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Life Safety DIGEST

FALL 2018

Six Design Criteria to Guide Perimeter
Fire-Containment Strategies in High-Rise Buildings

'DIIM' – The Industry Standard for Quality

Reliability of Today's Motorized
Life-Safety Dampers

Advancements in Lightweight
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– To Patch or Not to Patch

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LIFE SAFETY DIGEST

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ON THE COVER:

Salesforce Tower, San Francisco. Owens Corning/Thermafiber Photo
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EDITOR'S MESSAGE

High-Rise Buildings are desired in many parts the world. In fact, many of these structures are deemed 'iconic'. Think the Willis Tower in Chicago, the Prudential Building in Boston, the World Trade Center in New York, the CN Tower in Toronto and others. To protect people in stairwells and from floor to floor, or to separate certain occupancies, there are many fire-resistance-rated and smoke-resistant assemblies in these buildings.

At the last few speaking engagements we've asked this question:

Does your facility have a budget for fire sprinkler maintenance?
All said yes.

Does your facility have a budget for detection and alarm system testing and maintenance? *All said yes.*

Does your facility have a budget for fire-resistance-rated and smoke-resistant barriers? *A few said yes.*

The audience response, a few said "yes". It's not all the Building Owner and Manager's fault. The Specifier might not have had closeout documents spec'd in Division 1. The General Contractor might not have turned the fire-resistance-rated assembly listings and Manufacturer's instructions over to the Building Owner. Or, the Building Owner's documentation got lost during building ownership transfer.

This issue of *Life Safety Digest* focuses on new developments in fire-dampers, working with and maintaining fire-rated doors, patching SFRM and IFRM fireproofing, firestopping and more. It also has a few places where the "Inventory" of fire-resistance-rated and smoke-resistant assemblies are described.

From *Life Safety Digest*, we urge Building Owners and Managers to demand documentation that builds the "Fire-Resistance-Rated and Smoke Resistant Assembly Inventory" that's required by the 2018 International Fire Code. If you are thinking that since the building is under the 2015 or earlier versions of the Fire Code you are exempt from this requirement, think again. Older versions also had requirements for records to be kept.

Enjoy this issue of *Life Safety Digest*. Pass it on when you are finished by hand or link to www.fcia.org/magazine.htm. Thanks for reading. 🔥

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Editorial Advisory

Safe buildings can build your reputation.

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For Salesforce Tower, we worked with architects and contractors to create a custom Thermafiber® perimeter fire containment system. It's designed to contain fire and prevent hot gases from entering rooms through voids that would normally exist at the intersection of floor assemblies and exterior walls. It's pioneering fire safety. And the latest innovation from the experts at the Owens Corning Building Science Solution Center, who helped create the first formaldehyde-free mineral wool and the first insulation to receive Homeland Security's Safety Act designation as a Qualified Anti-Terrorism Technology. The result is the tallest building in San Francisco — smarter, safer and more comfortable.



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'DIIM' – THE INDUSTRY STANDARD FOR QUALITY

The Firestop Contractors International Association (FCIA) has focused the industry standards for quality through the **'DIIM' of Firestopping process** - the proper **'D'-Design, 'I'-Installation, 'I'-Inspection and 'M'-Maintenance/Management** of firestopping - for fire- and life-safety since its inception in 1999.

The FCIA has developed a complete package for 'DIIM' by working with the Contractor, Manufacturer and Consultant members to build meaningful standards, approvals and qualifications for firestop installation.

The idea is that following 'DIIM' results in installations that match the tested and listed design listings and manufacturers' installation instructions not just at installation, but for the building's complete life-cycle. While it's true that following the 'DIIM' includes many parties, we believe it provides reliable fire- and life-safety when called upon by fire.

The **'D'-Design** is the Manufacturer's investment in testing at the leading laboratories like UL, FM Approvals, Intertek and others. We have great respect for the companies that have invested in technologies and systems that are designed to protect holes, breaches, gaps, voids, joints - preventing fire, and when applicable, smoke spread in buildings outside the compartment of origin. 'D'-Design is also a well-detailed single 07 48 00 Firestopping specification for both penetrations and joints for eliminating confusion on jobsites.

The **'I'-Installation** part of firestopping's 'DIIM' focuses on the Firestop Contractor company and the process, or management system, it uses to get firestopping installed to the Tested and Listed Firestop System and Manufacturers' installation instructions.

MORE ON 'I'-INSTALLATION

The Manufacturers of firestop products invest millions of dollars in research, product development, and testing to prove the products work as intended. Once the product is produced to strict standards, the product is transported either to a Distributor then Contractor, or directly to a project construction site. If the Manufacturers have invested heavily making sure the product is just right, what programs exist to make sure the installation is according to the listings and Manufacturers' installation instructions?



**It is key that labels reflect the installed system.
If not, it's a variance to the system and possible rejection.
Performance Firestop Photo.**

That's where the FM 4991, *Standard for the Approval of Firestop Contractors*, or the UL/ULC Qualified Firestop Contractor Programs (UL QFCP) step in. Firestop products might look easy to install, but it's the SYSTEMS that make the product installation complex. Change a penetrating item and the system might change. Adjust the annular space or gap size, and again, the system might change.

A management system and zero tolerance installation protocol is needed to get firestop products installed to the Tested and Listed Systems designs from various directories matching the conditions at the jobsite.

The FM 4991 Approved and UL QFCP Programs are critical to the successful installation of a Firestop System. There are several components in these programs that drive the Contractor company to a quality installation:



Writing - and PASSING - the Firestop Exams positions qualified individuals to serve as DRI for their company and prove that Inspectors have competence. FCIA photo.

DESIGNATED RESPONSIBLE INDIVIDUAL

Both the FM 4991 Approved Contractor and UL/ULC QFCP require that an individual take - and pass with an 80% score - an examination based on the FCIA Firestop Manual of Practice, Systems Selection and Analysis and the FM and UL/ULC Programs. The FM Firestop Exam will have questions based on the FM 4991 Approval Standard while the UL/ULC Firestop Exam will have questions on the UL/ULC Program Requirements. Further, both the FM and UL/ULC Firestop Exams have questions on inspection as it's not only a vital part of the contractor quality control program, but is also required by the International Building Code in Chapter 17, Special Inspection and Tests.

Once the person passes the exam and the company becomes a FM 4991 Approved or UL/ULC QFCP company, the firm appoints the person that passed the exam as the Designated Responsible Individual, or DRI.

QUALITY MANAGEMENT SYSTEM

Both programs - the FM 4991 Firestop Contractor Approval and UL's QFCP - require a Quality Management System (QMS), the first step towards either company-based credential. This means simply having someone on staff who passed the Firestop Exam does not qualify the company as FM 4991 Approved or UL/ULC Qualified.

In a Quality Management System, the Firestop Contractor company must demonstrate that they have procedures in place to ensure firestopping happens in the field correctly. The QMS is a custom, company-specific set of processes and procedures for quality

assurance, systems selection/analysis, communication of the tested and listed systems and Manufacturers' installation instructions to field workers.

The procedures are all documented in a Quality Management System Manual that is unique to each contractor company. It's unique because not every company operates the same, which makes it unique to the company and their competitive advantage.

There are some requirements that must be met by companies who are FM 4991 Approved or UL/ULC Qualified. In addition to a QMS, the firestop company must employ a person who has passed an exam, referenced above.

QUALITY MANAGEMENT SYSTEM MANUAL TOPICS

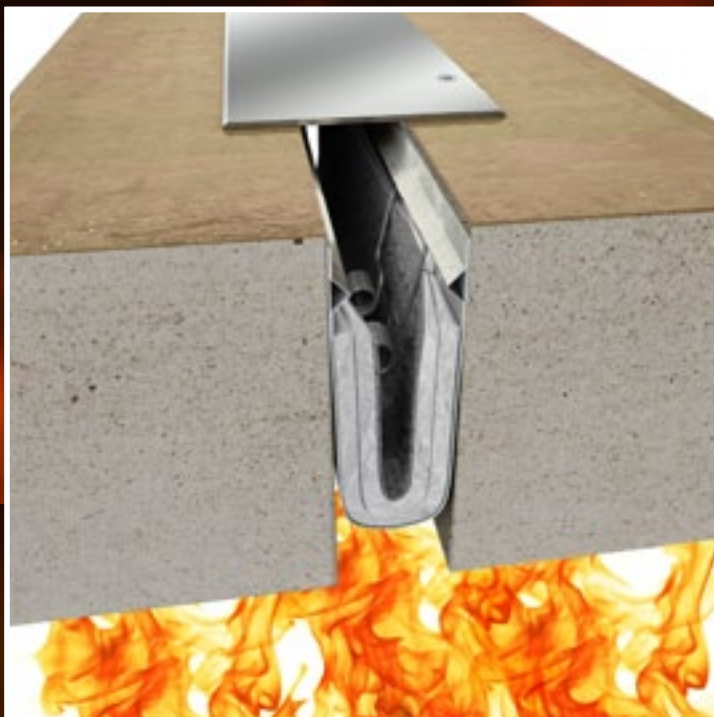
There are several topics that need to be addressed by the company with procedures - in other words, a management system.

- **Estimates, Proposals, Decisions, Job Start, Plans & Specs, Manufacturers Installation Instructions & Tested and Listed Systems** - Estimated systems become the work orders.
- **Employee Training & Education, with Documentation as Proof** - Firestop Containment Workers need to be trained in systems documentation, product technology and manufacturers installation instructions.
- **Systems Selection & Analysis** - This is the basis of the firestop industry. Firestop Contractors need to select and install firestop systems. Selection takes place during the estimate time, prior to providing proposals. The systems selected become the tool used to submit for approval from General Contractors, Building Owners and Managers, Fire Marshals/Inspectors and Building Code Officials. After installation, the systems selected are reviewed by the Contractor personnel for quality control. The same systems are also used by 3rd-party Specialty Inspection Agencies during their inspections.
- **Communication of Systems to Field** - This encompasses Tested and Listed Systems, Manufacturers installation instructions and Safety Data Sheets.
- **Material Controls, Shelf Life, Defectives** - Materials need to reflect the systems and not be installed after the expiration/expiry date, unless documented as allowed by the Manufacturer. Freezing and hot storage also need to be addressed.



