



Fire Protection

By Richard G. Schulte, Schulte & Associates, Evanston, IL

Analysis of Congressional Testimony on the World Trade Center Collapse

Last month in this column we offered a compendium of testimony presented before the House Science Committee of the United States Congress. (See March 2003 *Plumbing Engineer*, page 8.) This month we provide an analysis of those remarks.

To begin his testimony, the director of NIST, Dr. Bement, stated that the terrorist attack on September 11 was "... unprecedented when compared with any prior accident, natural disaster, or terrorist/war attack." Dr. Bement further stated that "the collapse of the twin World Trade Center towers was the worst building disaster in human history." Obviously, these statements are an exaggeration. Without thinking very hard, several other major building disasters which were far greater in magnitude and impact come to mind, for instance, the Great Chicago Fire in 1871, the San Francisco earthquake and fire in 1906, the destruction of Dresden by Allied bombers in 1945 and the destruction of Hiroshima and Nagasaki using atomic weapons also in 1945. The destruction of the World Trade Center towers pales in comparison to these events. The difference between these events and the collapse of the World Trade Center towers is that the collapse of the towers was recorded on film and played ad nauseam on television, while the Great Chicago Fire, the San Francisco earthquake and fire and the destruction of German and Japanese cities in World War II are "ancient" history. Although these other events are "ancient" history, one would have expected that the director of NIST could have put the destruction of the World Trade Center towers into proper perspective for a Congressional committee.

The inaccurate historical perspective on the magnitude of the collapse of the World Trade Center towers was not the only major distortion of facts contained in Dr. Bement's testimony. As one justification for a major investigation into the collapse of the World Trade Center, Dr. Bement stated that "an investigation would be critical to restore public confidence in the safety of tall buildings nationwide ..." Dr. Bement further stated that "anecdotal evidence also suggests that building vacancy rates have doubled in Manhattan, despite the 15 million square feet of space that was lost on September 11th." Of course, one way to restore the public's confidence in the safety of high rise buildings would be to conduct an expensive research study by NIST. Another, far more immediate, and far less expensive way of restoring the American public's confidence in the safety of our tall buildings would be for "experts" to simply stop scaring the public and cite the actual facts about high rise building safety.

The truth is that the fire record of American high rise buildings has been excellent over the last 20 years. This statement is supported by statistics published in a report written by Dr. John Hall, Jr. of the Fire Analysis and Research Division of the National Fire Protection Association (NFPA). Dr. Hall's report titled "High-Rise Building Fires" was published (coincidentally) in September, 2001. (A summary of some of the statistics presented in Dr. Hall's paper appeared in the fire protection column in the January, 2003 issue of *Plumbing Engineer*, along with other fire statistics published by the NFPA.) It is unfortunate that Dr. Bement did not provide the Congressional Science Committee with Dr. Hall's report, along with a summary of the statistics contained in the report. Dr. Bement missed an excellent opportunity to reassure the American public about the "dangers" of fires in high rise buildings.

Dr. Bement's reference to the fact that the (commercial) building vacancy rate in Manhattan has doubled since September 11 as an indication that the American public has developed an aversion to living or working in high rise buildings is a rather curious statement. Dr. Bement seems to have totally neglected the impact of the events of September 11 on the economy in New York City and the rest of the nation. Was the increase in the vacancy rate in Manhattan due to the fact that companies were fearful that other high rise buildings would be attacked by terrorists as suggested by Dr. Bement or could it be that the increase in the vacancy rate was mainly due to the impact that the September 11 attacks had on the economy? Common sense tells us that the impact of the September 11th events on the local economy had far more to do with rise in the vacancy rate in Manhattan than the fear of another terrorist attack.

Dr. Bement's testimony also included a statement that improvements in building and fire codes used in the United States are "urgently needed" and that the deficiencies in the codes "have begun to be recognized in recent years." Dr. Bement's testimony also stated that "the events of September 11th have brought even more focus and priority to this already important issue." If it is NIST's opinion that improvements in the building and fire codes used in the United States are so "urgently needed," why was NIST no where to be found when the two newest model building codes in the United States, the 2000 edition of the *International Building Code* and the 2003 edition of *NFPA Building Code*, were being developed? (It

Continued page 10

Fire Protection

Continued from page 8

should be noted that Mr. Richard Bukowski of the Fire Research Division of the Building and Fire Research Laboratory of NIST did participate in the development of the first edition of the *International Performance Code* published by the International Code Council.)

