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Exterior Cladding Components and Best Practices

9.1 Introduction

Chapter 7 presented information on the building structure—specifically roof decking and wall systems. Chapter 8 presented information on roofing materials and coverings. This chapter discusses exterior wall coverings, also known as *cladding*. As in previous chapters, the information herein will present specific building code requirements first, followed by guidance (or industry best practices) for various cladding materials. When possible, a discussion will be included on how these systems may prove resistant to those natural hazards that are prevalent in coastal environments. The discussion of the building envelope will conclude in Chapter 10 with the presentation of design criteria and best practices related to doors and windows.

The building envelope includes: cladding, roof coverings, glazing, exterior walls, door assemblies, window assemblies, skylight assemblies, and other components enclosing the building. In coastal areas, the floors of buildings elevated on open foundations may also be considered part of the envelope. Unlike construction that occurs within inland areas, coastal construction must be designed and built to withstand high-wind events (which can trigger windborne debris), flood events (possibly including wave effects), and other issues, such as the corrosion of fasteners and connectors.

The building envelope can be one of the weakest and most susceptible components of a building. Far more common than structural failures, envelope failures often lead to water intrusion and progressive envelope failures over a larger part of the building. Envelope failures—typically involving a failed component that is itself small in magnitude—may result in disproportionately greater building damage (and associated repair costs) than that caused by the initial breach in the envelope.

The durability of the structure's envelope is dependent upon the type of materials used, the design, and the method of installation. Building envelope components have also been observed to be the predominant source of windborne missiles, as generated from damaged buildings. Close design attention should be given to buildings within special wind regions and within areas where the basic wind speed exceeds 90 mph (in 3-second gusts). Technical guidance for improving the performance of building envelope elements and systems within coastal areas can be found in FEMA 55 and in MAT and BPAT reports. FEMA 499 Technical Fact Sheets also provide specific information on exterior cladding material, installation, and general best-practice guidance for coastal areas.

9.2 Exterior Wall Coverings and Claddings

High winds and flooding are natural hazards that can cause severe damage to exterior wall systems. Seismic events can also damage heavy wall systems or coverings such as brick veneer. Large hail has been reported to damage walls, although widespread damage is uncommon.

A variety of systems can be used for exterior wall construction or cladding. The following wall coverings are commonly used over wood-frame and masonry construction: aluminum siding, cement-fiber panels or siding, exterior insulating finishing system (EIFS), stucco, vinyl, sawn-wood siding, and wood-panel siding. Each of these wall coverings can exhibit varying performance characteristics, including those related to permeability. While material such as vinyl is non-permeable, when used as a siding material it is designed to resist—but not prevent—water intrusion. Concrete and masonry walls function differently than framed and surfaced walls. While framed walls are designed to shed water; when not surfaced with cladding materials, concrete and masonry construction is designed to absorb water and release it through evaporation. FEMA 499, Technical Fact Sheet No. 8: *Coastal Building Materials* contains additional information on coastal building materials and best practices for selecting and using different materials.

NOTE

ASCE 7-05, Section 6.1.4.2, on components and cladding (C&C), requires that the minimum design pressure for C&C shall be +/- 10 psf regardless of the basic wind speed at a site.

After recent hurricanes, MAT reports have documented that wall coverings ripped from houses can become windborne debris, easily capable of damaging other structures. These reports also show that pressurization and damage to the interior contents of buildings is often the result of a progressive failure of the exterior wall covering. High winds are the most common cause of these initial failures. While compliance with current codes and standards will make buildings much less vulnerable to water entry and damage from debris impacts, some actions (considered "code plus" or best practices) have been shown to improve building-envelope performance. Those construction practices exceed code minimums and their use is often warranted when trying to achieve improved protection within a coastal environment.

9.2.1 Designing for Wind Forces

Exterior walls must be designed and built to withstand code-specified basic (design) wind speeds; this includes both MWFRS and C&C loads. Basic wind speeds can be found using wind maps from various codes and standards (ASCE-7-05 contains a wind map used by the IBC, IRC, and most contemporary construction standards). In coastal areas, wind speeds are generally greater, so the effects of high winds on exterior cladding are a primary concern in coastal construction.

NOTE

Another solution still being developed involves air-permeable wall coverings. The discussion of air-permeable roof coverings presented in Chapter 8 also applies to air-permeable wall coverings, such as siding. Research on special-pressure coefficients for air-permeable wall claddings need to be conducted before new code requirements can be developed.

