The Code Corner

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Fire-Resistive Construction

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I once read an article by a plans examiner who wrote about a telephone conversation between a fellow examiner and a contractor. The contractor told the examiner "You know, I don't think I can get that wall built in an hour." Rather than falling to the ground in gut-wrenching laughter, the examiner calmly responded, "That's okay, go ahead and make it a two-hour wall."

The construction industry can have its funny moments at times, but the situation described above could easily have been the setup for a potential life safety problem in the future. It's obvious that the contractor didn't know the first thing about fire-resistive construction. I can use a lot of paper space writing about fire-resistive construction, but I'll focus on the basics so you'll have a better understanding of the need for fire-resistive construction.

Fire-resistive construction is that construction designed to prevent or slow the spread of fire using materials and assemblies tested for their fire-resistive properties. The 2003 *International Building Code* (IBC) defines fire resistance as:

> *"That property of materials or their assemblies that prevents or retards the passage of excessive heat, hot gases or flames under conditions of use."*

The fire-resistance property of a material or assembly is based on time, usually in either minutes or hours. The most common method for testing materials and assemblies to determine their endurance is ASTM E 119 *Standard Test Methods for Fire Tests of Building Construction and Materials*. Similar test methods are available from the National Fire Protection Association (NFPA 251 *Standard Methods of Tests of Fire Endurance of Building Construction and Materials*) and Underwriters Laboratories (UL 263 *Standard for Fire Tests of Building Construction and Materials*). The ASTM method takes a test specimen (100 SF for walls and partitions) that is representative of the construction expected to be built in the field, and places it in a furnace. The furnace is then heated following a strict time-temperature curve that takes the heat from 0 deg F to 2,300 deg F over an 8-hour period, if required. In the case of walls and partitions, the assembly will pass if the following conditions are met within the period of time the assembly is being tested (2 hours for a 2-hour-rated wall, for example):

- Sustain applied load (for load bearing assemblies).
- Prevent the temperature on the unexposed side from reaching more than 250 deg F above initial temperature, or more than 325 deg F at any point.
- Allow no passage of flame or gases hot enough to ignite cotton waste.

Assemblies rated 1-hour and longer, must also pass the hose stream test of ASTM E 119. This test has created some obvious confusion, in that people tend to relate the test to fire fighting operations. Actually, the test is to simulate the ability of the wall to withstand the impact from falling debris. Obviously, a wall's ability to prevent or retard a fire would be severely limited if a falling object punched a hole through it.

Building codes apply minimum fire-resistance ratings to building elements based on the building's construction type. For example, the 2003 IBC requires no fire-resistance rating for any building element in Type VB construction, which is typically the standard wood frame structure. On the other end of the spectrum, Type IA noncombustible construction requires 3-hour structural frame and bearing walls, 2-hour floors, 1-1/2 hour (also called 90 minute) roofs, and no rating for nonbearing interior walls; exterior nonbearing walls are rated based on occupancy and distance from the property line. Construction types (which could be the topic of a completely separate article) are assigned based on one or more factors such as building area, building height, or occupancy groups. If you're not sure of a building's construction type, you can typically find it on the cover sheet of the drawings, or on a separate code sheet depending on the complexity of the building.

The IBC in addition applies minimum fire-resistance ratings to building elements that do not depend on construction type. Under the *Uniform Building Code* (UBC), fire-resistive construction of this type may have had specific terms to define the assembly, while others were loosely defined, such as "__-hour construction" with no other details. To improve the quality of fire-resistive construction, the IBC has established 6 basic fire-resistive assemblies. These include:

- **Fire Walls** ("area separation walls" in the UBC): These are used to separate a single building into two or more "buildings." These walls have minimum fire-resistance ratings of 2 to 4 hours depending on the occupancy group (i.e. assembly, business, residential, etc.). One thing to keep in mind about fire walls is that they must be "walls"; they cannot be used in a horizontal condition.

- **Fire Barriers**: These are used to separate shafts from other building areas, in exit construction (exits, horizontal exits, and passageways), in separation of incidental use areas, and in separation of occupancies ("occupancy separations" in the UBC). Fire barriers have fire-resistance ratings of 1 to 4 hours depending on the application or occupancy.

