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“BALANCED” FIRE PROTECTION: THE ATRIUM PROVISIONS

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The concept of “balanced” fire protection has been a frequent topic in this column. The reason for this is that this concept has been the subject of acrimonious debate since the development of the International Building Code (IBC) began in the middle 1990's. One would have expected that this issue would be settled after more than 10 years (and the publication of three editions of the IBC), but the debate still continues to rage primarily because the manufacturers of passive fire protection products have generously funded a trade association known as the Alliance for Fire and Smoke Containment and Control (AFSCC).

An organization used to communicate the AFSCC's message regarding the “balanced” fire protection issue is the Alliance for Fire Safety (AFS). As noted previously in the October 2006 issue of Plumbing Engineer, the website indicates that the AFS is “*a consortium of concerned firefighting groups and built-in fire protection interests*” and that the purpose of the organization is “*to advocate [for] stronger building codes and higher fire safety standards for our nation's high-rise commercial buildings, hotels, schools, hospitals and other structures.*”

The AFSCC's principal concern is that sprinkler systems are not sufficiently reliable to justify many of the reductions in passive fire protection (“trade-offs”) permitted when sprinkler protection is provided and that these reductions should be removed from the model building codes used in the United States. Never mind that the fire safety record of commercial buildings, hotels, schools and hospitals protected by sprinkler systems has been excellent in recent years and that the vast majority of the fire losses in this country occur in dwellings.

Excerpts from the AFS web site addressing the reliability of sprinkler systems include the following:

"While it is clear that sprinklers are important in protecting property and lives, there is ample evidence to show that they do not always perform as intended. In fact, recent data obtained from the National Fire Protection Association shows that sprinklers failed to operate in one out of every six fires [large enough to activate sprinklers]. Since sprinkler systems can and do fail to operate, there is still cause for concern when fire- and smoke-resistant construction continues to be traded-off. So why place all of our fire protection eggs in one basket?"

"When viewed collectively, sprinkler trade-offs have the potential to place building occupants and firefighters in great danger should sprinkler systems fail to function properly during a fire."

"Given what is now known about the performance of sprinkler systems and fire-resistant components and materials, it seems prudent to require that new buildings incorporate both forms of fire protection in a manner consistent with previous, more conservative building codes."

Which brings us, of course, to a discussion of the floor opening and atrium provisions contained in the model building codes. The requirements for the enclosure of floor openings in buildings are contained in Chapter 7 in the IBC and the atrium provisions are contained in Chapter 4 of the Code. The following are a few excerpts of the code provisions in the IBC which address the protection of floor openings:

***"701.1 Scope.** The provisions of this chapter [Chapter 7] shall govern the materials and assemblies used for structural fire resistance and fire-resistance-rated construction separation[s] of adjacent spaces to safeguard against the spread of fire and smoke within a building and the spread of fire to or from buildings."*

***"707.1 General.** The provisions of this section shall apply to vertical shafts where such shafts are required to protect openings and penetrations through floor/ceiling and roof/ceiling assemblies. . . ."*

***"707.2 Shaft enclosure required.** Openings through a floor/ceiling assembly shall be protected by a shaft enclosure complying with this Section."*

***"707.2, Exception 2.** A shaft enclosure is not required in a building equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 for an escalator opening or stairway that is not a portion of the means of egress protected according to Item 2.1 or 2.2:"*

Item 2.1. *Where the area of the floor opening between stories does not exceed twice the horizontal projected area of the escalator or stairway and the opening is protected by a draft curtain and closely spaced sprinklers in accordance with NFPA 13. In other than Groups B and M, this application is limited to openings that do not connect more than four stories.*

707.2, Exception 5. *In other than Group H occupancies, a shaft enclosure is not required for floor openings complying with the provisions for atriums in Section 404.*

707.4 Fire-resistance rating. *Shaft enclosures shall have a fire-resistance rating of not less than 2 hours where connecting four stories or more, and not less than 1 hour where connecting less than four stories. . . . Shaft enclosures shall have a fire-resistance rating not less than the floor assembly penetrated, but need not exceed 2 hours.*

The atrium provisions contained in the IBC include the following excerpts:

404.1 General. *In other than Group H occupancies, and where permitted by Exception 5 in Section 707.2, the provisions of this section shall apply to buildings or structures containing vertical openings defined herein as "Atriums."*

ATRIUM. *An opening connecting two or more stories other than enclosed stairways, elevators, hoistways, escalators, plumbing, electrical, air-conditioning or other equipment, which is closed at the top and not defined as a mall. Stories, as used in this definition, do not include balconies within assembly groups or mezzanines that comply with Section 505.*

404.3 Automatic sprinkler protection. *An approved automatic sprinkler system shall be installed throughout the entire building.*

