

Coastal Construction Fact Sheet Series



FEMA



HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION FEMA 499/August 2005 Technical Fact Sheet Guide

Introduction

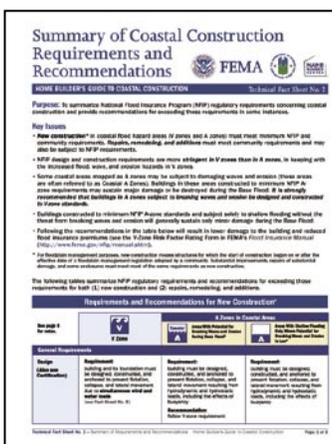
FEMA has produced a series of 31 fact sheets that provide technical guidance and recommendations concerning the construction of **coastal residential buildings**. The fact sheets present information aimed at improving the performance of buildings subject to flood and wind forces in coastal environments. The fact sheets make extensive use of photographs and drawings to illustrate National Flood Insurance Program (NFIP) regulatory requirements, the proper siting of coastal buildings, and recommended design and construction practices, including structural connections, the building envelope, utilities, and accessory structures. In addition, many of the fact sheets include lists of additional resources that provide more information about the topics discussed.

Available Fact Sheets

The following 31 fact sheets are available as Adobe® Portable Document Format (PDF) files and as plain text (.txt) files. You must have Adobe® Reader to view the PDF files. The latest version of Adobe Reader is recommended. Download the free Reader from www.adobe.com.



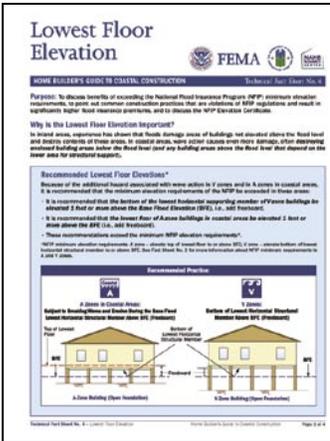
Fact Sheet No. 1, Coastal Building Successes and Failures – Explains how coastal construction requirements differ from those for inland construction, and discusses the characteristics that make for a successful coastal residential building. Includes design and construction recommendations for achieving building success.



Fact Sheet No. 2, Summary of Coastal Construction Requirements and Recommendations – Summarizes NFIP regulatory requirements for new construction and for repairs, remodeling, and additions, and presents recommendations for exceeding those requirements in some instances. Topics include building foundations, enclosures below the Base Flood Elevation (BFE), use of nonstructural fill, use of space below the BFE, utilities, certification requirements, and repairs, remodeling, and additions. Cross-references to related fact sheets are provided.



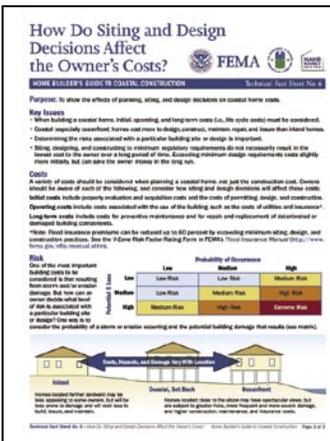
Fact Sheet No. 3, Using a Flood Insurance Rate Map (FIRM) – Explains the purpose of FIRMs; highlights features of a FIRM that are important to coastal builders, including flood hazard zones and flood elevations; and explains how to obtain FIRMs.



Fact Sheet No. 4, Lowest Floor Elevation – Defines “lowest floor,” discusses benefits of exceeding the NFIP minimum building elevation requirements, points out common construction practices that are violations of NFIP regulations, and discusses the NFIP Elevation Certificate. Also includes a copy of the certificate.



Fact Sheet No. 5, V-Zone Design and Construction Certification – Explains the certification requirements for structural design and construction in V zones. Also includes a copy of a sample certificate and explains how to complete it.



Fact Sheet No. 6, How Do Siting and Design Decisions Affect the Owner's Costs? – Discusses effects of planning, siting, and design decisions on coastal home costs. Topics include initial, operating, and long-term costs; risk determination; and the effect on costs of meeting and exceeding code and NFIP design and construction requirements.

Selecting a Lot and Siting the Building

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION

Purpose: To provide guidance on lot selection and siting considerations for coastal residential buildings.

Key Issues:

- Purchase and siting decisions should be made early in the process, and based on property location and conditions.
- Factor characteristics, including topography, environmental factors, and owner desires on lot siting options.
- Conformances with local state regulatory codes mean buildings will be built.
- Information about site conditions and history is available from several sources.



The Importance of Property Purchase and Siting Decisions: The single most common and costly siting mistake occurs for purchasers, builders, and owners in failing to consider future erosion and storm damage risks. An existing coastal home is purchased or when land is purchased and a new home is built. Purchase decisions—on price, design, and construction details—based on siting-related conditions other than lot siting building returns.

Over a long period of time, owners of poorly sited coastal buildings may spend more money on erosion control and erosion-related building repairs than they spent on the building itself.

What Factors Consider Siting Decisions? Many factors affect lot and siting decisions, and a builder's or owner's ability to select coastal residential buildings, but the most important is property owner's ability to understand, evaluate, and address siting-related risks. Other important factors include: regulatory considerations, and environmental considerations.

