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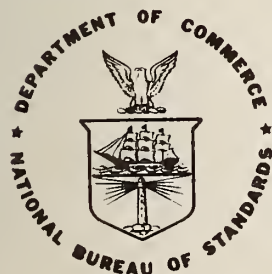
A Study of Fire Spread in Multi-Family Residences: The Causes — The Remedies

Bertram M. Vogel

Center for Fire Research
Institute for Applied Technology
National Bureau of Standards
Washington, D. C. 20234

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Final Report



U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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A STUDY OF FIRE SPREAD IN MULTI-FAMILY
RESIDENCES: THE CAUSES — THE REMEDIES

Bertram M. Vogel

Abstract

This report identifies the major elements contributing to the spread of fire in multi-family buildings, where the fire is beyond the area of origin. The data has been collected from 84 separate fires involving low-rise (garden apartments) residential buildings in the Washington, D.C. metropolitan area. This report categorizes the contributing factors of the fire spread into construction deficiencies, design deficiencies, and possible code violations; and suggests the need for specific revisions to building codes.

Key words: Apartments; building codes; fire; fire resistivity; firestopping; fire walls; garden apartments; multi-family residences.

1. INTRODUCTION

Since January 1971, the Center for Fire Research, Institute for Applied Technology, the National Bureau of Standards, has retained under contract, Mr. Francis L. Brannigan (Associate Professor, Fire Science Coordinator at Montgomery College, Rockville, Maryland), [1]¹ for the purpose of investigating serious multiple dwelling residential fires occurring in the Maryland and Virginia jurisdictions adjacent to Washington, D.C., a metropolitan area of 2-1/2 million people. Among several objectives of these investigations is the determination of those structural elements or construction practices contributing to the extension of fire beyond the area of origin. At a symposium on fire safety research held at NBS on August 22, 1973, Mr. Brannigan presented a paper [2] which summarized his observations on a number of fires that had occurred between January 1971 and August 1973.

¹ Numbers in brackets refer to the literature references listed at the end of this paper.

Subsequently, additional reports on these multiple dwelling fires have been received; they now number some 84 separate cases. The reports are limited to fires in the D.C. metropolitan area and pertain only to multi-family residences in which the fire left the apartment of origin.

This paper is an extension of the work reported in NBS Special Publication 411, bringing these investigations of fires in multiple dwellings up to date and containing an analysis of the data for application to existing code requirements. In addition, the various in situ conditions contributing to the extension of the fires beyond the area of origin, as identified by the investigator, are categorized.

While the majority of the subject buildings are relatively new (erected within the last 10 years) no attempt has been made here to ascertain specific information such as:

- (1) What building code, if any, the building was built under;
- (2) Date of construction and first occupancy;
- (3) Fire loading;
- (4) Estimation of length of time fire was underway before detection; and
- (5) Length of time for fire department response subsequent to detection.

The predominant building code now in effect in the jurisdictions involved in this study is some form of the "Basic Building Code." [3] For this reason the Basic Building Code is used as an example and the discussion that follows centers on the provisions in the Basic Building Code. However, the discussions and suggestions are equally applicable to other model codes.

The Basic Building Code divides building construction into four categories: Type 1 (fire proof), Type 2 (non-combustible), Type 3 (ordinary), and Type 4 (frame). The Code tabulates the fire resistance requirements for structural elements according to the type of construction used. The requirements for fire resistance are contained in Table A1 (see Appendix A). Table A2 identifies the building height and fire area limitations for various occupancy use groups and types of construction (see Appendix A).

Attention is directed to these tables to point out the specific regulatory limitations and requirements for R-2 multi-family residential buildings.²

Except for five cases, the buildings in this study were garden-type low-rise apartment houses or row-type townhouses with wood floor joists, wood roof framing, and either masonry, brick veneer, or wood frame exterior walls. The Basic Building Code defines these types of construction as Type 3B (ordinary protected) in the case of masonry exterior walls with wood joists and roof framing; and Type 4A (frame-protected) in the case of brick veneer or wood frame exterior walls with wood joists and roof framing.

In all types of construction, fire protection and fire-stopping of the various building elements are major deterrents to the spread of fire. In buildings of Type 1 (fireproof) or Type 2 (noncombustible) construction these requirements are not as critical as in Type 3 (ordinary) or Type 4 (frame) construction where the resistance of the partitions to fire penetration is lower and combustible materials in the partitions may contribute to flame spread.

