Board of Building Standards

EDUCATION COMMITTEE MEETING AGENDA
(AMENDED AUGUST 18, 2021)

DATE: AUGUST 20, 2021
TIME: 10:00 AM
LOCATION: TRAINING ROOM 3, 6606 TUSSING ROAD REYNOLDSBURG, OHIO

Call to Order

Consent Agenda

Course Applications

ER-1 Fire Door Systems for Elevator Lobbies (McKeon Door - OBOA/ODPCA Conference)
All Certifications (2 hours)
Staff Notes: Slides are chapters 1 and 2 and the appendix of the attached book. Based on 2021 code, not recommended for approval.
Committee Recommendation:

ER-2 Fire Door Systems for Vertical Opening Separations (McKeon Door - OBOA/ODPCA Conference)
All Certifications (2 hours)
Staff Notes: Slides are chapter 3 and the appendix of the attached book. Based on 2021 code, not recommended for approval.
Committee Recommendation:

ER-3 Understanding the UL Fire Resistance Directories, Various Assemblies (National Gypsum - OBOA-ODPCA Conference)
BO, MPE, BPE, BI, FPI, MI, PI, NRIUI, RBO, RPE, RBI, RMI, RIUI (2 hours)
Staff Notes: Expansion of previously approved one-hour course. Based on Gypsum Association 2021 standard, GA600. Not recommended tor approval.
Committee Recommendation:

ER-4 Considerations of the DWV and Storm System (Ohio Assn of Plumbing Inspectors)
All certifications (1 hour)
Staff Notes: Recommend approval
Committee Recommendation:

ER-5 Hangers and Restraints for Cast Iron Soil Pipe DWV Systems (Ohio Assn of Plumbing Inspectors)
All certifications (1 hour)
Staff Notes: Recommend approval for conference use only.
Committee Recommendation:

ER-6 Joining Methods for Cast Iron Soil Pipe and Fittings (Ohio Assn of Plumbing Inspectors)
All certifications (1 hour)
Staff Notes: Recommend approval pending changes to course to comply with OPC: conference only.
Committee Recommendation:

ER-7 Underground Installation Benefits of Cast Iron (Ohio Assn of Plumbing Inspectors)
All certifications (1 hour)
Staff Notes: Recommend approval for conference use only.
Committee Recommendation:

Old Business

New Business

Adjourn

EDUCATION COMMITTEE MEETING
CONSENT AGENDA

Course Applications

EC-1 2017 vs 2020 NEC Analysis of Changes (International Association of Electrical Inspectors)
All certifications except plumbing and IU certifications (30 hours - four 7.5-hour sessions)

EC-2 Building Enclosures Detailing and Evaluation (Wiss Janney Elstner - OBOA-ODPCA Conference)
BO, MPE, BPE, BI, NRIUI, RBO, RPE, RBI, RIUI (1 hour)

EC-3 Choices of Air Barriers for Commercial Enclosures (Parksite - OBOA-ODPCA Conference)
All certifications except ESI (1 hour)

EC-4 Electrified Hardware Facts and Myths (Allegion - OBOA/ODPCA Conference)
All Commercial Certifications (1 hour)

EC-5 Firewall Solutions for Wood-Framed Construction (Simpson Strong-Tie)
BO, MPE, BPE, BI, NRIUI, RBO, RPE, RBI, RIUI (1 hour)

EC-6 The Future of Fire-Rated Glass and Framing (Allegion - OBOA/ODPCA Conference)
BO, MPE, BPE, PPE, EPE, MechPE, FPPE, BI, FPI, MI, PI, NRIUI (1 hour)

EC-7 Solar Photovoltaics and the NEC (Full Course) (Matthews Electrical Services)
All Certifications Except Plumbing (8 hours)
Staff Notes: This is the full version of this course. Also on this agenda are submissions for Part 1 and Part 2 separately. The full version is intended for the classroom, the two-part version is intended for a webinar. The slides and instructor bio for both versions are the same.

