Technical Committee Supplement to The Constellation Volume 7 Number 1

Felt Tips

Published on an Occasional Basis September 1995

Fire Safing Curtainwall Systems

Many types of curtainwall construction have a serious short coming—fire may go through it and around it; through the horizontal space between the edge of the floor slab and the curtain wall or around the exterior of the building through the curtain wall system.

The latest codes now require that a fire resistant floor assembly be continuous from exterior wall to exterior wall. What do the Codes actually say?

- BOCA (National Building Code) 1993 edition: 713 Floor/Ceiling And Roof/Ceiling Assemblies, 713.2 Continuity: “Floor assemblies which are required to be fire resistant rated shall extend to and be tight against exterior walls, or other provisions shall be made for maintaining the fire resistance rating of the assembly at such locations.” The 1990 edition contains similar provisions.
- ICBO (Uniform Building Code) 1994 edition: 713 Floor-Ceilings or Roof-Ceilings, 710.3 Floors. “Fire-resistive floors and floors which are a part of a floor-ceiling assembly shall be continuous without openings or penetrations in order to completely separate one story or basement from another.”
- SBCCI (Southern Building Code) 1994 edition: 705 Protection of Openings, 705.3.1.6 “Any openings between the edge of a floor deck and an exterior wall shall be sealed using an approved material or assembly of materials designed and tested for this purpose. The material shall remain in place, sealing the opening, for a time period at least equal to the required fire resistance rating of the floor deck.”

However, in many situations, the exterior wall itself does not have to be fire rated. The problem is that there are few fire-rated safing systems tested by an independent laboratory to fill this gap next to an unrated curtainwall system. Before going any further, we need to take a step back and review some basic fire protection concepts.

In any building, the safety and well being of the occupants are of critical importance. In the event of a fire, the building fire protection systems are utilized to protect the occupants from harm and allow safe passage out of the facility. There are two basic methods of fire protection: active and passive. Active fire protection includes fire suppression systems (water, chemical, and foam). Passive fire protection includes compartmentalization and fire resistive construction. This *Felt-Tip* addresses fire-resistive construction only.

Many tests are used to evaluate the fire resistance capabilities of most construction assemblies. The following two tests are commonly associated with the issue of penetrations through floor slabs:

- ASTM E119 (UL 263, NFPA 251, and U.B.C. Standard 7-1 are similar) Fire Tests of Building Construction and Materials: Tests fire rated assemblies including columns, beams, floors-ceilings, roof-ceilings, walls and partitions. Few, if any, firestop devices or systems comply exactly with this test. ASTM E119 can also be used for design of hoistway and shaft enclosures for plumbing, HVAC, electrical, etc.
- ASTM E814 (UL 1479 and U.B.C. Standard 7-5 are similar) Fire Tests of Through-Penetration Firestops: This test was developed to address the unique situation of penetrations through fire-rated assemblies. Tests through penetration firestop devices and systems. Firestop devices or systems must comply with this test. If the code requires ASTM E119 protection, test assemblies complying ASTM E814 may be unacceptable unless the manufacturer can show that they also have been tested in accordance with ASTM E119, or the authority having jurisdiction accepts compliance with ASTM E814. ASTM E814 provides F-Ratings and T-Ratings:
  - F-Ratings are the time resistance to fire passage through the penetration.
  - T-Ratings are the time resistance to temperatures passing through the penetration which are capable of igniting paper and other combustibles.

There is no standard test method which can evaluate the unique conditions associated with edge of slab conditions. Edge of slab conditions are often evaluated using ASTM E119 modified specifically for each condition to be tested. Without a standard test method, evaluating and comparing results from the modified tests may be difficult.

Fire resistant construction, rated walls, floor-ceiling, and roof-ceiling assemblies, must be continuous and uninterrupted to work effectively. Fire resistant assemblies are tested and time-rated using ASTM E119 and their performance is listed by Underwriters Laboratory (UL) or other independent testing laboratories. Penetrations, pipes, ducts, conduit, and similar items through fire-rated assemblies, while inevitable in modern construction, are a potential source for the passage of fire, smoke, and gasses. Therefore, penetrations are required by code to be firestopped. Firestops are tested in accordance with ASTM E814 and their performance is listed by UL and other independent testing laboratories.