Excerpts of the Basic Building Code's fire protection and firestopping provisions are contained in Appendix B. Similar or comparable provisions exist in the other model building codes [4-6] in wide use throughout the United States. These requirements, if clearly understood and strictly enforced, constitute the major deterrents to the spread of fire from one apartment to another in a multi-family residential building.

Unfortunately, in real life we may find poor enforcement, poor workmanship and a lack of understanding by designers and builders of the basic philosophy of fire protection. The lack of appreciation of these factors relating to fire spread is a primary contributor to major losses of life and property. These factors become readily apparent during the review of Brannigan's investigations, 84 of which are pertinent to this report. These 84 fires resulted in 14 fatalities.

Seventy-nine of the fires investigated involved fires which extended vertically, horizontally or, in some cases, in both horizontal and vertical directions to another apartment. In 18 of these incidents the fire spread was abetted by more than one apparent deficiency in design, construction or workmanship. (See Appendix C for summary of multiple deficiencies.)

² Similar provisions are contained in other model building codes (see references [4-6]).

In four incidents operation of sprinkler systems in storage rooms (the room of fire origin) prevented the extension of fire. The requirement of sprinklered storage rooms in multiple family residential buildings is a relatively new building code requirement and, therefore, was not a mandatory requirement for all buildings involved in these investigations.

2. CONSTRUCTION DEFICIENCIES

This section is a breakdown of the apparent construction or workmanship deficiencies responsible for spread of fire and the number of incidents resulting from each type of deficiency. If the deficiencies violate sections of the Basic Building Code, the specific sections are noted.

2.1. Faulty Chase Construction

- (1) Wood stud partitions used to conceal utility piping or ductwork, in which the fire protective exterior sheathing was penetrated by the pipe or duct - 20 incidents (24%) (violates Sections 875.10³ and 919.1 of the Basic Building Code.)
- (2) Omission of fire protective sheathing above ductwork where ductwork was boxed-in below ceiling - 4 incidents (5%).

2.2. Violation of Fire Wall

- (1) Through penetrations of the fire wall construction by joists and beams - 2 incidents (2.4%) (violates Section 875.2 of the Basic Building Code.)

2.3. Lack of Firestopping

- (1) Partitions stacked one above the other without proper firestopping at intervening floor or ceiling levels, providing direct channels to floor, ceiling or attic framing — 24 incidents (29%) (violates Sections 875.1, 875.10 and 919.1 of the Basic Building Code.)

³ Section citations refer to sections of the Basic Building Code contained in Appendix B.

- (2) Omission of fire protective sheathing over or in back of kitchen cabinets, or in back of bathtubs, providing direct access to floor/ceiling framing — 5 incidents (6%).

2.4. Faulty Construction

- (1) Improper attachment of drywall or sheetrock — 6 incidents (7%) (code violation since fire resistance rating for drywall or sheetrock assemblies are based on screw or nail types and sizes, and spacing.)
- (2) Improper installation of required sprinkler heads — 1 incident (1%).
- (3) Improper firestopping for required subdivision of attic spaces (i.e., sheetrock improperly nailed, and joints not taped, spackled and properly finished) — 2 incidents (2%) (violates Section 875.6 of the Basic Building Code.)

2.5. Faulty Design

- (1) Combustible surface finishes in corridor materials which appeared to have flame-spread rating of greater than 75 were installed — 2 incidents (2%) (violation of Table 920 of the Basic Building Code.)
- (2) Nonconforming construction in stairway — 1 incident (1%) (exposed wood framed stairs installed in top story stairway.)
- (3) Omission of basement ceiling — 1 incident (1%).
- (4) Installation of combustible room finishes — one incident (1%) (this plywood paneling attached directly to wood studs — thickness of paneling undetermined but if less than 1/4 inch thickness this paneling would have been required to be applied directly to noncombustible backing in accordance with Sections 921.5 and 921.6 of the Basic Building Code.)

