FIRE PROTECTION
# Engineering

3RD QUARTER 2010

Issue No. 47

## Building in BUSHFIRE-PRONE AREAS after Black Saturday

Wildfire: Past, Present and Future

Building Code Seismic Requirements for Sprinkler Systems

Professional Liability Insurance

SFPE

THE OFFICIAL MAGAZINE OF THE SOCIETY OF FIRE PROTECTION ENGINEERS

*Main Conference Center auditorium, The Church of Jesus Christ of Latter-day Saints, Salt Lake City, UT*



***Melissa Meade***
*RJA/Chicago*

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FIRE PROTECTION **Engineering**


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*By Simon Carroll, Australian Bushfire Assessment Consultants*

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FIRE PROTECTION Engineering

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From the TECHNICAL DIRECTOR

# A Huge Step Forward in Fire Protection Engineering Education

On May 25, 2010, California Polytechnic State University in San Luis Obispo, California, announced that they had launched a new fire protection engineering program that will begin offering courses in September, 2010. The creation of the fire protection engineering program at Cal Poly represents the culmination of a decades-long desire to have a fire protection engineering degree program in the western United States. Cal Poly will offer a graduate-level education program that leads to a Master of Science degree in fire protection engineering. The university plans to offer both on-campus and distance learning options.

Prior to the creation of the fire protection engineering program at Cal Poly, the only fire protection engineering degree programs in the United States were located at Worcester Polytechnic Institute in Massachusetts and the University of Maryland. There was a fire protection engineering degree program at the Illinois Institute of Technology until it was discontinued in 1985.

For many years, the demand for fire protection engineers has greatly exceeded the number of qualified engineers available – particularly outside of the eastern United States – so there has been a strong desire for new academic programs in the United States. However, translating this demand into a formal academic program is exceptionally difficult.

First, universities are businesses, and academic administrators are hesitant to commit resources to an academic program in a discipline with which they are unfamiliar. Most university administrators are familiar with the "big four" engineering disciplines, but few are familiar with fire protection engineering. While all fire protection engineers and employers of fire protection engineers see the value of additional degree programs, most university administrators do not. In addition to concerns with supply and demand for students, universities will look for research and outside funding opportunities. Secondly, for a program to be accredited, it must have sufficient faculty to teach the associated courses. There are very few people available to serve as fire protection engineering faculty at an institution of higher learning, and hardly any of them are available to relocate to an institution in the western United States.

A number of factors contributed to the success at Cal Poly. There was interest at the state level, particularly in the State Fire Marshal's office, given the concern for wildland-urban interface fires in the state. The program attracted the support of the university's dean of continuing education and a senior faculty member in the department of mechanical engineering. And, importantly, a seasoned fire protection engineering faculty member was available to direct the program.

However, the work at Cal Poly is not finished; on the contrary, the work has just begun. The program has been introduced as a pilot program and has five years to become established as a regular program. This means that they need the help of the fire protection engineering profession to recruit students to fill their classrooms and on-line courses. Hopefully, this will not be difficult given the pent-up demand for educational opportunities in the western United States.

More information on the program can be found at *www.fpe.calpoly.edu*.

**Morgan J. Hurley, P.E., FSFPE**
**Technical Director**
**Society of Fire Protection Engineers**

*Fire Protection Engineering* welcomes letters to the editor. Please send correspondence to *engineering@sfpe.org* or by mail to *Fire Protection Engineering*, 7315 Wisconsin Ave., #620E, Bethesda, MD 20814.

## Correction

1. On page 46 of the article titled "Green Construction and Fire Protection," the article mistakenly stated that NFPA 25 requires a weekly test of at least 10 minutes for diesel-driven fire pumps. NFPA 25 requires a weekly test of at least 30 minutes for diesel-driven fire pumps.

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ELECTRICAL FIRES:

RESEARCH NEEDED TO IMPROVE SAFETY

By Dr. Vytenis Babrauskas, FSFPE

The NFPA's National Electrical Code (NEC[1]) may be the most technically detailed code—on any topic—that exists in U.S. practice. It has served well for the 110 years of its existence, especially in the area of electric shock hazard. While electrocutions still do occur, they usually require "a chain of human errors," something that a code generally cannot eliminate.

The other role for NEC is in fire safety. Here, the safety record has certainly improved over the decades, but there remains room for further improvement. A few years ago, this author had the opportunity to comprehensively examine the state of the art of the knowledge underlying electrical fires. This first-ever systematic review was published in 2003 as part of the *Ignition Handbook*.[2] The review indicated that while some topics had received considerable study, many other aspects of electrical fires are still not well enough understood. It is the purpose of this article to consider some of the salient gaps. In addition, some existing, but not well-publicized, research has already identified some safety concerns that should be addressed by appropriate actions.

STATISTICS

The system of obtaining fire statistics in the United States, based on NFPA 901[3] and the U.S. Fire Administration's NFIRS,[4] generally works well for identifying the broad problem areas. But it is very limited in the quality and accuracy of information that it can produce when it comes to fires caused by electrical or mechanical equipment.

To see why, it is necessary to consider how these statistics are obtained. NFIRS data are supplied by individual fire departments. Once the fire is extinguished, the fire department fills out a form describing the details of the event, and most fire departments use the coding system contained in NFPA 901 and NFIRS.

It is important to understand *who* fills out the form. The delegated individual can either be a fire company officer or the department's fire investigator. Except for the largest cities, it will be rare indeed that this individual would have any detailed knowledge of electricity or electrical fires. The national statistics[2] (Table 1) reported that around 33% of electrical distribution fires are attributed to "fixed wiring."[7] This is by far the largest single cause of electrical fires, with the next-largest category, "light fixture, lampholder or sign" accounting for only about 16%.

These statistics are almost certainly biased and incorrect. Fixed wiring, while it has various potential failure modes, is generally robust, in comparison to connections in various devices (e.g., outlets) or cords used by occupants.

It is easy to see why such statistics would be reported. If the individuals delegated with the task of providing the NFIRS information do not have good knowledge of both electricity and the modes of faults and failures, one can hardly expect them to provide detailed, reliable information on the topic.

This a not a criticism of fire departments in this regard. In most jurisdictions, the main investigation task for the fire department is to determine if arson has been committed. If it was not, their responsibility typically ends. Since it is exceptionally rare for arson to be committed by tampering with electrical systems, fire department investigatory expertise should not be expected in electrical matters.

Progress could be made on this issue, without requiring a major change in fire department training or investigation procedures. In actuality, fire investigation in the United States is typically a three-tier system. The initial investigation is conducted by the local fire department. In all except trivial losses, the next investigation is normally performed by a private fire investigator sent out by the insurance company that has insured the property. This investigator typically has more extensive training and better resources for conducting the investigation.

In addition, it is not uncommon for a private investigator to devote several days to investigating a fire that the fire department investigated in a few hours. If the loss

Table 1. Average annual losses in the United States for structure fires involving electrical distribution equipment, arranged by type of equipment involved in ignition[2]

| Equipment | Fires |
|---|---|
| Fixed wiring | 19,100 (32.7%) |
| Light fixture, lampholder or sign | 9,600 (16.4%) |
| Cord or plug | 8,600 (14.7%) |
| Switch, receptacle or outlet | 5,700 (9.8%) |
| Lamp or light bulb | 4,600 (7.8%) |
| Fuse, circuit breaker or other overcurrent protection device | 3,400 (5.8%) |
| Meter or meter box | 1,200 (2.1%) |
| Transformer | 1,200 (2.1%) |
| Unclassified electrical distribution equipment | 2,200 (3.8%) |
| Unknown-type electrical distribution equipment | 2,800 (4.7%) |
| **Total** | **58,300** |

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**Dear Editor,**

The article by Dr. Vyto Babrauskas in your second quarter 2010 issue was welcome as a wider exposure of his work of the last decade or so toward a better understanding of electrical fire ignitions. Unfortunately, the article also included some ill-informed sideswipes at other sources of understanding, including pattern analysis of national fire incident data.

There are different ways of gaining insight into a particular fire problem. One approach is to assemble a large database of relevant fires with heavy emphasis on representativeness and less emphasis on the expertise of those describing the fires. Those of us who do statistics for a living know that in large, representative databases, errors in individual cases normally cancel out, which means the statistics can be better and more accurate than the individual case descriptions. Another approach is to assemble a database of relevant fires that have been documented by people who are expert in all or most of the relevant aspects of science and engineering. That approach is subject to severe biases due to lack of representativeness. Additional biases are introduced if you develop statistics not from the few fires these experts have documented but from their impressions of what they think they have seen.

One does not have to dismiss Vyto's concerns about biases and errors from sources other than those he prefers in order to believe that there are multiple sources of useful information, each with different strengths and weaknesses, and we are better served by using each one to complement and challenge the others.

For example, Vyto dismisses the lead position of fixed wiring in certain tables of leading types of electrical distribution and lighting equipment involved in fire ignition because he considers such equipment to be less vulnerable to failure or harm than other types. I would say that we know from those maligned fire officer reports that the physical properties of equipment are rarely the dominant explanation for their performance in fires. That's why fuses, which are more inherently reliable than circuit breakers but also much easier to tamper with and defeat, are so often involved in actual fires.

For those readers who may still be more attracted to the approach of asking experts for their impressions, it is worth noting that a lot of people who might consider themselves experts would not necessarily qualify. The article excluded ordinary firefighters or fire officers as experts but also excluded ordinary fire investigators. A couple years ago, when I was discussing an earlier presentation on the same issues, Vyto indicated that he also would not treat as experts electrical engineers, electricians or laboratory researchers on electrical products – anyone who was not a forensic electrical ignition expert.

I'm interested in what these few experts have to say, of course, but I can't see throwing away every other source of information and ignoring the potentially severe biases in a database based on the impressions of a handful of the world's best experts. It's certainly easier to simply dismiss inconvenient data and arguments out of hand, but I don't think your readers would consider that good practice. We can do better.

John R. Hall, Jr., Ph.D.
Division Director – Fire Analysis & Research
National Fire Protection Association


colors
Counting
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FIRE

**Author's Response**

Statistics can be valuable in the fire safety field, since they can indicate priorities where research, regulatory or enforcement may be most needed. But to be valuable, statistics must be reliable. For technical data statistics to be reliable, the original data must be obtained by personnel who are qualified in the specific specialty involved. For most of the national fire data statistics (NFIRS data) this is not a problem. Fire department personnel surely are qualified to answer such questions as the number of casualties, the height and area of the structure, the presence or absence of smoke detectors, etc. But this does not extend to determining the fault which led to an electrical fire. Establishing the details of an electrical fire is not a simple matter. To do this competently requires that an engineer or scientist specialized in this type of work do the task. Even then, in most cases, this individual has to collect evidence and analyze it in the laboratory, before a definitive statement can be made.

Establishing the details of an electrical fire is not a simple matter. To do this competently requires that an engineer or scientist specialized in this type of work do the task. Even then, in most cases, this individual has to collect evidence and analyze it in the laboratory, before a definitive statement can be made.

To my knowledge, there is not a single municipal fire department in the United States that has an engineer or scientist on staff for the purpose of doing this type of investigation. This is not a criticism of fire departments—the main fire investigation task for fire departments is to determine if the fire was incendiary. There are extremely few fires that are caused by arsonists tampering with electrical distribution systems in buildings. Consequently, fire departments do not need to maintain personnel specialized in this area. But I do believe that it is unrealistic to expect that fire department investigators could make a reliable assessment in the field concerning the causation of an electrical fire, when it may take an engineer a week's worth of study in the laboratory to make such a determination to a sufficiently reliable extent that he/she will be willing to sign his/her name to the report.