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- **Systems installation "protocol" to the Systems Selected - See Above, Systems Selection & Analysis.** This is the basis of the industry. Without knowing systems, the result that Firestopping got installed correctly is a lucky guess at best.
- **Labeling Procedures, When Applicable** - In the FM 4991 Standard, there is a requirement that if FM Approvals Labeling is required by specification, that the labels follow the design below. Check out FCIA's NEW Recommended Professional Practice for Identification Systems, and also the Identification Systems Chapter of the FCIA Firestop Manual of Practice, for details.



- **Variance Procedures & Corrective Action**
 - Mistakes happen. How are they fixed and prevented in the future?
- **Documentation & Recordkeeping** - The FM 4991 Approved or UL/ULC QFCP require that the Firestop Contractor maintain records for seven (7) years. The International Fire Code requires that the Building Owner and manager keep records of all fire-resistance-rated and smoke-resistant assemblies.
- **Project Closeout** - In the 2018 International Fire Code, an "Inventory" of fire-resistance-rated assemblies is required to be kept as records by the Building Owner and Manager.
- **Documentation** - The Tested and Listed Firestop Systems, Manufacturers' installation instructions and safety data sheets - of firestop systems - and all fire-resistance-rated construction elements - is required. FM 4991 Approved and UL/ULC Qualified Firestop Contractors have procedures to document systems in their Quality Management System Manual.
- **Purchasing** - The purchasing process for firestopping in management system-based programs requires a purchase order system.
- **Management System Review** - At least annually, those responsible for the management system need to perform a self-audit and review of the program to be sure it's working properly. This is usually prior to the audit by FM Approvals or UL personnel.

AUDIT PROCESS

Third-party Contractor company Quality Management System audits of the firestop company Qualify Management System are required to become FM 4991 or UL/ULC Qualified. These audits are about 1 to 1-1/2 days long. They are provided by nationally recognized testing laboratories like FM Approvals and UL/ULC.

The FM and or UL/ULC auditor reviews project files and files related to the topics above, asking the contractor to prove that they have procedures in place and meet all requirements of the FM 4991 or UL/ULC Qualified Firestop Contractor Program to get firestop materials installed to the listing and Manufacturers' installation instructions.

After an audit takes place at the Firestop Contractor's office, the FM or UL/ULC Auditor then visits a project site with the Contractor to be sure they 'do as they say they do' in the QMS Manual.

In addition to the rigorous office and field audit for initial FM 4991 Approval or UL/ULC Qualification, there are also annual audits performed by FM Approvals or UL/ULC. The annual audit verifies that the Firestop Contractor's processes are still working as they did at the time of the initial audit. Firestop Contractors, FM 4991 Approved or UL/ULC Qualified, can be found at www.FCIA.org on the member lists. These contractors travel wide areas and can service projects worldwide.

ARE MANUFACTURER PROGRAMS EQUAL TO FM 4991 APPROVAL OR UL QFC?

Specifications sometimes require that the Manufacturer approve the Firestop Contractors. There are many Firestop Manufacturers that offer programs to meet specification requirements. We are unaware of Manufacturers approving Firestop Contractors. Some specifications even state that the Firestop Manufacturer education or accredited or Manufacturer educated contractor program is equal to the FM 4991 or UL/ULC Qualified Firestop Contractor Programs.

FCIA has great respect for the Firestopping Manufacturers. They have invested heavily in manufacturing, marketing, testing, innovations and personnel. The firestop manufacturer programs are an integral part of contractor company education. They are helpful to the contractor as they develop their management systems and installation protocols. However, the Manufacturer education programs are not equal to the FM 4991 or UL/ULC Qualified Firestop Contractor Programs. First, the Manufacturer accreditation, training programs, are not third-party run programs. There is a direct conflict to objectivity due to the sales relationship between the Manufacturer and



FCIA was the code proponent to add third-party independent inspection to the 2012 and onward International Building Code.
Katz Engineering photo.

Contractor. Also, the Manufacturers' programs do not require an audit of the company office procedures, nor a field audit of the Management System.

'I'-Inspection is gaining ground as the 2012 and later International Building Code (IBC) is adopted by jurisdictions. Inspection by the Contractor of their own work and Inspection Agency third-party independent inspection now take place regularly.

Special Inspectors working for Special Inspection Agencies must prove their competence and experience to the Authorizing Agency (AA) and Authority Having Jurisdiction(AHJ) to become Approved. The International Building Code requires competence and experience in the same type and complexity of materials inspected. That means the inspector should in firestopping pass the FM or UL Firestop Exam and the IFC's Firestop Exam to prove competence. The experience is proven through inspectors past project experience. Specialty Inspection Agencies can also participate in programs for quality, such as the International Accreditation Service's IAS AC 291 program to prove their competence as a company to the AHJ.

Contractor self-inspection, at a less frequent basis than ASTM E 2174/ASTM E 2393 standards mandate, is required in the FM 4991 and UL/ULC QFCP programs. One thing to note: Contractor self-inspection is not the same as the Special Inspection referenced in the IBC.

Finally, the **'M'-Maintenance and Management** of Firestopping and fire-resistance-rated and smoke-resistant construction is an ongoing issue that needs attention by Building Owners and Managers. Some hire this work out to professional Firestop Contractors who perform Barrier Management Services, while other Building Owners perform the annual survey required by the International Fire Code on their own. Looking to find companies that perform Barrier Management Services? Check out FCIA's new website section at www.FCIA.org, Barrier Management Services.

CONCLUSION

Specifiers, consider that your specification should specify FCIA Member, FM 4991 Approved, UL/ULC Qualified Firestop Contractors AND Manufacturer education programs. A specification that says, 'either FM 4991, UL/ULC QFC Firestop Contractors OR Manufacturer accredited' is a specification that will not draw a consistent level of quality assurance from the prospective installation companies. Why? The Manufacturer education program is not equivalent to the FM and UL/ULC Management System-based programs in scope or cost. The Manufacturer organization is not an independent organization auditing the Contractor, creating a conflict.

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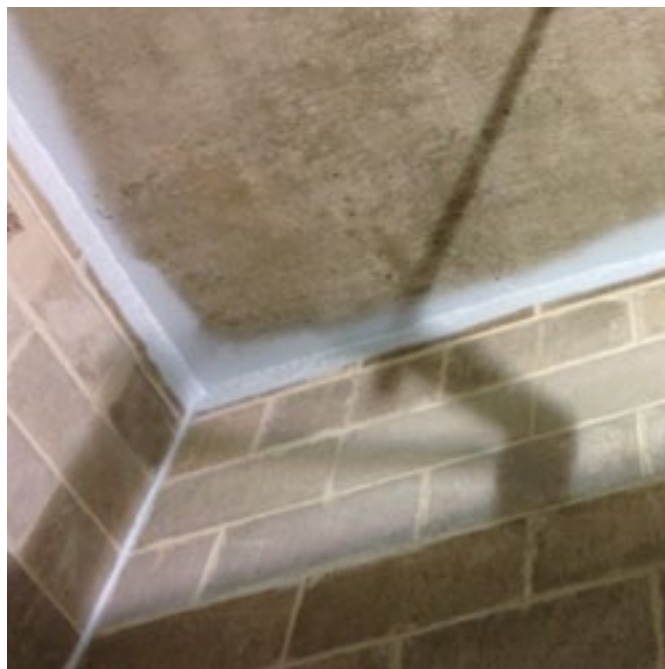
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General Contractors, Building Owners and Managers, check out the value that comes from FCIA Member, FM 4991 Approved Firestop or UL/ULC Qualified Firestop Contractors. There's a reason there are differences between the companies that just 'fire caulk everything' and those who understand what the technical aspects of firestopping are.

There are some that think firestopping is simply 'sealing pipes' with whatever they think is 'Fire Caulk'. Fire Caulk does not extend the fire-resistance of the wall where the breach was made. *It's the FIRESTOP SYSTEM that gets the rating, not the product.* Demand the Tested and Listed Systems and Manufacturers' instructions from those working in your buildings.

Building Owners and Managers, the annual visual inspection, recording of the inspection and repairs of fire-resistance-rated assemblies has been required for years. In existing buildings, check the barriers at least annually and have the barriers and the features that protect them documented into an inventory, as the International Fire Code requires.

FCIA Member, FM 4991 Approved Firestop or UL/ULC Firestop Contractors, thank you for being members and going the extra mile for fire- and life-safety in buildings. Interested in finding or becoming an FCIA Member, FM 4991 Approved or UL/ULC Qualified Firestop Contractor? Visit www.FCIA.org and you'll find all you need.



The MACC verifies that the Quality Management System processes in place are actually being followed in the field. Performance Firestop photo.

SIDEBAR

UL Announces a New Enhancement to UL Qualified Firestop Contractor Program

UL's Qualified Firestop Contractor Program (UL QFCP) has been in the industry for over 10 years now. As part of continued improvement, FCIA and UL partnered to develop the MACC - the Master Audit Certificate of Compliance.

This new program is an optional additional service UL can provide for UL QFC's and their Building Owner and Manager Partners. This new certificate brings great value to the Building Owner that they can use with insurance companies, AHJ's and others.

The new MACC program - available worldwide - includes a job site audit of the UL QFCP's Management System and a certificate for the Firestop Contractor to provide to the Building Owner and/or Manager that the contractor was found to be in compliance. The MACC even references the need for the Building Owner to comply with the International Fire Code requirement for annual visual inspection of fire-resistance including firestopping. And, the MACC is available only to UL QFCP's.

Watch for the UL Announcement and details shortly with a full explanation at FCIA's Symposium in Winnipeg and the FCIA Firestop Industry Conference & Trade Show in Austin, TX. 🔥

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SIX DESIGN CRITERIA TO GUIDE PERIMETER FIRE-CONTAINMENT STRATEGIES IN HIGH-RISE BUILDINGS

And one often overlooked liability consideration

Whether an office tower, high-rise hotel or mixed-use structure, high-rise buildings present complex challenges for architects and others involved in specifying life-safety systems. In addition to specifying detective life-safety systems, such as detection, alarms and monitors, and suppression life-safety systems such as sprinklers, building codes also require passive fire-containment systems to help protect a building's occupants.

