Overview

When performing inspections of buildings or structures after a catastrophic event, such as a hurricane, several types of damage conditions may be encountered. The unpredictability of storms can present many challenges when determining how to repair a storm damaged structure, a few examples of which are:

- Identifying damage caused by the storm versus other, unrelated conditions (i.e. weathering, age related wear and tear, anticipated movement, improper construction, etc.)
- Understanding how to identify and navigate the local Building Code in effect
- Knowing which Building Code requirements are applicable for repairing the damaged structure
- Being aware of common mistakes or misinterpretations related to Building Code requirements

Identifying Storm Related Damage Versus Other Conditions

Assessing storm-related damage is an exercise of cause and effect. There are specific types of damage and failure modes that can be expected based on the storm conditions experienced in the geographic region. Flooding, fire, tornadoes, heavy rainfall, hail, high wind speeds, and storm surge are some of the various elements of a storm that pose a threat to structures. Researching the storm conditions (i.e. wind speed, hail size, rainfall amount, etc.) at or near the site as documented by a reliable source or obtaining weather reports can provide useful information.

Being able to properly document the condition of the structure following a storm is critical as the proceeding actions are based on the information collected during this stage. Depending on the situation, it may be prudent to engage the services of a building consultant and/or licensed professional, such as a forensic engineer or architect, to inspect and document the observed damage as well as any reported conditions. While this may not always be feasible, thorough and timely documentation will be useful to a consultant or licensed professional if they become involved at a later time.

Information related to the storm conditions as well as the nature and location of the damage can be assessed to parse storm-related damage from other unrelated conditions. These unrelated conditions can include improper construction such as improperly installed flashing or missing sealants. Other unrelated conditions can also include varying degrees of distress or deterioration which developed gradually over time as a part of natural and anticipated aging, wear and tear, and/or deferred maintenance.
TYPICAL DAMAGE CAUSED BY FLOODING

- Saturated building components below an identifiable water line
- Structural/foundation instability associated with scour or soil washout
- Structural displacement due to hydrostatic forces

TYPICAL DAMAGE CAUSED BY HIGH WIND SPEEDS

- Damage or detachment of exterior finishes or cladding
- Interior water damage due to storm-created openings in the building envelope
- Structural instability or collapse due to movement of structural members and connections

OTHER CONDITIONS COMMONLY MISIDENTIFIED AS STORM DAMAGE

- Cracks or separations due to normal and anticipated building movement such as thermal expansion or minor settlement
- Interior water damage at pre-existing openings or improperly flashed or sealed joints
- Windows or doors deemed compromised based solely on exposure to high wind speeds
- Elevated moisture to substrates below roof or wall claddings due to pre-existing conditions or deferred maintenance
- Corner chips or cracking of roof tiles due to stresses induced by shipment, installation, and/or foot traffic

Identifying the Local Building Code

Once the extent of storm-related damage has been determined, the next step is to identify what building codes and requirements are in effect for the local jurisdiction. Any repair work performed to existing buildings is governed at a local level. Generally, some version or derivative of the International Existing Building Code (IEBC) is in effect. In many instances, the state or local municipality will adopt an edition of the IEBC and make modifications intended to meet local needs. Therefore, the guidelines and requirements governing the repair of storm damaged structures may vary based on location. Some states or municipalities will publish the current building codes in effect for their jurisdiction on their website, however in some instances a phone call may be required to confirm this information.
Another important consideration may be determining the original Building Code for the structure. Generally, the original Building Code is that which was in place on the date the application was submitted to the local building department for original construction. In instances where the building was subsequently reconfigured or any major alterations were performed, the date the permit application was submitted for that work may determine the effective original Building Code. Identifying the original Building Code can help clarify the context of the structure’s pre-storm configuration and provide insight on the necessity for code mandated upgrades if applicable.

Application of the Building Code for Repairs

The International Existing Building Code provisions outline conditions under which repairs may be made using materials and methods like those used during original construction (e.g. put it back the way it was before the storm caused damage) or the extent to which repairs must comply with requirements for new buildings (e.g. repair work shall comply with current requirements to some degree). In any case, repairs to an existing building cannot make the building any less compliant than it was before the damage was sustained. Some key considerations to be aware of are presented throughout the balance of this section.
SUBSTANTIAL STRUCTURAL DAMAGE

An analysis will need to be performed to determine if the storm damage rises to the level of substantial structural damage, as defined within Chapter 2, Section 202 of the International Existing Building Code. This analysis considers the extent of damage and the reduction in structural capacity and is typically performed by a licensed professional. An overview of the required course of action based on the determination of whether or not substantial structural damage has occurred is provided below:

In general, if it is found that the damage does not rise to the level of substantial structural damage, the structure can be restored to the pre-damage condition.

In general, if it is found that the damage does rise to the level of substantial structural damage, the structure will need to be restored to its original code with the potential for an increase in the original environmental design loads.

SUBSTANTIAL DAMAGE (“FEMA 50% RULE”)

If the damaged building is located in a flood hazard area, an analysis will need to be performed to determine if the criteria for substantial damage has been met. This applies to buildings damaged by any mechanism including wind and fire and is not limited to those damaged by flood. Substantial Damage (sometimes referred to as the “50% Rule”) is defined within Chapter 2, Section 202 of the IEBC as:

SUBSTANTIAL DAMAGE. Damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

DETERMINE THE FLOOD ZONE AND REQUIRED ELEVATION

To determine if the building is located in a flood hazard area, the applicable flood zone will need to be identified. The flood zone designation is established by the Federal Emergency Management Agency (FEMA) and translated to local jurisdictions through the publication of Flood Insurance Rate Maps (FIRMs). Each municipality adopts rules established by FEMA, along with the FIRMs, to implement their flood protection plan. There are four types of flood zones as follows:

- Structures located within the A Zone (non-velocity zone) must be designed to be inhabitable after inundation of rising water with limited wave action of three feet or less.
• Structures located within the **Coastal A Zone** (non-velocity zone) must be designed to be inhabitable after inundation of rising water with wave action of one and a half to three feet.

