SCHULTE & ASSOCIATES
Building Code Consultants
880D Forest Avenue
Evanston, IL 60202
fpeschulte@aol.com
847/866-7479

HIGH RISE BUILDING FIRE PROTECTION: THE NIST WTC 7 BUILDING INVESTIGATION REPORT

By Richard Schulte

On October 15, 2001, a little over a month after the terrorist attacks on the World Trade Center (WTC) towers on September 11, 2001, the Council on Tall Buildings and Urban Habitat (CTBUH) convened a meeting in Chicago to discuss the potential impact of the attacks on the design and construction of tall buildings. One of the attendees at this meeting, Jon Magnusson, brilliantly put the events which occurred in Lower Manhattan on September 11th in perspective. An excerpt from Magnusson's remarks is as follows:

> "*I can say without exaggeration, 99 percent of all buildings would collapse immediately if hit by a 767.*"

"*I can say without exaggeration, 99 percent of all buildings would collapse immediately if hit by a 767.*"

Jon Magnusson, October 15, 2001

Given Magnusson's comment, the fact that the World Trade Center towers did not collapse immediately was a testament to the fact that the WTC towers performed magnificently on September 11, 2010. The fact that both towers eventually collapsed was pretty much a foregone conclusion given the magnitude of the insult to the building structures. Buildings are simply not designed to be struck by missiles. (The hi-jacked aircraft used in the attack on the towers were utilized as missiles.)

From the standpoint of tall building fire protection, the collapse of the World Trade Center 7 Building was actually a far more interesting event than the collapse of the WTC towers since the WTC 7 Building was not struck by aircraft, yet collapsed after being exposed to fires on multiple floors (apparently ignited by debris from the collapse of the WTC 1 building). Hence, taking another look at the final report on the NIST investigation into the collapse of the WTC 7 Building is well worth both the time and the effort.

The following are excerpts from a portion of NIST's report referred to as NCSTAR 1-9 dated November 2008:

> "*Shortly after the* [WTC] *towers collapsed, fires began to appear at multiple locations in WTC 7. . .the building collapsed at 5:20:52 p.m. . . .*" (Page 87)

"*WTC 7 was a 47 story office building whose height from the ground floor to its roof-line was approximately 186 m (610 ft.). The structure was built over an existing Consolidated Edison electrical substation*. . ." (Page 98)

"*WTC 7 suffered structural damage to its southwest quadrant due to heavy debris falling from WTC 1 during its collapse*. . ." (Page 182)

"*Fires were observed on multiple floors of WTC 7 between the times when WTC 1 collapsed at 10:28:22 a.m. and WTC 7 collapsed at 5:20:52 p.m.*" (Page 188)

"*The fires in WTC 1 were more widespread and intense at the time of its collapse than those of WTC 2. When WTC 1 collapsed, there were several large fires burning in the tower*. . .*As the collapse of WTC 1 proceeded, it generated a pressure pulse that pushed flames from internally burning areas out of adjacent windows, thus revealing the extent of the fires.*" (Pages 188 and 189)

"*Following the collapses of the two towers, FDNY was focused on rescuing personnel trapped in the debris field and providing aid to the injured. At approximately 1:00 p.m., FDNY considered the possibility of fighting fires in WTC 7.*" (Page 303)

"*At approximately 2:30 p.m., FDNY gave the order to forgo firefighting activity and for personnel to withdraw to a safe distance from the building. This was based on the recognition that WTC 7 had already been evacuated, fires were growing in the building, the building had potentially sustained significant structural damage, the building was producing interior noise that indicated potential instability in the structure, FDNY had lost many of its assets that would be needed to fight the fires inside WTC 7, and there was no usable water in lower Manhattan's hydrant system to fight the fires.*" (Page 304)

Given Magnusson's comment, the fact that the World Trade Center towers did not collapse immediately was a testament to the fact that the WTC towers performed magnificently on September 11, 2010.

