Standards, Codes, and Guides

- **Leadership in Energy and Environmental Design – New Construction (LEED-NC)**
  - US Green Building Council

- **Green Building Initiative (GBI)**
  - Green Globe
Standards, Codes, and Guides

- **National Green Building Standard (ICC-700)**
  - National Association of Home Builders
  - International Code Council

- **Standard for the Design of High Performance Green Buildings Except Low-rise Residential Building (ASHRAE 189.1)**
  - American Society of Heating Refrigerating and Air-Conditioning Engineers
  - Illuminating Engineers Society of North America
  - US Green Building Council
Standards, Codes, and Guides

- **International Green Construction Code (IgCC)**
  - International Code Council
  - ASTM International
  - American Institute of Architects
  - American Society of Heating Refrigerating and Air-Conditioning Engineers
  - Illuminating Engineers Society of North America

- **Committee E60 on Sustainability (ASTM E60)**
  - ASTM International
Scope

- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere
- Materials and Resources
- Indoor Environmental Quality
The missing component?

Green Codes
Lack Enhanced Resilience
2011 National Disasters and Emergencies

- None
- 1 or 2
- 3 or 4
- 5 or More
‘02–’11 Disasters and Emergencies

- 4 or Less
- 5 to 9
- 10 to 19
- 20 or More

Map showing the number of disasters and emergencies by state from 2002 to 2011.
<table>
<thead>
<tr>
<th>Year</th>
<th>Hurricane</th>
<th>Severe Storms and Tornadoes</th>
<th>Storms and Flooding</th>
<th>Fire Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>55</td>
</tr>
<tr>
<td>2010</td>
<td>1</td>
<td>–</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>2009</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>16</td>
</tr>
<tr>
<td>2008</td>
<td>4</td>
<td>–</td>
<td>–</td>
<td>21</td>
</tr>
<tr>
<td>2007</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>–</td>
</tr>
<tr>
<td>2006</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td>2005</td>
<td>3</td>
<td>–</td>
<td>–</td>
<td>2</td>
</tr>
<tr>
<td>2004</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>2003</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>2002</td>
<td>–</td>
<td>–</td>
<td>2</td>
<td>–</td>
</tr>
</tbody>
</table>
Disaster Losses excluding Flood*  
Property Casualty Services in 2010 dollars

200,000
Earthquakes
Fire

150,000
Hail
Hurricanes
Thunderstorms

100,000
Tornados
Tropical Storms

50,000
Wildland Fire
Winter Storms

0
50,000
100,000
150,000
200,000

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

*Property Casualty Service
Disaster Losses vs. Population Change*

*U.S. Census Bureau
Losses vs. Residential Units*

Cumulative Construction

*U.S. Census Bureau
Losses vs. Commercial Put-in-Place*

*U.S. Census Bureau
Coincidence?

- Frequency of Events
- Population Re-Distribution
- Rate of Construction
Consider Changes in Regulations and Construction Practice

- Federal de-regulation
- Competition and short-term ownership
- Relaxation of criteria in model codes
- Changes in construction practices
- Changes in project responsibility and liability
- Green building codes and standards
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.
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 assistance to demonstrate alternative compliance
Timeless Architecture which requires durable, long-lasting materials and systems
Enhanced Resilience Needed

Flood

Snow

Wind
Enhanced Resilience Needed

Wildland Fires

Structure Fires

Conflagrations
Enhanced Resilience

90 West St.  
Built in 1907

Winecoff Hotel.  
Built in 1913

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

Completely gutted by fire in 1946, hotel in 1951, housing for elderly, vacant for 20 years, and became the Ellis Hotel in 2007.
Enhanced Resilience

- A must for sustainability
- Essential for community continuity
## Enhanced Resilience vs. Life Safety

<table>
<thead>
<tr>
<th>Extent of Damage</th>
<th>Time to Re-Occupy</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Damage</td>
<td>Hours, Days, Months, Years</td>
</tr>
<tr>
<td>Resilient</td>
<td>Time</td>
</tr>
<tr>
<td>Life Safety</td>
<td></td>
</tr>
<tr>
<td>Total Loss</td>
<td>Never</td>
</tr>
</tbody>
</table>

#### Time to Re-Occupy:
- **No Damage:** Hours
- **Resilient:** Days
- **Life Safety:** Months
- **Total Loss:** Years, Never
<table>
<thead>
<tr>
<th>Accepted Sustainability Aspects</th>
<th>Enhanced Resilience</th>
<th>HIGH PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Site Development</td>
<td>• Longevity</td>
<td></td>
</tr>
<tr>
<td>• Energy Conservation</td>
<td>• Durability</td>
<td></td>
</tr>
<tr>
<td>• Water Conservation</td>
<td>• Robustness</td>
<td></td>
</tr>
<tr>
<td>• Material Resources</td>
<td>• Low Maintenance</td>
<td></td>
</tr>
<tr>
<td>• Indoor Air Quality</td>
<td>• Disaster Resistance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Adaptive Re-Use</td>
<td></td>
</tr>
</tbody>
</table>
IBC Minimum Code
+ Sustainability
+ Resilience
= High Performance
Innovative Approach

