Design and Construction in Coastal A Zones

FEMA

HURRICANE KATRINA RECOVERY ADVISORY

Purpose: To recommend design and construction practices in coastal areas where wave and flood conditions during the base flood will be less severe than in V Zones, but still cause significant damage to typical light-frame construction

Key Issues

- Recent post-storm investigations have shown that typical A Zone construction techniques (e.g., wood-frame, light gauge steel or masonry walls on shallow footings or slabs, etc.) are subject to damage when exposed to less than 3-foot breaking waves, which is the current threshold for V Zone conditions.
- Coastal A zone buildings that employ typical residential and light commercial walls to elevate and support habitable space above the flood level will be susceptible to flood damage (see Figure 1). Laboratory tests and recent field investigations confirm that breaking wave heights as small as 1.5 feet will cause failure of these types of walls (see Figures 2 and 3).
- Other flood hazards associated with coastal waves (e.g., floating debris, high velocity flow, erosion and scour) also damage A Zone type construction in coastal areas (see Figures 4 and 5).
- NFIP flood hazard mapping is generally divided into two categories, V Zone and A Zone. In coastal areas, the A Zone category could be subdivided into "Coastal A Zone" and "A Zone." Base flood conditions in the Coastal A Zone will be similar to, but less severe than, those in the V Zone; base flood conditions in the A Zone will be similar to those in riverine or lake floodplains.
- The Coastal A Zone is not shown on the FIRM at present; therefore, communities, designers, and owners will have to determine whether a site lies within a Coastal A Zone.
- **V Zone design and construction standards are recommended in Coastal A Zones subject to erosion, high velocity flow, and/or wave heights greater than 1.5 feet.**

Figure 1. Failure of wood-frame walls used to support a coastal building, which was subjected to shallow flooding, small waves, and floating debris (Hurricane Opal).

Figure 2. Masonry walls destroyed by 3 feet of stillwater flooding and small waves (Hurricane Dennis).

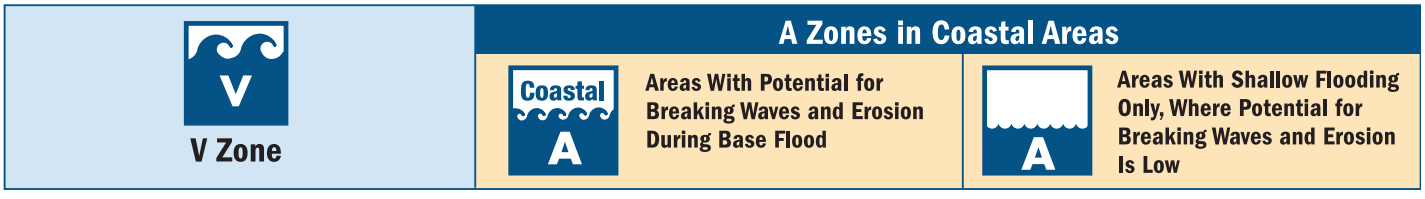

Figure 3. Failure of wood-frame wall, brick veneer, and windows as a result of 4 feet of stillwater flooding and small waves (Hurricane Katrina).

Figure 4. Failure of A Zone type foundation in coastal area, not subject to V Zone conditions (Hurricane Fran).

Figure 5. Damage to light frame walls due to floating debris and small waves. The damaged home was in the third row back from a bay shoreline (Hurricane Ivan).

Coastal A Zone, Defined

Coastal A Zone: area landward of a V Zone, or landward of an open coast without mapped V Zones. In a Coastal A Zone, the principal source of flooding will be astronomical tides, storm surges, seiches or tsunamis, not riverine flooding. During base flood conditions, the potential for breaking wave heights between 1.5 feet and 3.0 feet will exist (see Figure 6).

Coastal A Zone design and construction practices described herein are not mandated by the NFIP, but are recommended for communities that wish to adopt higher floodplain management standards. Community Rating System (CRS) credits are available for doing so. Note that some Coastal A Zone practices may be required by the International Building Code, through its reference to ASCE 24-98.