Wind design of exterior wall coverings on residential structures can be performed using prescriptive or performance-based codes. The prescriptive solutions in both the IBC and the IRC concern areas where the basic wind speed is less than 110 mph (or less than 100 mph in hurricane-prone regions). In areas where the basic wind speed is 110 mph or greater (or 100 mph or greater in hurricane-prone regions), the prescriptive solutions of the IBC and IRC do not apply. For those areas, Section R301.2.1 references high-wind standards such as AF&PA's WFCM, the ICC-600, and the AISI *Standard for Cold-Formed Steel Framing: Prescriptive Method for One- and Two-Family Dwellings*. As an alternative to prescriptive designs (and as required for buildings that fall outside of the range of prescriptive solutions), buildings can be engineered to meet the requirements of the IBC, which requires that building components resist loads in accordance with ASCE 7-05.

Many jurisdictions are still using the SSTD 10 and following its prescriptive guidance for the main wind force resisting system (MWFRS) of the building envelope. Although this is a very helpful standard, this detail for C&C design is limited. The ICC-600 provides more detailed guidance on the building envelope and addresses both the MWFRS and the C&C.

IBC Requirements

Wall-covering requirements are covered primarily in Chapter 14 of the IBC. Various requirements are contained in Section 1405.1 (general), Section 1405.2 (weather protection), and Section 1405.3 (flashing). Requirements for specific wall-covering systems are contained in subsequent sections: Section 1405.5 (wood veneers), Sections 1405.5 and 1405.9 (anchored and adhered masonry), Section 1405.6 (stone veneers), Section 1405.7 (slab-type veneers), Section 1405.8 (terra cotta veneers), and Section 1405.10 (metal veneers). Some of the more common exterior cladding materials include vinyl siding (Section 1405.13) and fiber-cement siding (Section 1405.17).

Each section includes requirements that are unique to that style of cladding. For example, heavier cladding materials (such as masonry or stone) have additional seismic requirements identified. Lighter materials, such as vinyl siding, may have additional requirements concerning backing material and fastening.

IRC Requirements

Like the IBC, the IRC contains general requirements for all exterior systems, as well as more specific requirements for individual wall covering systems, which are contained in other sections. Section R703.1 contains general requirements for all systems. These general requirements include: providing the building with a weather-resistant envelope, proving flashing (with some exceptions), preventing the accumulation of water within the wall, and protections from condensation. Water-resistive barriers requirements are contained in Section R703.2 and general requirements for wall system attachments are outlined in Section R703.4.

Exceptions exist for Section R703.1 requirements that pertain to concrete and masonry construction (that are less vulnerable to water damage) and tested systems that provide the same performance as the systems prescribed in Section R703 without using the specific components required in Section R703.1.

Subsequent sections address specific exterior coverings: Section R703.3 (wood, hardboard, and wood structural panel siding), Section R703.5 (wood shakes and shingles), Section R703.6 (plaster or stucco), Section R703.7 (stone and masonry veneer), Section R703.9 (Exterior Insulation Finishing System, or EIFS), Sections R703.9.1 and R703.9.2 (specific EIFS requirements for water-resistive barrier and flashing), Section R703.10 (fiber-cement siding), and Section R703.11 (vinyl siding).

Moisture Barriers

The IBC and IRC recognize three methods of weather protection for walls: 1) walls can be constructed with flashing and water-resistant barriers (WRB) (see Figures 9-1 and 9-2), 2) walls can be constructed with an exterior wall system which has been certified to resist wind-driven rain, or 3) walls can be constructed with concrete or masonry.

The first method (which is often used with wood siding, cementitious stucco, and brick veneer) functions to prevent water from entering the cladding and provides drainage paths for water that does enter. The second method (which includes many EIFS, curtain walls, and other specialized systems) strives to prevent water from entering the cladding and may or may not have drainage provisions to address water that does enter. The third method utilizes weather protection (using concrete or masonry walls), which allows water to be absorbed by the building and then be released to the exterior or interior through evaporation.

The first two methods are referred to as "barrier methods," with the first method serving as a traditional barrier method. The general requirements set forth by the IBC (Section 1403.2) and IRC (Section R703.1) state that a building must have a weather-resistant exterior wall envelope (unless that building is constructed with a concrete or masonry wall system that meets IBC and IRC requirements). Alternatively, the wall envelope must be demonstrated to resist wind-driven rain through testing of the envelope (including joints, penetrations, and intersections constructed of dissimilar materials) in accordance with ASTM E 331 and in accordance with the conditions listed in the sections of the standards. For protection over studs or sheathing, the IBC requires "a minimum of one layer of No. 15 asphalt felt, complying with ASTM D 226 for Type 1 felt or other approved materials, shall be attached to the studs or sheathing." The IRC states the same stipulations, but goes further to say that such felt or material shall be applied horizontally, with the upper layer lapped 2 inches over the lower layer and 6 inches at vertical end joints.

Traditional barrier systems function best when an air space exists between the exterior cladding and the WRB. Thin furring strips can be installed between lapped siding and the WRB to create this air space. Systems that incorporate a drainage gap into the WRB are also available. When brick veneer is used, mortar should not fill the air gap between the veneer and the WRB, even though doing so is allowed by code.