EC-8 Solar Photovoltaics and the NEC Part 1 (Matthews Electrical Services)
All Certifications except Plumbing

EC-9 Solar Photovoltaics and the NEC Part 2 (Matthews Electrical Services)
All Certifications except Plumbing (4 hours)

EC-10 Codes and Egress (Allegion - OBOA/ODPCA Conference)
BO, MPE, BPE, PPE, EPE, MechPE, FPPE, ESI, BI, FPI, MI, PI, NRIUI (1 hour)

EC-11 Hardware for Healthcare Openings (Allegion - OBOA/ODPCA Conference)
All Commercial Certifications (1 hour)

EC-12 NEC 2020 Electric Vehicles Charging Systems (Electrical League of Ohio)
ESI, BO, MPE, BPE, EPE, BI, RBO, RPE (4 hours)

File Attachments for Item:

ER-1 Fire Door Systems for Elevator Lobbies (McKeon Door - OBOA/ODPCA Conference)

All Certifications (2 hours)

Staff Notes: Slides are chapters 1 and 2 and the appendix of the attached book. Based on 2021 code, not recommended for approval.

Committee Recommendation:

1. **Elevator Shaft Protection**, 2 hours, *BBS 2021-XXX*, McKeon Door, David Dodge
    a. *(Certifications; BI, BO, BPE, EPE, ESI, FPI, FPPE, LPE, MPE, MI, MechPE, NRIU, PI, PPE, RBI, RBO, REPE, RIUI, RMI, RPE, RPI, application for course will be submitted by McKeon to OBBS)*
    b. Outline; Course will provide 2018 IBC information on the fire and smoke protection requirements for elevator shafts to include all the provisions of Section 3006 Hoistway Protection, 3007 Fire Service Elevators & 3008 Occupant Evacuation Elevators with emphasis on more of the controversial interpretations and protection methods. This course will also discuss fire and smoke protection provisions for horizontal exits, exit passageways, pedestrian walkways & tunnels.

David L. Dodge, CSI, CDT

VICE PRESIDENT, BUSINESS AND CODE DEVELOPMENT

David has been involved in the construction industry since 1975. With an extensive background in project estimating and management and a bachelor's degree in business management, David soon realized a great deal of success in building product marketing and sales. Within this venue he found his passion – building code development and architectural design compliance. Since 1988, he has assisted architectural firms in understanding and implementing the provisions of the model codes as they pertain to fire and life safety. His particular focus is on the fire door industry, promoting cutting edge technology to resolve code compliance challenges.

David is a corporate member of the International Code Council (ICC) and earned his Construction Document Technologist (CDT) from the Construction Specifications Institute. He has served on several ICC committees, both local, regional and national, for the adoption and implementation of the International Building Code throughout the US. He is a recognized speaker and instructor, teaching the fire and life safety provisions of the model codes to design professionals and regulatory officials. David is a certified CEU instructor under the ICC Education Provider program. As part of the McKeon Door Company team David draws on his 30-plus years of experience in the building code arena when assisting design professionals and product representatives with code and design compliance challenges.

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

Instructors: Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications for which the BBS has approved the class, and fees in promotion materials and advertising. ***The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising***. Advertising shall not disclose improper approval information to the public.

Course sponsors/co-sponsors: provide participants a certificate of completion containing the following information: name of participant, title of approved courses, BBS approval #, BBS approved certifications, date of the continuing education program, number of approved credit hours awarded and signature of authorized sponsor or instructor.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

Participants: Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

Board approval: Remains in effect through the calendar year of approval. The course may be renewed administratively by sponsor application in subsequent years so long as it references current codes and standards Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

Facility/training area: Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

APPLICATION

FOR

Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.

Board of Building Standards
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Reynoldsburg, Ohio 43068-9009
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dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: David Dodge (Contact Name)
Organization: McKeon Door Company (Organization/Company)
Address: 44 Sawgrass Drive, (Include Room Number, Suite, etc.)
City: Bellport State: NY Zip: 11713
E-Mail: ddodge@mckeondoor.com
Telephone: 801-471-7210 Fax:
Course Sponsor: McKeon Door

COURSE INFORMATION:

Course Title: Fire Door Systems for Elevator Lobbies, Exit Access Separation, & Corridor Separation

New Course Submittal: ■ Update Course: ■ Prior Approval Number: BBS2017-138

Purpose and Objective: Provide building code information (updated to the 2018 IBC) on fire doors and their role in Elevator lobbies & Hoistway Protection. Include information of requirements for Elevator smoke & draft control.

