PDHonline Course C816 (3 PDH)

Coastal Buildings – Maintenance and Retrofits

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Repairs, Remodeling, Additions, and Retrofitting – Wind

Purpose: *To outline requirements and "best practice" recommendations for repairs, remodeling, and additions, and propose opportunities for retrofitting in coastal high-wind areas.*

Key Issue

- 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 1).

Figure 1. Storm-damaged homes need repairs, but also provide opportunities for renovation, additions, and retrofitting. Review substantial damage and substantial improvement regulations before undertaking any work.

Code Compliance

Definitions from the International Code Council (ICC) Model Building Codes

Addition: An extension or increase in floor area or height of a building or structure.

Alteration: Any construction or renovation to an existing structure other than repair or addition that requires a permit. Also, a change in a mechanical system that involves an extension, addition, or change to the arrangement, type, or purpose of the original installation that requires a permit.

Repair: The reconstruction or renewal of any part of an existing building for the purpose of its maintenance.

Factors That Determine Whether and How Existing Buildings Must Comply With Current Building Code Requirements

When undertaking repairs, remodeling, additions, or improvements to an existing building, there are two basic factors that determine whether and how the existing building must comply with building code requirements for new construction.

- ***Value of damage/work–*** whether the value of the building damage and/or work qualifies as substantial damage or substantial improvement under NFIP regulations (see text box).

International Residential Code (IRC) Requirements for Additions, Alterations or Repairs

R102.7.1 Additions, alterations or repairs. Additions, alterations, or repairs to any structure shall conform to the requirements for a new structure without requiring the existing structure to comply with all of the requirements of this code, unless otherwise stated. Additions, alterations, or repairs shall not cause an existing structure to become unsafe or adversely affect the performance of the building.

- **Nature of work–** whether the work involves an expansion of the building, either laterally or vertically (an addition), or the demolition and reconstruction of an existing building, or the relocation of an existing building.

Two other factors occasionally come into play (consult the authority having jurisdiction [AHJ] regarding whether and how these factors apply):

- **Code violations–** certain work to correct existing violations of state or local health, sanitary, or safety code requirements that have been cited by a code official may be excluded from calculations of value of work used to determine substantial improvement or substantial damage.
- **Historic structures–** work on a building that is on the National Register of Historic Places or that has been designated as historic by federally certified state or local historic preservation offices (or that is eligible for such designation) may be excluded from calculations of value of work used to determine substantial damage and substantial improvement requirements, provided such work does not cause the building to lose its historic designation.

Substantial Damage and Substantial Improvement

It is not uncommon for existing coastal buildings to be modified or expanded over time, often in conjunction with the repair of storm damage. *All repairs, remodeling, improvements, additions, and retrofitting to buildings must be made in conformance with existing building code requirements pertaining to substantial improvement and substantial damage.*

What Is Substantial Damage?

Substantial damage is damage, of any origin, where the cost to restore the building to its pre-damage condition equals or exceeds ***50 percent of the building's market value before the damage occurred.***

What Is Substantial Improvement?

Substantial improvement is any reconstruction, rehabilitation, addition, or improvement of a building, the cost of which equals or exceeds ***50 percent of the building's pre-improvement market value.***

When repairs and improvements are made at the same time, all costs are totaled and compared with the 50 percent of market value threshold.

What Costs Are Included in Substantial Damage and Substantial Improvement Determinations?

- All ***structural items and major building components*** (e.g., foundations; beams; trusses; sheathing; walls and partitions; floors; ceilings; roof covering; windows and doors; brick, stucco, and siding; attached decks and porches).
- ***Interior finish elements*** (e.g., tile, linoleum, stone, carpet; plumbing fixtures; gypsum wallboard and wall finishes; built-in cabinets, bookcases and furniture; hardware).
- ***Utility and service equipment*** (e.g., HVAC equipment; plumbing and wiring; light fixtures and ceiling fans; security systems; built-in appliances; water filtration and conditioning systems).
- Market value of ***all labor and materials*** for repairs, demolition, and improvements, including management, supervision, overhead, and profit (do not discount volunteer or self-labor or donated/discounted materials).

What Costs Are Not Included in Substantial Damage and Substantial Improvement Determinations?

- ***Design costs*** (e.g., plans and specifications, surveys and permits).
- ***Clean-up*** (e.g., debris removal, transportation, and landfill costs).
- ***Contents*** (e.g., furniture, rugs, appliances not built in).
- ***Outside improvements*** (e.g., landscaping, irrigation systems, sidewalks and patios, fences, lighting, swimming pools and hot tubs, sheds, gazebos, detached garages).

Note: Some jurisdictions have enacted more restrictive requirements—some use a less-than-50-percent damage/improvement threshold. Some track the cumulative value of damage and improvements over time. Consult the AHJ for local requirements.

