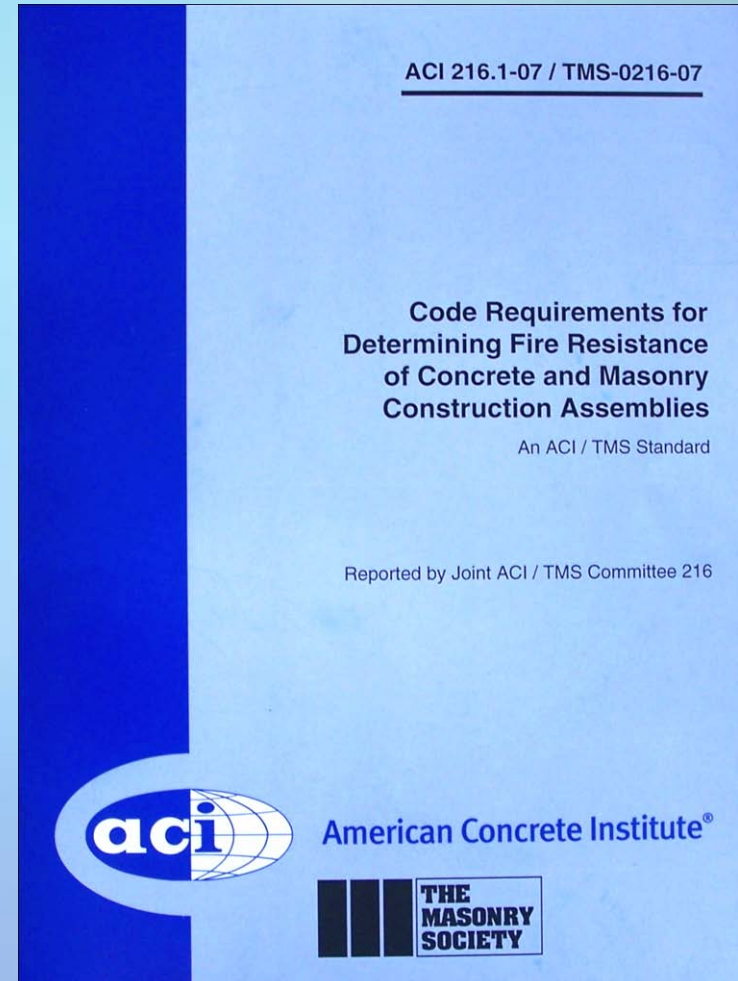
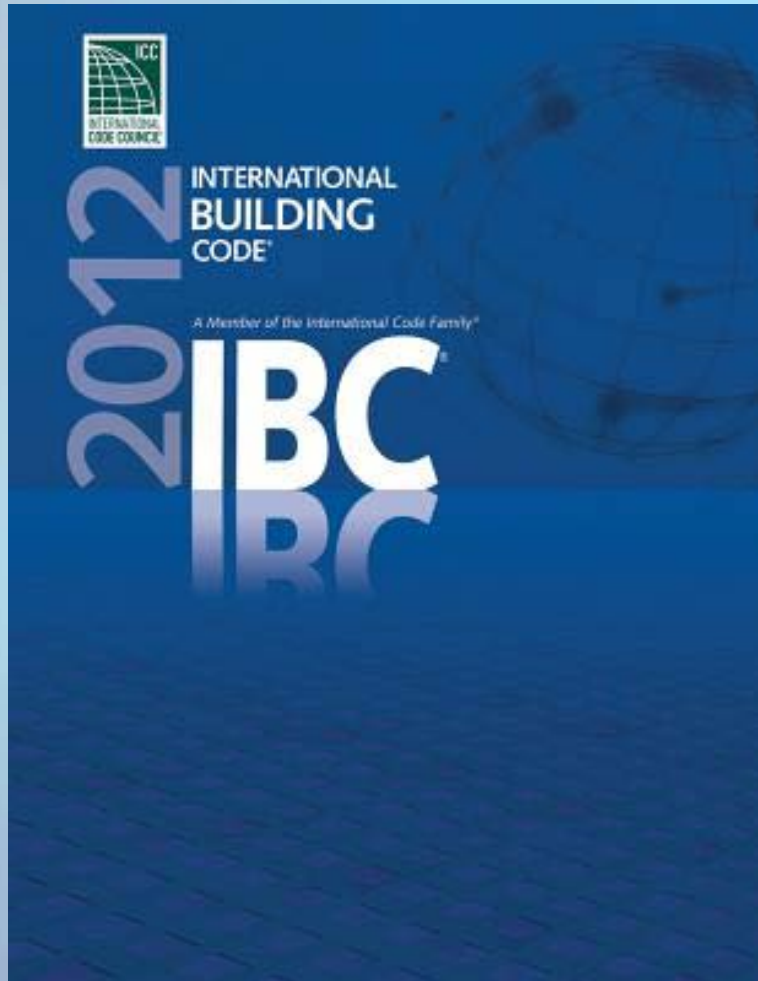


The background of the slide is a composite image. The upper portion shows a modern glass skyscraper with a curved facade, reflecting the sky. The lower portion shows the United States Capitol building in Washington, D.C., with its iconic dome, set against a sunset or sunrise sky. A dark horizontal band is overlaid across the middle of the image, containing the main title.

Increased Fire Protection A Component of Enhanced Resilience

Life Safety Organization
February 16, 2012
Stephen S. Szoke, P.E. LEED/AP
Director, Codes and Standards
Portland Cement Association

Fire Protection with Concrete and Masonry



Fire Protection with Concrete and Masonry

Fire Resistance of Concrete Floors and Walls

<i>Aggregate Type</i>	<i>Minimum Equivalent Thickness, inches</i>			
	<i>1 hour</i>	<i>2 hour</i>	<i>3 hour</i>	<i>4 hour</i>
Siliceous	3.5	5.0	6.2	7.0
Carbonate	3.2	4.6	5.7	6.6
Semi-lightweight	2.7	3.8	4.6	5.4
Lightweight	2.5	3.6	4.4	5.1

Fire Protection with Concrete and Masonry

Minimum Cover for Concrete Floors and Walls Non-Prestressed

<i>Aggregate Type</i>	<i>Restrained</i>	<i>Unrestrained</i>			
		<i>1 hr</i>	<i>2 hr</i>	<i>3 hr</i>	<i>4 hr</i>
Siliceous	3/4	3/4	1	1-1/4	1-5/8
Carbonate	3/4	3/4	3/4	1-1/4	1-1/4
Semi-lightweight	3/4	3/4	3/4	1-1/4	1-1/4
Lightweight	3/4	3/4	3/4	1-1/4	1-1/4

Fire Protection with Concrete and Masonry

Fire Resistance of Concrete Masonry Walls

<i>Aggregate Type</i>	<i>Minimum Equivalent Thickness, inches</i>			
	<i>1 hour</i>	<i>2 hour</i>	<i>3 hour</i>	<i>4 hour</i>
Calcareous or Siliceous	2.8	4.2	5.3	6.2
Limestone or Air-Cooled Slag	2.7	4.0	5.0	5.9
Expanded clay shale or Slate	2.6	3.6	4.4	5.1
Pumice or Expanded Slag	2.1	3.2	4.0	4.7

Enhanced Fire Safety

Non-Combustible Concrete Construction
Life Safety for Multi-Family Homes



Architect: Michael Green & Associates
Photographer: Robert J. Paulson

Where There's Smoke, There's Fire. And, too often, they result in loss of property, injury, and death. Fires in apartments, condominiums, hotels, motels, dormitories, and assisted living/nursing homes destroy property and disrupt lives; they also disfigure, disable, and kill. Is there a way to protect ourselves and our families, our homes, and cherished possessions from fire's devastating effects? The non-combustible concrete construction industries have long advocated balanced design for property protection and life safety. Balanced design combines active systems (fire detection and suppression) with passive containment and control through the use of non-combustible fire-resistant walls, floors, and roofs.





PCA Portland Cement Association

Enhanced Fire Safety

CHICAGO, IL		
Building System	Cost	Relative Cost
CONVENTIONAL WOOD FRAMING SINGLE BEDROOM SCHEME	\$14,261,140.00	100
3 STORY ONLY	\$10,968,692.00	
CONVENTIONAL WOOD FRAMING MIXED BEDROOM SCHEME	\$15,600,345.00	100
3 STORY ONLY	\$11,974,259.00	
LIGHT GAGE STEEL FRAMING SINGLE BEDROOM SCHEME	\$15,133,233.00	106
LIGHT GAGE STEEL FRAMING MIXED BEDROOM SCHEME	\$15,409,377.00	99
MASONRY & PRECAST SINGLE BEDROOM SCHEME	\$15,039,182.00	105
MASONRY & PRECAST MIXED BEDROOM SCHEME	\$15,181,382.00	97
FORM IN PLACE CONCRETE FLOOR ALTERNATE (SINGLE)	\$17,451,524.00	122
FORM IN PLACE CONCRETE FLOOR ALTERNATE (MIXED)	\$17,670,142.00	113

New National Trend...

