Coastal Building Materials

Purpose: *To provide guidance and best practices on selecting building materials to use for coastal construction.*

Key Issues

This fact sheet will cover special considerations that must be made when selecting building materials for a coastal building. The harsh environment requires that more substantial building materials be used and more care taken when using these materials in order to ensure durability, hazard resistance, and reduce maintenance. The materials discussed can be used when dealing with both flood and wind hazards. Other factors such as corrosion and decay resistance will also be covered. Although proper design is a key element it will be for naught if the proper materials are not selected. This fact sheet is also intended to provide the reader an idea of what the best practice should be when selecting a material for a coastal building. The following are some key considerations when screening materials.

Select building materials that can endure periodic flooding.

- Materials and construction methods in a coastal environment should be resistant to ***flood and wind damage, wind-driven rain, corrosion, moisture, and decay (due to sunlight, aging, insects, chemicals, temperature, or other factors).***
- Ease of installation or the ability to properly install the material should be a major consideration for the selection of materials.
- All coastal buildings will require ***maintenance and repairs*** (more so than inland construction) — use proper materials and methods for repairs, additions, and other work following initial construction (see Fact Sheets Nos. 9.1, *Repairs, Remodeling, Additions and Retrofitting – Flood* and 9.2, *Repairs, Remodeling, Additions and Retrofitting – Wind*).

The durability of a coastal home relies on the types of materials and details used to construct it. For flood-related information, see NFIP Technical Bulletin 2, *Flood Damage-Resistant Material Requirements for Buildings Located in the Special Flood Hazard Areas in accordance with the National Flood Insurance Program* 8/08. For other natural hazards, see the *Institute for Business and Home Safety Fortified…for Safer Living® Builder's Guide*.

Flood-Resistant Materials

Flooding accounts for a large percentage of the damage caused by a coastal storm, which is why building materials must be flood damage-resistant. The NFIP defines a ***flood damage-resistant material*** as "any building material capable of withstanding direct and prolonged contact (i.e., at least 72 hours) with floodwaters without sustaining significant damage (i.e., requires more than cosmetic repair)." The cost of cosmetic repair should be less than the cost of replacing building materials. Although flood-resistant materials typically refer to areas below the BFE, they may be appropriate in areas above the BFE in order to limit the amount of damage caused by wind-driven rain. **All building materials below the BFE must be flood damage-resistant,** regardless of expected or historic flood duration.

Section 60.3(a)(ii) of the National Flood Insurance Program (NFIP) regulations requires that all new construction and substantial improvements in flood-prone areas be constructed with materials below the Base Flood Elevation (BFE) that are resistant to flood damage. (See Fact Sheet No. 9a for a definition of "substantial improvement.")

The following are examples of flood-resistant materials:

- **Lumber:** Preservative-treated or naturally durable wood as defined in the International Building Code. Naturally durable wood includes the heartwood of redwood, cedar, black locust, and black walnut.
- **Concrete:** A sound, durable mix, and when exposed to saltwater or salt spray, made with a sulfate-resisting cement, with a 28-day compressive strength of 5,000 psi minimum and a water-cement ratio not higher than 0.40—such mixes are usually nominally more expensive and rarely add significant cost to the project (consult ACI 318-02, Building Code Requirements for *Structural Concrete and Commentary* by the American Concrete Institute). Reinforcing steel used in concrete or masonry construction in coastal areas should not be left exposed to moisture and should not be stored on bare ground. The reinforcing steel should be free from rust and clearances should be maintained as shown on the design drawings.
- **Masonry:** Reinforced and fully grouted. If left unfilled, then masonry block cells can create a reservoir that can hold water and can make the masonry difficult to clean following a flood.
- **Structural Steel:** Coated to resist corrosion.
- **Insulation:** Plastics, synthetics, and closed-cell foam, or other types approved by the local building official.