Additions

Additions increase the square footage or external dimensions of a building. They can be divided into *lateral additions, vertical additions,* and *enclosures* of areas below *existing buildings*. When considering additions, it is important to consider that changes to the shape and roof line of the structure may impact the potential damages to the house. A lateral addition may change the number of openings, the way wind travels around the structure, or create a large open space that may require additional bracing.

Vertical additions may also impose greater loads on the existing structure. A qualified design professional should evaluate the loading to the entire structure to see if additional structural modifications are required in order to maintain the structure's ability to sustain high-wind loading.

Lateral Additions

- If a *lateral addition* constitutes *a substantial improvement to a building*, both the addition and the existing building must comply with the current wind loading requirements. The foundation, walls, and roof may need to be altered in order to comply with wind loading requirements.

Vertical Additions

- If a *vertical addition* to a building constitutes a substantial improvement, both the *addition and the existing building must comply* with the current wind loading requirements. The foundation, walls, and roof may need to be altered in order to comply with wind loading requirements. Vertical additions may apply significantly higher loadings to the foundation and first story, it is important to consider all of the framing and foundation modifications that need to be made (see Figure 2). Vertical additions may require the use of a geotechnical engineer and soil borings may be needed prior to design.

Materials

When constructing in coastal environments, carefully consider what construction materials to select. For additional information, see Fact Sheet 1.7, *Coastal Building Materials*. Wind events can cause damage to several parts of the structure. Often the damage will consist of not only wind related damage, but also water intrusion. Following a storm event, repairs should not be started until the problem is properly evaluated and materials are selected that will entirely remedy the damage.

Repairs

Correction of the apparent surface damage can lead to unaddressed or overlooked problems that can cause major issues with the structural stability of the building. Inspections often not only require demolition or removal of the physically damaged building component, but also removal of associated exterior cladding. Wind-driven rain can lead to compromised connections and decaying or rotting building materials that may not be visible without more investigation.

The repair of interior finishes damaged by wind-driven rain should be carefully considered. Coastal buildings are often subjected to high-wind events, which many times are accompanied by wind-driven rain. The wind pushes water through small openings in doors and windows. This does not suggest improper functioning of the door or window, but this is more the result of the pressures these openings are subjected to during high-wind events. Interior surfaces such as walls, floor, and cabinets may be subjected to water on a regular basis. These building components may require finishes that will resist repeated water contact.

Repairs may present an excellent opportunity to upgrade the house. Additional connectors for maintaining a load path, additional moisture barriers, and installation of wind-resistant components are some possible options. The section on "Retrofit and Remodeling Opportunities" will outline some options to consider when undergoing repairs.

Figure 2. Vertical addition to a home damaged by Hurricane Fran. Preexisting 1-story home became the second story of a home elevated to meet new foundation and floor elevation requirements.

Retrofit and Remodeling Opportunities

Retrofit opportunities will present themselves every time repair or maintenance work is undertaken for a major element of the building. Improvements to the building that are made to increase resistance to the effects of natural hazards should focus on those items that will potentially return the largest benefit to the building owner. For example:

- When the ***roof covering*** is replaced, the attachment of the sheathing to the trusses or rafters can be checked, and additional load path connectors can be installed as necessary. The Technical Fact Sheets located in Category 7 of this publication provide details on how to improve the roof system's ability to resist wind and water intrusion. The common elements of a roof system should be carefully evaluated in order to address opportunities to improve the load path and water resistance of the system. The most common repair necessary following a storm event is the roof covering. When reroofing, tear-off is recommended instead of re-covering. Although some

jurisdictions allow for reroofing, this method may prevent the identification of more serious inadequacies in the system and result in more catastrophic failures in the next event. A roof covering project should be viewed as an opportunity to evaluate the strength of the roof sheathing. With the removal of the roof covering, a careful inspection of the sheathing should be conducted to look for darkened areas or areas subjected to water damage. If detected, these areas should be replaced. The thickness of the roof sheathing should be inspected to verify that it is of a sufficient thickness to resist the design wind speeds for your area. Also, consult the information in Fact Sheet 7.1, *Roof Sheathing Installation*, in order to improve roof system connections. Replacement of roof coverings also may provide opportunities to evaluate the adequacy of rafter or truss to wall system connections and install hurricane/seismic connectors. Information on these connections can be found in Fact Sheet 4.1, *Load Paths* and Fact Sheet 4.3, *Use of Connectors and Brackets*.