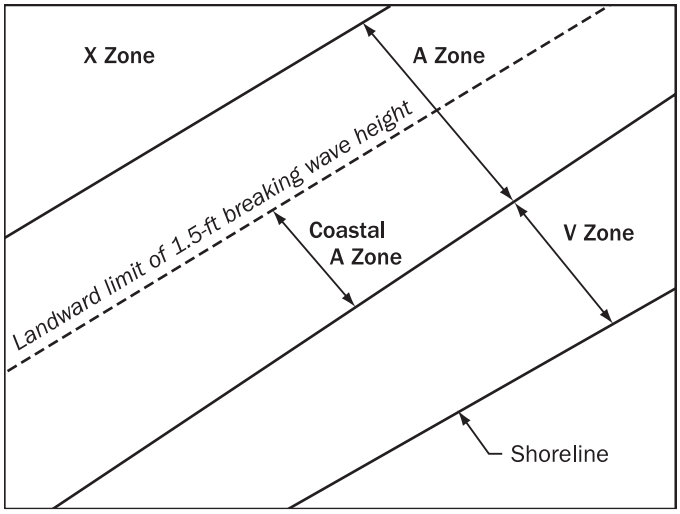

Figure 6. Plan view showing Coastal A Zone landward of V Zone (source: ASCE 24-05).

Coastal A Zone Construction Guidance

Because of the presence of damaging waves, V Zone design, construction, and certification practices are recommended for Coastal A Zones.

Coastal A Zone construction should include:

- Use of open foundations (pile or pier) designed to resist all base flood conditions (waves, high velocity flow, erosion and scour, floodborne debris). Where high velocity flow, scour, and erosion will not be experienced under base flood conditions, a traditional stem wall foundation may be acceptable – see Table 1.
- Elevation of the bottom of the lowest horizontal structural member supporting the lowest floor above the base flood wave crest elevation (see Figure 7).Since waves and debris will be impacting on the floor joists and other foundation elements during the base flood, *do not follow current NFIP minimum requirements that allow the lowest floor's walking surface to be set at the wave crest elevation in Zone A.*
- Use of flood-resistant materials above the level of the walking surface of the lowest floor (in the event that future flooding exceeds the lowest floor level).
- Specification of connections between the foundation and the elevated building that are capable of withstanding simultaneous wind and flood forces. Post-Katrina investigations found many foundation-to-building connections to be deficient (see Figure 8).
- Use of space below the lowest horizontal structural member for parking, access, or storage only. Adding sufficient freeboard to allow parking beneath the building will not only reduce future flood damages, but will also lower flood insurance premiums.
- Use of screen, lattice, or breakaway walls if space below the elevated floor is enclosed. Note: until flood regulations are changed, breakaway walls in Coastal A Zones must be equipped with flood openings.

Additional guidance for design and construction in Coastal A Zones can be found in FEMA 499, *Home Builder's Guide to Coastal Construction* (http://www.fema.gov/fima/mat/fema499.shtm). The publication is a series of 31 fact sheets that provide recommended design and construction practices for foundations, connections, building envelope, etc. Fact Sheet 2 summarizes recommended practices for Coastal A Zones, and references other fact sheets that provide more details.

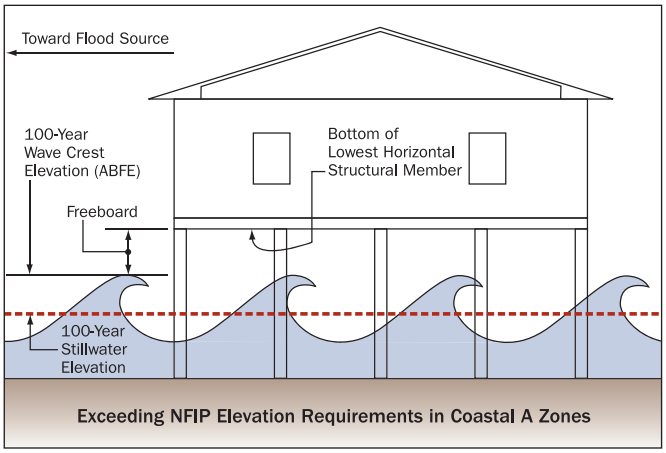

Figure 7. Recommended post-Katrina building standards in Coastal A Zones.

Figure 8. Post-Katrina investigations showed that many buildings were attached to foundation piers with light gauge metal straps. These straps failed in many instances. A stronger (preferably bolted) connection is recommended when attaching Coastal A Zone buildings to their foundations.

Table 1. Foundation Recommendations for Coastal A Zones (Users should read across from a foundation type to see under what soil and base flood conditions that foundation is acceptable. A foundation must be capable of resisting all base flood conditions likely to exist at the site, or it should not be used. For example, a properly constructed pier on a shallow footing will generally withstand 1.5- to 3.0-foot wave heights, but should not be used where soils are erodible, and where high velocity flow is possible, or where large floodborne debris may be present.)

Foundation Type	Base Flood Condition Present		
	Wave Heights Between 1.5 and 3.0 Feet*	Velocity Flow, Erodible Soils	Large Debris
Fill	no	no	no
Slab on grade	no	no	no
Crawlspace, shallow footing	no	no	no
Foundation walls, shallow footing	no	no	no
Stemwall, shallow footing	yes	no	yes
Stemwall, deep footing**	yes	yes	yes
Pier, shallow footing	yes	no	no
Pier, deep footing**	yes	yes	no
Post, shallow embedment	no	no	no
Pile/Column, deep embedment**	yes	yes	yes

*Wave heights greater than 3.0 feet mapped as V Zone: fill, slab, crawlspace, wall foundations not permitted.