A review of the fire statistics in the United States (published annually by the NFPA) indicates that the number of fire fatalities in the United States has steadily declined over the last quarter century, despite the fact that the population of the United States has continued to grow. The NFPA statistics for 2001 indicate only 80 Americans died as a result of fires in U.S. commercial (non-residential) buildings (excluding the fatalities which occurred as the result of the September 11 terrorist attack). These same statistics indicate that roughly 83 percent of the fire fatalities which occurred in the United States in 2001 occurred in residential occupancies

(excluding the fatalities which occurred on September 11) with 70.7 percent of the fatalities occurring in one- and two-family dwellings. (That means that more American civilians died as a result of fires in one- and two-family dwelling in 2001 than died as a result of the collapse of the World Trade Center towers.) Given these statistics, just what are these “urgently needed” improvements in our fire codes? If there are any “urgently needed” improvements in our fire codes, the NFPA statistics seem to suggest the need to address the fire problem in the smallest buildings that we construct, one- and two-family dwellings, not high rise buildings.

Dr. Bement’s testimony also included a statement that “current building design practice does not consider fire as a [structural] design condition.” Along these same lines, Dr. Bement’s further stated that “the current testing standards are based on work carried out at NIST in the 1920s” and that the test standards “do not represent real fire hazards in modern

buildings.” Dr. Bement’s statements regarding structural engineering design practice is correct, as is his statement regarding the fire resistance test (ASTM E119), but his inference that somehow these are major problems is another distortion of the facts. The reason that fire conditions are not presently considered in structural engineering design is that our “real world” experience with building fires indicates it simply isn’t necessary. While the fire exposure (the time-temperature curve) required to be used by ASTM E119 may not represent time-temperature curves derived from real fires, more than 50 years of experience with the ASTM E119 fire test indicates that the results derived from this test are adequate. Based upon fire testing, we are aware that the temperatures developed in a fire vary with the type of fuel, the quantity of fuel, the fuel configuration and the ventilation available to the fire. Hence, any standardized test using a single time-temperature curve will necessarily be a compromise.

It is assumed by many in the fire protection field that hourly fire resistance ratings assigned to structural assemblies represent the actual fire resistance of a structural assembly in a real fire. This assumption is erroneous, however. The variable with the greatest impact on the fire resistance of a structural assembly is the fire itself. If a structural assembly is exposed to a fire which is more severe than the ASTM E119 time-temperature curve, the actual fire resistance of the assembly will be less than indicated by the fire rating assigned to the assembly by testing per ASTM E119, while if the fire exposure is less severe than the ASTM E119 time-temperature curve, the actual fire resistance of the assembly will be greater than indicated by the fire rating assigned to the assembly. If you have an actual understanding of the E119 test standard, the above is obvious.

The issue of the actual structural fire resistance, versus the severity of the fire exposure, has implications in the collapse of the World Trade Center towers because the fire to which the structural systems in the towers were exposed was far more severe than the fire exposure utilized in the ASTM E119 fire test standard. (The severity of a massive flammable liquids fire will far exceed the

Continued on page 14

March 2003

Fire Protection

Continued from page 10

severity of the ASTM E119 time-temperature curve.) Hence, it should be obvious that the actual fire resistance of the structural systems in the World Trade Center towers would have been less than indicated by the hourly ratings assigned to the structural systems assuming that all of the structural fire protection provided for the structural systems in the building was intact. Of course, the impact of the aircraft damaged the structural fire protection provided for the towers reducing the actual fire resistance of the overall structure. (The damage to the building structural systems caused by the impact of aircraft also would have reduced the actual fire resistance of the structure by increasing the stress in some of the undamaged structural members.)

In Professor Corbett's testimony, he in essence attacked the model building codes because the code requirements that apply to high rise buildings "treat a 15-story building exactly the same as a 100-story building in terms of fire protection." Professor Corbett further stated that the model building codes "place heavy reliance on automatic sprinklers, with little redundancy in terms of structural fire resistance ..." The professor's testimony also included the statement that "we need a proper balance of passive and active [fire] protection in larger high-rise structures." As with some of Dr. Bement's testimony, Professor Corbett's statements regarding the high rise building provisions contained in the model building codes lack an historical perspective.

The high rise provisions presently included in the *International Building Code* and the *NFPA Building Code* (NFPA5000) were originally developed in the early 1970s and first included in the regional model building codes in the middle 1970s. The issue of whether sprinkler protection should be mandated in high rise buildings was the subject of much debate in the early 1970s and the first set of high rise building provisions included in the three regional model building codes contained two alternatives for protecting high rise buildings. One alternative was to "compartment" the building, while the other was to provide sprinkler protection in lieu of "compartmentation."

At that time, it was acknowledged that providing sprinkler protection in a high rise building would provide superior protection for the occupants of the building, however, there were concerns about the cost of installing sprinkler protection. To encourage the installation of sprinkler protection in high rise buildings, the high rise provisions included a number of "trade-offs" in the passive fire protection normally required. The purpose of allowing these "trade-offs" in passive protection was to at least partially offset the cost of installing sprinkler protection. Among the "trade-offs" allowed in the high rise provisions were reductions in the structural fire protection required, the elimination of fire dampers and the substitution of pressurized stair enclosures for smokeproof (exit stair) enclosures. It was not until the 1980s that the high rise provisions included in the three regional model building codes were revised to mandate the installation of sprinkler protection in high rise buildings.