Provide information on horizontal exists, exit passageways, and pedestrian walkways & tunnels and how fire doors can be used to meet fire resistance ratings for these items. The PPT slides used for this course duplicate the textbook as found in Chapters 1 & 2 and the Appendix.

NOTE: We are simply splitting the original approved course into two 2-hour courses. Please see attached pdf workbook that each attendee will receive as party of the course materials.

Number of Instructional Contact Hours that can be obtained upon completion: (2) hour

If Multi-Session, Number of Instructional Contact Hours Per Session:

Program Applicable for the Following Participants:

Building Official ■	Master Plans Examiner ■	Building Inspector ■	Fire Protection Inspector ■	Mechanical Inspector ■	
	Building Plans Exam. ✔			Plumbing Inspector ■	
	Plumbing Plans Exam. ■			Non-Res IU Inspector ■	
	Electrical Plans Exam. ■				
	Mechanical Plans Exam. ■				
	Fire Protect. Plans Exam. ✔				
Res Building Official ■	Res Plans Examiner ■	Res Building Inspector ■	Res Mechanical Inspector ■	Res IU Inspector ☐	

Electrical Safety Inspectors X
Location of ESI Course: Date(s) of ESI Course(s):

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**:		Check Off
Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	X
	Organization sponsoring or requesting the program (if any)	X
Course Title:	Name of course (related to content)	X
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	X
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	X
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	X
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	X
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	X
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	X
Test Materials:		
Completed Application:		X

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

McKEON®

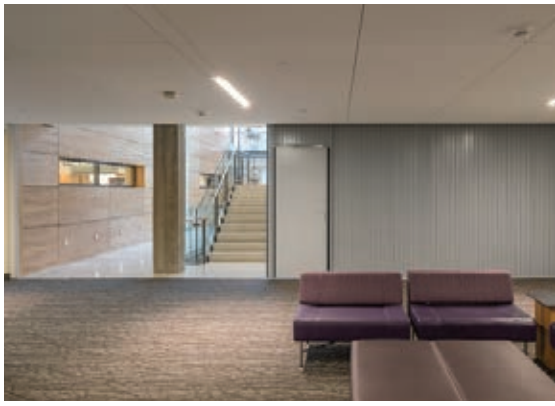
Updated! Based on the 2018 Edition of the IBC

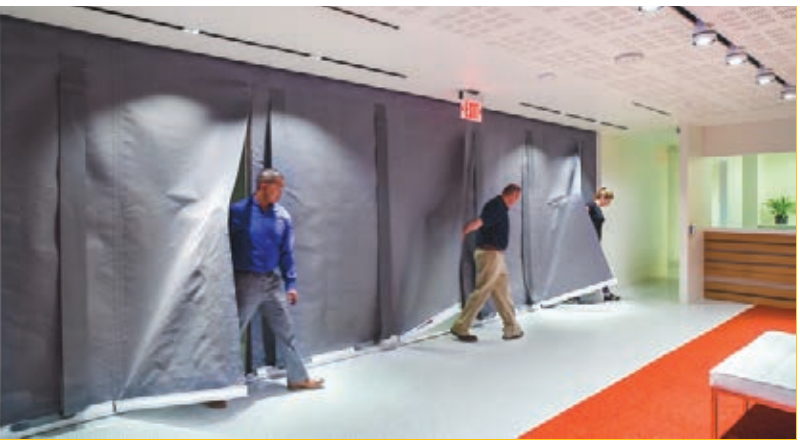
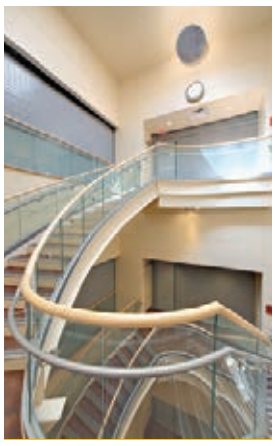
REV. 6/19

Fire Door Systems

A Guide to Code Compliance






McKEON®

Fire Door Systems

A Guide to Code Compliance

McKEON

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info@mckeondoor.com • www.mckeondoor.com

CONTENTS

APPLICATIONS

12th Edition - June 2019

Introduction

THIS EDITION of *Fire Door Systems, A Guide to Code Compliance* is based on the 2018 IBC with inserts from the "Group A" portion of the 2021 IBC code development cycle. The insertions reflect code changes that have been approved by the voting membership in both the general sessions and the subsequent on-line voting forum, and will be published in the next printing of the IBC.