The following are examples of materials that are unacceptable below the BFE:

- Normal, water-soluble adhesives specified for above-grade use or adhesives that are not resistant to alkali or acid in water, including groundwater seepage and vapor.
- Materials that contain paper-based materials, wood-based materials, or other organic materials that dissolve or deteriorate, lose structural integrity, or are adversely affected by water.
- Sheet-type floor coverings (e.g., linoleum, vinyl) or wall coverings (e.g., wallpaper) that restrict drying of the materials they cover.
- Materials that become dimensionally unstable when subject to wetting and drying.
- Materials that absorb water excessively or maintain a high moisture content after submergence.
- Wiring, outlets, and electrical components not designed to be flood resistant. It is important to locate any materials like these above the expected floodwater elevation. When this is not possible, it is important to allow for the isolation of these components.

Flood insurance will not pay a claim for damages to finish materials located in basements or in enclosed areas below the lowest floor of elevated buildings, even if such materials are considered to be flood damage-resistant. NFIP claims for damages below the BFE are limited to utilities and equipment, such as furnaces and water heaters.

This table lists examples of flood-resistant materials used in coastal homes.

Location of Material Use	Name of Material
Piles and Posts	Preservative-treated round, tapered wood piles; square-cross section piles; or wood posts.
Piers	Reinforced concrete or concrete masonry units (CMU) (see the section "Flood-Resistant Materials" and Fact Sheet No. 3.4, *Reinforced Masonry Pier Construction*).
Foundation Walls	Reinforced concrete or CMU, or wood that is preservative-treated for foundation or marine use (see Fact Sheet No. 3.5, *Foundation Walls*).
Beams	Solid sawn timbers and glue-laminated timber products, either naturally durable wood or preservative-treated for above ground exposure; built-up members preservative-treated for ground contact.
Decking	Preservative-treated or naturally durable wood
Framing	Sawn lumber or manufactured lumber that is preservative-treated or naturally durable wood if in close proximity to the ground.
Exterior Sheathing	Plywood that is marine grade or preservative-treated, alkaline copper quaternary (ACQ) or copper azole (C-A)
Subflooring	Plywood that is marine grade or preservative treated, alkaline copper quaternary (ACQ) or copper azole (C-A). (Although providing additional freeboard is recommended, as a redundant hazard mitigation measure, a flood-resistant material can also be considered for the subflooring).

Location of Material Use	Name of Material
Siding	Vinyl siding, fiber cement siding, or heartwood of naturally durable species (see Fact Sheet No. 5.3, *Siding Installation in High-Wind Regions*).
Flooring	Latex or bituminous cement formed-in-place, clay, concrete tile, pre-cast concrete, epoxy formed-in-place, mastic flooring, polyurethane formed-in-place, rubber sheets, rubber tiles with chemical-set adhesives, silicone floor formed-in-place, terrazzo, vinyl sheet-goods, vinyl tile with chemical-set adhesives, preservative-treated lumber or lumber from naturally durable wood. (Some tile types attached with ordinary mastic or thin set mortar may not be flood resistant and should be avoided. Verify with a manufacturer that a flooring material is flood-resistant.)
Walls and Ceilings	Cement board, brick, metal, cast stone in waterproof mortar, slate, porcelain, glass, glass block, clay tile, concrete, CMU, preservative-treated wood, naturally durable wood, marine grade plywood, or preservative-treated plywood.
Doors	Metal doors, either hollow, wood core, and foam-filled core should be evaluated after exposure to salt water flooding. Fiberglass, wood core doors may be another alternative to consider.
Insulation	Sprayed polyurethane foam (SPUF) or closed-cell plastic foams
Trim	Preservative-treated or naturally durable wood or artificial stone, steel, or rubber

Although the materials listed are considered flood-resistant materials, some sidings and wall coverings may need to be removed from framing members following a flooding event in order to allow the system to properly dry. For more information on repair techniques after a flood, see FEMA 234, *Repairing Your Flooded Home* (08/92).

Many jurisdictions will provide a list of approved flood-resistant materials that can be used in their local coastal environments. Check these lists and include all proposed construction and materials in approved plans.

Wind-Resistant Materials

Homes in many coastal areas are often exposed to winds in excess of 90 mph (3-second peak gust). Choose building materials (e.g., roof shingles, siding, windows, doors, fasteners, and framing members) that are designed for use in high-wind areas.

