

# SCHULTE & ASSOCIATES

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

## REFORMING BUILDING FIRE SAFETY REGULATION

By Richard Schulte

The Great Chicago Fire started on the evening of October 8<sup>th</sup>, 1871 and burned through nearly 4 square miles of the city before being extinguished on October 10<sup>th</sup>. The hurricane which destroyed the City of Galveston on September 8<sup>th</sup>, 1900 made landfall with wind speeds estimated at 135 miles per hour. The earthquake which caused the fires which destroyed the City of San Francisco occurred on the San Andreas fault early in the morning of April 18<sup>th</sup>, 1906. These historical events in the United States, along with other major disasters, served as the impetus for the development of building codes by the property insurance industry in the early 20<sup>th</sup> century.

While the development of building codes in the United States was initiated by property insurers, today model building codes in the US are promulgated by two organizations, the International Code Council (ICC) and the National Fire Protection Association (NFPA). The ICC publishes the International Building Code and other model construction codes, while the NFPA publishes NFPA 5000, the Life Safety Code and other fire safety-related standards.

Section 101.3 in the 2009 edition of the International Building Code (IBC) indicates that *“the purpose of this code is to establish the minimum requirements to safeguard the public health, safety and general welfare. . .and safety to life and property from fire and other hazards attributed to the built environment and to provide safety to fire fighters and emergency responders during emergency operations.”*

Obviously, the purpose statement included in the IBC provides little in the way of guidance as to the content of the regulations to be included. Given that there is no overarching direction, or philosophy, provided regarding the content of the code, the IBC is, in effect, simply a compilation of regulations determined by the “consensus” of a group of “code professionals” who voluntarily participate in the code development

At present, it could be said that the provisions which address fire safety contained in our model building codes resemble, with only just a bit of exaggeration, a “7 layer cake”.

process. Since the group of code professionals who participate in the code development process fluctuates over time, all too often the basis for including provisions in the code is weak. At present, it could be said that the provisions which address fire safety contained in our model building codes resemble, with only just a bit of exaggeration, a “7 layer cake”.

The issue of regulatory reform in the Federal Government was addressed by President Clinton in Executive Order 12866 issued on September 30, 1993. The following are excerpts from Executive Order 12866:

*“The American people deserve a regulatory system that works for them, not against them: a regulatory system that protects and improves their health, safety, environment, and well-being and improves the performance of the economy without imposing unacceptable or unreasonable costs on society; regulatory policies that recognize that the private sector and private markets are the best engine for economic growth; . . .and regulations that are effective, consistent, sensible, and understandable. We do not have such a regulatory system today.*

*With this Executive order, the Federal Government begins a program to reform and make more efficient the regulatory process. The objectives of this Executive order are to enhance planning and coordination with respect to both new and existing regulations; . . . to restore the integrity and legitimacy of regulatory review and oversight; . . .*

*Accordingly, by the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered as follows:*

### **Section 1. Statement of Regulatory Philosophy and Principles.**

- a. *The Regulatory Philosophy. Federal agencies should promulgate only such regulations as . . . are made necessary by compelling public need, such as material failures of private markets to protect or improve the health and safety of the public, the environment, or the well-being of the American people. In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider. . .*

*“The American people deserve a regulatory system that works for them, not against them: a regulatory system that protects and improves their health, safety, environment, and well-being and improves the performance of the economy without imposing unacceptable or unreasonable costs on society; . . .and regulations that are effective, consistent, sensible, and understandable. We do not have such a regulatory system today.”*

4. *In setting regulatory priorities, each agency shall consider, to the extent reasonable, the degree and nature of the risks posed by various substances or activities within its jurisdictions.*

*“Each agency shall . . .propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify the costs.”*

6. *Each agency shall access both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs.*

7. *Each agency shall base its decisions on the best reasonably obtainable scientific, technical, economic, and other information concerning the need for, and consequences of, the intended regulation.*

*“Each agency shall base its decisions on the best reasonably obtainable scientific, technical, economic, and other information concerning the need for, and consequences of, the intended regulation.”*

11. *Each agency shall tailor its regulations to impose the least burden on society, including individuals, businesses of differing sizes, and other entities (including small communities and governmental entities), consistent with obtaining the regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations.*

### **Sec. 3. Definitions.**

f. *“Significant regulatory action” means any regulatory action that is likely to result in a rule that may:*

1. *Have an annual effect on the economy of \$100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities; . . .*