- If ***siding*** or ***roof sheathing*** has to be replaced, hurricane/seismic connectors can be installed at the rafter-to-wall or truss-to-wall connections, the exterior wall sheathing attachment can be checked, and structural sheathing can be added to shearwalls. Adding wall-to-foundation ties may also be possible. Verify that all exterior sheathing (wall and roof) is approved for use on exterior surfaces. Verify that fasteners are indeed connecting the exterior sheathing to the framing. See Fact Sheet 4.1, *Load Paths* and Fact Sheet 4.3, *Use of Connectors and Brackets* for additional information.
- ***Gable ends*** can be braced in conjunction with other retrofits or by themselves. The illustration in Figure 3 shows a typical gable end wall bracing system. These improvements are typically inexpensive, allow the loads imposed on the gable end walls to be distributed through multiple roof trusses or rafters, and assist in distributing the wind loads on the gable ends. Additional guidance for gable ends can be found in the *Gable End Retrofit Guide – Florida Division of Emergency Management*.
- Exterior ***siding*** attachment can be improved with more fasteners at the time the exterior is recoated. See Fact Sheet 5.3, *Siding Installation in High-Wind Regions* for additional information.
- ***Window, door,*** and ***skylight*** reinforcement and attachment can be improved whenever they are accessible. Following a high-wind event, windows and doors should be checked for leaks. The framing should be checked for cracked paint or discolored paint. If the doors and windows are not shutting correctly, then this may indicate that the framing around the window or door suffered water damage. Check for worn areas where paint or caulking is missing and investigate for water damage or intrusion. Repair any water-damaged areas immediately. Framing should be inspected to verify that it is sufficiently attached to the wall system to provide sufficient protection. Improperly framed windows and doors have been found forced from their framing. See Fact Sheet 6.1, *Window and Door Installation* for additional information.
- When ***windows*** and ***doors*** are replaced, glazing and framing can be used that is impact-resistant and provides greater UV protection. The windows and doors must meet wind-resistance standards and be installed in accordance with the manufacturer's installation instructions for high wind. Fasteners should be long enough to attach the window or door to wall framing around the opening. Fasteners should be spaced no greater than 16 inches unless otherwise stated by the manufacturer's recommended installation instructions. See Fact Sheet 6.2, *Protection of Openings–Shutters and Glazing*, for additional information on protecting openings. Verify that doors meet ASTM E330 and DASMA 108 and that windows meet ASTM E1886 and E1996 or Miami-Dade TAS 201, 202 and 203.

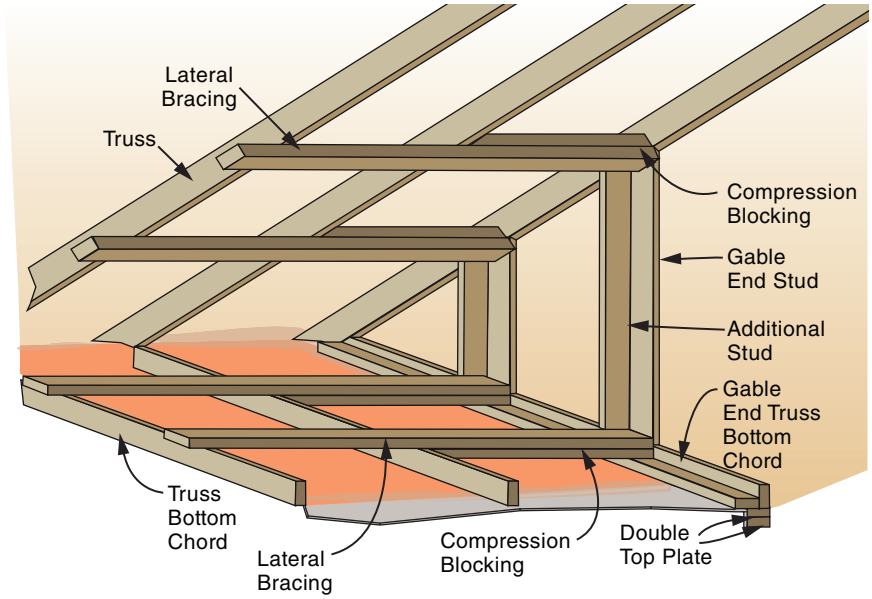

Figure 3. Typical gable end wall bracing retrofit example.

