



JENSEN HUGHES

Advancing the Science of Safety

HOT NEW TRENDS IN BUILDING CLADDING: CODE REQUIREMENTS FOR FIRE RATING ASSEMBLIES IN BUILDING ENVELOPE

Jeff Harris & Andy Lianto

January 18, 2018

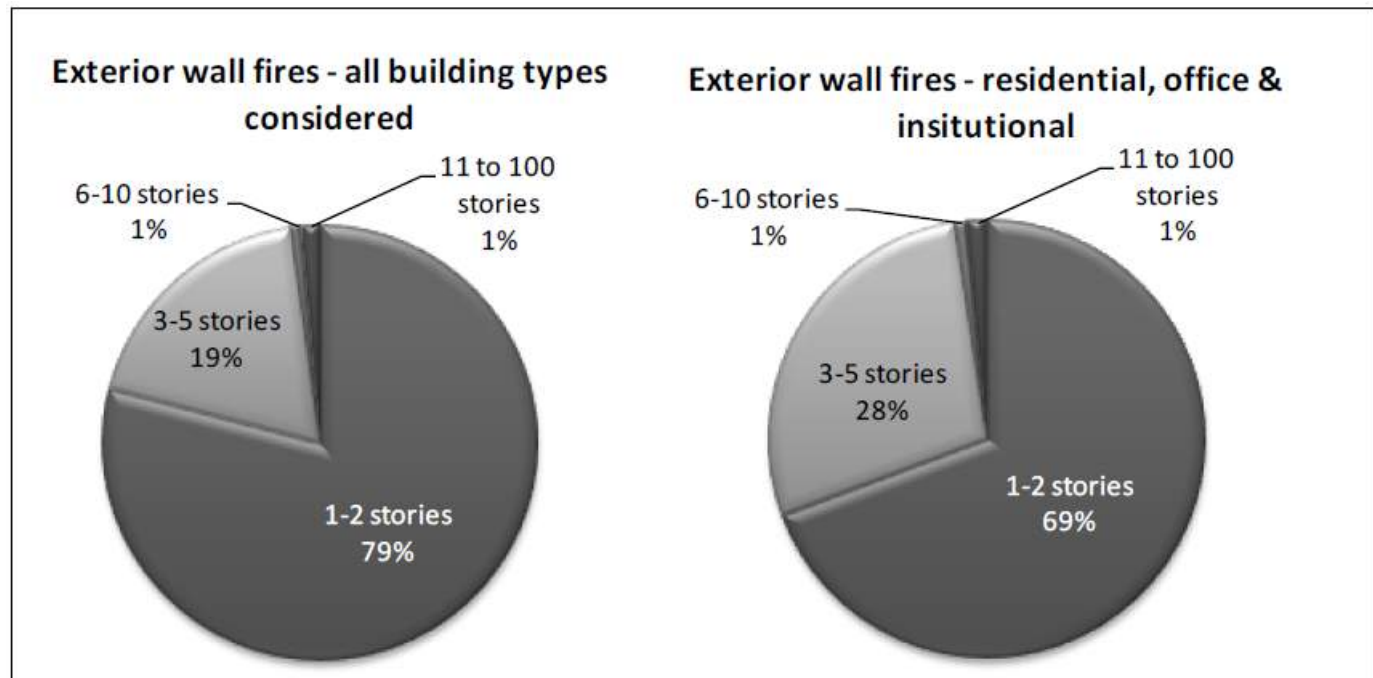
FIRE RISK



FIRE SPREADING ON EXTERIOR WALLS

2014 Fire Protection Research Foundation, NFPA

- Percentage of Exterior Wall Fires by Building Height



FIRE FROM ENCLOSED SPACES : ATTICS



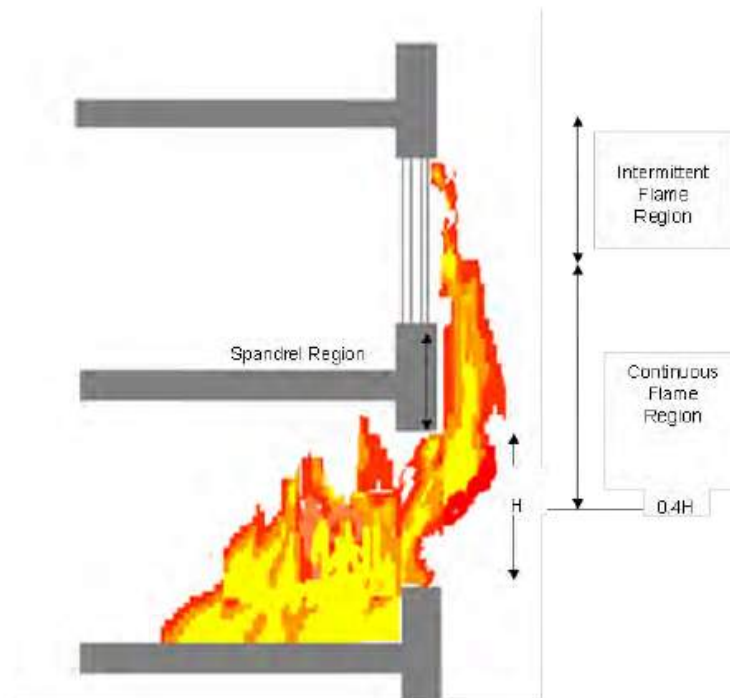
SOURCES OF IGNITION



SOURCES OF IGNITION



FLAME SPREAD- INSIDE OUT



Enclosure fire and floor to floor fire spread



BUILDING CODES: REDUCING RISKS

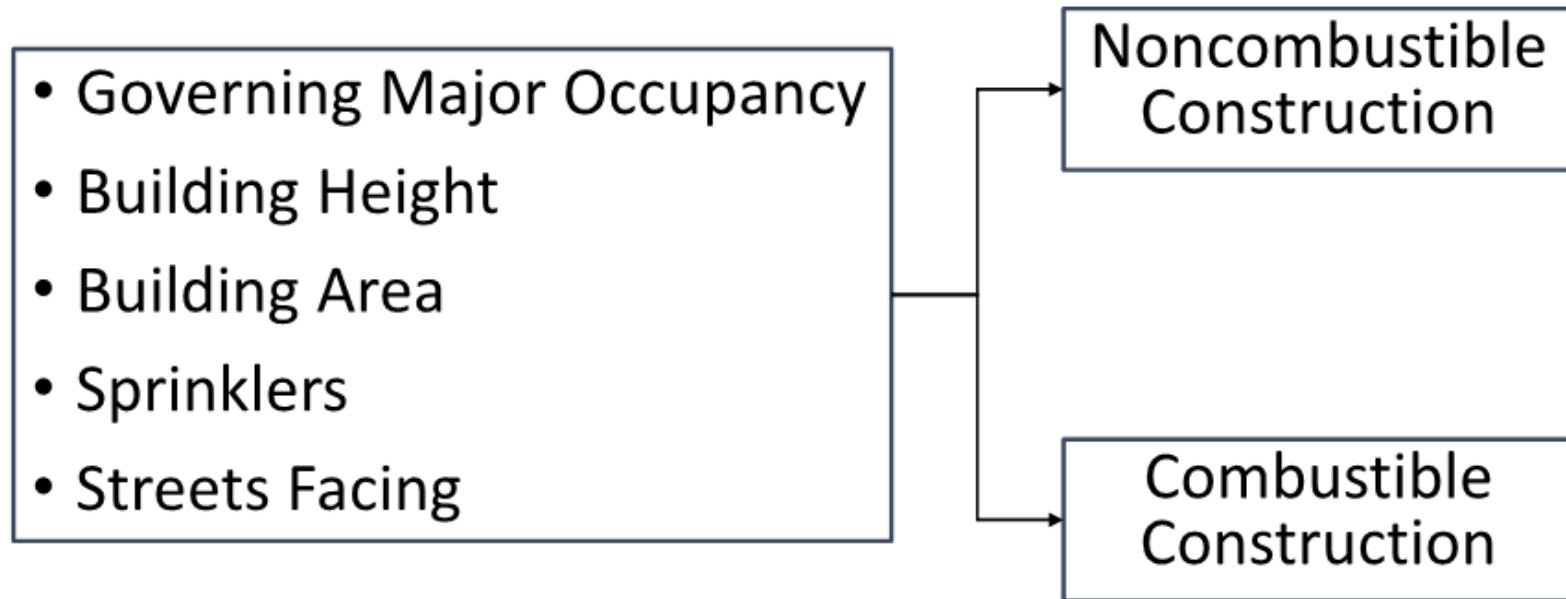
CANADIAN CODE REQUIREMENTS

- PART 3

- PART 9



BUILDING CHARACTERISTICS – SUBSECTION 3.2.3.



SPATIAL SEPARATION: % OF UNPROTECTED OPENINGS (UPO)