Figure 9-1 and 9-2.
Examples of moisture barrier systems. (Source: FEMA 549)

In areas where the duration of severe or wind-driven rains is brief, the weather-protection methods allowed by the IBC and IRC should perform satisfactorily. In coastal areas, however, rains can be prolonged, severe, and frequently driven by high winds. Prolonged wind-driven rains can overwhelm the water-storage capacity of mass systems (i.e., concrete or masonry structures) and driving winds can create pressures that exceed those of tested systems. The use of traditional barrier systems with flashings and drainage paths should be considered within coastal areas. Tested systems are appropriate to use if they have been certified for wind speeds and rain conditions present within coastal environments. Mass systems will function best when multiple layers of moisture protection are implemented. For example, if the building skin utilizes concrete or masonry, the building will withstand the significant wind forces of a hurricane, but will likely be oversaturated by the sustained heavy rains that also accompany hurricanes. This will cause water damage and associated problems in the building (e.g., mold). To effectively control water intrusion, the layers of moisture control should be increased by adding siding over the concrete or masonry walls and designing proper drainage paths between the two materials.

If siding is used, proper lapping must be ensured to maximize moisture control (see Figure 9-3). Capillary action causes water to travel in all directions and allows water to infiltrate siding if lapping is installed incorrectly. It is important that siding is spaced with enough lap distance to limit water intrusion. Manufacturer specifications should always be followed during installation; for improved performance, consult with a design professional for a longer lap distance. More information can be found on FEMA 499, Technical Fact Sheet No. 9: *Moisture Barrier Systems*.

The use of a secondary layer of protection against wind-driven water infiltration (e.g., an air-barrier film) is recommended underneath wall coverings. Designers should specify that horizontal laps be installed so that water is allowed to drain from the wall (i.e., the top sheet should lap over the bottom sheet in order to allow water running down the sheets to remain on their outer face). The bottom of the secondary protection needs to be detailed to allow drainage.

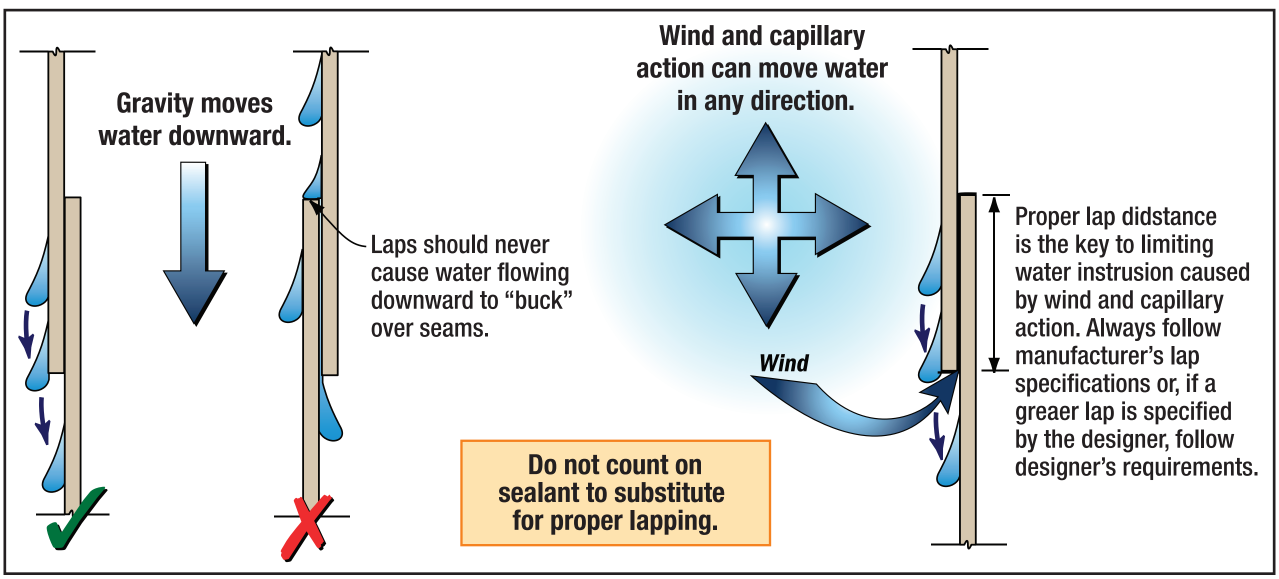


Figure 9-3.
Proper siding lapping to prevent moisture penetration. (Source: FEMA 499)

9.2.2 Flashings

Flashing is required by the IBC (Section 1405.3) and IRC (Section R703.8) in order to prevent moisture from entering the wall system or to redirect it to the exterior. Flashing is typically located at exterior door and window assemblies and at any penetrations, projections, or terminations in the exterior of the building. The poor performance of flashing, resulting in the loss of water-intrusion protection, is a common problem in many coastal homes. In areas that frequently experience strong winds, enhanced flashing details are recommended to provide better protection against wind-driven rain. Enhancements include flashings that have extra-long flanges, and the use of sealant and tapes. General guidance is offered herein, but it is recommended that designers also attempt to determine what type of flashing details have successfully been used within the area where the residence will be constructed.