"*Following the collapses of the two towers, FDNY was focused on rescuing personnel trapped in the debris field and providing aid to the injured. At approximately 1 p.m., FDNY considered the possibility of fighting fires in WTC 7.*"

"*This chapter addresses the initiating event and collapse propagation hypothesis that formed the basis of the technical approach to determine why and how the 47 story WTC 7 building collapsed on September 11, 2001. Specifically, NIST considered (1) building contents fires on tenant floors, (2) fuel oil fires from leaks in the emergency generator fuel systems, (3) hypothetical blast events, and (4) fires in the Con Edison substation.*" (Page 323)

"*An initial local failure occurred at the lower floors (below Floor 14) of the building due to fire-induced floor failures, leading to the buckling of a critical column (the initiating event) which supported a large-span floor bay with an area of about 200 m^2 (2,000 ft^2).*" (Page 323)

"*The leading hypotheses for the failure sequence that characterized the initial local failure was based on fire-induced failure events in the tenant floors. . .Sufficient floor component failures (connections and/or beams) resulted in at least one unsupported column over multiple floors at the lower floors. This column buckled and led to the initiation of global collapse.*" (Page 323)

"*The leading hypothesis was based on an initial local failure caused by ordinary contents fires, not fires from leaking pressurized fuel lines or fuel from day tanks. These other factors were considered as possible collapse hypotheses, but were ruled out, as discussed subsequently in Section 8.9.1.*" (Page 324)

"*While NIST found no evidence of a blast or controlled demolition event, it evaluated the consequences of hypothetical blast scenarios that could have led to the structural failure of one or more critical elements (Section 8.9.2).*" (Page 324)

"*At approximately 2:30 p.m., FDNY gave the order to forgo firefighting activity and for personnel to withdraw to a safe distance from the building. This was based on the recognition that WTC 7 had already been evacuated, fires were growing in the building, the building had potentially sustained significant structural damage, the building was producing interior noise that indicated potential instability in the structure, FDNY had lost many of its assets that would be needed to fight the fires inside WTC 7, and there was no usable water in lower Manhattan's hydrant system to fire fires.*"

"*The Con Edison substation was also found to have had no role in the collapse of WTC 7 (Section 8.9.3).*" (Page 324)

"*The global collapse of WTC 7 began approximately 7 s after the onset of downward movement of the east penthouse (Figure 8-5). At this time, the entire upper section of the building-all floors visible in the videos-moved downward together, suggesting widespread failure of the support structure (columns and/or transfer trusses) in the lower levels of the building (Figure 8-6).*" (Page 329)

"*If, as identified above, the failure of Column 79 were consistent with the observations and interpretations of the photographic and videographic evidence, then the possible causes of failure of Column 79 needed to be investigated.*" (Page 329)

"*If, as identified above, failure of Column 79 were consistent with the observations and interpretations of the photographic and videographic evidence, then the possible causes of failure of Column 79 needed to be investigated.*"

"*Steel column failure is generally characterized by inelastic buckling and, as a consequence, is a function of inelastic material behavior (i.e., yielding) and local and/or global instability. . .In a building frame, a column is considered to be braced where each floor frames into the column and, thus, the unbraced length would be the floor-to-floor height. Since a column's cross-section is not likely to change, a column subject to fire could fail (1) if its material properties are diminished by fire exposure sufficient to result in column instability, or (2) if failures of floor framing increase the unbraced length sufficient to result in column instability. Both of these possible hypotheses were investigated.*" (Page 330)

"*Heating of a column could occur as a result of a building contents fire, or as had been suggested, from a diesel* [fuel] *fire resulting from rupture of a fuel line supplying one of several emergency generators in the building. Prediction of growth and spread of building contents fires (Section 9.3.2) indicated that such fires moved from one location to the next (e.g., from one office cubicle to the next) and burned intensely in any one location for roughly 20 min to 30 min. However, the large floor area surrounding Column 79 would have had sufficient combustibles (i.e., cubicles) to support fires in that area for two to three hours. . .*" (Page 330)