Also referred to as compartmentation, a passive fire-containment system helps contain a fire to its room of origin and impedes the spread of gases and flames to other parts of the building. Properly installed, compartmentation systems promise to perform without the need for triggering an activation mechanism. As the elements of a passive fire-containment system work to inhibit the spread of fire within a structure, they help provide valuable time for occupants to evacuate.

A significant challenge for professionals specifying passive fire-containment systems in high-rise buildings is the breadth of materials and assemblies influencing design, codes and engineering judgments. Specific challenges for perimeter fire-containment assemblies may include special conditions, such as the geometry of the spandrel (curved, angular, or wide spandrels) relative to the curtain-wall, the aesthetic of the building design, exposed curtain-wall anchoring, and the overall fire performance of building materials used in various areas. The following six design concepts can help to inform designers on the critical components necessary for successful passive fire-containment systems:

1.) Insulate with mineral wool.

As one of the most tested and evaluated insulating material for buildings, mineral wool is an ideal material to support passive fire-containment. Fire-tested to ASTM E119, mineral wool has been shown to withstand temperatures well above 1,093° C / 2000° Fahrenheit. As part of a properly installed passive fire-containment system, mineral



Four out of five of the tallest buildings in North America trust mineral wool. Owens Corning/Thermafiber photo.

wool is an integral part of some of the world's most recognized buildings. For example, four out of five of the tallest buildings in North America trust mineral wool to protect building occupants. Because there is no one-size-fits-all approach when it comes to mechanical fasteners, proper installation is critical. Installation of the mineral wool must comply with the perimeter fire-containment assembly manufacturer's installation instructions to ensure the system operates as designed according to the fire exposure of ASTM E2307, Standard Test Methodology for Determining Fire Resistance of Perimeter Fire Barrier Systems using the Intermediate-Scale, Multi-story Test Apparatus.

2.) Consider the nature of the framing material and the building's unique geometry.

Because of their height, high-rise structures are typically framed with light-weight but extremely heat-sensitive aluminum framing. Properly installed, mineral wool's ability to withstand high temperatures protects a building's frame, helping to support the integrity of the structure when presented with a fire threat. Geometry of the

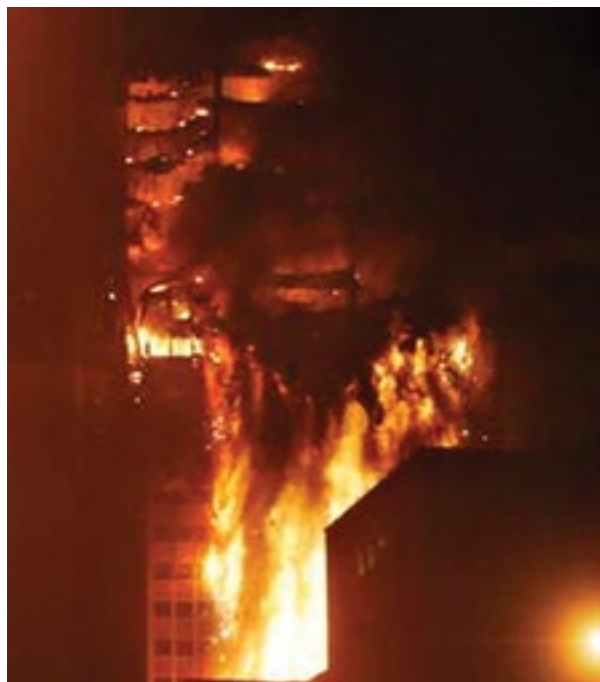


The curved exterior of the Salesforce Tower in San Francisco required a unique approach to perimeter fire-containment. Owens Corning/Thermafiber photo.

gap between the exterior wall and the horizontal assembly also influences approaches to passive fire-containment. Protecting exposed aluminum curtain-wall anchors is another important design consideration for successful system performance. The newly opened Salesforce Tower's appealing design features a curved spandrel that required a customized approach to insulating the perimeter exterior wall. Properly fitting the mineral wool curtain-wall insulation in this area was essential to protecting the curtain-wall and protecting against fire propagation up - and through - the cavity between the curtain-wall and the horizontal assembly.

- 3.) Plan for potential fire propagation paths. Building codes require a barrier to prevent the spread of fire from the interior joint where a void exists between the fire-rated slab perimeter joint and the exterior non-rated curtain-wall. A tested and proven (per ASTM E 2307), non-combustible mineral wool can contain the interior spread of fire.

Although currently not a requirement of the building codes and ASTM E 2307, another path of fire propagation demands consideration when it comes to achieving a high level of life-safety in a high-rise structure, the "Leapfrog" effect. "Leapfrog" occurs when fire breaks out the vision glass on the floor of fire-origin. Once the vision glass is broken, flame and hot gases can escape and move up the exterior face of the curtain-wall, causing the vision glass on the floor above to break. When this situation occurs, fire can re-enter the building through the window opening, engaging combustibles and allowing the fire to jump from floor-to-floor.



The photo above shows the results of "leapfrogging" fire propagation. Note how the fire has spread vertically along the outside of the building. Owens Corning/Thermafiber photo.

- 4.) Reinforce insulation. Most UL and Intertek listed designs require the installation of a backing element to provide a tight fit between the insulation and other components of the assembly. This detail provides reinforcement behind the curtain-wall insulation to prevent it from bowing due to the compression fitting of the safing material in the interior joint between the horizontal assembly and curtain-wall insulation.



Building codes require a barrier to prevent the spread of fire from the interior joint where a void exists between the fire-rated horizontal assembly perimeter joint and the exterior non-rated curtain-wall. Owens Corning/Thermafiber photo.

Although there are systems available that do not require a backer/reinforcement member, these systems are still designed to provide support to the curtain-wall insulation at the safing line. It is recommended to consult with the system test sponsor to determine whether a backer/reinforcement member is required for the specific design.

5. Help protect against smoke spread. According to the National Fire Protection Association, (NFPA) most fire deaths are caused not by burns, but rather by smoke inhalation. Therefore, it is important to help protect occupants from smoke inhalation.¹ UL and Intertek systems include smoke-resistant properties as part of the life-safety system when an air-leakage rating has been achieved. Typically, this is accomplished with a firestop sealant placed on top of the safing insulation.
- 6.) Learn from history. Every completed building project yields insights that can enhance future projects. Pioneering advances in passive fire-containment since the late 1960's, Thermafiber® insulation has assembled a deep resource library of projects presenting complex design challenges, multiple assemblies and diverse code requirements. Some of this content is available on the newly launched Owens Corning Building Science Center.

Despite a spectrum of advanced testing resources, tested assemblies rarely align completely with real-world projects. The variables described above make it impractical, if not impossible, to replicate systems with 100% precision. To inform decisions, those who specify passive life-safety systems rely on data to identify comparable real designs. Decades of experience testing assemblies means that if a lab hasn't fire-tested an exact assembly, most likely similar components and systems have been tested by manufacturers to help engineers predict performance. This databank of knowledge is critical in developing quality "engineering judgments" that architects and code officials can rely on.

THE U.S. SAFETY ACT: A DESIGNATION TO SUPPORT LIABILITY PROTECTION

While supporting occupants' life-safety will always be the first priority when it comes to designing passive fire-containment systems, liability risk is an ongoing concern. The September 11, 2001 terrorist attacks on New York City's World Trade Center and the 1995 bomb explosion at a nine-story federal building in Oklahoma City represent the two deadliest fires in American history. While acts of terrorism are fortunately very rare, they present liability risk for many parties involved in commercial construction, including building owners, architects, firestop contractors and manufacturers.



The SAFETY Act designation protects parties involved in perimeter fire-containment systems from liability related to acts of terrorism.

In 2017, Thermafiber® mineral wool became the first building insulation to earn the U.S. Department of Homeland Security's "Safety Act" designation. Retroactive to 2006, SAFETY Act designation provides architects with protection against liability related to acts of terrorism. The Act also protects related parties involved in perimeter fire-containment systems, including curtain-wall manufacturers and firestop contractors, from liability related to acts of terrorism.

While evolving design trends and evolving codes will continue to challenge those professionals responsible for life-safety, the six design considerations described above can help support a strategy for passive fire-containment across a wide breadth of high-rise buildings. In addition, the U.S. SAFETY Act designation provides a level of assurance for architects and other stakeholders, including firestop contractors involved in specifying and properly installing materials for the building enclosure. 🔥

Angela Ogino is the Technical Services Leader at Owens Corning® Thermafiber® Insulation. She can be reached at Angela.Ogino@owenscorning.com.

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- ¹. National Fire Protection Association (NFPA), 'A Reporter's Guide to Fire and the NFPA,' www.nfpa.org



PROJECT: Orlando VA Medical Center
ARCHITECT: RLF Architects
GLAZING CONTRACTOR: Harmon Inc.
APPLICATION: 1 and 2 hour fire resistive hurricane rated exterior curtain walls

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RELIABILITY OF TODAY'S MOTORIZED LIFE-SAFETY DAMPERS

Motorized fire, smoke and combination fire/smoke dampers and their testing requirements have come a long way since their introduction during the 1970s.

Originally, life-safety dampers were standard commercial control dampers with blade locks to hold them closed. They were UL-tested to the third edition of UL 555, *Standard for Fire Dampers* and the first edition of UL 555S, *Standard for Smoke Dampers*.

Testing consisted of fire, 250-cycle and heat-degradation tests. Because UL did not have a test procedure for actuators, damper manufacturers would list the actuator used in the test of their product. Actuators did not have to operate under fire conditions. Instead, a fusible link connected to the damper blades and a shaft connected to the actuator were utilized. During a fire event, the actuator would disconnect from the shaft, a spring would close the damper and a locking device would secure the blades closed. Because of the fusible link, full access to a damper via an access door was required for visual inspection and testing.

In the ensuing years, major changes were made to improve the efficiency of motorized fire, smoke and combination fire/smoke dampers. Today, they have their own UL 555S (Fourth Edition) test requirements, and there is a new test standard for actuators and dynamic assembly operation.

Modern life-safety dampers are specially designed to operate during exposure to high-temperatures and velocities. Also, instead of relying on fusible links and blade locks to close under fire conditions, they are designed with a jackshaft with solid connection that locks the blades into position when the dampers are closed.