Examples:

- Roof coverings rated for high winds (see Roofing Category, Fact Sheet Nos. 7.1–7.6)
- Double-hemmed vinyl siding (see Fact Sheet No. 5.3, *Siding Installation in High-Wind Regions*)
- Deformed-shank nails for sheathing attachments (see Fact Sheet No. 7.1, *Roof Sheathing Installation*)
- Wind-borne debris resistant glazing (see Fact Sheet No. 6.2, *Protection of Openings – Shutters and Glazing*)
- Reinforced garage doors
- Tie-down connectors used throughout structure (from roof framing to foundation — see Fact Sheet Nos. 4.1, *Load Paths* and 4.3, *Use of Connectors and Brackets*)
- Wider framing members (2x6 instead of 2x4)

As hurricanes in recent years have proven, even well-selected materials can fail if not installed properly. Proper installation requires attention to detail, following the manufacturer's recommended installation procedures, and proper maintenance. When selecting a material or building component it is important to consider the level of difficulty required to properly install the material. Improper installation of materials may expose the building's systems to wind loads that the systems were not designed to resist. Also, it is important to verify that any special requirements were followed and that specialized tools or adhesives were used. Even a building component that exceeds the design requirements can fail if it is installed incorrectly.

Corrosion and Decay Resistance

Buildings in coastal environments are prone to damage from corrosion, moisture-related decay, and termite damage to building materials. Metal corrosion is most pronounced on coastal homes (within 3,000 feet of the ocean), but moisture-related decay and termite damage are prevalent throughout coastal areas.

Corrosion-Resistant Metals

Preservative-treated wood used in a coastal environment often contains chemical preservatives such as Alkaline Copper Quat (ACQ), Copper Azole (CA-C), Dispersed or Micronized Copper (μCA-C), or Copper Naphthenate (CuN-W). The connectors and fasteners used in conjunction with these pressure-treated wood products should be properly selected and it should be verified that the connectors are compatible with the wood preservative. According to the 2009 International Residential Code (IRC) R317.3.1 and International Building Code (IBC) 2304.9.5.1 the fasteners should be compatible with the wood preservative per the manufacturer's recommendations. The fasteners shall be hot-dip zinc-coated galvanized steel, stainless steel, silicon bronze, or copper. If the manufacturer's recommendations are not available, then corrosion protection in accordance with ASTM A 653 type G185 for zinc-coated galvanized steel or equivalent is required. Exceptions to this rule may be noted in the building code.

Metals corrode at a much faster rate near the ocean. Always use well-protected hardware, such as this connector with thick galvanizing. (For information about pile-to-beam connections, see Fact Sheet No. 3.3, Wood Pile-to-Beam Connections.)

The term ***corrosion-resistant*** is widely used but, by itself, is of little help to those specifying or evaluating materials for use in a coastal home. Every material resists corrosion to some extent, or conversely, every material corrodes.

The real issue is *how long will a given material serve its intended purpose at a given home?* The answer depends on the following:

- The material.
- Where it is used in the home.
- Whether installation techniques (e.g., drilling, cutting, bending) will compromise its resistance.
- Its degree of exposure to salt air, moisture, and corrosive agents.
- Whether maintenance required of the homeowner is performed.

The bottom line: Do not blindly specify or accept a product just because it is labeled *corrosion-resistant.* Evaluate the nature of the material, its coating type and thickness (if applicable), and its performance in similar environments before determining whether it is suitable for a particular application.

For guidance on the selection of metal hardware for use in coastal environments, consult an engineer with experience in corrosion protection. For more information about corrosion in coastal environments, see FEMA Technical Bulletin 8-96, *Corrosion Protection for Metal Connectors in Coastal Areas* (see the "Additional Resources" section).

