problems with Documenting Flood Openings

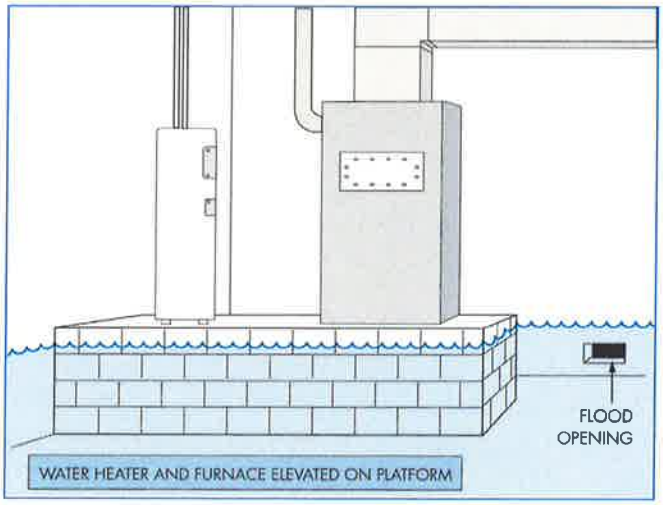
Most of the common mistakes found on Elevation Certificates come from counting the net opening of the non-engineered flood openings (see next section for engineered openings). Many surveyors disregard the fact that a device is installed in a hole in the wall and measure the total area of the hole. For example, typical foundation ventilation devices (air vents), which often play double duty as flood openings, typically are intended to be installed in a 16 inches x 8 inches hole (thus, the hole measures approximately 128 square inches). However, the square inches of the actual net open area (provided for air flow) of the vent device is typically much less. The net open area can vary considerably and can usually be found stamped on or imbedded into the face of the vent device itself. That same number, usually around 42 square inches on average, should be used for calculating the actual net area for passage of flood waters. Again, it is important to note that if this ventilation vent device is not disabled in the open position, is covered by a solid covering (usually a plastic cover used in the winter time to prevent the passage of cold air) or is the type that opens and closes based on temperature, or a thermostat, these devices do not qualify as flood openings and their net area should be calculated as zero (0).

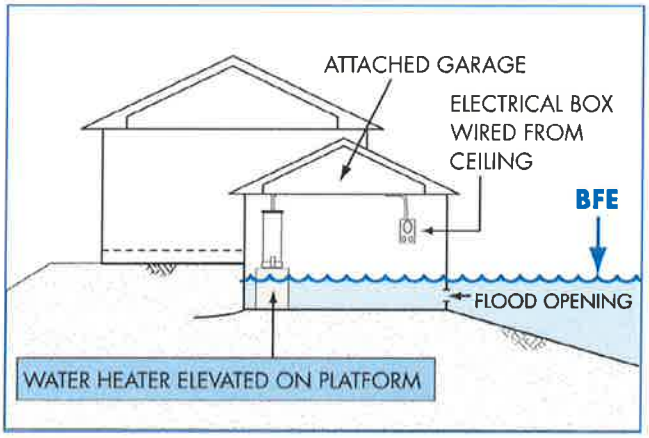
The use of insect screens is allowed if they do not impede the passage of floodwaters. It should be noted, however, that any covering, including screens and decorative coverings, can collect grass clippings, debris, and leaves

Enclosed areas below the Base Flood Elevation (BFE) may only be used for:

Parking (of vehicles)
Access (building access)
Storage

Note: Service facilities such as air conditioning, electrical, gas, plumbing , and heating equipment and associated ductwork cannot be located in the enclosure area, unless they are elevated above the BFE.