Life-safety actuators, meanwhile, have evolved from oil-filled foot-mounted motors with complicated linkages subject to breaking to specially designed anti-slip, direct-coupled devices that have passed rigorous UL cycle and holding tests.

UL555 and UL555S have been updated to meet today's building HVAC and smoke-evacuation systems. Current standards require damper and actuator assemblies to be cycle-tested for a minimum of 20,000 cycles and subjected to a heated-air dynamic-closure-and-operation test with a minimum temperature of 250°F (121°C), a minimum air velocity of 2,400 fpm (10.2 m/s) and a system pressure of 4.5 in. wg (1.1 Pa).

UL procedures include spontaneous inspections at manufacturers' facilities to ensure life-safety dampers are being built as tested, without modifications. Additionally, UL requires installation instructions accompany each shipment of dampers, so contractors have the most up-to-date guidance. In the installation instructions for each individually shipped damper are the listings for these important life safety products.

With non-motorized dampers operating with fusible links, visual inspection is the only way to determine if an issue exists with the damper. With motorized dampers, because of the rigorous standards to which all must adhere prior to being shipped to a job site and the documented installation instructions from the manufacturer, after an initial visual inspection and visual commissioning of a building, remote testing of the damper is possible. Remote testing can be accomplished multiple ways:

- **Control panel.** A control panel can be hard-wired directly to a damper with a momentary push button.
- **Computerized fire-alarm panel.** Requirements for damper testing vary from country to country. For example, in Europe, some countries require testing as often as every 48-hours, performed by a computerized fire-alarm panel that notifies users if something is wrong.
- **Remote control.** Technology similar to the technology that allows us to control our homes with a hand-held device is available for testing UL-listed motorized dampers.

With remote-testing capabilities, intrusion into ceiling cavities to test dampers is no longer necessary, and the cost of testing can be reduced by up to \$500 a damper. NFPA 80 and NFPA 105 2019 versions will bring this option to the process as well. Consult with the local Authority Having Jurisdiction, as with all these new developments, for applicability.

CONCLUSION

This new remote testing method for fire and smoke dampers is an efficiency tool for building owners and managers who must document their inventory of fire-resistance-rated and smoke-resistant assemblies and their features, and keep records of their maintenance, testing and repairs.

Because of improved accuracy and reliability, reduced tolerances and the development of specialized actuators and testing equipment, life-safety dampers no longer are glorified control dampers.

They are specially designed devices that play a vital role in passive fire-protection systems, preventing the spread of fire and/or smoke through openings in walls, ceilings, floors and partitions, protecting building occupants and property. 🔥

Kent Maune is the life-safety product manager at Ruskin Co., Grandview, MO.



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ADVANCEMENTS IN LIGHTWEIGHT FIRE-RESISTANT GYPSUM PANELS

FIRE-RESISTANCE IN MULTIFAMILY STRUCTURES

From 2009-2013, U.S. fire departments responded to an estimated 14,500 reported structure fires in high-rise buildings per year, even though they often have fire protection that makes them safer than other building types in the event of a fire¹. Beyond just active protection, these structures also employ passive protection, such as gypsum panels used in a fire-resistance-rated wall, floor-ceiling, roof-ceiling and/or column assemblies to restrict the transfer of heat and fire in the event of an emergency.

Depending on the formulation of the core, different gypsum panels perform different functions and are installed differently in critical components of fire- and life-safety construction. Understanding these differences is imperative to proper design, installation and performance in a life-safety system in multifamily structures.

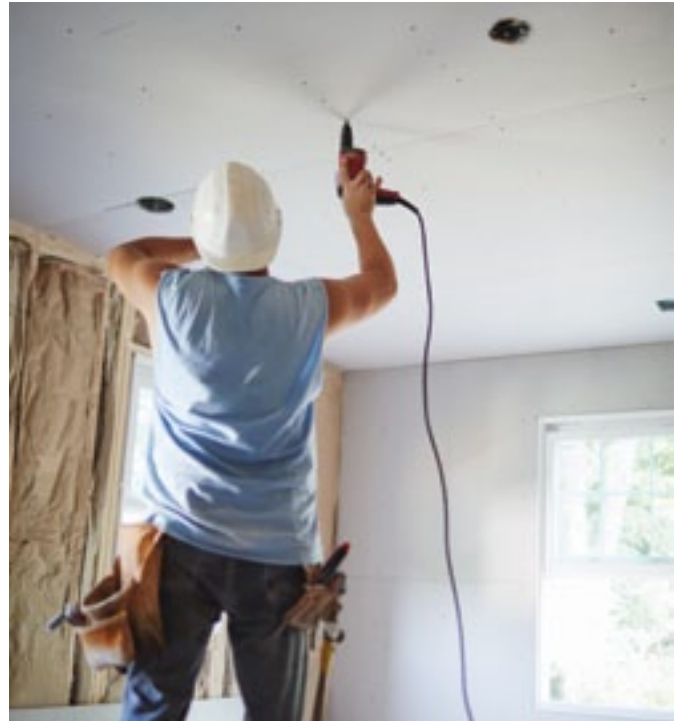
BUILDING UP POST-WAR AMERICA

World War II, the most devastating and widespread war in modern history, devilishly fueled the American economy. Advancements in technology took off faster than could have ever been imagined. Ultimately, it created a new world at home, with the country wanting to return to the safety of living the American dream—getting married, buying a house and raising a family.

During this time, there were longer periods of rapid growth for residential and commercial construction projects, and urban areas became more populated. The City of Chicago, for example, quickly became the ideal modern city, pushing skyscrapers to new heights and architects finessing high-rise multifamily structure living.

THE INTRODUCTION OF TYPE X GYPSUM PANELS

With the growing urban population, increasing the fire-resistance of gypsum panels in the event of a fire was the primary concern of manufacturers during this time. Fire-resistance, defined as the property of a building assembly to withstand fire or give protection from it, is first the ability of a building to maintain structural integrity and stability despite exposure to a flame.



Builders and designers are eager to use a one-solution panel for fire-resistance-rated wall, floor-ceiling and roof-ceiling assemblies.
USG photo.

In applications, like wall and floor-ceiling assemblies, fire-resistance then serves as a barrier to flame spread, providing temporary refuge and time to escape.

Considerable developmental efforts went into maximizing the inherent fire-resistive properties of gypsum panels. The result was the introduction of 5/8-inch, "fire-code" gypsum panel known as Type X, which increased a standard assembly's fire-rating to a minimum of one-hour, similar to metal lath and plaster which, for years, was considered the only acceptable one-hour fire-resistive construction.

Even in the early years of the industry, it was apparent that gypsum, by itself, or in combination with an aggregate, was a high performing barrier to the passage of heat, fire and smoke for long periods of time².

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In Type X panels, special glass fibers are intermixed with the gypsum to reinforce the core of the panels. These fibers have the effect of reducing the size of the cracks that form as the water is driven off, thereby extending the length of time the gypsum panels maintain their physical integrity under fire conditions.

As America moved into the 1960s, structures continued to grow even taller, thus the need for more time for occupants to safely evacuate during a fire emergency.

It was during this time USG invented Type C panels. As with the Type X panels, the core of the Type C panels contains glass fibers, only in a much higher percent by weight. In addition to the greater amount of glass fiber, the core of the Type C panels also contains vermiculite, which acts as a shrinkage-compensating additive that expands when exposed to the elevated temperatures of a fire. This expansion occurs at roughly the same rate as the calcination (or dehydration temperature) of the gypsum in the core. It allows the core of the Type C panels to remain dimensionally stable in the presence of fire, which in turn allows the panels to remain in place for a longer period of time, even after the combined water has been driven off. It's for this reason, Type C panels became synonymous with fire-resistance-rated horizontal assemblies, while Type X was primarily for wall assemblies—and it's been that way for more than 50 years.

Today, almost all UL Listed fire-resistance-rated floor- and roof-ceiling assemblies specify Type C gypsum panels as part of the design to ensure the proper level of fire performance. However, on the jobsite there's often confusion when determining which applications require the use of a Type X panel, versus those that require a Type C. The result is that misapplication of Type X in a listed fire-resistance-rated assembly where Type C is specified can lead to serious life-safety consequences.

Another reason these panels are so often misapplied is that there's little visual differentiation between them. Even product name differences are subtle and easily overlooked, which makes it a challenge to identify a panel after it's installed in a ceiling application and the gypsum panel joints are finished.

ADVANCEMENTS IN LIGHTWEIGHT FIRE-RESISTANT PANELS

Contractor demand for products that improve productivity and save money has been a driving force for greater innovations in building materials. The most significant advancement since USG commercialized gypsum panels in 1917 under the namesake "Sheetrock®" was the introduction of ultralightweight panels. These

panels were formulated to achieve all the strength and performance characteristics as standard 5/8-inch Type X panels, but at a significantly reduced weight.

Then in 2017, USG revolutionized the way gypsum panels are manufactured with the introduction of Sheetrock® Brand EcoSmart Panels Firecode® X (UL Type ULIX™), a single 5/8-inch gypsum panel solution for the most widely specified UL Listed fire-resistance-rated wall, column, floor-ceiling and roof-ceiling assemblies. These panels eliminate the need for separate Type X and Type C gypsum panels, and therefore misapplication or confusion on the jobsite. This panel is also the industry's lightest, helping to defy conventional thinking that mass is required to meet fire performance, regardless of hourly rating. This significant weight reduction compared to other Type X and Type C panels helps increase productivity while decreasing jobsite complexity. For more information about Sheetrock® Brand EcoSmart Panels Firecode® X (UL Type ULIX™) panels, please visit usg.com/eco.

IN CONCLUSION

The overriding goal of all fire-resistance-rated assembly designs is to mitigate risk, and thereby save lives and property in the event of a fire. For this reason, it's imperative to match products and assemblies installed to the listings and installation instructions to the end performance desired. By understanding proper product applications and the latest available technologies designed to help increase productivity, architects and contractors can avoid costly job re-work and delays, as well as control the potential for greater safety risks within the construction environment. 🔥

Nestor Sanchez is the architectural systems manager at USG Corporation where he's held the title for 24+ years. In his role, he focuses on evaluating products and systems through testing in accordance with ASTM and Underwriters Laboratories, Inc. (UL) standards. His expertise lies with testing the surface burning characteristics and combustibility of interior finishes, and the fire-resistance of walls, floor- and roof-ceiling assemblies. Prior to joining USG, Nestor held a succession of positions at Underwriters Laboratories, Inc. (UL). He received a master's degree in Business Administration from Lake Forest Graduate School of Management (Lake Forest, IL) and a Bachelor of Science in Civil Engineering from Universidad de los Andes (Bogota, Colombia). He can be reached at nsanchez@usg.com.