Given the cost of coastal property, careful siting is often critical and owners often build the largest building that will fit within the permitted development footprint. Builders frequently face the challenge of lot siting decisions in these cases have effectively been made at the time the lot was purchased or subdivided, and that effective erosion control measures are often not available for long-term consideration.

In some instances, however, careful siting may be enough to allow a future-erected coastal building to be sited and constructed in a manner that allows the building to remain in the structure as possible. However, the likelihood that the building will be damaged or destroyed in the future.

Revised Fact Sheet No. 7 - Coastal Building Materials

Fact Sheet No. 7, *Selecting a Lot and Siting the Building* – Presents guidance concerning lot selection and building siting considerations for coastal residential buildings. Topics include factors that constrain siting decisions, coastal setback lines, common siting problems, and suggestions for builders, designers, and owners.

Coastal Building Materials

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION

Purpose: To provide guidance on the selection of building materials used for coastal construction.

Key Issues:

- The durability of a coastal home relies on the types of materials used to construct it. For more details, see the U.S. Department of Housing and Urban Development (HUD) report Coastal Building Materials for Residential Builders and Designers, available at the HUD Blue Book at: <http://www.huduser.org/publications/builder/building.html>
- Materials and construction methods should be resistant to flood and other damage, including salt, corrosion, mold, and decay.
- All coastal buildings will require maintenance and repairs (even in non-eroded conditions) — the longer materials and methods for repair, addition, and other work following total construction (see Fact Sheet No. 30).

Section 602 (b) of the National Flood Insurance Program (NFIP) regulations require that all new construction and substantial improvement be designed and constructed to meet the design flood elevation (DFE) that is resistant to flood damage (see Fact Sheet No. 20 for a definition of "substantial improvement")."

Flood-Resistant Materials: Flood-resistant materials for a large percentage of the damage caused by a coastal storm. Building materials resistant to flooding must be resistant enough to resist a certain amount of water exposure in order to avoid the need for complete replacement after the flood.

FRM defines a flood-resistant material as any building material capable of withstanding short and prolonged contact with, or immersion in, floodwaters without exhibiting significant damage (i.e., structural member that remains usable).

The following are examples of flood-resistant materials:

- Lumber constructed of naturally decay-resistant, including rot-resistant, termite, and mold systems.
- Concrete or masonry systems and other systems that are resistant to salt water, acids with a surface-making cement with a 28-day compressive strength of



Revised Fact Sheet No. 8 - Coastal Building Materials

Fact Sheet No. 8, *Coastal Building Materials* – Provides guidance on the selection of building materials used for coastal construction. Flood, wind, corrosion, and decay resistance are discussed, including protection recommendations.

Moisture Barrier Systems

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION

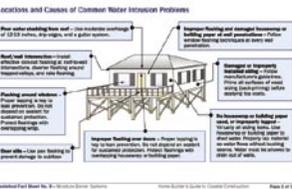
Purpose: To describe the moisture barrier system, explain how typical wall moisture barrier work, and identify common problems associated with moisture barrier systems.

Key Issues:

- A successful moisture barrier system will limit water infiltration into exterior walls and allow drainage and drying of wetted building materials.
- Moisture barrier systems for the walls (i.e., siding and back-sheath) are "water-resistant" systems, which means they resist water penetration (see page 21).
- Moisture or building paper (paper) attached to the exterior wall will provide an additional moisture barrier system.
- Proper flashing and sealing of windows and doors is critical to a successful moisture barrier system.
- Sealant should never be substituted for proper flashing.

The purpose of the building envelope is to control the movement of water, air, thermal energy, and other water into the building to prevent water infiltration into the structure, limit moisture content of the building components, and control air and vapor movement through the envelope.

Locations and Causes of Common Water Infiltration Problems:



- Water entering through roof — The moisture content of roof sheathing, rafters, and a gable end.
- Water entering through exterior walls — The moisture content of exterior walls, including windows and doors.
- Water entering through roof-to-wall connections — The moisture content of roof-to-wall connections, including roof-to-wall connections.
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Revised Fact Sheet No. 9 - Coastal Building Materials

Fact Sheet No. 9, *Moisture Barrier Systems* – Describes the moisture barrier system, explains how typical wall moisture barrier systems work, and discusses common problems associated with moisture barrier systems.

Load Paths

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION

Purpose: To describe the concept of load paths and highlight important connections in a wind uplift load path.

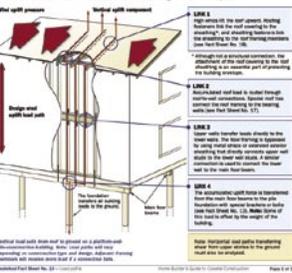
Key Issues:

- Loads acting on a building follow many paths through the building and must eventually be resisted by the ground, or the building will fail.
- Loads accumulate as they are moved through key connections in a building.
- Member connections are usually the weak link in a load path.
- Faded or missed connections need to be reinforced through unbroken load paths.

Wind uplift pressure: Wind uplift pressure is the force exerted on the roof surface by the wind. It is the force that causes the roof to be lifted off the building. Wind uplift pressure is the force that causes the roof to be lifted off the building.

Wind uplift component: Wind uplift component is the force exerted on the roof surface by the wind. It is the force that causes the roof to be lifted off the building. Wind uplift component is the force that causes the roof to be lifted off the building.

Design wind uplift load: Design wind uplift load is the force exerted on the roof surface by the wind. It is the force that causes the roof to be lifted off the building. Design wind uplift load is the force that causes the roof to be lifted off the building.



