RAPID/Collaborative Research: Wave and Surge Structural Damage to Shorefront Residential Properties from Hurricane Sandy

Andrew Kennedy, University of Notre Dame, Andrew.kennedy@nd.edu

Ning Lin, Princeton University, nlin@princeton.edu

Summary

This NSF Collaborative Rapid Response Research Grant (RAPID) project collected perishable damage data arising from Hurricane Sandy along the New Jersey coastline. Although the storm was judged to be Category 1 based on its wind speed, it generated high storm surge because of its large size and residential structures along the coastline sustained severe damage and destruction from waves and surge.

The project is focused on field data for residential building damage in Ortley Beach, New Jersey and surrounding regions. This area sustained severe destruction in some neighborhoods while other nearby areas experienced far less damage. The two major goals for data collection were: (1) to collect perishable data on residential building damage levels, failure modes, and building characteristics (elevation, specific connections/members failed, age); and (2) to find damage gradients, and to identify and quantify their causes. Small teams evaluated and recorded data for every residence in selected regions. Data taken included location, elevations, house type and size, approximate age, large scale storm erosion/accretion, local scale foundation scour, approximate waterlines, visible damage from wind/waves, damage levels, damage/failure modes, specific connection and member failures, and environmental exposure (sheltered behind buildings/dunes, open to sea). Numerous GPS-tagged pictures were taken of each house from multiple angles. With 3-4 teams of 2-3 people each, 495 structures including 444 houses were surveyed for the database. Additional data was taken from pre-and-post-storm airborne lidar, public tax records, satellite images and other publically available records such as newspaper stories and NOAA and USGS web sites.

Preliminary Findings and Examples

Although investigations are still ongoing, some preliminary conclusions are clear. First, newer houses survived much better than older houses. A large part of the reason appears to be that newer houses were built with better connections to the foundations: some older houses appear to have had very weak connections. Large wave heights and proximity to the open ocean were also variables that significantly increased the chance of high damage states. Wave and surge damage was much greater than wind damage in most instances.

When compared to many sites further south on the Gulf Coast, New Jersey houses were at much lower elevations, and fewer were on piled foundations. This tended to increase damage considerably over what might be expected if they were at higher elevations.

The greatest damage occurred in locations where dunes were breached and waves and surge propagated largely unimpeded into residential areas. In regions where dunes remained intact, damage was much lower. Figure 1 shows an example of damage in locations that were broadly similar except for the absence/presence of an intact dune system after the storm.

Figure 1. Contrast between large damage in an area with eroded dunes (left), and minimal damage in a more protected area with intact dunes (right).

Future Work

Analysis is ongoing. Future work will compare damage measurements taken here with observed and computed measurements of environmental properties such as wind, waves, and surge. The end goal is to provide links between environmental properties, building properties and damage. These damage data will be used to guide future research in developing storm surge resistant residential structures.

Once in near-final form, all data taken in this project will be uploaded into Cyber-Eye, an online geospatial tool being developed by the University of Notre Dame for the collection and dissemination of hurricane data. This will be made available to other interested researchers so that more complete datasets are available for the hurricane research community.

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