"*A thermal analysis was conducted of Column 79, typical of the geometry found on lower floors, i.e., a W14X730 section with cover plates and thermal insulation (see Chapter 9). Based on the knowledge that the yield strength of steel is reduced to roughly 50 percent of its room temperature value at steel temperatures of around 500°C to 600°C, it was found that it would take roughly 6 h of continuous exposure from a fully developed fire (gas temperatures of around 1100°C) to reach these temperatures. Therefore, it would not be possible for a building contents fire to have heated a massive, insulated column such as Column 79 to a point of failure.*" (Page 330)

"*Floors that frame into a column provide lateral support to the column. If a building had a regular floor-to-floor height, h, then failure of one floor would result in an unbraced length of 2h. Likewise, failure of two floors would result in an unbraced column length of 3h, and so on. If a sufficient number of floors were to fail, the column could buckle even if it were not weakened by heating. . .The possibility of floor failure in fire is explored in detail in later sections of this chapter.*" (Page 330)

"*Failure of a floor beam in fire is an infrequent event, and, indeed, there have been many building fires that have not resulted in even local failures of the floor system. The challenge was to determine if a fire-induced floor system failure could occur in WTC 7 under an ordinary building contents fire.*" (Page 331)

"*Failure of a floor beam in fire is an infrequent event, and, indeed, there have been many building fires that have not resulted in even local failures of the floor system. The challenge was to determine if a fire-induced floor system failure could occur in WTC 7 under ordinary building contents fire.*"

"*To determine whether there were aspects of the design or construction of the buildings that could have contributed to column failure by loss of lateral support, NIST considered other buildings that had survived multi-floor fires, particularly those for which there is documentation on the performance of the structural system as well as characterization of the fire conditions. Three buildings were considered: One Meridian Plaza building in Philadelphia, the First Interstate Bank building in Los Angeles, and the eight story steel frame building used in some Cardington Tests in England. . .*" (Page 331)

"*At approximately 8:30 p.m., February 23, 1991, a fire was reported at One Meridian Plaza, a 38 story office building in Philadelphia (Figure 8-9). The fire, which started on the 22nd floor, ultimately consumed the 21st through 29th floors. Fire fighting operations were suspended when it was determined that there was a possibility of a major structural collapse; the fire was extinguished only when it reached the 30th floor, which had a functioning automatic sprinkler system. . .*" (Page 331)

"*Fire fighting operations were suspended when it was determined that there was a possibility of a major structural collapse; the fire was extinguished only when it reached the 30th floor, which had a functioning automatic sprinkler system. . .*"

"*The One Meridian Plaza office building was designed and built to the 1949 Philadelphia Building Code and was completed in 1969. It was classified as "Type 1B" construction requiring 3 h fire-rated columns, and 2 h fire-rated beams. The building was steel frame construction with non-composite slab floors over metal deck. It had moment frame construction with all girder-to-column connections moment resisting, i.e., what would today be termed "fully restrained". Beams were protected with cementitious sprayed fire-resistive materials (SFRM), and the columns were encased in plaster and gypsum. Columns were reported to have a 4 h fire resistance rating, which exceeded the 3 h code requirement.*" (Page 332)

"*The* [One Meridian Plaza] *building was approximately 68 m by 29 m (223 ft by 94 ft) in plan and had an open-plan floor layout with offices around the periphery (Figure 8-10). There was a service core located on the south side of the building leaving roughly 1,600 m^2 (17,000 ft^2) of tenant space per floor. . .*" (Page 332)

"*An automatic sprinkler system was being installed in the* [One Meridian Plaza] *building, and tenant floors were sprinklered or would have been sprinklered as they became vacant or were renovated. At the time of the fire, sprinklers had been installed on Floors 30, 31, 34, and 35. . .There were three stairways, two served by 6 in. "wet"* [standpipe] *risers. Pressure-regulating valves on Floors 13 through 25 had not been properly calibrated on installation and initially limited available water for fire fighting operations.*" (Page 332)