Resilience!

Buildings

Communities

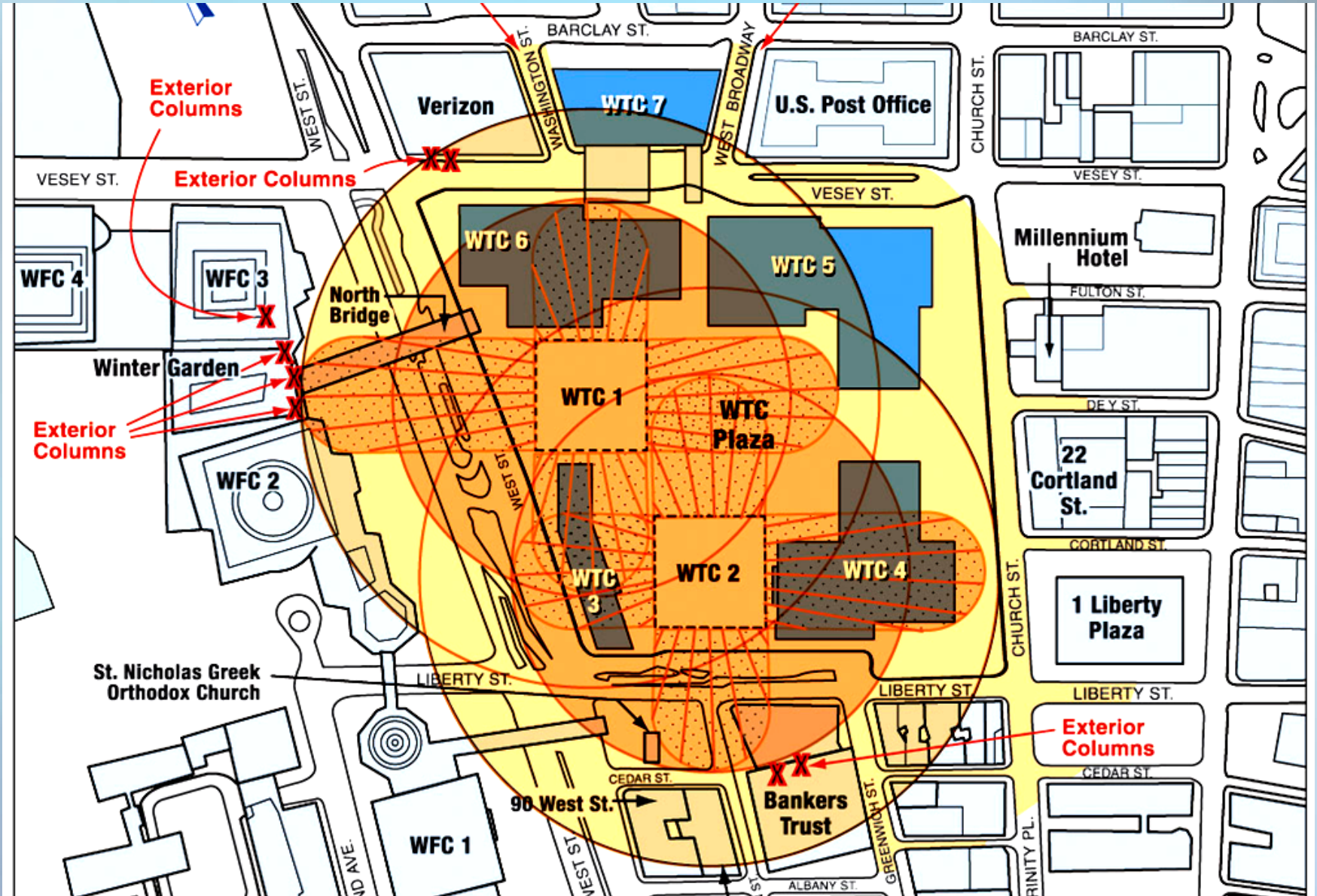
Nation

Enhanced Resilience Needed



Enhanced Resilience Needed





Enhanced Resilience



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



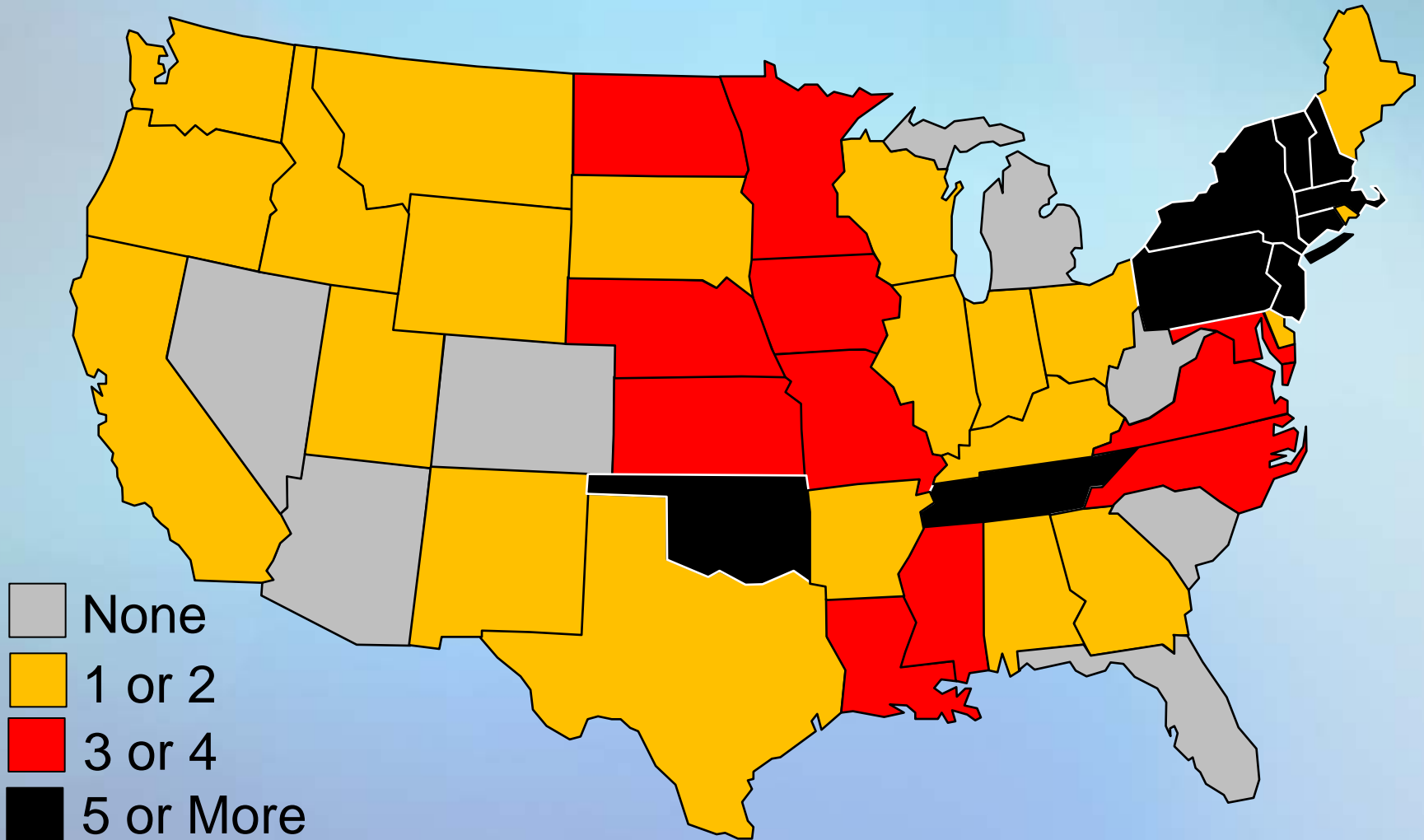
Completely gutted by fire in 1946, hotel in 1951, housing for elderly, vacant for 20 years, and became the Ellis Hotel in 2007