With due respect to Dr. John Hall's expertise in statistics, I also do not believe that statistical techniques can make good data out of bad. The best that statistical techniques can do is to purge a small fraction of bad data from a data set where the bulk of the data is reliable. But such is not the case with regards to determining electrical fire causation details on the basis of fire department reports, where the personnel characterizing electrical fires do not have in-depth expertise on the subject. Here, instead, none of such data can be assumed to be reliable.

I also want to reaffirm my statement, which John seems to doubt, that having an EE degree is not sufficient for the individual to be an expert on electrical fire causation. The electrical engineering profession is predominantly a design profession, and the vast majority of electrical engineers work as designers. The analysis of failure is very different and requires a narrow, relatively less common specialization. This can perhaps be more easily seen in the case of architecture. Architects are primarily experts in the design of buildings. But if a building falls down and the mechanism needs to be determined, it would be inappropriate to simply find a good local architect to do the job. Instead, there is a much smaller community of building failure experts, and such individuals have to be retained in order to do the job properly. Finally, I would note that the right person to determine the nature of an electrical failure may not necessarily need to be an EE, but does need to be an expert in this type of work. I know of metallurgists, materials scientists, physicists and mechanical engineers who are experts in this specialty, but all of these individuals devote a substantial part of their practice, if perhaps not the entirety, to such work.

Vyto Babrauskas, Ph.D.

**By Dan Gemeny, P.E., FSFPE**

On Saturday, Nov. 15, 2008, at approximately 9:00 AM, a fire started along the 91 Freeway from a spark emitted from the catalytic converter of a passing car. In less than two hours, it travelled almost two miles (3 km) before entering my Yorba Linda, Calif., neighborhood. By the time the fire was brought under control three days later, it had consumed 30,305 acres and destroyed 314 homes and apartments.

## My Story

That morning, I was five hours from home, duck hunting with my next-door neighbor. I received a call from my wife at 10:15 AM and his wife called him three minutes later. A fire was fast approaching our neighborhood, and they had just been ordered to leave immediately. "What should I take? What car? I'll load the dogs and grab what I can," was all that my wife could muster in the urgency of the moment. She loaded a computer, some pictures and a case of the "good wine." However, she never thought about jewelry, art or even our wedding album.

My neighbor was on his phone doing his best to instruct his wife about packing a few things and getting on the road with their three-year-old daughter. Both of our wives left together but got separated on the way out of our neighborhood in the dense smoke and traffic. My neighbor's wife ultimately was directed the wrong way onto the 12-lane 91 Freeway just in time to have the brushfire jump directly over her vehicle and into homes and apartments on the other side.

During the next 45 minutes, we watched a live feed showing the first houses in our neighborhood beginning to burn and the fire spreading quickly from east to west with the 50+ mph (80+ kph) Santa Ana winds in 90°F (32°C) and 8% humidity conditions that consumed dry brush, landscape, outdoor decks and homes in its path. Ultimately, our families reached safe locations and waited as the fire burned uncontrolled over the next three days.

We were finally allowed to return to our homes on Sunday evening. None of us had any idea if our homes had been lost in the fire. We were fortunate to find that only our backyards had burned and ash and smoke had collected inside. Across the street, our neighbor's home was nothing more than a smoldering pile of rubble.

Our home was on the leeward side of the ridge, and we saw evidence of the firefighters having taken a stand. There was no such opportunity across the street where the house stood at the top of the canyon, facing into the wind with no shelter from the flame front. Twenty-five homes were lost in our immediate neighborhood, almost all on the windward side of the ridge. Also, it appeared that the fire accessed many of the homes through roof vents.

## Pam's Story

I recently spoke to another neighbor who lost her home during the fire. Her home was located on the very east side of the neighborhood and was the first one to become fully involved in fire.

Her story sounded familiar. After observing the early stage of the fire and how it moved quickly from ridge to ridge "directly at their home," her husband began using a water hose to wet the landscape and structure along the east-facing side of their property. She began to pack. The next 30 minutes were filled with adrenalin-fed activities that led to collecting, packing and loading random valuables—some pictures, the best jewelry, her son's computer, a pair of jeans, two dogs and three suitcases, of which two turned out to be empty. Many people gathered in her yard to watch the advancing fire, yet she never thought to ask for help in evacuating.

She and her husband eventually evacuated to a local restaurant less than 90 minutes after they became aware of the fire. From there, they watched their house burn.

## Observations

The speed of fire spread under these conditions can easily be underestimated, but personal pre-planning for such an event can determine the outcome.

The structures in our neighborhood were built during the last 15 years with exterior stucco walls, clay tile roofs and double-paned windows. However, the vulnerability of the under-protected attic vent openings was part of the lessons learned from the fire.

It is possible for an individual and family to manage the personal risk of losing their home and belongings in a wildfire. In any location, the likelihood of extension of the fire into a home can be reduced by investing in construction features and systems that reduce the home's vulnerability. An investment in more aggressive fuel management also can reduce the likelihood of fire spread to a home. Guidance for these strategies can be found in references such as the Wildland-Urban Interface Code[1] and NFPA 1144[2].

Finally, it is impossible to eliminate all risk from a wildland fire exposure. For this reason, the financial and emotional recovery from an event largely depends on the decisions one makes.

In all, these are not new ideas. However, after living through this experience with my family and neighbors, I realize that the fire hazard of choosing to live in an urban-wildland environment is real and managing the risk is ultimately an individual responsibility.

A full report on this fire can be found at *www.ocfamedia.org*. For photos go to *www.fpemag.com* and select Viewpoint from the list of departments.

*Dan Gemeny is with Rolf Jensen & Associates.*

References:

1 International Wildland-Urban Interface Code, International Code Council, Washington, DC, 2009.

2 NFPA 1144, Standard for Reducing Structure Ignition Hazards from Wildland Fire, National Fire Protection Association, Quincy, MA, 2008.

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## FM Global Modifies Fire Protection Standards

FM Global has rolled out important modifications to its fire protection standards with the introduction of a new Property Loss Prevention Data Sheet 2-0, Installation Guidelines for Automatic Sprinklers and a revised version of its Data Sheet 8-9, Storage of Class 1, 2, 3, 4 and Plastic Commodities. These changes come as a result of FM Global's extensive research and testing of the latest sprinkler technology and are intended to help simplify fire protection choice, maximize protection while minimizing installation costs, and support overall sustainable business practices.

"Our latest research shows that specific design characteristics determine the effectiveness of a sprinkler—not ceiling density—and that these factors can be used to ensure that FM Global's fire protection standards offer the most potent protection schemes," says Brion Callori, senior vice president, Engineering and Research.

Callori adds that the evolution of FM Global's fire protection standards involves moving away from sprinkler density as a design criterion and toward key performance attributes associated with sprinkler design and installation characteristics, such as K-factor (ability to flow water), orientation, response time and temperature rating.

"Following these new guidelines will result in less fire, smoke and water damage should a fire occur," says Shivan S. Subramaniam, FM Global's chairman and CEO. "In addition, because these new standards require fewer sprinklers, less piping and lower water pressure to operate, we believe clients will realize reduced costs for more effective protection options, making automatic sprinklers not only simpler and cheaper, but also a more sustainable choice for loss prevention."

**For more information, go to *www.fmglobaldatasheets.com.***

## Code Changes to Reflect NIST WTC Findings

Faster and more efficient emergency evacuations from buildings—especially tall structures—and better communications between first responders during an emergency are among the safety improvements expected from 17 major and far-reaching building and fire code changes approved recently by the International Code Council (ICC) based on recommendations from the National Institute of Standards and Technology (NIST). The recommendations were based on NIST's investigation of the collapses of New York City's World Trade Center (WTC) towers and WTC 7 on Sept. 11, 2001.

The new changes, adopted at the ICC hearings held May 15-23, 2010, in Dallas, will be incorporated into the 2012 edition of the ICC's I-Codes (specifically the International Building Code, or IBC, and the International Fire Code, or IFC).

The 17 new code changes include safety improvements to existing requirements for elevators in tall buildings used during an emergency by occupants evacuating and firefighters entering, and provisions to ensure that emergency radio communications will effectively serve first responders throughout their local communities.

**For more information, go to *www.nist.gov.***

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# BUILDING IN BUSHFIRE-PRONE AREAS AFTER BLACK SATURDAY

**By Simon Carroll**


Australia is a land of contrasts, and the occurrence of natural disasters such as bushfires and floods at the same time in different parts of the country emphasize that this is a nation that is at the mercy of its environment. It is somewhat ironic that, in the last days of 2009, while floodwaters inundated vast areas of land in New South Wales on the east coast, severe bushfires destroyed approximately 40 homes in Western Australia.

It was during the early part of 2009 that the impact of perhaps the most significant natural disaster in Australia's history affected the way that Australians live within their environment. On Feb. 7, 2009, 173 people perished in Victoria as a result of bushfires – the "Black Saturday" bushfires – that swept across the State.[1]

## ROYAL COMMISSION

It is a tragic fact that a disaster such as the Black Saturday bushfires becomes the catalyst for change. In the case of the State of Victoria, the circumstances surrounding the bushfires are the subject of examination by the 2009 Victorian Bushfires Royal Commission.

The Royal Commission (the Commission) is an administrative inquiry established by the Victorian Government on Feb. 16, 2009, to independently and publicly examine and provide recommendations for the involvement of the government or its agencies in an event such as the Black Saturday bushfires.[1]

Fifty-one recommendations were made by the Commission in its first interim report, which was published in August 2009. Those recommendations dealt mainly with actions to be implemented prior to the commencement of the 2009-10 bushfire season and included:[1]

- The manner in which bushfire warnings are issued and the development of a new fire severity scale to identify the risk posed by bushfires;
- The provision of information during bushfire events and arrangements for multi-agency sharing and use of bushfire information;
- Arrangements to facilitate the ability for households or communities to relocate during bushfires, including amendments to operational policies of fire authorities to assess and recommend early relocation when warranted;
- The provision of advice by fire authorities – via a "stay or go" policy – that not all homes are defendable in all circumstances and that the safest option is to leave early rather than to stay or defend;
- The progressive identification, establishment and advertisement of designated community refuges, with priority given to areas where bushfire risk is identified as high;
- In order to avoid confusion in relation to incident management, the development of procedures by agreement between the fire authorities to ensure that the most experienced, qualified and competent person is appointed as Incident Controller for each fire;
- The requirement for the State to settle the higher level emergency management and coordination arrangements that are to apply during the bushfire season;
- The encouragement of coordination between the Commonwealth and States/Territories to ensure the rapid and effective use of Commonwealth resources during bushfire events, including the potential for resources to be used to detect, track and suppress bushfires.

## A NEW STANDARD FOR CONSTRUCTION OF BUILDINGS IN BUSHFIRE-PRONE AREAS

One important regulatory change that pre-empted the interim recommendations of the Royal Commission concerned the construction of buildings in bushfire-prone areas.

Australian Standard 3959, "Construction of Buildings in Bushfire-prone Areas,"[2] was published in 2009, approximately one month following the devastating Black Saturday bushfires. The new standard was adopted by the Victorian Government, via amendments to the Building Regulations 2006,[3] on March 11, 2009.

