



Fire Protection

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Facts Don't Matter: Passive Fire Protection, Part I

The Alliance for Fire and Smoke Containment and Control (AFSCC) Inc., is a trade association that represents manufacturers and installers of passive fire protection products. The January 2002 issue of the trade association's newsletter indicates the goals of the organization, which are:

"The promotion of the passive protection as part of a 'balanced design' approach to fire protection."

"The promotion of property protection and public welfare, as well as life safety."

"The education of code officials and [building] designers on fire protection issues."

"The promotion of fire fighter safety and the facilitation of fire fighting activities."

In order to promote one of the goals of the AFSCC, the education of both code officials and building designers, AFSCC technical director Richard Licht has written two papers on the subject of the fire protection requirements contained in building codes. These two papers are titled "Maintaining Life Safety Effectiveness in the New Building Codes" and "Balancing Active and Passive Fire Protection Systems in the Building Codes." In the interest of furthering the AFSCC's goal of educating both code officials and building designers, as well as other building professionals, a discussion of both papers written by Mr. Licht is warranted. This month, we'll take a look at "Maintaining Life Safety Effectiveness in the New Building Codes." Mr. Licht's second paper, titled "Balancing Active and Passive Fire Protection Systems in the Building Codes," will be analyzed in a future column.

The abstract of the paper titled "Maintaining Life Safety Effectiveness in the New Building Codes" puts forth the premise that "the challenge [to the writers of building codes] is to support construction economy and practicality while preserving life safety and property protection." While on the surface, this statement seems reasonable enough, it is, in fact, a misstatement of the purpose of both the International Building Code and NFPA5000. Section 1.2 in the 2003 edition of NFPA 5000 states that "the purpose of the Code is to provide minimum design regulations to safeguard life, health, property, and public welfare and to minimize injuries." While the purpose statement in NFPA5000 seems to support Mr. Licht's reference to property protection, explanatory material contained in Annex A of NFPA5000 clarifies the intent of the code with respect to property protection by stating, "it is not the purpose of the code to provide design regulations that solely affect economic loss to

private property." Hence, the basic premise of Mr. Licht's paper is in error.

Of course, there are many in the code enforcement field who would argue that property protection should be a basic part of any building code. To some extent, those who make this argument are correct. It is a legitimate concern of government that property owners not be allowed to construct buildings that would endanger their neighbor's property; however, the protection of one's own property against economic loss should not be a concern of government. More than likely, most Americans would agree that the government should not dictate where peo-

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ple live in an effort to minimize property damage caused by earthquakes, storms or floods, or dictate the specific auto someone drives in order to minimize damage to the vehicle in the event of an accident. Why then should the government be in the business of telling building owners how to protect their own property from loss?

Mr. Licht also states in his paper that "smoke detectors, containment area, passive fire protection and automatic fire sprinklers – taken in concert – this quartet of construction features is responsible for an improving record of life and property protection in commercial buildings that have been constructed in the U.S. over the past several decades." While most involved in building regulation would accept this statement as being true, it is not actually supported by any research. We can state with certainty, however, that the number of fire responses by fire departments in the United States has plummeted since 1980, despite the fact that the population of the United States has increased, from 226 million in 1980 to 281 million in 2000. According to statistics published by the National Fire Protection Association (NFPA), there were more than 2,988,000 fire responses in the United States in 1980, but only 1,708,000 fire responses in 2000. Given these statistics, the improved fire safety record in

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the United States in the last 20 years or so can certainly be attributed to the large drop in the number of fires occurring, combined with the installation of smoke detectors in residential occupancies. Although this may be considered to be heresy in some circles, the extent of the effect of "containment area, passive fire protection and automatic fire sprinklers" on the fire safety record of commercial buildings in the United States is unknown.

Mr. Licht further states in his paper, "it is crucial that the new Building Codes reflect a clear understanding of the systems nature of effective fire protection if we are to avoid sanctioning the construction of buildings that are code-compliant, but unsafe for life and property." Agreed – the protection afforded to the occupants of a particular building (and the building itself) is dependent upon the interaction of building features, but before making too much of this, it is critical to understand that the "trade-offs" in passive fire protection incorporated into the International Building Code and

NFPA 5000 are limited. In other words, simply because a building is protected throughout by a sprinkler system does not mean that all other fire protection features are permitted to be eliminated from a building. For instance, sprinklered buildings are still required to be provided with

"pressure is being applied by certain special interest groups to move away from proven and tested life safety practices in the model Building Codes for reasons of economy. These interest groups propose eliminating penetration firestops, fire-rated gypsum board, fire doors, fire

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egress routes and exits, and exit stairs are still required to be enclosed. In many cases, the rating of corridor wall construction is only permitted to be reduced, not eliminated. It appears that Mr. Licht would like us to believe that the fire safety of occupants of sprinklered buildings is totally dependent upon the successful operation of sprinklers, but this simply is not true.