THE INTERNATIONAL BUILDING CODE has been widely accepted in the United States and is recognized as a uniform code addressing the design and installation of building systems with performance-based requirements. The current International Building Code has been developed over the last two decades through the extensive work and efforts of code enforcement personnel organized at both local and national levels under the direction of the International Code Council. A vital part of the development of the building code is the involvement of industry and nationally recognized organizations with interests in building product development and the protection of public health, safety and welfare.

McKEON develops and manufactures numerous fire and smoke rated assemblies that function as wide-span opening protectives. These building products enter the marketplace specifically to assist design professionals and code enforcement personnel in satisfying open design without compromising fire and life safety requirements. This document is formatted to present the building code as it pertains to the use of opening protectives; first, recite specific prescriptive code requirements, second, performance-based language in laymen's terms for common sense understanding, and third, illustrate product case studies presented as design solutions to frequently approached complex code application challenges. The building code interpretations found herein represent the opinion and experience of the preparer, intended only to assist the reader in recognizing and understanding the potential use and application of McKEON fire and smoke rated opening protective assembly products.

1 Elevator Separation

Elevator Lobbies & Hoistway Protection

Elevator Smoke & Draft

Elevator Lobbies & Hoistway Protection

Section 3006

Hoistway protection is designed to isolate fire, smoke, heat and toxic gases or fumes from migrating floor to floor through vertical hoistways in multi-story structures. There are two fundamental methods prescribed in this code section – elevator lobbies or protection at the point of access to the elevator car.

Fire & Life Safety Concerns

Elevator shafts are the most common inter-connecting vertical shafts in multi-story buildings. These shafts become conduits for fire, heat, smoke and other toxins between the fire floor(s) and additional floors.

Code Requirements

3006.1 General. Elevator hoistway openings and enclosed elevator lobbies shall be provided with the following:

1. Where hoistway opening protection is required by Section 3006.2, such protection shall be in accordance with Section 3006.3.
2. Where enclosed elevator lobbies are required for underground buildings, such lobbies shall comply with Section 405.4.3.
3. Where an area of refuge is required and an enclosed elevator lobby is provided to serve as an area of refuge, the enclosed elevator lobby shall comply with Section 1009.6.
4. Where fire service access elevators are provided, enclosed elevator lobbies shall comply with Section 3007.6.
5. Where occupant evacuation elevators are provided, enclosed elevator lobbies shall comply with Section 3008.6.

3006.2 Hoistway opening protection required. Elevator hoistway door openings shall be protected in accordance with Section 3006.3 where an elevator hoistway connects more than three stories, is required to be enclosed within a shaft enclosure in accordance with Section 712.1.1 and any of the following conditions apply:

ELEVATOR SEPARATION

1. The building is not protected throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2.
2. The building contains a Group I-1 Condition 2 occupancy.
3. The building contains a Group I-2 occupancy.
4. The building contains a Group I-3 occupancy.
5. The building is a high rise and the elevator hoistway is more than 75 feet (22 860 mm) in height. The height of the hoistway shall be measured from the lowest floor to the highest floor of the floors served by the hoistway.

Exceptions:

1. Protection of elevator hoistway door openings is not required where the elevator serves only open parking garages in accordance with Section 406.5.
2. Protection of elevator hoistway door openings is not required at the level(s) of exit discharge, provided the level(s) of exit discharge is equipped with an automatic sprinkler system in accordance with Section 903.3.1.1.
3. Enclosed elevator lobbies and protection of elevator hoistway door openings are not required on levels where the elevator hoistway opens to the exterior.