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EXISTING BUILDINGS & FIREPROOFING - TO PATCH OR NOT TO PATCH

In existing buildings where the structure requires fire-resistance - the unexpected can happen. Plumbing, electrical, mechanical and cabling contractor employees hang piping, conduit, cables, etc., from protected structural elements and horizontal assemblies within buildings.

To provide proper attachment or weld to attach the piping, cables or other elements, they need to first remove the fireproofing material, either Spray-Applied Fire-Resistant Materials (SFRM) or Intumescent Fire-Resistant Materials (IFRM), to get to bare substrate - either metal or concrete. When that happens, repairs are needed since the continuity of fire-resistance protection is now compromised.

Studies have indicated that the fire-resistance of protected steel is significantly diminished if only a small portion of the fire-resistance material is removed. The reduction in the rating is dependent upon the extent of the removal and the size of the steel, but it can be as high as a 40% reduction in the time to failure for a 2-hour rated W10X49 column with only a 4% loss of fire protection material.¹

Where SFRM and or IFRM Fireproofing are used to protect the assembly, there are procedures that need to be followed to patch the fireproofing and provide continuous fire-resistance.

WHY PATCH FIREPROOFING?

The need for repair of fireproofing materials applied to structural steel or other building elements or assemblies raises the question, "Is it acceptable to use one material to patch or repair another already installed material that might be dissimilar, or from two different manufacturers?" Too often the answer is "Well, they looked the same, so we thought that it would be okay to use what we had available....".

Most of the commonly used codes, such as the International Building Code (IBC), National Building Code of Canada (NBC), International Fire Code (IFC), NFPA 5000, Building Construction and Safety Code

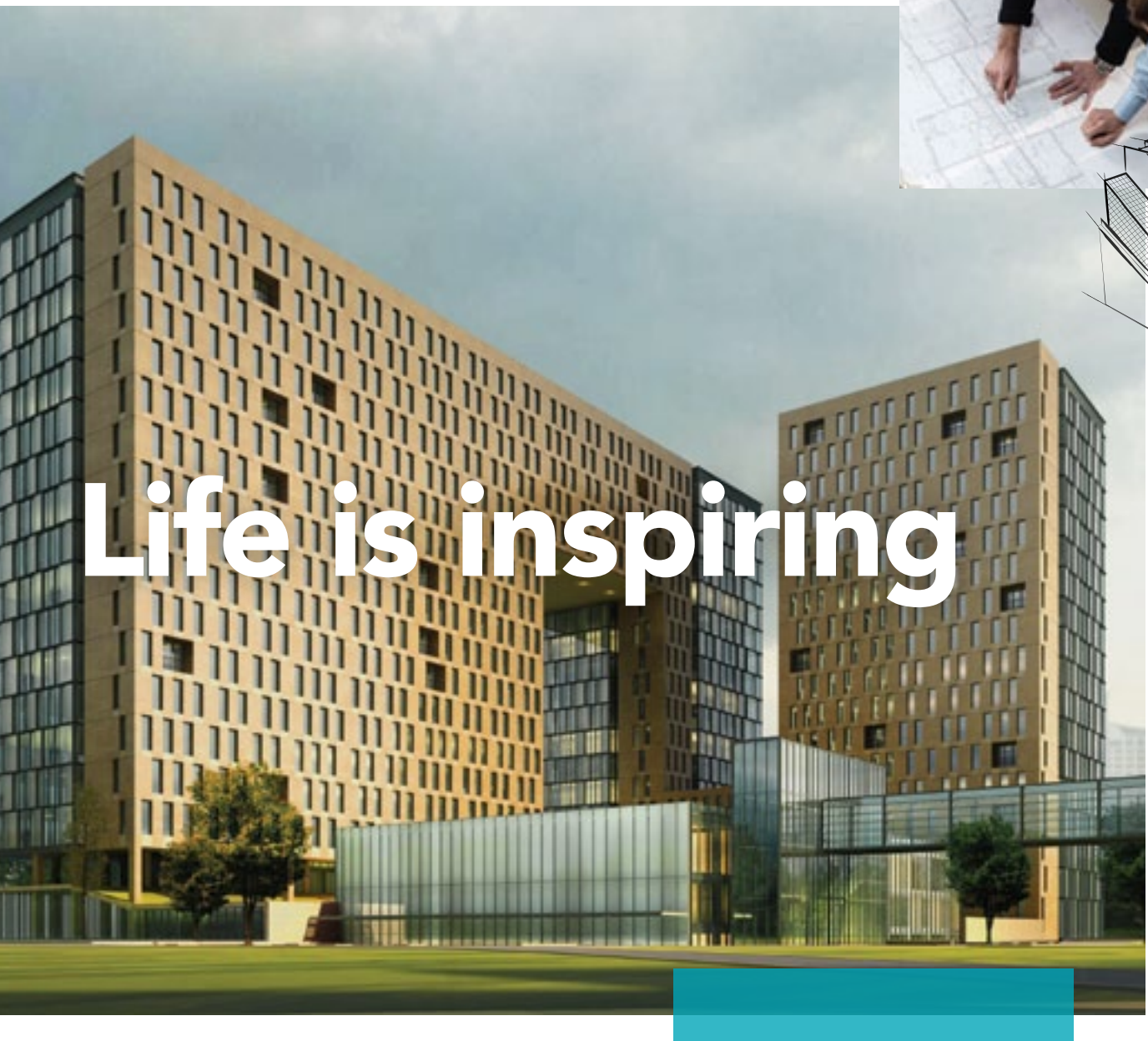


**SFRM or IFRM can be damaged during construction, then repairs are needed.
GCP Applied Technologies Photo**



**SFRM or IFRM can be damaged when new services are added to existing buildings and need repair and documentation of the repair to comply.
GCP Applied Technologies Photo**

and NFPA 101, the Life Safety Code, detail the steps needed to provide a fire-resistance-rating to structural steel or other building elements or assemblies.



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The fire-resistance directories of testing agencies such as Underwriters Laboratories (UL) and Intertek detail the steps (via designs) necessary to meet the ASTM E-119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, ANSI/UL 263, *Fire Tests of Building Construction and Materials* or ULC CAN S101, *Standard Methods of Fire Endurance Tests of Building Construction and Materials* requirements stated in the building and fire codes. (see sidebar on page 29)

All the listed fire-resistance designs published by those agencies within these directories detail the use of specific fireproofing products on the steel element or assembly at any one time for single source responsibility and for other various life-safety reasons.

THE QUESTION WAS...

Now, back to the question... Is the fire-resistance-rating maintained when the SFRM or IFRM Fireproofing disappears or has been removed? During construction, this is a relatively straightforward process as the applicator of the SFRM or IFRM might still be on-site and can patch the assemblies with the same material specified. The specifications are available, and the Fireproofing Contractor has the Manufacturers' installation instructions and the listings and patching requirements at his or her fingertips.

However, over time, that information may be lost for a variety of reasons. Or maybe the Building Owner or General Contractor may not wish to re-engage the original SFRM or IFRM Fireproofing applicator to do the patching work, preferring to do this themselves or even hiring another Fireproofing Contractor.

The question then arises - what if the Contractor cannot identify the product? What if there are no records to identify which Manufacturer's product it is? Is it acceptable to use a dissimilar product - something comprised of chemically different properties from the originally installed product - for patching?

"The simple answer is no," states GCP Applied Technology's John Dalton. "We are unaware of a design by any IAS-accredited testing agency that shows different products used on the same piece of steel simultaneously".

There are many companies involved in the production and testing of products used to provide a fire-resistance-rating for structural steel and other fire-resistance-rated building elements or assemblies.

The various Manufacturers of SFRM and IFRM fireproofing believe that the original product (or an approved equal - the same type) must be used to repair the SFRM or IFRM materials that, together with the structural element, provide the assembly with its fire-resistance-rating.

SFRM and IFRM Fireproofing materials have very complex chemistries unique to each Manufacturer's formulation. "There can be chemical incompatibilities at the junction point of the patch and the existing material, thus resulting in delamination under fire conditions," states GCP's Dalton. This means that without a specific fire test using the same structural element or assembly to verify that the material used for patching will perform under fire conditions, it's a guess if the IFRM or SFRM patch will work when exposed to fire. Isolatek International's Phil Mancuso agrees. Isolatek is a manufacturer of both SFRM and IFRMs.

For instance, if a gypsum-based SFRM product was used to provide the original fire-resistance-rating, a patch of a cement-based product may not be compatible, or vice-versa. The same principle applies to IFRM made from solvent or water-based, and even water to water-based materials.

PATCHING & MANUFACTURERS RECOMMENDATIONS

Can an IFRM intumescent material be used to patch cementitious materials?

"Of course, it can, but only if there exists a valid tested and listed design within the exact listing number that details that such a construction will not damage the fire-resistance-rating and is chemically compatible", states Carboline's Sean Younger. No such design currently exists, according to GCP's Dalton.

Of the manufacturers contacted while researching for this article, several indicated that they have data indicating that the areas of SFRM fireproofing that are patched with dissimilar materials might delaminate, or pop-off the structural element or steel in the event of a fire condition. This is even though the patching materials might bond to the steel or the original fireproofing material at the patching or repair installation.

Younger further states, "Another concern would be for environmental exposure of the patched area during a renovation where temperatures might change, heat or cold. Most SFRM application is performed while a building is in a semi-exposed, general purpose condition. This condition exposes fireproofing materials to fluctuating temperatures, humidity and exposure to the elements. Much of the patching work is carried out during this same time frame. This would subject a patch of dissimilar materials to expansion and contraction during rising and falling temperatures. A single material will expand and contract at the same rate, while dissimilar materials will tend to expand and contract at different rates, which can cause stress-cracking at a cold joint seam and, ultimately, loss of bond to the substrate."