Since the inclusion of the high rise provisions in the three regional model building codes, there has not been a major fire disaster in an American high rise building protected throughout by a sprinkler system (with the exception of the World Trade Center towers). Based upon the experience of the last 25 years, many, if not most, code professionals have accepted the con-

Continued on page 16

Fire Protection

Continued from page 14

cept of “trade-offs” in passive fire protection when sprinkler protection is installed. In recent years, however, manufacturers of passive fire protection products have begun to attack the concept of “trade-offs” for the installation of sprinkler protection and have developed a concept which is referred to as “balanced” fire protection. The implication is that allowing “trade-offs” in passive fire protection when sprinkler protection is installed is somehow “unbalanced” fire protection. One of the problems with the “balanced” fire protection concept as it applies to high rise buildings is that it neglects the history of the development of the high rise building provisions (and the fire record of sprinklered high rise buildings in the last 25 years). Unfortunately, Professor Corbett’s testimony before the Congressional Committee implied that the concept of “balanced” fire protection is generally accepted in the fire protection field.

Common sense tells us the impact of the September 11th events on the local economy had far more to do with rise in the vacancy rate in Manhattan than the fear of another terrorist attack.

Does the fact that both of the World Trade Center towers collapsed on the morning of September 11 validate the concept of “balanced” fire protection and does the World Trade Center towers collapse indicate that additional fire protection should be required in 100 story high rise buildings? The answer to both of these questions might be affirmative if the fires in the World Trade Center towers were typical fires which occur in high rise buildings, but the fires in the World Trade Center towers were anything but typical. The key question which must be answered in this debate is not whether the high rise building provisions contained in our model building codes are adequate, but what are our expectations regarding the structural stability of high rise buildings? It appears that the witnesses before the Congressional Committee have assumed that there is a consensus that buildings should remain stable, regardless of the magnitude of damage done to the building by terrorists (or the cost to construct such buildings).

Professor Corbett’s testimony also addressed “inadequacies” in ASTM E119 stating that “today, we basically use the same test with the same ‘fire’ temperature and exposure conditions developed over 75 year ago. I would argue that the fires in the 1920s are different than those of today, and that this nationally accepted test needs to be thoroughly reexamined in light of what happened on 9-11.” Are fires really different today, from fires which occurred in the 1920s? Obviously, the physics of fire is the same today as in the 1920s, but what Professor Corbett appears to be referring to is the increased use of petrochemical products (plastics) in modern American society. What

Professor Corbett has neglected in his assessment that the contents of buildings are different today than they were in the 1920s are the advancements made in material science over the last 80 years. In the early part of the 20th century, furniture and wall and ceiling finishes were combustible. Today, much of our furniture in commercial occupancies is constructed with non-combustible materials with only minor quantities of plastic finishes, and wall and ceiling finishes are mostly noncombustible. A strong argument can be made that the contents of a modern building are far less combustible and safer today than the contents of buildings in the 1920s. The fire safety statistics collected and published by the NFPA support this point of view, rather than Professor Corbett's viewpoint. The number of structure fires continues to decrease each year, as do the number of civilian and firefighter fatalities caused by fire, despite the fact that the population of the United States continues to grow. Over the past quarter century, we have, in essence, conquered the hazard of fire. Given this, is it really absolutely essential to address some of the "well-known" deficiencies in ASTM E119 test standard?

Closing comments

This column offers a far different perspective on the hazard of fire in the United States than that presented by Dr. Bement and Professor Corbett. Although the money to fund the NIST study of the World Trade Center towers collapse has already been appropriated and the study is under way, the Congressional Science Committee should be aware that some of the testimony before the committee provided a less than objective assessment of the importance of the World Trade Center collapse to our understanding of the hazard of fire in high rise buildings. It is likely that the staff of NIST wrote Dr. Bement's remarks for him. If this is the case, Dr. Bement can, perhaps, be excused for some of his misstatements.

Finally, back to my original question. Is the World Trade Center collapse incident simply being used by "experts" to "wring" more research funding out of the federal treasury? Why else would witnesses before the Congressional Committee exaggerate the magnitude of the World Trade Center collapse in comparison to other major building disasters and "cover up" the excellent fire record of American high rise buildings? Did the Congressional Science Committee get "rolled" by the "experts" who testified at the March 6, 2002, hearing? It certainly appears that the answer to this question is yes. □

About the Author

Richard Schulte is a 1976 graduate of the fire protection engineering program at the Illinois Institute of Technology. After working in various positions within the fire protection field, he formed Schulte & Associates in 1988. His consulting experience includes work on the Sears Tower and numerous other notable structures. He has also acted as an expert witness in the litigation involving the fire at the New Orleans Distribution Center. He can be contacted by sending email to rschulte@plumbingengineer.com.

This and Mr. Schulte's several previous columns comprising a series on the World Trade Center collapse can be downloaded (in PDF format) from the Plumbing Engineer Web site, www.plumbingengineer.com. They are located in the "Resources" section.