Revised Fact Sheet No. 10 - Coastal Building Materials

Fact Sheet No. 10, *Load Paths* – Illustrates the concept of load paths and highlights important connections in a typical wind uplift load path.

Foundations in Coastal Areas

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION Technical Fact Sheet No. 11

Purpose: To describe foundation types suitable for coastal environments.

Key Issues:

- Foundations in coastal areas must elevate buildings above the base flood elevation (BFE), where applicable. Flood zones, high winds, waves and erosion are leading risks.
- Foundations used for inland construction are generally not suitable for coastal construction.
- Simple, undisturbed piles in concrete foundations are preferred for most coastal areas. In other coastal areas, they are recommended instead of solid and masonry foundations. In other coastal areas, they can be substituted with "Deeply undisturbed" means. Additional protection may be provided to accommodate additional surge and erosion and to resist of design velocity and impact loads without structural damage.
- Areas below elevated buildings in V zones must be "free of obstructions" that can transfer flood loads to the foundation and building (see Fact Sheet No. 27).

Foundation Design Criteria:

All foundations for buildings in flood hazard areas must be constructed with flood-resistant materials (see Fact Sheet No. 8) and must also be designed to address the requirements for conventional construction. (1) ensure the building above the BFE, and (2) prevent flotation, collapse, and lateral movement of the building, resulting from loads and conditions during the design flood event. In coastal areas, these loads and conditions include inundation by salt-water water, breaking waves, floating debris, erosion, and high winds.

Because the most hazardous coastal areas are subject to erosion and extreme flood loads, the only preferred way to penetrate these areas is to elevate a building to a design water level "plus" (i.e., pile or column foundation). This approach avoids structural erosion and surge and it complies with the National Flood Insurance Program (NFIP) if it is done since after the ground elevation has above the BFE and is recommended for coastal A zones. Areas below elevated structures pile foundation will not prevent eventual undermining and thus due to long-term erosion (see Fact Sheet No. 7).

Performance of Various Foundation Types in Coastal Areas:

There are many types of foundation types used in coastal areas. All foundation types, including walls, will vary in performance. Not all of them are suitable for coastal areas. In fact, several of them are prohibited in V zones and are not recommended by the Home Builder's Guide to Coastal Construction for A zones (see Fact Sheet No. 8).

PI: Because PI is susceptible to erosion, it is prohibited as a means of providing structural support to elevated V zones and must not be used as a means of elevating buildings in any other coastal area subject to erosion, surge, or floating water.

Technical Fact Sheet No. 11 - Foundations in Coastal Areas Home Builder's Guide to Coastal Construction Page 2 of 9

Fact Sheet No. 11, Foundations in Coastal Areas – Explains foundation design criteria and describes foundation types suitable for coastal environments. Also addresses foundations for high-elevation coastal areas (e.g., bluff areas).

Pile Installation

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION Technical Fact Sheet No. 12

Purpose: To provide basic information about pile design and installation.

Key Issues:

- Use a pile type that is appropriate for local conditions.
- Have piles designed by a foundation engineer for ultimate forces, size, and length.
- Use installation methods that are appropriate for the conditions.
- Brace piles properly during construction.
- Make accurate field logs, and level off caps and drilled holes to prevent damage.
- Have all pile-to-beam connections engineered, and use non-combustible fasteners. (See Fact Sheet No. 13)

Pile Types:

Driven steel piles are the most common type of pile used in coastal construction. They can be square or round in cross section. Steel piles are readily cut and adapted to fit field and are suitable for most conditions. Concrete piles are commonly used in inland construction. Concrete piles are not recommended for coastal areas because they are more susceptible to erosion and are more difficult. Steel piles are easily used because of practical erection problems.

Pile Size and Length:

Pile size and length are determined by the foundation engineer based on bearing and penetration requirements. Pile size should have no less than an 8-inch top flange. The total length of the pile is based on code requirements, calculated penetration requirements, erosion protection, Design Flood Elevation (DFE), and allowance for set-off and beam width (see figure at right).

Note: Modified piles for special conditions. See Fact Sheet No. 13 for information about making connections to modified piles.

Technical Fact Sheet No. 12 - Pile Installation Home Builder's Guide to Coastal Construction Page 2 of 9

Fact Sheet No. 12, Pile Installation – Presents basic information about pile design and installation, including pile types, sizes and lengths, layout, installation methods, bracing, and capacities.

Wood-Pile-to-Beam Connections

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION Technical Fact Sheet No. 13

Purpose: To illustrate typical wood-pile-to-beam connections, provide basic construction guidelines on various connection methods, and show pile bracing connection techniques.

NOTE: The foundation connections shown in this document are designed by an engineer. See Fact Sheet No. 13 for "load cut" information. The number of bolts and special bolt placement dimensions shown on the drawings are determined by the engineer. The design is for these areas only, and not all of the information to be considered in the design is included in these illustrations. **Pile design is the responsibility of the engineer.**

Key Issues:

- Verify pile alignment and contact, or resistance before loading connections.
- Capable of full pile to ensure required load depth.
- Limit loads to no more than 50 percent of pile penetration.
- Use carbon-steel or hardware, such as stainless steel, when in contact with steel. (See Fact Sheet No. 8).
- Accurate caps and set-off look back.
- Field top of cap and level to prevent damage.
- Use sufficient size and beam width to allow proper edge stiffeners.