"For IFRM, the issue is equally important," states Isolotek's Phil Mancuso. "The chemistries are different between Manufacturers. And, who accepts liability for the 'tie in' from one Manufacturer's products to the other's products?" These are all issues that exist when working in new construction and existing buildings.

Hilti's Ernst Toussaint agrees. "Regarding patching our existing material, our material will be the only one used."

George Guanci of Sherwin Williams states, "We do not permit other materials to be used to patch Firetex, nor do we use Firetex to patch/repair other materials. It is our understanding that UL does not permit dissimilar materials to be used to repair fireproofing."

The National Fireproofing Contractors Association (NFCA) recognizes the complexity of material chemistries - SFRM and IFRMs - and recommends that patching fireproofing should be accomplished with the same material as is already in place, or with a patching material specifically listed by the Manufacturer of the SFRM and/or IFRM used throughout the building for use with the material and design listing that is in place. NFCA advocates for testing to be the proof of performance of a product in a specific application.

PATCHING BY TYPE OF FIREPROOFING

What happens when the original product is not known and there is a need to repair the fireproofing? Is there a way to determine what the product is, and what products may be used to repair it?

The Technical Service Departments of the Fireproofing Suppliers all indicated that they can provide some guidance as to the make-up of the original material, based upon photographic evidence and information about the age of the installation. They can also attempt to identify the products from sample extractions or visits.

If every possible means was used and the individual material cannot be identified, that is where another Manufacturers' products of the *same type*, but different than the original material Manufacturer, might be used - with a specific recommendation from the Manufacturer of the patch material, which should follow the guidelines from a major testing laboratory, such as UL.

The material type is referring to gypsum, cementitious, mineral wool SFRM, water-based or solvent-based IFRM and other material types. Patching recommendations likely would have similar type materials specified for the patching at a thickness as recommended by the Manufacturer, based on a listing that makes sense, and of course, approved by the AHJ.

There is a patented, trowel applied fire resistive material designed and tested as a patch for repairing damaged SFRM. "Tested for compatibility against all known types of SFRM including plaster/cementitious products. The patching product has a robust density, superior adhesion/cohesion, and a 2 hour fire-resistance-rating when used in accordance with UL listing design number Y737 and Intertek VEL/CF 120-01", states Universal Fireproofing Patch's Tim Vellrath, the Vellrath Group, manufacturer of the product.

As with all fire-resistance products, there are limitations to the product usage. The UL Listing design number Y737 is a continuous encasement listing where the steel column is a minimum, W10x49 and cementitious fireproofing is 1-3/16" thick, for a 2 hour fire-resistance-rating. Larger columns can also be protected using the material as listed.

The Intertek listing VEL/CF 120-01 seems to be meant for patching existing up to 2 hour fire-resistance-rated column assemblies with cementitious fireproofing. The listing states that the product can be used with cementitious fireproofing, be applied to a structural steel members including column, beam, joist, girt or corrugated steel decking, where fireproofing is already applied to the deck. The limitations are that a maximum area of 3 square feet of material can be used, with a minimum of 12" of original SFRM material between each patch.

The manufacturers interviewed for this article recommend patching first with their own material, to the listed design. If the manufacturer is not known, then patching with the same type of material as mentioned above.

PATCHING SFRM WITH IFRM?

"There are many issues that arise from attempting to patch an SFRM with an IFRM in existing buildings," states Younger. "How will the surface preparation be carried out correctly," is one question raised. "SFRM materials are generally applied over clean bare steel substrates, while IFRMs require even more detailed substrate preparation. IFRMs also require that an approved primer be applied to the steel. How should the cold joint between the SFRM and the IFRM be prepared? You would almost certainly get some type of disbondment at that interface."

According to Younger, intumescent materials rely on the bond strength to the primed substrate to hang on and perform during a fire. If this is compromised at the interface, a crack can form that will cause the entire patch to intumesce off the steel, leaving bare steel exposed to the fire. This could be especially troublesome on horizontal patches along the bottom of beams and decks.

He continues, "After extensive in-house testing and along with UL Guidelines, Carboline does not recommend patching IFRMs with different intumescent materials or types, as well as patching SFRMs with any other product other than what has originally been applied."

Younger adds, "At the present time, to the best of our knowledge, there has been no independently evaluated fire test data developed with both IFRM and SFRM products applied to the same structural member, or to intersections of independent members, where these products lie adjacent to each other." According to Younger, "In the absence of fire test data, UL has advised that the use of multiple products on the same structural member, unless specifically listed in the design, is not allowed. The use of multiple products, each applied to a separate structural member, is allowed provided that each structural member is fireproofed with the specific product as detailed in the applicable designs."

"Despite this general opinion by UL disallowing the use of multiple products on the same structural member," states Younger, "UL has issued job specific letters giving guidelines as to how mechanically fastened metal lath can be used to maintain fire-resistance-ratings when it is desired to use intumescent coatings and SFRM on the same structural member."

From NFCA's perspective, there needs to be full-scale fire testing to the ASTM E 119, UL 263 and ULC-S-101 Test Standards to prove that patches work. Not all structural members are equal under fire conditions.

NFCA has heard that there might be other methods to marry different materials on the same structural member or building element. The word 'different' in this context means different Manufacturers, as well as different types.

NFCA RECOMMENDATIONS

NFCA's recommendations to Contractors working with assemblies where two different types of materials are used is to get test data from Manufacturers stating compatibility and describing the method to apply the materials as a patch, as well as request guidance on which listing to use to present to the AHJ for approval.

Even when the materials are the same from the same Manufacturer, NFCA recommends getting instructions from the Manufacturers of fireproofing materials for how to repair the products. As time goes on and formulations change for various materials, the compatibility of the Manufacturer's own products can change. Anything can change in formulations that might affect how the materials are prepared, applied and finished. That's why Fireproofing Contractors and others that might perform patching need to understand the Manufacturer's patching requirements.

The critical point about patching installed fireproofing, SFRM, IFRM or a combination of the materials is that the objective of fireproofing is to maintain the fire-resistance of the assembly. It's not to patch with whatever material is around on the jobsite.

Since fire-resistance needs to be maintained to keep the building safe, guesses cannot be made about the patch integrity. When product Manufacturers cannot be identified, the fireproofing material patching Manufacturer needs to have testing that proves the material can work - through a fire, based on a listing of some kind - on the same-sized beam, column, tube, joist and/or horizontal assembly, as well as the type of material. Only then will due diligence have been completed to keep buildings safe.

REFERENCE

- ¹ Analyses of the Impact of Loss of Spray-Applied Fire Protection on the Fire Resistance of Steel Columns. J. Milke, N. Ryder, S. Wolin. International Association of Fire Safety Science Fire Safety Science Proceedings, seventh international symposium, pp. 1025-1036

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SIDEBAR 1

CODE REQUIREMENTS AND LABORATORY GUIDE INFORMATION AND PATCHING FIREPROOFING

The IBC's Chapter 7 states clearly that the SFRMs need to be installed to the Manufacturers' installation instructions and the listings/designs.

704.13.1 Fire-resistance rating.

The application of SFRM shall be consistent with the *fire-resistance rating* and the listing, including, but not limited to, minimum thickness and dry density of the applied SFRM, method of application, substrate surface conditions and the use of bonding adhesives, sealants, reinforcing or other materials.

704.13.2 Manufacturer's installation instructions.

The application of SFRM shall be in accordance with the manufacturer's installation instructions. The instructions shall include, but are not limited to, substrate temperatures and surface conditions and SFRM handling, storage, mixing, conveyance, method of application, curing and ventilation.

With the IBC speaking clearly, the SFRM or IFRM materials need to be installed to the listings and the Manufacturers' installation instructions. They also need to be maintained in the same way to the Manufacturers' instructions, the designer's construction documents and the listing as stated in the International Fire Code's Chapter 7 and NFPA 101's Chapter 8.

In addition, the UL Fire Resistance Directory contains the following language:

"Unless specifically detailed in the individual designs or in the product certification information, the interaction of dissimilar fireproofing materials on the same structural element or at the intersection of structural members, and the adherence of one product to the other, has not been investigated under fire test conditions".

SIDEBAR 2

TWO MORE COMMON SFRM AND IFRM RECENT FIREPROOFING QUESTIONS

SPRAY FOAM OVER FIREPROOFING?

A common question received at the National Fireproofing Contractors Association (NFCA) is about the application of Spray Polyurethane Foam and other insulations over Spray Fire-Resistant Materials and Intumescent Fire-Resistant Materials. A UL Bulletin states that the application has not been tested.

Here's what UL says:

Unless otherwise noted in the individual design or certification published in UL's Online Certifications Directory, the application of sprayed polyurethane foam or other insulation over Sprayed Fire Resistive Materials (SFRM) or Intumescent Fire Resistive Materials (IFRM) coatings has not been investigated.

When UL states it has not been investigated, it likely means that there is no data to prove that the assembly will perform under fire conditions.

DOES 2018 IBC REQUIRE FIREPROOFING ON COLUMNS IF THE ROOF DOESN'T?

Another question relates to Table 601, Note b in the 2018 International Building Code (IBC) and the protection of structural members in roof construction and primary structural frame members.

"....if a primary structural frame member (e.g., beam, girder) was part of the roof construction, the rating could be exempt; however, a rating will still be required for any columns." Excerpt from ICC's Staff Interpretation.

This helps answer the question of whether or not protection is needed in this section. Check out NFCA's website for the complete interpretation.

Need more info? Check out www.NFCA-online.org

“TECH SHORTS”

FOR FIRESTOPPING MORTAR USAGE

We commonly see penetrations passing through an opening in a concrete masonry unit (block) wall that have used cement mortar to fill the void between the penetrating item and the block.

This can be an effort to reduce the opening size so that there is less annular space, or no annular space around the penetrating item. We then sometimes see firestop sealant installed around the penetrating item over the top of the mortar or a skim coat of mortar in the annular space. This might be an unacceptable firestop solution.

In the UL Fire-Resistance Directory, there are listings for concrete block walls. In the U900 listing, there are no system design listings with openings or holes made with penetrating items running through them. Penetrations are found in the firestop section of the testing laboratory fire-resistance directories.

