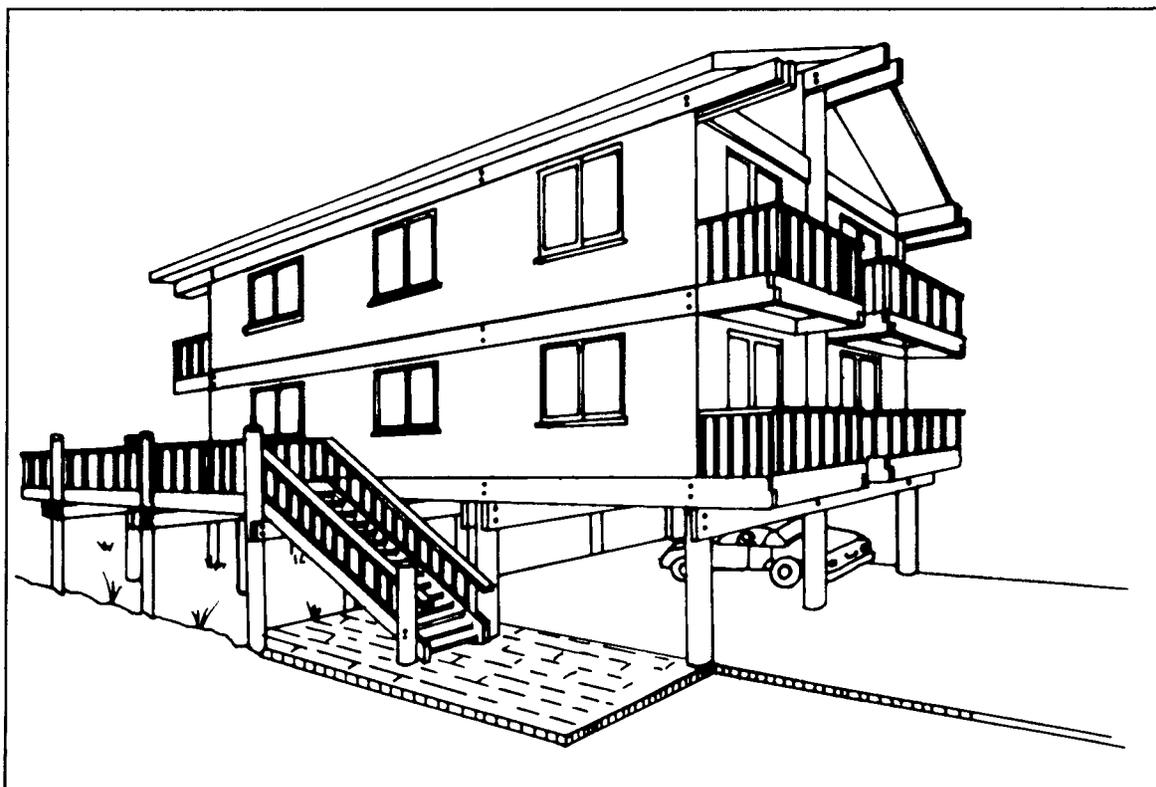




Free-Of-Obstruction Requirements

for Buildings Located in Coastal High Hazard Areas
in accordance with the
National Flood Insurance Program



FEDERAL EMERGENCY MANAGEMENT AGENCY
FEDERAL INSURANCE ADMINISTRATION

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Key Word/Subject Index:

This index allows the user to quickly locate key words and subjects in this Technical Bulletin. The Technical Bulletin User's Guide (printed separately) provides references to key words and subjects throughout the Technical Bulletins. For definitions of selected terms, refer to the Glossary at the end of this bulletin.

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Graphic design based on the Japanese print *The Great Wave Off Kanagawa*, by Katsushika Hokusai (1760 1849), Asiatic collection, Museum of Fine Arts, Boston.