3006.2.1 Rated Corridors. Where corridors are required to be fire-resistance rated in accordance with Section 1020.1, elevator hoistway openings shall be protected in accordance with Section 3006.3.

3006.3 Hoistway opening protection. Where Section 3006.2 requires protection of the elevator hoistway door opening, the protection shall be provided by one of the following:

1. An enclosed elevator lobby shall be provided at each floor to separate the elevator hoistway shaft enclosure doors from each floor by fire partitions in accordance with Section 708. In addition, doors protecting openings in the elevator lobby enclosure walls shall comply with Section 716.5.3 as required for corridor walls. Penetrations of the enclosed elevator lobby by ducts and air transfer openings shall be protected as required for corridors in accordance with Section 717.5.4.1.
2. An enclosed elevator lobby shall be provided at each floor to separate the elevator hoistway shaft enclosure doors from each floor by smoke partitions in accordance with Section 710 where the building is equipped with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2. In addition, doors protecting openings in the smoke partitions shall comply with Sections 710.5.2.2, 710.5.2.3 and 716.5.9. Penetrations of the enclosed elevator lobby by ducts and air transfer openings shall be protected as required for corridors in accordance with Section 717.5.4.1. Note: Smoke partitions as defined in Section 710.3 are not required to be fire rated. The doors located in smoke partition walls referenced in Section 710.5.2.2 are required to be UL 1784 labeled as smoke & draft control assemblies.
3. Additional doors shall be provided at each elevator hoistway door opening in accordance with Section 3002.6. Such door shall comply with the smoke and draft control door assembly requirements in Section 716.5.3.1 when tested in accordance with UL 1784 without an artificial bottom seal.
4. The elevator hoistway shall be pressurized in accordance with Section 909.21.

3006.4 Means of egress. Elevator lobbies shall be provided with at least one means of egress

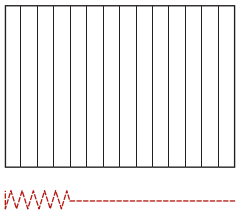
ELEVATOR SEPARATION

complying with Chapter 10 and other provisions in this code. Egress through an elevator lobby shall be permitted in accordance with Item 1 of Section 1016.2.

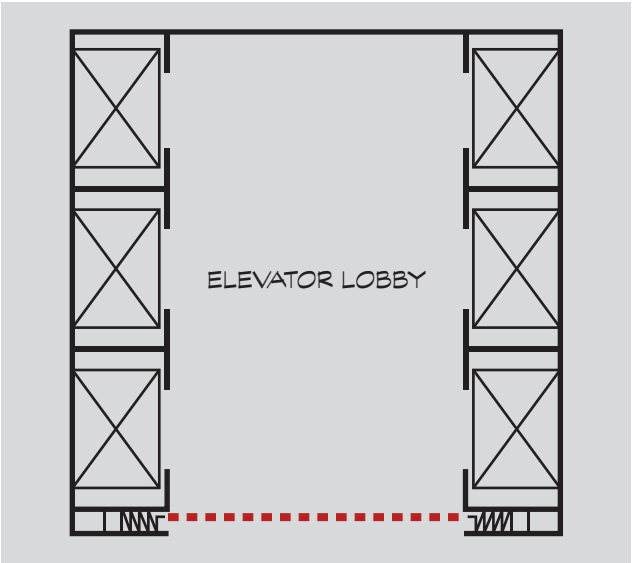
Design Solutions

A diverse line-up of McKEON door assemblies can easily accommodate wide-span openings, radius applications, and egress.

CASE 1: Side Acting Accordion with Power-assisted Egress

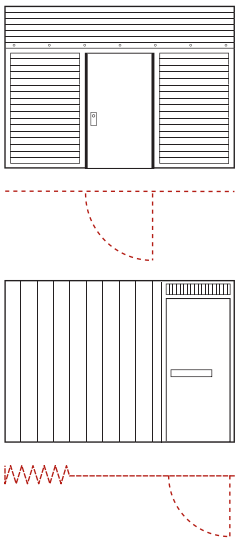


In the first case study, there is no headroom and side stacking space is limited. The McKEON bi-parting accordion fire door technology stepped up to meet the demand of hi-end design without compromising specific code requirements including conforming side acting accordion fire door egress acceptance.