4. *Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive order.*

#### **Sec. 4. Planning Mechanism.**

- B. *A summary of each planned significant regulatory action including, to the extent possible, alternatives to be considered and preliminary estimates of the anticipated costs and benefits;*
- D. *A statement of the need for each such action and, if applicable, how the action will reduce risks to public health, safety, or the environment, as well as the magnitude of the risk addressed by the action relates to other risks within the jurisdiction of the agency;*

*“A statement of the need for each such action and, if applicable, how the action will reduce risks to public health, safety, or the environment, as well as the magnitude of the risk addressed by the action relates to other risks within the jurisdiction of the agency;”*

#### **Sec. 5. Existing Regulations.**

*In order to reduce the regulatory burden on the American people, their families, their communities, their State, local and tribal governments, and their industries; to determine whether regulations promulgated by the executive branch of the Federal Government have become unjustified or unnecessary as a result of changed circumstances; to confirm that regulations are both compatible with each other and not duplicative or inappropriately burdensome in the aggregate; to ensure that all regulations are consistent with the President's priorities and the principles set forth in this Executive order, within applicable law; and to otherwise improve the effectiveness of existing regulations: . . .”*

More recently, the issue of regulatory reform has also been addressed by President Obama. The following is a press release issued by The White House on January 18, 2011 addressing regulations developed by the Federal Government:

*“By the authority vested in me as President by the Constitution and the laws of the United States of America, and in order to improve regulation and regulatory review, it is hereby ordered as follows:*

Section 1. General Principles of Regulation.

a) *Our regulatory system must protect public health, welfare, safety, and our environment while promoting economic growth, innovation, competitiveness, and job creation. It must be based on the best available science. It must allow for public participation and an open exchange of ideas. It must promote predictability and reduce uncertainty.*

*“Our regulatory system must protect public health, welfare, safety, and our environment while promoting economic growth, innovation, competitiveness, and job creation.”*

*It must identify and use the best, most innovative, and least burdensome tools for achieving regulatory ends. It must take into account benefits and costs, both quantitative and qualitative. It must ensure that regulations are accessible, consistent, written in plain language, and easy to understand. It must measure, and seek to improve, the actual results of regulatory requirements.*

b) . . .As stated in that Executive Order and to the extent permitted by law, each agency must, among other things: (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor its regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public.

c) *In applying these principles, each agency is directed to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. Where appropriate and permitted by law, each agency may consider (and discuss qualitatively) values that are difficult or impossible to quantify, including equity, human dignity, fairness, and distributive impacts.*

*“In applying these principles, each agency is directed to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible.”*

Sec. 2. Public Participation. a) *Regulations shall be adopted through a process that involves public participation. . .*

b) To promote that open exchange, each agency, consistent with Executive Order 12866 and other applicable legal requirements, shall endeavor to provide the public with an opportunity to participate in the regulatory process. . . To the extent feasible and permitted by law, each agency shall also provide, for both proposed and final rules, timely online access to the rulemaking docket on regulations.gov, including relevant scientific and technical findings, in an open format that can be easily searched and downloaded. . .

c) Before issuing a notice of proposed rulemaking, each agency, where feasible and appropriate, shall seek the views of those who are likely to be affected, including those who are likely to benefit from and those who are potentially subject to such rulemaking.

Sec. 3. Integration and Innovation. Some sectors and industries face a significant number of regulatory requirements, some of which may be redundant, inconsistent, or overlapping. Greater coordination across agencies could reduce these requirements, thus reducing costs and simplifying and harmonizing rules. . .

*“Some sectors and industries face a significant number of regulatory requirements, some of which may be redundant, inconsistent, or overlapping.”*

Sec. 4. Flexible Approaches. Where relevant, feasible, and consistent with regulatory objectives, and to the extent permitted by law, each agency shall identify and consider regulatory approaches that reduce burdens and maintain flexibility and freedom of choice for the public. . .

Sec. 5. Science. Consistent with the President's Memorandum for the Heads of Executive Departments and Agencies,

"Scientific Integrity" (March 9, 2009), and its implementing guidance, each agency shall ensure the objectivity of any scientific and technological information and processes used to support the agency's regulatory actions.

Sec. 6. Retrospective Analyses of Existing Rules. a) To facilitate the periodic review of existing significant regulations, agencies shall consider how best to promote retrospective analysis of rules that may be outmoded, ineffective, insufficient, or excessively burdensome, and to modify, streamline, expand, or repeal them in accordance with what has been learned. Such retrospective analyses, including supporting data, should be released online whenever possible.