Enhanced Resilience

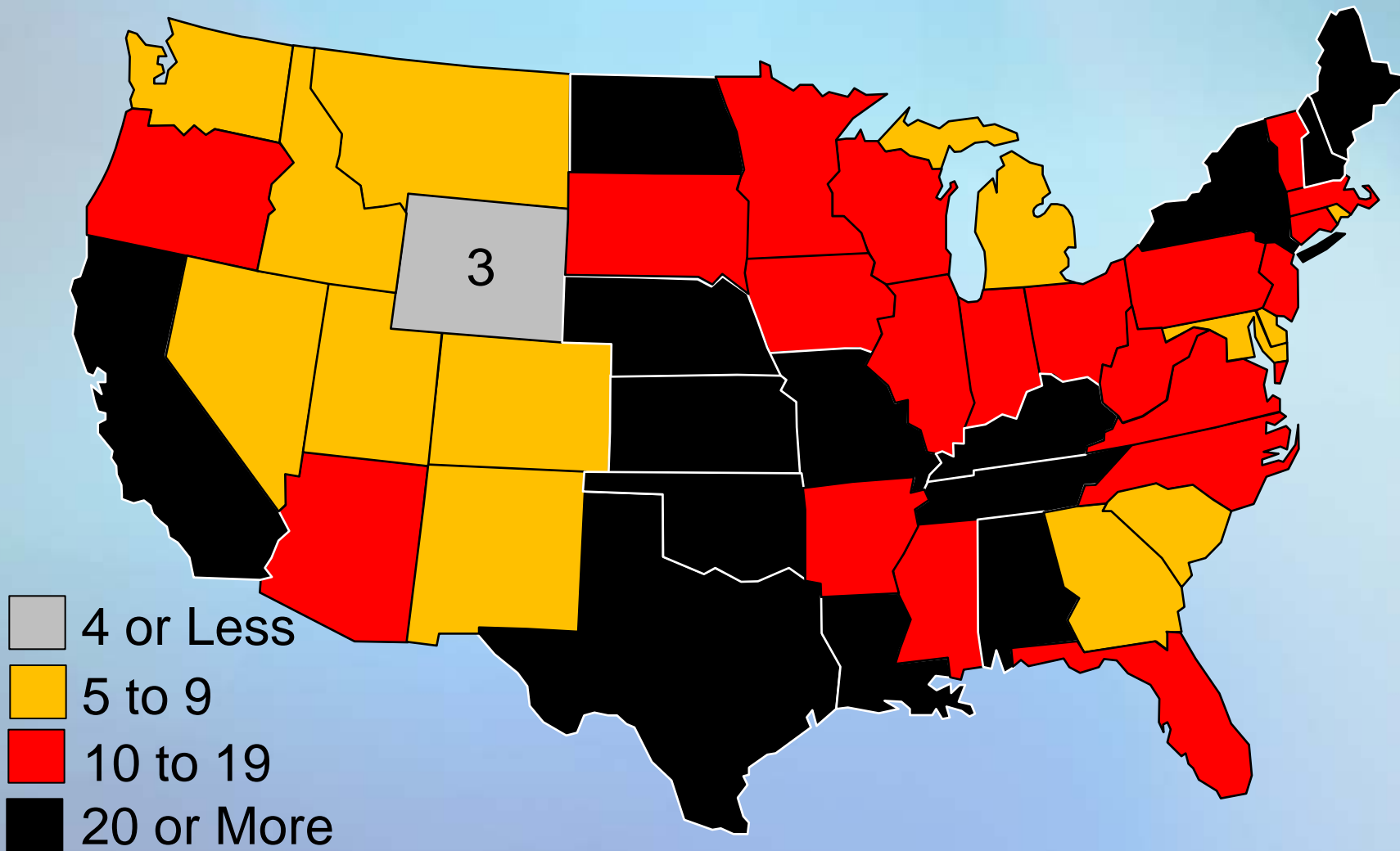
- A must for sustainability
- Essential for community continuity



