

# Building and Fire Codes

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# Just Another Government Report

- 2005 – NIST WTC Investigation
- 2003 – FEMA/ASCE Observations
- 1960 – 2005 – USFA Reports and **Specific** Recommendations for High-Rise Construction

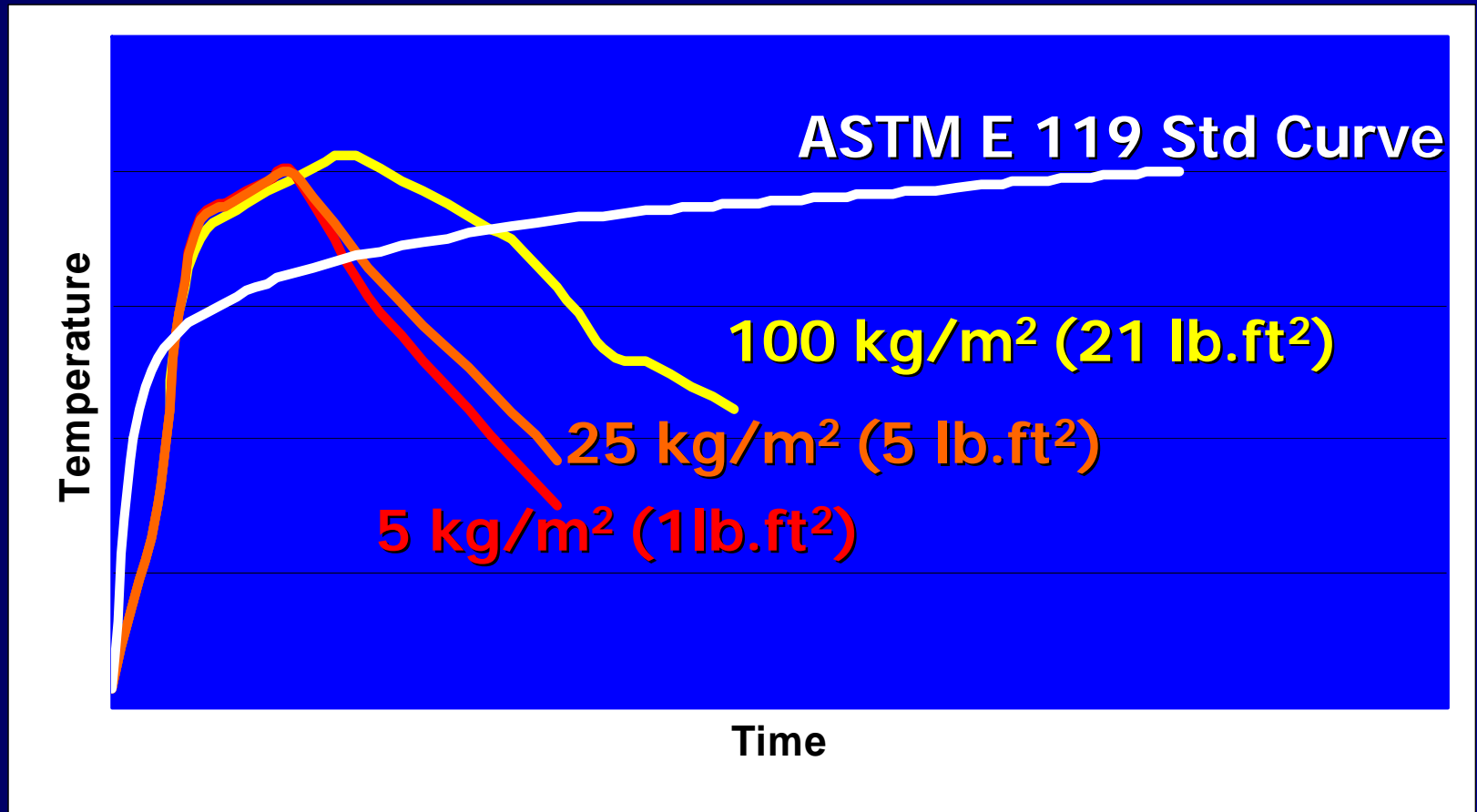
# Fire Codes and Standards

- **Building Code Requirements**
  - International Code Council
  - National Fire Protection Association
- **Fire Standards**
  - American Society for Testing and Materials