*b) Within 120 days of the date of this order, each agency shall develop and submit to the Office of Information and Regulatory Affairs a preliminary plan, consistent with law and its resources and regulatory priorities, under which the agency will periodically review its existing significant regulations to determine whether any such regulations should be modified, streamlined, expanded, or repealed so as to make the agency's regulatory program more effective or less burdensome in achieving the regulatory objectives. . .”*

## **Analysis**

In both good and bad economic times, it seems reasonable and logical to ask “how much fire protection is enough?” whenever more restrictive building code provisions are proposed. The procedure which can be utilized to answer that question is contained in Executive Order 12866 issued by President Clinton in 1993 and the Executive Order addressing regulation issued by President Obama on January 18, 2011. First, the problem being addressed by a code provision needs to be clearly defined. Second, the benefits of addressing the problem defined need to be clearly identified. Third, the costs of both addressing and not addressing the problem need to be determined. A simple equation can be used to express whether or not a code provision is appropriate for inclusion in the building code:

### **Benefits > Cost**

At present, the International Building Code includes a number of provisions where it appears that the cost of complying with code provisions may exceed the benefits derived from compliance. A list of just a few of the code provisions where the cost of compliance may exceed the benefits includes the following:

- The provisions for smoke/heat vents in one-story industrial and storage buildings protected by a sprinkler system.
- The provision for elevator lobby separations in multi-story buildings protected by a sprinkler system.
- The provision for a fire service elevator in buildings 120 feet or more in height protected by a sprinkler system.
- The provision for smoke/fire dampers at duct penetrations of shafts in buildings protected by a sprinkler system.
- The provision for area limitations in buildings protected by a sprinkler system.

To illustrate the application of a cost/benefit analysis in determining whether or not a provision should be included in the code, let's examine the examples above.

### **Smoke/Heat Vents in One-Story Industrial and Storage Buildings.**

The purpose of providing smoke/heat vents in one-story industrial and storage buildings protected throughout by a sprinkler system is to automatically vent smoke and heat from a building to facilitate interior manual fire fighting operations. In theory, venting smoke from the building prior to the arrival of the fire department at the building should maintain visibility at the floor of the building so that fire fighters conducting interior fire fighting operations will be able to locate the seat of the fire and apply hose streams.

In 1997/1998, large-scale fire tests of the interaction between spray sprinklers and automatic smoke/heat vents were conducted at Underwriters Laboratories' (UL) facilities in Northbrook, Illinois. The results of the testing demonstrated that the operation of automatic smoke/heat vents will be delayed, or prevented, by the activation of sprinklers where the temperature rating of the sprinklers and the temperature rating of the fusible links which control the operation of the vents is the same. The reason for the delay or failure to operate is thought to be the depositing of water droplets on the vent fusible link. The testing at UL demonstrated that the theory that automatic vents will prevent a building from becoming "smoke-logged" appears to be erroneous.

The results of the testing demonstrated that the operation of automatic smoke/heat vents will be delayed or prevented by the activation of sprinklers where the temperature rating of the sprinklers and the temperature rating of the fusible links which control the operation of the vents is the same.

In response to the results of the testing conducted in 1997/1998, the manufacturers of smoke/heat vents committed to further fire testing of the interaction of sprinklers and vents in September 1999. To date, that commitment has not been fulfilled.

In the summer of 2006, the smoke/heat vent manufacturers announced a fire modeling study of the interaction of sprinklers and vents and stated that the new research would "*concretely demonstrate the value of S&HV in terms of property protection, occupant safety, firefighter safety, and firefighter effectiveness. . .*". The report on the fire modeling study was published in February 2008 and introduced the concept of the "ganged" operation of smoke/heat vents to address the delay/failure of vents to operate in buildings protected by a sprinkler system. In March 2009, the smoke/heat vent manufacturers characterized the research study on the "ganged" operation of roof vents as "*worthless*".