Flashing design should recognize that wind-driven water can be pushed vertically. The height to which water can be pushed increases with wind speed. Water can also migrate vertically and horizontally by capillary action between layers of materials (e.g., between a flashing flange and house wrap).

9.3 Exterior Covering and Best Practices

While the exteriors of homes constructed to current building codes generally perform well in coastal environments, actions that go beyond code-minimums often improve building performance. Code-plus or best-practices approaches for common exterior-covering materials are presented in the following sections. With the evolution of modern building codes, approaches that have consistently resulted in good performance have been incorporated into codes and are now required.

Flashing guidance specific to roof/wall connections, windows, and doors is provided here. For more information, see FEMA 499, Technical Fact Sheets No. 22: *Window and Door Installation* and No. 24: *Roof-to-Wall and Deck-to-Wall Flashing*.

Roof/wall flashing. Specifically, roof and roof-to-wall flashing is addressed in Section 1503.2 of the IBC and Section R903.2 of the IRC. Figure 9-4 illustrates a good roof/wall flashing detail that is code-compliant and includes best practices recommended in this section. It recommends that where enhanced protection is desired above the code minimums, use step flashing that has a vertical leg that is 2 to 4 inches longer than normal. (This detail has been used successfully by a builder on the Delaware coast.)

Alternatively another recommendation (or for a more conservative design, in addition to the long leg), suggests taping the top of the vertical flashing to the wall sheathing with 4-inch-wide self-adhering modified bitumen roof tape. (Apply about 1 inch of tape on the metal flashing, and 3 inches on the sheathing.)

It is also considered good practice to extend the house wrap over the flashing in the normal fashion. It is important not to seal the house wrap to the flashing; if water reaches the house wrap higher up the wall, that moisture needs to be able to drain out at the bottom of the wall.

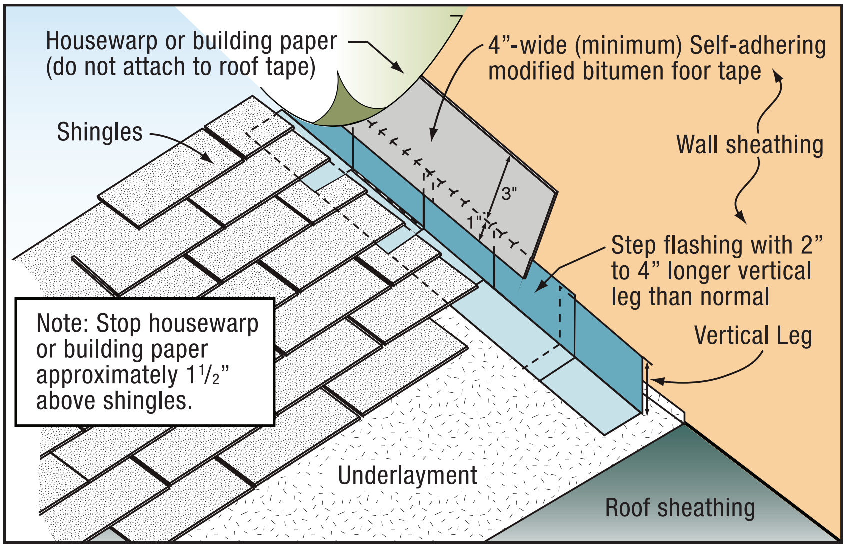


Figure 9-4.
Roof flashing. (Source: FEMA 499)

