

Other Voices

A White Paper

Balancing Active and Passive Fire Protection Systems *in the Building Codes*

By Richard Licht

Background

Representatives of BOCA (Building Officials and Code Administrators) International, ICBO (International Conference of Building Officials), and SBCCI (Southern Building Code Congress International) met in 1994, and agreed to cooperate in the development of a single family of comprehensive and coordinated model construction codes. The stated goal was to achieve a consistent and reasonable approach to code compliance and enforcement, and streamline the building regulatory system in the U.S.

This effort has been organized under the International Code Council (ICC), and its scope includes various aspects of construction, including general occupancy, egress, electrical, structural, mechanical, plumbing, and fire safety issues.

This single code family concept has received wide support from the building community, including architects, government agencies, building owners and managers, and the insurance industry. A series of drafting sessions have been held over the past to review code change proposals from various industries and code enforcement professionals. A first edition of the new building, residential and fire codes, known as the family of 2000 International Codes, is now in publication.

Balancing the Fire Protection Features of the International Building Code

The drafting of the International Codes consisted of reviewing and combining provisions of the BOCA, ICBO, and SBCCI model codes. The BOCA National Building Code (NBC) has emerged as the primary model for the ICC International Building Code (IBC). Of the three traditional model-building codes, the NBC features the most trade-offs of fire ratings and other passive fire protection features. The other model codes have placed a greater reliance on a balance of active and passive fire protection.

During the drafting process for the IBC, several thousand proposed changes were received and reviewed by the various ICC code development committees. One of the most hotly debated issues centered on differences of opinion with regard to active and passive fire protection measures. Participants in the code discussion presented various points of view that reflect concerns for life safety, protection of property, design simplicity, construction economy, and inspection and enforcement.

Interpretations of historical information and statistical data continue to be debated as the participants in the ICC process attempt to establish effective and practical fire safety code provisions.

The purpose of this white paper is to define the primary issues at the center of the debate, and to present a balanced conclusion that acknowledges and incorporates the benefits of both active and passive fire protection design. For purposes of this discussion, a balanced fire protection design is defined as one having the optimum combination of life safety and structural protection.

Sprinkler Trade-Offs

Perhaps the most significant element in ongoing ICC fire code discussions is the concept of exchanging established passive fire containment code provisions for active protection such as fire sprinklers. Such code provision exchanges have come to be known as sprinkler trade-offs.

Historically, such trade-offs were proposed as economic incentive for building owners. Reducing an hourly fire rating from three to two hours if a full sprinkler system was present was not considered to be a compromise in fire safety, and the practice encouraged the use of sprinklers, which have been shown to reduce property loss and deaths in fires.

However, as time went on, the practice of trading hourly ratings escalated until such ratings have been significantly reduced or completely eliminated in some locations by use of sprinklers. These permissive trade-offs have been approved based on a broad interpolation of the fire record, and some are concerned that an over-reliance on sprinklers has evolved in the IBC.

For example, one proposal approved in the IBC permits an unsprinklered corridor enclosure or incidental use area normally rated for one-hour — using traditional passive fire protection construction practices — to be converted to a non-rated space with the installation of sprinklers. In such a case, penetrations and joints through walls and floors would no longer be sealed, and doors, duct-openings, windows and walls would not have to withstand the effects of a fire for any rated period.

Another approved sprinkler trade-off proposal is to double or triple the allowable height and area of a fire containment space in certain types of construction by virtue of adding sprinklers.

Some have argued that sprinkler trade-offs simplify construction and reduce costs. This concept has obvious appeal for building owners because of potential labor and material cost savings. Lower fire ratings mean reduced wall board cost, elimination of fire dampers and penetration seals, and less expensive ceiling tiles. However, what seems attractive at first glance could lead to catastrophes in the future.

Passive Fire Protection - What is it Worth?

In approximately half of the United States, the National Fire Incident Reporting System (NFIRS) gathers data about significant fire incidents, particularly when fatalities occur. This information is reported to the National Fire Protection Association (NFPA) and/or the U.S. Fire Administration. After a serious fire, the first questions likely to be asked are, "Were sprinklers present?", "Did the sprinkler system operate satisfactorily?", or "Did they extinguish the fire?"

The NFIRS forms provided by the U.S. Fire Administration contain spaces for answers to these questions.

However, there is no location on any form that asks investigators to answer other important questions, such as: "Did penetration seals, dampers, fire doors, fire-rated walls, floors, ceiling materials or other passive features perform satisfactorily?"

Occasionally, an investigator may provide a narrative that addresses some of these issues, if they are known by that particular investigator to have contributed to (or to have prevented) fire or smoke spread. The NFPA and the U.S. Fire Administration have no means to incorporate such important details in the fire incident database.

Likewise, the NFPA has collected their own information on fire incidents for decades, and this NFPA data is often cited to justify sprinkler trade-offs. However, NFPA discontinued the tracking of unsatisfactory sprinkler performance in their database around 1970. At that time, the NFPA determined that it was more valuable to collect information measuring fire loss. That is, they decided to record property damage and details related to loss of life in fires, but not sprinkler performance. Until about 1970, the NFPA measured sprinkler effectiveness by looking at the percentage of fires in sprinklered properties that showed satisfactory sprinkler performance.

