Parametric Study of Losses with Hurricanes Passing Through Houston Ship Channel

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Abstract This project uses FEMA software HAZUS-MH to study the effects of hurricane parameters on losses and debris when hurricanes make landfalls along the Galveston city coastline and go up through Houston Ship Channel. The hurricane parameters used in this study include landfall wind speed, center pressure, maximum wind radius, and translation speed. The study shows that the losses in the property damage and business interruptions and the amount of debris increase exponentially when hurricane intensity increases from category I hurricane to category V hurricane. The estimated results from HAZUS show that the property damage from the studied hurricane path are more than double of the property damage from IKE.

Introduction Tropical storms and hurricanes are the costliest natural disasters in the United States. The Texas coast is highly vulnerable to catastrophic strikes by landfalling hurricanes. During the past century, over 36 hurricanes had made landfalls along the Texas coast. About 30% of these were major hurricanes of category 3 or above according to the Saffir-Simpson intensity scale. Due to extensive damage caused by hurricanes along coastline, an accurate and efficient method of predicting storm damage is needed in order to accelerate post-hurricane recovery. It is often very time consuming to identify the exact amount of structural and nonstructural damages to each affected coastal structure in the event of a major storm. Prompt action is of utmost important. HAZUS software is developed by FEMA to estimate potential damage by natural disasters, such as earthquake, hurricane, flood and tornados. Houston Ship Channel concentrates heavy oil and gas industries, the Port of Houston and the NASA Space Center. It is very important to systematically study the effects of hurricane parameters on the damages of the industries and identify vulnerable areas; assess level of readiness and preparedness, estimate potential losses before and after hurricanes.

Objective In order to better prepare and to accelerate post hurricane recovery, The objective of this study is using FEMA software HAZUS-MH to study the effects of hurricane parameters, such as sustain wind speed, translation wind speed, radius of maximum wind speed and center pressure, on the property damages when hurricanes landfall at the Galveston coastline and go through Houston Ship Channel and to develop an easy method to estimate the losses before hurricane landfalling.

Results and Discussions In recent years, the Gulf Coast region has been tremendously affected by the landfall of these huge storms. In 2008, Hurricane IKE devastated the coastal regions of Texas—Galveston is still recovering from the aftermath today. Houston—the fourth largest city in the U.S., the Energy Capital of the World, home to the Texas Medical Center (largest in the world), NASA and the Port of Houston—is only 30 miles north of Galveston, the threat to Houston is unprecedented.

In this project, hurricanes directly landfalling in the Galveston coastline and going through Houston Ship Channel were studied (Figure 1). The losses due to building damages

and debris produced vs. hurricane wind speeds, maximum wind radius, and translation speed were investigated. The correlations between building damage, debris and hurricane parameters were derived from HAZUS-MH Typical total property damage during hurricane landfalling in Galveston from HAZUS-MH is shown in Figure 2.

