fire protection planning report

BUILDING CONSTRUCTION INFORMATION FROM THE CONCRETE AND MASONRY INDUSTRIES

NO. 1 OF A SERIES

Firesafety in Residential Buildings

Concrete and masonry low-rise apartments help to increase firesafety and decrease property loss. It is unfortunate that many communities permit low-rise multifamily buildings to be built with the same combustible materials as can be used in single-family residences.

The need for firesafe construction in single-family homes, townhouses, and garden apartments is often ignored. The steady growth of multifamily, low-rise buildings (townhouses with common walls and apartment buildings of three or four floors), which are constructed essentially the same as single-family residences but with many families living under one roof, multiplies the fire danger.

More fires, and fire deaths and destruction occur in residential buildings than in any other type of building. In 1974, 57% of fire deaths, 71% of building fires, and 34% of property loss from all types of fires occurred in residences. Annual estimated building fire losses in the United States are $3,260,000,000 of which $1,302,800,000 are for residences. It is estimated that 12 people die in high-rise building fires each year, while 6,600 die in fires in low-rise and single-family buildings. Yet firesafety concern continues to be concentrated on high-rise buildings.

This condition will continue until action is taken to demand firesafe materials and construction methods for low-rise residences.

Factors contributing to the problem:

1. Low-rise multifamily building construction is increasing.
2. Many low-rise apartment buildings are being constructed to much the same standards as single-family residences.
3. Building and fire code requirements for single-family and low-rise multifamily construction are much less stringent than they are for high-rise residential buildings.

Suggestions for dealing with the problem:

1. Regulatory codes and laws governing construction, which are intended to protect the public's safety and property, must be changed to realistically fulfill that intent.

Table 1. Comparison of Estimated U.S. Building Fire Losses by Occupancies

	Number of Fires		Estimated Loss	
	1973	1974	1973	1974
Residential	795,800	901,000	$1,103,400,000	$1,302,800,000
Public assembly	34,100	47,000	155,000,000	181,400,000
Educational	24,100	35,500	99,000,000	124,800,000
Institutional	21,600	31,500	23,900,000	39,400,000
Mercantile and office	76,100	86,800	366,700,000	432,600,000
Basic industry, defense, and utility	6,900	7,200	76,300,000	88,400,000
Manufacturing	40,400	53,000	364,400,000	584,900,000
Storage	57,300	68,500	300,000,000	434,300,000
Other buildings	30,200	39,500	48,500,000	71,400,000
Totals	1,086,500	1,270,000	$2,537,200,000	$3,260,000,000

These estimates by the National Fire Protection Association are intended to show the relative order of magnitude of fire losses by occupancies. While they are reasonable approximations based on experience in typical states, they are not exact records for each class.

2. Construction methods and materials that will effectively minimize fire hazards should be required by all building codes. The same fire-resistant materials and methods should be required for low-rise construction as are now required for high-rise construction.
3. Active upgrading of safety conditions for all types of residences is the responsibility of everyone in the construction industry. Building code and fire officials, especially, should take the lead in the development and enforcement of an upgraded building code.

Building Codes

Building code changes to bring the construction requirements for low-rise apartment buildings close to those for high-rise apartment buildings should include the following:

—Noncombustible materials for building envelopes, floors, and party walls.

—Provision for proper exits, building separations, and compartmentation.

—Provision for combustion detectors and alarms to warn residents of danger from smoke and toxic fumes generated by fire.

—Provision for flame-suppressant systems, such as automatic sprinklers, to control damage within a compartment and to assist fire fighters. Codes, however, should not permit substitution of sprinklers for adequate structural fire resistance and compartmentation. If the codes permit less stringent fire-resistant construction when sprinklers or other devices are used, adequate safety will not be provided when these electrical and mechanical devices fail to operate.

—Careful examination of fire-testing provisions for the selection of materials to ensure that the testing reflects actual conditions.

Table 2. Estimated Annual U.S. Fire Costs

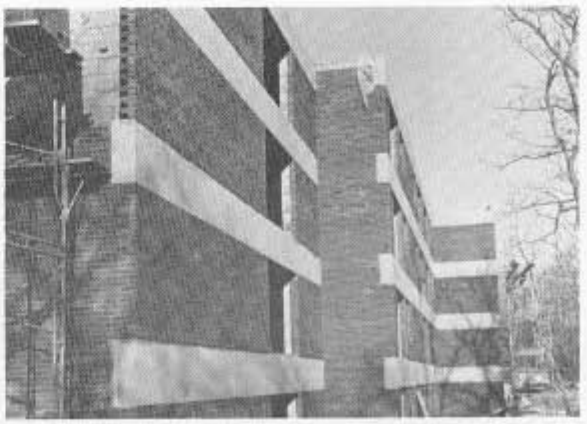
Property loss (all types)	$ 2,700,000,000
Fire department operations	2,500,000,000
Burn-injury treatment	1,000,000,000
Operating cost of insurance industry	1,900,000,000
Productivity loss	3,300,000,000
Total	$11,400,000,000

Source: National Commission on Fire Prevention and Control, May 1973.