2.6. Exterior Walls

- (1) Interior side of wall
 - (a) Omission of firestopping in furred-out areas of exterior walls — 1 incident (1%). (Violates Section 875.8 of the Basic Building Code.)
 - (b) Mansard roof framed to provide direct connection to attic space without intervening firestopping — 2 incidents (2%) (violation of Section 925.6 of the Basic Building Code.)
- (2) Exterior side of wall
 - (a) Vertical extension from floor to floor via window openings in exterior walls without apparent involvement of exterior surface finish — 2 incidents (2%).
 - (b) Fire extension due to combustible balconies or exterior surface finish — 13 incidents (15%). (This is an area where code revision may be desirable since the Basic Building Code addresses only "Exterior Trim Restrictions.")
 - (c) Fire extension to combustible materials or soffits of roof overhangs; or exposed roof framing without firestopping at exterior wall line — 21 incidents (25%). (Note: in these cases fires originating below roof level extended vertically into attic via involvement of combustible exposed roof framing, combustible soffits of roof overhang or through vent openings in roof overhang.) (This is an area where code revision may be desirable.)

It is readily apparent that each of these identified deficiencies could fall into one or more of the following categories, i.e.:

- (1) Improper code enforcement;
- (2) Poor workmanship;
- (3) Building design that does not respond to basic fire protection philosophy;
- (4) Code gaps.

While the cases described above involve construction in those jurisdictions of Maryland and Virginia adjacent to the District of Columbia, these conditions are not unique to these jurisdictions. These conditions suggest that the design professions, regulatory community and contractors need to reassess the existing state-of-the-art of low-rise, multiple-dwelling design and construction with regard to fire safety; and make those changes that are needed in both regulation and building practice to be conducive to reduction in life and property losses. The following are some "Code Gaps" which may be worth considering.

3. CODE GAPS AND RECOMMENDATIONS

- A. A review of information available on partition assemblies tested by Underwriters' Laboratories, Inc., Ohio State University and other testing facilities does not identify any partition assemblies (bearing or non-bearing) which have been tested and rated with utility services penetrating the fire protective membrane on either or both sides of the assembly. This lack is in contrast to a number of floor-ceiling assemblies wherein test reports indicate maximum permissible areas of penetration. Yet it is common practice of the regulatory authorities to permit penetrations in the field which may negate the fire resistance ratings of the assembly assigned by the testing facility.

Performance criteria for building assemblies should be based on sound fire protection engineering principles or tests. Building officials could use these criteria for establishing maximum permissible areas of penetrations of fire-rated wall and partition assemblies. Meanwhile, the necessity of installing noncombustible packing or other non-combustible materials in oversized openings for utility services penetrating firestops or fire protective sheathing should be emphasized.

- B. We have previously identified in this study a relatively high incidence of fires which have spread from exterior windows and doors into attic spaces through the involvement of combustible roof overhangs or through vent openings in the soffits of roof overhangs. In all cases, these roof overhangs were directly connected to the open attic spaces without intervening full depth firestopping between the terminus of the exterior wall and the roof sheathing.

All existing building codes require venting of attic spaces. The general design practice to accomplish this venting is by the provision of soffit vents in the roof overhangs, or in those cases where the roof overhang soffits are not sheathed, by installation of screening in the rafter spaces.

Several of the model building codes have recognized the fire problems associated with these practices. The 1976 National Building Code in Section 530.6b provides "Eaves constructed of fire retardant treated wood, lumber, or plywood or of wood or other combustible materials shall extend not more than three (3) feet beyond exterior walls, and, where connected to attics, shall be firestopped between the upper terminus of the exterior wall and the bottom side of the roof deck."

The 1976 Uniform Building Code, in recognizing the potential hazard of fires extending from door and window openings directly into attic spaces through eave vents, provides the following requirement in the second paragraph of Section 3205(c):

"Where eave or cornice vents are used to provide the required ventilation of combustible attic spaces, vent openings shall not be located within 3 feet measured laterally above window or door openings in the wall of the story immediately below." While this requirement may provide adequate protection from the extension of fire from a wall opening into the attic space by way of eave or cornice vents under one set of fire conditions, it may not provide sufficient protection under every set of fire loading and wind conditions.

Consideration should be given to the prohibition of venting of attic spaces by means of eave, cornice or soffit vents.

Extension of fire into attic spaces through the involvement of combustible roof overhangs would still be possible if full depth firestopping at the exterior wall were not present. Therefore, the following two additional code changes are suggested:

- (1) "Eaves constructed of combustible materials, where connected to attics, shall be firestopped between the upper terminus of the exterior wall and the bottom side of the roof deck or sheathing."