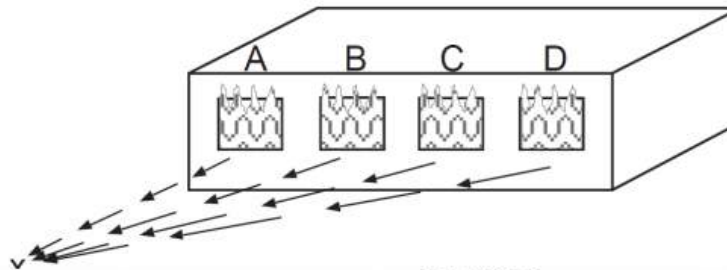
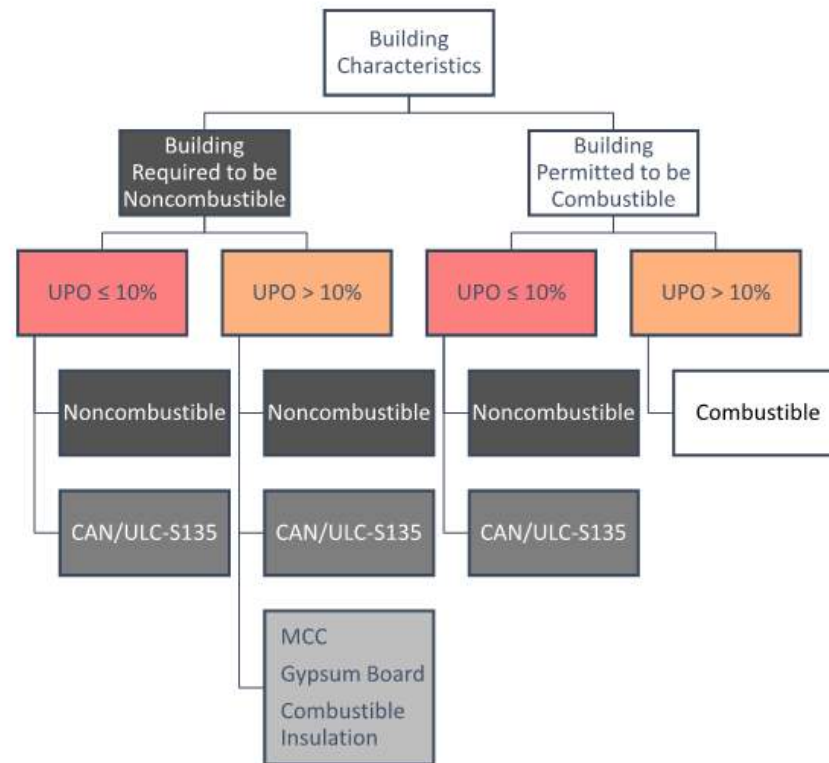


Table 3.2.3.1.D
Unprotected Opening Limits for a Building or Fire Compartment that is Sprinklered Throughout
 Forming part of Article 3.2.3.1.

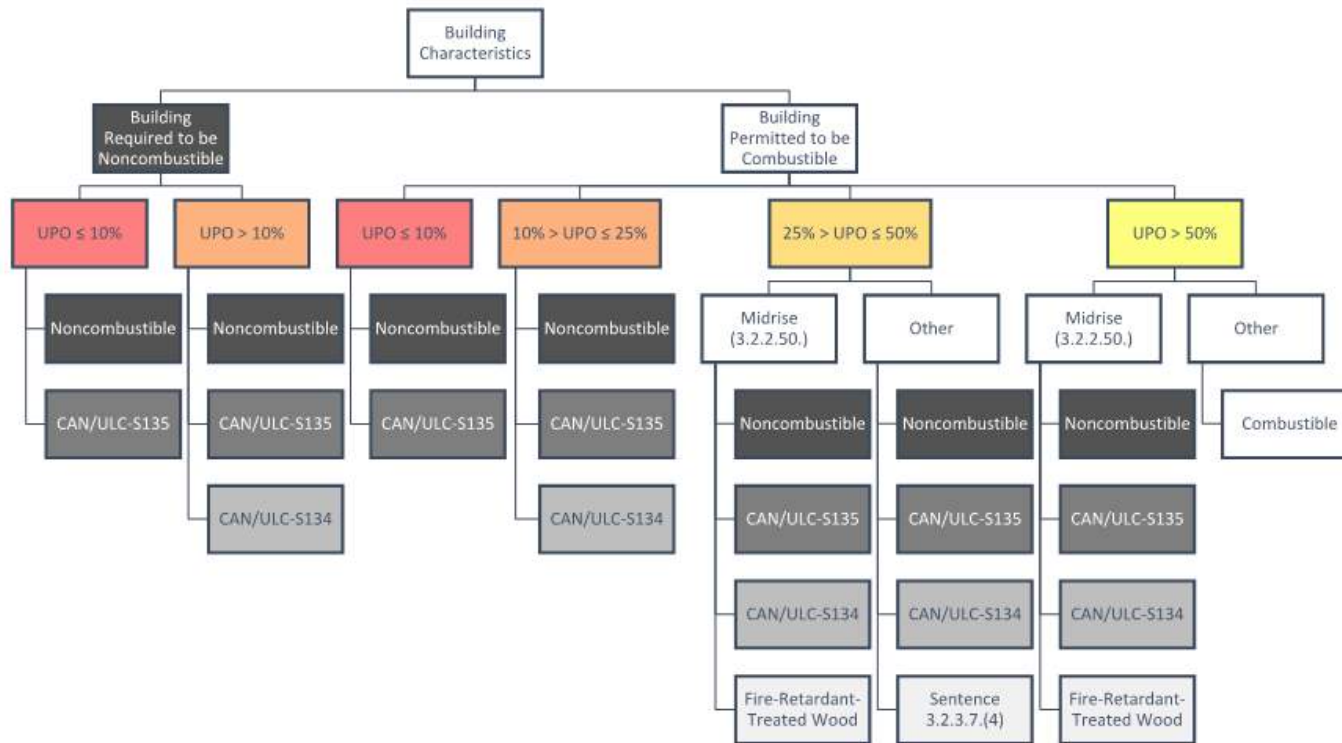
Exposing Building Face	Area of Unprotected Opening for Groups A, B, C, D and F, Division 3 Occupancies, %											
	Limiting Distance, m											
Max. Area, m ²	0	1.2	1.5	2.0	2.5	3	4	5	6	7	8	9
10	0	16	24	42	66	100						
15	0	16	20	34	50	74	100					
20	0	16	20	30	42	60	100					
25	0	16	18	26	38	52	90	100				
30	0	14	18	24	34	46	78	100				
40	0	14	16	22	30	40	64	96	100			
50	0	14	16	20	28	36	56	82	100			
60	0	14	16	20	26	32	50	72	98	100		
80	0	14	16	18	22	28	42	58	80	100		
100	0	14	16	18	22	26	36	50	68	88	100	
150 or more	0	14	14	16	20	22	30	40	52	66	82	100