- ***Soffits*** should be inspected following high-wind events to determine whether structural upgrades are necessary. Soffit failures are common during storms and damage is often experienced in attics due to water being blown in through open soffits. Proper attachment is the most common problem noted with soffit failures. Wood backing or supports should be installed in order to provide a structural member to attach the soffit panels to. If it is not possible to install wood supports, the soffit should be secured at 12-inch intervals on each side in order to limit its ability to flex during high-wind events. See Fact Sheet 7.5, *Minimizing Water Intrusion through Roof Vents in High-Wind Regions* for additional information.
- Hurricane ***shutters*** can be added at any time (see Fact Sheet 6.2, *Protection of Openings–Shutters and Glazing*). Shutter systems should be purchased and installed well before a storm event. It is important to take the time necessary to verify that hangers and attachment systems are properly anchored to the structural system of the building. Shutter systems should be anchored to the building and maintain the load path of the building.
- ***Floor-framing-to-beam connections*** can be improved whenever they are accessible. See Fact Sheet 4.1, *Load Paths* and Fact Sheet 4.3, *Use of Connectors and Brackets* for additional information.
- ***Beam-to-pile connections*** can be improved whenever they are accessible. See Fact Sheet 3.3, *Wood Pile-to-Beam Connections* for additional information.
- At any time, deficient ***metal connectors*** should be replaced with stainless steel connectors or metal connectors with proper corrosion protection such as hot-dip galvanized steel. See Fact Sheet 1.7, *Coastal Building Materials* for additional information.
- When ***HVAC equipment*** is replaced, the replacement equipment should be more durable so that it will last longer in a coastal environment. It should also be elevated at, or above, the Base Flood Elevation (BFE) and adequately anchored to resist wind and seismic loads. See Fact Sheet 8.3, *Protecting Utilities* for additional information.
- ***Utility attachment*** can be improved when the outside equipment is replaced or relocated. See Fact Sheet 8.3, *Protecting Utilities* for additional information.
- In the ***attic space***, at any time, *straps* should be added to rafters across the ridge beam, straps should be added from rafters to wall top plates, and gable end-wall framing should be braced. In addition, the uplift resistance of the roof sheathing can be increased through the application of APA AFG-01 or ASTM 3498 (see additional resources for more information) rated structural *adhesive* at the joints between the roof sheathing and roof rafters or trusses. The adhesive should be applied in a continuous bead and extended to the edges of the roof (where some of the highest uplift pressures occur). At the last rafter or truss at gable ends, where only one side of the joint is accessible, wood strips made of quarter-round molding may be embedded in the adhesive to increase the strength of the joint. For more information about the use of adhesive, see the "Additional Resources" section.
- The addition of ***air admittance valves (AAV)*** on all plumbing fixtures can reduce the need for roof penetrations required for conventional venting systems. The reduction in roof penetrations will reduce roof maintenance and reduce the number of openings available for water penetration. AAVs are not allowed in all jurisdictions, so verify with a licensed plumber that they are allowed in the jurisdiction where the house is being constructed.
- At any time, ***garage doors*** should be reinforced or replaced with new wind- and debris-resistant doors. There are some reinforcement kits available to provide both vertical and horizontal reinforcement of the garage door. If the garage door requires replacement, then select one that meets the design wind-speed requirements for your area. See Fact Sheet 6.2, *Protection of Openings– Shutters and Glazing*, for additional guidance on protecting openings and garage door guidance.
- To minimize the effects of corrosion, ***metal light fixtures*** can be replaced at any time with fixtures that have either wood or vinyl exteriors. However, wood may require frequent treatment or painting. See Fact Sheet 1.7, *Coastal Building Materials* for additional information.
- To minimize the effects of corrosion, carbon steel ***handrails*** can be replaced at any time with vinyl-coated, plastic, stainless steel, or wood handrails. Wood handrails may require frequent treatment or painting and appropriate fasteners must be used (see Fact Sheet 1.7, *Coastal Building Materials* for additional information). Carbon steel handrails may also be painted with a zinc-rich, vinyl, or epoxy paint appropriate for exposed wet and salt-spray environments. Regardless of the product used, proper maintenance is always necessary in order to ensure a safe handrail.

Additional Resources

APA – The Engineered Wood Association, 2001, *APA Specification* AFG-01.

ASTM, *Standard Specification for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems,* 2003, ASTM 3498-03.

Clemson University, *Not Ready to Re-Roof? Use Structural Adhesives to Strengthen the Attachment of Roof Sheathing and Holding on to Your Roof* – A guide to retrofitting your roof sheathing using adhesives, Department of Civil Engineering and South Carolina Sea Grant Extension Program, (http://www.haznet.org/haz_outreach/outreach_factsheets.htm)

FEMA, *Substantial Improvement /Substantial Damage Desk Reference* FEMA P-758, 2010, (http://www.fema.gov/library/viewRecord.do?id=4160)

FEMA, *Coastal Construction Manual*, FEMA-55, 2005, (http://www.fema.gov/library/viewRecord.do?id=1671)

Florida Department of Community Affairs, *A Local Official's Guide to Implementing the National Flood Insurance Program* in Florida, 2000, (http://www.floridadisaster.org/Mitigation/NFIP/NFIPStudyCourse/Appendix%20E%20-%20FL%20Handbook.pdf)

Florida Division of Emergency Management, *Gable End Retrofit Guide*. (http://www.floridadisaster.org/hrg)