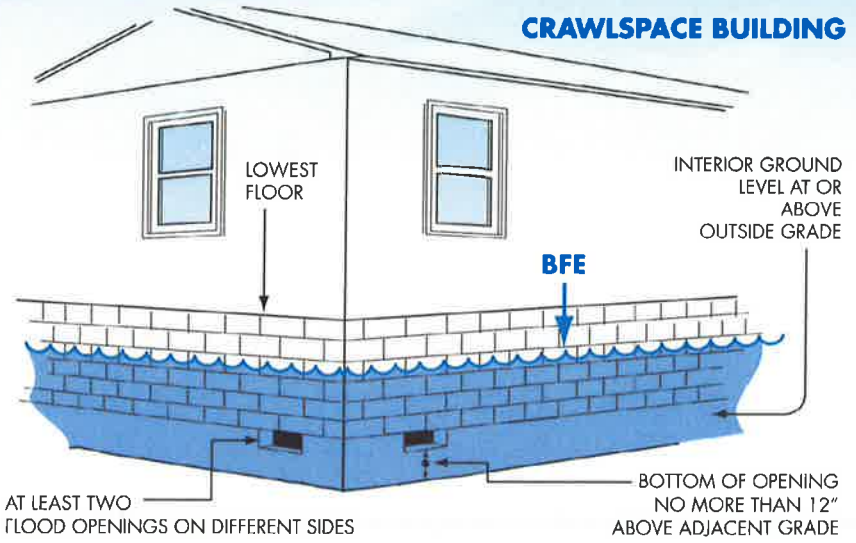




Elevated Utilities *(Detail courtesy of RCQuinn Consulting, Inc.)*

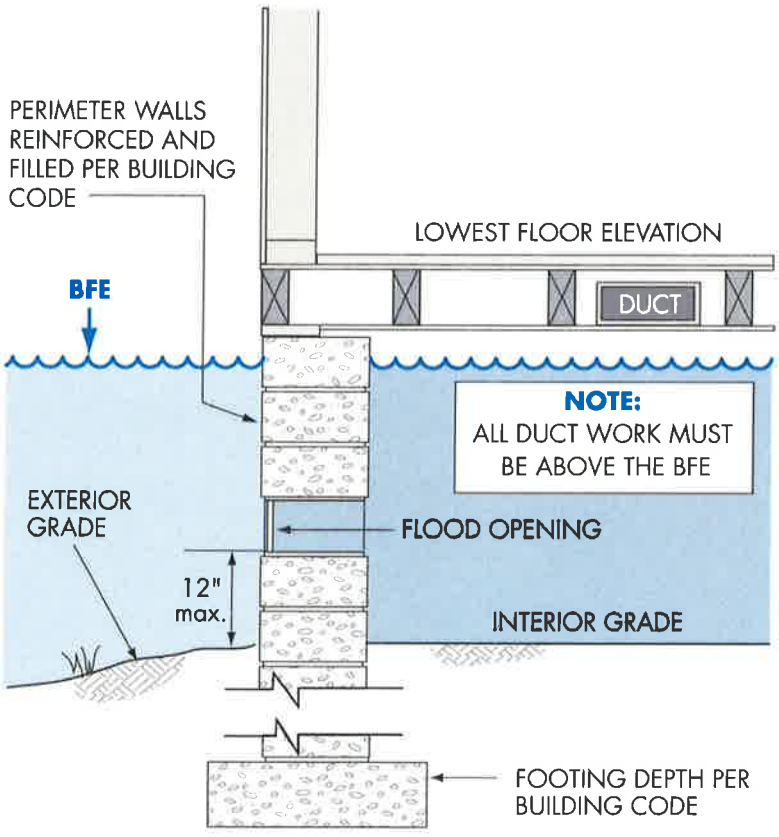
over time. Clogged openings perform less adequately than expected during a flood event. For this reason, some localities require additional openings, at up to 50% more than required by the NFIP, based on the square footage of the enclosed area, if screens or decorative coverings are used on flood openings.

Garage doors and crawlspace access doors cannot be counted as flood openings, since they do not "automatically allow for the entry and exit of floodwaters". Therefore, the square footage of garage doors and crawlspace access doors cannot be used in computing whether or not the required square inches of flood openings has been met. However, flood openings may be installed in these doors in the same fashion as they can be installed in foundation perimeter walls and walls of enclosures, and those flood openings may be used in computing whether or not the required square inches of flood openings has been met.



Structure Crawlspace *(Detail courtesy of RCQuinn Consulting, Inc.)*

Another important factor to watch for is an enclosed area (crawlspace) that is below grade on all four sides. An enclosed area that is below grade on all four sides is, by definition, a basement. According to Technical Bulletin 11, these below grade areas may be allowed only in very specific circumstances: only if "the wall height is less than 4 feet when measured from the bottom of the floor joist / truss to the top of the footing, which must be no more than 2 feet below grade. Flood openings are required in the foundation walls surrounding these crawlspaces.....". Note that TB 11 also states that communities that want to permit below-grade crawlspaces are required to modify their ordinances.



Crawlspace Detail *(Detail courtesy of RCQuinn Consulting, Inc.)*

While below-grade crawlspaces that meet the requirements of TB 11 may be permitted, these areas are still considered basements for flood insurance purposes and NFIP insurance is expected to be higher if this type of construction is utilized. In addition, below-grade crawlspaces may contribute to increased humidity underneath the structure and promote mold growth both underneath and within the structure. Therefore, Technical Bulletin 11 requires that an adequate drainage system be provided in order to minimize floodwater contact with crawlspace materials and related moisture damage.

