Hazus for Hurricane Modeling

Hazus is a nationally standardized risk modeling methodology that combines expertise from many disciplines to create actionable risk information that increases community resilience. It is distributed as free GIS-based desktop software with a collection of inventory databases for every state and territory in the country. Hazus identifies areas with high risk for natural hazards and estimates physical, economic, and social impacts of earthquakes, hurricanes, floods, and tsunamis. The Hazus Program, managed by FEMA's Natural Hazards Risk Assessment Program, partners with other federal agencies, research institutions, and regional planning authorities to ensure Hazus resources use the latest scientific and technological approaches and meet the emergency management community's needs.

Hazus produces a variety of actionable risk information:

- **Physical damage** to residential and commercial buildings, schools, critical facilities, and infrastructure
- **Estimated social impacts** including displaced households, shelter requirements, and exposure to floods, earthquakes, hurricanes, and tsunamis
- **Economic impacts** such as business interruptions and reconstruction costs
- **Cost effectiveness** of common mitigation strategies, such as elevating structures in a floodplain

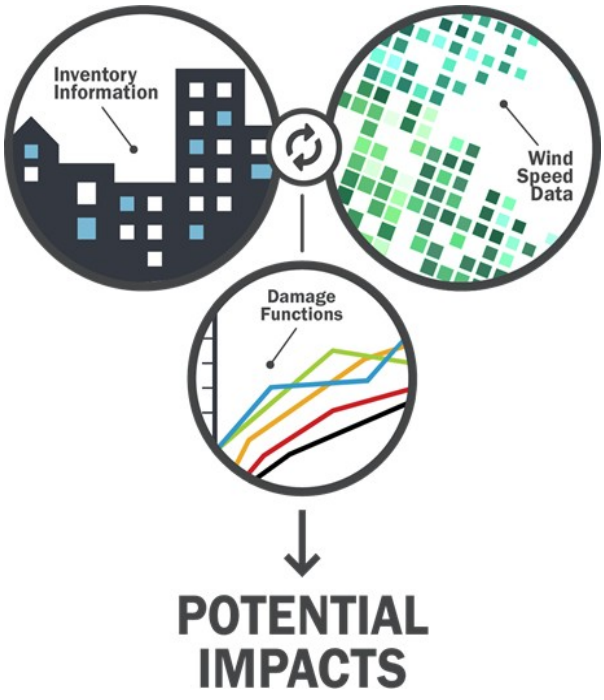

Figure 1: The Hazus Hurricane Model – *The Hazus Hurricane Model combines inventory information andwind speed data with damage functions to estimate disaster impacts. Learn more about the hurricane modeling methodology byreading the Hazus Hurricane Technical Manual.*

How Hazus Works

The Hazus Hurricane Model, developed in 2004, continues to evolve through partnerships with wind and coastal surge experts and engineers from organizations like the National Oceanic and Atmospheric Administration (NOAA), the Department ofHomeland Security (DHS) Coastal Resilience Center (CRC), and universities. The model estimates physical and economic damage to buildings due to wind and windborne debris. Wind hazard data are generated at the census tract level. The model considers peak gusts,terrain roughness and tree coverage data for incominghurricanes, historic storms, or probabilistic hazards. This process can be combined with an internal storm surge model or user-supplied surge data to estimatethe damage to buildings caused by coastal flooding driven onshore by hurricane winds.

The Hurricane Modeling Workflow

Hazus risk analyses are categorized as Basic or Advanced, depending on the level of effort and expertise required by the user. Basic results are based on generalized national databases and best available information included in Hazus software. Users can learn how to run a basic Hazus analysis by watching FEMA's Hazus training videos on YouTube. Advanced Hazus analyses incorporate more detailed local data about a community's population and assets to generate more accurate and applicable loss estimates. Any Hazus hurricane risk analysis project should consider the following steps:

1. Prepare Inventory Data

The Hazus General Building Stock, available for download along with Hazus software from FEMA's website, provides a nationwide database of estimated building characteristics, summarized at the census block level, to facilitate baseline risk assessment in communities without building-level inventory data. Risk assessment results are more accurate when produced using building-level information, which can be found through the U.S. Army Corps of Engineers (USACE) National Structure Inventory or local tax assessor offices.

Whether users rely on aggregated General Building Stock data or building-level inventory information, it is important to review inventory vulnerability characteristics for accuracy before running a Hazus analysis. Building characteristics determine which damage functions are applied to a given set of buildings during the modeling process and should be edited to reflect conditions in a user's Study Region.

