

# SCHULTE & ASSOCIATES

Building Code Consultants  
880D Forest Avenue  
Evanston, IL 60202  
fpeschulte@aol.com  
847/866-7479

## IS BUILDING FIRE PROTECTION AN ART OR A SCIENCE? (MAKING THE SIMPLE COMPLEX)

By Richard Schulte

*“Science is nothing without truth-telling and honesty, and you're no scientist.”*

James Lewis

Recently, there seems to be quite a lot of talk in the field of fire protection about “fire science”. Actually, this talk about “fire science” has been going on for more than a decade, maybe two decades. Is there really such a thing as “fire science” or is fire protection still more an art than a science?

At stake, perhaps, is the appeal or overturning of over 700 convictions for the crime of arson in the State of Texas.

In the Willingham residence fire case, “experts” in “fire science” have been called in to testify before the Texas Forensic Science Commission in an effort to determine whether a fire investigation which took place in late 1991 and early 1992 came to the correct conclusion regarding whether the fire was accidental or a case of arson. At stake, perhaps, is the appeal or overturning of over 700 convictions for the crime of arson in the State of Texas.

For close to 30 years, researchers at the Building and Fire Research Laboratory (BFRL) at the National Institute of Standards and Technology (NIST) (and its predecessor, the National Bureau of Standards (NBS)) have been at work developing computerized fire models. Recently, questions concerning the “validation” of these models, in particular, the Fire Dynamics Simulator (FDS), have been raised and examples of the intentional inappropriate use of the FDS by modeling “experts” have surfaced.

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After the collapse of the World Trade Center (WTC) towers and other buildings on the World Trade Center site on 9/11, NIST conducted a 3 year investigation into the collapse of the towers and followed this investigation up with an investigation into the collapse of the WTC 7 Building. A substantial part of these two investigations included a combined fire modeling and structural modeling analysis of these buildings. However, the NIST reports on the investigations contain little in the way of a discussion of the “validation” of the modeling utilized by NIST. Legitimate questions are now being asked about whether or not NIST’s use of modeling in the WTC investigations was appropriate.

Before launching into a discussion of the issue of whether or not there is such a thing as “fire science”, a review of fire safety statistics is of interest. The following statistics have been collected by the National Fire Protection Association (NFPA) for the United States in 2009:

- An estimated 480,500 structure fires occurred.
- 78.4 percent of the structures fires occurred in residential occupancies.
- An estimated 2,695 civilian fatalities occurred as a result of structure fires.
- An estimated 2,565 civilian fatalities occurred as a result of structures fires in residential occupancies.
- Based upon the above, 95.1 percent of the civilian fatalities in structure fires occurred in residential occupancies.
- An estimated 105 civilian fatalities (3.9 percent of the total number of fatalities occurring as a result of structure fires) occurred as a result of structure fires in non-residential occupancies.

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A few other fire safety statistics collected by the NFPA for the US are worth noting:

- Between 2003 and 2006, the average annual number of fire fatalities occurring in mercantile occupancies in the United States was ten.
- Between 2000 and 2004, the average annual number of fire fatalities occurring in office buildings in the United States was one.
- Between 2003 and 2006, the average annual number of fire fatalities occurring in educational occupancies in the United States was zero.

- In 2006, the number of fatalities caused by lightning strikes was 47.

In addition to the statistics noted above, we know that the installation of sprinkler protection in residential occupancies reduces the number of fire fatalities which occur to very near zero. The same can be said about other occupancies where sprinkler protection is provided.

Based upon the information above, it seems reasonable to conclude that the structure fire problem in the United States is primarily limited to unsprinklered residential buildings. This also means that the solution to the structure fire problem in the United States is to provide sprinkler protection in residential occupancies. If we could do this, while at the same time maintaining

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the requirements for sprinkler protection for non-residential buildings at the same level as at present, we could virtually eliminate civilian fire fatalities in the US.

Not only do the NFPA fire statistics tell us that fire fatalities in buildings protected by a sprinkler system are rare, but statistics collected by the NFPA on fire fighter fatalities also tell us the same thing. Typically, the number of fire fighter fatalities which occur annually in sprinklered buildings in the US is either one or zero.

Given the above, it would seem that sprinkler protection is the “magic bullet” which can be used to prevent fatalities in building fires. The only question which remains is whether or not sprinkler protection is reliable enough to accomplish the goal of practically eliminating civilian fire fatalities.