Mr. Licht also asserts in his paper,

dampers, structural fire-proofing and fire-rated ceiling tiles from the Building Code in favor of sprinkler systems." Again, these statements are exaggerations of the actual facts about sprinkler "trade-offs." First, many of the "trade-offs" in passive fire protection have been included in the model building code published by BOCA and in the Life Safety Code for more than 25 years. Hence, it can be stated that many of the "trade-offs" in passive fire protection have actually been "field tested" in jurisdictions that have utilized either one of these two construction codes. Given this, it would be difficult for anyone to assert that many of the "trade-offs" in passive fire protection are not proven and tested life safety practices. Indeed, one of the advantages of having multiple model building codes in use in the United States is that various fire safety schemes can be "field tested" and the sprinkler "trade-offs" included in the International Building Code and NFPA 5000 have successfully passed 20 years of "field trials."

Along the same lines as the previous statement, Mr. Licht also writes, "more and more fire ratings are being reduced as a financial incentive to encourage the use of sprinklers. However, as noted in the following material, there are serious questions related to the ultimate safety of this practice." Given the fact that "trade-offs" in passive fire protection have been permitted by the BOCA Code and the Life Safety Code for more than 20 years, Mr. Licht should be able to cite a multitude of examples of the failure of buildings designed to comply with the BOCA Code and/or the Life Safety Code to provide adequate protection for the building occupants. Interestingly enough, Mr.

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Licht does not provide even a single example in his paper. The reason why Mr. Licht doesn't provide any examples of the "failures" in buildings designed utilizing "trade-offs" in passive fire protection should be obvious – there simply aren't any.

While Mr. Licht doesn't provide any examples to support his assertions, I can cite a number of examples of major failures of passive fire protection to contain the spread of fire and smoke: the fire at the MGM Grand Hotel in Las Vegas in 1980, the fire at the First Interstate Bank Building in Los Angeles in 1988 and the fire at the One Meridian Plaza Building in Philadelphia in 1991.

Mr. Licht's paper also states, "in effect, the suggested Building Code modifications serve to roll back the level of public safety and reduce the level of protection that has been achieved in structural fire safety over the past several decades without technical substantiation." Given the examples of the

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failure of passive fire protection cited above, it should be obvious that the ability of this form of fire protection to reliably perform its intended function is questionable, which is not any great revelation. Fire protection professionals realized that this was the case more than 30 years ago and began to advocate for the installation of sprinkler protection in buildings. Today, it is almost universally recognized that the installation of sprinkler protection in buildings provides far superior protection to that provided by passive fire protection. Despite Mr. Licht's assertion that there is a lack of technical substantiation for "trade-offs" in passive fire protection, the fire record in jurisdictions that utilize either the BOCA Code and/or the Life Safety Code speaks for itself.

Mr. Licht's paper also includes the often-quoted statement that "according to 'America Burning Revisited,' published by NFPA, the United States – along with Canada – still has the worst fire death rate for all industrialized countries for which we have comparable data. The U.S. fire deaths per million in population are almost twice the average fire death rates for other industrialized countries." This statement seems to document that there is indeed a "fire problem" in the United States, but note that Mr. Licht doesn't provide any further fire statistics in the paper. The per capita fire fatality rate in the United States may be twice that of other industrialized countries, but the actual fire fatality statistics paint an entirely different picture of the "fire problem" in the United States than inferred by the statement above. In a typical year, more than 60 percent of the fire deaths that occur in the United States occur in one- and two-family dwellings, and more than 80 percent of the deaths in the country occur in residential occupancies. Typically, fewer than 200 Americans die each year as a result of fire in commercial (non-residential) buildings. In recent years, fewer than

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100 Americans have died as a result of fire in commercial buildings.

Mr. Licht also writes, "smoke kills approximately 75 percent of the fire victims in the United States." While I haven't verified that this statement is correct, let's assume that this statement is accurate. One of the "trade-offs" that the AFSCC objects to is a "trade-off" in structural fire resistance when sprinkler protection is provided. Mr. Licht provides no explanation of how an increase in structural fire resistance addresses the issue of smoke and smoke spread.