REQUIREMENTS – EXTERIOR WALL CONSTRUCTION



REQUIREMENTS – CLADDING



TEST STANDARDS – CAN/ULC-S114 AND –S135

CAN/ULC-S114, “Standard Method of Test for Determination of Non-Combustibility in Building Materials”

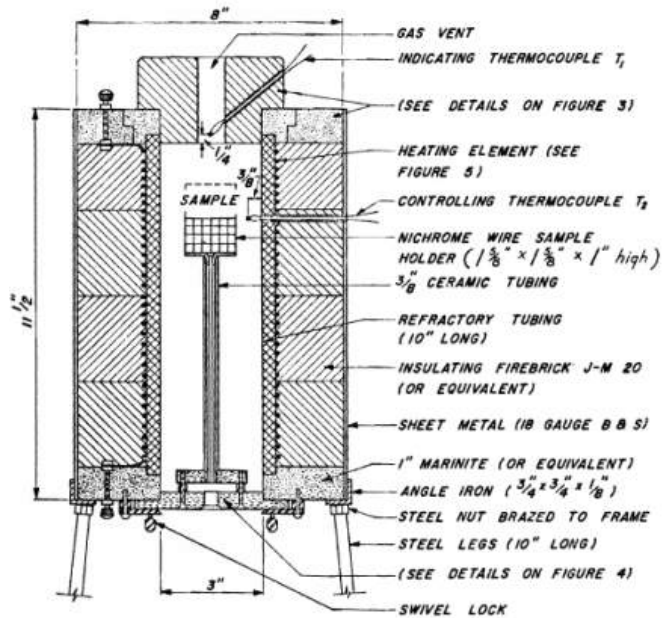
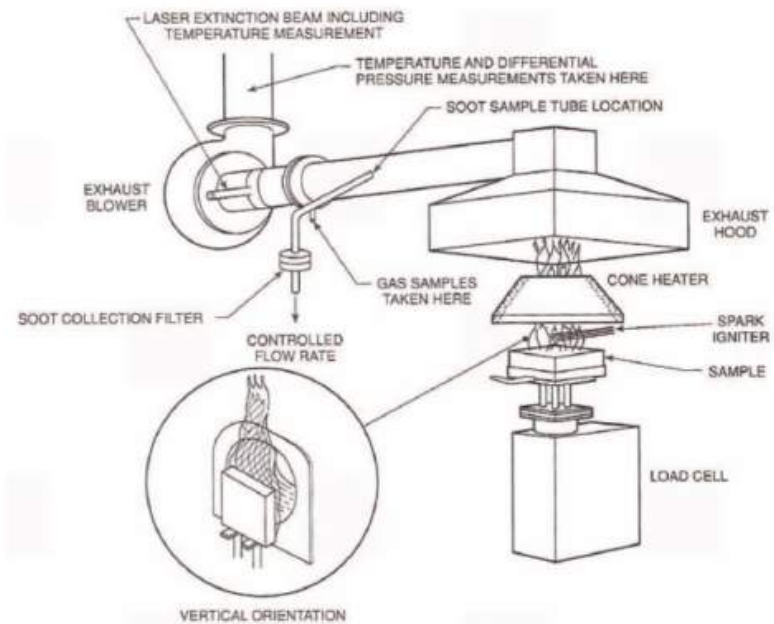
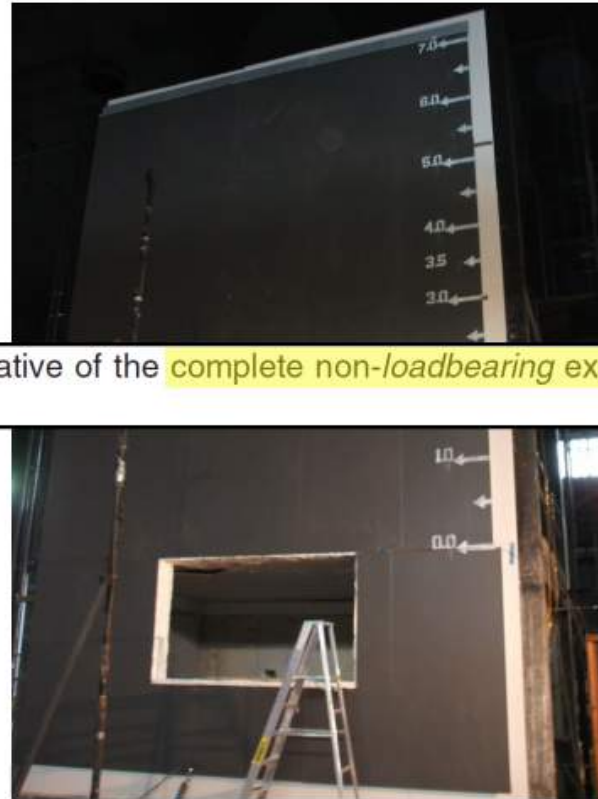
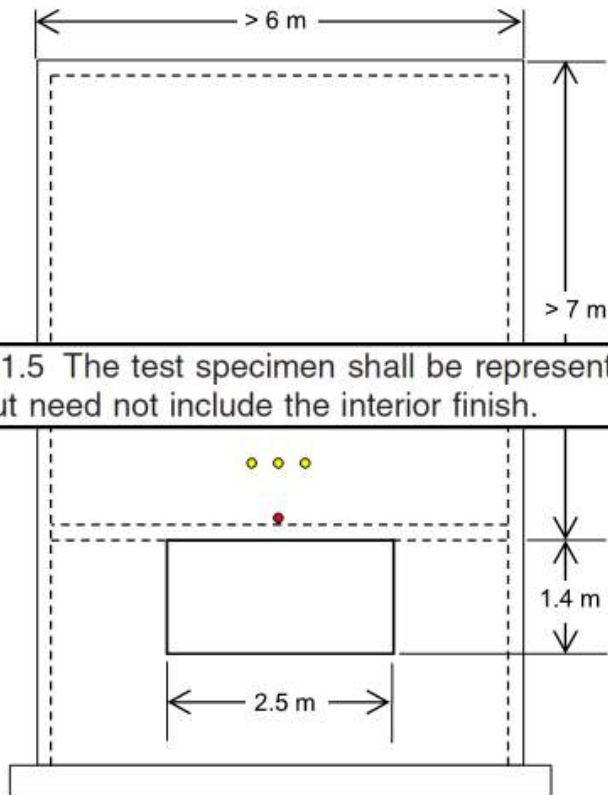


FIGURE 2
DIAGRAM OF COMBUSTIBILITY FURNACE

CAN/ULC-S135, “Standard Test Method for the Determination of Combustibility Parameters of Building Materials Using an Oxygen Consumption Calorimeter (Cone Calorimeter)”



TEST STANDARDS – CAN/ULC-S134



6.1.5 The test specimen shall be representative of the **complete non-loadbearing exterior wall assembly** but need not include the interior finish.