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The NFPA also collects statistics on the reliability of sprinkler systems. According to the NFPA statistics, sprinkler protection performs as intended in 95 percent of fires in residential occupancies. While the reliability of sprinkler protection is not as high in other occupancies, the NFPA indicates that sprinkler protection performs its intended function, on average, in 91 percent of fires (large enough to activate sprinklers).

The NFPA statistics on sprinkler system performance also indicate that the cause of 53 percent of sprinkler system failures is a closed water supply valve. Given this statistic, there is no reason why the sprinkler system reliability statistic can't be pushed up to over 95 percent simply by implementing periodic inspections of sprinkler water supply valves by fire department fire prevention personnel.

Now back to the original topic of this article-is fire protection more of an art than a science?

Actually, based upon the statistics and the discussion above, it would seem that that question is hardly even relevant any more. If we provide sprinkler protection in residential occupancies, and maintain the present thresholds for sprinkler protection in non-residential occupancies, there is not much need for “fire science”. In other words, “fire science” has been made obsolete by sprinkler protection.

Of course, the concept of providing sprinkler protection in dwellings is not a new idea. This concept originated in the late 1960's or the early 1970's. Pioneers in the concept of providing sprinkler protection in dwellings included Richard Patton, Chester Schirmer and Rolf Jensen, as well as many others. The first edition of NFPA 13D was published in 1975 and another residential sprinkler standard, BOCA 101, was developed and proposed in 1978 as a companion document to the BOCA sprinkler standard, BOCA 100, developed by Building Officials and Code Administrators (BOCA).

Although “fire science” was essentially made obsolete by the development of NFPA 13D in the middle 1970's and the listing of the first residential sprinkler by Grinnell Fire Protection in the early 1980's, the origins of “fire science” can be traced to around the same time. Hence, we could say that the concept of “fire science” was “hatched” at the same time that it was made obsolete by residential sprinkler protection.

Given all of the above, it's not too difficult to conclude that “fire science” is fire protection made complex. If our goal is to reduce both civilian and fire fighter fatalities and injuries, do we really need to be more complex than sprinkler protection? You can't get a whole lot simpler than sprinkler protection.

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Is sprinkler protection the answer to the “fire problem” in the United States? The answer to that question is a simple “yes” and that answer has been “validated” by the statistics cited above.

As for “fire science”, if the simple answer gets the job done effectively and efficiently, then there is really no reason to get complex. Problem solved-let's move on to the next problem please.

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Of course, it is expected that the “fire science” gurus will howl after reading the above. If the “fire scientists” were really serious about their field, they would have long ago addressed the issue of the “validation” of their fire models, rather than just getting around to it now.

When Dr. Alan Beard wrote articles published in Industrial Fire Journal magazine questioning the use of fire models, the “fire scientists” should have responded calmly with evidence that Dr. Beard’s comments were in error. Instead, the “fire scientists” collectively ignored Dr. Beard. (The articles by Dr. Beard referred to above are titled “*Reliability of Computer Fire Models in Fire Safety Design*” and “*Computer models and the limitations in fire safety design*”.)

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When evidence surfaced that a renowned “fire scientist” was intentionally involved in the inappropriate use of fire models and made false statements in sworn deposition testimony in litigation, the “fire scientists” should have rose up and kicked that renowned “fire scientist” out of the field. Instead, the “fire scientists” just “circled the wagons” around the renowned “fire scientist”.

Developing and using fire models without knowing whether or not the models actually perform their intended function, simply ignoring questions raised about fire models by Dr. Beard and “circling the wagon” around a renowned “fire scientist” who intentionally provided false sworn testimony in litigation doesn’t sound like science to me.

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As James Lewis so eloquently said:

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Based upon what I have observed, it is my opinion that “*truth-telling and honesty*” are a major problem in the world of “fire science”. I guess that means that “*you're no scientist*” and without “fire scientists”, there is no “fire science”.

The fact that “fire scientists” would tolerate dishonesty and intentionally making false sworn statements in deposition testimony by a renowned “fire scientist” does have consequences-it serves to taint the entire fire protection field.

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How does the “fire science” field remove that taint? For starters, just follow the example set by the NCAA in regard to Reggie Bush’s Heisman Trophy award and the example set by Major League Baseball (MLB) in regard to Pete Rose. If the NCAA and MLB can do it, certainly the fire protection field can do it. Until that happens, it will be difficult for many to take the field of “fire science” seriously.

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Richard C. Schulte