The March 2009 amendments to the regulations related to residential buildings (or residential parts of buildings) including single dwellings, duplexes, boarding houses, guest houses, hostels (or the like), residential flat buildings and residential parts of buildings such as hotels, motels, schools, healthcare buildings and detention centers. The amendments also relate to non-habitable buildings associated with residential buildings, for example, private garages and sheds.[4]

Table 1. Bushfire attack levels

| Bushfire Attack Level (BAL) | Heat flux exposure thresholds | Description of predicted bushfire attack and levels of exposure |
|---|---|---|
| BAL — LOW | N/A – distance to vegetation greater than 100m from the site/building | There is insufficient risk to warrant specific construction requirements |
| BAL — 12.5 | $\leq$12.5 kW/m$^2$ | Ember attack |
| BAL — 19 | >12.5 kW/m$^2$<br>$\leq$19 kW/m$^2$ | Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux |
| BAL — 29 | >19 kW/m$^2$<br>$\leq$29 kW/m$^2$ | Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux |
| BAL — 40 | >29 kW/m$^2$<br>$\leq$40 kW/m$^2$ | Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux with the increased likelihood of exposure to flames |
| BAL — FZ | >40 kW/m$^2$ | Direct exposure to flames from fire front in addition to heat flux and ember attack |

From a legislative point of view, the buildings covered by the amendments to the Building Regulations are those identified as Class 1, 2, 3 and 10a buildings for the purposes of the Building Code of Australia (BCA).

The BCA details provisions for the design and construction of buildings and other structures in Australia. Australian Standard 3959-2009 is referenced in the 2010 edition of the BCA, which came into force as of May 1, 2010.[4]

AS3959 contains cautionary notes to advise that compliance with the requirements of the standard do not guarantee survival of a building. In Section 1[1] (Scope), the following is noted:[2]

> *Although this Standard is designed to improve the performance of buildings when subjected to bushfire attack in designated bushfire-prone areas, there can be no guarantee that a building will survive a bushfire event on every occasion. This is substantially due to the unpredictable nature and behaviour of fire and extreme weather conditions.*

The objective of AS3959 is to prescribe particular construction details for buildings to reduce the risk of ignition from a bushfire while the fire front passes.

AS3959 identifies a "bushfire-prone area" as "an area that is subject to, or likely to be subject to, bushfire attack."

Importantly, AS3959 only applies if the site and building are located in a designated bushfire-prone area as defined by the BCA. The BCA defines "designated bushfire-prone area" as:[4]

> *land which has been designated under a power of legislation as being subject, or likely to be subject, to bushfires.*

What is, or is not, land within a "designated" bushfire-prone area varies between virtually every state and territory within Australia. In Victoria, the March 2009 amendments to the Building Regulations apply to the effect that a reference in the standard to a bushfire-prone area or a designated bushfire-prone area is a reference to the whole of Victoria. AS3959, therefore, applies to the entire State of Victoria and a site-specific assessment should be undertaken.

The process of determining construction requirements for the purposes of AS3959 requires an initial determination to be made as to the Bushfire Attack Level (BAL) for the particular building. This determination is made via an assessment of the site (of the building) and the vegetation impacting the site.

There are six BALs identified by AS3959, based upon heat flux exposure thresholds. An abridged version of Table 3[1] from AS3959 is reproduced in Table 1,[2] which describes

the predicted bushfire attack and levels of exposure for each BAL.

While not discussed in more detail here, AS3959 provides two methods for the determination of the BAL: a simplified procedure or a detailed procedure.

One of the key features of AS3959 is that the standard seeks to prescribe a deemed-to-satisfy solution for any building built within 100 meters of vegetation that is identified as a bushfire hazard. This has also been one of the main criticisms of the new standard.

The adoption of AS3959 was opposed by two significant stakeholders on the FP-020 committee, Australasian Fire and Emergency Service Authorities Council (AFAC) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The main reason for the opposition of AFAC, in particular, was that organisation's belief that there are serious flaws in the new standard. The clear message from the opposition to the adoption of the standard is that construction standards in bushfire-prone areas need to be much tougher.[5]

The reasons for AFAC's opposition included:[6]

- *Provisions for construction in the flame zone (highest level of risk)* – any home/building that is being constructed in these areas (flame zone) needs an individual assessment and needs to be individually designed to the specific fire risks the property faces.
- *Gaps* – the new standard specifies gaps to be up to 3 mm (or of an unspecified size if sarking is used behind the gap), allowing for a much greater likelihood of ember ignition of roof cavity, wall cavity and the occupied spaces within the house. Sarking (or, more specifically, sarking-type material) is defined by the BCA as "a material such as a reflective insulation or other flexible membrane of a type normally used for a purpose such as water proofing, vapor proofing or thermal reflectance".[4]
- *Test methods* – there are reservations about test methods identified by the standard for determining the performance of components under bushfire conditions.
- *Subfloor requirements for BAL 12.5 and BAL 19* – the new standard has no requirements for subfloors or to prevent the spread of fire from adjacent decks into the subfloor of the building.
- *Grasslands* – the new standard provides no requirements for this fuel type.
- *Issues relating to doors, windows, shutters and wall barriers.*
- *Egress* – no consideration of requirements for the egress path or destination.
- *No provisions for ongoing maintenance* – to ensure compliance to the standard for the life of the building.

The issues relating to construction in the flame zone, gaps (aperture size of window mesh and perforated sheeting), test methods, subfloors, grasslands, doors, sarking-type material and glazed elements are identified in the Preface to AS3959 as being issues that are likely to be reconsidered by the FP-020

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## PRIORITIES FOR BUILDING IN BUSHFIRE-PRONE AREAS

The second interim report of the 2009 Victorian Bushfires Royal Commission – *Priorities for Building in Bushfire-Prone Areas* – was published in November 2009.

The commission's second interim report contained seven additional recommendations, with specific reference to the commission's terms of reference, which require it to "consider and make recommendations on the fireproofing of houses and other buildings, including the materials used in construction".[7]

In relation to AS3959, the commission heard evidence in relation to several issues relating to the standard, including: [7]

- The apparent weakening of the intent of the standards via a combination of no requirements for subfloor materials and the allowance of grassland fuels right up to the structures;
- Key concerns regarding the use of sarking-type material behind wall cladding, effectively as a secondary ember-protection measure, in the absence of any definitive testing of such material to determine its performance as an ember barrier;
- Concerns that AS3959 provides for a lesser level of ember-protection measures for BAL 12.5 and BAL 19 in the areas of subfloors and material prescriptions for doors, windows and wall barriers (than the 1999 version of the standard).

The recommendations made by the commission in its second interim report[7] included amendments to AS3959 to:

> The rebuilding process is a key part of the recovery of individuals, families and communities affected by any natural disaster, especially one of the scale and intensity of the Black Saturday bushfires.

- address the inclusion of unmanaged grassland in the vegetation types and classifications, and use of sarking as a secondary ember-protection measure; and
- increase ember-protection measures at lower Bushfire Attack Levels, in particular in relation to subfloor requirements and materials prescribed for doors, windows and wall barriers.

## REBUILDING

In the meantime, recovery and rebuilding efforts are well under way.

The first interim report of the Royal Commission noted that in excess of 2,200 homes were lost during the Black Saturday bushfires on February 7, 2009.[1]

The rebuilding process is a key part of the recovery of individuals, families and communities affected by any natural disaster, especially one of the scale and intensity of the Black Saturday bushfires.

It is apparent that the publication of AS3959, and its subsequent adoption in Victoria via amendments to the Victorian Building Regulations, was intended to clear the way for the rebuilding process to commence as soon as possible after the devastation of Black Saturday.[8]

The process has not been without its problems, however.

The issues identified by stakeholders in relation to the standard, particularly those in relation to provisions for construction in the flame zone (that is, those buildings assessed as being subject to BAL-FZ) have translated to delays for rebuilding.

A significant criticism of authorities has been that rebuilding efforts are being hampered by bureaucratic delays and an obsession with process.[9] The criticisms have seized upon the perception that there does not appear to be any defined policy from regulators as to how to deal with issues with building in the flame zone. As a result, rebuilding has been slow due to the continued disagreement of how to deal with houses identified as being subject to BAL-FZ under AS3959.

The challenges facing those wishing to rebuild have been acknowledged by the Victorian Bushfire Reconstruction and Recovery Authority (VBRRA). A key contributing factor to delays in plans for rebuilding has been identified as a lag in terms of the availability of building materials that are approved as being suitable for use in BAL-FZ situations.[5]

The issues relating to the unavailability of building materials have been most prevalent in terms of requirements to install bushfire (proof) shutters or fire-rated window systems[10] in BAL-FZ situations.

The VBRRA identified the availability of an increased range of


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BAL-FZ-compliant materials as helping to reduce delays in rebuilding efforts.[5]

Cost is another significant issue for those people seeking to rebuild their homes. Anecdotal evidence suggests that the costs associated with achieving the construction requirements for buildings proposed to be rebuilt in the most extreme bushfire areas could amount to an additional $22,000 (AUD) for fire safety measures on top of the usual construction costs.[8]

While the State Government has indicated that the Victorian Bushfire Appeal Fund was likely to make some funds available to help compensate for rebuilding costs, there has been no decision to commit the fund to meeting all of the extra expenses for the bushfire victims relating to the achievement of the additional construction requirements of AS3959-2009.[8]

The Royal Commission plans to deliver its final report by July 31, 2010, on its investigations of the causes and responses to the bushfires that swept through parts of Victoria in late January and February 2009.

The recommendations made in the commission's final report will be intended to minimize the likelihood of a recurrence of the tragedy of February 7, 2009.[1]

A review of AS3959 following the release of the commission's final report will have the benefit of the commission's findings and recommendations to assist in shaping future editions of the standard.

*Simon Carroll is with Australian Bushfire Assessment Consultants.*

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# WILDFIRE: past, present and future

By Ronny J. Coleman and Kate Dargan

## THE PAST

Fire, as a force of nature, has been in existence since the dawn of time. From the Big Bang to the Big Burn,[1] fire has helped make the world what it is today. Once the human race was able to use the process of combustion to create creature comforts and control the environment, life improved for most people.

It also was quickly understood that fire is an unforgiving force. Building a better life and a better world includes treating fire with respect and, for the most part, the world has become a better place because the human race has mastered the use of fire.

But not always. Accidental or uncontrollable fire has been traumatic to both life and property and birthed the fire profession industry. As a profession, the practice of mastering fire has various aspects ranging from fire prevention through fire engineering to fire suppression. To keep this article within a specific scope, the focus is on only one type of fire: wildfire and its impact on an urbanized society.

In the past, forests had forest fires and cities had structural fires. Seldom did the two environments collide. The U.S. fire legacy contains numerous stories of urban conflagrations. Very few of these incidents were caused by wildland fires entering cities prior to the turn of the 20th century. For example, Boston, Philadelphia, Baltimore and Chicago all suffered urban conflagrations from the late 1700s to the 1800s. Yet, there is little mention of wildland fires during those eras. The two fire problems were isolated from one another.

The convergence began when two famous fires occurred at the same time in October 1871. One was called the "Great Chicago Fire" and the second was called the "Peshtigo Fire."[2] Both resulted in major loss of life and property. However, one created a watershed of concern over the need for fire prevention in cities while the second went mostly unobserved by the media.

There have always been wildfires on the landscape. Many devastating ones have occurred since European colonization. However, they were considered part of nature, not a threat to cities and towns. A firestorm in 1910 changed all of that – the "Big Burn" of 1910 killed 86 individuals and destroyed town after town. The difference between that firestorm and previous ones was that it occurred in the midst of the nation struggling over what policies were best to protect its natural assets. The battle over policy was shaped by the opinions of President Theodore Roosevelt and his hand-picked forestry advisor Gifford Pinchot. Well before the fires actually occurred, President Roosevelt made a speech that clearly stated his attitude:

> *"And now, first and foremost, you can never afford to forget for one moment what the objective of our forest policy is. The object is not to preserve the forests because they are beautiful, though that is good in itself, nor because they are refuges of the wild creatures of the wilderness, though that, too is good in itself, but the one primary object of our forest policy, as of the land policy of the United States, is the making of prosperous homes, …every other consideration comes as secondary. …Your attention must be directed to the preservation of the forests, not as an end in itself, but as a means of preserving and increasing the prosperity of the nation".*[3]

Behind this contention was the idea that forests were being devastated by lumbering and special interests and that preservation really meant restraint on the use of forest products.