Compliance with the NFIP regulations for flood openings is very important. Compliance affects the vulnerability of the enclosed structure, but also affects the cost of NFIP flood insurance. Non-compliant flood openings cause the floor of the enclosed area (the ground within the crawlspace) to be considered

the lowest floor of the structure for flood insurance ratings, and thus, may drastically increase insurance premiums. Obviously, the deeper the enclosed area is below the BFE, the higher the flood insurance premium.

Engineered Flood Openings

Engineered flood openings that are designed and individually certified by a registered design professional may be used as flood openings. The design professional must submit a certification attesting that the engineered flood opening is designed to "automatically equalize hydrostatic flood loads on exterior walls by allowing the automatic entry and exit of floodwaters in accordance with the engineered opening design requirements of the NFIP". The certification must also include the type of flood events for which the engineered flood opening has been designed for, and the specific installation requirements for the engineered flood opening.

In lieu of the aforementioned individual design professional certification, engineered flood openings may be certified as having met ICC-ES technical evaluation design and testing standards. In either case, a copy of the design professional's certification or the ICC-ES Evaluation Report must be on file with the community's permitting office and must accompany (be attached to) the Elevation Certificate for each engineered vent installed.

When a builder has used engineered flood openings, the surveyor should note it on the Elevation Certificate and be sure to take one close-up photograph of one opening (if they are all the same). The comment section should include the make and model number of the manufactured devices being utilized. A copy of the individual certification should be attached or, if available, the number of the ICC-ES Evaluation Report should be noted in comments and / or a copy attached to the EC.

An example of an engineered flood opening that has an ICC-ES Evaluation Report is a Smart Vent–which has been "tested, rated and certified for their coverage of 200 square feet per 16" x 8" unit". SmartVent provides a wealth of information on engineered flood openings on their website at www.smartvent.com. They also provide information for surveyors, as well, at www.smartvent.com/news/enewsletter/unacceptable-flood-openings-pose-a-huge-risk1. In addition, SmartVent provides a quarterly newsletter for surveyors on flood code compliance and regulations. They also provide a one hour free training course on TB-1 and Elevation Certificates and even provide a Surveyor Locater Service for those that have taken their one hour training.

Wise Use of Flood Openings

It should be noted here that the flood openings, as described above, whether engineered or non-engineered, are for reducing hydrostatic loads only. Enclosed areas that are subject to high flow velocities (more than 5 feet per second) or where wave heights are anticipated to be 1.5 feet or greater, should be designed by a registered design professional (engineer or architect) to adequately consider the additional hydrodynamic loads that these enclosed areas may be subject to.

FEMA Technical Bulletins

The intent of the National Flood Insurance Program is to protect buildings that are constructed in Special Flood Hazard Areas (SFHAs) from the devastation of flood waters during a flood event. To further this intent, the NFIP includes design criteria that apply to new construction, substantial improvement of existing structures (improvement that costs more than 50% of the market value at the time of construction) and repair of substantially damaged structures (repairs that cost more than 50% of the market value of the structure at the time of the damaging event).

FEMA has produced a number of Technical Bulletins that provide technical guidance concerning the construction requirements of the NFIP. Technical Bulletin 1, Openings in Foundation Walls and Walls of Enclosures, explains flood openings far better than I would ever attempt to do here, or in any other publication that I might write for. Technical Bulletin 1, which has been cited extensively in this article, can be found on the FEMA website at: www.fema.gov/library/viewRecord.do?id=1579. Additionally, FEMA Technical Bulletin 11, Crawlspace Construction for Buildings Located in Special Flood Hazard Areas can also be found on the FEMA website at: www.fema.gov/library/viewRecord.do?id=1724.

In addition, many states have "Quick Guides" that assist the state's citizens and local officials in "understanding what floodplain management is and why floodplain development is regulated". For example, Georgia's Quick Guide is available online at: www.gaepd.org/Files_PDF/techguide/wpb/GAQG2009_ScreenView.pdf

Finally, information on Elevation Certificates can be found on the FEMA website at: www.fema.gov/national-flood-insurance-program-2/elevation-certificate.

Hopefully, these sites and resources, along with the information provided in this article, will help to demystify the need for, and use of, flood openings. It is also hoped that utilization of the information contained within this article will ensure proper compliance with the NFIP requirements on flood openings, and ultimately, reduce the escalating costs of repairing damage to structures caused by the devastating effects of floods from use of noncompliant flood openings.

***Note:** A special thanks is extended to Rebecca Quinn, the principle of RCQuinn Consulting, Inc, who graciously provided technical editing and also many of the graphics for this article.*

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