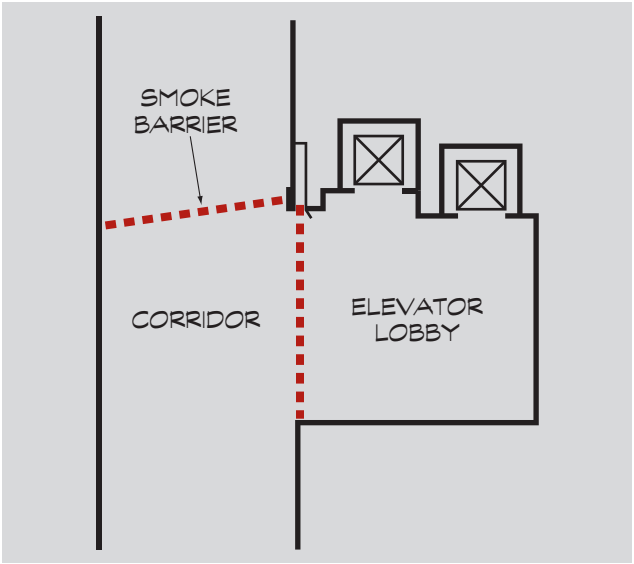


ELEVATOR SEPARATION

CASE 2: Side Acting Accordion with Complying Swing Egress Door & Vertical Acting with Complying Swing Egress Door(s)

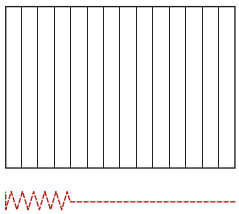


This case study includes both a side acting accordion with conventional egress elevator lobby separation and a vertical acting with conventional egress smoke barrier opening protective.

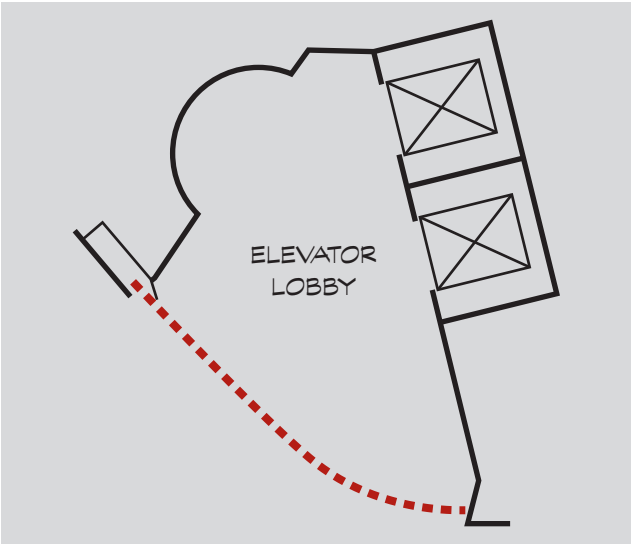


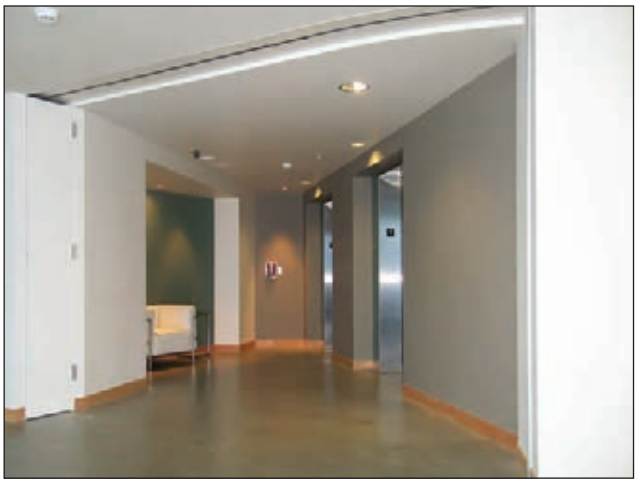
ELEVATOR SEPARATION

CASE 3: Side Acting Accordion with Power-assisted Egress



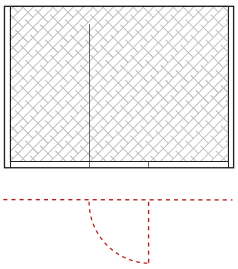
The side acting accordion technology will accommodate custom radius applications as well as serve as the primary means of egress from the space.