The year 2010 represents the 100th anniversary of the official creation of U.S. national policy on dealing with wildland fires. These policies were shaped by the points of view of three key people: President Roosevelt, Gifford Pinchot and H.M. Suter.

Pinchot, both friend and appointee of President Roosevelt, had been appointed the first Chief of the U.S. Forest Service in 1905. At the time the Big Burn occurred in 1910, he was on a crusade to preserve the national forests. There were many people – influential corporate barons and their politicians - who were just as dedicated and opposed to Pinchot's policies. Out of the Big Burn and its political firestorm emerged a common enemy: wildfire. A forester named H.M. Suter wrote an article that reduced the argument about preserving the forests to one sentence.[4] According to Suter, the first objective in forest protection was "to extinguish small fires promptly and thus avoid the great expenditures inherent in well-nigh hopeless struggles with conflagrations." The policy of exclusion of fire from the natural way of things was born.

For the next 30 years, the political debate about protecting one of America's valuable forest resources was waged at every possible level of involvement. The issue was not solely focused on the consequences of fire's exclusion from the natural world, but also on contentions that preservation of timberland was in the national interest.

Out of the Big Burn and its political firestorm emerged a common enemy: wildfire.

At the center of the fight was the U.S. Forest Service (USFS), which fought for and received the responsibility for wildfire protection on federal lands. This was a fundamental decision as it completely shaped the intervening 100 years of wildland firefighting history. Because USFS was designated the premier agency of U.S. wildfire protection, wildfires and their consequences have been largely managed by forest or land agencies around the country. When wildfires burned homes, it was considered to be collateral damage and secondary to protecting the forests.

The past contains evidence that the problem of forest fires did not remain in the wildlands, but rather came down into the urbanized part of the country. As early as 1928, less than two decades after the 1910 fire, the cities of Oakland and Berkeley were struck by a fire that could best be classified as the classic wildland urban interface fire.[5] The fire started as a wildfire and came into the city where it converted to an urban conflagration. The period since 1930, therefore, could best be described as the beginning of the wildland-urban interface problem. It existed where the forests per se were not the problem, but the homes in or near them were.



## THE PRESENT

In the aftermath of the 1993 Fire Storm, the California State Fire Marshal's Office received a grant from the U.S. Fire Administration to write an urban-wildland interface code. Following are the foundational premises of the present "wildfire" problem:

- Wildfires are widely perceived as a single type of fire much like structure fire is used to separate building fires from vehicle, subterranean or vegetation-fuel fires. However, this simple designation doesn't begin to define the more complex variations of wildfires and their benefit/loss consequences.
- Wildfires can be divided into two categories: the vegetation-is-the-primary-fuel "wildland fire," and the building-is-the-primary-fuel "interface fire." The term "wildland fire" is a poor choice for this category, but it is most commonly recognized as a name for a large fire that is burning in a wildland setting far enough away from human communities that it is not a direct threat. In contrast, an "interface fire" is a fire that burns in and around human communities where buildings contribute to the fire load. Each of these fire types has a very different set of behaviors, fire physics, mitigation

and management solutions, and consequences.

- Too many homes are burning in concentrated times and places. This is driving a perception that the wildfire issue is a large fire problem, and this is true when viewed from a geographic (California) or temporal (single day) perspective. When viewed from an actuarial perspective, however, interface fire losses are not a primary loss-leader for the insurance industry, nor do they represent a significant volume of structural losses in America. More lives and homes are lost to standard residential fires every year than to wildfires.
- Fires of both types – wildland and interface – are growing in frequency, severity and cost. Frequency is a function of increased human activity and its ignition source impact; severity is a function of vegetation fuel loads and defensively oriented fire-suppression policies; and cost is a function of the rising personnel and equipment costs for firefighting, increased deployment of those resources before, during and after the fire threat event, and improved accounting for both direct and indirect losses to human and natural environments.
- There are two significant consequence categories of the wildfire problem: human and natural. Assuming for a moment that one can separate the two, the human consequence falls mainly on the damage to lives, homes, communities and economies. The other consequence is environmental in both the short and long-term. Short-term environmental impacts from fire are the obvious destruction of plant and animal life, habitat, air quality and watershed functions such as erosion, water quality and negative impact on aquatic life. The longer-term impacts of the wildfire event focus more on the change of habitat, plant and animal diversity, carbon release losses, watershed degradation and soil damage.

The immediate goal is to recognize that there are two separate problems. The first is that forest/ecosystem health, watershed degradation, fuels buildup, air quality and loss of land development potential are real environmental issues. The second is that public and firefighter safety is a risk mitigation problem of significant importance. One hundred years after the Big Burn, the United States is still struggling with a "growing fire problem" in the eyes of the nation's forest and fire agencies.

Currently in California and other

parts of the country, there are major efforts underway that acknowledge two core facts of the wildfire threat. First is that fighting wildfires (interface or wildland-type) has been lifted out of military organizational philosophy. Fires are fought much like going to war – same terms, intent, mission and technologies. Second, the present approach has not succeeded; otherwise, losses would be declining rather than increasing. To succeed, it is necessary to use the tools of prevention, engineering and mitigation rigorously before the fire event occurs. California is steadily developing or implementing these five approaches for WUI fires: firesafe land use planning, building construction and design, vegetative fuels management, community education, and first responder training.

## FIRESAFE LAND USE PLANNING

Currently the California land use approach employs several tools relevant to both interface and wildland fires. The state has some of the most rigorous planning requirements in the nation and requires wildfire planning as part of city, county and state planning documents. From state level hazard planning to local residential subdivision development plans, the public safety and environmental impact of fire, fire suppression and fuels management are beginning to be systematically addressed. Many areas prepare community wildfire protection plans and specific fire protection plans that incorporate fire behavior modeling. Mitigation prescriptions customized for the building project are becoming more common for larger subdivision projects.

## BUILDING DESIGN AND CONSTRUCTION

Building materials, design and placement are the linchpin key for mitigation of interface fire consequences. The engineering world is just coming to force on this issue and the role of the engineer and researcher is critical to success. The national model codes for both NFPA and ICC have relevant sections that deal with wildfire-specific building concerns. An important shift is that for interface fires, one must prevent the building from igniting rather than simply slowing its rate of burn. When many homes are burning simultaneously, there are too few fire engines to go around and suppress all the fires; the consequence is that homes burn to the ground. The concept and technology of "ignition-resistant"[6] recognizes that it is necessary to reduce the buildings' vulnerability to the small wind-carried embers that swirl around an interface fire and assault the home with a blizzard of ignition sources.

California Building and Fire Codes (CBC/CFC) have specific chapters for residential and commercial construction in the WUI. These provisions are the result of the limited research, laboratory testing and technical committee development available and are continually evolving. More research is needed to fully understand the mechanism of exposure in an interface fire event, how building materials and applications reduce that exposure, and how to develop "barrier" technologies that keep all three main types of heat sources from igniting buildings. Across the country, there are a few bright spots to watch as the research world starts to harness focus. A few examples are: California State University Cal Poly – San Luis Obispo, which is developing a fire protection engineering graduate program and looking toward the applied building sciences for interface fires; National Institute of Standards and Technology (NIST), which is pursuing modeling and testing specific to the interface fire building exposure mechanisms; and the insurance-industry sponsored Institute for Building and Home Safety (IBHS), which is constructing a center for natural hazard building materials testing that will identify more about wildfire exposures and appropriate building materials and technologies.

Meanwhile, California building codes are focused on keeping the home from igniting and code provisions cover roof types (Classes A/B/C), eave and vent design and screening for embers, wall coverings, dual-pane windows with tempered

glass, and deck materials. Like other state-adopted provisions, these are statewide minimums for construction; local agencies must use these standards or adopt more stringent ones; also, all homes built in California in a designated Fire Hazard Severity Zone must be built to these code standards. Mobile or manufactured homes for sale in the state also are included in these requirements through the state authorities that regulate that industry.

## VEGETATIVE FUELS MANAGEMENT

It is important to break down interface fire fuels into two types: structural and vegetative. Building standards address the home-as-fuel-type issue by improving ignition resistance, exposure and building materials. Vegetative fuels are most effectively addressed through a linear perspective—the closer the fuel is to the home, the more impact it has on structural survivability. This approach recognizes that the type of wildfire primarily being addressed is the interface fire and its impact on life and property. Based on past experience, most homes ignite and burn as a result of exposure to embers or under-eave bushes (conductive heat) or to adjacent house fires (radiative heat), so the vegetative fuels treatment priority order is best begun at the house, then extends to the yard, the yard next door, the community vegetation, and finally, the regional vegetation.

## COMMUNITY EDUCATION

As in structural fire prevention, all of a building's built-in fire safety features can be wasted effort if the occupants have no idea how to respond to an alarm, to exit effectively or maintain their safety systems. This also applies to interface fire protection—communities must be educated and trained on how and why their home defense features must be maintained, how their emergency alerting system works, how to evacuate and return, and what to realistically expect from the fire service in large-scale WUI events.

## FIRST RESPONDER EDUCATION

Finally, the education of public safety first responders is crucial. Fire departments traditionally focus on the skills necessary to maintain scene safety and fire suppression needs, but interface fires require a broader skill set. Massive and rapid evacuations in a dynamic environment, the confluence of multiple agencies, demand for incident intelligence and information all reach beyond the currently required training for wildfire suppression tactics. This includes multi-jurisdictional training on the National Incident Management System/Incident Command System, large-scale evacuation drills, emergency operations centers and incident command post relationships, and communications and information/intelligence-sharing strategies.

> Observations one hundred years later are that the problem is increasingly complex and the traditional solutions are losing effectiveness.

## THE FUTURE

In order to envision the future, it is necessary to have a strong grasp of the present. One term that is used for this is "situational awareness." Situational awareness is the primary basis for subsequent decision making and performance in the operation of complex, dynamic systems. Developing a situational awareness of the international wildfire issue is a daunting task because so many factors are threaded into the whole. The Big Burn of 1910 birthed a simple approach to fire management – suppress all wildfires. Observations one hundred years later are that the problem is increasingly complex and the traditional solutions are losing effectiveness. A broader perspective is emerging – one that begins to redefine the discipline of "wildfire." These observations include:

- WUI fire problem-solving is growing out of federal land management agencies and is migrating toward local government and private sectors.
- A growing body of technical experts are beginning to agree on a few fundamental starting points such as terminology, problem description, trend analysis and research requirements.
- Wildfire mitigations such as defensible space, building engineering and land use planning are described as the necessary missing links by all WUI experts but only some policy makers, firefighters and citizens.
- The environmental community is beginning to focus opposition to development and fire suppression as negative consequences to ecosystems.
- Large "landscape level" fuels management is being challenged as a solution to interface fire losses.
- Climate change and increased wildfire threat are emerging as having possible environmental consequences.
- There is collective, concentrated focus on the WUI issue from the fire service, insurance industry, policymakers, research institutions and universities, and partnered disciplines such as engineering, building and planning fields.

