

What is Hazus: An Introduction to FEMA's Hazus Program

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 U.S. state and territory. 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 incorporate the latest scientific and technological approaches and meet the needs of the emergency management community.

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

How Hazus Works

Each Hazus model – earthquake, flood, tsunami, and hurricane – combines inventory information, hazard extent and intensity data, and damage functions to estimate the impacts of disasters (Figure 1). Default datasets are provided for each of these inputs so that any community can quantify risk, regardless of data availability. However, the accuracy of risk assessment information is driven by the quality of modeling inputs, so users are encouraged to customize their Hazus analyses with best available data from local or authoritative sources whenever possible.

Inventory Information

The Hazus General Building Stock, available for download along with Hazus software from FEMA.gov, provides a baseline inventory dataset complete with the vulnerability information required to analyze natural hazard risk. Other sources include the U.S. Army Corps of Engineers National Structure Inventory or local tax assessor offices.

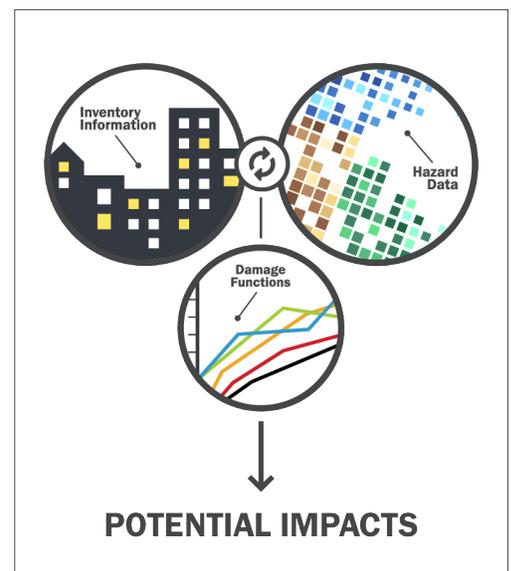


Figure 1: The Hazus Model



FEMA

Damage Functions

A damage function is the mathematical relationship between hazard intensity and the amount of damage sustained by a building. The damage functions in Hazus were developed by engineering and research communities and are based on observations from past disasters and rigorous science-based evaluations.

Hazard Data

Accurate risk assessments depend on hazard information produced by experts in each hazard scientific community. The U.S. Geological Survey produces earthquake hazard data called *ShakeMaps* that provide detailed event information, including ground motions at multiple frequencies. FEMA's Risk MAP produces flood hazard data called *depth grids* for probabilistic flood scenarios in communities selected for floodplain mapping projects. The National Oceanic and Atmospheric Administration (NOAA) National Hurricane Center forecasts the *spatial distribution of hurricane wind speeds* for landfalling U.S. storms in advisories disseminated every 6 hours as storms approach. 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. The NOAA Pacific Marine Environmental Laboratory produces tsunami hazard data as *gridded measurements of wave depth and strength* (momentum flux) for near- and distant-source tsunamis.

Uncertainty

Hazus results are based on established science and best available nationwide data – but like any modeled information, even when improved data are used, they contain uncertainty. Sources of uncertainty include assumptions about the categorization of buildings and flawed empirical relationships between damage, hazards, and buildings. Hazus does not quantify the uncertainty of model results. Quantifying uncertainty requires robust sensitivity analyses – repeated model runs with changes in single building and hazard parameters – to understand the variability of model results.

Learn More

Get more details about how each Hazus model works by reading our [Technical Manuals](#).

The Hazus General Building Stock

The Hazus Program 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 (Figure 2). Risk assessment results – especially those developed for flood hazards – are significantly more accurate when produced using building-level information. Building footprint data are increasingly available from local collection efforts or nationwide providers like Microsoft. However, these data often do not include the vulnerability attributes required for natural hazard risk assessment. Building characteristic distributions in the Hazus General Building Stock can serve as a starting point for analysts developing structure-level inventory databases for risk assessments. To learn more about how Hazus inventory information is used to estimate disaster impacts, read the [Hazus Inventory Technical Manual](#).



Example Hazus Census Block: 356 Buildings

30% Residential, 20% Commercial, 10% Industrial

Occupancy Type	Residential	All Hazards
Median Year Built	1984	
Replacement Cost	\$104/SQFT	Flood
Foundation Type	Basement 25%, Slab 20%, Pile 50%	
First Floor Height	4 FT 50%, 2 FT 20%	Earthquake
Number of Stories	3 30%, 2 20%, 1 50%	
Construction Type	Masonry 50%, Wood 40%	Hurricane
Seismic Design	High	
Wind Design	Roof Straps + Shutters 50%, No Straps 40%	

Figure 2: Hazus General Building Stock

Learn More

The Hazus General Building Stock is a free resource, available for download [here](#).

Hazus for Emergency Management

Hazus is used for mitigation, recovery, preparedness, and response. Mitigation planners, GIS specialists, and emergency managers use Hazus to determine potential losses from disasters and to identify the most effective mitigation actions for minimizing those losses. Hazus supports the risk assessment requirement in the mitigation planning process. Response planners use Hazus to map potential impacts from catastrophic events and identify effective strategies for response and preparedness. Hazus is also used during real-time response efforts to estimate impacts from incoming storms or ongoing earthquake sequences.

PREPAREDNESS & RESPONSE

-  The hurricane model can help assess **which hospitals will be functional** in the days following a storm.
-  The earthquake model can help assess **which bridges will function** right after shaking has occurred.
-  The flood model can help assess which **emergency routes might be flooded** during a storm.
-  The tsunami model can identify which **residential areas will be hard to evacuate** and in need of early warning systems.

MITIGATION & RECOVERY

-  **The hurricane model** can assess the benefits of hurricane straps, shutters, tie-downs, and different roof types.
-  **The earthquake model** can assess the benefits of seismic retrofits and strengthening building codes.
-  **The flood model** can assess the benefits of structure elevation, community buyouts, and floodplain development.
-  **The tsunami model** identifies inundation areas, at-risk structures, and critical evacuation routes.

Hazus Resources

The Hazus program offers technical guidance, training, certifications, 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](#)

 [YouTube Videos](#)

 [Risk Assessment Guidance](#)

 [GitHub Resources](#)

 [User & Technical Manuals](#)

 [Contact the Hazus Team](#)

Hazus is going open source!

Check out our growing collection of simple risk assessment tools on [GitHub](#).