CONCRETE AND MASONRY INDUSTRY POSITION STATEMENT ON

FIRE SAFETY IN HIGH-RISE BUILDINGS*

The Concrete and Masonry Industry recognizes the need for a program to increase fire safety and reduce property loss for high-rise buildings.

The Fire Safety Committee of the Concrete and Masonry Industry recommends that the following basic principles of building design, construction and materials be considered and adopted in order to safeguard the welfare of individuals, property and the community from fire:

1. The fundamental axiom in fire safety for high-rise buildings is that the building must remain intact throughout the fire and offer refuge for the occupants until they can be evacuated. There must be no structural failure should there be a burnout in any portion of the building.

2. New building code regulations for high-rise buildings should be directed towards reducing fire hazards that are not now adequately regulated.

3. Compartmentation, smoke control, and early detection constitute a viable basis for high-rise fire safety.

4. Use of combustible structural elements, insulation and finishes should be carefully restricted and controlled.

5. Automatic fire-suppressing systems (sprinklers) should be required for hazardous areas and for occupancies with high combustible contents.

6. Automatic fire-suppressing systems (sprinklers) should be in addition to compartmentation within a story.

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*From a fire protection standpoint, high-rise buildings are all structures that rise more than 75 to 80 feet above ground level. However, the principles stated herein should also apply to lower buildings not classified as high-rise structures.

1. The fundamental axiom in fire safety for high-rise buildings is that the building must remain intact throughout the fire and offer refuge for the occupants until they can be evacuated. There must be no structural failure should there be a burnout in any portion of the building.

The collapse of a multistory building would not only be dangerous to firemen and occupants still in the buildings, but also would constitute a hazard to people and property around the building and could result in disastrous losses to the building itself.

Fire ratings of floors and structural elements should not be reduced until codes have adopted a more rational and definitive basis for determining both the performance requirements (code-required fire ratings) and the methods to determine performance in fire (rating assigned to structures). Current methods for determining requirements and ratings are largely based on adverse experience and laboratory tests that, for the most part, are not representative of actual fire conditions. Safety factors for buildings in actual fires are not presently known with a high degree of accuracy. Structural elements having a 2-hour or greater fire rating have performed well under a variety of fire conditions typically found in high-rise buildings, however, using the present system, it is not possible to extrapolate with confidence from this experience to predict a performance record for structures having lower ratings for the same variety of conditions.

Recent studies indicate that a basis for determining structural life safety is feasible. This should make it possible in the future to develop criteria for performance and design with sufficient reliability to re-evaluate structural fire requirements as to achieve an optimum balance of safety and economy. Thereafter, code changes in the fire ratings for high-rise buildings may be desirable.

2. New building code regulations for high-rise buildings should be directed towards reducing fire hazards that are not now adequately regulated.

Actual fires and studies have disclosed that hazardous conditions may exist in modern high-rise buildings resulting from the use of materials and design features without sufficient consideration of their influence on fire safety. These may include: use of combustible and smoke-generating materials; inconvenient access to exits; large open areas without compartmentation; large exterior openings contributing to fire spread from story to story outside the building; elevator controls; and mechanical systems that do not provide for quick exhausting of exit corridors and stairwells.

Also, other studies have increased the understanding of conditions having an adverse affect on fire safety in modern high-rise buildings. These conditions include stack effects that contribute to the spread of fires, smoke, and toxic gases; unreasonable time required for evacuation of occupants; and difficulties of fighting fires from the outside due to the limitations of present-day fire fighting equipment. These problems can be controlled by code regulation of design and construction.

In developing new regulations it is important that "trade offs" do not, in effect, eliminate old hazards by creating new hazards.

3. Compartmentation, smoke control, and early detection constitute a viable basis for high-rise fire safety.

Compartmentation consists of enclosing each story, and each stairwell, elevator, and service shaft to form an effective barrier. Each story should also be divided into two or more compartments. The layout of compartments must be based on restricting the fire, protecting occupants during evacuation and rescue operations, and providing safe places of refuge. Compartments should be separated by fire-resistive barriers which also control smoke movement. Special attention should be given to maintaining separation at openings by installation of appropriate self-closing doors, dampers, etc. Means of egress such as corridors, vestibules, and stairs may require mechanical smoke control devices. Early fire and smoke detection is essential to notify fire fighting services, to activate protective devices and equipment, and to warn occupants.