- The "WUI Problem" is creating an independent, capitalistic industry. This refers to the range of private interests that are now participating in the problem-solving process by creatively inventing products and services such as firefighters-for-hire, home safety systems, individual or community notification technologies, building products or specialized WUI consulting services for landscaping, architecture and land use planning. These are the harbingers of a large-scale paradigm shift.
- Technology, specifically GIS and remote sensing, offers solutions that take advantage of every aspect of the problem, from risk analysis to firefighting to community education.

Some of the current challenges of the WUI fire problem to which the engineering world can contribute solutions include:

- Developing a systematic taxonomy of interface fires. It is not possible to develop solid science without a common vocabulary that describes types of fires, behaviors, impacts and losses. An example is the Hurricane Scale: a Category 4 hurricane is measured the same around the world.
- Defining the causes of structural ignition and how interface fire behavior is impacting buildings. A common methodology is needed to describe post-fire impact, data gathering components and data-sharing such as has evolved for evaluating structural fire for interior components. Testing standards, building materials, lab research – all need to be supplied with consistently common data in order to advance research and design.
- Acknowledging that interface fires are not natural disasters anymore than urban conflagrations were. They are predictable fire events that require people and buildings. Today's interface fires have a lot in common with the loss of entire wood-roofed cities a few hundred years ago. Building design, placement, landscaping, water and roads, passive and active fire protection, and appropriately scaled fire departments have helped eliminate urban conflagrations – the same will hold true for interface fires.

All the above must be able to take research and technology development and turn it into actions at a granular (house by house – neighborhood by neighborhood – city by city) level. Converting fire loss research into cost-effective solutions that can be integrated into the existing risk management process is crucial.

There is a classic definition of insanity that goes "doing the same thing over and over again and expecting a different result." The interface fire future must include doing something different by developing, testing, and discarding or accepting solutions in a systematic fashion to shape the wildfire battlefield of the future.

*Ronny J. Coleman and Kate Dargan are retired California State Fire Marshals.*

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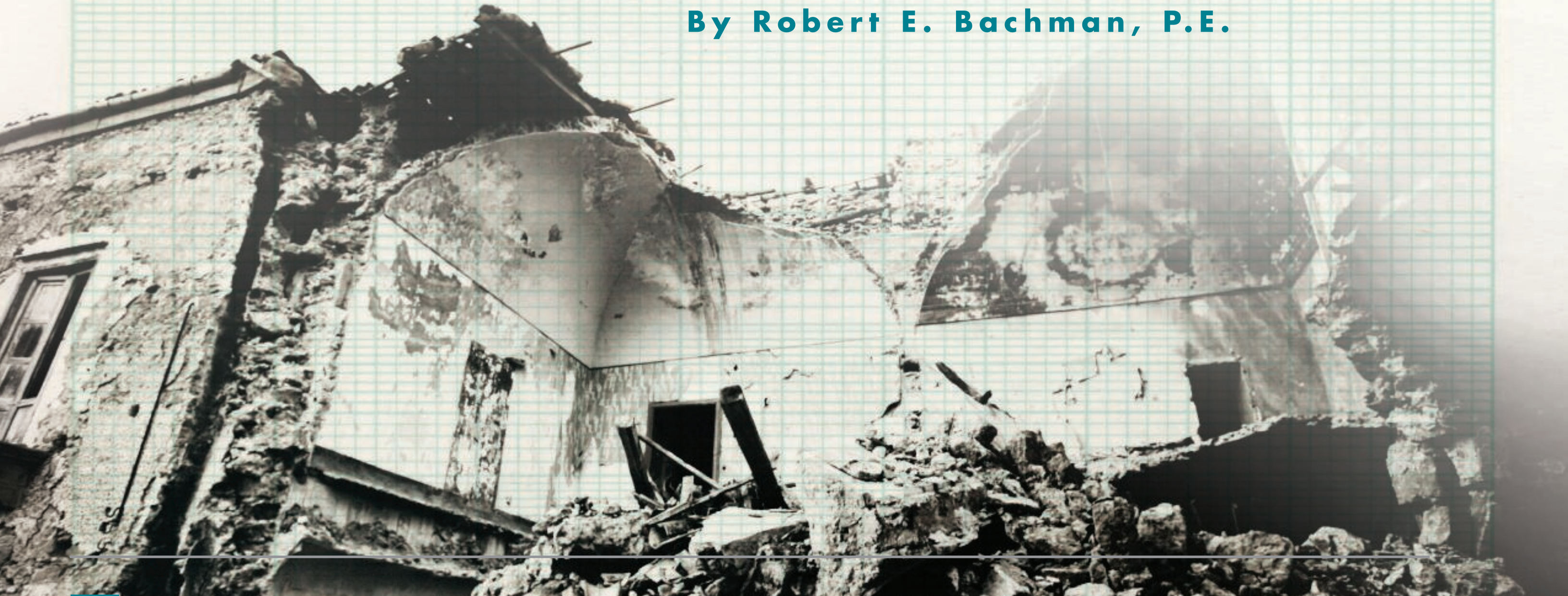
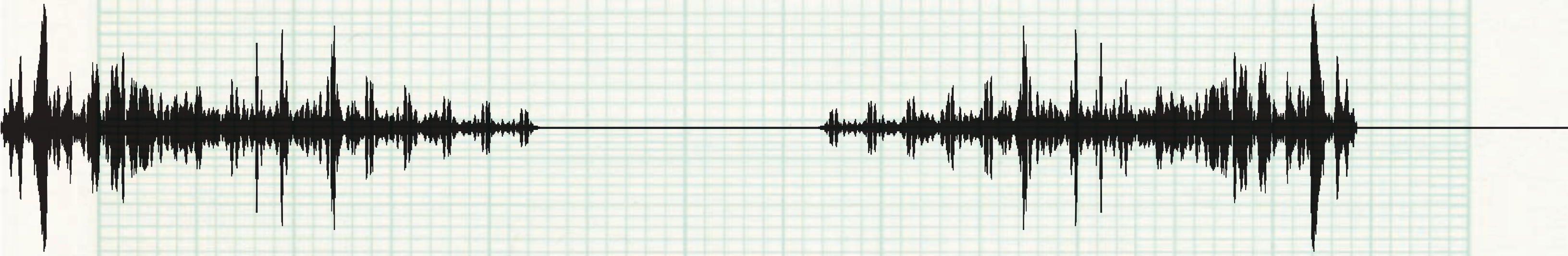
# BUILDING CODE SEISMIC REQUIREMENTS FOR SPRINKLER SYSTEMS AND SPECIAL INTERFACE REQUIREMENTS WITH CEILING SYSTEMS

**By Robert E. Bachman, P.E.**





## INTRODUCTION

Over the past 20 years, the seismic requirements in building codes adopted in the United States have changed significantly. These changes have been prompted primarily by observations of the performance of structural and nonstructural systems in major earthquake events, and have included additional seismic requirements for sprinkler systems that were beyond those specified in NFPA 13. The evolution of the building code seismic requirements over the past 20 years, and specifically the additional requirements for sprinkler systems beyond those found in NFPA 13, are described in this article along with the evolution of NFPA 13 to incorporate these requirements.

The current building code seismic requirements for nonstructural components (including sprinkler systems) are provided in Chapter 13 of ASCE 7-05,[1] which are referenced by the International Building Code[2] (IBC). The requirements for nonstructural components are primarily based on Chapter 6 of the 2003 NEHRP Recommend Provisions.[3] Much of the requirements found in Chapter 6 of the 2003 Recommended Provisions were based on earlier developmental work primarily done between 1991 and 1997 by Technical Subcommittee (TS-8) of the NEHRP Provisions Update Committee (PUC). During this time frame, TS-8 was greatly influenced by the observations on the performance of nonstructural components during the 1989 Loma Prieta and the 1994 Northridge earthquakes. Both of these earthquakes caused significant nonstructural damage, including damage to sprinkler systems.

Until the IBC was published in 2000, building code seismic requirements in higher seismic areas were primarily based on those found in the Uniform Building Code[4] (UBC). The UBC first introduced seismic lateral force requirements for nonstructural components in 1961. There was no significant change in the seismic force requirements for nonstructural components in the UBC until 1997. The 1997 UBC adopted the nonstructural force requirements that were provided in the 1994 NEHRP Recommended Provisions and included considerations from both the 1989 and 1994 earthquakes. These nonstructural force requirements are very similar to those found in ASCE 7 today.

Somewhat independently, the National Board of Fire Underwriters first developed nonmandatory seismic requirements for the hanging and bracing of sprinkler systems starting in 1947.[5] In 1951, a specific requirement was added to the rules requiring that hanging and bracing be designed for a lateral force coefficient of 0.50 g. In 1980, the earthquake requirements were moved into a mandatory portion of NFPA 13[6] for areas subject to earthquakes. Although other improvements were made to the seismic provisions of NFPA 13, the lateral force coefficient of 0.50 g remained unchanged until the 2007 edition of NFPA 13. It should be noted that the NFPA 13 seismic forces were also meant to be used with the allowable stress design procedures. So through the 1994 UBC, the NFPA 13 seismic force coefficients and other design requirements were compatible with and slightly more conservative than those found in the building code (0.50 g versus 0.45 g). However, after 1994, building code seismic requirements and NFPA 13 seismic requirements started to diverge.

A report[5] provided a comprehensive review of the observed sprinkler damage and comparison with existing codes and standards requirements. In this document, each type of damage was observed and suggestions were made as to what type of code change would be required in the 1996 edition of NFPA 13 to address the concern. Many changes were considered and adopted into the 1996 NFPA 13 based on the Northridge earthquake performance observations. However, some changes were not adopted and other concerns were not addressed. Among the changes not adopted or addressed were:

- Increasing the lateral seismic coefficient to greater than 0.50 g in some highly seismic areas and noticing that seismic accelerations were greater at the top of a building than on the ground
- Providing specific design requirements to avoid interference problems between sprinkler drops and suspended ceilings
- Providing specific drift criteria that needs to be accommodated by sprinkler drops in storage racks

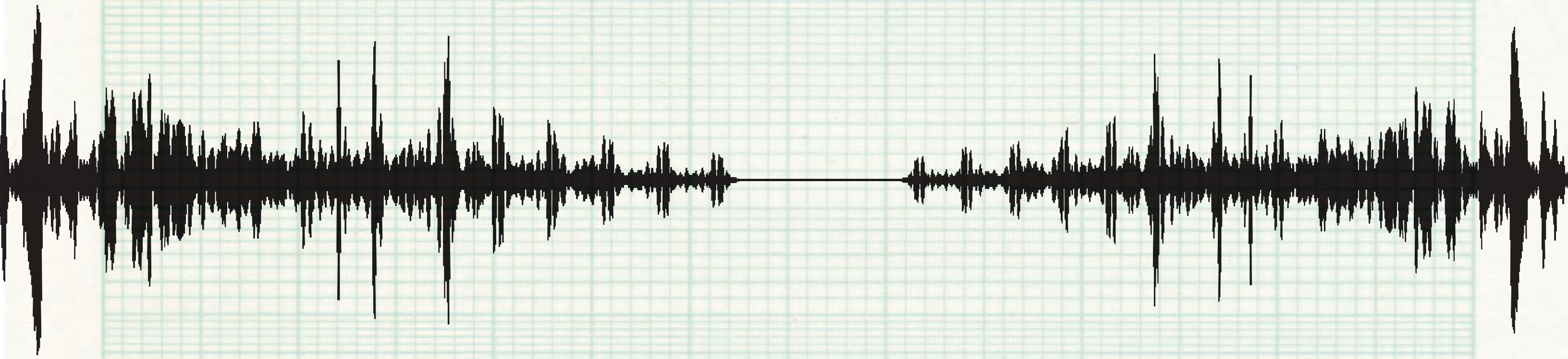
Chapter 13 of ASCE 7[1] specifies two types of nonstructural demands. These are equivalent static lateral forces and relative displacement demands. It should be noted that nonstructural components located in buildings in low seismic areas are exempt from the seismic requirements of Chapter 13 of ASCE 7.