Pile-to-beam connections must:

- provide required bearing area for beam to rest on pile
- provide required **uplift** (tension) resistance
- transfer loads in an **upright position**
- be capable of resisting beam loads (shear and seismic)
- be constructed with **ductile** connectors and fasteners

Note: Pile-to-beam connections must be designed by an engineer.

Technical Fact Sheet No. 13 - Wood-Pile-to-Beam Connections Home Builder's Guide to Coastal Construction Page 2 of 9

Fact Sheet No. 13, Wood-Pile-to-Beam Connections – Illustrates typical wood-pile-to-beam connections; presents basic construction guidance for various connection methods, including connections for misaligned piles; and illustrates pile bracing connection techniques.

Reinforced Masonry Pier Construction

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION Technical Fact Sheet No. 14

Purpose: To provide an alternative to piles in V zones and A zones in coastal areas where soil properties preclude pile installation, or the need for an "open foundation system" still exists. Includes recommendations for good masonry practice in coastal environments.

Key Issues:

- The footing must be designed for the soil conditions present. Pier foundations are generally not recommended for use in A zones.
- The connection between the pier and its footing must be properly designed and constructed to resist separation of the pier from the footing and vertical loads, including forces.
- The base of the footing must be below the anticipated erosion and scour depth.
- The pier must be reinforced with steel and fully grouted.
- There must be a positive connection to the beam at the top of the pier.
- Special attention must be given to the application of mortar in order to prevent water from intruding into the pier when the pier cap is completed.

Piers vs. Piles:

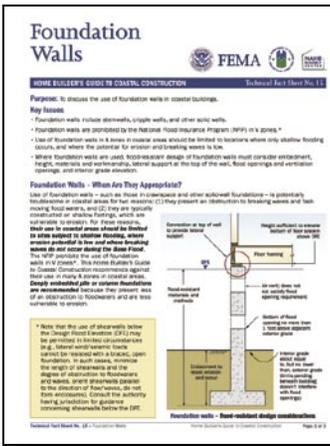
Use only where the following conditions exist: (1) where the soil is such that piles are not recommended; (2) where the pier cap is not subject to erosion; (3) where the pier cap is not subject to erosion; (4) where the pier cap is not subject to erosion.

Note: Piers are subject to erosion, settlement, and lateral loads. The foundation and footing size are critical to meeting these loads. Foundations and footing design must be checked by an engineer.

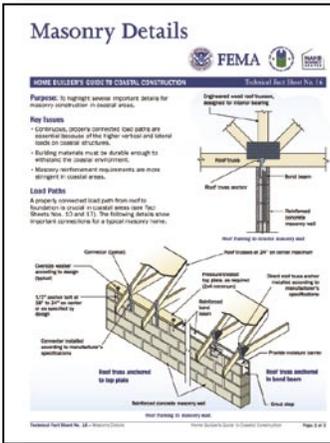
In coastal areas, masonry pier foundations are not recommended in V zones with erosion risk, or in A zones subject to waves and erosion — use pile foundations in these areas.

Technical Fact Sheet No. 14 - Reinforced Masonry Pier Construction Home Builder's Guide to Coastal Construction Page 2 of 9

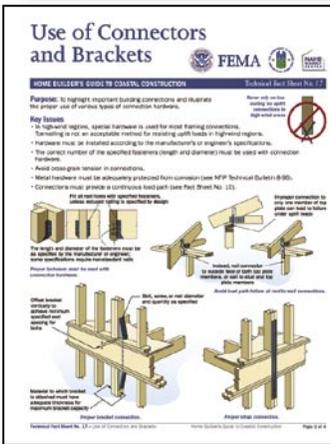
Fact Sheet No. 14, Reinforced Masonry Pier Construction – Provides an alternative to piles in V zones and A zones in coastal areas where soil properties preclude pile installation, but the need for an "open foundation system" still exists. Includes recommendations for good masonry practice in coastal environments.



Fact Sheet No. 15, *Foundation Walls* – Discusses and illustrates the use of foundation walls in coastal buildings. Topics include footing embedment, wall height, materials and workmanship, lateral support, flood openings and ventilation requirements, and interior grade elevations for crawlspaces.



Fact Sheet No. 16, *Masonry Details* – Illustrates important roof-to-wall and wall-to-foundation connection details for masonry construction in coastal areas. Topics include load paths, building materials, and reinforcement.



Fact Sheet No. 17, *Use of Connectors and Brackets* – Illustrates important building connections and the proper use of connection hardware throughout a building.



Fact Sheet No. 18, *Roof Sheathing Installation* – Presents information about proper roof sheathing installation and its importance in coastal construction; also discusses fastening methods that will enhance the durability of a building in a high-wind area. Topics include sheathing types and layout methods for gable-end and hip roofs, fastener selection and spacing, the treatment of ridge vents and ladder framing, and common sheathing attachment mistakes.

Roof Underlayment for Asphalt Shingle Roofs

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION Coastal Fact Sheet No. 19

Purpose: To provide recommended practices for use of roofing underlayment as an enhanced secondary water barrier in coastal environments.

Notes: The underlayment options illustrated here are for asphalt shingle roofs. See FEMA publication 55, Coastal Construction Manual, for guidance concerning underlayment for other types of roofs.

