IN-CORE

- ✓ *Resilience*-informed decision-making for natural hazard events
- ✓ Models of "what if" scenarios for natural hazard impacts specific to your community
  - ➢ Reflects your community's unique socio-demographics and infrastructure
  - ➢ Projects population displacement
  - ➢ Models damage to buildings including household impacts, transportation system disruptions, utility network outages, and critical services
  - ➢ Predicts the economic impact on households, businesses, and the local region
  - ➢ Provides insights for planning that will reduce losses and social impacts, and accelerate recovery
- ✓ Optimized *resilience* planning for hurricanes, tornadoes, earthquakes, floods, climate change, and sea-level rise

Resilience

Community Brief: Mayfield

Mayfield, KY Field Study

After a devastating tornado hit Mayfield, KY in Dec. 2021, an IN-CORE simulation helped the city explore changes to building codes that could decrease damage to buildings and decrease population dislocation.

On December 10-11, 2021, a deadly tornado struck several U.S. states, including Arkansas, Illinois, Kentucky, and Tennessee, resulting in $3.9 billion in damage, more than 90 deaths, and hundreds of injuries. Mayfield, KY was one of the most heavily damaged communities. More than 3,778 residential buildings (typically single-family dwellings), 183 commercial properties, and 103 other buildings were damaged or completely destroyed (NOAA 2021)[1].

Mayfield's City Lead Recovery Coordinator, Ryan Drane, requested an analysis to help support their resilience planning from the Center for Risk-Based Community Resilience Planning (referred to as the Center of Excellence or CoE) funded by the National Institute of Standards and Technology.

The CoE used IN- CORE's modeling environment to hindcast the community-level building damage in Mayfield for residential buildings to explore how a different building codes or policies could have decreased housing damage and decreased population dislocation.

What is IN-CORE & the CoE?

The CoE is a 14-university consortium across the U.S., funded by the National Institute of Standards Technology (NIST). They developed a multi-disciplinary computational environment that models natural hazard impacts and resilience planning called IN-CORE (Interdependent Networked Community Resilience modeling Environment). This open-source computational environment is designed to integrate physical infrastructure with socio-economic systems and to perform community resilience assessment affected by various natural hazards.

For more information about the study

[1] Department of Commerce, NOAA. 2021. "The Violent Tornado Outbreak of December 10-11, 2021." National Weather Service, *NOAA's National Weather Service*, https://www.weather.gov/pah/December-10th-11th-2021-Tornado.

[2] Wang, L., van de Lindt, J.W., etc. 2023. Community Testbed Model to Support Potential Structural Design Code Changes: The 2021 U.S. Midwest Tornado Outbreak. *Disaster Prevention and Resilience (under review).*

Want to use IN-CORE?

Sign up to use IN-CORE:	NIST-Funded CoE:
https://incore.ncsa.illinois.edu/	http://resilience.colostate.edu/in_core/

Field Study Procedures and IN-CORE Modeling Results

Step 1: Create a model in IN-CORE that is reflective of Mayfield's building structures and design model of the EF4 tornado wind fields based on historical data and recreate the approximate the 2021 tornado path in Mayfield.

Step 2: Run damage analysis based on existing building stock and document the damage.

Step 3: Include proposed changes to building code (provided by R. Drane) and update residential buildings with specific levels of strength, stiffness, and performance and re-run the simulation and damage analysis.

Step 4: Provide Mayfield with a comparison of damage analyses with and without proposed changes to building code to support decisions on changes in building code.

Comparisons of damage (figures 1 and 2) with *dark blue* indicating a *greater chance* that buildings will become *nonfunctional*.

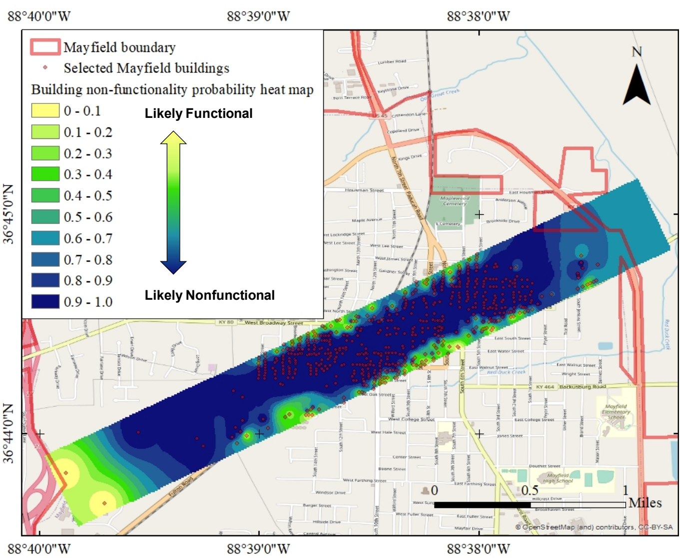


Figure 1. Probability of Non-functional Buildings under Current Building Design for an EF4 tornado, showing greater risk of building destruction