MINOR COMBUSTIBLE COMPONENTS (MCC)

3.1.5.2. Minor Combustible Components

1) The following minor *combustible* components are permitted in a *building* required to be of *noncombustible* construction:

- a) paint (see also Sentence 3.1.5.10.(1)),
- b) mastics and caulking materials, including foamed plastic air sealants, applied to provide a seal between the major components of exterior wall construction, (see also Article 3.6.4.3. for limits on the use of *combustible* materials in *plenum* spaces),
- c) <fire stops and fire blocks> conforming to Sentence 3.1.9.1.(1) and Article 3.1.11.7.,
- d) tubing for pneumatic controls provided it has an outside diameter of not more than 10 mm,
- e) adhesives, *vapour barriers* and sheathing papers,
- f) electrical outlet and junction boxes,
- g) wood blocking within wall assemblies intended for the attachment of handrails, fixtures, and similar items mounted on the surface of the wall, and
- h) similar minor components.

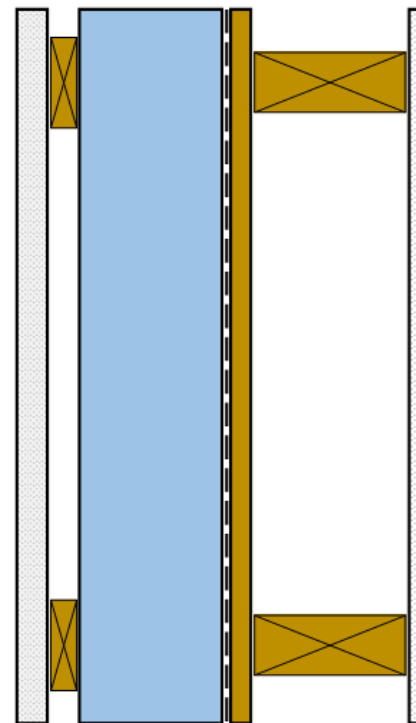


COMBUSTIBLE CONSTRUCTION: FOAMED PLASTIC INSULATION

Exterior

UPO > 10%
Building Height > 3 Storeys

1. Concrete or masonry ≥ 25 mm,
or
2. NC protective material tested for
15 min to CAN/ULC-S101,
or
3. CAN/ULC-S134 Test

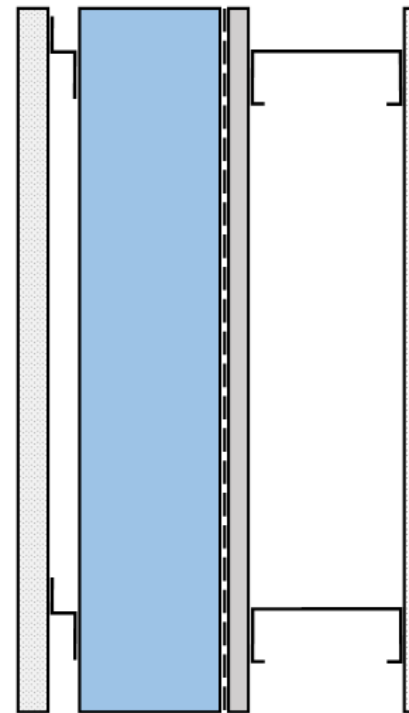


NONCOMBUSTIBLE CONSTRUCTION: FOAMED PLASTIC INSULATION

Exterior

UPO > 10%
Building Height > 3 Storeys

1. Concrete or masonry ≥ 25 mm,
or
2. NC protective material tested for
15 min to CAN/ULC-S101,
or
3. CAN/ULC-S134 Test



U.S. CODE REQUIREMENTS:

- IBC
- IRC



IBC: The (not so) International Building Code: Height

TABLE 504.3*
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION								
		TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
A, B, E, F, M, S, U	NS ^b	UL	160	65	55	65	55	65	50	40
	S	UL	180	85	75	85	75	85	70	60
H-1, H-2, H-3, H-5	NS ^{c,d}	UL	160	65	55	65	55	65	50	40
	S			65	55	65	55	65	50	40
H-4	NS ^{c,d}	UL	160	65	55	65	55	65	50	40
	S	UL	180	85	75	85	75	85	70	60
I-1 Condition 1, I-3	NS ^{d,e}	UL	160	65	55	65	55	65	50	40
	S	UL	180	85	75	85	75	85	70	60
I-1 Condition 2, I-2	NS ^{d,f,g}	UL	160	65	55	65	55	65	50	40
	S	UL	180	85	75	85	75	85	70	60
I-4	NS ^{d,g}	UL	160	65	55	65	55	65	50	40
	S	UL	180	85	75	85	75	85	70	60
R	NS ^{d,h}	UL	160	65	55	65	55	65	50	40
	S13R	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	85	70	60

For SI: 1 foot = 304.8 mm.

Note: UL = Unlimited; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2.

- a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.
- b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.
- c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.
- d. The NS value is only for use in evaluation of existing building height in accordance with the *International Existing Building Code*.
- e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies, Condition 1, see Exception 1 of Section 903.2.6.
- f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and Section 1103.5 of the *International Fire Code*.
- g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.
- h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.



IBC – Building Area

TABLE 506.2¹
ALLOWABLE AREA FACTOR (A, NS, S1, S1Z, or SM, as applicable) IN SQUARE FEET