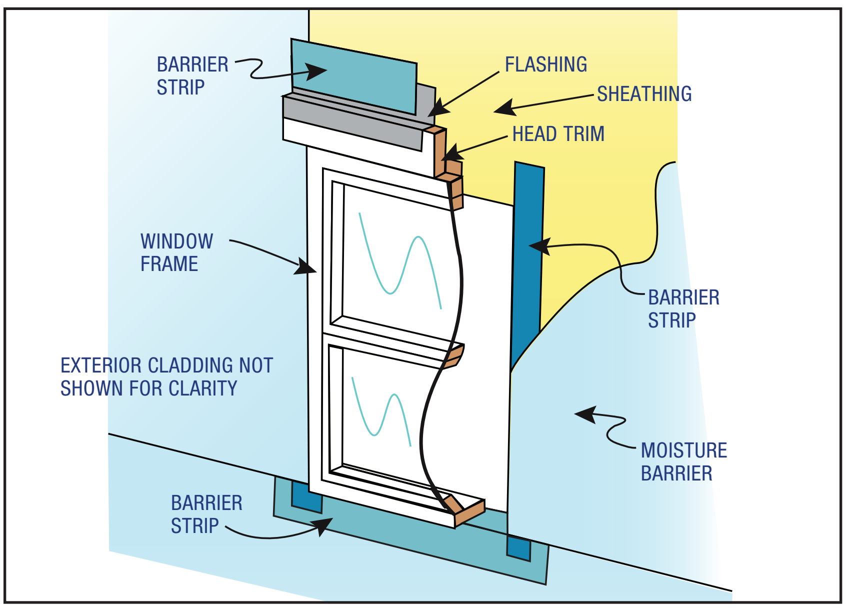


Figure 9-5.
Window flashing details.

Window/Door Flashings. For windows with nailing flanges, it is considered good practice to apply a generous bead of butyl sealant to the wall sheathing before setting the window. Then place the sealant inward of the fasteners. At sheathing joints, place sealant over the joint, from the window opening out past the flange. Place the house wrap over the head-trim flashing, and tape the flange to the housewrap with duct tape or modified bitumen roof tape. A recommended flashing detail is shown in Figure 9-5.

Conceptually, the exterior siding should not be thought of as the only barrier to water intrusion. The housewrap (typically required under most sidings), flashings, and underlayment must be used to shed and direct water away from openings in the building envelope. The overriding principle of successful water diversion is to install the layers of building materials correctly so that water cannot get behind any one layer and into an opening.

Vinyl Siding. Vinyl siding can successfully protect homes and function adequately within a coastal environment, if properly installed. Designers and builders should choose siding that is rated for high winds. These products typically have an enhanced nailing hem and are sometimes made from thicker vinyl. Figures 9-6, 9-7, and 9-8 provide details and illustrate proper installation techniques for vinyl siding. Thick, rigid panels provide greater wind resistance, withstand dents, and lie flatter and straighter against the wall. Panels that have performed well possess an optimum thickness ranging from 0.040 inch to 0.048 inch, depending upon the style and design. Also, many vinyl-siding systems must be installed over solid sheathing to perform at their rated wind speed without damage or failure. Manufacturers' installation instructions should contain this information and other requirements. More information can be found in FEMA 499, Technical Fact Sheet No. 25: *Siding Installation and Connectors*.

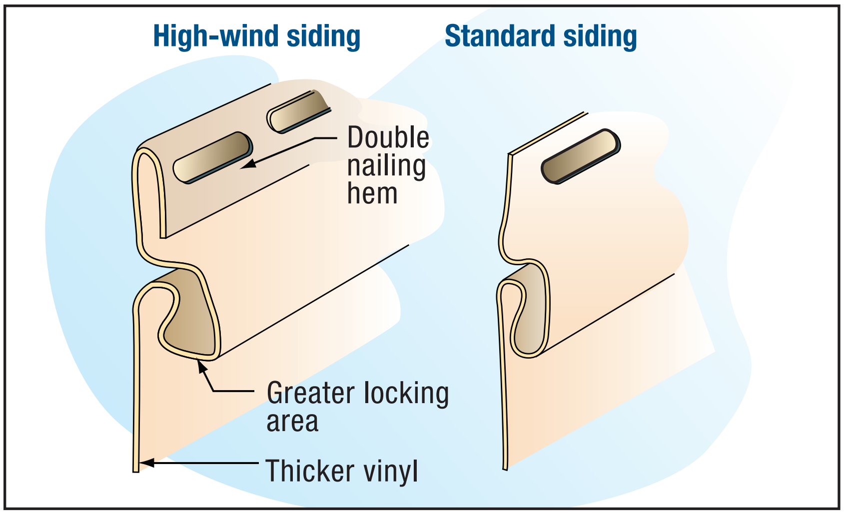
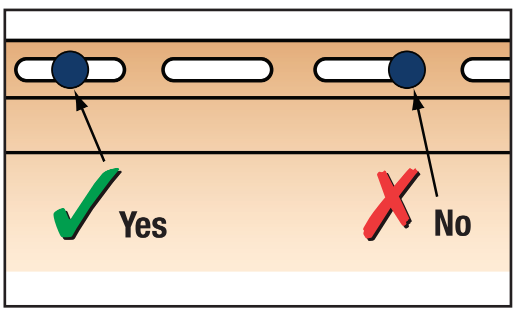


Figure 9-6.
Comparison of typical high-wind siding verses standard siding.
(Source: FEMA 499)