Key Issues:

- Verify proper attachment of roof sheathing to framing.
- Verify proper attachment of roof sheathing to framing.
- Lapping and fastening of underlayment and roof sheathing.
- Selection of underlayment material type.

Sheathing Installation Options:

The following three options are shown in order of decreasing resistance to roof uplift forces: 1) for greatest resistance, use plywood sheathing; 2) for moderate resistance, use OSB sheathing; 3) for least resistance, use 1/2" thick OSB sheathing. Option 1 provides the greatest resistance to uplift forces, it is advocated in many code provisions before being used in areas of high wind. Option 2 provides moderate resistance and is advocated only in areas with a moderate gust force density and a design wind speed less than or equal to 132 mph (Category 1 and 2).

Installation Sequence - Option 1:

- Install the roof covering in the field, over the deck (sheathing) to verify that it is well fastened to the deck (sheathing) with roof fasteners.
- Install underlayment over the roof covering in the field, over the deck (sheathing) to verify that it is well fastened to the deck (sheathing) with roof fasteners.
- Install underlayment over the roof covering in the field, over the deck (sheathing) to verify that it is well fastened to the deck (sheathing) with roof fasteners.

Fact Sheet No. 19, Roof Underlayment for Asphalt Shingle Roofs – Presents recommended practices for the use of roofing underlayment as an enhanced secondary water barrier in coastal environments. Optional installation methods are illustrated.

Asphalt Shingle Roofing for High-Wind Regions

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION Coastal Fact Sheet No. 20

Purpose: To recommend practices for installing asphalt roof shingles that will enhance wind coverings in high-wind, coastal regions.

Key Issues:

- Special installation methods are recommended for asphalt roof shingles used in high-wind, coastal regions (i.e., greater than 90 mph gust force wind speeds).
- Use manufacturer's instructions to ensure proper installation, including proper fastening, nailing, and fastening.
- Consult local building code for specific installation requirements. Requirements may vary locally.
- Always use underlayment. See Fact Sheet No. 19 for installation techniques in coastal areas.

Construction Guidance:

Follow shingle installation procedures for enhanced wind resistance.

Single Installation of Eaves:

Install shingles over the roof sheathing in the field, over the deck (sheathing) to verify that it is well fastened to the deck (sheathing) with roof fasteners.

Single Installation of Hips and Ridges:

Install shingles over the roof sheathing in the field, over the deck (sheathing) to verify that it is well fastened to the deck (sheathing) with roof fasteners.

Fact Sheet No. 20, Asphalt Shingle Roofing for High-Wind Regions – Recommends practices for installing asphalt roof shingles that will enhance the wind resistance of roof coverings in high-wind, coastal regions. Issues include installation at hips, eaves, and ridges; shingle characteristics; weathering and durability; and wind resistance.

Tile Roofing for High-Wind Areas

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION Coastal Fact Sheet No. 21

Purpose: To provide recommended practices for designing and installing tile roofing systems and their fasteners that will enhance wind resistance in high-wind areas.

Key Issues:

- Roofs are only suitable for tile roofing in high-wind areas if they are designed and installed in accordance with the design and construction requirements for tile roofing in high-wind areas.
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Attachment Methods: Storm damage investigations have shown that tile roofs are vulnerable to wind damage. The most common failure mode is the detachment of tiles from the roof sheathing. This is caused by the wind lifting the tiles and causing them to impact the roof sheathing. This impact causes the tiles to become dislodged and fall to the ground. This is a major cause of roof damage in high-wind areas.

Design and Construction Requirements: To ensure high-wind resistance, licensed contractors should be selected. The roof must meet design requirements for high-wind areas. The roof must be designed and constructed in accordance with the design and construction requirements for tile roofing in high-wind areas.

Fact Sheet No. 21, Tile Roofing for High-Wind Areas – Presents design and construction guidance for tile roofing attachment methods. Topics include uplift loads, uplift resistance, special considerations concerning tile attachment at hips and ridges, tile installation on critical and essential buildings, and quality control.

Window and Door Installation

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION Coastal Fact Sheet No. 22

Purpose: To provide flashing detail concepts for window and door openings that provide adequate resistance to water intrusion in coastal environments.

Key Issues:

- Water intrusion around windows and door openings can occur due to poor installation of the window or door.
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ASTM E 2112: General information about windows and door openings is provided in the American Society for Testing and Materials (ASTM) Standard E 2112, a comprehensive information guide intended for use in testing windows and door openings. The standard provides information on testing and installation procedures for windows and door openings. The standard includes a variety of window and door details. The design should meet the details described in the standard and meet the manufacturer's installation instructions. The manufacturer's installation instructions should be followed in the field. The manufacturer's installation instructions should be followed in the field. The manufacturer's installation instructions should be followed in the field.

Specific Considerations: Flashing details for windows and door openings should be designed to provide adequate resistance to water intrusion. The flashing should be installed in accordance with the manufacturer's installation instructions. The flashing should be installed in accordance with the manufacturer's installation instructions. The flashing should be installed in accordance with the manufacturer's installation instructions.

Fact Sheet No. 22, Window and Door Installation – Presents flashing detail concepts for window and door openings that provide adequate resistance to water intrusion in coastal environments, do not depend solely on sealants, are integral with secondary weather barriers (e.g., housewrap), and are adequately attached to the wall. Topics include the American Society for Testing and Materials (ASTM) Standard E 2112 and specific considerations concerning pan flashings, Exterior Insulation Finishing Systems, frame anchoring, shutters, and weatherstripping.

