Storm Solutions™

An Ounce of Prevention:

The Irrefutable Facts Supporting Wind Damage Mitigation

White Paper

"The Northeast is staring down the barrel of a gun. The Northeast coast is long overdue for a powerful hurricane, and with the weather patterns and hydrology we're seeing in the oceans, the likelihood of a major hurricane making landfall in the Northeast is not a question of if but when."

-Joe Bastardi, Chief Forecaster, Accuweather.com

Introduction

The concept of coastal hazard mitigation has consistently been undervalued and viewed as secondary to hazard recovery. The vulnerability of the building envelope as well as the impact of windborne debris is documented to lead to the majority of damage to buildings during coastal storms. Building codes that are either inadequate or improperly enforced habitually compound the risks associated with unsound building practice. Despite overwhelming evidence that mitigation is crucial to the preservation of the building envelope and structural integrity of coastal property, regulation and incentive programs receive little support. In particular, the use of storm shutters has proven to eliminate the majority of wind damage from coastal storms and is cost effective both on a federal and private level. A change in public policy and corporate leadership is needed to support programs and incentives that promote mitigation efforts.

Mitigation Makes Cents

Substantial research supports the economic value inherent in wind and storm mitigation solutions. The Multi-hazard Mitigation Council found that for every dollar spent on mitigation, society saves an average of four dollars of future loss (2005). Multiple studies have shown that 25-40% of insurance losses from Hurricane Andrew would have been prevented if buildings were built to code, and a study by Godschalk et al. showed that effective mitigation can substantially reduce the cost of disaster response and recovery (Stewart et al, 2003). FEMA's Coastal Construction Manual states that, "the often minimal cost of additional mitigation measures offers long-term benefits that will provide a positive lifecycle cost (3rd Edition)."

Coastal Growth & Vulnerability

The ceaseless trend towards increased population and concentrated wealth along the coastline makes mitigation even more economically valuable. Due to population growth and insured wealth along the coast, economic hurricane damage in the United States has been doubling every 10-15 years (Pielke Jr. et al., 2008). The same study predicts that if growth continues at this rate, a storm such as the Great Miami Hurricane of 1926 could result in $500 billion in damage as early as 2020. Similarly, it is estimated that a severe storm along the coastline of the north Atlantic states would be the most expensive natural disaster in American history. Experts agree that, "avoiding huge losses will require a change in the rate of population growth in coastal areas, major improvements in construction standards or other mitigation actions (Pielke Jr. et al., 2008)." While the trend towards increasing coastal growth may be difficult to slow, supporting proactive mitigation is economically and physically feasible.

Breaking Through the Fog

In order to reap the economic benefits of mitigation, its barriers must be understood. A lack of concise, systematic data collection on the viability of storm protection practices has led many to ignore its critical place in sound coastal management. Despite tepid support, the urgency of hazard mitigation is clouded by the infrequency and outlying nature of major hazard events (FEMA, 3rd Edition). In addition to the inaccurate notion that chances of a hazard occurring are remote, support for mitigation is hard to sustain because policy makers are, "reluctant to impose limitations on private property, often unwilling to bear the costs incurred by mitigation plans, and frequently are ambivalent toward hazard mitigation, because they see it as being in conflict with other values and goals (Grant, 1996)." While all of these mindsets exist, they should not be viewed as conflicting with the proven benefits of hazard mitigation, which have proven to be cost effective and in the best interest of property owners and insurers alike. A reappraisal of the economic and social benefits of hazard mitigation as well as an acceptance of the importance of the building envelope is necessary to combat these erroneous mindsets.

The Weakest Link

Even though the building envelope has been documented as crucial to the overall performance of a structure in windstorms, it receives little attention. It is widely suggested that breaching of the windows, doors and other openings comprises the majority of damage to buildings and their contents. A summary report on building failure from the 2004 hurricane season found that, "The winds primarily damaged building envelope systems, which, upon failure, allowed wind-driven rain to enter the building interior causing not only loss of function, but millions of dollars of damage to building contents (FEMA 490, 2005)." With the building envelope breached, the structure becomes increasingly vulnerable to internal pressurization and structural failure as well as damage from water entry. Sparks et al. found that there was a dramatic increase in insured loss when damage included breaching of the building envelope (1994).

Threat of Water Damage

Water entry through building envelope failure caused the dollar value of direct building damage to be magnified by a factor of two to nine hundred percent depending on wind speed (Sparks et al., 1994). Wind driven rain and consequent water entry through window and door failure is a major component of damage, "even small breaches can allow a significant amount of water to leak into buildings, damage building contents, and allow mold to develop (FEMA 548, 2005)." The enormity of water damage can not be ignored as buildings with minor structural damage may be considered total losses due to water entry that resulted from building envelope failure (FEMA 548, 2005). The fact that dislodged elements of the building envelope comprise the majority of wind borne missiles during a windstorm aggravates the damage from such failures; not only does failure of a building envelope compromise the integrity of the building impacted directly, it poses a threat to surrounding buildings and can initiate a chain of damage. Although building codes have addressed the need for wind related structural changes, window and door openings continue to require additional attention.