- **Shaft Enclosures**: These are additional requirements for fire barriers used in shaft construction. Shafts are used for refuse and laundry chutes, elevator and dumbwaiter hoistways, and mechanical chases. Shafts have a fire-resistance rating of 1 hour where the shaft connects less than 4 stories. However, if the floors penetrated are rated for 2 hours, then the shaft is required to be 2-hour rated, as well. Shafts than connect 4 or more stories require a fire-resistance rating of 2 hours.

- **Fire Partitions**: These are used to separate dwelling units in the same building, to separate sleeping units (in hotels, care facilities, etc.), to separate tenant spaces in covered malls, in corridor walls, and in elevator lobby separation. Fire partitions have a fire-resistance rating of at least 1 hour.

- **Smoke Barriers**: These are used in various locations as required to prevent the movement of smoke and have a 1-hour fire-resistance rating. A similar assembly is the smoke partition, which is not required to have any fire-resistance rating.

- **Horizontal Assemblies**: These apply to floor and roof construction. The fire-resistance rating is based on construction type and ranges from 1 to 2 hours.

In addition to the assemblies described above, building codes also establish fire-resistance requirements for opening protection (doors and windows), duct and other through-penetrations, and joint systems. The protection of these items is only necessary if the assembly in which they are installed or

penetrate have a fire-resistance rating. The logic behind these additional requirements goes back to the ASTM test, which requires no passage of flame or hot gasses. Successful completion of the test would be impossible if the assembly had an opening, penetration or joint that was not adequately protected. These items are tested using methods other than ASTM E 119. For fire-resistant doors and windows, NFPA 80 *Fire Doors and Fire Windows* is typically used. Fire-resistant joint systems are tested using either ASTM E 1966 *Test Method for Fire-Resistant Joint Systems* or UL 2079 *Tests for Fire Resistance of Building Joints*. Through-penetration fire-stop systems are tested in accordance with either ASTM E 814 *Test Method of Fire Tests of Through-Penetration Firestops* or UL 1479 *Fire Tests of Through-Penetration Firestops*.

In some cases, ratings for these items are not required, provided they comply with specific requirements. For example, windows and doors within fire-resistance-rated exterior walls need not be rated provided the total area of the openings does not exceed the allowable area based on distance from the property line. Another example is steel electrical boxes. Electrical boxes, 16 square inches or less in area, are permitted in fire-resistance-rated assemblies provided that no more than 100 square inches are within 100 square feet of wall area. They must also be separated from boxes on the other side by either a distance of 24 inches, listed putty pads, approved insulation, solid fire blocking, or other listed methods.

Many assemblies, both proprietary and generic, have been tested, and the reports are readily available. Chapter 7 of the IBC includes prescriptive requirements for some common assemblies, as well as provisions for calculating fire resistance to allow some flexibility. The Gypsum Association publishes GA-600, *Fire Resistance Design Manual*, that provides ratings for wall, floor, roof, column, and beam protection utilizing wood or metal studs and gypsum board. Another excellent resource is UL's annual *Fire Resistance Directory*. This 3-volume set provides fire resistance ratings for hundreds of assemblies, including penetrations and joints.

Fire resistance is a key element of the building code's intent to provide "safety to life and property from fire." If you're a designer, specifier, product representative, or contractor, you need to be aware of the requirements for fire resistance. Most jurisdictions will insist that tested or listed assemblies be used and specifically identified in the contract documents. Care must be taken in selecting and specifying materials and products used in fire-resistance-rated assemblies. Skilled labor must be utilized when constructing fire-resistance-rated assemblies, including the penetrations, which require more attention than just applying "red putty" around the item. In the end, the assembly you design, specify, provide, or install, may be the one thing that prevents a tragic event. Just recall the aftermath of September 11, 2001. The fire resistance of the World Trade Center was heavily scrutinized at all levels, and although the event far exceeded what anyone could have imagined, the outcome may eventually have a significant impact on fire-resistive construction in all future construction, big or small.

To comment on this article, suggest other topics, or submit a question regarding codes, contact the author at ron@specsandcodes.com.

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