". . .*The fire was first detected by a smoke alarm that activated at approximately 8:23 p.m. The Philadelphia Fire department was notified at 8:27 p.m. and the first unit arrived within 4 minutes, at which time heavy smoke was reported, with fire observed from one window on the 22nd floor.*" (Page 333)

". . .*Fire fighting efforts were severely hampered by low pressure in the standpipe water supply system and loss of electrical power, allowing uncontrolled fires to continue to spread vertically.*" (Page 333)

"*About six hours after the fire started, at 2:15 a.m. the next day, "fire was reported to be burning on the 24th and 25th floors and extending to the 26th floor" (Routley et al. 1991). Thus, fires were burning simultaneously on at least two floors at a time, and the vertical fire spread rate was approximately 90 min per floor*. . ." (Page 333)

". . .*The order* [for fire fighters] *to evacuate the building was issued at about 7:00 a.m. on February 24. Fire continued to spread vertically until, at the 30th floor, it was stopped by automatic sprinklers.*" (Page 333)

". . .*The order* [for fire fighters] *to evacuate the building was issued at 7:00 a.m. on February 24. Fire continued to spread vertically until, at the 30th floor, it was stopped by automatic sprinklers.*"

"*The USFA report (Routley et al. 1991) indicated that, "After the fire, there was evident significant structural damage to the horizontal steel members and floor sections on most of the fire damaged floors. Beams and girders sagged and twisted-some as much as three feet-under severe fire exposures, and fissures developed in the reinforced concrete floor assemblies in many places." It was reported that columns continued to support their loads without obvious damage*. . .*Recall that the fire protection for the columns was reported to exceed the code requirements.*" (Page 333)

"*On May 4, 1988, fire broke out in the First Interstate Bank Building in downtown Los Angeles, burning out four floors and damaging a fifth (Figure 8-11). Fire originated on the 12th floor*. . .*The fire was eventually controlled by the Los Angeles City Fire Department that had summoned 64 companies, totaling 383 firefighters and support personnel*. . ." (Page 334)

"*On May 4, 1988, fire broke out in the First Interstate Bank Building in downtown Los Angeles, burning out four floors and damaging a fifth. Fire originated on the 12th floor*. . ."

"*The 62 floor office building, completed in 1973, was a steel moment frame structure with lightweight composite concrete floors over metal deck. The steel was protected with sprayed fire-resistive material. The building had a floor plan measuring 38 m by 68 m (124 ft by 184 ft), a central core, and approximately 1,600 m^2 (17,500 ft^2) of office space per floor. The tenant space was largely open-plan office space.*" (Page 335)

"*An automatic sprinkler system was being installed at the time of the fire. Installation was about 90 percent complete and included piping and sprinkler heads* [sprinklers] *on the five floors affected by the fire (Floors 12 through 16). Valves controlling the system, however, had been closed until installation of water flow alarms was to be completed. The building was served by a standpipe system with four risers-one on each stairway-providing water for fire fighting operations. While it was determined that activating the automatic sprinkler system on the fire floors would overwhelm the system and, thereby, limit the available water for fire fighting operations, the sprinklers on Floors 17 through 19 were activated in the event that fire extended above the 16th floor.*" (Page 335)

"A *smoke detector on the 12th floor was activated at 10:30 p.m., and the first alarm was called in at 10:37 p.m. The first fire company arrived on the scene at 10:41 p.m. . . .*" (Page 335)

"*The fire spread vertically, mostly as flames extended 30 ft up the face of the building and through the space between the floor and the glass curtain wall. . .The fire was eventually brought under control by the fire department at about 2:19 a.m., nearly 4 h after smoke was first detected at 10:30 p.m. the previous night.*" (Page 335)

"*The fire was eventually brought under control by the fire department at about 2:19 a.m., nearly 4 h after smoke was first detected at 10:30 p.m. the previous night.*"

"*The USFA report (Routley 1988) indicated that:*

> *"The fire extended at a rate estimated at 45 min per floor and burned intensely for approximately 90 minutes on each level. This resulted in two floors being heavily involved at any point during the fire."* " (Page 335)