Windborne Debris

The majority of building envelope damage is caused by windborne debris. Unprotected windows and doors fail repeatedly when impacted by airborne objects. Four large scale damage investigations following hurricane Andrew found that windborne debris was a major cause of property damage (Minor, 2005,). Mitigation Assessment Teams (MAT) investigating damage from Hurricane Katrina determined that, "windborne debris caused significant envelope damage, and virtually all of the (window) glazing damage that the MAT observed (FEMA 548, 2005)." With the majority of damage coming from building envelope failure, it is imperative that mitigation solutions be used. Securing the building envelope with storm shutters or other protective devices is proven to limit damage and subsequent insured losses.

Promise in the Building Code

While codes supporting the structural integrity of the buildings are effective, similar efforts must be made for the support of the building envelope itself. Homes built to the requirements of the Florida Building Code 2001 or the IBC 2000/2003 have proven to withstand the majority of wind related structural issues and, "at this time, improvements must focus on preventing rain water intrusion and protecting the building envelope (FEMA 490, 2005)." The success of a strengthened building code that has a focus on mitigation is evident through the improved performance of buildings built with updated codes. The complacency discussed before regarding the risks associated with coastal storms led to, "helter-skelter development, lackluster code enforcement, building code amendments, shortcuts in building practices, and violations that seriously undermined the integrity of the building code and the quality of building stock (FEMA, 3rd Edition)." Not only do codes need to continue to be updated, code enforcement is crucial. Estimations from claim studies after hurricane Andrew revealed that 25 percent of insurance losses, approximately $4 billion, were due to inferior construction practices that failed to meet code (FEMA 490, 2005). A focus on the benefits of mitigation coupled with stringent code enforcement will help slow down the increase in potential coastal property damage.

Mitigation Works

The majority of damage during wind storms is preventable. With proper mitigation and sound building practice, homes will perform well when confronted with high winds. Due to the importance of securing the building envelope, storm shutters should be considered for any building located in a wind zone. Multiple studies have shown that damage would have been prevented if building openings had been protected:

- Only limited use of (window) glazing protection was observed and, consequently, there was also significant damage to building glazing (FEMA 548, 2005).
- Storm shutters and the covering of windows and other openings (exterior wall openings) significantly reduced such failures (FEMA, 3rd Edition).
- Shutters reduce the potential for damage from windborne debris impact during a storm event and reduce the potential for wind-driven rain water infiltration (FEMA, 3rd Edition).
- Shutters are an important part of a hurricane-resistant or storm-resistant home. They provide protection for glass doors and windows against windborne debris, which is often present in coastal storms (FEMA 499, 2005).
- Preventable damage to building contents occurred in building located in 'windborne debris areas', where glazing was not impact resistant or protected by shutters (FEMA 490, 2005).
- Most of the wind damage was preventable. The winds primarily damaged building envelope systems, which, upon failure, allowed wind-driven rain to enter the building interior causing not only loss of function, but millions of dollars of damage to building contents (FEMA 490, 2005).

Enforcement

While protecting window and door openings can reduce damage, such protection must meet stringent codes and be installed correctly to provide a proper solution. Failure of glazing systems occurred when, "non-rated shutter systems were used; when they were not properly installed; or when they did not have the strength to withstand high winds or the impact of large windborne debris (FEMA 490, 2005)." This highlights the need for policy-level support of mitigation practices in order to ensure proper installment and enforcement. Storm shutters provide protection from windborne debris and from consequent water damage. Although laminated or "impact-rated" glazing will stop fragmentation of the glass, it fails to prevent water entry when the opening is breached. Since failure of the building envelope and subsequent water entry account for the majority of damages to homes during wind storms, storm shutters provide the best solution.

Dangerous Exceptions

When considering the use of window and door opening protection it should be noted that not all approved solutions are effective. Unfortunately, while most building codes permit the use of plywood, they do so despite overwhelming and abundant data showing its ineffectiveness as a form of mitigation against storm damage. Plywood has consistently failed to withstand stringent testing standards (Miami-Dade), its weight makes it hazardous to install and it lacks durability. Most importantly, plywood rarely makes it onto the building in the event of a storm; left stored, it does not provide any protection at all. Even in those cases where an attempt is made to deploy it, plywood is rarely installed correctly. A statewide spot inspection in Florida revealed that *only two* plywood installations were deployed according to building codes. However, both failed full compliance because they used non-approved ¼ inch plywood (Leggett, 2004).

Regrettably, despite all of the compelling data supporting the need for hurricane storm mitigation systems, insurance companies have been slow to provide financial incentives to homes and business owners to deploy such protection. Whether due to a lack of concise data or an unwillingness to accept the viability of risk reduction, mitigation continues to be placed behind recovery. Confronted with the evidence favoring mitigations economic, structural, and social effectiveness, it becomes clear that a transfer of focus is necessary. Resources need to be allocated to mitigation solutions which reduce future losses. In particular, protection of the building envelope against impact and water entry is essential.

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