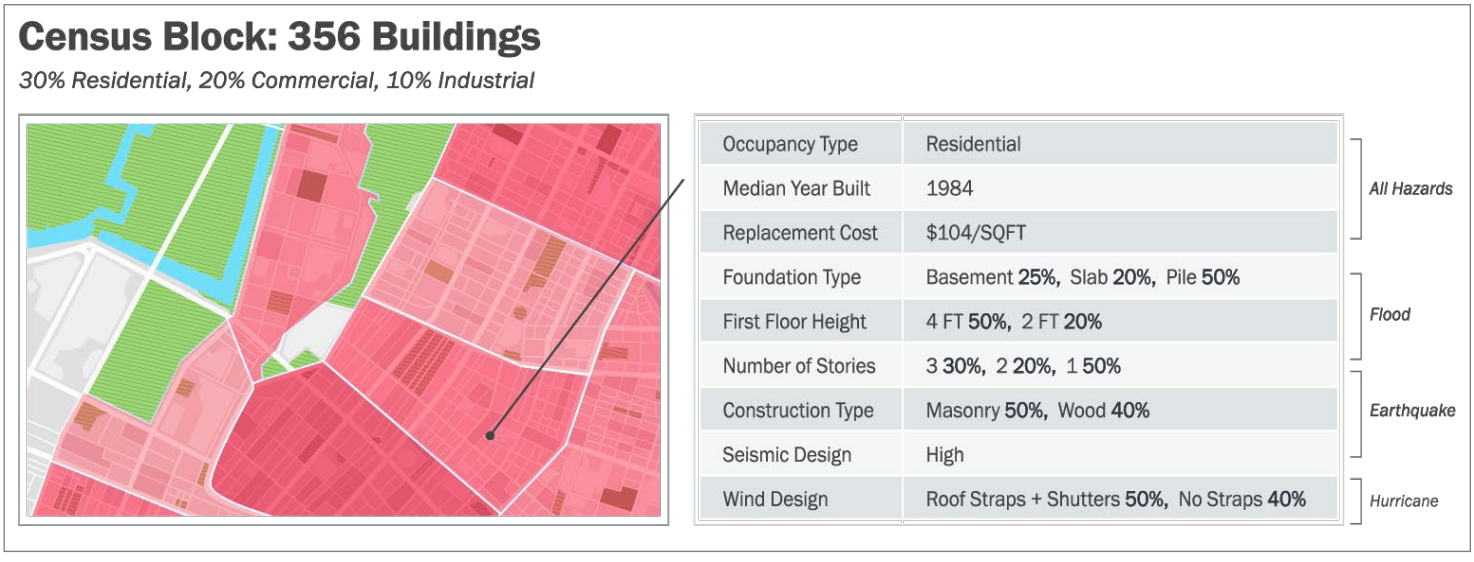

Figure 2. The Hazus General Building Stock *provides a baseline inventory dataset for risk assessment, aggregated at the census block level. Building-level datasets may provide more accuracy. Local information about building vulnerability should be incorporated into a Hazus hurricane risk analysis.*

Learn More

A **damage function** is the mathematical relationship between hazard intensity and the re developed by experts across the engineering community using damage information from past disasters.

2. Fetch Hazard Data

Accurate risk assessments depend on hazard information produced by experts in each hazard scientific community. NOAA's National Hurricane Center forecasts the spatial distribution of hurricane wind speeds for landfalling U.S. storms in advisories disseminated every six hours as storms approach. Advisories are summarized into datasets that include the location, direction, and speed of tropical storm winds by Hurrevac, a storm tracking decision support tool jointly developed by FEMA, USACE, and NOAA. The Hazus Hurricane Hazard Import Tool (HHIT) is an open-source tool that downloads, prepares, and imports Hurrevac hurricane data into a user's local Hazus database for hurricane loss modeling.

For some storms, the National Institute for Standards and Technology (NIST) produces observed wind speed data after landfall for use in impact modeling and recovery. These data can be fetched directly from the Hazus storm data interface. Hazard data for wind events association with a specific return interval are produced by Hazus using a 100,000-year stochastic model.

3. Analyze & Communicate Results

During analysis, the Hazus Hurricane Model will assign wind and surge damage functions to inventory data according to building vulnerability characteristics. Building damages are then calculated using wind speeds, surge heights, and damage functions. The model combines damages with demographic, geographic, and economic information to estimate additional hurricane impacts like economic loss, shelter requirements, and debris generated by the storm.

Hazus studies produce dozens of risk metrics that should be summarized according to the intended audience using infographics, maps, and suggested areas for risk reduction efforts. The open-source Hazus Export Tool can be used to produce simplified results tables and a one-page graphical report summarizing hurricane impacts. Results tables should be explored for hurricane risk reduction opportunities like mitigation projects for vulnerable building types or optimized shelter location.

Hazus Resources

The Hazus program offers technical guidance, training, and information about ongoing and recent projects to help stakeholders complete successful risk assessments. Please review the resources listed below for assistance using Hazus and reach out to the Hazus Team with questions.

- Self-Guided Course Materials
- Sign Up for Risk Assessment Guidance
- User & Technical Manuals
- YouTube Videos
- GitHub Resources
- Contact the Hazus Team