Enhancements in Building Design and Construction: Prerequisites for Resilient Communities

Life-Cycle Performance: Moving Forward to More Resilient Communities
NIBS Multi-Hazard Mitigation Council
Washington, DC
January 7, 2014
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Senior Director, Codes and Standards
Portland Cement Association
Part 1: Disasters and Property Losses
NOAA, Census Bureau, and Insurance Industry
Statistics and Data

Part 2: Influencing Factors
Consideration of Demographics, Amount of
Construction and Construction Practices

Part 3: Community Resilience
Opportunities: Voluntary or Mandatory Programs
Disaster Resistance

Earthquake

Flood

Snow and Ice

Wind
Disaster Resistance

Wildland Fires

Structure Fires

Conflagrations
Fires after Disasters

Hurricane Katrina

Super Storm Sandy
2012 National Disasters and Emergencies

Source: FEMA.gov
03-12 National Disasters and Emergencies

Source: FEMA.gov
Combined Losses: Tornadoes and Storms
In Billions of 2010 Dollars per Decade*

Billions of Dollars

Thunderstorms
Hail Storms
Tornadoes

'50-'59 '60-'69 '70-'79 '80-'89 '90-'99 '00-'09

56.5 Billion
3.1 Billion

1700%

*Property Claims Service
Combined Losses: Hurricanes and Storms
In Billions of 2010 Dollars per Decade*

Tropical Storms
Hurricanes

Billions of Dollars

'50-'59 '60-'69 '70-'79 '80-'89 '90-'99 '00-'09

0 20 40 60 80 100 120

101.1 Billion
1.5 Billion

6700%

*Property Claims Service
Winter Weather Event Losses
In Billions of 2010 Dollars per Decade*

<table>
<thead>
<tr>
<th>Decade</th>
<th>Billions of Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>'50-'59</td>
<td>0.5 Billion</td>
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<tr>
<td>'60-'69</td>
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<tr>
<td>'70-'79</td>
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<td>'80-'89</td>
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<tr>
<td>'90-'99</td>
<td>10.3 Billion</td>
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<tr>
<td>'00-'09</td>
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</tbody>
</table>

*Property Claims Service

1800% increase from 0.5 Billion to 10.3 Billion
Flood Losses
In Billions of 2010 Dollars per Decade*

*Property Claims Service
Fire Losses

In Thousands of 2010 Dollars per Fire

*US Fire Administration National Fire Incident Reporting System data Complied by National Fire Protection Association
Tornado Losses
Versus Number EF3 - EF5 Tornadoes*

*National Weather Service
Hurricanes and Tropical Storms Losses

Versus Number of Strikes*

Frequency of Landfalls

'50-'59 '60-'69 '70-'79 '80-'89 '90-'99 '00-'09

Losses in Billions of 2010 Dollars

100 80 60 40 20

*National Weather Service
Disaster Losses Excluding Flood*
In Millions of 2010 Dollars per Decade

Earthquakes
Fire
Hail
Hurricanes
Thunderstorms
Tornados
Tropical Storms
Wildland Fire
Winter Storms

190.6 billion
5.3 billion

*Property Claims Service
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Disaster Losses vs. Population Change*

Population in Millions and Losses in Billions of 2010 Dollars

Northeast
MidWest
South
West
Losses in 2010 $

*U.S. Census Bureau
Type I and II High-Rises
Replace Type V Low-Rise
Losses vs. Residential Units*

Residential Units in Millions and Losses in Billions of Dollars

*U.S. Census Bureau
Losses vs. Commercial Put-in-Place*
In Billions of 2010 Dollars

*U.S. Census Bureau
Coincidence?

- Frequency of Events
- Population Re-Distribution
- Amount of Construction
Where’s the Bar Now?