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION									
		TYPE I		TYPE II		TYPE III		TYPE IV		TYPE V	
		A	B	A	B	A	B	HI	A	B	
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	15,000	11,500	6,000	
	S1	UL	UL	62,000	34,000	56,000	34,000	60,000	46,000	22,000	
	SM	UL	UL	48,500	25,500	42,000	25,500	45,000	34,500	16,500	
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000	
	S1	UL	UL	62,000	38,000	56,000	38,000	60,000	46,000	24,000	
	SM	UL	UL	48,500	28,500	42,000	28,500	45,000	34,500	18,000	
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000	
	S1	UL	UL	62,000	38,000	56,000	38,000	60,000	46,000	24,000	
	SM	UL	UL	48,500	28,500	42,000	28,500	45,000	34,500	18,000	
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000	
	S1	UL	UL	62,000	38,000	56,000	38,000	60,000	46,000	24,000	
	SM	UL	UL	48,500	28,500	42,000	28,500	45,000	34,500	18,000	
A-5	NS										
	S1	UL	UL	UL	UL	UL	UL	UL	UL	UL	
	SM										
B	NS	UL	UL	37,500	21,000	28,500	19,000	36,000	18,000	9,000	
	S1	UL	UL	150,000	92,000	114,000	76,000	144,000	72,000	36,000	
	SM	UL	UL	112,500	69,000	85,500	57,000	108,000	54,000	27,000	
E	NS	UL	UL	26,500	14,500	23,500	14,500	25,500	18,500	9,500	
	S1	UL	UL	106,000	58,000	84,000	58,000	102,000	74,000	38,000	
	SM	UL	UL	79,500	43,500	70,500	43,500	76,500	55,500	28,500	
F-1	NS	UL	UL	25,000	15,500	19,000	12,000	23,500	14,000	8,500	
	S1	UL	UL	100,000	62,000	76,000	48,000	134,000	76,000	34,000	
	SM	UL	UL	75,000	48,500	57,000	36,000	100,500	42,000	25,500	
F-2	NS	UL	UL	37,500	23,000	28,500	18,000	36,000	21,000	13,000	
	S1	UL	UL	150,000	92,000	114,000	76,000	144,000	72,000	36,000	
	SM	UL	UL	112,500	69,000	85,500	57,000	108,000	54,000	27,000	
H-1	NS ^a										
	S1	21,000	16,500	11,000	7,000	9,500	7,000	10,500	7,500	NS ^b	
	NS ^c										
H-2	NS ^c										
	S1	21,000	16,500	11,000	7,000	9,500	7,000	10,500	7,500	3,000	
	SM										
H-3	NS ^c										
	S1	UL	60,000	26,500	14,000	17,500	13,000	25,500	10,000	5,000	
	SM										
H-4	NS ^d	UL	UL	37,500	17,500	28,500	17,500	36,000	18,000	6,500	
	S1	UL	UL	150,000	70,000	114,000	70,000	144,000	72,000	26,000	
	SM	UL	UL	112,500	52,500	85,500	57,000	108,000	54,000	19,500	
H-5	NS ^d	UL	UL	37,500	23,000	28,500	19,000	36,000	18,000	9,000	
	S1	UL	UL	150,000	92,000	114,000	76,000	144,000	72,000	36,000	
	SM	UL	UL	112,500	69,000	85,500	57,000	108,000	54,000	27,000	

(continued)



Exterior Wall Ratings

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A	B	A	B	HT	A	B
Primary structural frame ^f (see Section 202)	3 ^a	2 ^a	1	0	1	0	HT	1	0
Bearing walls									
Exterior ^{a,f}	3	2	1	0	2	2	2	1	0
Interior	3 ^a	2 ^a	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions	See Table 602								
Exterior	See Table 602								
Interior ^d	0	0	0	0	0	0	See Section 602.4.6	0	0
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members (see Section 202)	1 ^{1/2} ^b	1 ^{b,c}	1 ^{b,c}	0 ^c	1 ^{b,c}	0	HT	1 ^{b,c}	0

For SI: 1 foot = 304.8 mm.

- a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.
- b. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.
- c. In all occupancies, heavy timber shall be allowed where a 1-hour or less fire-resistance rating is required.
- d. Not less than the fire-resistance rating required by other sections of this code.
- e. Not less than the fire-resistance rating based on fire separation distance (see Table 602).
- f. Not less than the fire-resistance rating as referenced in Section 704.10.



RISK FROM ADJOINING BUILDINGS

TABLE 602
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE^{a, d, g}

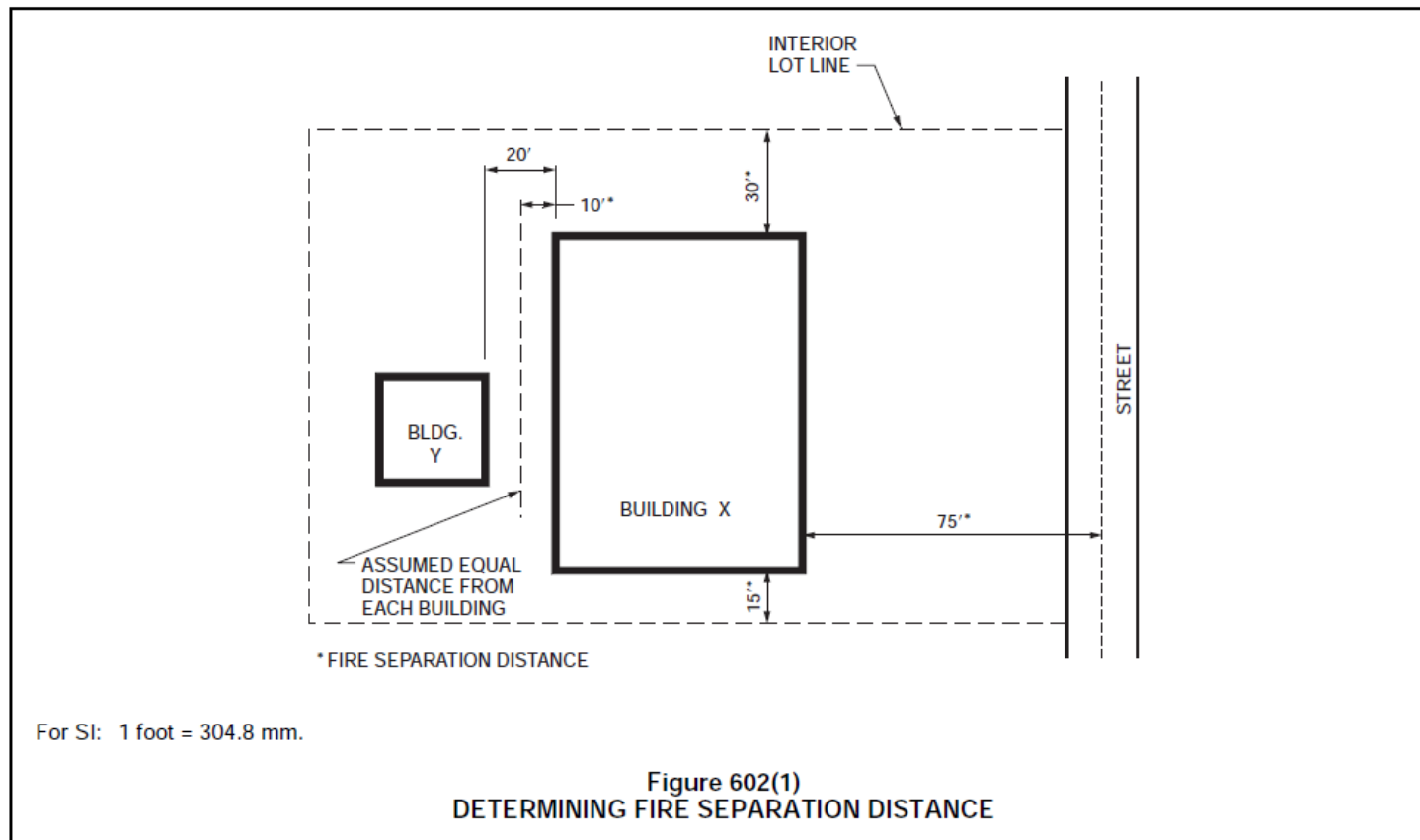
FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H ^e	OCCUPANCY GROUP F-1, M, S-1 ^f	OCCUPANCY GROUP A, B, E, F-2, I, R, S-2, U ^h
X < 5 ^b	All	3	2	1
5 ≤ X < 10	IA	3	2	1
	Others	2	1	1
10 ≤ X < 30	IA, IB	2	1	1 ^c
	IIB, VB	1	0	0
	Others	1	1	1 ^c
X ≥ 30	All	0	0	0

For SI: 1 foot = 304.8 mm.