Table 3. Type of Residential Building Construction

1960	79%	one- and two-family units
	11%	low-rise apartment units
	10%	high-rise apartment units
	100%	
1972	55%	one- and two-family units
	35%	low-rise apartment units
	10%	high-rise apartment units
	100%	

There is a steady increase in low-rise apartment and townhouse construction each year. As more families are housed in multifamily units, they find their lives and property at the mercy of others who live in the same building.



Low-rise apartment building for the elderly combines cast-in-place floors with brick and block walls. It has a two-hour fire-rated floor system.

Fire Resistance

The fire rating of a building element is determined by its resistance to damage under standard fire-test conditions. The time and temperature relationship of the standard fire test is shown in Fig. 1.

Admittedly the standard fire test is not representative of many fires as they actually occur. Some materials that are now classified with rather high fire-resistance ratings actually contribute fuel to a fire. This is not true of concrete, which is fire resistant and an excellent protection against the spread of fire. Fig. 2 is a chart of the fire resistance of reinforced concrete floors for various thicknesses based on temperature transfer. Fig. 3 gives the fire resistance for concrete masonry and solid concrete walls.

Compartmentation

The amount of damage done by a fire depends on the fuel available, detection time, fire suppression capacity of the fire department and of automatic equipment, and the containment of the fire within a manageable area. Buildings designed to prevent fire or smoke and gas from spreading beyond certain defined areas are said to be compartmented. Compartmenting each family unit of low-rise apartment buildings by concrete, concrete masonry, or brick walls is an effective means of controlling and limiting the spread of fire.

Fire suppression systems such as sprinklers, no matter how sensitive, are not totally reliable. Provision for fire-resistant walls and floors for building compartments should never be compromised in order to reduce costs.

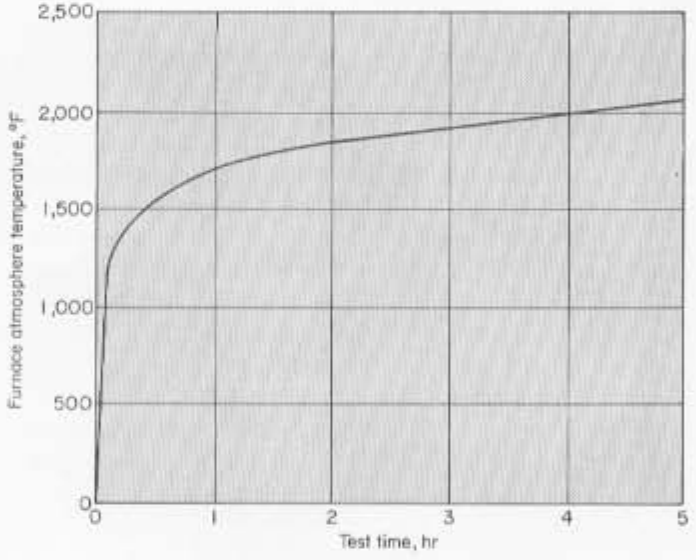
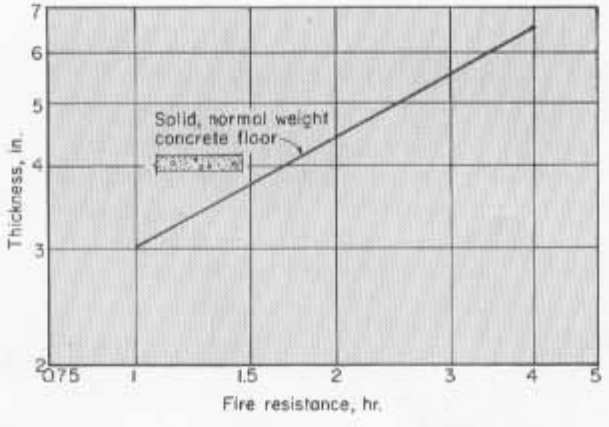
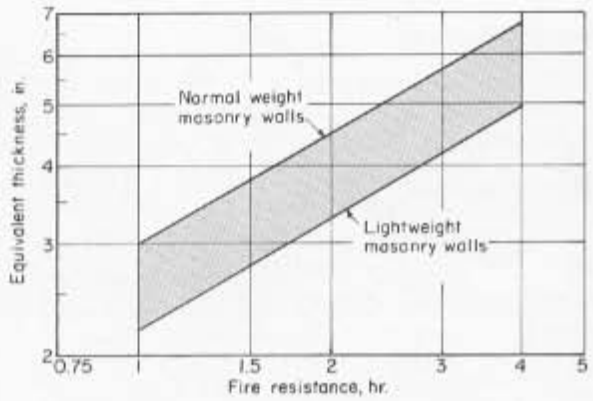


Fig. 1. Standard ASTM time-temperature curve. Standard Methods of Fire Tests of Building Construction and Materials (ASTM E119), under which tests are conducted, specifies the intensity of the fire, size of specimen, and criteria for the end point of test. The principal criteria are (1) the structure must carry its design load throughout the test without allowing passage of flame or gasses hot enough to ignite cotton waste; and (2) the unexposed surface temperature shall not rise more than 250 deg. F. as an average nor 325 deg. F. at any point. The fire resistance or endurance is the time from the beginning of the test until an end point is reached. Many features of these test standards are inconsistent with the conditions that actually occur during a fire and there is a need now for reviewing and revising them.



