economics

BOUNCING BACK

Sustainability, resilience and the economic impacts of Harvey, Irma and Maria.

BY JOHN CROSS, PE

THE DESTRUCTION CAUSED BY a series of hurricanes in late August and September was of epic proportions.

Harvey, a category 4 storm when it made landfall near Rockport, Texas, stalled over the Gulf Coast, dumping in excess of 4 ft of rain on much of the region. Hurricane Irma sliced across the Caribbean with wind speeds exceeding 135 miles per hour before crossing directly over the Florida Keys and making landfall in southern Florida. Irma then continued to drive northward creating damage as far north as Georgia. And Maria delivered a devastating blow to Puerto Rico, with the eye of the category 4 hurricane passing directly over San Juan, destroying homes, decimating infrastructure and dumping in excess of 20 in. of rain across the island. In addition to the damage suffered in the United States and Puerto Rico, multiple Caribbean islands were rendered nearly uninhabitable by the storms.

While dollars can never measure the loss and disruption of life experienced in these storms, the monetary damage caused by each of these storms will exceed the damage resulting from either Hurricane Katrina in 2005 ($118 billion) or Super Storm Sandy in 2012 ($70 billion). The very preliminary estimates (late September 2017) for Harvey are now placed between $65 and $190 billion; Irma's estimate is $100 billion to $150 billion and Maria's is $200 billion. Included in these very early estimates are the economic losses sustained as a result of the storms as well as the costs of rebuilding, and it's clear that the combined impact of Harvey, Irma and Maria will exceed $500 billion—or more than twice the combined impact of Katrina and Sandy.

Impacts to the Construction Economy

This level of damage and the associated monetary impact will impact construction from several different perspectives. Construction activity levels will increase as rebuilding moves forward, which in turn will impact the cost and availability of construction materials and the supply of labor over the next several years. Discussions regarding the impact of global warming on the severity of these storms will intensify the focus on sustainable design and construction. The increased attention being paid to resilience of the built environment at the material, system, building and community levels will also be ratcheted up several notches.

The majority of property damage occurring from hurricanes occurs to single-family and low-rise structures that are primarily framed in wood. Concrete and steel structures may suffer significant interior water damage from flooding or penetration but generally maintain structural integrity. Many of the damaged wood-framed structures will require demolition or significant repair. Even where the structure remains standing, water and moisture exposure will result in mold, mildew and eventually rot that will require replacement of structural members. Water damage to steel and concrete structures will primarily compromise wallboard and finishes, not the framing system itself.

Infrastructure impacted by a hurricane event will primarily be related to transportation or the equipment required for the provision of public services such as water supply, sewage and electricity. Roads and bridges may require removal and reconstruction, increasing demand for cement, concrete and some steel. The buildings housing the equipment that supports municipal services generally remain intact. The reconstruction pattern following Katrina and Sandy indicates that water and sewer facilities will receive the earliest attention, followed by transportation infrastructure. Residential construction will follow after a short lag to complete cleanup efforts, damage assessments and insurance settlements. During this period nonresidential construction will focus primarily on schools, healthcare and municipal facilities, with commercial structures driving by demand levels. In general, the level of public nonresidential construction activity will not increase greatly, as funds will be redirected to reconstruction from new construction activity.

The construction market trends following Hurricane Katrina, which severely impacted New Orleans in 2005, provide a possible model for what will occur following Harvey, Irma and Maria. Approximately four to five months following Katrina, softwood lumber, concrete and cement experienced a moderate cost increase of between 5% and 7%. While overall employment in the region dipped, demand for construction labor increased almost immediately, with the increased demand lasting for sev-

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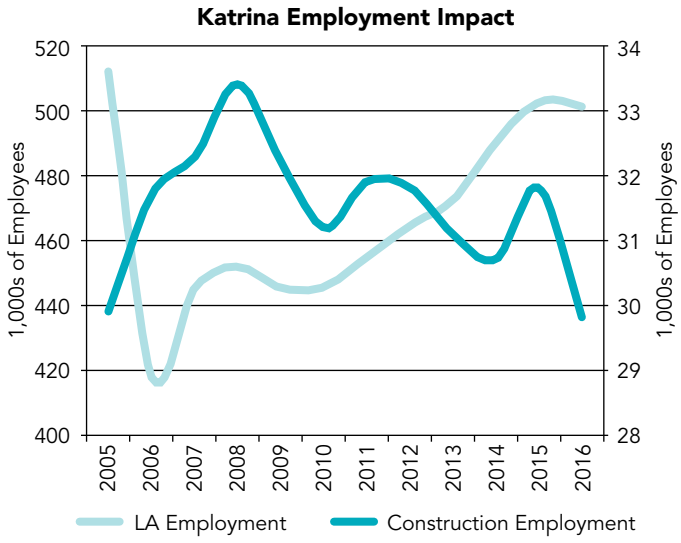
eral years. There was not a significant increase in demand for structural steel or its price beyond normal market trends in the aftermath of Katrina, as few structural steel buildings experienced significant damage to the structural frame. There was, however, an increased demand for steel piling over a period of several years to upgrade the levee system in New Orleans.



Louisiana employment dipped sharply after Katrina (light line) but construction employment (dark line) increased dramatically and remained above pre-Katrina levels for nearly 10 years.