Housewrap

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION Technical Fact Sheet No. 23

Purpose: To explain the function of housewrap, examine its attributes, and address common problems associated with its use.

Key Issues:

- Housewrap is not a vapor barrier. It is designed to allow water vapor to pass through.
- The intent is to use housewrap in building exterior assemblies to prevent air and water vapor from entering the building.
- Housewrap must be installed properly or it could cause more structural damage than proper installation, especially in logging, as the key to successful housewrap use.



Purpose of Housewrap: Housewrap serves as a multi-layer weather barrier. It not only minimizes the flow of air in and out of a house, but also blocks liquid water from entering as a result of rain. The unique characteristic of housewrap is that it allows water vapor to pass through it while blocking liquid water. The primary reason for this is the nature of the house, with penetrating outside liquid water rarely from entering the home.

When Should Housewrap Be Used? Almost all exterior building walls, at least before water penetration. If this water continually soaks the wall sheathing and framing members, problems such as rot and mold growth could occur. Housewrap stops water from penetrating the wall and allows it to drain away from the structure exterior, to be collected and removed. Housewrap is recommended to prevent water damage to the framing. Use in other climates may be at the discretion of the contractor. All exterior housewrap must provide protection through the wall cavity which is beneficial for insulating purposes.

Housewrap or Building Paper? To answer this question, it is important to know what attributes are most important for a particular climate. The attributes associated with secondary weather barriers are:

- Air permeability** - ability to allow air to pass through.
- Water permeability** - ability to prevent liquid water from passing through.
- Moisture resistance** - ability to prevent moisture absorption.
- Stability** - resistance to tearing and deterioration.

Technical Fact Sheet No. 23

Fact Sheet No. 23, Housewrap – Explains the function of housewrap, examines its attributes, and addresses common problems associated with its use. Topics include housewrap vs. building paper and housewrap installation.

Roof-to-Wall and Deck-to-Wall Flashing

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION Technical Fact Sheet No. 24

Purpose: To emphasize the importance of proper roof and deck flashing, and to provide typical and enhanced flashing techniques for coastal homes.

Key Issues:

- Proper performance of flashing and subsequent water intrusion is a common problem for coastal homes.
- Enhanced flashing techniques are recommended to areas that frequently experience high winds and driving rain.
- Water penetration of deck ledges can lead to rot and corrosion of structure leading to deck collapse.

Roof and Deck Flashing Recommendations for Coastal Areas:

- Always use flashing and other moisture barrier products.
- Use increased slopings for added protection.
- Do not rely on sealants as a substitute for proper flashing.
- Use fasteners that are compatible with all of the same side of metal as the flashing material.
- Use flashing cement at joints to help secure flashing.
- Use flashing over intersections (see Figure 1).
- Use step flashing that has a 2" to 4" overhang vertical leg that is normal.
- Use the top of step flashing with airtight sealant, with flashing modified to meet roof slope.
- Do not seal housewrap or building paper in step flashing.
- Use deck flashing.
- Follow proper installation sequence to prevent water penetration at deck ledger (see Figure 2).
- Leave gap between roof deck and flashing to allow for thermal (see Figure 3).
- Use caulk behind ledger to provide gap for drainage (see Figure 3).
- Use drainage board deck correction methods.
- Use roof bleed hole (1/2" and 2" for open and close drains).



Technical Fact Sheet No. 24

Fact Sheet No. 24, Roof-to-Wall and Deck-to-Wall Flashing – Emphasizes the importance of proper roof and deck flashing, and presents typical and enhanced flashing techniques for coastal homes.

Siding Installation and Connectors

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION Technical Fact Sheet No. 25

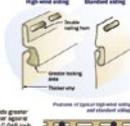
Purpose: To provide basic installation tips for various types of siding, including vinyl, wood, and fiber cement.

Key Issues:

- Always follow manufacturer's installation instructions.
- Use products that are suitable for a coastal environment. Many manufacturers do not use their products in a way that makes it easy to determine whether the product will be adequate for the coastal environment. Request suppliers to provide information about product suitability in the environment.
- Use high-wind installation procedures if available. These may include spacing nails closer together, using longer nails, or nails.
- Use recommended fasteners to avoid staining. Avoid using stainless steel fasteners.
- Coastal siding requires more maintenance than inland climates. The maintenance requirements need to be considered at time the selection and installation of siding.

Vinyl Siding: Vinyl siding can be used successfully in a coastal environment if properly installed.

- Choose siding that has been tested for high winds. These products usually have an enhanced nailing pattern and are sometimes made from heavier vinyl. Tight joints provide greater wind resistance, withstand debris, and do not get damaged by the salt. Spacing of fasteners should be 12" on center, depending on style and design. Thinner gauge vinyl walls will be more likely to crack, chip, or delaminate. Use 1/2" nails with high winds and extreme temperature changes.
- Position nails in the center of the nailing slot.
- Do not drive the head of the nail against the nail from further than the nail has been specifically designed for. Drive 1/2" or 3/4" nail clearance between the fastener head and the nailing slot.
- Do not drive the nails tight to prevent distortion and bowing in the panel.
- Do not use the panels where they meet the number of nailing points, outside corners, or joints. Do not cut the nailing points.
- Do not fastener or splice through siding.
- Use aluminum, galvanized steel, or other corrosion-resistant nails when installing vinyl siding. Aluminum pins require aluminum or stainless steel fasteners. Nail heads should be 5/16" inch minimum in diameter. Shank should be 1/8" inch in diameter.