Mr. Licht's paper also includes the statement, "the U.S. Fire Administration's most recent tabulated data for the National Fire Incident Reporting System (*Fire in the United States, 1987-1996, 11th Edition*) shows that sprinklers have been ineffective in stopping the migration of smoke in reported fires. This conclusion is based on the study of fire incidents in sprinklered high-rise buildings where smoke migrated beyond the floor of origin to expose occupants to toxic smoke dangers." A study titled "High Rise Building Fires" written by Dr. John R. Hall of the NFPA Fire Analysis and Research Division and published in September 2001, addresses the issue of fire and smoke spread in high-rise buildings, as well as providing fire fatality statistics for high-rise buildings. The statistics included in Dr. Hall's study seem to refute Mr. Licht's statement regarding the spread of fire and smoke in high-rise buildings and the danger of the spread of "toxic smoke." For instance, in the five-year

period between 1994 and 1998, Dr. Hall's study indicates that smoke generated from fires that occurred in U.S. high-rise office buildings was confined to the floor of origin in 80.4 percent of the fires. This means that smoke migrated beyond the floor of origin in 19.6 percent of the fires, roughly one in five fires. Dr. Hall's study also indicates that only seven fire fatalities were recorded in U.S. high-rise buildings in the 14-year period between 1985 and 1998. These statistics coupled together clearly show that the dangers of "toxic smoke" Mr. Licht warns us about are grossly exaggerated.

Mr. Licht also writes, "a primary problem in the U.S. today is that many buildings do not have sprinkler systems, and if sprinklers are installed, there is no established mechanism for maintenance enforcement that can ensure sprinkler effectiveness." In this statement, Mr. Licht seems to infer that all buildings should be protected by a sprinkler system, but then questions the reliability of sprinkler protection. In fact, building codes require that sprinkler protection be maintained, just as building codes require that passive fire protection features be maintained. While Mr. Licht questions the reliability of sprinkler protection, his paper does not discuss the reliability of passive fire protection. The fires at the MGM Grand Hotel, the One Meridian Plaza Building and the First Interstate Bank Building are a testament to the lack of reliability of passive fire protection. Mr. Licht's paper is written as though passive fire protection is 100 percent reliable. This is certainly not the case.

The reliability of sprinkler protection will always exceed that of passive fire protection features simply because the maintenance of sprinkler protection is far simpler than the maintenance of passive fire protection features.

Mr. Licht also states, "without secondary passive fire protection, buildings and occupants are left with no protection in event of sprinkler failure, a smoldering, shielded fire, or a fire that overwhelms the sprinkler system." Again, this statement is an exaggeration of the facts. Neither the International Building Code nor NFPA 5000 permit the elimination of all passive fire protection and other life safety features in buildings that are protected throughout by a sprinkler system. Sprinklered buildings are still required to be provided with exits, floor openings are still required to be enclosed and smoke detectors are still required in residential occupancies. The fact that the model building codes require multiple life safety features in sprinklered buildings accounts for the fact that, even in the event of a failure of sprinkler system, occupants of the building are still protected. This assertion is borne out by a statement published on the NFPA Web site on Oct. 11, 2002, that in the five-year period between 1994 and 1998, no fire fatalities occurred in U.S. hotels or motels that were protected throughout by a sprinkler system (despite the fact that many hotels were protected by sprinklers that were defective). Yes, sprinkler systems do fail occasionally, but this does not mean that a disaster will result.

Mr. Licht also writes, "the trend to a singular, sprinkler-based

approach to fire control and life safety can be traced to changes in the BOCA National Building Code in the early 1980s." A quick review of the 1970, 1975 and 1978 editions of the BOCA Basic Building Code indicates that this assertion is erroneous and clearly demonstrates a lack of research on Mr. Licht's part. A review of the 1970 and 1975 editions of the BOCA Basic Building Code indicates that many of the "trade-offs" in passive fire protection allowed were in place in the early and middle 1970s. This is important, because it means that we now have more than 20 years of experience with passive fire protection "trade-offs" in states that have adopted the BOCA Basic Building Code in the 1970s, including New Jersey, Virginia, Ohio and Kentucky.

Mr. Licht also states, "sprinklers can be an effective fire protection measure, but experience shows that this fire control method has limitations, and that the risks of damage, injury and death are reduced with the additive benefits of a multi-layer, active and passive approach to fire safety, incorporating effective control of smoke for safe egress." Mr. Licht is correct in stating that sprinkler protection has its limitations. For instance, the operation of sprinklers may not be able to save an occupant who is intimate with the initial fire source, i.e. someone who falls asleep while smoking, but no amount of passive fire protection will protect an occupant in this scenario, either. Does a combination of active and passive fire protection produce a

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“safer” building? Yes, but the law of diminishing returns comes into play. Once sprinkler protection is provided in a building, the risk to the occupants from fire is minimized. Each passive fire protection feature provided in addition to the sprinkler protection further reduces the risk, but the reduction in risk with each layer of passive fire protection provided is minimal because the level of risk already approaches zero with the installation of sprinklers. In other words, it’s a question of how much we are willing to spend on additional passive fire protection features trying to further minimize already minimal risk.