# Fire Standards

- **ASTM E 119 Standard Test Methods for Fire Tests of Building Construction and Materials**

# Time Temperature Curve Real Fires



# Safety Factors

**Structural Design Load Factor**

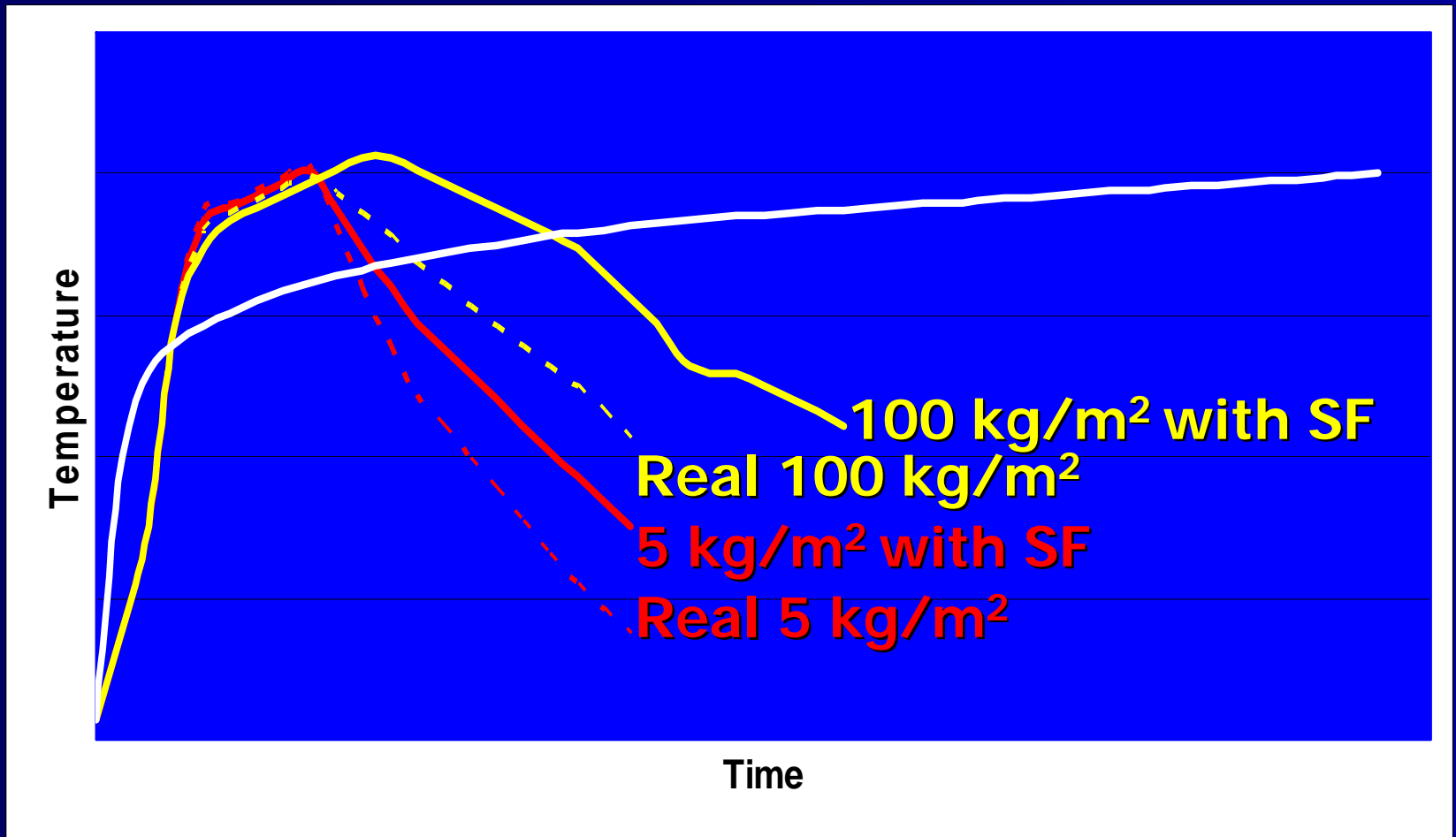
**1.2 Dead + 1.6 Live Load**

**Structural Design Resistance Factor**

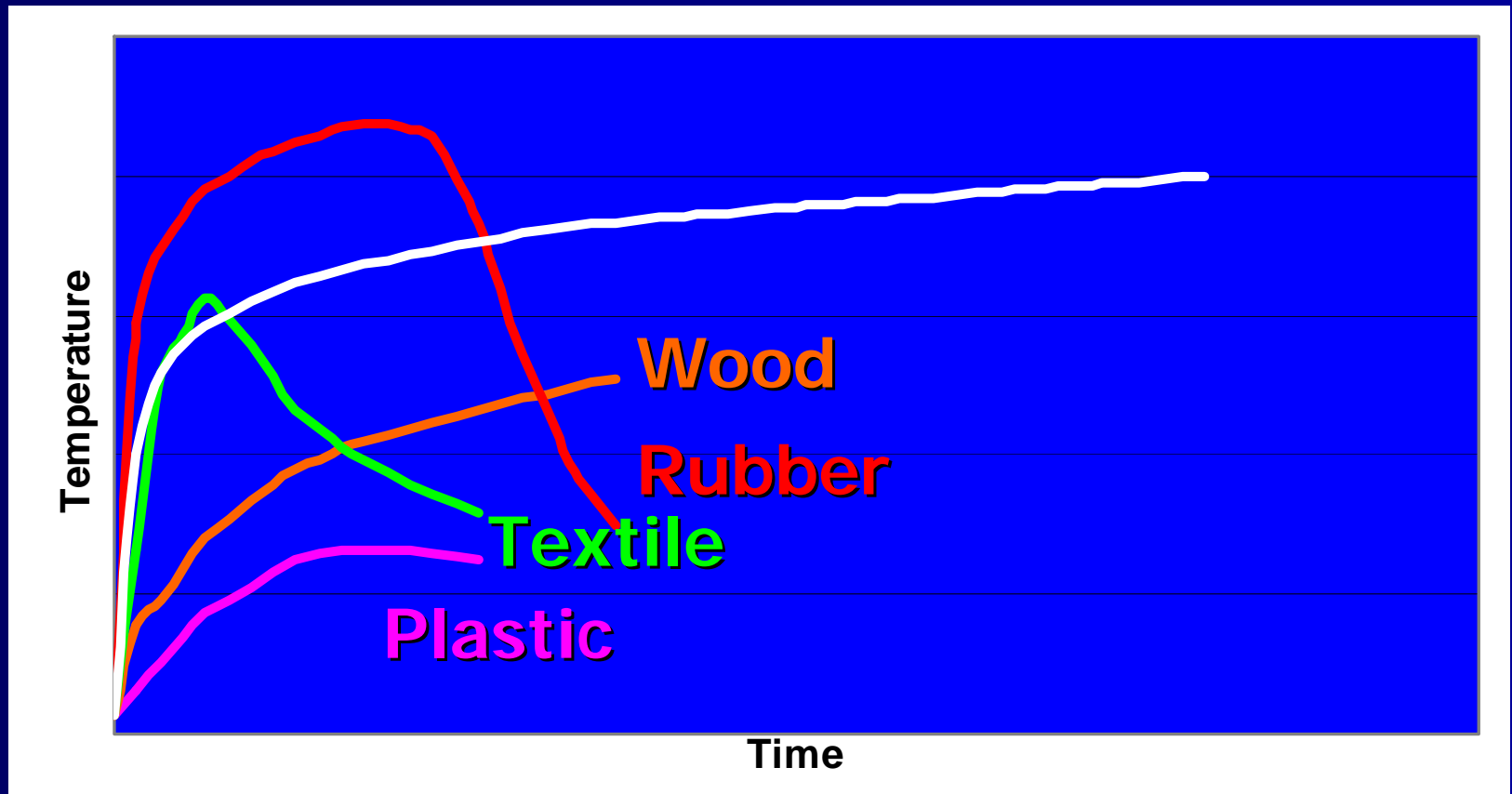
**0.60 to 0.85 concrete elements**

**Overall Safety Factor of 1.8 to 2.7**

# Safety Factor Applied to Real Fires



# Various Combustible Content





# Real Fires

- **Safety Factors**
- **Complications**
  - **Combustible content of assemblies**
  - **Type of building contents**
  - **Quantity of building contents**
- **Numerous Tests**
- **Huge Expense**

# Standard E 119

**Time-Temperature Curve may be un-conservative for engineering design.**

**Time-Temperature Curve could be replaced by Heat Flux-Time Curve**

**Reporting could be improved**

**Measurements and equipment could be improved and more consistent**

**Standardized testing apparatus**

# Meeting Standard Test Requirements

More robust systems initially  
