Performance to Resilience-Based Wind Design

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ABSTRACT

Traditionally designed buildings have repeatedly shown a lack of resilience in the face of extreme windstorm events. Year after year, such storms result in displaced communities, many billions of dollars of losses to building stock, and massive disruptions in their aftermath. This damage stretches from individual buildings to entire communities, and often includes systemic factors that extend beyond the design of any individual building.

Current building codes exist largely to ensure a minimum level of human life safety during an extreme event. Their main objective is to minimize structural risk, but they do not always provide a reliable level of performance for all building components at every storm severity level. They also do not typically account for the impact that the changing climate is having on amplifying extreme windstorm hazards with each passing year.

As a supplement or alternative to the prescriptive nature of typical building codes, performance-based design is increasingly being employed to enhance the design of individual structures. Performance-based wind design (PBWD) approaches require more sophisticated design techniques to validate said performance, but the result is a building that better addresses key goals of performance across the building's full life cycle. The methodology aims to achieve a design that attains uniform reliability across the entire building system. While performance-based design yields a better understanding of the structural and non-structural performance of the building, it does not create holistic building resilience.

The goal of resilience-based design is simple: follow a design approach which results in a desired level of physical robustness, enhanced safety, and a faster return to operations post-event, relative to a typical design. Resilient buildings should be thought to be sustainable buildings, as reducing potential building damage engenders a longer usable lifetime, conserving reconstruction material, energy, and waste in the long term. Resilient design principles include consideration of structural and non-structural components, along with operational and ambient features, to address the key drivers of building damage and downtime.

Climate change represents both a significant challenge for designers as stewards of the built environment, but also an unrivaled opportunity to build resilienly, improve business certainty, and to make a lasting impact in ensuring the health and wellbeing of future generations. Both performance and resilence based approaches aim to consider the impact that climate change has over the entire "design space" in which a building lives. These advanced design techniques naturally steer the designer to placing material in the areas of a structure where it is most needed, thereby resulting in a more sustainable outcome.