The equivalent static lateral forces are primarily used for design anchorage and bracing of a component. However, when the component is a designated seismic system, the component itself must be designed for the forces. Sprinkler systems are designated as seismic systems.

The relative displacement demand $p$ is simply determined from the analysis of the structure in which the components are being attached. As a default, if the relative displacements are unknown, the relative displacement demands may be taken as the maximum allowable drift displacements allowed for the structure by ASCE 7. The relative displacement demand is used to determine the effects on displacement-sensitive components caused by relative anchor movements. For such components, inelastic deformations are acceptable, but failure of the component that can cause life-safety hazard is not.

In addition to the force requirements, ASCE 7 specifies that sprinkler drops that penetrate suspended ceilings in high seismic areas must satisfy at least one of the following criteria:

1. The ceiling panels must have oversized penetration holes that provide 1 inch (25 mm) of clearance around the drops.
2. The piping, HVACR system and ceiling system must be designed to act as an integral unit.



3. Sprinkler drops must be designed with articulating connections that can accommodate at least one inch (25 mm) of displacement at the ceiling interface in all horizontal directions.

Except for criteria for different materials, the above items were all issues that were recognized in the NISTR report but were not incorporated into NFPA 13 in 1996.

Between 2004 and 2007, members of the NEHRP PUC TS-8 subcommittee and ASCE 7 nonstructural subcommittee worked with the NFPA 13 subcommittees to incorporate changes to NFPA 13 that made them consistent with ASCE 7-05. The result was to modify the influence tables in NFPA 13 (2007) so that the hangers, bracing and piping design itself satisfied ASCE 7. In addition, the term "flexible device" was added as an option for sprinkler drops to allow that concept as one means of satisfying articulating connections. Because NFPA 13 (2007) was compatible with ASCE 7, NFPA 13 (2007) was deemed to comply with ASCE 7 in the 2009 IBC and 2009 NEHRP Recommended Provisions. NFPA 13 (2010) provided further enhancements to improve compatibility with ASCE 7.

Members of the NEHRP PUC TS-8 subcommittee and ASCE 7 also worked closely with the ceiling industry to update the ASTM E 580[7] standards, which provide a "Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground." The updated standard includes a requirement that where the ceiling panels are penetrated by sprinklers, they must satisfy one of the criteria specified above.

In ASCE 7 (2010), because both NFPA 13 (2007) and ASTM E 580 (2009) have been adopted, there are essentially no amendments to these documents in the area of seismic requirements for sprinklers and interfaces between sprinklers and ceilings. So, if both documents are satisfied, ASCE 7 (2010) is considered satisfied.

> One of the options provided in Chapter 13 of ASCE 7 is to permit nonstructural systems and components to be evaluated by shake table testing.

## FLEXIBLE SPRINKLER DROP DEVICES AND SUSPENDED CEILING SYSTEM SEISMIC PERFORMANCE

One of the options provided in Chapter 13 of ASCE 7 is to permit nonstructural systems and components to be evaluated by shake table testing. A shake table testing protocol[8] has been developed by the International Code Council Evaluation Services (ICC-ES). It provides shake table testing criteria that is tied to the nonstructural force equation. Basically, floor (or ceiling) test motions have been derived from the parameters that are used to construct the nonstructural force equation. The greater the test motion and higher the value of floor motions, the greater the seismic qualification value.

Suspended ceilings are particularly difficult to confidently analyze by normal structural analysis procedures. For this reason, a number of ceiling manufacturers have performed shake table testing to objectively evaluate the seismic performance of their ceiling system product lines.

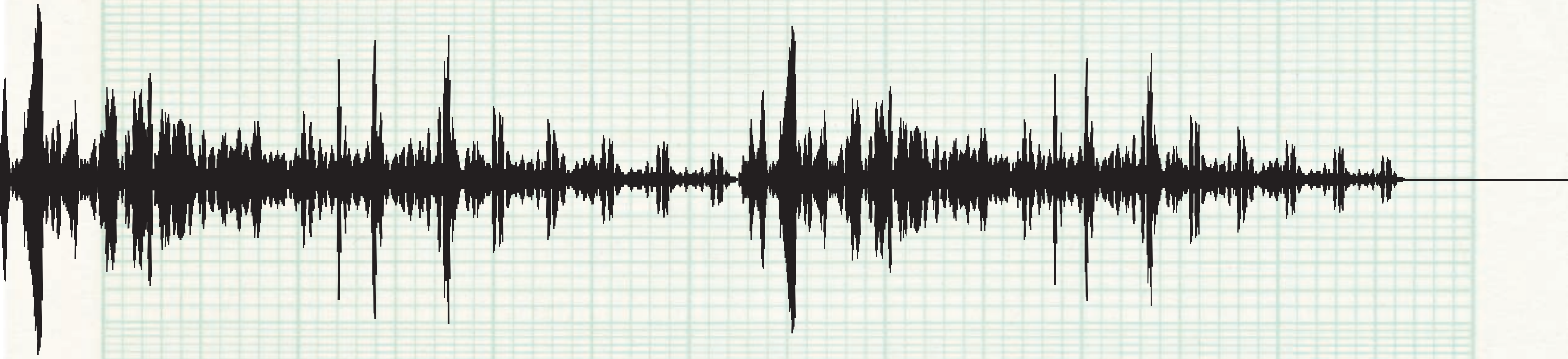


Figure 1. Shake table

As part of the shake table testing that was performed on Armstrong ceilings in early 2006, suspended ceiling systems were tested with flexible sprinkler drop devices (provided by FlexHead Industries) in lieu of hard-armover sprinkler drops. The devices were connected to a full installed and operational sprinkler system. A photograph of the testing is provided in Figure 1. A variety of low seismic and high seismic ceiling systems were tested for a range of shake table test motions.

It was concluded that FlexHead's flexible devices in conjunction ceiling systems performed excellently together and offered no downside to the performance of the ceiling system. These types of flexible devices are what was envisioned when the provision for articulating connections was conceived by seismic code developers in the NEHRP Recommended Provisions in the early 1990s.

Furthermore, these flexible devices also eliminate the problem of sprinkler drops jumping out their penetration holes because of vertical motions and snapping the sprinkler when the drop tries to reinsert itself. This particular problem with sprinkler drops was highlighted in the NISTR report.[5] It is worth noting that flexible devices are produced differently by each manufacturer. One should not make the broad assumption that every flexible device will perform the same way in a seismic event. There is no substitute for testing data.

*Robert E. Bachman is with R. E. Bachman Consulting Engineers.*

References:


1 *SCE/SEI Standard 7, Minimum Design Loads for Buildings and Other Structures*, American Society of Civil Engineers, Reston, VA, 2005.

2 *International Building Code*, International Code Council, Washington, DC, 2009.

3 *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures, FEMA 450-1/* Building Seismic Safety Council, Washington, DC, 2003.

4 Uniform Building Code, International Conference of Building Officials, Whittier, CA, 1997.

5 Fleming, R. "Analysis of Fire Sprinkler System Performance in the Northridge Earthquake," NIST-GCR-98-736, National Institute of Standards and Technology, Gaithersburg, MD, 1998.

6 NFPA 13. *Installation of Sprinkler Systems*, National Fire Protection Association, Quincy, MA, (edition as noted).

7 *ASTM E 580, Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground*, ASTM International, West Coshohocken, PA, 2009.

8 *Acceptance Criteria for the Seismic Qualification Shake-Table Testing of Nonstructural Components and Systems, AC-156*, International Code Council Evaluation Services, Country Club Hills, IL, 2007.

# POTENTIAL PITFALLS WITH PROFESSIONAL LIABILITY INSURANCE

**By Mark Blankenship**

Risk transfer through insurance is an important part of any risk management strategy. This article summarizes techniques for preserving insurance coverage.

A scenario can be used to illustrate potential liability exposure: A fire protection engineer designs a dry pipe sprinkler system with appropriate slope in the pipe runs to allow for drainage of the system. The contractor installs the pipe level, with the result that water does not fully drain. Water accumulates in the piping and freezes, bursting the pipe. The owner is unhappy and demands to know why the problem happened and who is going to fix it. The fire protection engineer feels that he or she did not do anything wrong. Should he or she report this to their insurance company?

The correct answer is "yes." The key question is not whether or not the engineer did anything wrong. The important question is whether or not the incident is likely to result in a claim. All professional liability insurance policies are written on a "claims made" basis. This means that they will only cover claims that are made and reported during the current policy period.

Furthermore, all "claims made" policies have a clause that says coverage only applies to claims when the insured had no knowledge of circumstances likely to result in a claim at the policy inception date. (A few insurers say one has coverage if they had no knowledge of those circumstances at the first date of continuous coverage with that company. This is called a "knowledge date" and is a desirable feature in an insurance policy.)

## DENIAL OF COVERAGE

The most common reason that professional liability insurers deny coverage is failure by the insured to report claims, or knowledge of potential claims, during the policy period in which the insured became aware of the claim or potential claim. This situation is preventable. The usual scenario involves a problem caused by others. Maybe the owner made a value engineering change. Maybe the contractor installed something out of conformance with the plans. The design professional didn't do anything wrong and feels he or she should not be implicated in any claim. He or she also is afraid to report the matter to their professional liability insurance because he or she is afraid the insurance rates will be increased. So, the matter is not reported until later in a new policy period.

When the claim is made, the circumstances are judged with the benefit of hindsight and it may appear that the insured did have knowledge of circumstances likely to result in a claim prior to the inception date of the current policy. It seems to the insurer that the insured was trying to buy insurance on a burning building, and the claim was denied.

Claims against engineers may occur, even if the engineer did nothing wrong. This is because if there are large losses, all potentially responsible parties may be sued with a goal of letting the courts determine who is at fault. Design professionals get named in lawsuits because they were at the scene of the crime.

The legal obligation of any engineer is to perform in accordance with the generally accepted professional standard of care.

The learning point is that while there is some risk of increased rates due to reporting potential claims, this risk pales in comparison to the impact of an uninsured claim. The choice is even clearer if one considers that a significant rate increase is not likely unless an actual claim develops and the insurance company sets aside a substantial amount of money to pay anticipated defense costs and losses.

## OTHER COVERAGE PROBLEMS

Most other coverage problems for engineers stem from assuming liability in a contract beyond that which is imposed by law. Professional liability insurance provides broad coverage for "legal liability," or the same liability that would be imposed by a handshake deal. The legal obligation of any engineer is to perform in accordance with the generally accepted professional standard of care. One is liable to others for damages caused by failure to perform to this standard of reasonable care. And, in states that follow the "economic loss rule," the only party that can sue an engineer for purely economic loss is the engineer's client.

When owners' attorneys draft a contract, they frequently try to transfer as much risk as possible to the engineering firm. They require that the engineering firm perform to the highest standard of care, and indemnify third parties to the contract, such as the owner's lenders, affiliated companies, agents, other consultants and their attorneys. While they may think they are doing their client a favor, what they are really doing is jeopardizing the coverage that everyone is relying on to back the promises made in the contract.

A typical owner-drafted indemnification might look like this:

> *The consultant agrees to defend, indemnify and hold harmless the client, the client's partners, members, affiliated companies, agents, attorneys, contractors, volunteers, other retained consultants, and the representatives, directors, officers and employees of all of them, against all claims, liabilities, attorneys fees, fines and penalties arising out of the work.*

This defense and indemnification imposes liability beyond what is required by law and exposes the consultant to uninsured risk. One should delete the "defend" obligation because this is the issue that is most likely to come into play in the event of a claim.