Recommendations

- Use hot-dip galvanized steel or stainless steel hardware. Stainless steel hardware is acceptable in virtually all locations, but hot-dip galvanized hardware may not be appropriate in every location. Reinforcing steel should be protected from corrosion by sound materials (e.g., masonry, mortar, grout, concrete) and good workmanship (see Fact Sheet No. 4.2, *Masonry Details*). Use galvanized or epoxy-coated reinforcing steel in areas where the potential for corrosion is high (see Fact Sheet No. 3.4, *Reinforced Masonry Pier Construction*).
- It is important to verify that the connector plate and the fastener are the same type of metal. Avoid joining dissimilar metals, especially those with high galvanic potential (e.g., copper and steel) because they are more prone to corrosion.

- Metal-plate-connected trusses should not be exposed to the weather. Truss joints near vent openings are more susceptible to corrosion and may require increased corrosion protection. Verify the connectors used near any roof vent openings are stainless steel or a minimum of ASTM A 653 type G185 zinc-coated galvanized steel or equivalent.
- Due to the potential for galvanic corrosion, standard carbon-steel, aluminum, or electroplated fasteners and hardware are not recommended for direct contact with preservative-treated wood.
- The use of aluminum flashing with many types of treated wood should be avoided. Aluminum will corrode quickly when in contact with most wood preservatives. Copper flashing in many instances is the best choice although products such as vinyl flashing are becoming more common.

Moisture Resistance

Moisture-resistant materials can greatly reduce maintenance and extend the life of a coastal home. However, such materials by themselves cannot prevent all moisture damage. Proper design and installation of moisture barriers (see Fact Sheet No. 1.9, *Moisture Barrier Systems*) are also required.

Wood decay at the base of a wood post supported by concrete.

Recommendations

- Control wood decay by separating wood from moisture, using preservative-treated wood, using naturally durable wood, and applying protective wood finishes.
- Use proper detailing of wood joints and construction to eliminate standing water and reduce moisture absorption by the wood (e.g., avoid exposure of end grain cuts, which absorb moisture up to 30 times faster than the sides of a wood member).
- Do not use untreated wood in ground contact or high-moisture situations. Do not use untreated wood in direct contact with concrete.
- Field-treat any cuts or drill holes that offer paths for moisture to enter wood members. Field treatment shall be done per M4-06 of the American Wood-Preservers' Association.
- For structural uses, employ concrete that is sound, dense, and durable; control cracks with welded wire fabric and/or reinforcing, as appropriate.
- Use masonry, mortar, and grout that conform to the latest building codes.
- Cavity wall systems (two masonry wall systems separated by a continuous air space) should be avoided in flood-prone areas since they can fill with water, retain moisture, and be difficult to repair without a significant level of demolition.
- Consider the interior finishes for first floors where floodwaters exceeding the design event could cause significant damage (See Fact Sheet No. 1.6, *Designing for Flood Levels Above the BFE*). It is also important to consider that wind-driven rain can cause damage to interior finishes around door and window openings.

Termite Resistance

Termite damage to wood construction occurs in many coastal areas (attack is most frequent and severe along the southeastern Atlantic and Gulf of Mexico shorelines, in California, in Hawaii, and other tropical areas). Termites can be controlled by soil treatment, termite shields, and the use of termite-resistant materials.

Recommendations

- Incorporate termite control methods into design in conformance with requirements of the authority having jurisdiction.
- Where a masonry foundation is used and anchorage to the foundation is required for uplift resistance, the upper block cores must usually be completely filled with grout, which may eliminate the requirement for termite shields (see Fact Sheet No. 3.4, *Reinforced Masonry Pier Construction*).
- Use preservative-treated wood for foundations, sills, above-foundation elements, and floor framing.
- In areas with infestations of Formosan termites, wood products treated with insect-resistant chemicals or cold-formed steel framing are material options for providing protection against termite damage.

Additional Resources

FEMA. NFIP Technical Bulletin 2-08, *Flood-Resistant Materials Requirements*. (http://www.fema.gov/plan/prevent/floodplain/techbul.shtm)

FEMA. NFIP Technical Bulletin 8-96, *Corrosion Protection for Metal Connectors in Coastal Areas*. (http://www.fema.gov/plan/prevent/floodplain/techbul.shtm)

American Concrete Institute. (http://www.aci-int.org/general/home.asp)

American Wood Protection Association. (http://www.awpa.com)