Shortages of construction workers in the north Texas (Dallas) and Oklahoma markets are already being noted as workers have temporarily relocated to Houston. It is anticipated that this pattern will be repeated in the southeast United States, with workers moving into the Florida market, and that it will expand from a regional to a national trend. Anecdotal reports following both Katrina and Sandy indicated that workers from even the Pacific Northwest temporarily moved to the impacted areas. This increased demand for construction workers will further aggravate the current shortage of skilled trade workers, particularly carpenters, in the United States.

The devastating impact of Maria on Puerto Rico will create a much different and more difficult situation. It is anticipated that few construction workers will migrate to Puerto Rico to help with reconstruction while at the same time, the flow of building materials into Puerto Rico will be constrained by transportation requirements. The result is that a longer time frame will be required for rebuilding there compared to either Texas or Florida.

Sustainability

The impact of these three hurricanes on the design and construction industry will not be limited to the level of construction activity. The fact that these three mega-storms occurred in a short period of time—as part of a cycle of increased extreme storm activity that includes hurricanes, typhoons, tornadoes and blizzards—will again turn the attention of the general public and the design industry to the need for sustainable construction. Reducing the environmental impacts associated with the materials used in construction, the construction processes and the operational energy consumption of the buildings being constructed will be seen as necessary steps to lessen the probability of such extreme weather events and the impacts of the events when they occur.

Over the past twenty years, the movement toward sustainable design and construction has been driven primarily by the U.S. Green Building Council (USGBC) through a series of increasingly stringent versions of the LEED rating program. Today, more buildings are being designed incorporating the goals of sustainable design regardless of whether they are seeking what they perceive as costly LEED certification. This trend will continue to accelerate in the face of increased storm activity. Two areas will be the primary focus of attention as sustainable design becomes the norm for construction. First, increased emphasis will be placed on reducing the operational energy of buildings, with the ultimate goal of designing and constructing net-zero buildings. A simplified description of net-zero building is a building that produces as much emissions-free energy as it consumes.

The second area of focus will be on selecting construction materials. The current LEED version emphasizes the transparent disclosure of impacts. Future versions of LEED and other rating systems will focus on the selection of construction products based on the impacts that have been disclosed. When comparing similar products such as domestically fabricated structural steel and non-domestic fabricated structural steel, a direct comparison of impacts will be made (structural steel produced in the U.S. will show a clear advantage over structural steel produced in China). When comparing dissimilar products such as wood, concrete and steel, the comparison will be based on a life-cycle assessment of the whole building. A discussion of how structural steel contributes to the sustainability of a building can be found in the white paper *More than Recycled Content: The Sustainable Characteristics of Structural Steel*, which you can view at **www.aisc.org/discover**.

Resilience

But the change in building design won't just be a function of increasing the sustainability of the building and minimizing its impact on the environment, with the goal of reducing the potential impacts of global climate change on weather patterns and human health. The impact will also be on how buildings are constructed so as to reduce the level of damage they sustain during an extreme event and to minimize the amount of time required to return the building to full functionality.

Resilience is about to emerge as the "hot" topic in the design and construction industry, possibly even surpassing the focus on sustainability. It is impossible to view the damage experienced in Texas, Florida and Puerto Rico without asking whether current practice is the best way to construct buildings in these locations. It is not enough to build sustainable buildings; it is necessary to build buildings that will absorb and recover quickly from these extreme events.

Resilience can be viewed from the perspective of the building material, the structural systems used in the building, the building itself and the community in which the building is located. Each of these perspectives generates a different set of concerns for determining the required level of resilience of the building. Community resilience necessitates the continuing functionality of key services such as healthcare, sewer, water, electric power, police, emergency shelters and transportation. The buildings and infrastructure that support these services must be able to either continue to function during the disruptive event, or be rapidly placed back in service following the event. To be genuinely resilient, these buildings must have resilient structural framing systems constructed using resilient materials.

At the same time, structures that are less critical need to be constructed to resist damage and minimize the volume of waste generated by extreme event. The volume of waste generated by Hurricane Katrina in 2005 exceeded 113.5 million cubic yards or just over 7% of the total waste generated in the U.S. during that same year. The waste from Harvey, Irma and Maria will certainly exceed that amount and severely tax landfill facilities in the affected areas.

It is at this point that sustainability and resilience cross paths. It is not sustainable to mandate systems requiring an increase in construction materials when the probability of an extreme event in a given area is low. Increases in material requirements means increased environmental impacts. At the same time, disposing of damaged construction materials does not contribute to the overall sustainability of the built environment. The solution is to design by keeping in mind both the sustainable and resilience needs of the project through selecting building materials that provide reserve strength, elasticity, toughness, resistance to decomposition, non-combustibility and the ability to be recycled—i.e., materials that can be used to create resilient framing systems that support resilient buildings. See the white paper *The Impact of Material Selection on the Resilience of Buildings*, also at **www.aisc.org/discover**, for additional information.

There can be no question that the greatest impact of Harvey, Irma and Maria is on those who live and work in the affected areas. The human and economic disruption has been and will continue to be significant. The impact of these storms will also reverberate through the design and construction industry, impacting current construction projects and how buildings are designed and built on the future. ■

The American Institute of Steel Construction encourages contributions to the relief agency of your choice to support the continuing recovery efforts in Texas, Florida and Puerto Rico.