4. Use of combustible structural elements, insulation and finishes should be carefully restricted and controlled.

Older high-rise buildings, built to early code requirements, often are less hazardous than some modern buildings. One of the primary reasons for this is the use of greater amounts of combustible materials and materials causing greater flame spread and/or smoke propagation in newer buildings. This hazard can and should be limited. Tight controls should be placed on materials used for all elements of the building, including secondary structural members, insulation, and finishes. Realistic criteria for combustibility and for smoke and gas production should be developed and used. Consideration should be given to limiting the use of highly combustible contents, such as furnishings. While control of contents in most occupancies may presently represent a seemingly insurmountable obstacle for local law enforcement, it is practical for institutional occupancies, and other high-population-density occupancies such as hotels and dormitories.

5. Automatic fire-suppressing systems (sprinklers) should be required for hazardous areas and for occupancies with high combustible contents.

Automatic fire-suppressing systems, such as sprinklers, are required for these areas by most modern building codes. These extinguishment requirements have typically been, and should continue to be, in addition to basic fire resistance and compartmentation requirements.

Weakening the integrity of the building by reducing the fire resistance of the structural elements based on introduction of sprinklers may not be safe and is presently not supported by experience. To do so is to jeopardize the one feature of high-rise buildings that has a nearly perfect record – structural integrity. While many medium- and low-rise buildings with lower fire resistance requirements and some with extremely high fire loads have collapsed, the structural failure of a properly designed high-rise building due to fire has never occurred. To the contrary, cases are recorded where the structural integrity of concrete high-rise buildings offered refuge to people in parts of the burning building during fires lasting many hours.

If sprinklers malfunction or otherwise fail to control a fire, the building is no better protected than if the sprinklers were not present. History is replete with examples of tragedies resulting from mechanical or electrical failures, including sprinkler failures. One closed valve, for whatever reason, can completely negate the protection of a sprinkler system. Also, rates of water flow may vary and a sprinkler system may not provide the protection as the design indicates.

During earthquakes, sprinklers may fail, thus increasing the probability of serious fire. Following the San Fernando, California, earthquake in 1971, it was reported that nearly half of the sprinkler systems in the affected area were damaged.

Fire ratings based on heat transmission through structural members could be reduced when sprinklers are provided (except for designated areas of refuge), if building codes would separate the structural and heat-transmission fire ratings. One state code already has divided ratings into structural and heat transmission. The transmission rating is one-half of the structural rating, thereby emphasizing the greater importance of structural integrity. For example, when a 2-hour floor rating is required, it would be appropriate to consider limiting the heat transmission criteria to one-half the endurance period (one hour or perhaps less), provided the structural fire endurance of the floor remained 2 hours. This approach, which is also sound for some occupancies without sprinklers, differentiates between the relative consequences of structural failure and excessive heat transmission. Furthermore, heat transmission through an assembly is not affected by variations in loading, span, and conditions of support found in buildings. Results of the standard test for heat transmission can be used with a relatively high degree of confidence. On the other hand, variations in the loading, span and support conditions in actual buildings can produce results in structural performance that do not compare with a standard fire test, therefore, fire ratings higher than the anticipated fire severities are required in order to maintain an acceptable confidence level.

6. Automatic fire-suppressing systems (sprinklers) should be in addition to compartmentation within a story.

Automatic fire-suppressing systems, such as sprinklers, should be used where large non-compartmented areas exist within a story (where flashover of an incipient fire would involve large areas within a short period of time). However, sprinklers or other systems should not be substituted for: structural fire resistance; compartmentation between floors; compartmentation of stairwells, elevator or service shafts; or compartmentation between tenants. Nor should sprinklers be used as a reason for increasing the use of combustible materials.

The Concrete and Masonry Industry Fire Safety Committee is composed of representatives from:

Brick Institute of America
Concrete Reinforcing Steel Institute
Expanded Shale, Clay and Slate Institute
National Concrete Masonry Association
National Ready-Mix Concrete Association
Portland Cement Association
Prestressed Concrete Institute

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