- a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.
- b. See Section 706.1.1 for party walls.
- c. Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.
- d. The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.
- e. For special requirements for Group H occupancies, see Section 415.6.
- f. For special requirements for Group S aircraft hangars, see Section 412.4.1.
- g. Where Table 705.8 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.
- h. For a building containing only a Group U occupancy private garage or carport, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet or more.



RISK FROM ADJOINING BUILDINGS



IBC CHAPTER 14: EXTERIOR WALLS

1403.5 Vertical and lateral flame propagation. Exterior walls on buildings of Type I, II, III or IV construction that are greater than 40 feet (12 192 mm) in height above grade plane and contain a combustible *water-resistive barrier* shall be tested in accordance with and comply with the acceptance criteria of NFPA 285.

WITH 2 exceptions



IBC: Other Requirements

Section 705 on the fire separation distance and amount of permitted unprotected/protected openings. This is related to Section 601 which is already mentioned.

Section 718 about concealed space and fire blocking in concealed spaces.



NFPA 285

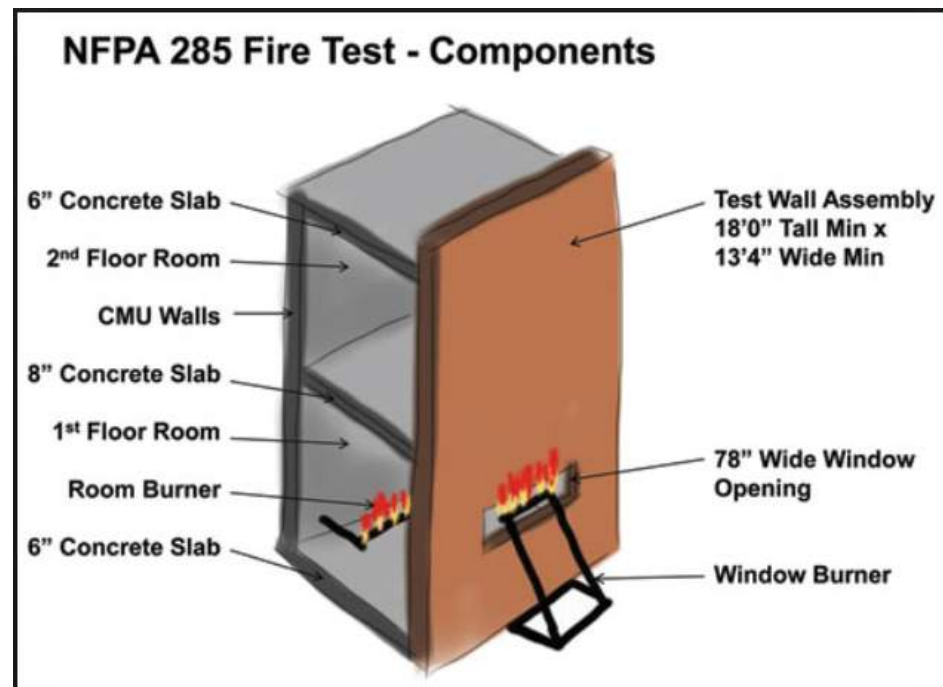
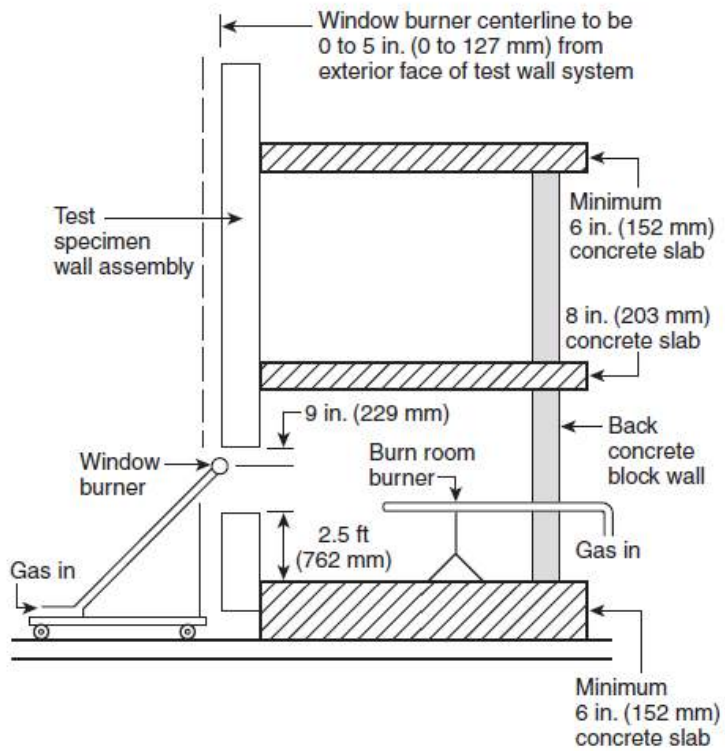


FIGURE A.4.4.3.6 Section View of Burner Placements for First-Story Test Room (not to scale).



SECTION R302 FIRE-RESISTANT CONSTRUCTION

R302.1 Exterior walls. Construction, projections, openings and penetrations of *exterior walls* of *dwellings* and accessory buildings shall comply with Table R302.1(1); or *dwellings* equipped throughout with an *automatic sprinkler system* installed in accordance with Section P2904 shall comply with Table R302.1(2).

Exceptions:

1. Walls, projections, openings or penetrations in walls perpendicular to the line used to determine the *fire separation distance*.
2. Walls of *dwellings* and *accessory structures* located on the same *lot*.
3. Detached tool sheds and storage sheds, playhouses and similar structures exempted from permits are not required to provide wall protection based on location on the *lot*. Projections beyond the *exterior wall* shall not extend over the *lot line*.
4. Detached garages accessory to a *dwelling* located within 2 feet (610 mm) of a *lot line* are permitted to have roof eave projections not exceeding 4 inches (102 mm).
5. Foundation vents installed in compliance with this code are permitted.



**TABLE R302.1(1)
EXTERIOR WALLS**

EXTERIOR WALL ELEMENT		MINIMUM FIRE-RESISTANCE RATING	MINIMUM FIRE SEPARATION DISTANCE
Walls	Fire-resistance rated	1 hour—tested in accordance with ASTM E 119 or UL 263 with exposure from both sides	< 5 feet
	Not fire-resistance rated	0 hours	≥ 5 feet
Projections	Not allowed	N/A	< 2 feet
	Fire-resistance rated	1 hour on the underside ^{a, b}	≥ 2 feet to < 5 feet
	Not fire-resistance rated	0 hours	≥ 5 feet
Openings in walls	Not allowed	N/A	< 3 feet
	25% maximum of wall area	0 hours	3 feet
	Unlimited	0 hours	5 feet
Penetrations	All	Comply with Section R302.4	< 3 feet
		None required	3 feet

For SI: 1 foot = 304.8 mm.

N/A = Not Applicable.

- a. Roof eave fire-resistance rating shall be permitted to be reduced to 0 hours on the underside of the eave if fireblocking is provided from the wall top plate to the underside of the roof sheathing.
- b. Roof eave fire-resistance rating shall be permitted to be reduced to 0 hours on the underside of the eave provided that gable vent openings are not installed.