**Deep means sufficiently deep to withstand erosion and scour, including that induced by the presence of the foundation itself.

Identifying Coastal A Zones

Coastal A zones are not shown on present day Flood Insurance Rate Maps (FIRMs) or mentioned in a community's Flood Insurance Study (FIS) Report. Those maps and studies show zones VE, AE, and X (or older designations V1-30, A1-30, B, and C). Therefore, until Coastal A Zone designations or wave height contours are incorporated into Flood Insurance Studies, the community official, designer, or owner will have to determine whether or not a site will be subject to Coastal A Zone conditions during the base flood.

In order for a Coastal A Zone to be designated, two conditions are required:

1) a water depth sufficient to support waves between 1.5 and 3.0 feet high, and

2) the actual presence of wave heights between 1.5 and 3.0 feet.

Condition 1 requires stillwater depths (vertical distance between the 100-year stillwater elevation and the ground elevation) of 2 to 4 feet at the site.

Condition 2 requires wave heights at the shoreline greater than 1.5 to 3.0 feet (under the 100-year flood conditions), sufficient water depth between the shoreline and the site and few, if any obstructions (buildings, dense tree stands, etc.) that may block or dampen the waves, between the shoreline and the site.

Figure 9 illustrates the relationships between the stillwater flood elevation, ground elevations, associated 1 percent annual chance (100-year) stillwater flood depths, ABFEs, and associated flood hazard zones (see Hurricane Katrina Recovery Advisory *Reconstruction Guidance Using Hurricane Katrina Surge Inundation and ABFE Maps*).

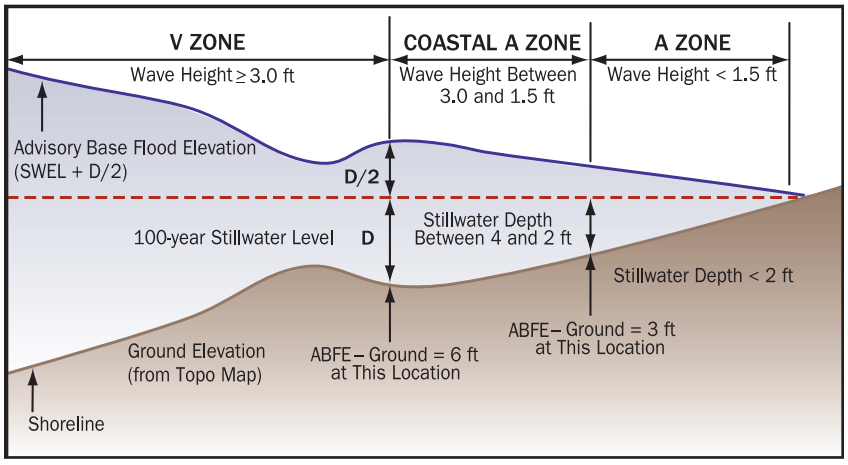

Figure 9. Cross-section showing 1 percent annual chance stillwater elevation, stillwater depth and ABFE, and inland limits of V Zone and Coastal A Zone.

Communities, designers, and owners can obtain the information necessary to make a post-Katrina Coastal A Zone determination by observing the site and its surroundings, knowing site ground elevations, and using 1 percent annual chance stillwater elevations from the Advisory Base Flood Elevation (ABFE) guidance (see Table 2). Figure 10 shows how site and surrounding conditions would influence a Coastal A Zone determination.

Table 2. Updated 1 Percent Annual Chance (100-Year) Stillwater Elevations for Use in Calculating ABFEs (see Figure 9)

County	Updated 100-year Stillwater Elevations (SWEL), (ft NGVD*)	
	Gulf of Mexico Shoreline	Back Bay Shorelines
Jackson	14	12
Harrison	18	16
Hancock	20	18

*National Geodetic Vertical Datum

Figure 10. Although the site on the left is mapped Zone AE, proximity to the Gulf of Mexico shoreline and limited obstructions to waves indicate the site could be classified as a Coastal A Zone. The site on the right is over 4,000 feet from the Gulf shoreline and over 1,000 feet from the bayou, mapped as Zone AE, and has a base flood stillwater level sufficient to support >1.5-foot wave heights – but obstructions to waves (e.g., trees and other buildings between the site and the shoreline), and distance from the sources of flooding would indicate the area is not a Coastal A Zone.