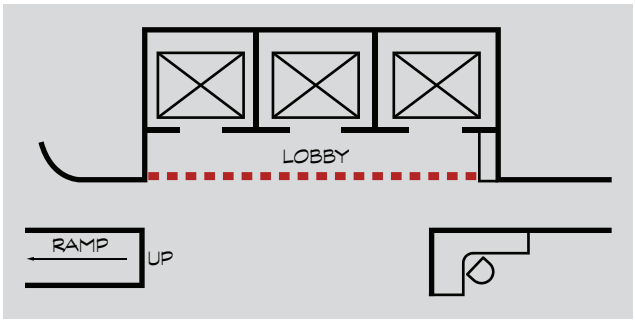




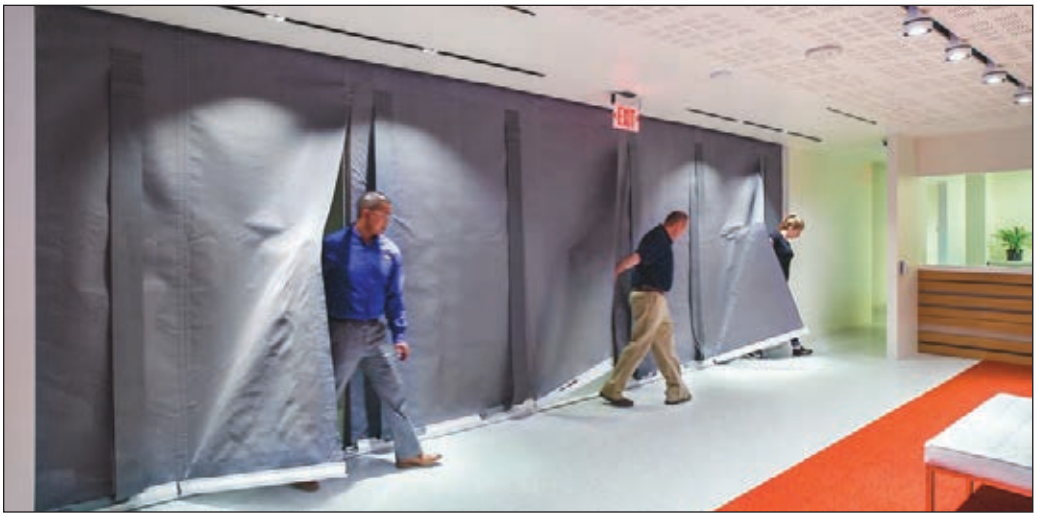
ELEVATOR SEPARATION

CASE 4: Vertical Acting with Multiple Complying Swing Egress Doors



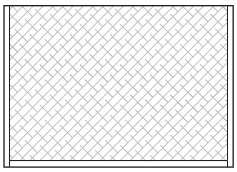


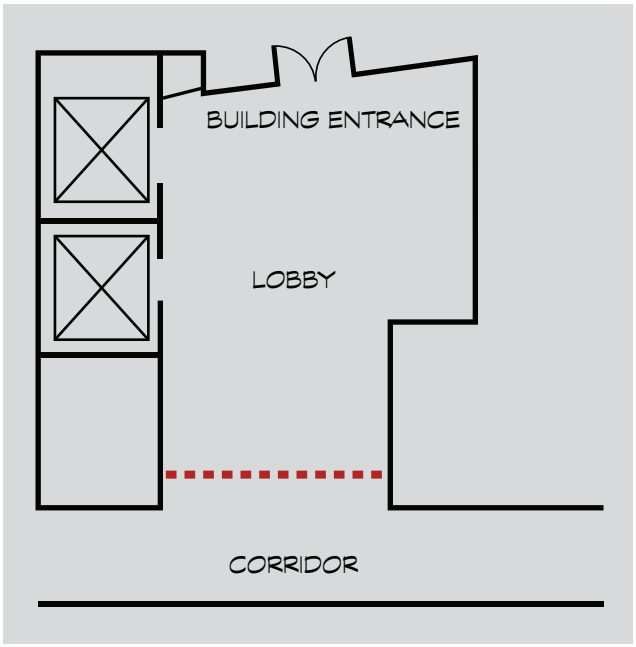
This project introduces the use of fire protective curtain assemblies that have been approved in accordance with the current editions of the model buildings codes (see IBC Section 3006.3, Item #2. Specific reference to this technology is now approved as opening protectives without hose stream performance [UL 10D 20-minute fire rated] for publication in the 2021 edition of the IBC [See Appendix, Resource IBC 2021]).