TECHNICAL BULLETIN 5-93

Free-Of-Obstruction Requirements for Buildings Located In Coastal High Hazard Areas in accordance with the National Flood Insurance Program

Introduction

In coastal high hazard areas (Zones V, VE, and V1 -V30), the National Flood Insurance Program (NFIP) requires that all new and substantially improved buildings be elevated to or above the base flood elevation (BFE). Foundations must be designed to allow water moving at high velocities (velocity water) and waves to flow beneath the elevated superstructure of the building. The result is that floodwaters transfer only minimal forces to the foundation system, and flood damage to the elevated superstructure is thereby minimized. The NFIP further requires that the area beneath an elevated building remain free of any obstructions that would reduce or eliminate the free flow of coastal floodwaters during a design coastal storm. This free-of-obstruction requirement is critical to the protection of buildings constructed in V zones.

The velocity water and wave action associated with coastal flooding can exert strong hydrodynamic forces on any obstruction to the flow of water. Standard foundations such as solid masonry walls or wood-frame walls will obstruct flow and be at risk to damage from high-velocity flood forces. In addition, solid foundations can direct coastal floodwaters into the elevated portion of the building or into adjacent buildings. The result is generally structural failure of the building. Therefore, foundations that offer minimal resistance to floodwaters passing beneath an elevated building are required in V zones. The use of pile or column foundations meets the elevation requirement in V zones. It should be noted that the use of structural fill as a means to elevate buildings is expressly prohibited in V zones.

Under the free-of-obstruction requirement, open lattice panels, insect screening, and non-bearing solid breakaway walls are allowed below the elevated lowest floor because they will easily break away under the combined effects of storm wind and water loads without transferring damaging flood loads to the foundation. Breakaway solid enclosure walls will not significantly increase the damage potential to the foundation and/or superstructure provided they meet the applicable NFIP criteria. Under the free-of-obstruction requirement, any type of lower area enclosure or other construction element (as described later in this bulletin) that will obstruct the flow of velocity water and wave action beneath an elevated building during a base flood event is not allowed. For NFIP purposes, an enclosure is defined as an area partially or totally enclosed by rigid walls.

Under the NFIP general requirement that buildings be constructed by methods that will minimize flood damage, the placing of any construction element (such as bulkheads, swimming pools, and septic systems, as described later in this bulletin) on a building site in a V zone must include consideration of the potential effects on the building and adjacent buildings. V-zone obstructions placed outside the perimeter (footprint) of a building located in a V zone must not result in

damage to nearby buildings during coastal storms. Floodwaters can be redirected by such obstructions through ramping and deflection. This will increase the potential for damage to nearby buildings, either on the site or on adjacent sites. In addition to causing ramping and deflection, obstructions can become debris that may result in unanticipated impact forces on the foundation systems of nearby buildings.

To evaluate the effects of construction elements as potential obstructions in V zones, FEMA recommends referring to the U.S. Army Corps of Engineers' (COE's) "Shore Protection Manual" for detailed engineering information and guidance related to wave ramping and deflection as well as localized scour and erosion.

This bulletin provides specific guidance concerning how to meet the NFIP free-of-obstruction requirement in V zones as well as the general requirement for construction that will minimize flood damage potential, as it applies to V-zone construction. Typical construction elements and their relationship to the NFIP V-zone requirements are discussed.

NFIP Regulations

Section 60.3(a)(3) of the NFIP regulations states:

"If a proposed building site is in a floodprone area, all new construction and substantial improvements shall. ..(iii) be constructed by methods and practices that minimize flood damages..."