Many times, when grout or mortar is placed around penetrating items, it is not installed the full-depth of the wall assembly or the thickness required to attain the hourly fire-resistance-rating.

Normally when mortar is added after the penetrating items have been installed, the depth of mortar may be a skim coat to 1 inch or less. The point is that mortar that's not the thickness needed to maintain the fire-resistance-rating means an unsafe and non-code-compliant building.

Another aspect to consider when mortar is used as a fill material is the heat transfer. When a metallic pipe is penetrating the opening in the wall there will be an increase in heat transfer conducted through the wall. When a firestop sealant is used over a mortar where the thickness was incorrect, the mortar installed around the penetrating item will get hot quickly driving moisture out of the mortar possibly causing brittleness, cracks and potential crumbling. The sealant that is attached to the mortar that has been installed around the penetrating item will also fall out along with the mortar.

The firestop sealant needs to be installed to the required depth of, *and inside*, the annular space tolerance found in the tested and listed firestop system. The sealant is to adhere directly to the block to match the installation system.

To comply with the International Building Code [IBC] (and National Building Code of Canada), there are very strict requirements. Below is from the IBC:

714.4.1 Through penetrations. *Through penetrations* of fire-resistance-rated walls shall comply with Section **714.4.1.1** or **714.4.1.2**.

Exception: Where the penetrating items are steel, ferrous or copper pipes, tubes or conduits, the *annular space* between the penetrating item and the fire-resistance-rated wall is permitted to be protected by either of the following measures:

1. In concrete or masonry walls where the penetrating item is a maximum 6-inch (152 mm) nominal diameter and the area of the opening through the wall does not exceed 144 square inches (0.0929 m²), concrete, grout or mortar is permitted where installed the full thickness of the wall or the thickness required to maintain the *fire-resistance rating*.
2. The material used to fill the *annular space* shall prevent the passage of flame and hot gases sufficient to ignite cotton waste when subjected to ASTM E119 or UL 263 time-temperature fire conditions under a minimum positive pressure differential of 0.01 inch (2.49 Pa) of water at the location of the penetration for the time period equivalent to the *fire-resistance rating* of the construction penetrated.

[IBC 2018, 714.4.1, Exceptions 1, 2]

As shown in the IBC description, to provide fire-resistance with mortar at penetrations, the mortar or grout must be the full-depth of the assembly, or a depth which results in an hourly fire-resistance-rating. The mortar must also demonstrate that it prevents flame and hot gases sufficient to ignite cotton waste using ASTM

E 119 or UL263 as the test method, for the rating time period. Plus, the opening size needs to be under 144 square inches, with a *maximum of one bare metallic pipe not exceeding a 6" in diameter*. There are no multiple metallic penetrating items shown in the codes. There also are no combustible nor insulated penetrating items.

To properly install mortar to extend the fire-resistance of the assembly, there needs to be enough annular space to install a material under the penetrating item to fill the holes on the inside of the block. Or, the holes in the block need to be plugged before the penetrating item is installed so that the full thickness of the block or the thickness required to meet the rating can be achieved with the mortar.



Cement mortar around penetrating items, not allowed by IBC. Fire Stop Technologies Photo



Small annular spaces mean it is difficult to get full thickness of the block or enough mortar to meet the fire-resistance-rating. Note that insulated penetrating items are not allowed to have mortar installed according to the International Building Code. Cement mortar is not compatible with copper piping. Fire Stop Technologies Photo

FCIA Member Firestop Contractors can install mortar around penetrating items to provide fire-resistance-ratings and do when needed. These Specialty Firestop Contractors can also select a firestop system from the UL Directory, Intertek Directory or FM Approval Guide and can provide many solutions for applications.

As you can see, what looks easy isn't so easy.



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EQUAL FIRE-RESISTANCE-RATING TO TEMPERATURE RATING

One common question we get at the FCIA Office is the question about T-Rating requirements for horizontal assemblies as it relates to the International Building Code (IBC) and meeting the requirement to have the Temperature (T) Rating equal to the Fire-Resistance-Rating of the assembly penetrated.

Section 714.5.1.2 of the 2018 IBC covers Through-Penetration Firestop Systems and T-Ratings.

714.5.1.2 Through-penetration firestop system.

Through penetrations shall be protected by an approved through-penetration firestop system installed and tested in accordance with ASTM E814 or UL 1479, with a minimum positive pressure differential of 0.01 inch of water (2.49 Pa). The system shall have an F rating/ T rating of not less than 1 hour but not less than the required rating of the floor penetrated.

Exceptions:

1. Floor penetrations contained and located within the cavity of a wall above the floor or below the floor do not require a *T-rating*.
2. Floor penetrations by floor drains, tub drains or shower drains contained and located within the concealed space of a *horizontal assembly* do not require a *T-rating*.
3. Floor penetrations of maximum 4-inch (102mm) nominal diameter metal conduit or tubing penetrating directly into metal-enclosed electrical power switchgear do not require a *T-rating*.

As you can see, there are exceptions to needing a T-Rating in horizontal assemblies.

From ANSI/UL1479, the Ratings are described as follows:

ANSI/UL 1479, "Fire Tests of Penetration Firestops, "defines the criteria for hourly F, T, L and W ratings for firestop systems. The F-rating criteria prohibits flame passage through the system and requires acceptable hose-stream test performance. The T-rating criteria prohibits flame passage through the system and requires the maximum temperature rise on the unexposed surface of the wall or floor assembly, on the penetrating item and on the fill material not to exceed 325°F (181°C) above ambient, and requires acceptable hose-stream test performance."

The ANSI/UL 1479 standard goes on to discuss the Air Leakage (L-Rating) for simulation of smoke movement through the firestop assembly and also the Water Resistance (W-Rating) abilities of the systems.

Note in the T-Rating section it states that there are several measurement points for thermocouples (TC) to measure temperature rise on the 'unexposed' or non-fire-side of the test assembly. The TC's are placed:

1. On the unexposed side of the assembly 1" (25mm) from each type of penetrating item,
2. At a minimum of one point on the firestop material surface at the periphery of the test sample,
3. At a point on any frame installed around the perimeter of the opening,
4. At a point on the non-fire side of the assembly, 12" (.3m) from any opening, and
5. At one point on each type of through penetrating item, at a point 1" (25mm) from the unexposed side of the assembly.

There are a lot of thermocouples on the assembly.

(Continued on page 38)



CODES AND STANDARDS NEWS

FCIA AT NFPA FPF

The Fire Protection Features (FPF) Committee of NFPA met in Minneapolis in late July. Discussion covered a wide-range of topics like Performance Based Fire-Resistance Design, adding testing to prove the distance required away from the barrier for when a metal penetrating item is used for the penetration and

is attached to plastic pipe past the wall assembly and much more. The FPF meetings are for the development of the 2021 version of NFPA 5000 and NFPA 101. Watch for more as the code development process progresses.

ICC PUBLIC COMMENT HEARINGS & ANNUAL CONFERENCE

In Richmond, VA, Oct. 21-22, is the ICC Annual Conference and Annual Business Meeting. Following immediately is the ICC Public Comment Hearings to the 2021 International Family of Codes.

There will be several topics watched during the ICC Public Comment Hearings including high-rise wood construction, Special Inspection for fireproofing and

firestopping, issues with fire dampers, fire-resistance-ratings and much more. The hearings are webcast at www.ICCSafe.org during the entire October 21-31 period. Check them out and watch codes develop. An online Governmental Consensus Vote takes place into December, with final codes published about June, 2019.

ICC'S INTERNATIONAL FIRE CODE

The 2018 Version of the International Fire Code has some very important items in it. In the new code is a requirement for the Building Owner and Manager to maintain an INVENTORY of Fire-Resistance-Rated and Smoke-Resistant Assemblies, as well as their features. The Building Owner and Manager can build this inventory if nothing exists at their facilities through a survey of the structure using its Life Safety Drawings.

If no Life Safety Drawings exist, a professional can be hired to recreate them based on the code in effect at the time the original permit was issued. Then, the listings for the individual elements, assemblies, and manufacturers' installation instructions can become the inventory. In new construction, Building Owners and Managers need to insist on this information being transferred at project closeout. Don't miss FCIA's education program at the ICC Annual Conference on this topic.

ICC OFFERS WILDFIRE SAFETY RESOURCES

The International Code Council (ICC) built the International Wildland Urban Interface Code about 10 years ago with significant participation from those Building Officials and Fire Marshals most affected by the issue, along with Manufacturers and others. It's nice to see authors of the code provide resources for wildfire

safety. Visit www.ICCSafe.org for info, or click the link in the E-version of Life Safety Digest.

FIRESTOP, FIREPROOFING SPECIAL INSPECTION & ICC CODES

FCIA was successful adding Special Inspection requirements for firestopping at the ICC Committee Action Hearings in April. This includes buildings that have more than 250 people occupying the structure. The 250 people justification comes from the Table 1604.5 in the International Building Code (IBC). The code committee agreed almost unanimously to move forward with this key concept to help improve fire- and life-safety through firestopping where people live, sleep and play.

The National Fireproofing Contractors Association (NFCA) had several proposals pass at the Committee Action Hearings to help make Fireproofing Inspection in Chapter 17 of the IBC reflect what actually takes place in the field. 🔥

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INDUSTRY NEWS

TJC/ASHE/UL/FCIA'S BARRIER MANAGEMENT SYMPOSIUM

FCIA pulled together the faculty this August for a Barrier Management Symposium in St. Louis, MO hosted by the Missouri Society for Healthcare Engineering (MOSHE) and the Southern Illinois Chapter of Healthcare Engineers (SICHE). The event had over 225 people in attendance

with a full faculty educating and reinforcing that ALL fire-resistance is needed, and that it's a Tested and Listed SYSTEM that builds protection.

FCIA AT ASHE

The American Society for Healthcare Engineering's (ASHE) Annual Conference event was in Seattle, WA this year. FCIA's booth was active with Healthcare Facility Directors visiting FCIA. At each convention, FCIA promotes the FCIA Member and the proper 'Design, Installation,

'Inspection and Maintenance - 'DIIM' - of Firestopping and the 'inventory' of fire-resistance documentation for firestopping, fire dampers, fire doors, fire-rated glazing, the wall and floor assemblies and fireproofing.