Technical Fact Sheet No. 25

Fact Sheet No. 25, Siding Installation and Connectors – Provides basic installation tips for various types of siding, including vinyl, wood, and fiber cement.

Shutter Alternatives

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION Technical Fact Sheet No. 26

Purpose: To provide general information about the installation and use of storm shutters in coastal environments.

Why Are Storm Shutters Needed? Shutters are an important part of the protection of a building's exterior walls. They protect against windborne debris, which is often driven to coastal areas, which is often driven to coastal areas, which is often driven to coastal areas. They protect against windborne debris, which is often driven to coastal areas, which is often driven to coastal areas.

Where Are Storm Shutters Required and Recommended? Most building codes, which incorporate and provisions from ICC 703 (1998) and other codes, require that buildings with walls that are vulnerable to windborne debris be protected. The building code should be consulted for the specific requirements for the building. The building code should be consulted for the specific requirements for the building. The building code should be consulted for the specific requirements for the building.

Notes: Many coastal homes have large and unusually shaped windows, which will require custom, custom-made, alternatives. Alternatives, such as windows can be fabricated with laminated (tempered) glass.



Technical Fact Sheet No. 26

Fact Sheet No. 26, Shutter Alternatives – Presents general information about the installation and use of storm shutters in coastal environments. Shutter types addressed include temporary plywood panels; temporary manufactured panels; permanent, manual closing; and permanent, motor-driven.

Enclosures and Breakaway Walls

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION Technical Fact Sheet No. 27

Purpose: To discuss requirements and recommendations for enclosures and breakaway walls below the Base Flood Elevation (BFE).

Key Issues:

- Enclosures below enclosed buildings can be used only for building access, service, and storage.
- Areas enclosed by walls below the BFE ("enclosures") are subject to strict regulations under the National Flood Insurance Program (NFIP). Note that some local jurisdictions enforce stricter regulations for enclosures.
- Nonretaining enclosures are prohibited in V-zone buildings. Retaining enclosures in V-zones must meet specific requirements and must be certified by a registered design professional.
- Enclosures (breakaway and nonbreakaway) in A-zone buildings must be designed with flood damage reduction (FDR) and must be elevated to meet the design water depth.
- For V-zone enclosures below the design flooding, wall height must be higher than maximum permit height.

Special Below the BFE – What Can Be A Used Full?

Design: NFIP regulations state that the area below an elevated building must be used for building access, parking, and storage. These areas must not be finished or used for residential or business purposes. No mechanical equipment, or plumbing equipment is to be installed below the BFE.

What is an Enclosure?

An "enclosure" is a horizontal area located between the BFE or elevation of an area in a building. A zone building elevated on an open foundation (see Fact Sheet No. 23), without an enclosure or other alternative below the BFE, is subject to NFIP requirements and must be elevated to meet the design water depth. Enclosures in V-zones must be elevated to meet the design water depth. Enclosures in A-zones must be elevated to meet the design water depth. Enclosures in V-zones must be elevated to meet the design water depth.

Enclosures can be divided into two types: breakaway and non-breakaway.

Breakaway enclosures are designed for other than flood damage reduction by providing the intended building and below-BFE enclosure to be destroyed by flooding.



WARNING
Improper construction of enclosures below enclosed residential buildings can result in fatalities and property damage. Enclosures below the BFE must be elevated to meet the design water depth. Enclosures in V-zones must be elevated to meet the design water depth. Enclosures in A-zones must be elevated to meet the design water depth.

Design: The enclosure design should be designed to meet the design water depth. Enclosures in V-zones must be elevated to meet the design water depth. Enclosures in A-zones must be elevated to meet the design water depth.

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Fact Sheet No. 27, Enclosures and Breakaway Walls – Defines enclosures and breakaway walls, and discusses requirements and recommendations for their use below the Base Flood Elevation (BFE).

Decks, Pools, and Accessory Structures

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION Technical Fact Sheet No. 28

Purpose: To summarize National Flood Insurance Program (NFIP) requirements and general guidelines for the construction and installation of decks, pools and structures, swimming pools, and accessory buildings for coastal buildings.

Key Issues:

- Any deck, accessory building, or other construction element that is attached to or dependent on an elevated building must meet the NFIP regulatory requirements for construction in the V-zone (see NFIP Technical Bulletin 28-1 and Fact Sheet No. 2, 4, 6, 8, 11, 27, and 30). Attached construction elements that do not meet these requirements are prohibited.
- If permitted elements are attached to a building that is otherwise compliant with NFIP requirements, a separate permit may be required against the entire building.
- Swimming pools, accessory buildings, and other construction elements attached to the perimeter (top or side) of an elevated building must be designed to resist the design water depth. A design professional should consider their general effects on nearby buildings.
- The Home Builder's Guide to Coastal Construction provides requirements for all decks, pools, accessory structures, and other construction elements in a zone in coastal areas be designed and constructed to meet the NFIP regulatory requirements.