Section 60.3(e)(4) states that a community shall require:

"...that all new construction and substantial improvements in Zones V1-V30, VE, and also Zone V if base flood elevation data is available, on the community's FIRM, are elevated on pilings or columns so that: (i) the bottom of the lowest horizontal structural member of the lowest floor (excluding pilings or columns) is elevated to or above the base flood level; and (ii) the pile or column foundation and the structure attached thereto is anchored to resist flotation, collapse, and lateral movement due to the combined effects of wind and water loads acting simultaneously on all building components. Water loading values used shall be those associated with the base flood. Wind loading values used shall be those required by applicable State or local building standards. A registered professional engineer or architect shall develop or review the structural design, specifications, and plans for the construction, and shall certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of paragraphs (e)(4)(i) and (ii) of this section. "

Section 60.3(e)(5) further states that a community shall require:

"...that all new construction and substantial improvements within Zones V1-V30, VE, and V on the community's FIRM have the space below the lowest floor either free of obstruction or constructed with non-supporting breakaway walls, open wood lattice-work, or insect screening intended to collapse under wind and water loads without causing collapse, displacement, or other structural damage to the elevated portion of the building or support-

ing foundation system. For the purpose of this section, a breakaway wall shall have a design safe loading resistance of not less than 10 and no more than 20 pounds per square foot. Use of breakaway walls which exceed a design safe loading resistance of 20 pounds per square foot (either by design or when so required by local or State codes) maybe permitted only if a registered professional engineer or architect certifies that the designs proposed meet the following conditions: (i) Breakaway wall collapse shall result from a water load less than that which would occur during the base flood; and (ii) The elevated portion of the building and supporting foundation system shall not be subject to collapse, displacement, or other structural damage due to the effects of wind and water loads acting simultaneously on all building components (structural and non-structural). Water loading values used shall be those associated with the base flood. Wind loading values used shall be those required by applicable State or local building standards. Such enclosed space shall be useable solely for parking of vehicles, building access, or storage. ”

Section 60.3(e)(6) states that a community shall:

“Prohibit the use of fill for structural support of buildings within Zones VI-30, VE, and V on the community’s FIRM. ”

It is important to note that any building materials used below the BFE must meet the flood-resistant materials requirement of Section 60.3(a)(3). Further guidance on this requirement can be found in Technical Bulletin 2, “Flood-Resistant Materials Requirements.”

It should be noted that Technical Bulletins provide guidance on the minimum requirements of the NFIP regulations. Community or State requirements that exceed those of the NFIP take precedence. Design professionals should contact the community to determine whether more restrictive local or State regulations apply to the building or site in question. All applicable standards of the State or local building code must also be met for any building in a flood hazard area.

Obstruction Considerations

Any construction element, such as a garage, deck, bulkhead, or accessory building, that is structurally dependent on or attached to a V-zone building is considered to be part of that building and must meet the requirements of Sections 60.3(e)(4),(5), and (6). If any of these elements are attached to the building and located below the lowest horizontal structural member of the building, they constitute an obstruction and are prohibited unless constructed to the breakaway standards of Section 60.3(e)(5). The construction of such a prohibited feature attached to an otherwise compliant building may result in a significantly higher flood insurance premium being assessed against the entire building because of the increased risk of damage to the building.

Construction elements outside the perimeter (footprint) of and not attached to a coastal building (such as bulkheads, swimming pools, and accessory buildings) may alter the physical characteristics of flooding or significantly increase wave or debris impact forces affecting nearby buildings. As part of the certification process for V-zone buildings, as detailed in Section 60.3(e)(4),

the design professional must consider the effects that any of these elements will have on the building in question and any nearby buildings. Construction elements that will increase storm-related loadings on the building (and that are not specifically precluded by the NFIP regulations) may be constructed if the impacted buildings are designed to withstand the additional impact (hydrodynamic) forces. Increased foundation element embedment depth, size, and number should be employed to compensate for any increased impact forces. Such compensatory design considerations must be made by the design professional and reviewed by the community floodplain administrator prior to construction.

Following are common construction elements for coastal buildings and sites. The factors that must be considered prior to construction in order to comply with the NFIP requirements are discussed for each.

Access Stairs and Elevators Access stairs and elevators attached to or beneath an elevated building are excluded from the breakaway requirement but must meet the flood-resistant material requirements of Section 60.3(a)(3). Further requirements regarding elevators can be found in Technical Bulletin 4, "Elevator Installation." Although access stairs and elevators need not be breakaway, the potential loads generated by these obstructions must be taken into account in the design of the building.