The 2010 edition of the NFPA 13 now contains specific provisions which address the use of smoke/heat vents in buildings protected by a sprinkler system. These provisions specifically permit the use of vents in buildings protected by a sprinkler system provided that the vents are not arranged to operate automatically or the fusible link which

In March 2009, the smoke/ heat vent manufacturers characterized the research study on the “ganged” operation of roof vents as “*worthless*”.

causes the opening of the vents has a temperature rating of at least one classification higher than the temperature rating classification of the sprinklers. The purpose of these provisions included in NFPA 13 is to prevent the automatic operation of vents in sprinklered buildings, if the sprinkler system successfully controls the fire. The substantiation for the vent provisions now included in NFPA 13 states that “*the intent of the [NFPA 13] standard is that roof vents and draft curtains should not be used in conjunction with storage protection.*”

In order for smoke/heat vents to work properly, NFPA 204 indicates that draft curtains should be provided and that the temperature differential between the smoke layer which forms and the ambient temperature must be at least 110°C (198°F). The provisions which require smoke/heat vents contained in the International Building Code do not require that draft curtains be provided and the fire testing at Underwriters Laboratories demonstrated that the operation of spray sprinklers rapidly “knocks down” the temperatures of the smoke layer so that

The substantiation for the vent provisions now included in NFPA 13 states that “*the intent of the [NFPA 13] standard is that roof vents and draft curtains should not be used in conjunction with storage protection.*”

the temperature differential required to make the vents work effectively is only achieved for a short period of time, if at all. Given the above, even if smoke/heat vents were to open, the vents would not operate properly.

With all of the information above, it seems clear that smoke/heat vents provided in buildings protected by a sprinkler system will not perform according to theory. Hence, it can be concluded that the benefits of providing smoke/heat vents in one-story industrial and storage buildings provided with sprinkler protection are strictly theoretical and will not occur in the real world.

Given the above, it can be concluded the benefits of vents are nil in industrial and storage buildings where the sprinkler system successfully operates. In the case where the sprinkler system fails, **NIOSH 2005-132**, *Preventing Injuries and Deaths of Fire Fighters due to Truss System Failures*, and **NIOSH 2010-153**, *Preventing Deaths and Injuries of Fire Fighters using Risk Management Principles at Structure Fires*, recommend against the use of interior manual fire fighting tactics in large one-story buildings.

Even in the event of successful sprinkler system operation, early manual interior fire fighting tactics in large industrial and storage buildings are not necessarily recommended because of the potential for failure of the sprinkler system (due to the possibility of supply pipe or sprinkler obstructions or fire pump failure) while interior fire fighting operations are underway. From a fire fighter safety standpoint, it is better for fire fighters to allow the sprinkler system to

With all of the information above, it seems clear that smoke/heat vents provided in buildings protected by a sprinkler system will not perform according to theory.

perform its intended function.

With all of the above, it can be concluded that the only benefit to providing smoke/heat vents in industrial and storage buildings provided with sprinkler protection is for “mop up” purposes after the fire is extinguished. Exterior wall openings and mechanical exhaust systems can also perform this function equally as good, or better, than smoke/heat vents. Based upon this, it would appear that the benefits of providing smoke/heat vents in buildings protected by a sprinkler system are nil. If there are no benefits to providing smoke/heat vents in buildings protected by a sprinkler system, then the IBC provision which requires that vents be provided in large one-story industrial and storage buildings fails the “cost/ benefit test” outlined by the Executive Orders issued by President Clinton and President Obama.

. . .then the IBC provision which requires that vents be provided in one-story industrial and storage buildings fails the “cost/ benefit test” outlined by the Executive Orders issued by President Clinton and President Obama.

### **Elevator Lobby Separations in Building Protected by a Sprinkler System**

The purpose of providing elevator lobby separations in buildings is to prevent the movement of smoke from the floor of fire origin to other floors via the elevator hoistways. Given the clearances at elevator doors, the spread of smoke and heat through the elevator hoistways is more likely to occur through the elevator hoistway than through other vertical shafts in buildings.

The accessibility requirements (ADA Accessibility Guidelines-ADAAG) developed by the Federal Government in the early 1990's included egress provisions for people with physical disabilities. These egress provisions mandated that areas of refuge for occupants with disabilities be provided within exit stair enclosures and that a minimum clearance of 48 inches be provided between the handrails of stairs serving areas of refuge. The regional model building codes soon incorporated the accessible egress provisions contained in the ADAAG into the egress provisions contained in the model codes. Both the ADAAG and accessible egress provisions contain an exception for the area of refuge provided within stair enclosures for buildings protected throughout by a sprinkler system.