404.4 Smoke control. *A smoke control system shall be installed in accordance with Section 909.*

404.5 Enclosure of atriums. *Atrium spaces shall be separated from adjacent spaces by a 1-hour fire barrier constructed in accordance with Section 706 or a horizontal assembly constructed in accordance with Section 711, or both.*

404.5, Exception 1. *A glass wall forming a smoke partition where automatic sprinklers are spaced 6 feet (1829 mm) or less along both sides of the separation wall, or on the room side only if there is not a walkway on the atrium side, and between 4 inches and 12 inches (102mm and 305 mm) away from the glass and designed so that the entire surface of the glass is wet upon activation of the sprinkler system without obstruction. The glass shall be installed in a gasketed frame so that the framing system deflects without breaking (loading) the glass before the sprinkler system operates.*

404.5, Exception 3. *The adjacent spaces of any three floors of the atrium shall not be required to be separated from the atrium where such spaces are included in the design of the smoke control system.*

Although the AFSCC has proposed numerous code changes to modify or eliminate the “trade-offs” in passive fire protection based upon the assertion that sprinkler protection is not sufficiently reliable, it is interesting to note that the AFSCC has never introduced a proposal to eliminate the atrium provisions contained in the IBC. One would think that the atrium provisions would be first on the list of code provisions to be eliminated by any group who expresses concern about the reliability of sprinkler systems since these provisions (and Exception 2 to section 707.2) permit the violation of the most basic compartmentation in a building, the floor-to-floor compartmentation, solely based upon the fact that the building is protected by a sprinkler system.

Note: The provisions for the design of a smoke control system for an atrium contained in the IBC are based upon the assumption that the sprinkler system will successfully control the fire. If the sprinkler system fails to control the fire, the smoke control system will likely not perform as intended because the system is not designed to withstand the heat generated from a fire which has not been controlled by sprinkler operation and because the rate of smoke generation from an uncontrolled fire will far exceed the design capacity of the smoke control system. Hence, the sprinkler system and the smoke control system are not redundant forms of protection for an atrium.

The atrium provisions contained in the IBC and the predecessors to the IBC, the regional model building codes, are perhaps the most glaring example of a “trade-off” in building compartmentation permitted by the model codes. Yet a major fire has never occurred in a building in the United States complying with the atrium provisions since the atrium provisions were first included in the model building codes in the late 1970's. If sprinkler protection is as unreliable as the AFSCC says it is, why hasn't there been a major fire in a building containing an atrium in the United States?

There are a number of answers to that question. First, the statistic that sprinkler systems fail to operate (discharge water) on average in 1 in 6 fires (large enough to activate sprinklers) cited on the AFS web site is an erroneous statistic (and the AFSCC is aware that the statistic is erroneous, but still continues to use the statistic). According to a study on the reliability of sprinkler systems published by the National Fire Protection Association (NFPA) in late summer of 2005, the actual (average) operational failure rate of sprinkler systems is actually 1 in 14 fires (large enough to activate sprinkler systems) and the overall (average) failure rate is roughly 1 in 9 fires. Second, the statistics cited are an average failure rate for all occupancies and types of sprinkler systems. As might be expected, the failure rate of sprinkler systems varies by occupancy and by the type of sprinkler system with higher failure rates for storage occupancies and for buildings protected by dry pipe sprinkler systems. Since storage buildings rarely contain atriums (because new storage buildings are typically one story in height) and since almost all buildings containing atriums are protected by wet pipe sprinkler systems, the performance of the sprinkler systems protecting buildings with an atrium would be expected to be better than the average performance statistics.

The fact that the Alliance for Fire and Smoke Containment and Control has never proposed a code change to delete the atrium provisions would seem to call into question this organization's commitment to its stated concerns and objectives. Or perhaps the reason is just that the Air Movement and Control Association (AMCA) International is also a member of the AFSCC. (The AMCA International's web site indicates that “the mission of AMCA International is to promote the health and growth of the industries covered by its scope”.) Obviously, if the atrium provisions were deleted, the principal requirement for smoke control in buildings would be removed from the code and the members of the AMCA would be less than thrilled.

If you're beginning to get an uneasy feeling about how the model building codes are being written after reading the above, that's understandable. A number of other trade associations also utilize the building code as the primary means of marketing their fire protection products. For example, the manufacturers of smoke/heat vents utilize some of the same consultants (lobbyists) as the AFSCC to keep the requirements for smoke/heat vents in the code despite the fact that research and testing conducted in 1997 and 1998 clearly indicates that (automatic) roof vents will not operate as intended in sprinklered buildings.

And you thought that the fire safety provisions contained in the IBC were about fire safety.

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