SMALL BUILDING PERFORMANCE IN HURRICANE IKE ON THE BOLIVAR PENINSULA

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INTRODUCTION

Hurricane Ike made landfall on the U.S. Gulf of Mexico coast on September 13, 2008 over the Galveston Bay Entrance in Texas (Edge, 2013). The Bolivar Peninsula is a barrier island/peninsula on the east side of the Entrance that received peak overland storm surge and wave heights in the right front quadrant of the hurricane. Prior to the storm Bolivar had been developed with 6000+ buildings, primarily low-density, single-family houses elevated on piling foundations. Over 2000 buildings were destroyed during the storm.

STORM DATA COLLECTION AND MODELING

An unusual wealth of storm surge and wave data was collected in the area. Multiple pre-storm deployed storm surge/wave gages recorded both nearshore and onshore conditions for the duration of the storm. Two gages reported overland conditions near the center of the 16 km study area. Several aerial overflights before and after the storm provided rectified images and LIDAR ground elevations for comparison. Post-storm storm surge and wave modeling was made available for ADCIRC+SWAN and SLOSH. Flood Insurance Rate Map studies are available both before and after Ike, defining the historical and most recent national construction requirements for the area.

BUILDING DAMAGE

Post-storm inspections indicated that the primary causes of damage to buildings were storm surge flooding and waves forces. Foundation damage due to shoreline erosion and overland scour was also apparent. Partial structural damage was surprisingly rare (Kennedy, 2010). Building failures and the few cases of partial structural damage appeared to be initiated when wave elevations exceeded the lowest horizontal structural member parallel to the shoreline above the piling foundations. As the distance from the Gulf shoreline increased, buildings were more likely to be deeply flooded, in low elevation buildings to roof levels, but without apparent wave-induced structural damage.

EXPANDED DATA COLLECTION

Building elevation surveys for this study were expanded from previously several hundred to 5000+ buildings. 1000 field surveys of surviving buildings were conducted. However, post-storm field surveys are costly and cannot document the floor elevations of buildings where all trace of the building was destroyed. For this study 3000+ building floor elevations were determined using an innovative application of pre-storm Google SteetView images to determine the floor elevation above the ground, combined with LIDAR ground elevations (Kennedy, 2011). Where pre-storm StreetView images exist, the method allows floor elevations to be determined for buildings that were destroyed and no longer exist to be field surveyed.

ANALYSIS

Analysis will include a comparison of the storm surge and wave modeling ability to predict building damage. Pre- and post-storm Flood Insurance Rate Maps will be compared to survival or failure of the buildings on an individual and community scale. Preliminary results are shown in Figure 1. Depth damage curves will be developed and the uncertainty evaluated.

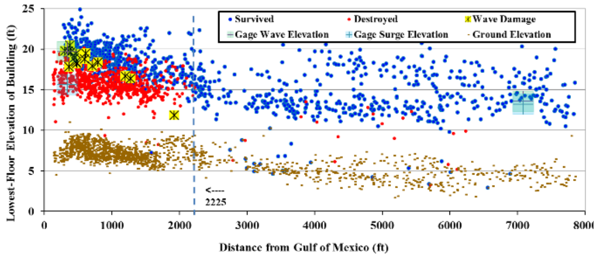

Figure 1 - Building damage distribution by floor elevation and distance from the Gulf of Mexico (Rogers, 2015).

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