The basis for the exception for the area of refuge within stair enclosures is that the operation of the sprinkler system is capable of limiting both the temperatures which develop and the quantity of smoke which is generated in a fire. In other words, the floor of fire origin is considered to be an area of refuge for occupants with physical disabilities in buildings protected by a sprinkler system. Occupants of the fire floor only need to move away from the area of fire origin to protect themselves from both excessive temperatures and smoke.

In other words, the floor of fire origin is considered to be an area of refuge for occupants with physical disabilities in buildings protected by a sprinkler system.

With nearly 20 years of experience with the ADAAG and model code provisions for accessible egress under our belts, it appears that sprinkler protection is indeed capable of protecting occupants with physical disabilities from fire. The number of Americans, both able-bodied or with disabilities, who die as a result of fires in buildings provided with sprinkler protection is close to zero on an annual basis. Given this experience, it would seem both reasonable and logical to assume that sprinkler protection is capable of limiting the exposure to excessive temperatures and smoke on floors other than the floor of fire origin.

Given this experience, it would seem both reasonable and logical to assume that sprinkler protection is capable of limiting the exposure to excessive temperatures and smoke on floors other than the floor of fire origin.

Based upon this, logic would indicate that floors other than the fire floor, can also be considered to be areas of refuge without protecting the elevator hoistway entrance with a lobby separation.

Proponents of the need for an elevator lobby separation make the argument that sprinkler protection is not 100 percent reliable and also express concern about injury caused by the movement of smoke through elevator hoistways.

While there is no argument over the fact that sprinkler protection is not 100 percent reliable, statistics collected by the National Fire Protection Association (NFPA) indicate that sprinkler protection successfully controls over 90 percent of fires which are large enough to cause the activation of the sprinkler protection. These same statistics indicate that the lowest percentage of successful sprinkler operation occur in industrial and storage occupancies and that dry pipe sprinkler systems are more prone to failure than are wet pipe sprinkler systems. The latest statistics on sprinkler system reliability also indicate that the cause of roughly one-half of the sprinkler system failures is a closed water supply valve.

[See **Editor's Note** dated February 13, 2010 on page 17 for additional information.]

What all of this means is that the reliability of sprinkler protection in occupancies other than industrial and storage occupancies is much higher than the average reliability statistic. The statistic on the primary cause of sprinkler system failure also indicates that the reliability of sprinkler systems can easily be increased simply by doing inspections to verify that the water supply valves in the system are open and that the operation of the system has not been disabled. There is no reason why the reliability statistic for sprinkler system can't be increased to the neighborhood of 98 percent or better with periodic inspections of the operational status of the system.

With respect to the concern about injuries caused by smoke, the NFPA statistics on civilian fire injuries which occur in the United States do not differentiate between minor injuries and major injuries. While there is no difference of opinion as to the meaning of the term "fatality", the term "injury" is subject to differences in interpretation. What is of interest in this discussion is "serious injuries" caused by smoke, not "minor injuries".

While there is no difference of opinion as to the meaning of the term "fatality", the term "injury" is subject to differences in interpretation. What is of interest in this discussion is "serious injuries" caused by smoke, not "minor injuries".

Given that we do not have a definition of the term "serious injury", nor statistics on the number of serious injuries caused by smoke, it is difficult to discuss this issue with any degree of authority or certainty. It would seem logical that "serious injury" to occupants on floors, other than the floor of fire origin, would be rare if "serious injury" to occupants with physical disabilities in buildings provided with sprinkler protection are rare on the floor of fire origin.

Based upon the discussion above, it would seem that the need to prevent the movement of smoke to floors other than the fire floor via elevator hoistways is unnecessary due to the lack of both fatalities and serious injury caused by smoke on the floor of fire origin in buildings protected by a sprinkler system. Given the lack of fatalities and serious injuries in sprinklered buildings, it would seem that there is little benefit in preventing the movement of smoke to other floors via elevator hoistways.

It should be noted that the conclusion stated above assumes 100 percent reliability of elevator lobby separations to prevent the movement of smoke into and out of elevator hoistways. Of course, the assumption that elevator lobby doors will always be functional is a “leap of faith”.

Of course, the assumption that elevator lobby doors will always be functional is a “leap of faith”.

Those in the fire protection and fire safety field know that the fire protection and smoke protection provided by doors depends upon their operability, just like sprinkler protection. The reliability of fire door assemblies is notoriously low relative to the reliability of sprinkler protection. Simply because elevator lobbies are properly separated from other portions of the floor when the certificate of occupancy for the building is issued does not mean that the elevator lobby separation will remain functional during the life of the building.