Under the law, an engineer is not required to pay anything until he or she has been found to be liable. If an engineer agrees to defend his or her client, then the engineer will have to pay for the client's legal defense regardless of whether or not the engineer did anything wrong. This deprives the engineer of due process. And, since their legal fees will be covered, there is no incentive for the client to shop for a reasonably priced lawyer.

This makes the engineer the insurer of the client, but the consulting fee probably does not include a premium to assume this risk. The obligation to defend a client is not covered by professional liability insurance because additional insureds cannot be added to a professional liability policy.

One also should limit the duty of indemnification to the "client, its officers, directors, members (if the client is an LLC) and employees." The "partners, affiliated companies, agents, attorneys, contractors, volunteers, other retained consultants, and representatives" are not parties to the contract. In states that follow the economic loss rule, they cannot sue for economic loss. Therefore, an agreement to indemnify them against economic loss is a purely contractual liability that will not be covered by professional liability insurance.

Finally, one should change "arising out of the work" to "to the extent caused by the negligent performance of the work." The words "arising out of" have been construed by the courts to mean that one is responsible for the fault of other parties who were also involved in the work. One should also delete "fines and penalties" because many policies exclude coverage for fines and penalties. And, the words "reasonable" should be inserted before "attorneys fees" because claimants have a duty to mitigate their damages.

## STANDARD OF CARE

Language contained in a contract between an engineer and his or her client might require him or her to perform to the highest standard of care. According to Black's Law Dictionary, the highest standard of care is the highest standard ever attained by anyone at any time. This is a very difficult standard to meet each and every day!

An engineer's standard of care can be increased in more subtle ways as well. A contract might require that the consultant "comply with all codes, laws and rules in effect at the federal, state and local levels." When dealing with abstractions such as building codes, reasonable minds can differ. An engineer should not be responsible for costs associated with revisions to comply with the interpretation of a code official if the engineer's interpretation was reasonable and customary. This language amounts to a warranty of perfection. A suggested revision would be to say that the engineer will "comply with the professional standard of care relative to applicable laws."

## WITHHOLDING PAYMENT

Another provision that owners might try to insert for their own protection is right to withhold payment of fees. Professional liability policies say that withholding fees is not a covered event, even if the basis of withholding is to protect the owner against potential claims. The effect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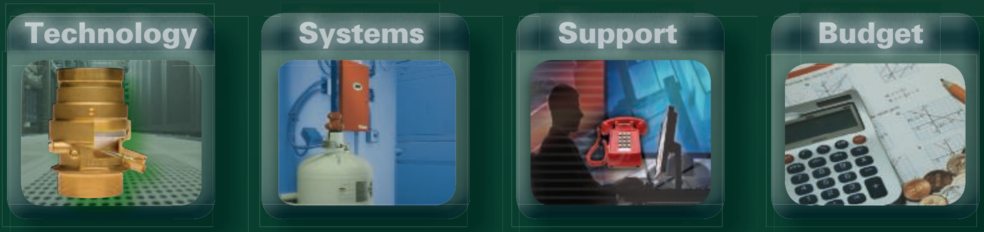


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of such a provision is to make the consultant the insurer of the project. Giving the owner the right to withhold payment in anticipation of a possible claim deprives the consultant of due process.

If the owner insists on a right to withhold payment, it should only be for services that are not properly performed. In that event, payment should be made for the portion of services performed satisfactorily. However, the preferred position is that there shall be no withholding of the consultant's compensation except for sums for which the consultant has been adjudged to be liable.

## RECOMMENDED APPROACH

The goal of negotiations is generally a win-win solution. Frequently, the best argument to revise unfair contract language is to appeal to the owner's self-interest, which is served by preserving the insurance coverage available to the consultant. Claims for purely contractual liability will not be covered by professional liability insurance and will likely complicate the adjustment of any claims that the owner may have. In order to assure a smooth process, it is better to have a contract that reflects the legal liability exposures of the consultant. The following language should be acceptable to any insurer:

**Standard of Care**

*In performing services, the consultant shall endeavor to exercise that degree of skill shown by similarly situated professionals practicing in the community at the time services are offered.*

**Indemnity**

*The consultant shall indemnify the owner, and the owner's directors, officers and employees against damages to the extent caused by the negligence of the consultant.*

Fortunately, the vast majority of reported professional liability claims are covered. The two most important things an engineer can do to preserve his or her coverage are to report claims or potential claims to his or her carrier immediately, and strive to negotiate contracts that reflect legal liability standards in the engineer's jurisdiction. It is wise to consult with legal and insurance counsel who have appropriate experience in professional liability.

While construction experience is useful, there are significant differences between the commercial general liability policy, which is relied upon by contractors, from the professional liability policy, which is relied upon by consultants. An attorney can provide general risk management advice, while an insurance broker should review select contract clauses for insurability issues. Most brokers will not charge additional fees for this service.

*Mark Blankenship is with Willis HRH.*

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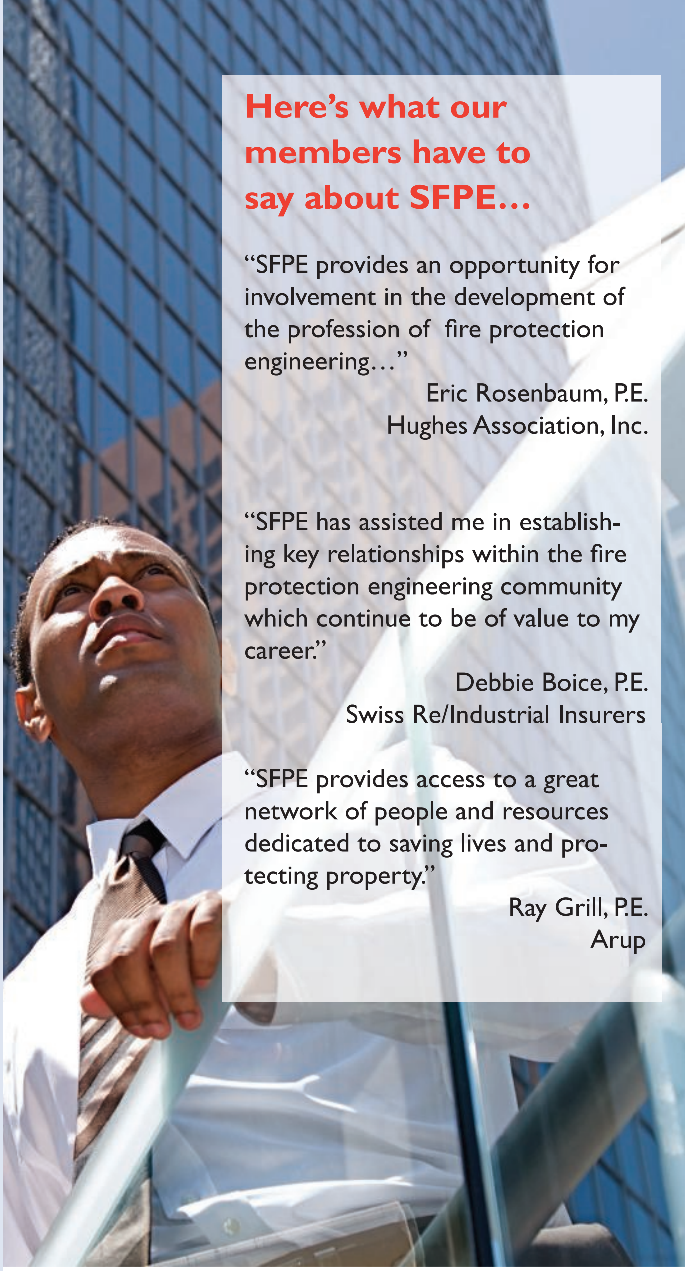

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# RESOURCES >>>

## UPCOMING EVENTS

**July–October 2010**
2010 Fire Protection Engineering P.E. Exam Online Review Seminar
**Info: http://www.sfpe.org/Education/2010OnlineStudySeminarforFPEPEExam.aspx**

**September 29–30, 2010**
FIVE – Fires In Vehicles
Gothenburg, Sweden
**Info: http://www.firesinvehicles.com/en/Sidor/default.aspx**

**October 3–8, 2010**
The Annual Meeting – SFPE Professional Development Conference & Expo
New Orleans, LA, USA
**Info: www.sfpe.org**

**October 20–23, 2010**
International Congress on Combustion and Fire Dynamics
Santander, Spain
**Info: http://grupos.unican.es/GIDAI/**

**December 16–17, 2010**
SFPE Advanced Fire Alarm Systems Design
Orlando, FL, USA
**Info: http://www.nfpa.org/catalog/product.asp?pid=ADFA&cookie%5Ftest=1**

**December 7–9, 2010**
8th Asia-Oceania Symposium on Fire Science and Technology
Melbourne, Australia
**Info: www.vu.edu.au/aosfst**

**March 23–24, 2011**
FSE '11 – Raising the Bar
Sydney, Australia
**Info: www.sfs.au.com**

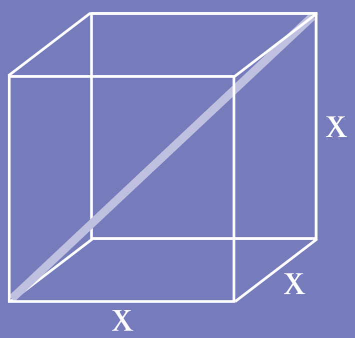
**May 25–27, 2011**
Eurofire 2011
Paris, France
**Info: www.eurofireconference.com**

**June 20–24, 2011**
10th International Symposium on Fire Safety Science (IAFSS10)
University of Maryland, USA
**Info: www.iafss.org**

# BRAINTEASER > Problem/Solution

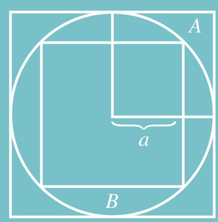
## Problem

**If a cube has sides with a length of "X", what is the length of the interior diagonal of the cube?**




## Solution to Last Issue's Brainteaser

A square is circumscribed within a circle, which is in turn circumscribed within another square as shown at right.




Which area is larger – area "$A$" or area "$B$"?

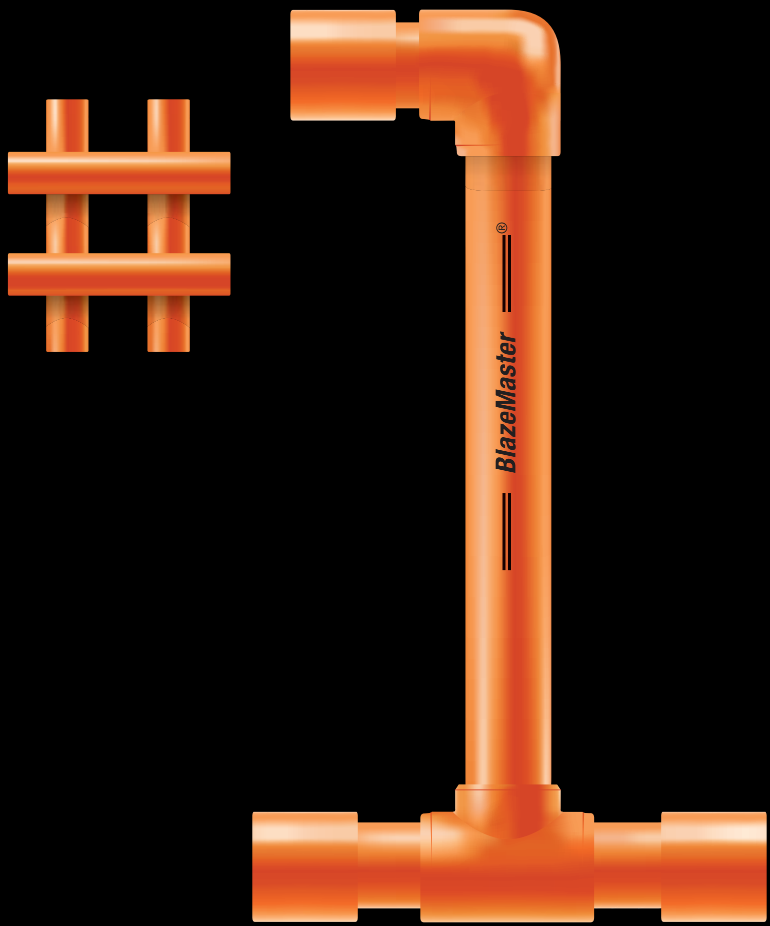
If a side of the largest square has length "$S$," then the largest square has an area of $S^2$. Also, the circle has an area of $\pi/4\, S^2$.