Accessory Buildings Unless properly elevated on piles or columns in accordance with Section 60.3(e)(4), accessory buildings in V zones must be limited to low-value or small structures such as small metal or wooden sheds that are "disposable." If a low-cost or small building is placed on a site, consideration must be given to the effects the debris from the building will have on the building or adjacent buildings. If the building is of significant size and strength to create either a debris impact or flow diversion problem, it must be elevated in accordance with Section 60.3(e)(4).

For purposes of defining and administering the floodplain ordinance, if a community wishes to allow unelevated accessory buildings, the community must establish the meaning of low-cost and small accessory buildings. FEMA recommends that low cost be defined as having a value of less than \$500 and small be defined as less than 100 square feet of floor space. Accessory buildings meeting these criteria must be unfinished on the interior, constructed with flood-resistant materials below the BFE, and used only for storage. Unless properly elevated on piles or columns in accordance with Section 60.3(e)(4), detached garages are not allowed in V zones.

Bulkheads Any bulkhead beneath a coastal building, whether or not it is attached to the foundation system, is an obstruction and is therefore prohibited. Bulkheads transfer damaging flood loads to piles and greatly increase the potential for redirecting velocity water and wave action into the elevated portions of coastal buildings.

While the NFIP does not prohibit bulkheads or seawalls that are not beneath or attached to a coastal building, the community and the design professional must carefully consider the potentially significant effects of these structures before construction is initiated. As with all floodplain construction, local and State requirements must be determined and complied with. If a proposed seawall or bulkhead will result in ramping or deflection of velocity waters, or erosion that will damage any nearby buildings or other structures, its construction should be prohibited by the

community. Determining the potential damaging effects of a seawall or bulkhead is an important part of the design professional's responsibility. The COE'S "Shore Protection Manual" should be consulted for guidance on bulkheads.

Concrete Pads A concrete pad with minimal or no reinforcement, to be used for parking, as a floor in an enclosed storage area, or as the floor of an enclosed area used for access to the elevated lowest floor of a building, may be poured beneath an elevated coastal building. A concrete pad placed at grade is not considered an obstruction if it is not structurally attached to the building's foundation system. The use of fill beneath an elevated building to elevate a slab above natural grade is considered an obstruction and is therefore prohibited. It is important to note that compliant concrete pads often collapse during coastal storms due to erosion and localized scour of underlying soils.

Decks and Patios Decks or patios constructed at grade may involve considerable alteration of the site in the construction process. The proposed construction must be evaluated to determine whether buildings on the site or on adjacent sites will be adversely affected. Floodwaters should not be diverted into the elevated building or into nearby buildings. Debris from destroyed decks or patios should not damage the foundation of the building or of adjacent buildings. Decks and patios constructed below the BFE must be structurally independent of the building's foundation system.

If a deck is structurally attached to the building, the lowest horizontal member of the deck must be elevated to or above the BFE. Like an at-grade deck, an elevated deck should not worsen flooding conditions or create debris that will damage adjacent buildings. A deck that is properly elevated on embedded piles to withstand flood forces generated by a base flood should not cause additional flood or debris damage to adjacent buildings.

Enclosed Areas The area beneath the elevated superstructure of a V-zone building may be enclosed only with non-loadbearing breakaway walls. Open lattice and insect screening may also be used in lower areas.

Uses of the area beneath an elevated building are restricted to parking, access, and storage; lower areas must not be finished or used for recreational or habitable purposes. No mechanical, electrical, or plumbing equipment is to be installed below the BFE.

There are no NFIP restrictions on the size of the area that may be enclosed. However, V-zone buildings with lower area enclosures (constructed with breakaway walls) that exceed 300 square feet may be subject to higher insurance premiums due to the potential for increased loadings on the foundation system caused by the enclosure. Design professionals may wish to contact an insurance agent for information regarding any additional insurance premium that would be assessed.