Once again, with the benefits of providing elevator lobby separations questionable at best, the provision which requires elevator lobby separations in buildings provided with sprinkler protection appears to fail the “cost/ benefit test” outlined by the Executive Orders issued by President Clinton and President Obama.

### **Fire Service Elevators in Buildings Protected by a Sprinkler System**

The development of a safety device for elevators by Elisha Otis in the 1850's paved the way for the construction of high rise buildings. Since the construction of high rise buildings, fire department personnel have either used the exit stairs or the elevators to gain access to the upper stories of high rise buildings. In the wake of the collapse of a number of high rise buildings due to the terrorist attack on September 11<sup>th</sup>, a proposal to require a “fire service elevator” in buildings with a height greater than 120 feet was introduced in the code development process for the International Building Code. The purpose of this provision is to provide additional safety for fire department personnel utilizing elevators to gain access to the upper floors of high rise buildings.

Prior to the inclusion of the requirement for a “fire service elevator” in the 2009 edition of the International Building Code, fire departments seemed satisfied with using the same elevators as the occupants utilized to gain access to the building. Given that the provisions for the “fire service elevator” include a lobby and access between the lobby and an exit stair, the requirement for a fire service elevator will fundamentally transform the design of new high rise buildings.

Given that the provisions for the “fire service elevator” include a lobby and access between the lobby and an exit stair, the requirement for a fire service elevator will fundamentally transform the design of new high rise buildings.

The model building codes utilized in the United States all require that high rise buildings be protected throughout by a sprinkler system and a major fire has never occurred in a high rise building protected throughout by a sprinkler system since the early 1970's (when sprinkler protection first began to be installed in high rise buildings in the U.S.), except on September 11th. With this magnificent safety record, do the benefits of providing a "fire service elevator" justify the costs? It would seem that the answer to this question is obvious.

If the World Trade Center towers had been provided with a "fire service elevator" complying with the new provisions contained in the IBC, would the results of the September 11<sup>th</sup> terrorist attack on the towers been any different? More than likely, the answer to that question is no. Would the impact of the aircraft on the towers disabled the fire service elevator too? More than likely, the answer to that question is also yes.

Prior to the 1970's, fire service personnel were able to address fires in high rise buildings without the assistance of sprinkler protection, self-contained breathing apparatus (SCBA), modern protective clothing and a "fire service elevator". Given this, it seems reasonable to ask: what has changed in the fire service that makes it more difficult to fight fires in high rise buildings with all of the modern protection features the fire service now has available?

. . .and a major fire has never occurred in a high rise building protected throughout by a sprinkler system since the early 1970's (when sprinkler protection first began to be installed in high rise buildings in the U.S.), except on September 11th.

Are the benefits of a "fire service elevator" worth the costs? It would seem that the provisions for a "fire service elevator" also fails the "cost/benefit test" outlined in the two Executive Orders outlined above.

### **Smoke/Fire Dampers at Ventilation System Penetrations of Shaft Enclosures**

The requirement to install combination smoke/fire dampers at ventilation system penetrations of shaft enclosures was included in the Uniform Building Code for a number of years and this provision has migrated into the International Building Code. The purpose of the requirement is to limit the spread of smoke from the floor of fire origin to non-fire floors through the ventilation system. Is it necessary to provide combination smoke/fire dampers at penetrations of shaft enclosures in buildings provided with sprinkler protection?

The arguments for and against this requirement are essentially a mirror of the argument for elevator lobby separations. If elevator lobby separations are not necessary in buildings protected by a sprinkler system, it seems reasonable to conclude that combination smoke/fire dampers are also unnecessary, however, in the discussion of this code provision, the reliability of the dampers takes on even more importance.

Dampers in the ventilation system are even more unreliable than are fire doors in providing protection and are far more expensive to maintain.

Dampers in the ventilation system are even more unreliable than are fire doors in providing protection and are far more expensive to maintain.

In addition to the maintenance issue, the listing for combination smoke/fire dampers requires that a clearance between the damper and wall in which the damper is installed be maintained to allow for expansion of the damper assembly when the assembly is exposed to high temperatures. While the damper will reduce the movement of smoke through the ventilation system, the damper installation itself will allow the movement of smoke into the shaft due to the necessary clearance required so that the damper will operate properly.