2011 National Disasters and Emergencies



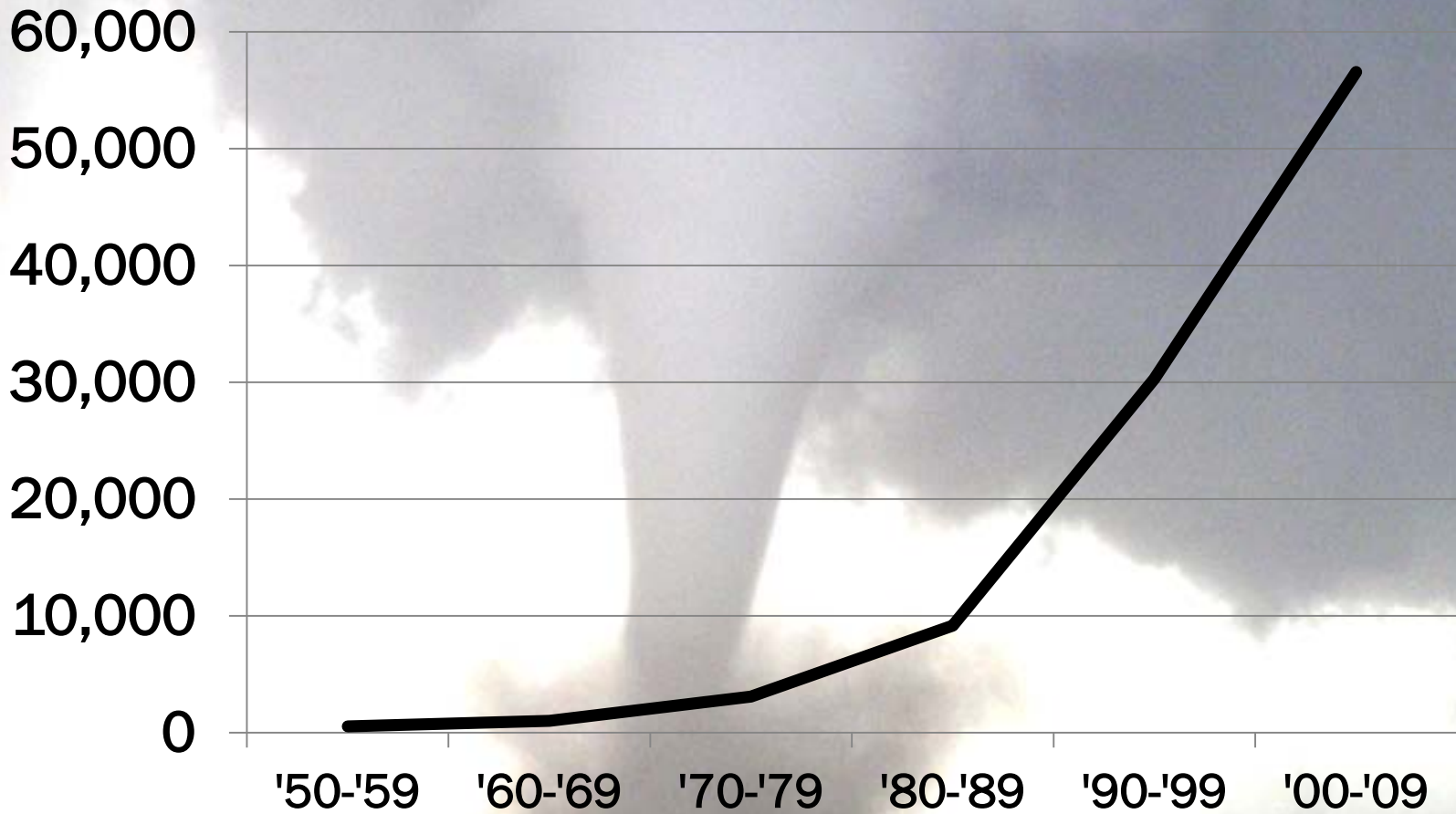
'02-'11 Disasters and Emergencies



Illinois National Disasters and Emergencies

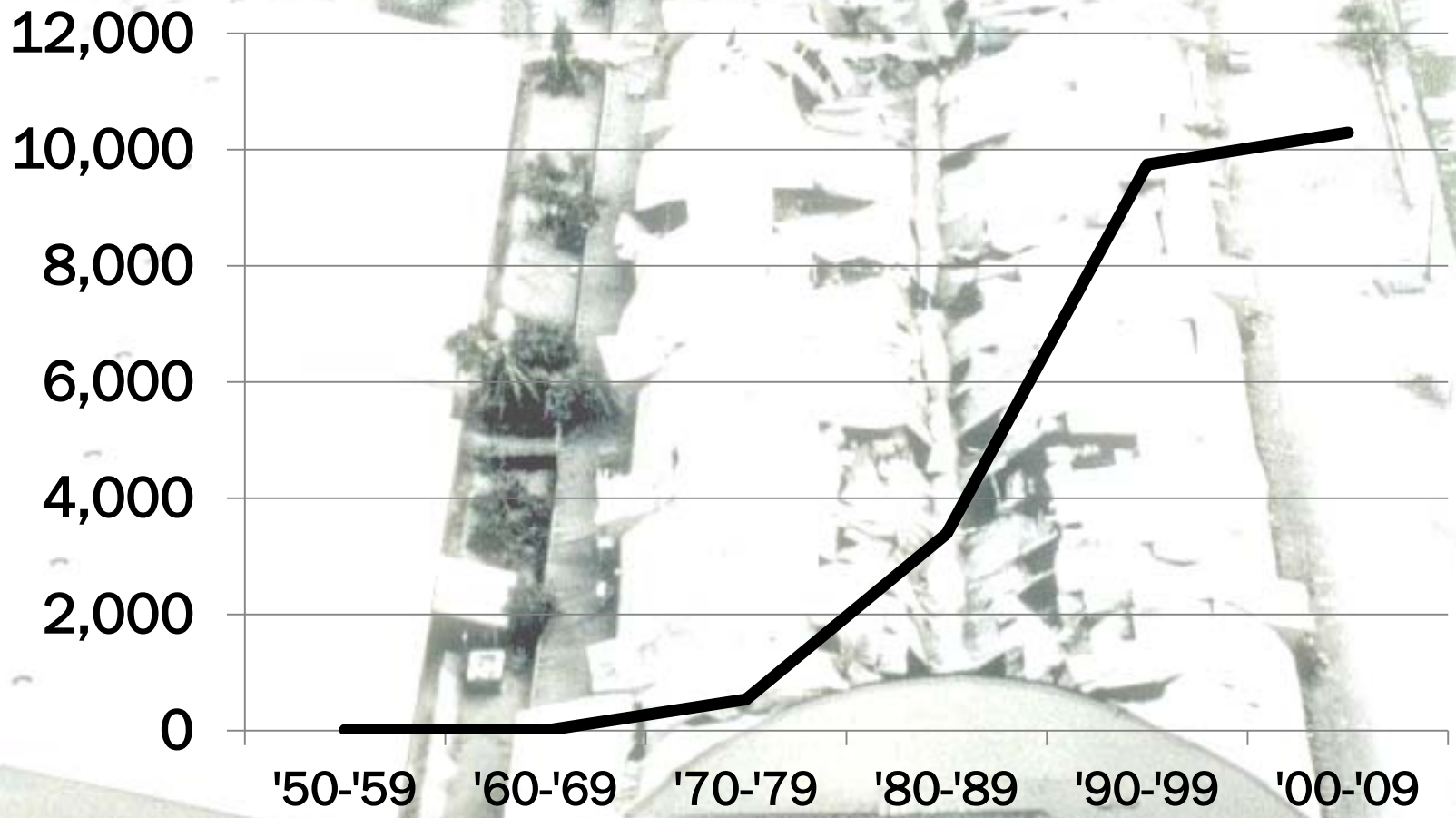
Year	Severe Storms and Flooding	Tornadoes, Storms, and Flooding	Winter Storm
2011	1	–	1
2010	1	–	–
2009	–	1	1
2008	3	–	1
2007	2	–	1
2006	–	1	1
2005	–	–	1
2004	–	1	–
2003	1	–	–
2002	1	–	–

Combined Losses, Millions per Decade: Thunderstorm, Hail, and Tornado*



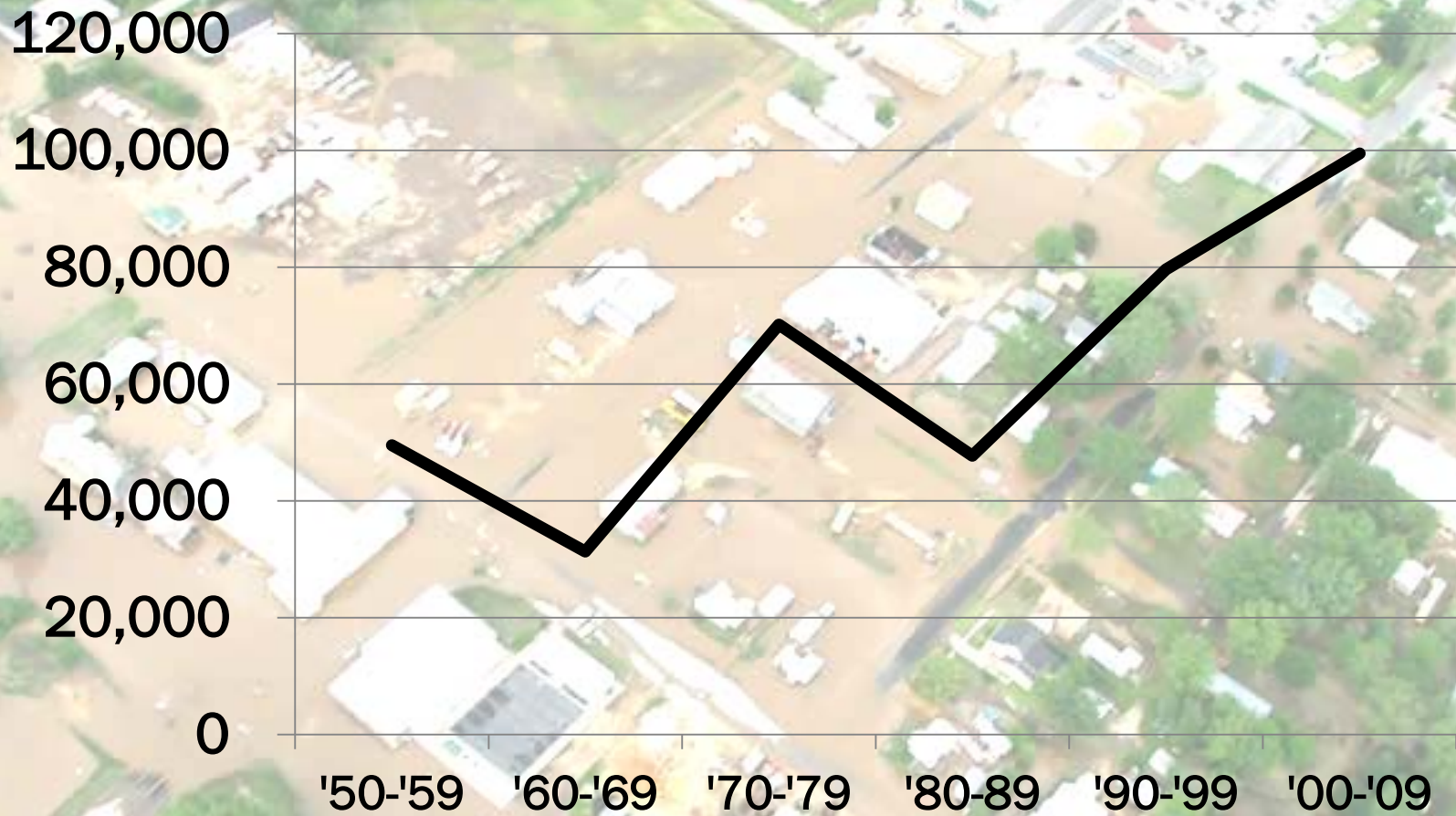
*Property Casualty Service

Winter Storm Losses,* Millions per Decade:



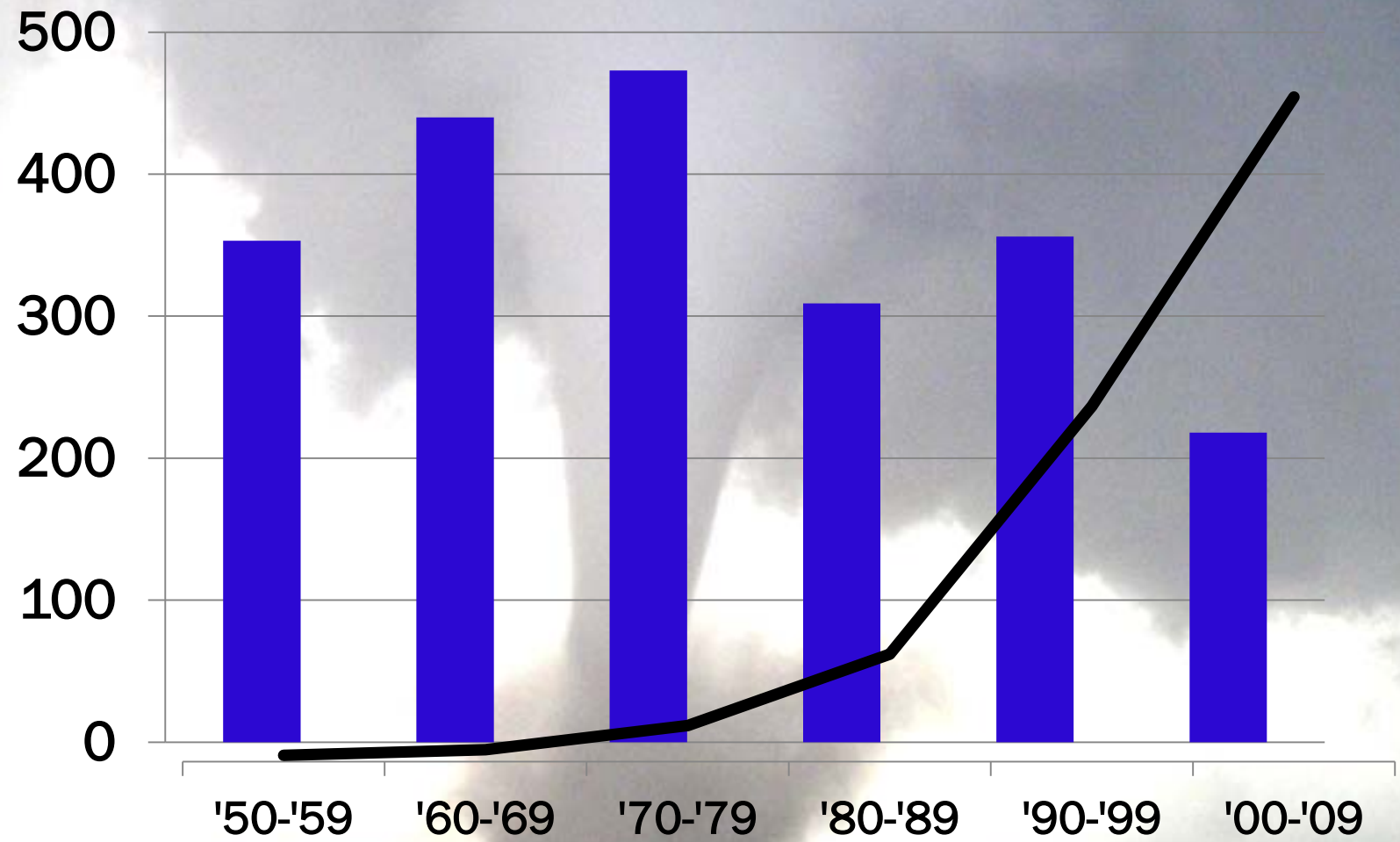
*Property Casualty Service

Flood Losses, * Millions per Decade:



*National Weather Service

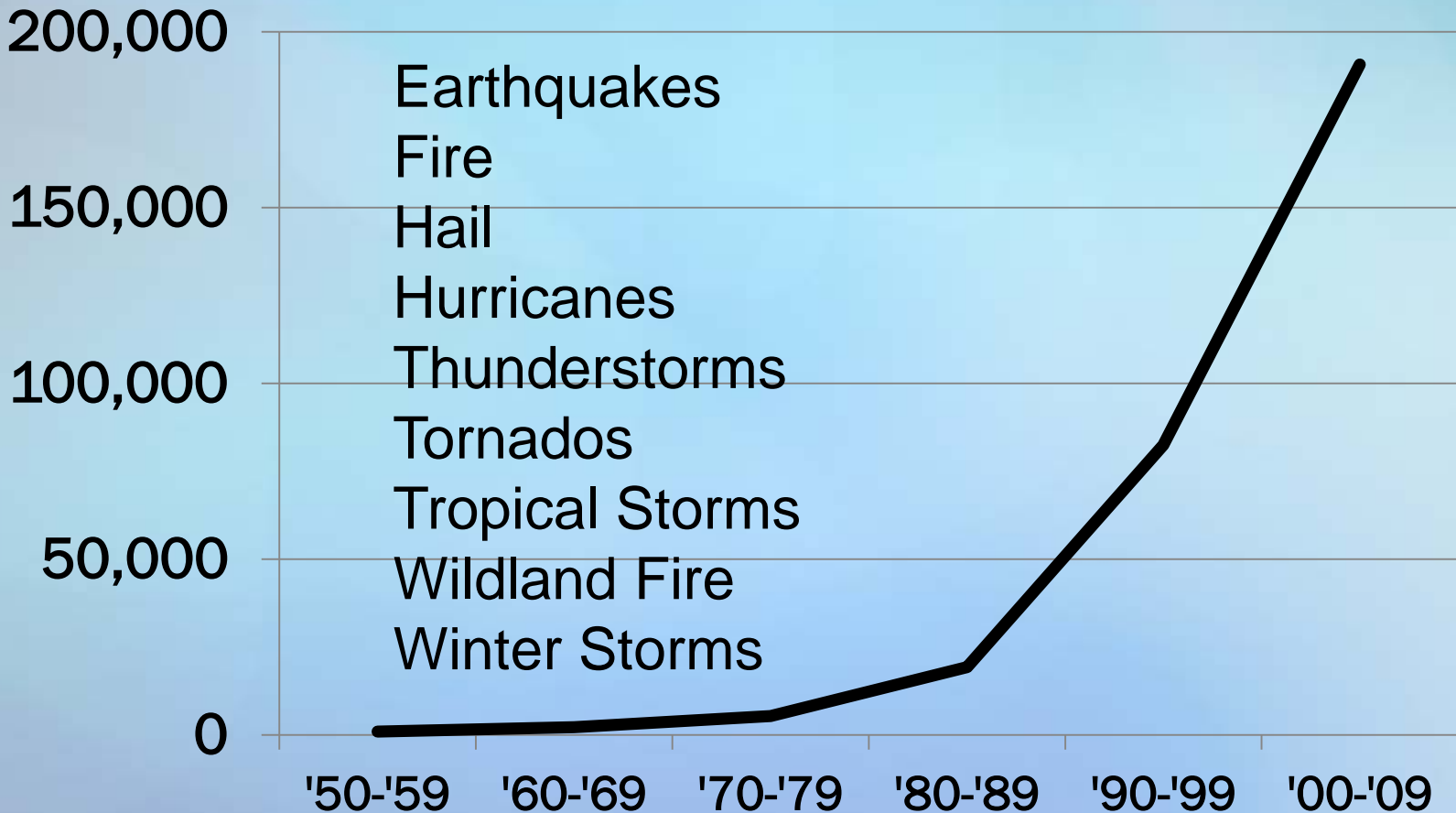
Tornado Losses vs. Number of EF3-EF5*



*National Weather Service

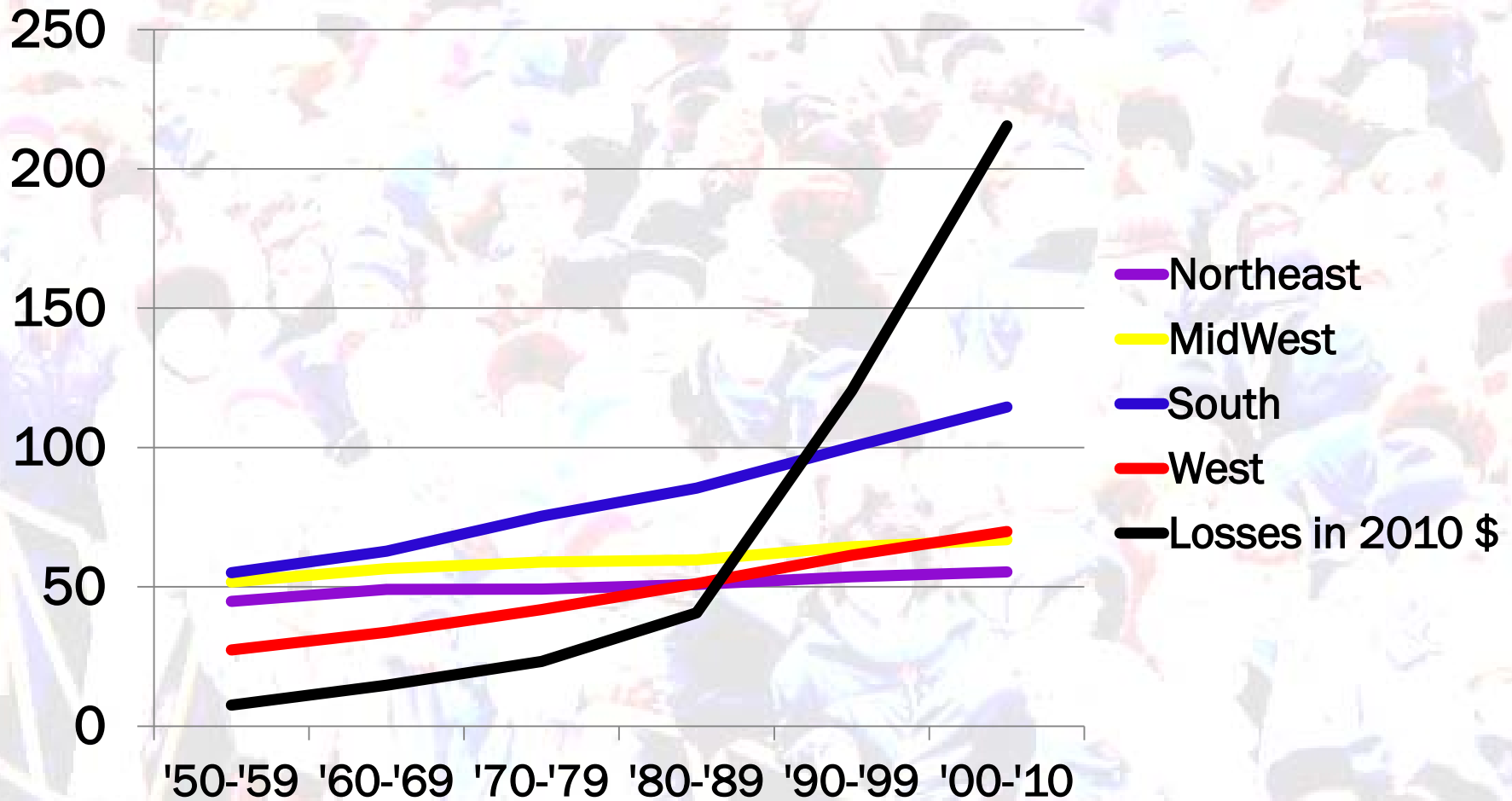
Disaster Losses excluding Flood*

Property Casualty Services in 2010 dollars



*Property Casualty Service

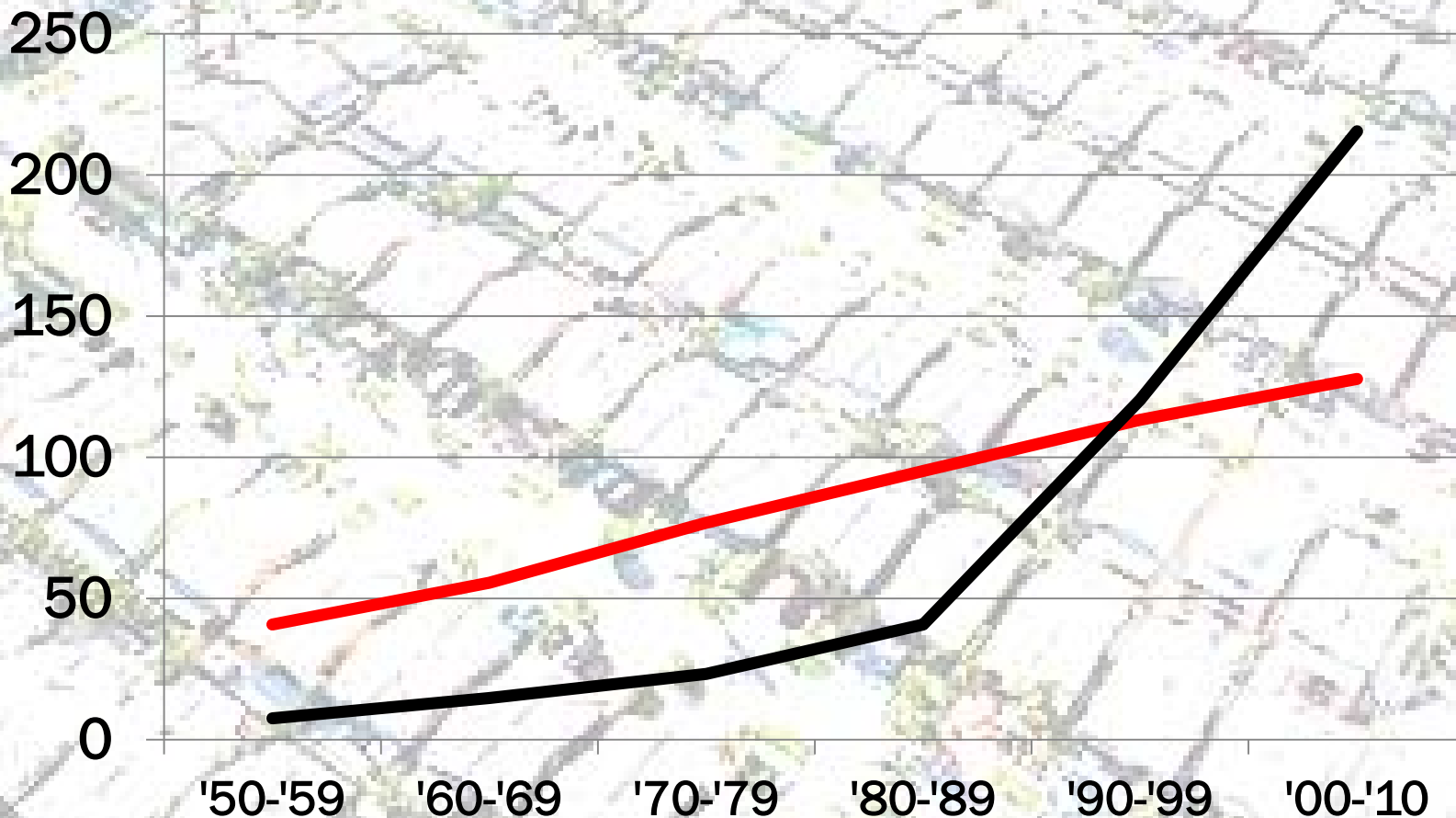
Disaster Losses vs. Population Change*



*U.S. Census Bureau

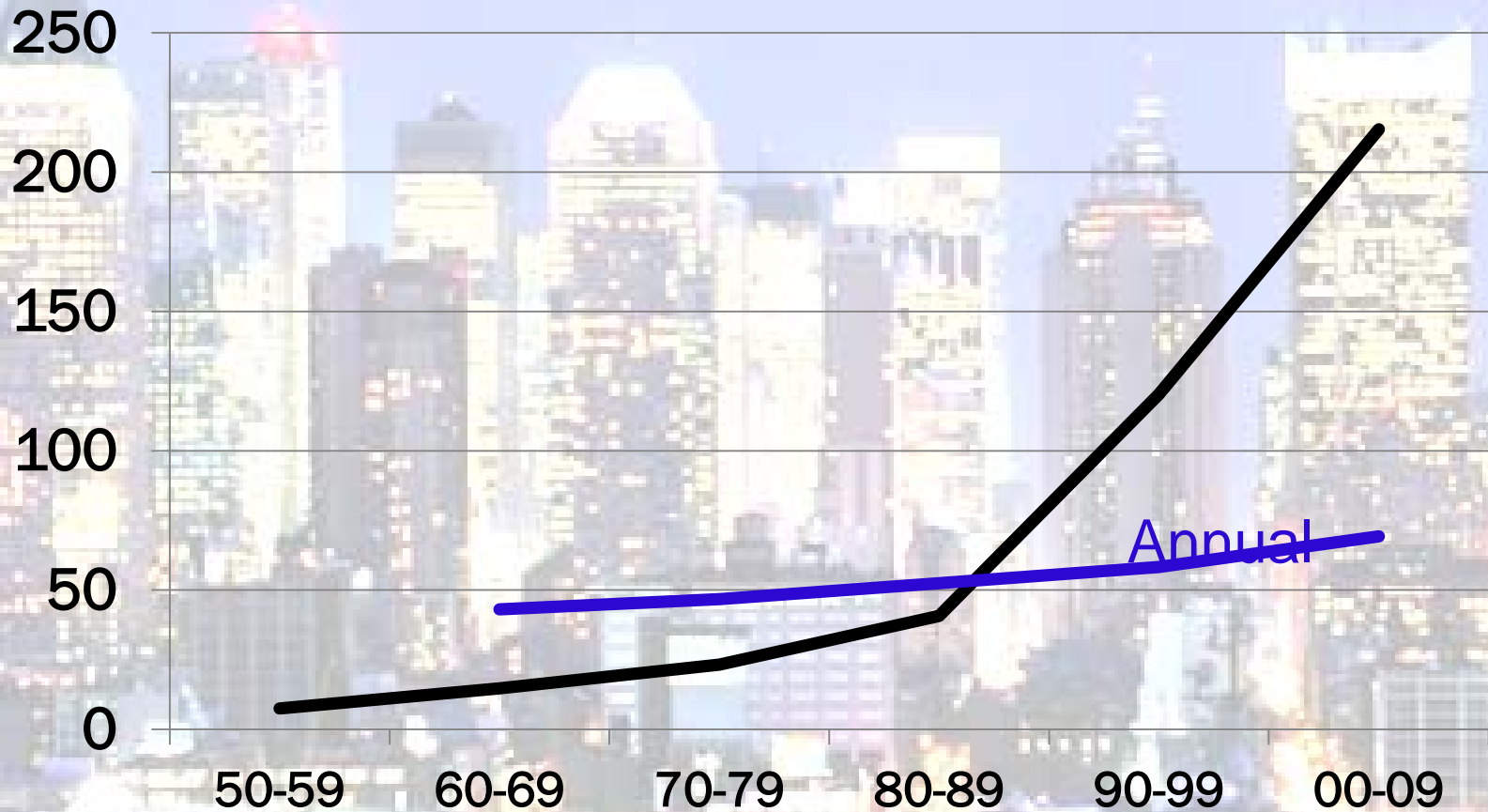
Losses vs. Residential Units*

Cumulative Construction



*U.S. Census Bureau

Losses vs. Commercial Put-in-Place*



*U.S. Census Bureau

Coincidence?

