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BUILDING FIRE SAFETY TECHNOLOGY (CIRCA 1999)

By Richard Schulte

The "roaring 90's" in the United States came to a screeching halt on September 11th, 2001. You might say that September 11th was a turning point in the history of the United States, if not world history. While the U.S. economy seemed to be able to rebound from the spectacular terrorist attack on New York City, the Panic of 2008 occurred just 7 years later. Is there a connection between September 11th and the Panic of '08? There is little doubt in my mind that there is.

> Is there a connection between September 11th and the Panic of '08?

In the wake of the Panic of '08 and the Great Recession that followed in Western nations, many Western countries are struggling under the strain of years of deficit spending (brought on, in part, by our response to September 11th). The results of that deficient spending are now being felt both in the United States and in Europe.

Recently, the National Fire Protection Association (NFPA) released a study which estimates that the United States spends in aggregate in excess of $300 billion annually on fire and fire protection. That means that the US will spend $3⁺ trillion on fire and fire protection. over the course of a decade. Yes, that's correct, $3⁺ trillion on fire/fire protection-related expenditures in a decade in the US alone.

Given our economic circumstances, and the fact that the hazard of fire has been "tamed" in the last half of the 20th century, it seems reasonable that we should be able to reduce our national fire/fire protection budget. In fact, it would seem that we have little choice in the matter. How do we go about making rational decisions about cutting our national fire/ fire protection budget?

One answer to that question may be contained in a paper titled "*A Description of the Probabilistic and Deterministic Modelling Used in FIRECAM™*" authored by D. Yung, G. V. Hadjisophocleous and G. Proulx, Fire Risk Management Program, National Research Council of Canada (NRCC). This paper appeared in the *International Journal on Engineering Performance-Based Fire Codes* in 1999. Excerpts from this paper include the following:

“*To permit flexibility and cost-effectiveness in fire safety designs, many countries in the world, notably New Zealand, Japan, the U.K. and Australia, are moving towards performance-based building regulations, and away from the current restrictive, prescription-based regulations. . . .Similar to other engineering practices, performance-based regulations allow designers and regulatory officials the freedom to apply engineering principles to identify fire safety designs that meet the required fire safety performance.*”

“*To support the introduction of objective/performance-based building regulations in Canada, the National Research Council of Canada (NRC) is developing a computer fire risk-cost assessment model that can be used to assess both the expected risk to life to the occupants and the expected costs of fire protection and fire losses in a building.*”

“FiRECAM™ *assesses the expected risk to life to the occupants in a building as a result of all probable fire scenarios over the design life of the building. . .* ”

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“*The objective of this study was to evaluate alternative fire safety designs for such a building that could provide the occupants with the same, or better, level of safety as that required by the current prescriptive building code but at lower costs.*”

“*A description of* FiRECAM™ *and its submodels can be found in previous publications [1-9] and is not repeated here. The model was developed in collaboration with the Victoria University of Technology in Australia [3-4] and in partnership with Public Works and Government Services Canada (PWGSC) and the Canadian Department of National Defence (DND).*”

“FiRECAM™ *assesses the fire safety performance of a fire safety design in terms of two decision making parameters : the expected risk to life (ERL) and the fire cost expectation (FCE). The ERL is the expected number of deaths per year.*”

“*The separation of life risks and protection costs in* FiRECAM™ *avoids the difficulty of assigning a monetary value to human life and allows the comparison of risks and costs separately.*”

"FiRECAM^{TM} *uses statistical data to predict the probability of occurrence of fire scenarios, such as the type of fire that may occur or the reliability of fire detectors.*"

"*The probability of occurrence of each design fire is based on statistical data. For example, in Canada, statistics [10] show that the probability of fire starts in office buildings is 7.68 x 10^{-6} per m^2. Of these fires, 24% reach flashover and become fully developed fires, 54% are flaming fires that do not reach flashover and the remaining 22% are smouldering fires that do not reach the flaming stage [10].*"

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Note: One m^2 = 10.758 ft^2. Hence, the probability of fire in office buildings expressed in English units is 7.14 X 10^{-7} per SF (0.000000714) or 7.14 x 10^{-4} (0.000714) per 1,000 SF.

Note: Based upon the information above, the probability that a fire which reaches flashover stage in office buildings is 1.71 X 10^{-4} (0.000171) per 1,000 SF (24 percent of 7.14 x 10^{-4}). In other terms, the chances of a fire in an office building reaching flashover stage is 1 in 5,835 for each 1,000 SF of floor area. Hence, in an office building with a total floor area of 100,000 square feet, the probability of a fire reaching flashover state would be 1 in 58.353. In other words, given a group of 58 office buildings each with an aggregate floor area of 100,000 SF, it would be expected that 1 fire which reaches flashover stage would occur.

It can be reasonably be assumed that the probability of a fire in an office building reaching flashover stage would be greater in a building not provided with sprinkler protection and lower for buildings provided with sprinkler protection.

"*The evacuation paths are generated on the basis of the assumption that occupants will use preferred routes to evacuate.*"

"*To evaluate the predictability of the model, its predictions are compared to results from evacuation drills in apartment and office buildings [13] and are shown in Figs. 3 and 4, respectively.*"

"*FiRECAM™ was applied to a six-storey Canadian federal government office building, located in London, Ontario. . . .The building was constructed in the 1930's and has unique architectural features. With the heritage designation, no renovation to the building would be permitted unless such renovation would not cause any change to the building's unique architectural characteristics.*"

"*The building is a six-storey concrete building with three staircases, two passenger elevators and two service elevators.*"

"*Fig. 6 also shows that none of the non-sprinkler options can provide equivalent life safety to the reference option.*"

"*The cost of installing sprinklers was estimated to be $575,000, whereas the cost of installing voice alarms was only $73,000. If funding to install the sprinklers is a problem, this option could be an attractive one to consider as a possible solution that could achieve most of the intended reduction in life risk, but with a capital cost of about $500,000 less.*"

Analysis

Assuming that the NFPA's study on our nation's annual expenditures on fire/fire protection is reasonably accurate, it seems almost certain that most would agree that a $300⁺ billion expenditure is excessive. The question then becomes: how and where to we begin trimming our national fire/fire protection budget? The approach outlined in the paper from 1999 is certainly one way to approach both the "fire problem" in the US and the "fire/fire protection budget problem".

While the concept outlined in the paper is both reasonable and logical, the approach depends upon the accuracy of the models employed in implementing the concept. Are the models used in this proposed concept actually capable of predicting building performance in a fire accurately?

NFPA statistics indicate that an average of 4 civilian fire fatalities occurred annually in U.S. office occupancies in the 5 year time period between 2004 and 2008. The NFPA statistics do not provide a break-down between the annual number of fire fatalities which occurred in unsprinklered office buildings, versus the number of fatalities which occurred in office buildings provided with sprinkler protection, however, it is likely that the number of civilian fire fatalities occurring in sprinklered office buildings was either zero or very close to 0.

Given the NFPA statistics of fire fatalities in office buildings, it seems reasonable to ask whether such a complex analysis as that proposed in the paper by the National Research Council of Canada is necessary, at least for office buildings protected by a sprinkler system. Statistically speaking, sprinklered office buildings in the United States provided with two exit stairs are "safe" buildings.

Based upon the last statement, it would seem that the concept proposed by the National Research Council of Canada is overly complex. Building fire protection is not “rocket science”, nor does it have to be made out to be “rocket science”.

The problem here seems to be that everybody wants to make this out to be complex. It’s not really a complex problem. The “keep it simple, sweetheart” (KISS) principle should apply here.

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