New designs of materials and systems to meet the minimum requirements of tests

Need for a robustness component for all assemblies

# Building Codes Requirements

- **Passive fire protection requirements**
  - Routinely relaxed over the last forty years
  - Routinely reduced for as economical justification for sprinklers

# Building Code Requirements

- **Increases in cost for structural design and construction to resist seismic forces**
- **Increases in cost of energy conservation with no direct relation to life safety**
- **No increases in costs for fire protection and relaxation of requirements to justify expense of sprinklers**

# Building Code Requirements

	<b>1968 Chicago</b>	<b>WTC Towers</b>	<b>2003 IBC</b>
<b>Columns, girders, beams, trusses and spandrels</b>			
<b>Supporting floors</b>	<b>4 hr</b>	<b>3 hr</b>	<b>2 hr</b>
<b>Supporting roofs</b>	<b>3 hr</b>	<b>2 hr</b>	<b>1 hr</b>
<b>Floor Systems</b>	<b>3 hr</b>	<b>2 hr</b>	<b>2 hr</b>
<b>Roof Systems</b>	<b>2 hr</b>	<b>1 hr</b>	<b>1 hr</b>

# Major Burnout Without Collapse

- 2004 LaSalle Bank Building, Chicago
- 2001 90 West, New York
- 1991 One Meridian Plaza, Philadelphia (1973)
- 1988 Interstate Bank Building, Los Angeles (1973)

# One Meridian Plaza

- 3 hour columns
- 2 hour floors
- Concrete and masonry shafts and stairways
- Burned for 19 hours
- Severe floor deflections



# LaSalle Bank Building

- 4 hour columns
- 3 hour floors
- Burned for 5-1/2 hours
- Central core of steel encased on concrete and masonry
- Minimal floor deflections

# Building Code Requirements

- Restore historic passive fire protection requirements
- Eliminate sprinkler trade offs
  - Hurricanes, earthquakes, other disruptions in water supply
- Require redundancy
  - Alarms, sprinklers, and passive fire protection
- Collapse resistance
  - Design to permit total burnout without collapse

# Consideration of Other Projects May Indicate:

- Robustness component is equally as important as fire endurance
- Continued trend for reduced passive fire protection is not appropriate
- Sprinkler trade-offs not appropriate, redundancy is needed in high-rise

# Thank you!

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