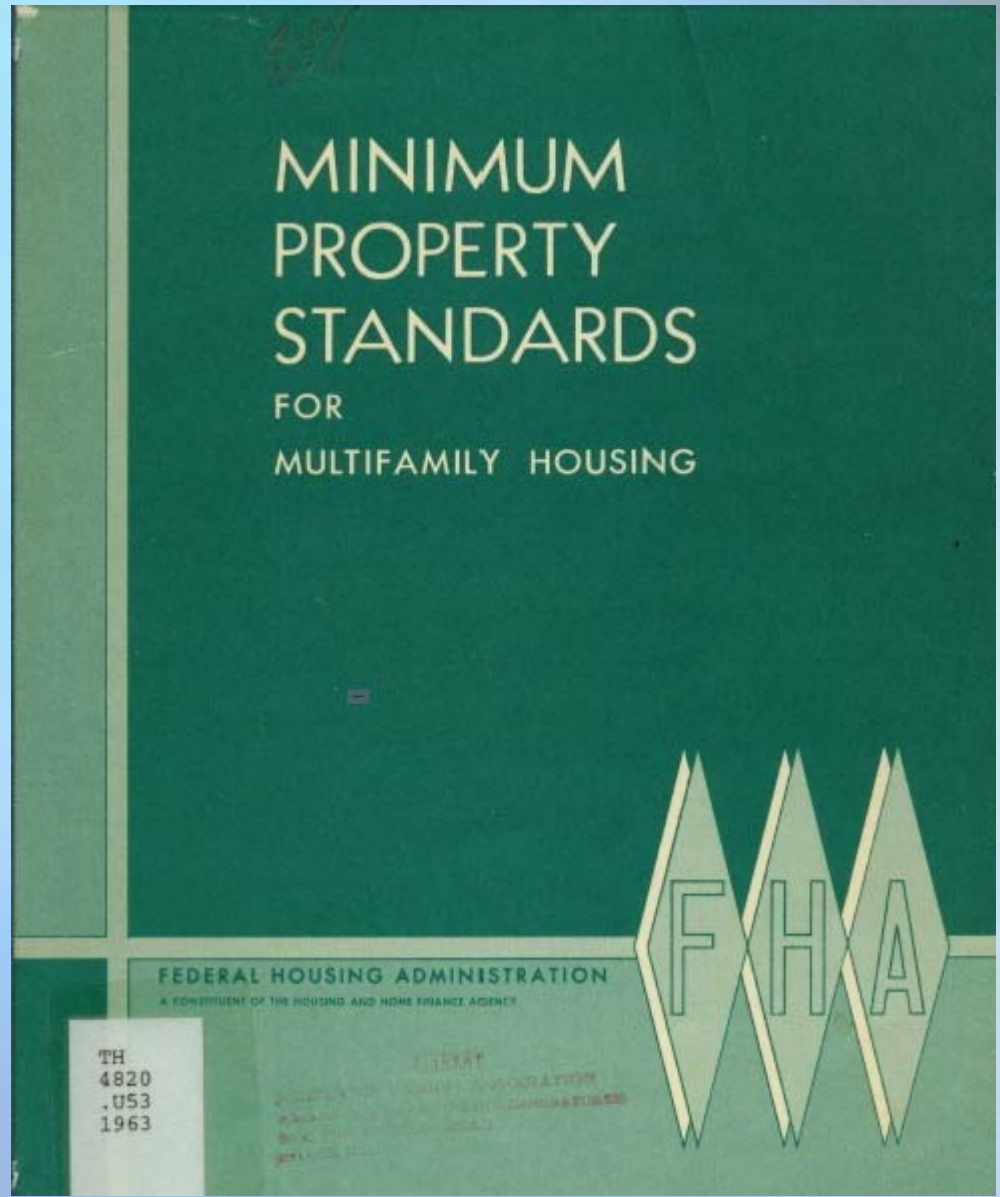
- Frequency of Events
- Population Re-Distribution
- Rate of Construction

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

De-Regulation

- More stringent passive fire protection
- More stringent sound transmission loss criteria
- Etc...



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**

Relaxation of Model Codes ('70s & '80s)

- Height and area tables permitting larger Type V buildings.

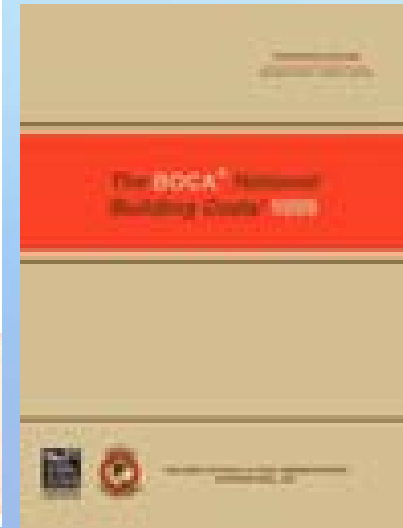
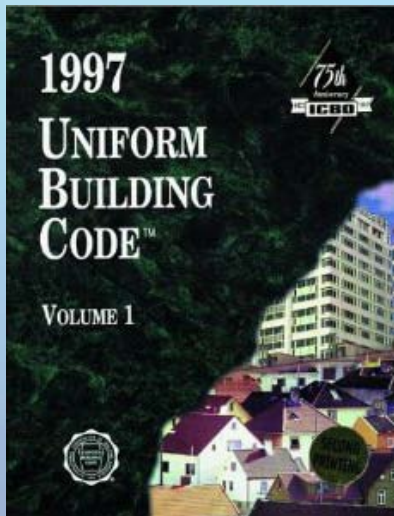


Relaxation of Model Codes ('70s - '80s)

- 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.



Changes in Construction Practices

- Move to lighter/less expensive construction
 - Plywood or structurally comparable oriented strand board sheathing to foam board
- Changes in project management and liability
 - Project managers to alter architect specifications
 - Architects shed extent of liability

Enhanced Resilience vs. Life Safety

<p>No Damage</p>	<p>Hours</p>
<p>Resilient</p>	<p>Days</p>
<p>Life Safety</p>	<p>Months</p>
<p>Total Loss</p>	<p>Years</p>
<p>Extent of Damage</p>	<p>Never</p>
<p>Time to Re-Occupy</p>	

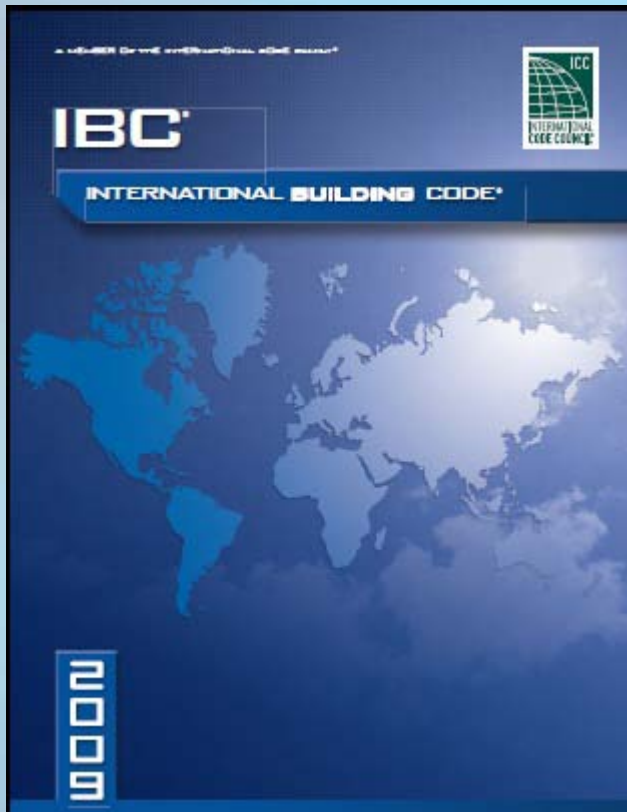
National Institute of Building Sciences Sustainable Building Industries Council



Whole Building Design Guidelines

Institute for Business & Home Safety®





**IBC Minimum Code
+ Green Building
+ Resilience
= High Performance
Building
Requirements for
Sustainability**

Enhanced Fire Safety – Structural Fire Resistance

IBC	Enhanced Resilience
<p data-bbox="208 682 923 962">Non-fire rated structural elements permitted</p>	<p data-bbox="1083 682 1798 962">Only fire rated structural elements permitted</p>

Enhanced Flood Resistance – Design

I-Codes	Enhanced Resilience
Except where determined to be protected by dams, levees, and flood walls, shall comply with:	Except where determined to be protected by dams shall comply with:

Flood Resistant Design and Construction of (ASCE 24)

Enhanced Flood Resistance – Elevation

I-Codes	Enhanced Resilience
Habitable spaces above Base Flood Elevation (BFE)	Habitable spaces <u>3</u> feet above Base Flood Elevation (BFE)

Enhanced Load Resistance - Seismic

Importance Factors, I_e			
Risk Category Types of Buildings	I-Codes	Enhanced Resilience 0.2 sec. spectral response	
		less than 0.4 g	0.4g or more
I - Agricultural and temporary	1.00	1.00	1.00
II - Not I, III, or IV	1.00	1.00	<u>1.15</u>
III - Substantial hazard to life	1.25	1.25	<u>1.35</u>
IV - Essential	1.50	1.50	<u>1.60</u>

