

NSF Highlights

A Vertical Haven: Making High-Rises Safer in Major Storm Events

Highlight ID: 13075

In extreme weather situations such as hurricanes, wind and windborne debris are responsible for most structural damage to buildings. According to a team of researchers from the NatHaz Modeling Laboratory at the University of Notre Dame, this was true of the damage to several high-rise buildings in downtown New Orleans during Hurricane Katrina. The team inspected several buildings in the New Orleans Central Business District. They found considerable evidence that the damage to their exterior glass and cladding came from windborne debris on rooftops.

They also found that vertical evacuation—allowing citizens to escape hurricane floodwaters by seeking shelter at higher elevations in engineered structures—was an effective way to provide refuge to a large number of people despite the significant damage these buildings sustained.

Researchers visited twenty high-rise buildings in New Orleans' Central Business District within weeks of Hurricane Katrina. They assessed damage through field surveys and interviews with building owners, managers, maintenance personnel, and residents and visitors who took refuge in these buildings. They visited and assessed damage to high rises in the damaged areas and the rooftops of buildings such as the Hyatt Regency Hotel, the Amoco Building and the 1250 Poydras Building. They found that the damage varied based on the amount of debris available and the direction of the prevailing winds when Hurricane Katrina passed near the city.

The researchers found that the three buildings mentioned above sustained significant glass and roof damage, from a combination of wind and other projectile debris. This finding was supported by the large amount of windborne debris the team found on or inside the buildings, including pea gravel, components of rooftop furniture and equipment such as rooftop air conditioners and electrical systems. It appears that most of the damage to the high rises in the Central Business District was caused by the airborne debris from gravel roofs and rooftop equipment from buildings that were upwind of them. Poor construction of the rooftop areas and inadequate supports for rooftop structures such as communications and cooling systems contributed to the damage. The severe winds experienced during Hurricane Katrina were well within the conditions for which these buildings were designed. However, the design and construction was inadequate to withstand the severe winds associated with that storm and contributed to the presence of damaging projectiles. In particular, the Amoco Building suffered from inadequate connections and bracings to its rooftop components.

Despite the considerable damage these buildings experienced, they provided refuge for more than 4,000 people. Based on interviews with people who took refuge in these buildings, the team found that the hotels, in particular, provided a safe shelter for occupants, although it wasn't always comfortable.

Additional Details on the Notre Dame Team's Study:

http://www.nd.edu/~nataz/doc/Katrina_AAWE_9-21.pdf

Primary Strategic Outcome Goal:

- Discovery: Foster research that will advance the frontiers of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the nation as a global leader in fundamental and transformational science and engineering.

Secondary Strategic Outcome Goals:

- Learning: Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens.

How does this highlight address the strategic outcome goal(s) as described in the [NSF Strategic Plan 2006-2011](#)?

This research supports the NSF goal of fostering research that provides fundamental understanding and the greatest benefit to society. The perishable data gathered in this research provided evidence of the need for more stringent regulations governing the wind resistance and reinforcement of cladding and other rooftop components of high-rise buildings. The teams recommendations inform the engineering and construction industries, urban officials and other groups involved in the construction of high-rise buildings so that they can prevent damage in future hurricanes. This research will help communities with few escape routes and limited transportation to develop evacuation plans that provide shelter for their citizens. High-rise buildings can play a key role in evacuation if the integrity of their structural systems and cladding are improved.

Does this highlight represent transformative research?

Yes

This work is transformative. The researchers recommendations for improving the construction and reinforcement of high-rise structures could help to ensure more robust structures that can better withstand severe weather. The validation of vertical evacuation could provide new methods of ensuring the safety of people worldwide in the face of a natural disaster such as Hurricane Katrina.



Damage to Buildings in the Central Business District of New Orleans from Hurricane Katrina: (a) Glass/Cladding Damage to Hyatt Regency Hotel and Amoco Building, (b) Destroyed Rooftop Penthouse on Amoco Building, (c-e) Inside view of the top, north floor of the Hyatt Hotel: (c) East View, (d) Ceiling fan pushed upwards in a guest room, (e) West View

Permission Granted

Credit: Ahsan Kareem, University of Notre Dame

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