Mr. Licht’s paper also includes the statement that “smoke is widely recognized as the primary killer in structural fires. It asphyxiates, limits visibility, reduces the possibility of escape, endangers fire fighters, and hampers their efforts. It is in the highest interest of all concerned that proposed code revisions do not weaken construction requirements that pertain to smoke control and life safety.” The first part of Mr. Licht’s statement is correct, but it does not provide any perspective on the risk of smoke and other combustion products to building occupants. To reiterate, more than 60 percent of the fire deaths that occur in the United States occur in one- and two-family dwellings, and more than 80 percent of fire deaths in the United States occur in residential occupancies. The arguments made by Mr. Licht simply do not address the issue of smoke generated from fires within dwelling units and the fire deaths within dwelling units, which result from these fires.

Mr. Licht’s paper cites an example stating, “the horrific Las Vegas MGM Grand Hotel fire in 1980 is a particularly chilling example of the deadly effects of fumes that spread quickly throughout a building without effective smoke control. Poisonous smoke trapped guests in hallways, rooms and stairwells, killing 84 people. Most of them were overcome and asphyxiated many floors away from the fire.” It seems odd that Mr. Licht would reference the fire at the MGM Grand Hotel as an example of the need for passive fire protection, in addition to sprinkler protection, because the MGM Grand Hotel was a partially sprinklered building – only portions of the first floor of the building were protected by sprinklers. In other words, the “trade-offs” in passive fire protection permitted by the International Building Code and NFPA 5000 would not have been applicable to this building.

The fire at the MGM Grand Hotel originated in an unsprinklered portion of the first floor, and smoke spread to the upper floors of the building. This fire clearly demonstrates a failure of the passive fire protection features incorporated into the design of the building and the need for effective fire control by sprinklers in the event that a major fire occurs on the non-compartmented floors of a hotel. In other words, if the sprinkler system fails, a fire disaster may occur, regardless of the passive fire protection measures included in the building design and, if the sprinkler system works as intended, there is simply no need for the passive fire protection in excess of those required for sprinklered buildings by the International Building Code or NFPA 5000.

Mr. Licht further addresses the issue of toxicity of combustion products by stating, “the toxicity of combustion byproducts in smoke is compounded by the mix of materials used today in the construction and furnishing of modern buildings.

This life safety threat can be further compounded by sprinkler action, which tends to increase the level of smoke and toxins created by burning materials.” Again, the fire statistics published by the NFPA contradict this statement. A comparison between the U.S. fire statistics for 1977 and for 2000 shows that both civilian and fire fighter fire fatalities and both civilian and firefighter fire injuries are down (despite the increase in the population of the United States). From a fire safety standpoint, Americans and our country’s fire fighters have never been safer. Forget about all of the talk about the increased toxicity of smoke and that the operation of sprinklers generates more toxic combustion products – it’s simply meant to scare the American public and play on the emotions of code officials who will vote on code change proposals.

Mr. Licht’s conclusion states, “in summary, reliance exclusively on sprinkler systems as an alternate to fire containment and specific smoke control provisions is a serious error.” The analysis of his above statements demonstrates that this is not really the case. His conclusion also includes the statement, “a commission formed by FEMA [Federal Emergency Management Agency] in 2000 to examine the role of the nation’s fire services in the safety of U.S. communities, concluded, in part, ‘The frequency and severity of fires in America is a result of our nation’s failure to adequately apply and fund known loss reduction strategies...America today has the highest fire loss in terms of both frequency and total losses of any modern technological society.’” Obviously, the FEMA Commission did not review the NFPA fire safety statistics that have been cited in this column. By almost every measure, Americans have never been safer from fire than they are today. If there is a fire problem in the United States, it is most certainly a residential fire problem. The conclusions of the FEMA Commission quoted in Mr. Licht’s paper are simply wrong. This statement, more than likely, was intended to justify increases in funding of government fire safety programs, rather than being a reflection of reality.

Both technical papers written by Mr. Licht can be found at www.afsconline.org/press.htm □

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 several of Mr. Schulte’s 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.*