The radius of the circle is $\tfrac{1}{2}S$. The length of a side of the smaller square is $2a$. The length of $a$ can be found using the Pythagorean theorem:

$$a^2 + a^2 = (\tfrac{1}{2}S)^2.$$

Solving for $a$ yields $a = S\sqrt{1/8}$. Therefore, the area of the small square is $(2a)^2 = (2S\sqrt{1/8})^2 = \tfrac{1}{2}S^2$.

The area "A" is equal to $\tfrac{1}{4}(S^2 - \pi/4\, S^2) = \tfrac{1}{4}S^2(1 - \pi/4)$, and the area "B" is equal to $\tfrac{1}{4}(\pi/4\, S^2 - \tfrac{1}{2}S^2) = \tfrac{1}{4}S^2(\pi/4 - \tfrac{1}{2})$. Therefore, the area "B" is larger than the area "A".

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CASE STUDY

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A 1,840,000 square foot behemoth that holds three complete concourses. Yet, the American Airlines mega terminal at Kennedy Airport in New York pushed the envelope for designers, engineers and contractors who seemed to have less space to work with, not more.

Traditional fire sprinkler system seismic joints require a convoluted Rube-Goldberg style arrangement of connections that would allow movement in all directions. "There was just no room for all that extra hardware," explained David McMahon, Senior Project Manager, SIRINA Fire Protection Corp. "That's when we found the Fireloops. They solved all our problems."

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"We installed dozens of Fireloops throughout the terminal in places I know we could not have used any other type of seismic joint," comments Rocco Abbate Executive Vice President, SIRINA Fire Protection Corp. "The loops (Fireloops) solved a lot of issues.

"In fact, it was the first set of Fireloops we ordered that convinced us it was the right product," he continues. "They were so easy to install in the first phase of construction we knew it was the perfect seismic joint to use for the rest of the project."

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In problem areas with false fire alarms or vandalism to pull stations (schools, public buildings, etc.), a protective cover will reduce or eliminate false alarms. According to national and local codes, these fire alarm pull stations must be UL Listed. To avoid negating the alarm's UL Listing, confirm the protective cover is also UL Listed (such as STI's STI-1100 or STI-6600 pull station covers).

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CASE STUDY

# Edwards – A UTC Fire & Security Company

Since 1872, Edwards has led the way with innovative processing solutions that make built space today as safe as it's ever been. From economical hardwired control panels to high-end life safety platforms – and even hybrid panels that offer both conventional and intelligent solutions – this rich legacy of inventiveness and uncompromising quality has distinguished Edwards control panels as the technologies of choice among building owners and designers the world over. The easy-to-install FireShield™ fire alarm panel for small to mid-range applications takes the very best conventional fire alarm technology available today and balances it with features that benefit small building installers, contractors, building owners and occupants alike. The EST3-Sixty is a top-level, facility-wide solution that offers response personnel the tools they need, not only to warn people of imminent danger, but to guide them to safety as well. And it offers building owners the security of a fully UL Listed solution – an edge that ensures outstanding performance and ongoing compliance for years to come.

From pioneering work in multisensor technology, to award-winning design breakthroughs, Edwards has also established itself as the leader in cutting-edge detection and signaling technology. Making the best of true multisensor capability, the Signature Series™ Intelligent Detection systems continually monitor the environment, then run the gathered information through a sophisticated algorithm that compares the sensor readings over time to known signatures of fires. When the algorithm finds a match, an alarm condition results. If no match is found, no alarm is sounded. The key here is that Signature detectors don't simply react to the conditions – they interpret information from several sources over time to arrive at a carefully "considered" conclusion. The FireWorks™ Command and Control system delivers an effective, yet simple means of monitoring and control by organizing all necessary life safety network information into context sensitive event-driven screen quadrants that graphically display the building down to the detail of a single room. Able to monitor all facilities remotely over a LAN or WAN, or even the World Wide Web, FireWorks provides the means for getting the right information to the right people at the right time.

**Edwards A UTC Fire & Security Company**
8985 Town Center Parkway
Bradenton, FL 34202
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**www.utcfireandsecurity.com**

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1

## Two-Wire Fire Alarm Panels

Kentec Electronics launches its new AlarmSense compatible Sigma CP-A 2, 4 and 8 zone fire alarm control and indicating panels. Apollo AlarmSense devices, including smoke and heat detectors, call points, base sounders, base sounder/beacons and relay units, can all be wired to the same pair of cables, with rapid system configuration for common, zonal, or two-stage alarm using simple menu options on the panel.

**www.kentec.co.uk**
—Kentec Electronics Ltd.

2

## Fire Alarm Amplifier

New 125-watt amplifier can be mounted up to 6,000 feet away from any compatible Silent Knight VIP Series of fire alarm control panels. The self-contained amplifier comes equipped with a built-in power supply, battery-backup connection and four speaker circuits. An optional circuit splitter card is available to double each unit's speaker circuits to eight. As many as eight VIP-125s can be distributed across extensive installations.

**www.farenhyt.com**
—Silent Knight

3

## Residential Pump System

General Air Products has expanded its residential line with the addition of the Econo RFP System for NFPA 13D applications. The Econo RFP System is designed to provide all 13D required features and functionality at a low cost without sacrificing quality. The unit consists of a stainless steel pump, non-ferrous components, an industrial-duty pressure switch, a water hammer and is completely customizable.

**www.generalairproducts.com**
—General Air Products

4

## Analog Addressable Control Panels

Hochiki America Corp. has expanded its analog fire product line with the addition of FireNET™ Plus to the Hochiki America FireNET™ line. FireNET™ Plus is an analog addressable control panel suitable for small- to mid-sized installations. Each panel has one SLC loop that can be expanded to two loops. An optional, integrated, digital alarm communicator (DACT) with 64-panel network capability adds power and flexibility.

**www.hochiki.com**
—Hochiki America Corp.

5

## Concealed Residential Sidewall Sprinkler

Viking Corp. announces the Freedom® VK480 sprinkler, a 4.0 (58) K-factor residential, flat plate concealed, horizontal sidewall sprinkler. Using the VK480's special installation pipe guide, the new sprinkler easily installs into a standard 2 x 4-in. stud wall. The pipe guide, which is shipped standard with the sprinkler at no additional charge, ensures the proper location of the sprinkler to allow for 1/4-in. adjustment of the cover plate.

**www.vikinggroupinc.com**
—Viking Corp.

6

## Early Warning Detectors

The System Sensor FAAST Fire Alarm Aspiration Sensing Technology will protect mission-critical facilities and high-value assets from smoke or fire events up to 60 minutes before combustion. FAAST's smoke detection performance is built around its Dual Vision sensing technology, incorporating both an extremely sensitive blue LED to provide Very Early Warning Fire Detection and an infrared laser to identify nuisances such as dust that can cause false alarms and downtime.

**www.systemsensor.com**
—System Sensor


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## 7

## Integrated Voice System

Fike announces a new, fully digital, modular Integrated Voice Evacuation and Voice Messaging System to its line of fire alarm solutions. The system includes integrated back-up amplifiers for built-in redundancy, virtually unlimited messaging capability, and multiple levels of fault protection. It also offers flexibility to fit any application, from single-, dual- and multi-channel operation to large distributed systems.

**www.fike.com**

—Fike Alarm Systems

## 8

## Web-based Inspection Solution

BuildingReports' ScanSeries technology runs on standard Internet browsers enabling inspectors to scan bar-coded devices and upload data with mobile PDAs. It provides complete data and statistical analysis on every device inspected. Inspection results are instantly retrievable from a secure, online database 24/7 from any location. ScanSeries digital reporting ensures accurate inspections that are fully documented in compliance with regulatory standards. Third Party Verification assures verifiable inspection results.

**www.buildingreports.com**

—BuildingReports

## 9

## Dry Pipe Accelerator

The VIZOR Electronic Dry Pipe Accelerator is a fully supervised, self-contained, riser-mounted, quick-opening device that reduces the time required to operate a dry pipe system with the activation of one or more automatic sprinklers. All essential components are located inside its enclosure. Microprocessor technology enables the VIZOR Accelerator to monitor and control dry systems cleanly. It is approved for use with new or existing dry pipe systems and can replace mechanical-type accelerators.

**www.tyco-fire.com**

—Tyco Fire Suppression & Building Products

## 10

## Gas and Flame Detectors

NOTIFIER introduces three gas and flame detectors designed to integrate with its fire alarm systems. $E^3$Point sensors monitor for toxic and combustible gases in commercial applications. Sensepoint XCD detectors monitor industrial sites for toxic and flammable gases and deliver diagnostic, alarm and gas concentration values directly to a NOTIFIER system. FD Series flame detectors are designed to monitor common flame emissions in high-risk industrial applications, including oil/gas and petrochemical sites.

**www.notifier.com**

—NOTIFIER

## 11

## Underground Water Storage Tanks

Fiberglass underground tanks, listed in NFPA 22, are ideally suited for storage of standby water as part of a fire protection system. The tanks are available in 600 to 62,000-gal. sizes. They are watertight, constructed with long-lasting fiberglass to be rustproof, and are H-20 load rated.

**www.xerxes.com**

—Xerxes

## 12

## Breach Valves

In the event of a line break, these Breach Valves will automatically close, preventing the fire-reserve water from draining the system, ensuring that adequate water is available for fire fighting. They will prevent flooding when installed in domestic water, wastewater, and HVACR water piping near computer rooms and elevator shafts, and also can be used to protect mechanical equipment rooms with high-voltage equipment.

**www.cla-val.com**

—Cla-Val

# Sales Offices


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FIRE PROTECTION Engineering

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EDWARDS

A UTC Fire & Security Company

## Proven leadership. Proud heritage. Shared vision.

In 1872 when Robert Edwards installed an electrically-operated gas lamp igniter in a New York City church, he began a tradition of innovation that would chart the course of building safety and security for the next 140 years. Today the company that bears his name draws on this rich legacy of inventiveness, and benefits from fresh new alliances established with one underlying goal: uncompromised excellence.

Our EST brand under the Edwards banner meets this goal with quality products and an exceptional sensitivity to the needs of our customers. Now we have access to the combined resources, talent, and experience that is already setting a coordinated plan for excellence into action. The result is a unique synergy sustained by a strong organization with a well-defined vision of the future.

That vision of excellence is why Edwards is among the fastest growing building systems providers today. It's also why, with more than a century of solid growth behind us, you can put your trust in Edwards.


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