Modeling Performance of Residential Wood Frame Structures Subjected to Hurricane Storm Surge

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Significant research has been conducted to model the performance of low-rise wood frame residential buildings subjected to earthquake and wind loading. This research has been incorporated into building damage prediction models, such as FEMA's HAZUS Earthquake and Hurricane models. These models are based on structural load vs. resistance calculations that provide estimates of the severity of building damage for a given earthquake or hurricane. Models such as these supply valuable information to multiple stakeholders, including the disaster management, insurance, planning and engineering communities. In the case of flood hazards, however, damage functions are generally limited to depth-damage relationships that do not adequately account for the forces associated with hurricane storm surge. Recent hurricanes have left thousands of homes destroyed by storm surge alone, exposing a critical need for a more detailed understanding of the performance of residential structures subjected to storm surge hazards.

Complex hydrodynamic models exist that are capable of accurately predicting the height and velocity of storm surge, but this information has not yet been used to estimate building damage. This paper presents an engineering-based analytical damage model that explores the load vs. resistance relationship between hurricane storm surge hydrostatic, hydrodynamic, buoyant and wave forces and the structural resistance of typical residential structures in a GIS-based computational environment. The model accepts input from an existing, validated hydrodynamic storm surge model and is calibrated using damage data collected in the aftermath of Hurricane Katrina along the Mississippi Gulf Coast. Advancements in the areas of wood frame building response to earthquake, high wind and tsunami loads are investigated and applied.

This paper discusses the loads associated with hurricane storm surge and proposes a method to model the response of typical wood frame residential construction. This research makes a significant contribution in the development of new capabilities through the synthesis of available technologies. By creating a model capable of estimating hurricane storm surge damage to buildings, a vital component in assessing hurricane risk is made available. Through a more thorough understanding of the loads associated with hurricane events, more sustainable planning and development can be encouraged.