ASHE'S NEW BARRIER MANAGEMENT SYMPOSIUM VIDEO SERIES



The FCIA/UL/ASHE/TJC Barrier Management Symposiums are now offered as a virtual program in addition

to the live programs. Search for Barrier Management Symposium Video Series at www.ASHE.org to access the videos.

FCIA AT APPA

APPA, the Association for Physical Plant Administrators, is the Association for Facility Directors at Colleges and Universities. FCIA's Bill McHugh spoke to facility directors at APPA's Annual Conference in Washington, DC on Saturday, August 4.

Since the education program delivered at APPA and action at the ASHE Annual Convention FCIA Booth, FCIA has already had responses from Facility Directors who are building a line item budget for Fire-Resistance, just like the Sprinkler and Detection/Alarm Maintenance and Management budget.

How do we find Barrier Management Services Contractors? Check out Contractors who survey and repair walls and floors, as well as install firestopping, at the new Barrier Management Services Section of www.FCIA.org. Find it at <https://fcia.org/barriermanagementservices.php>.



FCIA.ORG'S NEW BARRIER MANAGEMENT SERVICES SECTION

At FCIA's Barrier Management Symposiums, we are always asked, "Where do we find Firestop Contractors who do both Firestop AND Barrier Management Services?" Now, FCIA Members providing Barrier Management Services have a presence at FCIA's Member

List Barrier Management Services section (www.fcia.org/barriermanagementservices.php). FCIA Members, get your company found. Sign up today.

FCIA BRINGING FIRESTOP & EFFECTIVE COMPARTMENTATION EDUCATION TO CANADA

FCIA heads to Winnipeg, MB for the FCIA Firestop & Effective Compartmentation 'DIIM' Symposium Canada in September 2018. This one-day Symposium, held at The Fairmont Winnipeg, looks at the various parts of the 'DIIM' of Firestop, the National Building Code of Canada requirements

for Fire-Separations and more. Learn more at fcia.org/articles/DIIM_Winnipeg_2018.htm.

FIRE-RESISTANCE EDUCATION SPREADING WORLDWIDE

Education is key to having the building industry, Building Owners and Managers and its influences recognize the value of fire-resistance in buildings.

The **National Fireproofing Contractors Association** heads to Denver, CO to educate Architects, Specifiers, Building Code Officials, Fire Marshals and Fireproofing Contractors at a "Fireproofing and Fire-Resistance in Buildings" session.

Find FCIA this fall at the **CONSTRUCT2018 Show** in Long Beach, CA Wednesday, October 3 and at the **ICC Annual Conference & Expo** in Richmond, VA, October 23. Also, on the agenda at ICC's Conference are two 3-hour classes on firestopping and fire-rated grease duct wraps. Plus, FCIA Consultant Bill Koffel speaks on the International Existing Building Code requirements.

Plus, the **Barrier Management Symposiums** with FCIA, UL, The Joint Commission and ASHE continue to deliver education to healthcare occupancies. While there, attendees hear from the BMS faculty, which includes representation from the Gypsum Industry, Door and Hardware, Fire-Damper, Firestop and Fire-Rated Glazing, Test Standards (UL) and Code Requirements (Koffel). As a faculty, these disciplines bring a wealth of knowledge to Healthcare and Educational Occupancies. For educational occupancies, the APPA is planning Barrier Management Symposiums. Watch for more as other occupancies get involved.

Additionally, FCIA educates delegates around the world. FCIA spent time in Dubai, UAE and Doha, Qatar, earlier this year **educating for the FM & UL Firestop Exams** and will be presenting to CSC Edmonton this December on the 'DIIM' of Firestopping.

GA STATE FIRE MARSHAL GARRISS RECOGNIZED

Sponsored by the International Code Council and the Fire & Life Safety Section (FLSS) of the International Association of Fire Chiefs (IAFC), the 2018 Excellence in Fire & Life Safety Award was presented to Georgia State Fire Marshal and ICC Immediate Past President M. Dwayne Garriss on August 10, 2018, during the annual business meeting of the Fire & Life Safety Section of the IAFC in Dallas, Texas.

"At the International Code Council, we are truly 'Many Voices for One Purpose,' and that purpose is to advance our

mission of providing a safe built environment while serving our member jurisdictions," Garriss explained. "The 'many voices' are all the members of the ICC, and the 'one purpose' is providing the highest-quality codes and standards for protecting the health, safety, and welfare of people in the built environment."

DHI'S DSSF & EDUCATION

The Door Security and Safety Foundation (DSSF) of the Door and Hardware Institute's (DHI) Laura Frye does a great program educating about fire doors at the Barrier Management Symposiums. The DHI and DSSF offers education for healthcare facility personnel who need to learn more about the new fire door inspection requirements from NFPA 80. These and many other classes are taught by Fire Door Assembly Inspectors (FDAI's) and DHI/DSSF Staff across North America. For details, visit www.DoorSecuritySafety.org.



GYPSUM ASSOCIATION & PATCHING WALLBOARD

The GA-225-2015: Repair of Fire-Rated Gypsum Panel Product Systems is the industry document that discusses everything from patching a small hole to full-scale replacement of damaged areas. This is a publication published by the Gypsum Association, which encompasses the major gypsum board manufacturers. Since patches in fire-resistance-rated assemblies must pass the hose-stream

test, patching is more robust and complicated than simply putting a board over the hole and fastening it to another board. Visit www.Gypsum.org for a free download. 🔥

BILL INCLUDES FIRE PROTECTION AND ALARM SYSTEMS CREDITS

- In the USA, the Tax Reform Act from the 2017 Budget process brought immediate depreciation of up to \$500,000 for qualifying taxpaying entities, for certain building improvements. The types of improvements are listed below on Page 130 of the link, extracted below.

<https://docs.house.gov/billsthisweek/20171218/CRPT-115HRPT-%20466.pdf>

“(ii) at the election of the taxpayer, qualified real property (as defined in subsection (f)), and”.

(2) QUALIFIED REAL PROPERTY DEFINED – Subsection (f) of section 179 is amended to read as follows:

“(f) QUALIFIED REAL PROPERTY – For purposes of this section, the term ‘qualified real property’ means–

“(1) any qualified improvement property described in section 168(e)(6), and

“(2) any of the following improvements to nonresidential real property placed in service after the date such property was first placed in service:

“(A) Roofs.

“(B) Heating, ventilation, and air-conditioning property.

“(C) Fire protection and alarm systems.

“(D) Security systems.”.

Here's how Fire-Resistance and Firestopping fits in: Firestop is Fire Protection because Chapter 7's title in the International Fire Code is “Fire and Smoke Protection Features”.

FCIA was the code proponent to change the chapter title from “Fire-Resistance” to “Fire and Smoke Protection Features”. NFPA 101 and NFPA 5000's Chapter 8 is named “Fire Protection Features” too.

If the Building Owner's tax consultant agrees, then the immediate depreciation might apply to Firestop and Barrier Management Services work. And, the Firestop or Barrier Management Services Contractor will have recommended the method, showing your value to the owner.

(Continued from Page 33)

THE COMMON QUESTIONS WE GET AT THE FCIA OFFICE INCLUDE:

QUESTION: We have a penetrating item(s) located inside a wall above the horizontal assembly. Do we need to provide a T-Rating?

ANSWER: No, in exception 1, if the penetrating item is in the wall, no T-Rating is required.

FOLLOW-UP QUESTION:

What if the wall is not completed above the horizontal assembly? Is a T-Rating still required?

ANSWER: This is a tough one. A T-Rating now might be required due to the wall not being continuous above the horizontal assembly. Is it the firestop contractors responsibility to pay for the extra to make the metal penetrating item(s) now T-Rated? Maybe not. Certainly the T-Rating can be provided.

QUESTION: What about floor drains not in concealed space - T-Rating required?

ANSWER: Exception 2 states that the floor drains located in a concealed space are not required to have a T-Rating. When not in a concealed space, a T-Rating needs to be provided.

As with all of these situations, testing is always taking place to get better systems providing T-Ratings. Contact a firestop contractor, manufacturer, inspection agency, or distributor or representative that stays on top of these systems as they are released. They can help you solve these puzzles.

Jay McGuire is Vice-President, Fire Stop Technologies, Inc. and Eric Keeton, Senior Firestop Specialist at Dalton Protection. Reach Jay jay@thornburgh-stl.com and Eric at eric@daltonprotection.com

FCIA INDUSTRY CALENDAR

SEPTEMBER

September 16-18

Canadian Healthcare Engineering Society (CHES) Annual Conference
St. John, NF
www.CHES.org

September 20-21

FCIA Canada Fire Resistance Educational Symposium
Winnipeg, MB
www.fcia.org

OCTOBER

October 3-5

International Facility Managers Association (IFMA) World Workplace
Charlotte, NC
www.worldworkplace.IFMA.org

October 3-5

CSI CONSTRUCT
Long Beach, CA
www.ConstructShow.com

October 21-31

ICC Annual Conference and Public Comment Hearings
Richmond, VA
www.ICCSAFE.org

NOVEMBER

November 6-9

FCIA Firestop Industry Conference & Trade Show
Austin, TX
www.FCIA.org

November 28-30

Construct Canada
Toronto, ON
www.thebuildingsshow.com/en/home.html



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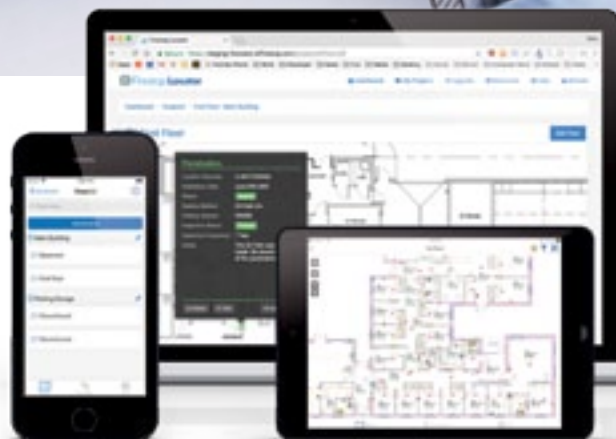


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