However, the association decided to discontinue monitoring this statistic because information on fewer and fewer small or medium size fires could be captured, and NFPA felt that this created a bias toward cases of poor sprinkler performance. Such cases produced larger fires that were more likely to require fire department intervention or insurance company attention, and were more likely to be reported. Investigators felt that such data would cause some to believe that sprinkler effectiveness was declining. As a result, sprinkler performance is no longer monitored and reported by the NFPA.

While the negative bias argument has merit, the decision to suspend investigation has left a 30-year gap in NFPA's statistical fire record or the history of sprinkler performance. The effects of maintenance (or lack of), human errors, design flaws, the relationship between active and passive protection, aging systems, corrosion and other important factors would have been useful in determining equivalents in justifying sprinkler trade-offs. It may have also inadvertently created a false sense of security due to the conspicuous lack

of information on sprinkler system malfunction.

According to the NFPA, data collected from 1925 through 1969 shows that the major causes for unsatisfactory sprinkler performance have been failure to maintain the system in operational status (closed valves). Human error accounts for more than half the cases of unsatisfactory sprinkler performance. Secondly, systems fail to meet expectations when building owners neglect to assure that the system in place is complete and adequate for the current use of the property.

This accounts for nearly one-fourth of the instances of unsatisfactory performance.

Historically (though the reporting period ending in 1969), inadequate sprinkler system performance accounted for less than six percent of failures. However, recent instances of sprinkler head malfunction and component recalls may cause some to question that low figure.

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Sprinklers — A Partial Answer

The NFPA report quoted numerous conditions, and concluded that during the years of 1988 to 1997, sprinkler systems are highly effective, reducing the chance of death and property loss by 1/2 to 2/3 compared to structures with no sprinklers. However, it is important to note that the average age of a building in the U.S. is approximately 30 years old.

It may be assumed that many of the buildings that were included in NFPA data were built during times when passive systems were also present. The presence of sprinklers, combined with compartmentalization, contributed to a very impressive record. It is of concern, then, that many of the critical passive features that contributed to that record are now being traded off in the ICC.

Clearly, a well-maintained, properly installed suppression system is a key element in fire safety and property protection. However, when sprinklers do not deliver the desired result, the NFPA report explains, it is due to partial coverage, antiquated installations, and to systems that are poorly maintained or have been inadvertently disabled. In cases of explosion or flash fires, a sprinkler system might be overpowered, and fires occurring close to people or sensitive property may do significant damage despite the activation of a sprinkler system.

Underwriter's Laboratories Inc. (UL) has investigated and listed automatic sprinklers since the early 1900s. The UL 199 Standard (Automatic Sprinklers for Fire-Protection Service) and UL 1626 (Standard for Residential Sprinklers for Fire-Protection Service) pertain to testing of commercial and residential automatic sprinklers for fire protection service. Automatic sprinkler manufacturers must meet applicable test requirements in the Standards in order to apply the UL mark to their products.

On October 14, 1998, the U.S. Consumer Product Safety Commission (CPSC) and a major sprinkler system supplier announced a nationwide recall of approximately 8.4 million units manufactured since 1982 because the CPSC alleged that

such sprinklers are defective and could likely fail in a fire.

Installations with these heads may fail to function, or may function inadequately in the event of a fire. The units in question are constructed with o-ring water seals that can be affected by crystallized deposits or corrosion. In the case of one series, 20 percent of tested units failed to operate at the UL minimum pressure of 5 psi or the NFPA pressure of 7 psi.

This major recall of sprinkler components, combined with the voluntary recall of others, serves to dramatize the vulnerability of sprinkling systems to malfunction or human error, and the fallacy of depending on this particular approach to fire protection to the exclusion of a more balanced program of active and passive components.

The NFPA report stresses the importance of a balanced approach to fire protection, summarizing "...Even a well-maintained, complete, appropriate sprinkler system is not a magic wand. It requires the support of a well-considered integrated design for all the other elements of the building's fire protection."

Finally, the NFPA study concludes, "Unsatisfactory fire protection performance can occur if the building's design does not address all five elements of an integrated system — slowing the growth of fire, automatic detection, automatic suppression, confining the fire, and occupant evacuation."

Summary

Firefighters and building inspectors have long recognized the importance of using fire resistance rated walls, floors, and penetration and joint seals and other passive features to

"compartmentalize" a structure into discrete and isolated units, and to confine a fire and its smoke and toxic byproducts to the point of origin. The industry continues to advance the technology with developments such as positive pressure fire doors and new, high-performance construction joint seals. The presence of an effective sprinkling system does not obviate the need for the containment of smoke.

The existing model codes have rightfully incorporated passive fire protection provisions, to the clear benefit of both life safety and structural preservation. The attempt to retreat from balanced fire protection by incorporating overly permissive sprinkler trade-offs in the new International Building Code is an invitation to future disaster. If new structures are built with a compromised approach to containment and passive fire control, it will cost far more (possibly in lives as well as property loss) to bring them up to standard later than to build according to justified and uncompromised standards at the onset.

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