- (2) "The soffits of all roof overhangs shall be sheathed in noncombustible material not less than 1/2 inch thick."

It should be noted that required attic ventilation would have to be accomplished by either gravity- or power-driven roof ventilators or where gable ends exist by means of louvres in the gable ends, or by a combination of gable end louvres and roof ventilators.

- C. While not totally pertinent to this report, there is a possible omission of fire resistance rating requirements for the structural elements which support fire resistive dividers, in Table 214 of the Basic Building Code (see Table A1 in Appendix A). In Types 3C and 4B construction fire resistance rated partitions, i.e., Item 4, fire separation assemblies, Item 5, fire enclosure of exitways, etc., and Item 6, shafts other than exitways, etc., partitions requiring fire resistance ratings of either one or two hours could be wholly supported by floor constructions (Item 10) which do not require fire resistance ratings in Types 3C and 4B construction. A note should be added to Item 10 and should read "Construction supporting walls and partitions shall have a fire resistance rating not less than the wall or partition supported." This condition can also possibly exist in application of the Uniform and Standard Building Codes.
- D. While all of the model building codes have statements on firestopping similar to that contained in Section 875.1 of the Basic Building Code, there is a definite need to provide guidance to building officials on how they can readily accomplish effective firestopping which would preclude "free passage of flame through concealed spaces" and would allow firestoppage of all vertical and horizontal draft openings." This is specifically the case in partitions which: (1) run from lower levels to the ceiling of the top story; and (2) contain utility runs that pierce the required firestopping at each floor and ceiling level. These two conditions create "draft openings" and afford "free passage of flame through concealed spaces," which are interconnected at each floor level and the attic space. A partial solution to this interconnection of partition/floor-ceiling voids could be accomplished by the following suggested revision to the Basic Building Code. (Similar provisions already exist in other model building codes.)

"Joists in all types of construction shall be fire-stopped at the ends and over supports for the full depth of the joists."

It shall be noted that earlier editions of a number of building codes required that joists be doubled under partitions running parallel to the joist span. Why this requirement has been dropped in subsequent editions of these codes is unknown. Construction of this type would provide desirable firestopping in the joist space.

- E. As previously indicated, in at least 15 percent of the fires investigated, combustible balconies and exterior finish contributed to the spread of fire on the exterior surfaces of the buildings after the fires left the rooms of origin through openings in exterior walls. Section 608.4 of the 1976 Standard Building Code and Section 1705(d) of the 1976 Uniform Building Code address the subject of exposed exterior wood veneers or paneling applied to exterior walls; but only in relation to the separation from adjoining property lines. No consideration is given to the possible spread of fire along the exterior walls from sources within the building, where the location of the building with respect to other buildings or property lines does not dictate opening protectives. Section 924.4 of the 1975 Basic Building Code requires that balconies on Type 3 and 4 buildings have the same fire resistance rating as required for the floors. Section 1108 of the 1976 Standard Building Code while concerned with certain criteria for balcony construction does not address fire resistance ratings for balconies. In Section 924, the 1975 Basic Building Code establishes restrictions on exterior trim but not on overall exterior finish. In discussions with staff personnel of several of the model code organizations, it is their interpretation that the existing requirements of their codes do not address the subject of exterior finish requirements for exterior walls and balconies.
- F. In view of the failures, due to exterior fire spread, reasonable requirements should be provided to place some flame spread limitations on the use of combustible exterior finishes including balconies in Types III and V⁴ buildings. A suggested code requirement is as follows:

⁴ Types III and V construction as referred to in this section are the respective designations for "Noncombustible Exterior Wall" and "Combustible," as defined by the Model Codes Standardization Council (MCSC) and are the typical types of construction most generally used in multi-family garden-type apartments. This suggested code change may also be appropriate for the other types of construction.

"All exterior finish, including balconies located within 5 feet measured horizontally or vertically, of openings in the exterior walls of buildings of Types III and V construction, shall have a flame spread rating not exceeding 75."