"*An eight story test building was constructed by the British Research Establishment (BRE) at its Cardington Laboratory for the purpose of conducting a series of fire tests. The steel-braced frame building was designed and constructed to represent a typical office building, and was completed in 1993. The floor framing had simple shear connections and a rectangular grid. A series of seven tests were conducted, two of which are discussed in this section. Information regarding the various fire tests at the Cardington facility has been reported (British Steel 1999). Here, Test No. 3 is referenced in qualitative terms, and Test No. 6 is compared with the One Meridian* [Plaza]*, First Interstate Bank and WTC 7 fires.*" (Page 336)

"*Test No. 6 involved an open-plan compartment that contained work stations consisting of modern day furnishings, computers, and filing systems. The total combustible loading was equivalent to 46 kg/m^2 (9.2 lb/ft^2).*" (Page 337)

"*Test conditions (quantity and make-up of combustibles, ventilation, etc.) were designed to create the most severe fire possible. Within 10 minutes of ignition, hot gas temperatures exceeded 900^{o}C* [1,652^{o}F] *and reached a maximum of just over 1200^{o}C* [2,192^{o}F] *within 40 minutes. The combustibles were nearly all consumed in 1 h. At its maximum, the heat release rate was calculated to be 58 MW. Complete burnout, including contents of the filing cabinets, was achieved.*" (Page 337)

"*An eight story test building was constructed by the British Research Establishment (BRE) at its Cardington Laboratory for the purpose of conducting a series of fire tests. The steel-braced frame building was designed and constructed to represent a typical office building, and was completed in 1993.*"

"*No structural failures were reported in Test No. 6, but the maximum floor sag was reported to be 0.64 m (25 in.) in a span of 9 m (29.5 ft). In Test No. 3, where the maximum compartment temperatures was* [were] *approximately 960^{o}C (1760^{o}F), the maximum floor beam deflection was 428 mm (16.8 in.), also in a span of 9 m (29.5 ft).*" (Pages 337 and 338)

"*On August 5, 1970, fire broke out on the 33rd floor of One New York Plaza, a 50 story office building in New York City (Powers 1970). Fire spread to the 34th floor and then to the 35th floor. Damage to the structural steel was reported on the 33rd and 34th floors. . .While there were no floor collapses in this case, there were connection failures, and deflection and distortion of floor beams.*" (Page 338)

"*First Interstate Bank and One Meridian Plaza, both commercial office buildings, had fires that fully involved entire floors. In both buildings, vertical spread of fire was by external flame exposure, breaking glass windows from the outside and igniting office furnishings in the floor above. By contrast, the fires in WTC 7 spread across several floors, but did not involve an entire floor at any given time. Additionally, in WTC 7 there was no evidence of floor-to-floor fire spread in the photographic and videographic records. Finally, the combustible load was likely similar in First Interstate Bank, One Meridian Plaza, and WTC 7, with the combustible load in the One Meridian Plaza perhaps even greater as it was described subjectively as "heavy". NIST therefore concluded that the fires in First Interstate Bank and One Meridian Plaza were at least as severe, and probably more severe, than the fires in WTC 7.*" (Page 341)

"*The maximum gas temperature for large, open-floor plan burning of office furnishings is approximately 1200°C (2200°F)* [2192°F]*, as measured in Cardington Test No. 6. Note that Cardington Test No. 3, which was also characterized as a severe fire, produced maximum gas temperatures of approximately 1000°C (1800°F)* [1832°F]*. These maximum temperatures were consistent with the maximum gas temperatures of 1100°C (2000°F)* [2012°F] *determined by fire simulations and measured experimentally for fires of workstations similar to those in WTC 7 (NIST NCSTAR 1-5E).*" (Page 341)

"*First Interstate Bank and One Meridian Plaza, both commercial buildings, had fires that fully involved entire floors. . . NIST therefore concluded that the fires in First Interstate Bank and One Meridian Plaza were at least as severe, and probably more severe, than the fires in WTC 7.*"