Decks

Requirements:

- If a deck is structurally attached to a V-zone building, the bottom of the lowest horizontal member of the deck must be elevated to exceed the elevation of the building's lowest horizontal member.
- A deck to be below the Design Flood Elevation (DFE) must be structurally independent of the main building and must not cause an obstruction.
- If an eligible, structurally independent deck is to be constructed, a design professional must evaluate the proposed deck to determine whether it will adversely affect nearby buildings (e.g., by diverting flood flows or creating damage).

Recommendations:

- Decks should be built on the same type of foundation as the primary building. Decks should be structurally independent of the primary structure and designed to resist the respective wind and wave loading.
- Attachment decks can be constructed from the primary structure. Use techniques to minimize the need for additional foundation members.



Design: The enclosure design should be designed to meet the design water depth. Enclosures in V-zones must be elevated to meet the design water depth. Enclosures in A-zones must be elevated to meet the design water depth.

Fact Sheet No. 28, Decks, Pools, and Accessory Structures – Summarizes NFIP requirements, general guidelines, and recommendations concerning the construction and installation of decks, access stairs and elevators, swimming pools, and accessory buildings under or near coastal residential buildings.

Protecting Utilities

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION Technical Fact Sheet No. 29

Purpose: To identify the special considerations that must be made when installing utility equipment, such as fuel, sewage, and water/sewage lines in a coastal home, and presents recommendations for utility protection.

Key Issues: Hazards, requirements, and recommendations

Special considerations must be made when installing utility systems in coastal homes. Proper placement and installation of utility and mechanical equipment is important to reduce the risk of damage caused by coastal winds and waves. Recommendations for protecting these lines from other structure, debris, and water are included in a neighborhood.

Coastal Hazards That Damage Utility Equipment

- Standing or moving floodwaters
- Impact from floating debris in floodwaters
- Erosion or scour from floodwaters
- High winds
- Whirlpools/misales

Common Utility Damage in Coastal Areas

Floodwaters (from coastal and inland) can cause damage to utility equipment and other critical damage.

Pool: Floodwaters can float and capture tanks, containers, and other critical components and cause gas accumulations. In extreme cases, damage to fuel systems can lead to fires.

Basement: Floodwaters can corrode and short critical electrical systems components, causing heating to electrical circuits. In coastal low areas, electrical panels can be high from attachments by the force of floating debris or the impact of floating debris.

Water Damage: Water can be exposed to erosion and water caused by floodwaters with velocity. Risk A damage buildup can occur over time without the structure flooding.

Basic Protection Methods:

The primary protection method is an elevation or component protection.

Elevation: Elevation refers to the location of a component and/or utility system above the Design Flood Elevation (DFE).

Component Protection: Component protection refers to the implementation of design techniques that protect a component or group of components from flood damage when they are located below the DFE.



Design: The enclosure design should be designed to meet the design water depth. Enclosures in V-zones must be elevated to meet the design water depth. Enclosures in A-zones must be elevated to meet the design water depth.

Fact Sheet No. 29, Protecting Utilities – Identifies the special considerations that must be made when installing utility equipment, such as fuel, sewage, and water/sewage lines in a coastal home, and presents recommendations for utility protection.

Repairs, Remodeling, Additions, and Retrofitting

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION Technical Fact Sheet No. 30

Purpose: To outline National Flood Insurance Program (NFIP) requirements for repairs, remodeling, and additions, and discusses opportunities for retrofitting in coastal flood hazard areas. Also presents recommendations for exceeding the minimum NFIP requirements. Definitions of "substantial damage" and "substantial improvement" are included.

Key Issues:

- Existing buildings that sustain substantial damage or that are substantially improved (see fact sheet No. 27) will be treated as new buildings and must meet the minimum NFIP construction requirements (e.g., meet floor elevation, foundation, and structural requirements).
- Work on any NFIP-eligible building that is not substantially damaged or substantially improved (see fact sheet No. 27) will be treated as NFIP reconstruction work.
- With a single minor exception (e.g., code updates and historic buildings), substantial damage and substantial improvement requirements apply to all buildings in the flood hazard area, whether or not a flood insurance policy is in force.
- Buildings damaged by flood and elevated to meet minimum flood height for additional protection through the Advanced Care of Compliance (ACC) safety provisions. Check with an insurance agent and the authority having jurisdiction (AHJ) for details.
- Repairs and remodeling – either before or after storm damage – provide many opportunities for retrofitting homes and making them more resistant to storm damage (see Figure 3).
- Building structural safety and other conditions in the region of a flood hazard may be addressed as follows:
 - Check with the AHJ for details.
 - Check with the AHJ for details.

Factors That Determine Whether and How Existing Buildings Meet Coastal NFIP Requirements:

When gauging the applicability of NFIP new construction requirements to existing buildings are working for many years – this fact sheet and Fact Sheet No. 2 provide guidance on the subject.



Design: The enclosure design should be designed to meet the design water depth. Enclosures in V-zones must be elevated to meet the design water depth. Enclosures in A-zones must be elevated to meet the design water depth.

Fact Sheet No. 30, Repairs, Remodeling, Additions, and Retrofitting – Outlines NFIP requirements for repairs, remodeling, and additions, and discusses opportunities for retrofitting in coastal flood hazard areas. Also presents recommendations for exceeding the minimum NFIP requirements. Definitions of "substantial damage" and "substantial improvement" are included.