A fire safe building requires that a fire be limited to the compartment, room, floor, etc., of origin. Compartmentalization is accomplished through the use of fire resistant construction as noted previously; but what happens when the compartment contains a non-rated exterior wall? Below are some situations with some possible solutions:

- Edge Of Slab: Though the wording is different in each of the codes, the intent is clear: *no gaps are allowed in a fire resistant floor assembly*. And the charge is equally clear: a containment system is required to close horizontal openings and maintain the passive fire resistance of the floor slab. Since the edge of slab to exterior wall interface is considered a construction joint, instead of a penetration that is covered by ASTM E814, the void must be filled by a system that complies with ASTM E119. As mentioned earlier, there are few systems available, and they are specialized with limited applications, to accomplish the task.
- Exterior Wall: Precast concrete, masonry, stone, aluminum and glass curtain wall systems are typically not fire-resistant rated construction. In an actual fire situation, glass panels quite often break out or the wall system itself may fail. This results in fire spreading to adjacent floors before the fire-rated floor assembly and any firestops can be breached.

Laboratory testing was performed on a commercial aluminum curtainwall assembly and a concrete floor slab. Four different configurations of glass fiber or mineral fiber insulation on the face of the curtain wall and mineral fiber firestops were tested. The testing was performed using a *modified* ASTM E119 testing procedure. The results indicated, regardless of the insulation configuration, that the fire had spread from its place of origin up to the next floor in less than 15 minutes.[1]

The following systems have been used for protection at edge of slab locations:

- Foil-faced mineral fiber curtain wall insulation installed (under compression) behind spandrel area and in horizontal void, attached with impaling pins. Foil facings of insulation are sealed to each other and to slab edge to stop smoke. System is proprietary (manufactured by United States Gypsum) and is not UL approved nor independently tested. Many designers and fire protection / life safety professionals consider it preferable because of its smoke stopping capabilities.
- Unfaced mineral or ceramic fiber curtain wall insulation is installed (under compression) behind spandrel area and in horizontal voids and attached with impaling pins. These systems are proprietary and the designs depend on the insulation manufacturer. For example, USG's systems are not UL approved; some of those tested have UL reports, but all are manufacturer-tested. Unfaced insulation systems do not address smoke passage.
- Intumescent composite sheets (expand when subjected to extreme heat) are mechanically fastened to curtainwall and slab. Edges and joints are secured with a compatible sealant. System is proprietary (manufactured by 3M) and expensive, but it has an engineering judgment[2] based on a UL design and provides 3 hour F-Rating on 3 hour fire rated assemblies.

- Calcium silicate boards, 15 mm (5/8 inch) thick, are applied across the edge condition and are lapped 90 mm (3-1/2 inches) across and attached to the top and bottom the of slab. 96 kg/m^3 (6 lb/ft^3) mineral curtain wall insulation fills the void between the calcium silicate panels. Edges are sealed with sealant to prevent smoke passage. System is proprietary (manufactured by Eternit using Promat® boards). System was tested at Omega Point Laboratories and has a fire-rating of 2 hours.

ASTM E119 tested systems exist for edge of slab at concrete or masonry exterior walls. Both the tested floor and wall assemblies must be fire resistant and the joints are rated at 1-1/2 hours maximum.

Designers should be familiar with the codes that apply to their projects and with the various systems now available. Keep in mind that none of the systems are tested and approved in accordance ASTM E119. Each system should be studied and evaluated for application to individual projects. Since this circumstance is open to interpretation by the authorities having jurisdiction, designers should consider making their first step proactive. Consider meeting with building officials; reviewing proposed construction details and soliciting their opinions; and following documentation procedures normal to your practice.

If you have encountered this situation, and are willing to share your experiences, please contact the contributor.

Notes:

1. The Building Official and Code Administrator, November/December 1987
2. Engineering judgements are not the same as fire test results. Based upon the observed behavior of fire and its effect on building materials, fire protection engineers are capable of issuing "engineering judgements" which are opinions of the ability of the materials's or construction assembly's ability to resist fire. Engineering judgements may or may not be accepted by code officials.

Contributed by Keith McCormack, CCS. Edited by Scott Sider, CCS