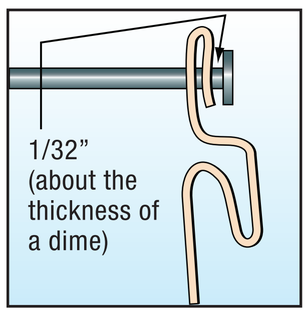


Figure 9-7.
The center of the nailing slot is the proper fastener location.
(Source: FEMA 499)

Figure 9-8.
Proper fastener clearance.
(Source: FEMA 499)

After Hurricane Katrina, the FEMA MAT Report (FEMA 549) concluded that, while much of the vinyl siding damage from the storm was due to application deficiencies (i.e., excessive spacing of fasteners), the siding observed was rated only for 90 mph basic wind speeds (at 3-second gusts) yet it was installed in an area without code-specific basic wind speeds of 110 to 120 mph. Findings reported in the Hurricane Charley MAT (FEMA 488) Report also show that vinyl siding frequently tears around the fasteners during high-wind events. Some general recommendations to improve the performance of vinyl siding within coastal areas include:

- Drive nails straight and level to prevent distortion and buckling in the panel.

- Do not caulk the panels where they meet the receiver of inside corners, outside corners, or J-trim. Do not caulk the overlap joints.

- Do not face-nail or staple through siding.
- Use aluminum, galvanized steel, or other corrosion-resistant nails when installing vinyl siding. Aluminum trim pieces require aluminum or stainless steel fasteners.
- Nail heads should be no less than 5⁄16 of an inch in diameter. Shank should be 1⁄8 inch in diameter. (Source: FEMA 499)

Wood Siding. Many requirements for wood siding materials are cited in Chapter 23 of the IBC, but the detailed design and fastening of wood siding needs to be calculated according to the C&C loads described in ASCE 7. The IRC gives C&C loads in Table R301.2(2) that are applicable to designing and selecting wood-siding systems for wind speeds up to 110 mph. Section R603.7 provides prescriptive guidelines for areas in which the basic wind speed is less than 110 mph. To meet the design requirements when the wind speed exceeds 110 mph (for these code sections), a designer must determine wind loads per the IBC or other publications referenced in Chapter 3 of this guide. Figure 9-9 shows an example of each layer of material applied to the exterior of a wood-framed house using wood siding. Some general recommendations to improve the performance of wood siding within coastal areas include:

- Use naturally decay-resistant wood—such as redwood, cedar, or cypress.
- Back-prime wood siding before installation.
- Carefully follow the manufacturer's detailing instructions to prevent excessive water intrusion.
- Use high-quality stainless-steel nails to prevent siding damage (i.e., staining).

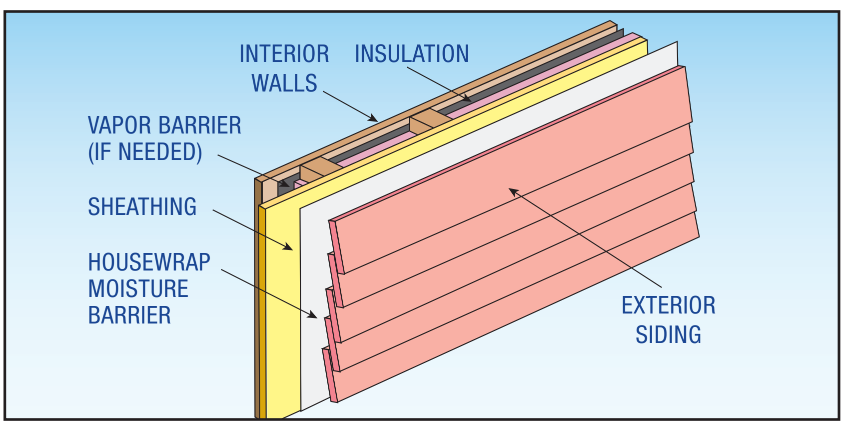


Figure 9-9.
Example of wood siding on a wood-framed house.

Brick Veneer. The current masonry code referenced in the IBC and IRC is ACI 530-08/ASCE 5-08/TMS 402-08, 2008 Building Code Requirements for Masonry Structures. This code provides both prescriptive and performance-based requirements. Brick-veneer construction in residential applications tends to follow prescriptive requirements. Brick veneer is addressed by the IRC with prescriptive minimum requirements for sizing and spacing of masonry ties. In high-wind areas (where more than 30 pounds per square foot of pressure is applied to the brick), each tie is not permitted to support more than 2 square feet of wall area. The ICC-600 provides design requirements that vary with design wind speed. At greater speeds, ties are required to be designated as a percentage of the tributary area that would be used at lower wind speeds. Figures 9-10 and 9-11 illustrate how brick veneers failed during Hurricane Katrina, due to improper design and construction of the wall covering.