4. REFERENCES

- [1] Brannigan, Francis, L., Building Construction for the Fire Service, NFPA No. FSP-33, National Fire Protection Association (Nov. 1971).
- [2] Brannigan, Francis L., A Field Study of Non Fire-Resistive Multiple Dwelling Fires, in Fire Safety Research, Proceedings of a Symposium held August 1973. eds: J. Slater and M. Butler, Nat. Bur. Stand. (U.S.) SP-411 (Nov. 1974) pp. 178-194.
- [3] Basic Building Code, promulgated by the Building Officials and Code Administrators International, Inc., 1313 East 60th Street, Chicago, Illinois 60637, Current Edition is 1975.
- [4] Standard Building Code, promulgated by the Southern Building Code Congress International, Inc., 3617 Eighth Avenue South, Birmingham, Alabama 35222, Current Edition is 1976.
- [5] Uniform Building Code, promulgated by the International Conference of Building Officials, 5360 South Workman Mill Road, Whittier, California 90601, Current Edition is 1976.
- [6] National Building Code, promulgated by the American Insurance Association, 86 John Street, New York, N.Y. 10038, Current Edition is 1976.

APPENDIX A

Appendix A contains excerpts from two tables from the 1975 Edition of the BOCA Basic Building Code.

Table A1 (Excerpts from Table 214 of the Basic Building Code) provides the required fire resistance ratings of structural elements of buildings with relation to the type of construction.

Table A2 (from Table 305) establishes the height and fire area limitations of buildings based on the occupancy use group and type of construction. The garden-type multi-family dwelling residential buildings identified in this paper are classified as R-2 occupancy.

TABLE A1.
(Excerpts from Table 214)
Fire-resistance Ratings of Structural Elements (In Hours)

Structural Element Note a	Type of Construction — Section 214.0				
	Type 3		Type 4		
	Exterior masonry walls		Frame		
	Protected	Unprotected	Protected	Unprotected	
	3B	3C	4A	4B	
Exterior walls (Section 906.0 and Note b)					
On street lot lines or with fire separation of 30' or more from interior lot lines or any building	Bearing	2	2	1	0
	Non-bearing	0	0	0	0
1 On interior lot lines or less than 6' therefrom or from any building	Bearing	2	2	1	1 Note d
	Non-bearing	2	2	1	1 Note d
6' or more but less than 11'	Bearing	2	2	1	0
	Non-bearing	2	2	1	0
11' or more but less than 30'	Bearing	2	2	1	0
	Non-bearing	1-1/2	1-1/2	1	0
2 Interior bearing walls and partitions		1	0	1	0
3 Fire walls and party walls (Section 907.0)		2	2	2	2
		Not less than fire grading of use group (See Table 902.)			
4 Fire separation assemblies Note a		Fire-resistance rating corresponding to fire grading of use group - (See Table 902.)			
5 Fire enclosure of exitways, exitway hallways and stairways (Section 909.0 and Note f)		2	2	1	1
6 Shafts, other than exitways, elevator hoistways (Section 910.0)		2	2	1	1
7 Exitway access corridors & vertical separation of tenant spaces (Section 910.0)		1	0	1	0
Other non-bearing partitions		0	0	0	0
	Supporting more than one floor	1	0	1	0
8 Columns, girders, trusses, (other than roof trusses) and framing (Section 911.0)	Supporting one floor only	1	0	1	0
	Supporting a roof only	1	0	1	0
9 Structural members supporting wall (Section 911.0)		1	0	1	0
		Not less than fire-resistance rating of wall supported			
10 Floor construction including beams (Section 912.0 and Note g)		1	0	1	0
	15' or less in height to lowest member	1	0	1	0
11 Roof construction including beams, trusses and framing arches and roof deck (Section 912.0 and Notes g and j)	More than 15' but less than 20' in height to lowest member	0	0	1	0
	20' or more in height to lowest member	0	0	0	0

Notes applicable to Table 214

- Note a. For special high hazard uses involving a higher degree of fire severity and higher concentration of combustible contents, the fire-resistance rating requirements for structural elements shall be increased accordingly (see Section 400.3).
- Note b. The fire separation or fire exposure in feet as herein limited applies to the distance from other buildings on the site, or from an interior lot line or from the opposite side of a street or other public space not less than thirty (30) feet wide to the building wall (see Definitions, Section 201.3).
- Note d. See Section 303.2.
- Note e. See Sections 213.0, 909.0 and 912.0.
- Note f. In all buildings of Types 3 or 4 construction, the stairways and their enclosures may be constructed of wood or other approved materials of similar characteristics and of adequate strength; except in school buildings (see Section 616.9.3).
- Note g. In Type 3A construction, members which are of material other than heavy timber shall have a fire-resistance rating of not less than one (1) hour (see Section 853.2).
- Note i. Where the omission of fire protection from roof trusses, roof framing and decking is permitted, the horizontal or sloping roofs in Type 1 and Type 2 buildings, immediately above such members shall be constructed of noncombustible materials of the required strength without a specified fire-resistance rating, or of mill type construction in buildings not over five (5) stories or sixty-five (65) feet in height (see Section 913.3).