- Amends & Appends the IBC
- Limited to Building Department Responsibility
- Jurisdiction Choices for mandatory enforcement
## Enhanced Longevity – Design Service Life

<table>
<thead>
<tr>
<th>I-Codes</th>
<th>Enhanced Resilience</th>
</tr>
</thead>
</table>

- Design Service Life: Minimum 50 years
### Enhanced Flood Resistance – Design

<table>
<thead>
<tr>
<th>I-Codes</th>
<th>Enhanced Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Except where determined to be protected by dams, levees, and flood walls, shall comply with:</td>
<td>Except where determined to be protected by dams shall comply with:</td>
</tr>
</tbody>
</table>

*Flood Resistant Design and Construction of (ASCE 24)*
Enhanced Flood Resistance – Elevation

DFE = Design Flood Elevation in feet above datum

d_{fp} = Design flood protection depth in feet

BFE = Base Flood Elevation in feet above datum
## Enhanced Load Resistance - Seismic

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Types of Buildings</th>
<th>I-Codes</th>
<th>Enhanced Resilience 0.2 sec. spectral response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>less than 0.4 g</td>
</tr>
<tr>
<td>I</td>
<td>Agricultural and temporary</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>II</td>
<td>Not I, III, or IV</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>III</td>
<td>Substantial hazard to life</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>IV</td>
<td>Essential</td>
<td>1.50</td>
<td>1.50</td>
</tr>
</tbody>
</table>
## Enhanced Load Resistance - Snow

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Types of Buildings</th>
<th>Importance Factors, $I_s$</th>
<th>I-Codes</th>
<th>Enhanced Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Agricultural and temporary</td>
<td></td>
<td>0.80</td>
<td>0.80</td>
</tr>
<tr>
<td>II</td>
<td>Not I, III, or IV</td>
<td></td>
<td>1.00</td>
<td>1.15</td>
</tr>
<tr>
<td>III</td>
<td>Substantial hazard to life</td>
<td></td>
<td>1.10</td>
<td>1.20</td>
</tr>
<tr>
<td>IV</td>
<td>Essential</td>
<td></td>
<td>1.20</td>
<td>1.30</td>
</tr>
</tbody>
</table>
## Enhanced Life Safety – Storm Shelters

<table>
<thead>
<tr>
<th>I-Codes</th>
<th>Enhanced Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Required except where within ¼ mile of adequate shelter</td>
</tr>
<tr>
<td>Where present shall comply with:</td>
<td>Where present shall comply with:</td>
</tr>
</tbody>
</table>

*Design and Construction of Storm Shelters (ICC 500)*
# Enhanced Load Resistance - Wind

<table>
<thead>
<tr>
<th>Importance Factors, $I_w$</th>
<th>I-Codes</th>
<th>Enhanced Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk Category</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Types of Buildings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I - Agricultural and</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>temporary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>II - Not I,III, or IV</td>
<td>1.00</td>
<td>1.15</td>
</tr>
<tr>
<td>III - Substantial hazard</td>
<td>1.00</td>
<td>1.10</td>
</tr>
<tr>
<td>to life</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV - Essential</td>
<td>1.00</td>
<td>1.10</td>
</tr>
</tbody>
</table>
# Enhanced Firesafety – Structural Fire Resistance

<table>
<thead>
<tr>
<th>IBC</th>
<th>Enhanced Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-fire rated structural elements</td>
<td>Only fire rated structural elements</td>
</tr>
<tr>
<td>permitted</td>
<td>permitted</td>
</tr>
</tbody>
</table>
### Enhanced Fire Safety – Sprinkler Protection

<table>
<thead>
<tr>
<th>I-Codes</th>
<th>Enhanced Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprinklers required in all hazardous, institutional and most residential and most assembly, educational, factory, mercantile and storage</td>
<td>Sprinklers required in all occupancies except some low-hazard factory and storage</td>
</tr>
</tbody>
</table>
## Enhanced Fire Safety – Fire Walls

<table>
<thead>
<tr>
<th>I-Codes</th>
<th>Enhanced Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combustible materials allowed</td>
<td>All Noncombustible</td>
</tr>
<tr>
<td>Reductions in fire ratings allowed</td>
<td>No fire rating reductions permitted</td>
</tr>
</tbody>
</table>
## Enhanced Fire Safety – Exterior Exposure