• Structures located within the **V Zone** (velocity zone) are required to be able to withstand wave action greater than three feet in height.

• Structures located within the **X Zone** do not have any specific flood provision requirements.

A FIRM is needed to determine which flood zone a building is located in. **Substantial damage** should be considered for buildings located in any zone other than Zone X. The FIRM and/or local ordinances may also list the minimum flood elevation as well as any additional requirements such as freeboard. However, local amendments may exist so it is advised that the applicable requirements be confirmed with the local building department.

**CALCULATE THE REPAIR COST**

When calculating the cost of repairs for a **substantial damage** determination, most expenses associated with the repair work should be included, such as: labor, materials, finishes, fixtures, appliances, HVAC equipment, and the contractor overhead and profit. These values must be calculated at fair market value, even if the materials could be donated or the owners intend to perform the repair work themselves. Additionally, any work performed beyond the scope of required repairs such as owner elected changes, updates, or additions will be added to the cost. However, there are certain expenses that are not included in the calculation, such as: costs to produce plans, specifications, surveys, building permit fees, costs for debris removal, items not considered to be permanently built-in, and costs associated with repairing existing health or safety code violations identified by the local authority.

**DETERMINE THE MARKET VALUE**

The market value used for the **substantial damage** calculation only considers the structure and does not include land, landscaping, outbuildings, pools, driveways, or sidewalks. There are multiple methods that can be used to establish the market value of the structure. In some cases, the local authority will provide a formula that can be used to calculate the market value based on the value of the structure reported by the property appraiser.

It is advisable to confirm with the local building department what they recognize as items to be included in both calculating the cost of the repair and the market value of the structure, and what documentation or proof will be required for each figure.

**DETERMINE COMPLIANCE WITH THE MINIMUM FLOOD ELEVATION**

If **substantial damage** is triggered, the existing building must comply with the flood elevation requirements for new construction. An elevation certificate or survey is needed to determine if the building meets the minimum flood elevation requirement for its respective flood zone. Depending on the applicable
zone, the elevation of the finished floor level or the lowest horizontal member will need to be identified and compared to the minimum required flood elevation to determine compliance. In some instances, an elevation survey can be found on file with the building department. Otherwise, a licensed surveyor may need to be engaged to determine the appropriate elevation.

If the building is compliant, no additional work is required. If the building is not compliant, meaning it is located in a flood hazard area and sits below the minimum elevation, it will have to be elevated or rebuilt to be brought into compliance with flood elevation requirements. This can result in costly code upgrade costs.

**WINDOW AND DOOR REPAIRS**

When damage occurs to windows or doors, the *International Existing Building Code* Section 702.6 provides guidance regarding the replacement of garage doors, exterior doors, skylight, and both operative and inoperative windows by stating that, “all new work shall comply with the materials and methods requirements in the *International Building Code*, *International Energy Conservation Code*, *International Mechanical Code*, and *International Plumbing Code*, as applicable, that specify material standards, detail of installation and connection, joints, penetrations, and continuity of any element, component, or system in the building.” In other words, replacement windows and doors must meet the current building code requirements which could include resistance to high wind loads or protection from debris impact, depending on the geographic location of the structure. However, the replacement of damaged windows or doors does not require the undamaged windows or doors to also be replaced. Undamaged materials are permitted to remain in place.

Protection of the new or replacement window and door openings are required when the structure is located within one mile of the coastal mean high-water line where the design wind speed is 130 mph or greater, and all areas where the design wind speed is 140 mph or greater. Protection can be in
the form of shutters, impact resistant glazing, or on certain defined residential buildings the use of plywood or similar wood structural panels anchored to the structural framing surrounding the opening.

**ROOFING REPAIRS**

In some instances, the extent of storm damage may include damaged roof shingles or other roof coverings. The *International Existing Building Code* identifies, in Chapter 6, the requirements for *repairs* to damaged elements. However, in the event of a full *replacement* or a *roof recover*, the *International Existing Building Code* provides additional requirements in Chapter 7.

Some states or local jurisdictions may have additional requirements regarding *repairs* to roof systems. These additional requirements may instigate the full replacement of the roof covering depending on the extent of damage. Other requirements may include an increase in the required R-value for the roof insulation or additional deck fastening requirements.

**REPAIRS TO HISTORIC BUILDINGS**

Within Chapter 12, Section 1202 of the *International Existing Building Code* are the repair requirements for historic buildings. This chapter is of particular interest as it is the only chapter that specifically addresses historic buildings and allows for flexibility in code compliance. With the approval of the local building official, alternative repairs can be made in order to preserve the character of historic buildings and protect the elements, spaces, and features that make these buildings historically or architecturally significant. However, the code still requires that whenever strict compliance is not achieved, the
alternative must provide for equivalent protection and that no hazard will be created or continued through noncompliance. The services of a registered architect or engineer is often required in order to perform evaluations and support the intent of alternative designs.

Conclusion

In the wake of a catastrophe, the primary goal is to return the damaged property to its pre-loss condition as quickly as possible while ensuring compliance with local building codes and requirements. The ability to parse storm-related damage from other conditions, knowledge of the code related issues that may be present, an understanding of which code requirements are in effect in that affected area, and knowing how to navigate and apply the applicable codes for repairs are critical steps in achieving code compliance and returning the structure back to its pre-damage condition in a timely manner.

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References


