Current Research Towards Tornado Resilient Communities

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April showers bring May showers ....

But in Moore, OK ....

$4 billion direct economic losses in 15 years
• Debris removal costs and lost production
• Reduced tax base, and lost utility fees to city

Research Motivation

What building performance should we expect from improved building codes?

Are the Moore’s code changes sufficient and sustainable in the long-term?

What is now needed to leverage current national focus on tornado-resilience?

The Building Code

Establishes minimum standards that will allow effective and reasonable protection for public safety, health and general welfare, and secondarily for protection of property as appropriate.

Codes regulate:
• Building design, construction & repair
• Material quality and performance
• Building use and occupancy

Codes are for life safety not property

City councils and mayors “absolutely do not know” about the life-safety objective & how damaged a code-compliant building stock will be in the aggregate, and (they) are unsatisfied when they do learn of (the expected damage.)


Florida Statutes; Cl. 553.72 (Intent)
Who are “We”?  
- Stakeholders  
  - Building Officials  
  - Building Professionals  
  - General Insurance Companies  
  - Federal / State Government  
  - ... etc.  
- The Public-at-Large

What performance do “We” expect?  

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Public-at-Large</th>
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</thead>
<tbody>
<tr>
<td>• No loss of life?</td>
<td>• No loss of life?</td>
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<tr>
<td>• No catastrophic collapse?</td>
<td>• No catastrophic collapse?</td>
</tr>
<tr>
<td>• All building remain usable?</td>
<td>• All building remain usable?</td>
</tr>
<tr>
<td>• No building damaged?</td>
<td>• No building damaged?</td>
</tr>
</tbody>
</table>

...it depends on whom you ask!

Vision 2060  
Moore’s homes will be tornado-resilient  
- Will the 2014’s building code still be enforced?  
  - Or would it have been changed - strengthened?  
- Is tornado building collapse a thing of the past?  
  - Have direct economic tornado losses been decreased?  
- Do all buildings have safe rooms?  
  - Do fatalities and injuries still occur in tornadoes?

The Moore of 2060 starts in 2015  
We establish building performance in 45 years by the choices we make today for the building code and the code improvements over time.

How did Moore 2015 come about?  
It started more than 45 years ago
Moore homes of 2015 started in 1970

Building code decisions we made (or failed to make) following the Lubbock, Texas tornado and others determined how the Moore, OK buildings collectively performed in 2013.
Since 2011 - a realignment of forces

- Federal Level
  - NOAA/ Weather Ready Nation / Storm Prediction Center have re-doubled efforts to share damage reports.
  - NIST – recently awarded a $20 M Community-resilience project to improve nation’s response to natural hazards
  - NSF – awarded multi-disciplinary research projects where engineers and social scientists address solutions together

- Private Organizations
  - FLASH and IBHS continue to provide practical solutions
  - ASCE developed a Tornado Design Guide in Commentary

- Public-at-Large
  - Represented by Mayor of Moore, OK are more on board to provide commitments to not repeat past errors

**VISION 2060**

CHANGING CURRENT PARADIGMS

BY TWO RESEARCH EXAMPLES
Over 70% of individual observations in Joplin either were in agreement or within 1 EF range of the predicted wind speeds using tree-fall data.

For the homes designed to 115 mph (ASCE 7-10)...

...... most performed well below 115 mph (white region)

If instead homes were designed to 135 mph (EF2) instead......

...... reduce the EF2 level damage (white region), narrow the damage

AN ENGINEERING-BASED CATASTROPHE MODEL TO PREDICT TORNADO DAMAGE

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Research Assistants
Xinlai Peng, David B. Roueche
Summary

- Building codes ought to reflect a collective agreement of what’s acceptable in society
- Technology isn’t the block – it is commitment
- The public must be more engaged early in the process and educated of real costs to them
- Implications of building code on future tornado performance is critical to share with the public
- Intangible benefits – “i.e. suffering avoidance” must be considered in building code decisions

**Where do we want to be in 2060?**

Building codes address one building at a time. Today’s codes will produce the 2060 building stock.

Who will turn the ship?

@davidprevatt2
Minimum ASCE 7-10 Design Wind Speeds (0.00143 Annual Probability of Exceedance)

Minimum Tornado Design Wind Speeds (0.00001 Annual Probability of Exceedance)


Figure 5A: Tree-Fall Patterns in the 22 May, 2011 Joplin Tornado

Figure 5B: Tree-Fall Patterns in the 22 May, 2011 Joplin Tornado

Figure 6A: Comparison of two methods of near-surface wind speed estimation in the 22 May, 2011 Joplin, Missouri Tornado.