Fire and Tall Buildings: Basic Issues for the Future

The Next Five Years in Fire and Electrical Safety Symposium
District Architecture Center, Washington D.C.
November 2013

Daniel O’Connor
Chief Technical Officer
Aon Fire Protection Engineering Corp.
Tall Building Tool Box

- Compartmentation features
- Smoke management systems
- Pressurized stairs
- Water tank storage
- Fire pumps
- Standpipes
- Emergency generators
- Fire detection
- Voice and visual notification
- Mass notification systems
- Evacuation elevators
- Extra stairs / stair width
- Enhanced stair enclosures
- Fire resistive components
  - Wiring
  - Fire stopping
  - Joint systems
  - Perimeter slab edge containment
- High-bond strength fire proofing
- Low level exit signage
- Photoluminescent markings
- Fire/smoke dampers
- Special suppression systems
- Fire department operations support technologies
- Refuge areas/floors
- Automatic Sprinklers
Concerns for the Future

• Exterior Facade Materials

• Ventilated & Double Skin Facades

• Automatic Sprinklers must be the highest priority
Combustible Facade Components

• Combustible Cladding Materials
  – Metal/Aluminum composite Materials (ACM, MCM)
  – Fiberglass Reinforced Plastics (FRP)
  – High Pressure Laminates (HPL)
  – Insulated foam core sandwich panels
  – Spray applied foam
Basic Assumptions NFPA 285 Test Method

- Interior Post-Flashover fire
- Glass breaks
- Flames project out
- Performance should be comparable to noncombustible wall

- Test does not address
  - Burning Fuel loads exterior to building
  - Exposure fire from adjacent property
  - Unusual wall geometry, corner scenarios
  - Man tossing water on flames
Heat Flux Comparisons

Elevation above Window or Top of Fire Source [m]

Peak Total Heat Flux Specified or Measured [kW/m²]
CCTV & Mandarin Oriental Hotel
Violation of Law, Extreme Ignition Source, Combustibles in a Flue Space
Russian Republic of Chechnya

- 40 story apartment
- No deaths /injuries
- 100 firefighters
- 16 engines
Ventilated and Double-Skin Facades

- Exterior glazed surface of double skinned building
- Vertical cavity allows for upward channeled and confined flame and smoke flows
- Floor-to-floor double glazing
- Concrete slab

Materials:
- Mineral wool
- Aluminum
- Steel
- Cantilever anchor bracket
56-story Commerzbank
Frankfurt, Germany

Figures courtesy CTBUH, 2013
Meiji University, Tokyo

Figures courtesy CTBUH, 2013
Extreme Fire Department Response

• First Interstate Bank
  – 3½ hours burned out of control; nearly abandoned
  – 64 fire companies, 383 firefighters

• One Meridian Plaza
  – Burned 18 hours through 8 floors
  – 3 FF deaths, 24 injured
  – 51 engine companies, 15 ladder companies, over 300 firefighters
  – After 11 hours FF effort abandoned due to structural risks
Parque Central – Caracas, Venezuela

- Venezuela’s tallest, built 1970, fire 2004
- Burned 17 hours
- FF efforts abandoned after 11 hours due to structural fears

- Fully sprinklered
- On/off sprinklers leaked
- Systems shut off
Automatic Sprinklers

• Developing Urban areas worldwide
  – Limited fire department resources
  – Common view outside US - Systems maintenance costs money and is avoided
  – Fundamental lack of understanding of sprinklers value

• Worldwide Need for
  – Education of building owners
  – Training for building maintenance/engineering staff
  – Review – are systems getting too complex
  – Reliability – what features make a difference
  – Strong ordinances, rules for systems out-of-service
  – Fire Service play a major role: survey and enforcement
Concerns for the Future

• Exterior Facade Materials
  – Need to evaluate materials for range of conditions – heat flux, geometry, establish criteria for use
  – Sprinklers are mitigation against internal spread

• Ventilated & Double Skin Facades
  – Pros, cons, many design concepts,
  – Sprinklers key to safe use

• Automatic Sprinklers must be the highest priority
  – Urban areas cannot tolerate large scale events
  – Fires must be kept small