Fences Like other construction elements on V-zone building sites, fences must be analyzed for their effects on flood conditions, including ramping effects on adjacent buildings and the effects of debris during flood events.

Fill The NFIP prohibits the use of fill for structural support of buildings in V zones. Fill maybe used on coastal building sites for landscaping and site grading as long as the fill does not interfere with the free passage of floodwaters and debris underneath the building or cause changes in flow direction during coastal storms such that floodwaters will cause additional damage to buildings on the site or to any adjacent buildings. Under the building, no fill may be used except for minor landscaping and minor site grading for drainage purposes. An example of unacceptable placement of fill would be the construction of a small berm or retaining wall that is back-filled and used for landscaping purposes when it has been determined that ramping or deflection of floodwaters will adversely affect adjacent buildings and thereby create additional flood damage potential.

Foundation Bracing Bracing is intended to provide lateral wind-resistance support to a pile or column foundation by stiffening the foundation system. While diagonal bracing is allowed under the NFIP, it will obstruct velocity floodwaters and waves to some degree and will often trap debris. Foundation bracing may not be necessary for a V-zone building if the number, size, and embedment of the piles or columns are adequate.

Bracing is to be placed parallel to the primary direction of flow, generally perpendicular to the shoreline. Only the minimum amount of bracing that is necessary to stiffen the foundation may be used. Bracing should be composed of members that will offer the least resistance to floodwaters flowing under the elevated building.

Grade Beams Grade beams, made of wood or reinforced concrete, tie together the perimeter piles or columns to provide additional lateral support. Grade beams that are placed with their upper surfaces flush with the natural grade are allowed under the NFIP. However, storm erosion and localized scour will generally expose grade beams, leaving them elevated above the post-storm beach profile. Therefore, grade beams must be designed to remain in place when erosion and localized scour remove the supporting soil beneath them. It must be noted that grade beams are not to be used as a substitute for adequate number, size, and embedment of piles or columns.

Septic Systems Mounded septic systems generally require a significant volume of fill and therefore constitute an obstruction if placed under an elevated coastal building. Septic systems must not be attached directly to the foundation. Mounded septic systems may be allowed on a V-zone site if they will not worsen flooding conditions for the building in question or any adjacent buildings.

An additional consideration for septic systems in V zones is addressed by Section 60.3(a) (6)(ii), which requires “on-site waste disposal systems to be located to avoid impairment to them or contamination from them during flooding. ”

Swimming Pools A swimming pool maybe placed beneath a coastal building only if the top of the pool and accompanying pool deck or walkway are flush with the existing grade and only if the lower area (below the lowest floor) remains unenclosed. Lower-area enclosures around pools constitute a recreational use and are therefore not allowed, even if constructed to breakaway standards. Lattice and insect screening are allowed as they do not create an enclosed area.

Pools, either at-grade or elevated, are allowed adjacent to coastal buildings only if the pools will not act as obstructions that will result in damage to nearby buildings. Community officials must be assured by the design professional that a pool beneath or near a V-zone building will not be subject to breaking up or floating out of the ground during a coastal flood and will therefore not increase the damage potential to the foundation and elevated portion of any nearby buildings. In addition, the design professional must design and site the pool so that any increased wave or debris impact forces will not affect any nearby buildings.

Pools, pool decks, walkways, and associated accessory buildings placed under or adjacent to coastal buildings must be structurally independent of the building and its foundation.