"*If the fires in the First Interstate Bank, One Meridian Plaza, the Cardington Test Building, and WTC 7 generated comparable gas temperatures, and of the four buildings cited only the WTC 7 building collapsed, the reason for the different outcomes likely lay in differences in the structural systems and the details of how the steel frames were constructed. . .*" (Page 341)

"*. . .the reason for the different outcomes likely lay in differences in the structural systems and the details of how the steel frames were constructed . . .*"

". . .Although all four buildings have been described as "steel frame structures," comparison of construction features between the three buildings that did not collapse in an uncontrolled fire and WTC 7 revealed the following differences:

- *Simple framing connections for girders in WTC 7 vs. fully restrained moment connections of girders-to-columns in the One Meridian Plaza and First Interstate Bank buildings;*

- *Floor beam spans up to 16 m (52 ft) in WTC 7, rather than a maximum of 9 m (30 ft) in the other structures;*

- *Asymmetric framing in WTC 7 (providing one-sided lateral support to girders) rather than regular floor framing (providing two-sided lateral support to girders) in the other three structures (Section 8.6);*

- *Non-composite girders in WTC 7 rather than composite girders (presence or absence of shear studs) in two of the other three structures; and*

- *Seated connections used for girder-to-column connections in WTC 7; NIST found no evidence that such connections were used in the First Interstate Bank and Cardington buildings.*" (Page 341)

"*The exterior of WTC 7 was a moment frame with relatively closely spaced columns. The core structure was simply connected and derived its lateral support from the moment frame through diaphragm action of the floors. Simply-connected floor beams and girders spanned between the exterior moment frame and the core. Where the spans between the exterior and core were large (on the east side), intermediate size columns (79, 80 and 81), designed to carry gravity loads only were used.*" (Page 342)

"*The floor framing layout was somewhat unique due, in part, to the unusual trapezoidal shape of the building, but also to the need to match* [the] *existing column layout in the Con Edison substation (Chapter 2). The result was that, in some locations, floor beams framed into girders on only one side of the girder. . .The use of single shear plates and double angles is typical for steel framing connections. Seated connections, though generally less common, are nevertheless found in high-rise construction and have advantages during steel erection.*" (Page 342)

"*Thus, it was concluded that the hypothetical fuel oil fires on the 5th floor, or hypothetical fires on Floor 5, 7 and 9 involving day tanks, did not contribute to the collapse of WTC 7.*"

"*Thus, it was concluded that the hypothetical fuel oil fires on the 5th floor, or hypothetical fires on Floors 5, 7, and 9 involving day tanks, did not contribute to the collapse of WTC 7.*" (Page 355)

"*Preparations for a blast scenario would have been almost impossible to carry out on any floor in the building without detection.*" (Page 357)

"*People on the street would have heard 9 lb of RDX go off a mile away in air (and even further away if the wind were blowing in their direction). There were no witness reports of such a loud noise, nor was such a noise heard on audio tracks of video tapes that recorded the WTC 7 collapse. Thus, from this study, NIST concluded that blast events could not have occurred and found no evidence of any blast events.*" (Page 357)

"*NIST considered the possibility of fire in the Con Edison Substation (Chapter 2). . .NIST found no evidence that significant physical damage to the Con Edison portion of WTC 7 occurred due to the collapse of WTC 1 at 10:29 a.m.*" (Page 357)

"*Thus, from this study, NIST concluded that blast events could not have occurred and found no evidence of any blast events.*"

"*Based upon this evidence, NIST concluded that fire within the Con Edison substation was not a factor in the collapse of WTC 7.*" (Page 358)

Discussion

". . .the Los Angeles Fire Department utilized 383 fire fighters and other support personnel to combat the fire at the First Interstate Bank Building."

While NIST's comparison of the fires which occurred the One Meridian Plaza Building, the First Interstate Building and the experiments referred to as the Cardington tests to the fire in the WTC 7 Building is interesting, and appears to have merit, NIST seems to have glossed over one essential difference between the high rise fires in Los Angeles and Philadelphia and the fire in the WTC 7 Building. In both the fires in the First Interstate Bank Building and the One Meridian Plaza Building, fire fighters responded quickly to both of these fires and actively fought both fires.