Table A2.
 (Excerpts from Table 305)
 Height and Area Limitations of Buildings

Height limitations of buildings (shown in upper figure as stories and feet above grade), and area limitations of one- or two-story buildings facing on one street or public space not less than 30 feet wide (shown in lower figure as area in square feet per floor).

Use Group	Type of Construction			
	Type 3 Exterior masonry walls Ordinary Joisted		Type 4 Frame	
	Protected	Unprotected	Protected	Unprotected
	Note a 3B	3C	4A	4B
R-1 Residential, hotels	4 St. 50' 13,200	3 St. 40' 9,600	3 St. 40' 10,200	2-1/2 St. 35' 4,800
R-2 Residential, multi-family	4 St. 50' 13,200 Note f	3 St. 40' 9,600	3 St. 40' 10,200	2-1/2 St. 35' 4,800
R-3 Residential, 1 & 2 family	4 St. 50' 13,200	3 St. 40' 9,600	3 St. 40' 10,200	2-1/2 St. 35' 4,800

Notes applicable to Table 305

- Note a. See the following sections for general exceptions to Table 305.
 - Section 305.4 Allowable area reduction for multi-story buildings.
 - Section 306.2 Allowable area increase due to street frontage.
 - Section 306.3 Allowable area increase due to automatic fire suppression system installation.
 - Section 306.4 Maximum building area.
 - Section 306.4 Maximum building area.
 - Section 307.0 Unlimited area one-story buildings.
 - Section 308.1 Allowable height increase due to automatic fire suppression system installation.

Note f. For exceptions to height and area limitations for high hazard use buildings, see Article 4 governing the specific use. For other special fire-resistive requirements governing specific uses, see Section 905.0.

APPENDIX B

EXCERPTS FROM FIRE PROTECTION AND FIRESTOPPING PROVISIONS OF THE BASIC BUILDING CODE

"Section 875.0 Fire Protection and Firestopping --

875.1 General: To prevent the free passage of flame through concealed spaces or openings in event of fire, provision shall be made to trim all combustibile framing away from sources of heat, to provide effective fire barriers against the spread of fire between all subdivisions and all stories of the building, to provide adequate fire separation against exterior exposure, and to firestop all vertical and horizontal draft openings as specified herein.

875.2 Beam separation in ordinary construction (Types 3B and 3C): All wood and other combustibile floor, roof and other structural members framing into masonry walls shall be cut to a bevel of three (3) inches in the depth and shall project not more than four (4) inches into the wall; and the distance between embedded ends of adjacent beams or joists entering into the wall from opposite sides shall be not less than four (4) inches.

875.3 Girder separation in heavy timber construction (Type 3A): Wood girders framing into walls shall have at least eight (8) inches of masonry between their ends and the outside face of walls and at least eight (8) inches of masonry between adjacent beams entering the wall from opposite sides. The girders shall be fire-cut, supported in pockets or in self-releasing metal boxes, or otherwise supported to minimize destruction of the wall in the event of fire.

875.6 Concealed roof spaces: Concealed roof spaces enclosed by combustibile ceiling and roof construction shall be subdivided into areas of not more than three-thousand (3,000) square feet as provided in Section 314.0.

875.7 Architectural trim: Exterior cornices and other exterior architectural elements, where permitted of combustibile construction in Section 924.0, or when erected with combustibile frames, shall be firestopped at maximum intervals of twenty (20) feet. If non-continuous, they shall have closed ends, with at least four (4) inches separation between adjoining sections.

875.8 Wall furring: In masonry wall construction (Types 3A, 3B, and 3C) and in frame construction (Types 4A and 4B) where walls are furred, the space between the inside of the furring and the face of the wall for the full depth of the combustible floor or roof joists shall be firestopped.