**TABLE R302.1(2)
EXTERIOR WALLS—DWELLINGS WITH FIRE SPRINKLERS**

EXTERIOR WALL ELEMENT		MINIMUM FIRE-RESISTANCE RATING	MINIMUM FIRE SEPARATION DISTANCE
Walls	Fire-resistance rated	1 hour—tested in accordance with ASTM E 119 or UL 263 with exposure from the outside	0 feet
	Not fire-resistance rated	0 hours	3 feet ^a
Projections	Not allowed	N/A	< 2 feet
	Fire-resistance rated	1 hour on the underside ^{b, c}	2 feet ^a
	Not fire-resistance rated	0 hours	3 feet
Openings in walls	Not allowed	N/A	< 3 feet
	Unlimited	0 hours	3 feet ^a
Penetrations	All	Comply with Section R302.4	< 3 feet
		None required	3 feet ^a

For SI: 1 foot = 304.8 mm.

N/A = Not Applicable

- a. For residential subdivisions where all *dwelling*s are equipped throughout with an automatic sprinkler system installed in accordance with Section P2904, the *fire separation distance* for nonrated exterior walls and rated projections shall be permitted to be reduced to 0 feet, and unlimited unprotected openings and penetrations shall be permitted, where the adjoining *lot* provides an open setback *yard* that is 6 feet or more in width on the opposite side of the property line.
- b. The roof eave fire-resistance rating shall be permitted to be reduced to 0 hours on the underside of the eave if fireblocking is provided from the wall top plate to the underside of the roof sheathing.
- c. The roof eave fire-resistance rating shall be permitted to be reduced to 0 hours on the underside of the eave provided that gable vent openings are not installed.



SECTION R316 FOAM PLASTIC

R316.1 General. The provisions of this section shall govern the materials, design, application, construction and installation of foam plastic materials.



NFPA 13R SPRINKLERS & BUILDING ENVELOPES (IN LOW-RISE RESIDENTIAL OCCUPANCIES)

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NFPA® 13R

Standard for the

Installation of Sprinkler Systems in Low-Rise Residential Occupancies

2013 Edition

This edition of NFPA 13R, *Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies*, was prepared by the Technical Committee on Residential Sprinkler Systems, released by the Technical Correlating Committee on Automatic Sprinkler Systems, and acted on by NFPA at its June Association Technical Meeting held June 11–14, 2012, in Las Vegas, NV. It was issued by the Standards Council on August 9, 2012, with an effective date of August 29, 2012, and supersedes all previous editions.

Tentative interim amendments (TIAs) to Chapter 5 were issued on August 9, 2012. For further information on tentative interim amendments, see Section 5 of the NFPA Regulations Governing Committee Projects available at: <http://www.nfpa.org/assets/files/PDF/CodesStandards/TIAErrataFI/TIAREgs.pdf>.

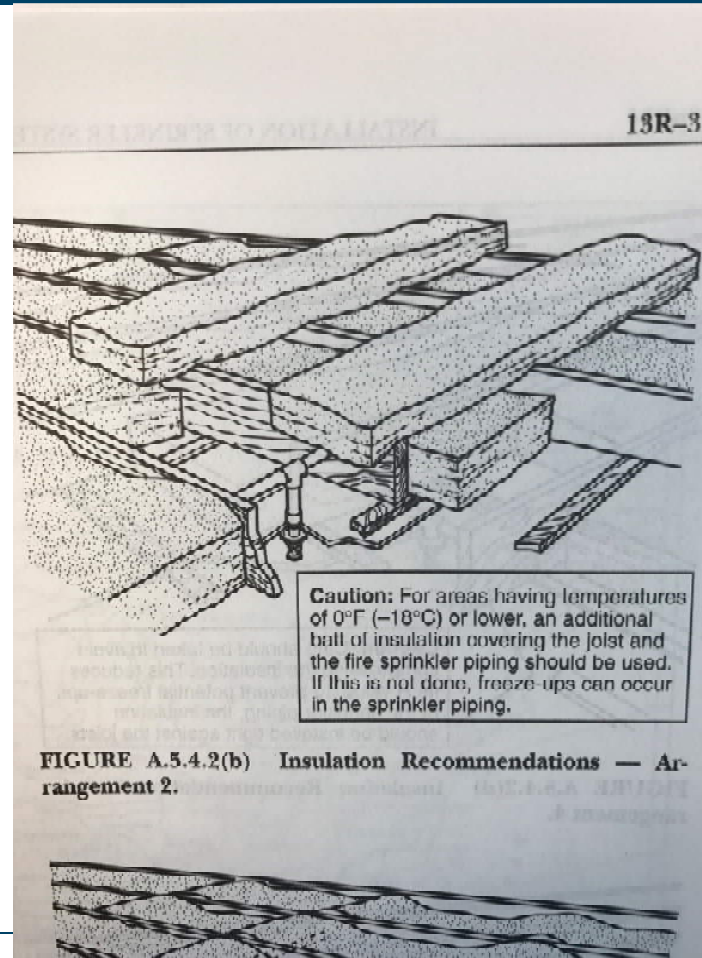
This edition of NFPA 13R was approved as an American National Standard on August 29, 2012.

Origin and Development of NFPA 13R

The first edition of NFPA 13R, which was published in 1989, represented a milestone in the



NFPA 13R SPRINKLERS (IN LOW-RISE RESIDENTIAL OCCUPANCIES)



NFPA 13R - UNINTENDED ADDED RISKS



NFPA 13R - UNINTENDED ADDED RISKS)



Advancing the Science of Safety

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FOLLOWING THE CODE PATH

HOW TO USE THE UNIFORM BUILDING CODE

THE following procedures will be helpful in the use of the Uniform Building Code:

1. Determine the **Occupancy Group** in which the use of the building most nearly fits—the “01” sections of Chapters 6-15 inclusive. Where portions of the building are used for different purposes, walls of specific fire-resistive ratings may be required. Section 503.
2. Determine the **Type of Construction** which it is desired to use—Chapters 17-22 inclusive.
3. Check the location of the site as to local **Fire Zone** from the city hall and check limitations in that Fire Zone—Chapter 16.
4. Check **Area Limitations** for the particular Occupancy Group and Type of Construction—Table No. 5-C. If allowable area is not adequate, check **Allowable Area Increases**, Section 506, for possible increase of area, or change Type of Construction to one allowing greater areas.
5. Check **Number of Stories**, Table No. 5-D, for allowable number of stories for the particular Occupancy Group and Type of Construction. If allowable number of stories is not adequate, check **Maximum Height of Buildings**, Section 507, for possible increase, or change Type of Construction to one allowing a greater number of stories.
6. Check **Detailed Occupancy Requirements** in the appropriate chapter, Chapters 6-15.
7. Check **Detailed Construction Requirements** in the appropriate chapter, Chapters 17-22.
8. **Location on Property** in relation to side and rear property lines and other buildings located on the same property should be guided by Section 504 and Table No. 5-A. This will help determine wall and opening requirements.
9. **Design** and other **Detailed Requirements** are found in Chapters 23-52.