Based upon information provided in the NIST report (excerpted above), the Los Angeles Fire Department utilized 383 fire fighters and other support personnel to combat the fire at the First Interstate Bank Building. While the number of fire fighters involved fighting the fire at the One Meridian Plaza Building was, to my knowledge, never tabulated, the number of personnel involved in fighting this fire was likely substantial. Even though the Philadelphia Fire Department initially encountered problems with the pressure reducing valves in the standpipe system, hose streams were applied on the fire from the rooftops of adjacent buildings.

According to NIST, after the collapse of the World Trade Center towers and the FDNY's loss of a substantial number of fire fighters and equipment in the collapse of these two buildings, the decision was made not to risk further losses of personnel and equipment fighting the fires which occurred in the WTC 7 Building. Given this, it is likely that most in the fire protection field would say that there is little similarity between the fires which occurred in at the First Interstate Bank Building and the One Meridian Plaza Building and the fires which occurred in the WTC 7 Building on September 11th.

. . .it is likely that most in the fire protection field would say that there is little similarity between the fires which occurred in at the First Interstate Bank Building and the One Meridian Plaza Building and the fire which occurred in the WTC 7 Building on September 11th.

It would appear that the fire in the WTC 7 Building was most similar to the experiments conducted at Cardington where no active fire fighting occurred during the course of the experiments. Since the floors in the experiments at Cardington were only partially loaded with combustibles and the experimental conditions utilized limited the fire to only one floor, it would still be a stretch to consider the experiments at Cardington to be similar to the WTC 7 Building fires.

Based upon the above, it seems obvious to conclude that NIST's comparison of the fire in the WTC 7 Building to the fires in the First Interstate Bank Building and the One Meridian Plaza Building, as well as to the Cardington experiments, is a faulty analysis.

Based upon the above, it seems obvious to conclude that NIST's comparison of the fire in the WTC 7 Building to the fires in the First Interstate Bank Building and the One Meridian Plaza Building, as well as to the Cardington experiments, is a faulty analysis.

Would the WTC 7 Building have collapsed if the NYFD had actively fought the fire in the building with an adequate water supply at the WTC site or if the NYFD had used a relay to provide a water supply at the site?

One can only speculate on the answer to that question, but it would seem that the probability that the NYFD could have prevented the collapse of this WTC 7 Building is extremely high. The basis for this opinion is the fact that the NYFD has been able to control other multi-floor fires which have occurred in a number of non-sprinklered high rise buildings in New York, such as the fire which occurred in WTC 1 on February 14, 1975.

The purpose of this article is not discuss the fire in the WTC 7 Building however, but rather to highlight the vast amount of information and research that we have on fires in high rise buildings. NIST has done an admirable job of pulling this information together. Although NIST's analysis of this information may be faulty, there is still plenty to be learned from the information contained in NIST's report. Hence, a study of NIST's report is still worthwhile for those who have an interest in high rise building fire protection.

Would the WTC 7 Building have collapsed if the NYFD had actively fought the fire in the building with an adequate water supply at the WTC site or if the NYFD had used a relay to provide a water supply at the site?

Conclusion

The fact that the NCSTAR 1-9 contains such an obviously faulty analysis should give anyone reviewing NIST's investigation work on the collapse of the WTC buildings pause. No one can say that NIST's work on the collapse of the WTC 7 Building was rushed. Hence, such an obvious error in the report is cause to wonder whether or not there are additional major errors in NIST's investigation work on the collapse of the WTC Buildings.

Hence, such an obvious error in the report is cause to wonder whether or not there are additional major errors in NIST's investigation work on the collapse of the WTC Buildings.

While there may be errors in the NIST report, the collection of information on building fire protection all in one document is impressive, but this is still no excuse for making such a basic error in the analysis of why the WTC 7 Building collapsed.

* * * * *