Appendix E of FEMA Hurricane Katrina Recovery Advisory (*Attachment of Brick Veneer in High-Wind Regions*) provides recommended practices for brick-veneer attachment. This advisory was based upon observations from hurricanes Ivan and Katrina.

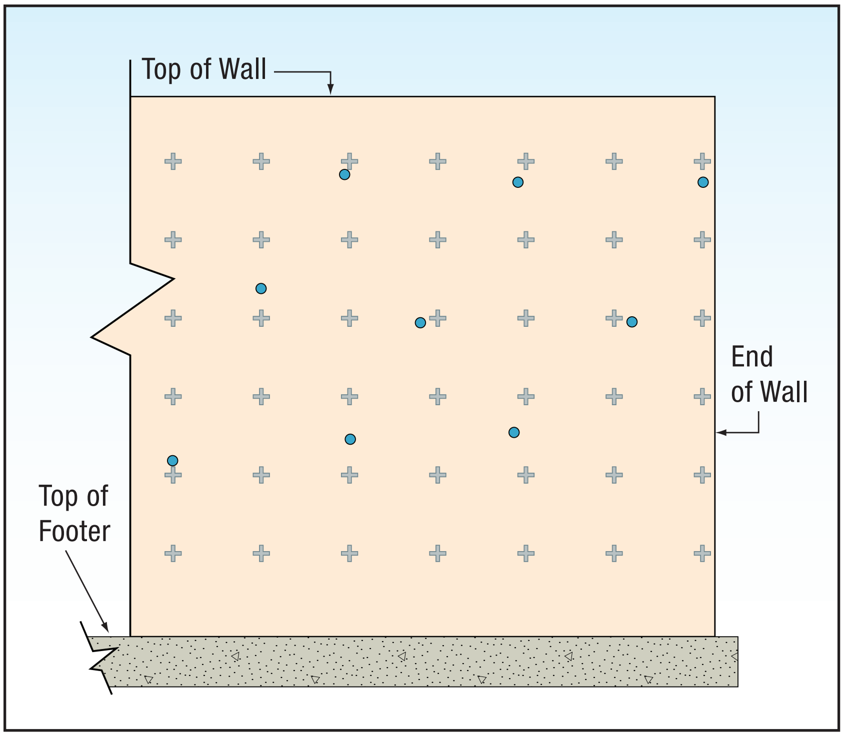


Figure 9-10.
This figure illustrates the layout of brick ties at house under construction in Ocean Springs, Mississippi, observed after Hurricane Katrina. At this wall, nine ties were installed (blue circles); however, 42 ties ("+" symbol) are needed to comply with the advisory. (Source: FEMA 549)

Figure 9-11.
WAVELAND, MISSISSIPPI:
House with collapsed brick veneer as a result of insufficient wall ties. (Source: FEMA 549)

Exterior Insulation and Finish System (EIFS). This exterior wall covering system has been assessed in detail in FEMA MAT reports and the official should consult FEMA 488, 489, and 549 for information related to the performance of these systems following storm events. In addition, the official should consult the manufacturer's product information before making a final determination on the suitability of the system for the requested application.

9.4 Exterior Floor Coverings

Residential buildings located near the ocean are almost always elevated. In such a structure, the space underneath the building is exposed to the elements unless it has been enclosed with sheathing or another weather-resistant covering. Applying sheathing to the underside of the bottom-floor joists or trusses helps minimize corrosion of framing connectors and fasteners by limiting exposure to salt spray and other environmental factors. The sheathing also protects insulation installed between the joists/trusses from the effects of wave spray. (If fiberglass insulation is installed, the paper or foil face should be installed adjacent to the underside of the floor decking. Barring this, the insulation should be faced correctly if a moisture trap is used, so that downward water-vapor migration is not impeded. For long-term durability, exterior-grade sheathing is recommended for the exposed sheathing and it should be fastened with stainless-steel or hot-dipped galvanized nails or screws.)

Suction forces induced by high winds will cause floor systems to be pulled downward. Installing rated roof sheathing at under-floor applications and securing it to the floor framing using the same nailing schedule as that required for roof sheathing will adequately secure the under-floor sheathing. To prevent moisture from being trapped, the floor-joist cavity created by the under-floor sheathing should be vented. Figure 9-12 shows how the exterior floor covering (which was damaged during the event itself) prevented decay of the floor system and may have contributed to the survival of the building.

Figure 9-12.
Example of an exterior floor covering system damaged by Hurricane Ivan. Note the good condition of the floor joists and flooring, due to their protection from salt spray prior to the storm. (Source: FEMA 489)

9.5 Soffits

Vinyl (along with aluminum) is also a commonly used material for soffits in residential buildings. However, aluminum and vinyl soffits are very prone to failure when exposed to high winds. If the soffits of a home fail, wind-driven rain can enter the ceiling and areas above the top of the wall and cause extensive water damage. Also, loss of soffits can increase internal pressures and lead to loss of the roof sheathing and, ultimately, to building failure.