If the provision for elevator lobby separations does not pass the “cost/benefit test” in buildings provided with sprinkler protection, then certainly the provision which requires the installation of combination smoke/fire dampers will not make the “cost/benefit” cut.

### **Area Limitations for Buildings Protected by a Sprinkler System**

Since the development of building codes in the early 1900's, the model codes have included provisions which relate the height and floor area of a building and the fire resistance of the structural elements of a building. Back in those days, the installation of sprinkler protection was rare, except in large industrial, mercantile and storage buildings. While relating structural fire resistance and building height seems logical given that building evacuation time and fire fighting time increases with building height, does it make sense to require increased structural fire resistance in low-rise buildings with larger floor areas where a building is protected by a sprinkler system? In low-rise buildings, evacuation time is principally determined by horizontal travel distance, and not vertical travel down stairs.

In buildings where the sprinkler system is operational and successfully controls the fire, structural fire resistance performs no function. The activation of sprinklers reduces the temperatures to which the structural elements of a building are exposed to in a fire and provides the necessary protection for all types of structural systems (because the water supply piping for the system is supported by the building structure and structure must remain stable in order for the sprinkler protection to remain functional). The only question with respect to the structural fire protection provided by sprinklers is the reliability of sprinkler protection.

The argument that will be made in favor of retaining the area limitations for buildings provided with sprinkler protection is the reliability issue. That issue has been previously addressed above. In the event of a sprinkler system failure in a building with a large area, fire fighters conduct interior manual fire fighting operations at great peril to themselves. The lessons of the Sofa Super Store in Charleston, South Carolina indicate that even a relatively small building without sprinkler protection can be dangerous from a fire fighting operations standpoint.

With respect to fire fighter safety, the record is clear—fire fighter fatalities in buildings protected by a sprinkler system are rare. Given the safety record of sprinklered buildings, both in terms of occupant fire safety and in terms of fire fighter safety, the benefits of applying area limitations to sprinklered buildings are questionable. If the benefits are questionable, then the area limitations provisions would fail the “cost/benefit test” contained in the Executive Orders.

## Conclusion

In many ways, the model code utilized throughout the United States, the International Building Code, is antiquated even though the International Building Code has only been in existence for a little over 10 years. The concept of “balanced fire protection” being “pushed” by the lobbyists representing passive fire protection interests was a big step backward in building fire safety regulation.

Who can argue with the concept of efficient and effective regulation of building safety (other than the lobbyists representing manufacturers who would lose market share)?

President Clinton’s Executive Order dating back to 1993 and President Obama’s recent Executive Order provide a methodology for improving the code, retaining provisions which are essential to the protection of both the public and fire fighters, while at the same time reducing construction costs and, hence, costs to the public.

President Clinton’s and President Obama’s Executive Orders are all about the efficient use of regulation and our capital resources. Who can argue with the concept of efficient and effective regulation of building safety (other than the lobbyists representing manufacturers who would lose market share)?

. . .the goal of the fire service should be to deliver public fire protection in the most cost-effective and efficient means possible.

It is likely that the fire service may object to a strict “cost/benefit” analysis being utilized to determine what provisions belong in our model building codes, but the goal of the fire service should be to deliver public fire protection in the most cost-effective and efficient means possible. To date, the best, most reliable and, typically, the most cost-effective means of delivering fire protection for the public is sprinkler protection.

\* \* \* \* \*

Copyright © 2011 Richard C. Schulte  
All Rights Reserved

**[Editor’s Note:** The statistics on the reliability of sprinkler systems cited in this article are based upon a study published by the National Fire Protection Association (NFPA) dated February 2010. The NFPA has published a more recent study of the reliability of sprinkler systems. This study titled “*U.S. Experience with Sprinkler and Other Automatic Fire Extinguishing Equipment*” authored by John R. Hall, Jr. of the NFPA Fire Analysis and Research Division is dated September 2010. The September 2010 study includes a sprinkler system reliability statistic lower than that contained in the February 2010 study. (Editor’s note dated February 13, 2011).]

**Editor’s Note:** Richard Schulte is a 1976 graduate of the fire protection and safety engineering program at the Illinois Institute of Technology (IIT) in Chicago. Schulte worked as the fire protection engineer for the San Jose (California) Fire Department from 1980-1982. Schulte was named as one of ENR’s “Top 25 Newsmakers of 2004” by Engineering News-Record for his work on critiquing the National Institute of Standards and Technology (NIST) investigation into the collapse of the World Trade Center towers on 9/11.