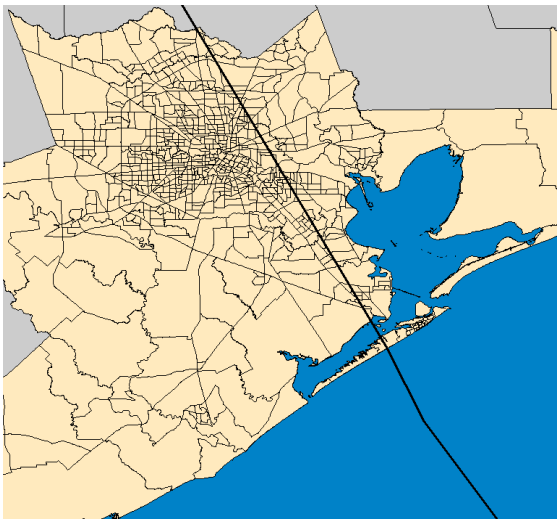

Figure 1. The path of hurricane landfaling in Galveston

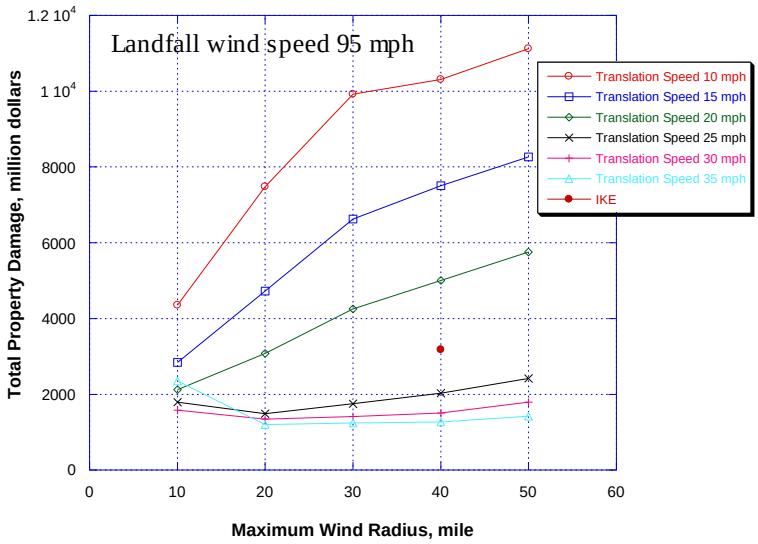

Figure 2. Typical total property losses vs. hurricane parameters

Figure 2 shows that the total property loss increases dramatically when maximum wind radius increases. When translation speed decreases, the total property loss also increases. Hurricane IKE had translation speed 15 mph, maximum wind radius 40 miles, and estimated landfall wind speed 95 mph. The total property loss of IKE from the HAZUS-MH model was 3.2 billion dollars (Fig. 2). If a hurricane has the same intensity and landfalls in Galveston, from Figure 2, the estimated total property damage is 7.5 billion dollars, which is more than double the value of the loss from IKE.

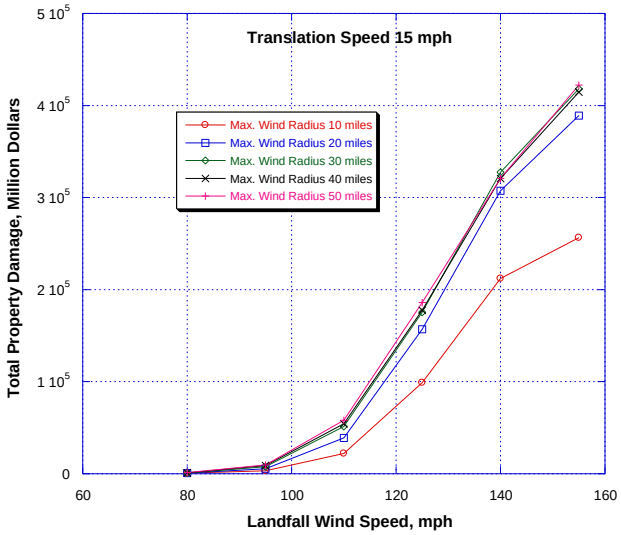

Figure 3. Typical total debris vs. hurricane parameters

The data from HAZUS-MH (Fig.2) also shows that when translation speed greater than 25 mph, the total property damage vs. maximum wind radius linearly increase. Data deviations were observed at lower maximum wind radius, which could be caused by the limitation of the model.

Figure 3 shows total debris produced by hurricanes vs. hurricane parameters. The data shows that total debris increase linearly when landfall speeds exceed 100 mph.

Conclusions Systematically study Hurricane parameters using FEMA HAZUS Software can allow us to identify vulnerable areas, prepare and estimate potential loss before hurricanes, allocate resources for most effective and efficient response and recovery.

References:

http://www.fema.gov/hazus/index.shtm http://www.hazus.org