Enhanced Load Resistance - Snow

Importance Factors, I_s

Risk Category Types of Buildings	I-Codes	Enhanced Resilience
I - Agricultural and temporary	0.80	0.80
II - Not I, III, or IV	1.00	<u>1.15</u>
III - Substantial hazard to life	1.10	<u>1.20</u>
IV - Essential	1.20	<u>1.30</u>

Enhanced Life Safety – Storm Shelters

I-Codes	Enhanced Resilience
	<p><u>Required except where within ¼ mile of adequate shelter</u></p>
<p>Where present shall comply with:</p>	<p>Where present shall comply with:</p>
<p><i>Design and Construction of Storm Shelters (ICC 500)</i></p>	

Enhanced Load Resistance - Wind

Importance Factors, I_w		
Risk Category Types of Buildings	I-Codes	Enhanced Resilience
I - Agricultural and temporary	1.00	1.00
II - Not I, III, or IV	1.00	<u>1.15</u>
III - Substantial hazard to life	1.00	<u>1.10</u>
IV - Essential	1.00	<u>1.10</u>

Enhanced Fire Safety – Sprinkler Protection

I-Codes	Enhanced Resilience
<p data-bbox="195 582 942 1358">Sprinklers required in all hazardous, institutional and residential and most assembly, educational, factory, mercantile and storage</p>	<p data-bbox="1097 582 1779 1058">Sprinklers required in <u>all occupancies</u> except some low-hazard factory and storage</p>

Enhanced Fire Safety – Fire Walls

I-Codes	Enhanced Resilience
Combustible materials allowed	All Noncombustible
Reductions in fire ratings allowed	No fire rating reductions permitted

Enhanced Fire Safety – Exterior Exposure

IBC	Enhanced Resilience
No openings within 3 ft of property line	No openings within 3 ft of property line
Increases in opening area for sprinklers	<u>No</u> increases in opening area for sprinklers

Enhanced Fire Safety – Sprinkler Protection

IBC	Enhanced Resilience
<p data-bbox="202 682 933 1263">1-hour reduction in fire barriers and structural fire resistance rating for sprinklers</p>	<p data-bbox="1078 682 1808 1263"><u>No</u> reduction in fire barriers and structural fire resistance rating for sprinklers</p>

Enhanced Fire Safety – Sprinkler Protection

IBC	Enhanced Resilience
<p data-bbox="179 782 948 1162">Reduction in flame spread for interior finish with sprinklers</p>	<p data-bbox="1051 682 1819 1162"><u>No</u> reduction in flame spread classification for interior finish with sprinklers</p>

Enhanced Fire Safety – Sprinkler Protection

IBC	Enhanced Resilience
<p>Increase in travel distances for sprinklers</p>	<p><u>No</u> Increase in travel distances for sprinklers</p>

Enhanced Fire Safety – Sprinkler Protection

IBC

Areas of refuge for persons with a disability not required on upper floors in buildings with sprinklers

Enhanced Resilience

Areas of refuge for persons with a disability required on upper floors in buildings with sprinklers

Enhanced Air-Borne Sound Resistance

Separations	I-Codes	Enhanced Resilience
Dwelling to dwelling or public area	STC = 50	<u>STC = 50</u>
Classroom to classroom	N/R	<u>STC = 50</u>
Classroom to restrooms and showers	N/R	<u>STC = 53</u>
Classroom to other areas	N/R	<u>STC = 60</u>
Exteriors in Groups A, B, I, M, or R	N/R	<u>STC = 50</u>

Enhanced Structure-Borne Sound Resistance

Separations	I-Codes	Enhanced Resilience
Dwelling to dwelling to public area	IIC = 50	<u>IIC = 50</u>
Rooms to rooms or public areas in Groups A, B, I, or M	N/R	<u>IIC = 50</u>

Enhanced Moisture Resistance

Smooth, hard, non-absorbent finishes	I-Codes	Enhanced Resilience
Application	Toilets bathing, and shower rooms	Toilets, bathing, and shower rooms; <u>kitchens, laundries, and spas</u>
Height up onto walls	4"	<u>6"</u>

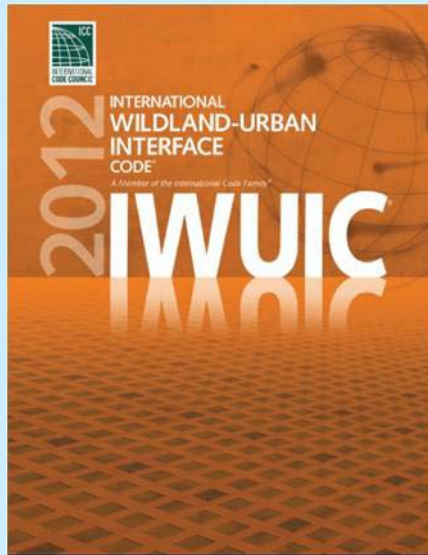
Enhanced Fire Safety – Exterior Exposure

I-Codes	Enhanced Resilience
Min 1-hour fire rating within 5 ft of property line	Min 1-hour fire rating within 5 ft of property line
	<u>No vinyl siding or EIFS within 30 ft of property line</u>
	<u>No combustible exterior wall covering within 5 ft of property line</u>

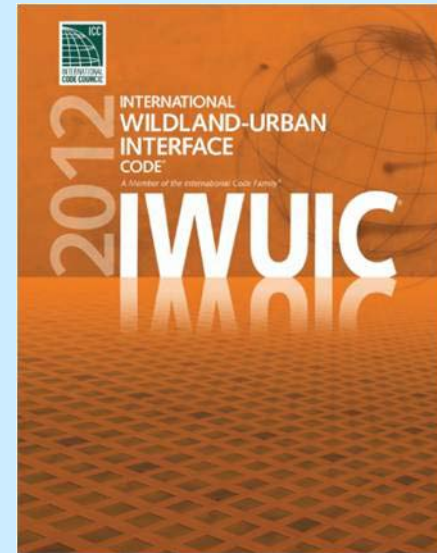
Enhanced Fire Safety – Wildland-Urban Fires

I-Codes

Enhanced Resilience



Optional



Mandatory

Enhanced Damage Resistance - Wind

I-Codes	Enhanced Resilience
<p>No vinyl siding where:</p> <p>$V_{asd} > 100$ mph or ($\approx V_{ult} > 130$ mph)</p>	<p>No vinyl siding <u>or EIFS</u> where:</p> <p><u>$V_{ult} > 115$ mph</u> or</p>
<p>No vinyl siding more than 40 feet in height</p>	<p>No vinyl siding or EIFS more than 40 feet in height</p>

Enhanced Damage Resistance - Hail

Roof or Wall	I-Codes	Enhanced Resilience
<p>Low Slope Roof <2:12</p>	<p>ASTM D3746 ASTM D4272 CGSB 37-GP52M FM 4470</p>	<p>ASTM D3746 ASTM D4272 CGSB 37-GP52M FM 4470</p>
<p>Any Slope Roof and All Walls</p>		<p><u>UL2218</u> <u>FM4473</u></p>

Enhanced Damage Resistance - Infestations

I-Codes	Enhanced Resilience
Optional in International Building Code	Mandatory for all buildings
IBC Appendix F – RODENTPROOFING	

Enhanced Radon Penetration Resistance

I-Codes	Enhanced Resilience
<p data-bbox="117 619 946 951">Option for dwellings under the International Residential Code in high radon prone areas</p> <p data-bbox="295 1096 768 1162">IRC Appendix F</p>	<p data-bbox="1054 619 1777 862">Mandatory for all buildings in high radon prone areas</p> <p data-bbox="1108 1096 1711 1239">IRC Appendix F or EPA 625-R-92-016</p>

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





Longevity

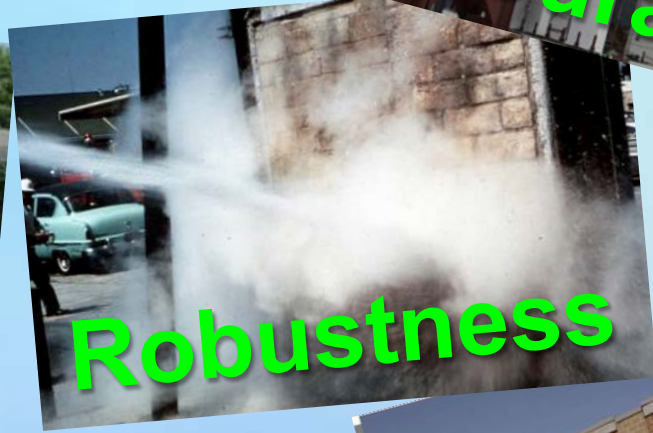
Enhanced



Durability



Life Safety



Robustness



Disaster
Resistance

Resilience



Sustainability

■ Better buildings



- Better buildings
- Better communities



- Better buildings
- Better communities
- Better environment



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