The NFIP

The NFIP was created by Congress in 1968 to provide federally backed flood insurance coverage, because it was generally unavailable from private insurance companies. The NFIP is also intended to reduce future flood losses by identifying floodprone areas and ensuring that new development in these areas is adequately protected from flood damage. The NFIP is based on an agreement between the federal government and participating communities that have been identified as floodprone. FEMA, through the Federal Insurance Administration (FIA), makes flood insurance available to the residents of a participating community provided that the community adopts and enforces adequate floodplain management regulations that meet the minimum NFIP requirements. The NFIP encourages communities to adopt floodplain management ordinances that exceed the minimum NFIP criteria. Included in the NFIP requirements, found under Title 44 of the U.S. Code of Federal Regulations, are minimum building design and construction standards for buildings located in Special Flood Hazard Areas. Through their floodplain management ordinances, communities adopt the NFIP design performance standards for new and substantially improved buildings located in floodprone areas identified on FIA's Flood Insurance Rate Maps.

Technical Bulletins

This is one of a series of Technical Bulletins FEMA has produced to provide guidance concerning the building performance standards of the NFIP. These standards are contained in Title 44 of the U.S. Code of Federal Regulations at Section 60.3. The bulletins are intended for use primarily by State and local officials responsible for interpreting and enforcing NFIP regulations and by members of the development community, such as design professionals and builders. New bulletins, as well as updates of existing bulletins, are issued periodically, as necessary. The bulletins do not create regulations; rather they provide specific guidance for complying with the minimum requirements of existing NFIP regulations. Users of the Technical Bulletins who need additional guidance concerning NFIP regulatory requirements should contact the Natural Hazards Branch of the appropriate FEMA regional office. The "User's Guide to Technical Bulletins" lists the bulletins issued to date and provides a key word/subject index for the entire series.

Ordering Information

Copies of the Technical Bulletins can be obtained from the appropriate FEMA regional office. Technical Bulletins can also be ordered from the FEMA publications warehouse. Use of FEMA

Form 60-8 will result in a more timely delivery from the warehouse — the form can be obtained from FEMA regional offices and your state’s Office of Emergency Management. Send publication requests to FEMA Publications, P.O. Box 70274, Washington, D.C. 20024.

Further Information

The following publications provide further information concerning NFIP free-of-obstruction requirements:

1. “Answers to Questions About Substantially Damaged Buildings,” FEMA, May 1991, FEMA-213.
2. “Coastal Construction Manual,” FEMA, February 1986, FEMA-55.
3. “Elevated Residential Structures,” FEMA, March 1984, FEMA-54.
4. “Shore Protection Manual,” U.S. Army Corps of Engineers, (latest edition).

Glossary

Base flood — The flood that has a 1-percent probability of being equaled or exceeded in any given year (also referred to as the 100-year flood).

Base Flood Elevation (BFE) — The height of the base flood, usually in feet, in relation to the National Geodetic Vertical Datum of 1929 or other datum as specified.

Basement — Any area of a building having its floor subgrade (below ground level) on all sides.

Coastal High Hazard Area — An area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high-velocity wave action from storms or seismic sources.

Federal Emergency Management Agency (FEMA) — The independent federal agency that, in addition to carrying out other activities, oversees the administration of the National Flood Insurance Program.

Federal Insurance Administration (FIA) — The component of FEMA directly responsible for administering the National Flood Insurance Program.

Flood Insurance Rate Map (FIRM) — The insurance and floodplain management map issued by FEMA that identifies, on the basis of detailed or approximate analyses, areas of 100-year flood hazard in a community.

Floodprone area — Any land area susceptible to being inundated by floodwater from any source.

Lowest floor — The lowest floor of the lowest enclosed area of a building, including a basement. Any NFIP-compliant unfinished or flood-resistant enclosure useable solely for parking of vehicles, building access, or storage (in an area other than a basement) is not considered a building's lowest floor.

Special Flood Hazard Area (SFHA) — Area delineated on a Flood Insurance Rate Map as being subject to inundation by the base flood and designated as Zone A, AE, A1-A30, AR, AO, AH, V, VE, or V1-V30.

Substantial damage — Damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

Substantial improvement — Any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the “start of construction” of the improvement. This term includes structures that have incurred “substantial damage,” regardless of the actual repair work performed.