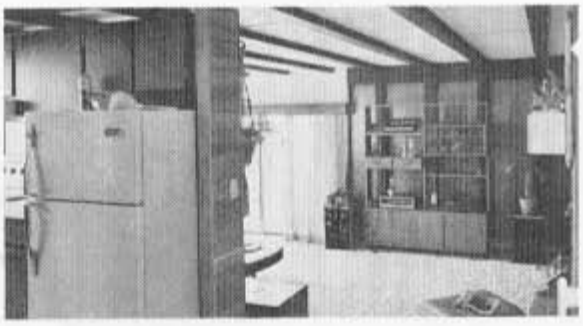
Source: *Fire Resistance of R/C Floors*, PCA 1963.

Fig. 2. Fire resistance and thickness relationship for solid, normal-weight reinforced concrete floors, based on a suggested rating for heat transfer, is conservative and is compiled from tests of concrete floors made with seven different aggregate types. High fire resistance is a quality inherent in concrete floors. Note that a 5½-in.-thick floor is ample for a 3-hour fire rating. Concrete does not contribute to flame, heat, or smoke, and it does not depend on the proper operation of sprinkler systems to maintain protective capacities during a fire.



Source: National Concrete Masonry Association, *Estimating the Fire Resistance of Concrete Masonry*, 1966.

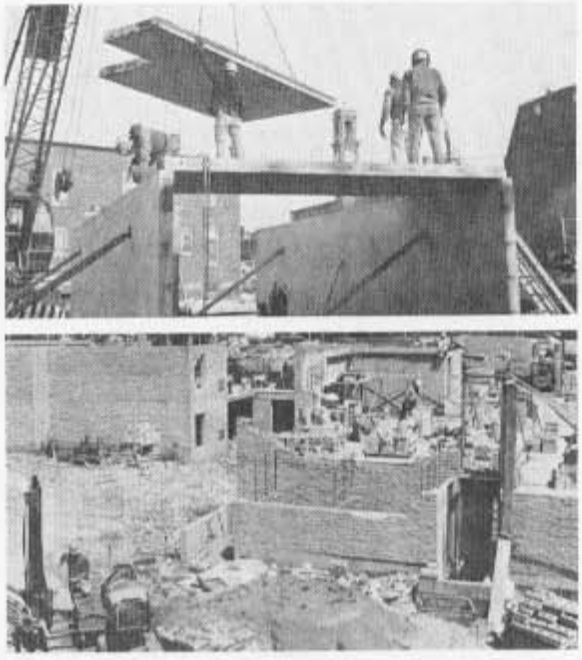
Fig. 3. The fire resistance and thickness relationship of concrete masonry walls, based on heat transfer, was developed from fire tests of walls made of normal-weight and lightweight aggregates. Concrete walls have the ability to provide safety during and after fire exposure by containing the fire and maintaining structural integrity.



Should the furnishings or finishes in this apartment be on fire, the all-concrete walls, floors, and exposed beams will prevent the fire from spreading to other apartments and protect the property and lives of the other residents.

Fire Hazards

The use of flammable and smoke-generating plastics for interior finishes, insulation, and furnishings creates a potential for increased property damage and loss of life. Building codes and life safety codes do not now adequately regulate use of these materials. Realistic criteria are needed for determining the combustibility of materials and their potential gas and smoke generation capabilities. Tighter controls must be established over materials used in residential furnishings as well as in building construction.



Concrete and masonry construction materials provide needed firesafety for residents of low-rise apartment buildings.

Summary

Fire deaths, injuries, and property loss in single-family and low-rise multiple-occupancy buildings are a serious, growing problem.

Present standards for high-rise construction are much more comprehensive and restrictive than for low-rise construction. Requiring the same fire-resistant materials and methods for low-rise residential construction as for high-rise residential construction will be a major step in improving the firesafety of all residential buildings.

Active upgrading of firesafety for residential buildings is the responsibility of everyone in the building industry.

Associations represented on the
CONCRETE AND MASONRY INDUSTRY FIRESAFETY COMMITTEE

BIA – Brick Institute of America
CRSI – Concrete Reinforcing Steel Institute
ESC&SI – Expanded Shale, Clay and Slate Institute
NCMA – National Concrete Masonry Association
NRMCA – National Ready Mixed Concrete Association
PCA – Portland Cement Association
PCI – Prestressed Concrete Institute

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