875.9 Combustible trim and finish: The space behind combustible trim and finish where permitted under this code and all other hollow spaces where permitted in fire-resistance rated construction shall be back-filled with noncombustible materials or firestopped as required in Section 920.0.

875.10 Firestopping: Firestopping meeting the requirements of Section 919.0 shall be provided in stud walls and partitions at each floor level and between the ceiling of the top story and roof space; in all furred spaces of frame walls and studded off spaces of masonry walls at maximum intervals of eight (8) feet; at the top and bottom and at least once in the middle of each run of stairs; in concealed wall pockets for sliding doors; at openings for pipes, belts, shafting, chutes and conveyors passing through combustible floors or partitions with close-fitting noncombustible caps or metal shutters or other approved noncombustible means; and in all other locations that would permit the free travel of flame."

"Section 919.0 Firestopping--

919.1 Where required: Firestopping shall be designed and constructed to close all concealed draft openings and to form effectual fire barriers against the spread of fire between stories of every building and in all open structural spaces therein, including the following locations: for the subdivision of attic spaces in Section 314.0; for combustible wall, partition and floor framing in Section 875.0; for ceiling spaces in Section 912.0; for open spaces behind acoustical and other finishes in Section 921.0; for floor sleeper spaces in Section 922.0; and for pipe, duct and flue openings in the mechanical code listed in Appendix B.

919.2 Firestopping materials: All firestopping shall consist of approved noncombustible materials securely fastened in place. Firestops of two (2) thicknesses of one (1) inch lumber with broken lap joint or of two (2) inch lumber installed with tight joints shall be permitted in open spaces of wood framing.

919.3 Required inspection: Firestopping shall not be concealed or covered from view until inspected and approved by the building official.

921.5 Class II, and III material: Interior finish materials, other than Class I material, which are less than one-quarter (1/4) inch in thickness shall be applied directly against a noncombustible backing unless the tests under which such material has been classed were made with the materials suspended from the non-combustible backing.

921.6 Noncombustible backing: Noncombustible backing for interior finish materials shall be a continuous surface with permanently tight joints, equal in area to the area of the finish, and extending completely behind such finish in all directions; and may be of any materials meeting the requirements of this code for noncombustible classification of material under Section 903.5.1 or of fire-retardant treated wood. When the noncombustible backing does not constitute an integral part of the structural elements or system, it shall be attached directly to the structural elements or to furring strips as required for the application of finish according to Section 921.2, or may be suspended from the structural members at any distance provided concealed spaces created thereby shall be firestopped in accordance with the applicable requirements of this code. Where Class III interior finish is applied to a continuous noncombustible backing beneath wood joist construction, the allowable area for firestopping required in Section 912.4 may be increased to three thousand (3,000) square feet."

APPENDIX C.

SUMMARY OF INCIDENTS WHERE MULTIPLE DEFICIENCIES WERE APPARENT

I. Double Deficiencies

- (a) Unfirestopped partitions, duct or pipe shaft - combustible balcony or exterior finish - 2 fires.
- (b) Unfirestopped partitions, duct or pipe shaft - improper nailing or installation of sheetrock - 1 fire.
- (c) Omission of fire protective sheathing at kitchen cabinets - roof soffit vents - 1 fire.
- (d) Omission of fire protective sheathing at kitchen cabinets - ductwork not properly boxed out - 1 fire.
- (e) Improper installation of sprinklerhead - omission of firestopping under partitions - 1 fire.
- (f) Combustible balcony or exterior finish - roof soffit vents - 4 fires.
- (g) Unfirestopped partitions, duct or pipe shaft - omission of fire protective sheathing at kitchen cabinets, bathtubs - 2 fires.
- (h) Unfirestopped partitions, duct or pipe shaft - omission of attic firestopping - 1 fire.
- (i) Faulty firewall construction - mansard roof construction - 1 fire.
- (j) Combustible balcony or exterior finish - omission of attic firestopping - 1 fire.

II. Triple Deficiencies

- (a) Combustible balcony or exterior finish - roof soffit vents - unfirestopped partitions, duct or pipe shaft - 2 fires.
- (b) Unfirestopped partitions, duct or pipe shaft - combustible balcony or exterior finish - combustible room finish - 1 fire.

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