<table>
<thead>
<tr>
<th>IBC</th>
<th>Enhanced Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td>No openings within 3 ft of property line</td>
<td>No openings within 3 ft of property line</td>
</tr>
<tr>
<td>Increases in opening area for sprinklers</td>
<td><strong>No</strong> increases in opening area for sprinklers</td>
</tr>
</tbody>
</table>
## Enhanced Fire Safety – Sprinkler Protection

<table>
<thead>
<tr>
<th>IBC</th>
<th>Enhanced Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1-hour reduction in structural fire resistance rating for sprinklers</strong></td>
<td><strong>No reduction in structural fire resistance rating for sprinklers</strong></td>
</tr>
</tbody>
</table>
Enhanced Fire Safety – Sprinkler Protection
# Enhanced Fire Safety – Sprinkler Protection

<table>
<thead>
<tr>
<th>IBC</th>
<th>Enhanced Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-hour reduction in fire resistance of fire barriers and partitions for sprinklers</td>
<td>No reduction in fire resistance of fire barriers and partitions for sprinklers</td>
</tr>
</tbody>
</table>
## Enhanced Fire Safety – Flame Spread

<table>
<thead>
<tr>
<th>IBC</th>
<th>Enhanced Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction in flame spread for interior finish with sprinklers</td>
<td>No reduction in flame spread classification for interior finish with sprinklers</td>
</tr>
</tbody>
</table>
## Enhanced Fire Safety – Travel Distance

<table>
<thead>
<tr>
<th>IBC</th>
<th>Enhanced Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in travel distances for sprinklers</td>
<td><strong>No</strong></td>
</tr>
<tr>
<td></td>
<td>Increase in travel distances for sprinklers</td>
</tr>
</tbody>
</table>
### Enhanced Fire Safety – Areas of Refuge

<table>
<thead>
<tr>
<th>IBC</th>
<th>Enhanced Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Areas of refuge for persons with a disability not required on upper floors in buildings with sprinklers</td>
<td>Areas of refuge for persons with a disability required on upper floors in buildings with sprinklers</td>
</tr>
</tbody>
</table>
## Enhanced Firesafety – Exterior Exposure

<table>
<thead>
<tr>
<th>I-Codes</th>
<th>Enhanced Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min 1-hour fire rating within 5 ft of property line</td>
<td>Min 1-hour fire rating within 5 ft of property line</td>
</tr>
<tr>
<td></td>
<td>No vinyl siding or EIFS within 30 ft of property line</td>
</tr>
<tr>
<td></td>
<td>No combustible exterior wall covering within 5 ft of property line</td>
</tr>
</tbody>
</table>
## Enhanced Firesafety – Wildland-Urban Fires

<table>
<thead>
<tr>
<th>I-Codes</th>
<th>Enhanced Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optional</td>
<td>Mandatory</td>
</tr>
</tbody>
</table>
Community Benefits

- Offer longevity and community acceptance
- Maintain a more consistent tax base
- Minimize the expenditure of community resources when disasters occur
- Provide improved fire protection and reduce the potential for conflagrations
Environment, Society, and Economics

- Energy Conservation Interests
- Environmental Interests
- Emergency Management
- Emergency Responders
- Disaster Relief
- Human Services
- Insurers
HPBRS and Resilient Timeline

PCA Dec 2008

IBHS Feb 2010

IgCC V2.0 1st Hearings May 2011

IgCC V2.0 2nd Hearings Nov 2011

FCIA Update April 2012
ICC IgCC

- Site Design
- Materials
- Energy
- Water
- Indoor Air Quality

Still lacks enhanced resilience
Enhanced Resilience

Longevity

Fire and Life Safety

Durability

Robustness

Disaster Resistance

Sustainability

Resilience
HPBRS and Resilient Timeline

- IgCC V2.0 Hearings Nov 2011
- FCIA Update April 2012

Partners
- PCA
- IBHS
- MACS
Enhanced Resilience Code Changes

Non-Mandatory Appendices

- S338 – Structural loads
  - Snow
  - Wind
  - Flood
  - Seismic
  - Storm Shelters
  - Wildland fires
Enhanced Resilience Code Changes
Non-Mandatory Appendices

- FS200 – Exterior exposures
  - Wind
  - Hail
  - Fire from adjacent properties
Enhanced Resilience Code Changes
Non-Mandatory Appendices

- G252 – Fire resistance enhanced
  - Require 1-hr structural fire resistance
  - Require sprinklers except F2 & S2
  - No reduction in FR for sprinklers
  - No H&A increases for sprinklers
Enhanced Resilience Code Changes

Non-Mandatory Appendices

- G253 – Fire compartmentation enhanced
  - Require FR enclosures & sprinklers for incidental use areas
  - Require FR separations of all mixed uses
  - Require NC fire walls
  - No FR reductions for sprinklers
HPBRS and Resilient Timeline

- IgCC V2.0 Hearings Nov 2011
- FCIA Update April 2012
- IBC 2015 Hearings May 2012

Partners
PCA
IBHS
MACS
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