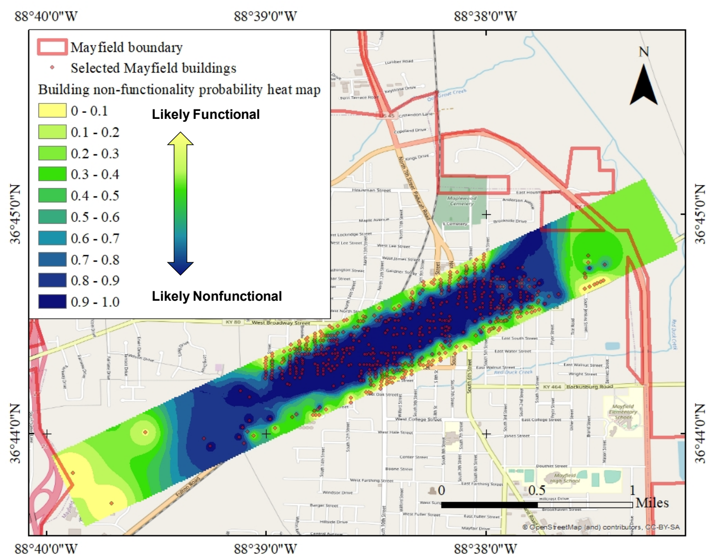
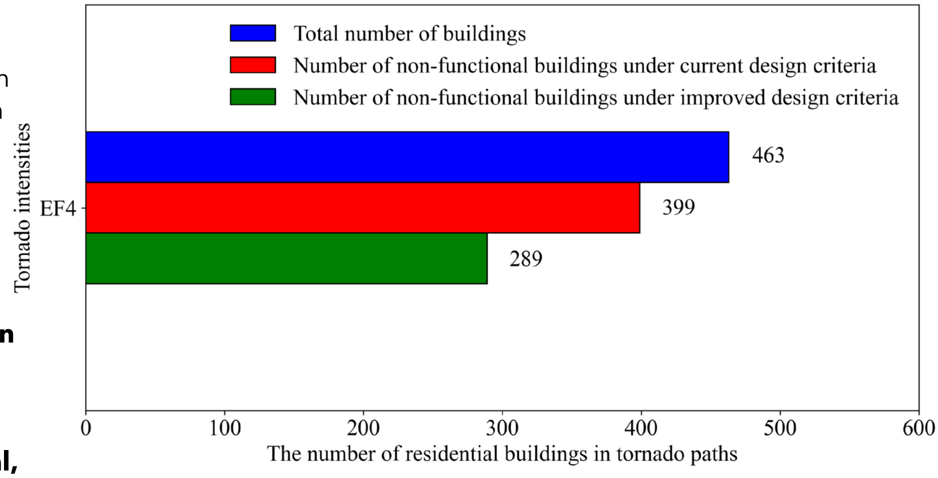


Figure 2. Probability of Non-functional Buildings under Proposed Building Design for an EF4 tornado, showing improvements in functionality

The graph on the right shows the total number of buildings in the path of the simulated EF4 tornado shown in figures 1 and 2, and the resulting number of buildings rendered nonfunctional under current design and under improved building designs.

Analysis indicates a 24% reduction in nonfunctional buildings under improved building codes after an EF 4 tornado, resulting in 62% of buildings becoming nonfunctional, versus 86% under current design.



The Center for Risk-Based Community Resilience Planning is a NIST-funded Center of Excellence; the Center is funded through a cooperative agreement between the U.S. National Institute of Standards and Technology and Colorado State University (NIST Financial Assistance Award Numbers: 70NANB15H044 & 70NANB20H008). The views expressed are those of the presenters, and may not represent the official position of the National Institute of Standards and Technology or the US Department of Commerce.