• Societal and Cultural Trends
  – Least Initial Cost/Maximum Return on Investment
  – Increased Political Pressure
  – Emotion Versus Technical Substantiation
  – Acceptance of Disposable Products

• Changes in Construction Practice
  – Move to Lighter/Less Expensive Construction
  – Project Management and Value Engineering

• Rules and Regulations
Societal and Cultural Changes

- Maximum Return on Investment
- Competition and Short-Term Ownership
Societal and Cultural Changes

• Political Pressures and Influence
• Economic Development = Revenue
  – Short-Term versus Long-Term Mentality
  – Aging Infrastructure
Disposable Mentality

☑️ Consumer Goods
☒ Buildings
☒ Infrastructure

Societal and Cultural Changes
Demolition* vs. All Buildings* by Age

Age of Buildings

- >75: 20%
- 51-75: 18%
- 26-50: 49%

*The Athena Group
Changes in Construction Practices

Move to lighter/less expensive construction

• Plywood sheathing
• Oriented strand board sheathing
  – Structurally comparable
  – Comparable impact resistance
• Foam board sheathing
Change in Owner’s Role

Project Management and Value Engineering

Copper Flashing

Plastic Flashing
De-Regulation

- More stringent passive fire protection
- More stringent sound transmission loss criteria
- Etc...
Relaxation of Model Codes (‘70s & ‘80s)

- Height and area tables permitting larger Type V buildings
Relaxation of Model Codes (‘70s - ‘80s)

• Sprinkler protection required in more buildings.

• Trade-offs in passive protection and egress safety used to offset sprinkler costs.

• Moving away from prescriptive material specific provisions to performance based requirements.
Relaxation of Model Codes (‘97-‘00s)

- The merger resulted in the least common denominator for passive fire protection.
- Most aggressive trade-offs for sprinklers were also included from any one code.
Green Codes and Standards

Fixtures and Equipment
Green Codes and Standards

Building Core and Shell
Cultural/Societal Change: Increased Competition and Increased Emphasis on ROI

- Least initial cost is *minimum* building code or *less*
- *Minimum* building code is becoming the *standard of practice* in the United States
- Design *firms* advertising *alternative compliance* to lower initial costs
Trend suggests that the problem of aging buildings will become greater in the future if we do not improve the way we build new buildings today.
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Key Attributes of Enhanced Resilience

- Increased Resistance to Disasters
- Increased Longevity
- Increased Robustness
- Improved Sustainability
- Improved Life Safety
- Increased Durability
- Increased Adaptability for Reuse
90 West St. built in 1907

Damaged by WTC collapse, uncontrolled fire for 5 days, and reopened as apartment building in 2005
Winecoff Hotel built in 1913

Gutted by fire in 1946,
Hotel in 1951,
Housing for elderly,
Vacant for 20 years,
Luxury Ellis Hotel in 2007
WTC 7 Completed in 1984
Enhanced Resilience vs. Life Safety

<table>
<thead>
<tr>
<th>Extent of Damage</th>
<th>Time to Re-Occupy</th>
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<tbody>
<tr>
<td>No Damage</td>
<td>Hours</td>
</tr>
<tr>
<td>Resilient</td>
<td>Days</td>
</tr>
<tr>
<td>Life Safety</td>
<td>Months</td>
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<tr>
<td>Total Loss</td>
<td>Years</td>
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<td>Never</td>
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San Francisco Target Recovery (SPUR)

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<td>4</td>
<td>24</td>
<td>48</td>
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<td>Residences</td>
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<td>Neighborhood</td>
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<td>Neighborhood Services</td>
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Risk Assessment

Any Hurricane
Category II
Category III or IV

Event
Structural Damage
Non-Structural Damage
National Institute of Building Sciences
Sustainable Building Industries Council

Whole Building Design Guidelines
DHS launched the Resilience STAR pilot, a voluntary certification program that aims to make homes and buildings more secure and resilient to all hazards. The RESILIENT Homes Pilot brings DHS together with local officials, private sector insurers and builders, and community leaders in risk-prone communities to rebuild private residences recently destroyed by hazards such as tornados and floods.
Voluntary Programs

• Knowledge / Understanding of Benefits
• Knowledge / Understanding of Consequences
• Ability / Opportunity to Influence
• Commitment to Overcome Barriers / Resistance
• Financial Resources
Enhanced Resilience

• A must for sustainability
• Essential for community continuity
IBC Minimum Code  
+ Enhanced Resilience  
= Improved Community Resilience, Continuity, and Sustainability  

www.cement.org/codes/hpbrs.asp
TUNDRA by Chad Carpenter

I think you'll find this charming straw house surprisingly affordable.
Thank You!

- Better Buildings
- Better Communities
- Better Environment

Building Stronger Communities One Building at a Time