POST FIRE INVESTIGATION



POST FIRE INVESTIGATION



POST FIRE INVESTIGATION



POST FIRE INVESTIGATION



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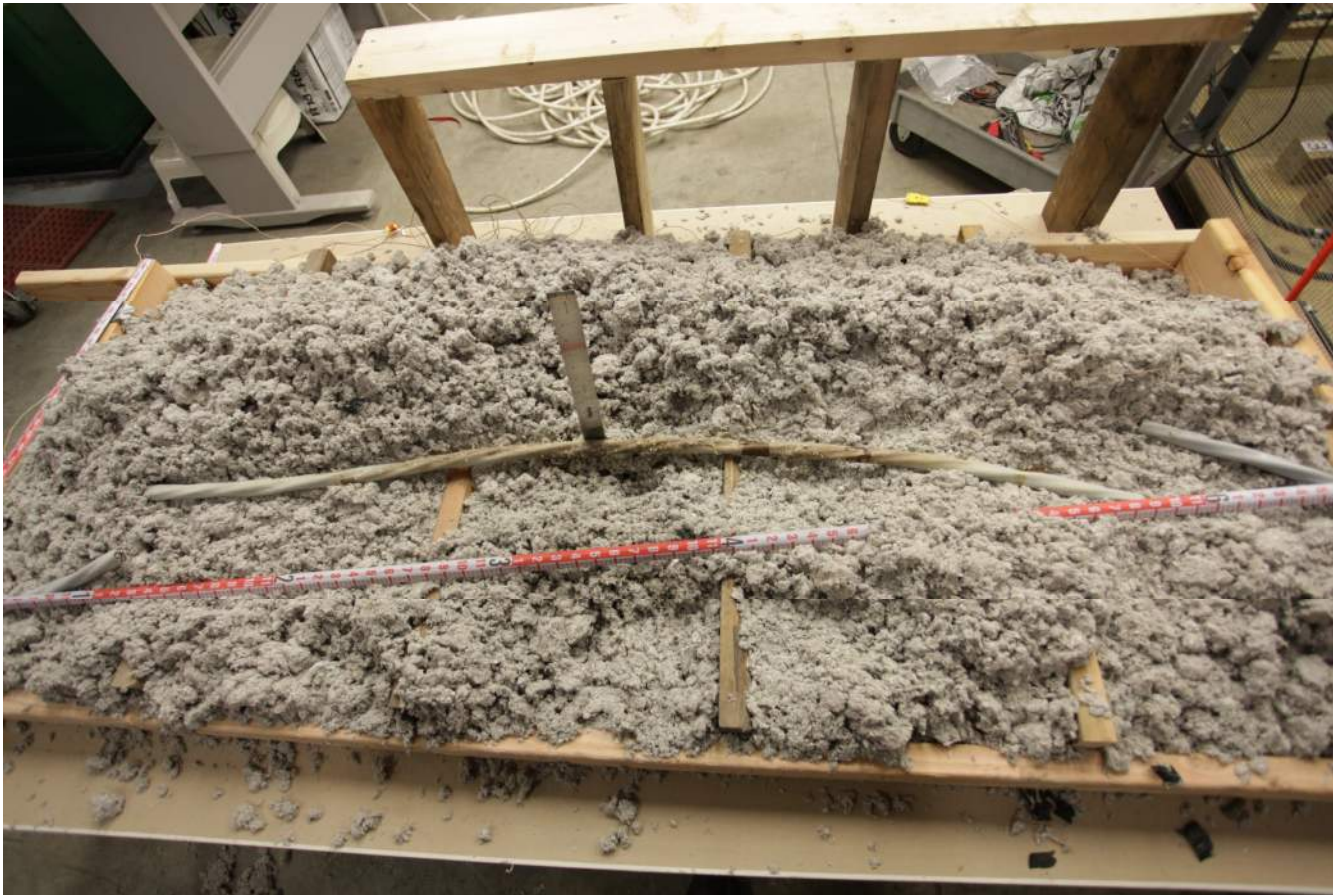
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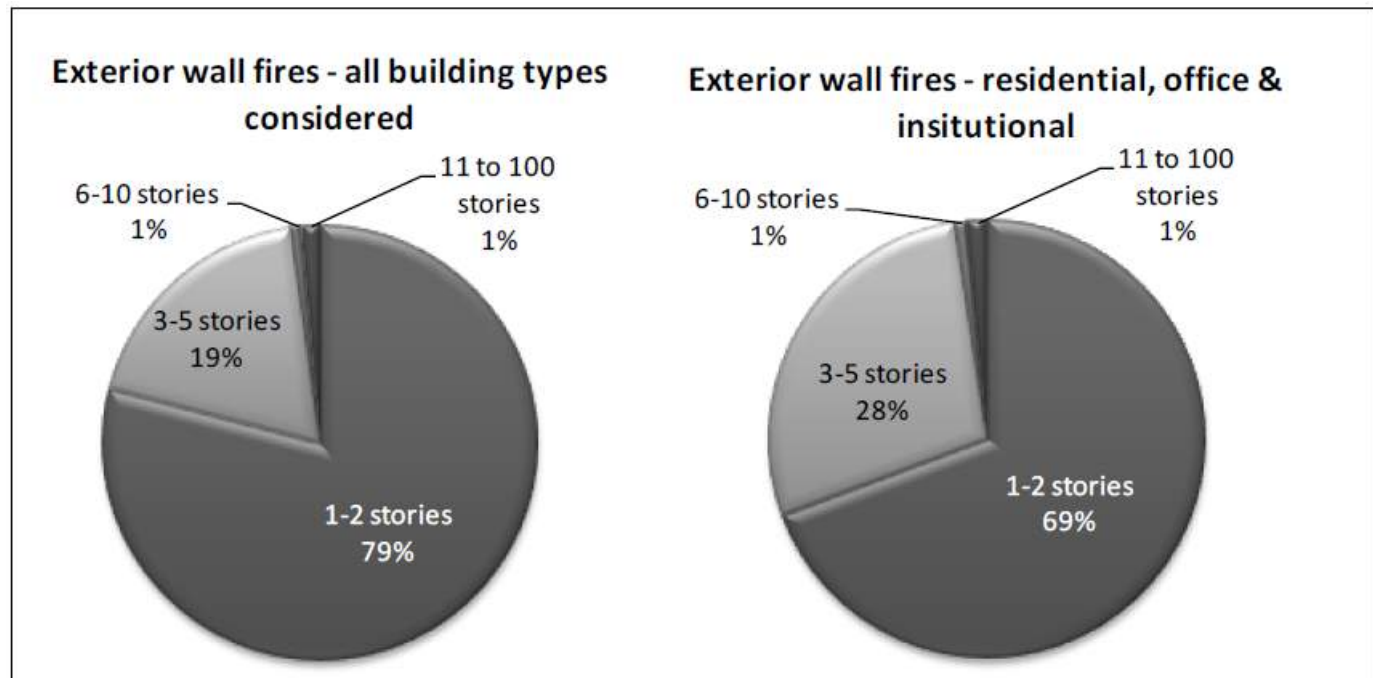
POST FIRE INVESTIGATION



FIRE SPREADING ON EXTERIOR WALLS

2014 Fire Protection Research Foundation, NFPA

- Percentage of Exterior Wall Fires by Building Height



QUESTIONS?

Contact

Jeff Harris & Andy Lianto

+1 425-775-5550

jharris@jensenhughes.com

alianto@jensenhughes.com

For More Information Visit

jensenhughes.com



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