To perform adequately, these building elements must be able to resist suction (i.e., downward) pressure and positive (upward) pressure. The general requirements (that include wind loads) contained in Section 1609.1 of the IBC and in Section R301.1 of the IRC mandate that all portions of buildings (this includes soffits) resist design-wind pressures. However, neither the IRC nor the IBC include prescriptive designs for soffits and very little industry guidance or information about best practices exists. In the IRC, most of the attention given to soffits focuses on fire resistance. Section R703.11.1 requires that "vinyl siding, soffit and accessories shall be installed in accordance with the manufacturer's installation instructions."

Recent assessments of high-wind events—most notably FEMA 488 (in Florida) and FEMA 549 (in the Gulf Coast)—report widespread failures in building soffits. The lack of prescriptive designs for vinyl soffits has likely contributed to these widespread failures. The MAT reports recommend that research be performed so that prescriptive requirements may be developed and proposed for adoption in the I-codes.

9.6 Concrete and Masonry Walls

Concrete and masonry walls are valued in coastal construction for their ability to resist high wind loads and windborne debris when properly grouted and reinforced. However, with respect to drainage, the material properties of both concrete and masonry allow them to absorb water into their mass for evaporation later. When exposed to long, sustained periods of rain, the water-storage capacities of concrete and masonry assemblies may be overwhelmed, forcing excess water to the interior of the building. Thus, the moisture-collecting properties of these wall systems may not yield positive results. While both the IBC (Section 1403.2) and IRC (Section R703.1) allow concrete and masonry walls to be installed without water-resistive barriers, it is recommended that a properly installed exterior cladding system with a water-resistive barrier be installed to provide excellent overall protection within coastal areas.

NOTE

Durability: To avoid corrosion problems, stainless steel or hot-dipped galvanized fasteners (preferably heavy-duty, hot-dipped galvanized fasteners) are recommended for buildings located within 3,000 feet of an ocean shoreline. If air can freely circulate in a cavity (i.e., above a soffit), access panels should be provided so components within the cavity can be periodically observed for corrosion. In areas with severe termite problems, if the use of wood is specified, it should be pressure-treated.

Siding, panels (e.g., textured plywood), and stucco over masonry and concrete typically perform well during high winds. The key to the successful performance of a siding and panel system is proper attachment, involving a sufficient number of proper corrosion-resistant fasteners (based upon design loads and tested resistance) that are correctly located. The dislodging of stucco applied directly to concrete walls has occurred in areas where wire mesh was not applied over concrete.

Where required by code, concrete and masonry walls (and veneers) need to be designed for the seismic load. When the use of a heavy covering (such as stucco, cement-fiber panels or siding, or brick veneer) is specified, the seismic design should account for the added weight of the material, and its connection to the base material (in the case of veneer). Inadequate connection of veneer material to the base substrate has been a problem during past earthquakes and can result in a life-safety hazard. Some non-ductile coverings (e.g., stucco and cement-fiber products) may become cracked during seismic events. If the use of these coverings is specified in areas prone to large ground-motion accelerations, the structural sheathing behind the covering should be designed with additional stiffness to minimize damage to the wall covering.

Fiber-cement siding is a product used in applications similar to wood siding materials. Following flood events, it was noted to be an effective exterior siding within those areas exposed to sustained floodwaters. Careful consideration should be given to the installation procedures required for these products and the manufacturer's recommendations should be consulted for proper application. Anecdotal evidence following Hurricane Katrina noted that for wood-framed buildings it was important that the siding be attached to the building at the stud locations and that this distance should not exceed 24 inches. The siding should not have fasteners within 1 inch of the top of the siding. The manufacturer should be consulted on whether concealed fasteners are appropriate based upon the building's required design wind speed.

For buildings in areas prone to wildfires, the greatest protection is offered by concrete, masonry, stucco, or cement-fiber panels or siding. Sheathing the underside of joists or trusses with a fire-resistant material (such as cement-fiber panels) is recommended. Cement-fiber panels should be attached with stainless steel or hot-dipped galvanized screws. If a wall surface is specified, a fire-resistive system should also be specified for soffits (e.g., stucco or cement-fiber). Gable and soffit vents should have openings covered with wire mesh that itself has openings no greater than 1/4 inch, in order to inhibit the entry of burning brands. For added protection, non-combustible hinged shutters that can quickly be placed in the "closed" position could be designed and installed.

NOTE

Additional guidance on seismic-resistant residential construction can be found in FEMA 232, *Homebuilders' Guide to Earthquake Resistant Design and Construction*. This guide provides supplemental information on the 2003 IRC and also includes "above-code recommendations" and low-cost measures to improve building performance.