ELEVATOR SEPARATION

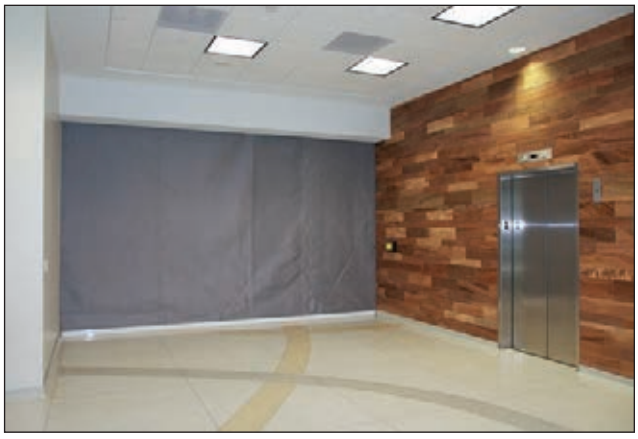
CASE 5: Vertical Acting without Egress





For the same reasons of acceptance explained in CASE 4, Fire Protective Curtain Assemblies satisfied two code compliance challenges in this design. Even though an elevator lobby is not necessarily required on the level of exit discharge in a sprinklered building, this separation takes on the form of a lobby since it protects the remaining structure from the vertical features of the building. Egress is not required though the fire protective curtain due to exiting out of the lobby or separated space through the main entrance.

Specific reference to this technology is now approved as opening protectives without hose stream performance (UL 10D 20-minute fire rated) for publication in the 2021 edition of the IBC (See Appendix, Resource IBC 2021).



ELEVATOR SEPARATION

Inquiry Discussion & Questions

There has been much discussion in the regulatory arena about the purpose and usefulness of the elevator lobby. It can be argued the lobby is a dual application fire and life safety component of the structure, a barrier against smoke migration in and out of the vertical shaft as well as an area of refuge for building occupants. These fundamental occupant safety features are tempered with sprinkler exceptions but consistently remain as salient provisions each code development cycle.

If there is a trend in preference it appears to be for more passive redundant protection surrounding the elevator shaft rather than less. For example, the code requirements outlined in this application study include several sprinkler exceptions that allow the elimination of the elevator lobby for normal-use passenger elevators in Section 3006. However, once the building goes into alarm, Section 3007 Fire Service Access Elevator and Section 3008 Occupant Evacuation Elevators do not allow the same exceptions. Not only are lobbies required in these two applications, with no exemptions, each lobby must be fully fire and smoke rated with prescribed physical size requirements. Interestingly, in a fire event the elevator often becomes an integral part of the means of egress system.

Elevator lobbies can be considered a viable choice based on three premises. Let's use the layout as diagrammed in Case Study #2 as an example. First, from a design ambiance perspective, it is cumbersome to provide independent separation at the point of each elevator car to simply eliminate the lobby. The space would certainly be interrupted at each elevator car opening. A single separation creating a full space lobby would have less impact on the overall design.

Secondly, a single separation opening protective is clearly less costly than multiple systems located at each car opening. The third and perhaps the most important consideration is fire and life safety. By creating a conforming full space lobby we stop smoke and heat from penetrating the shaft, and provide an area of refuge for building occupants. In other words, rather than provide closures at each individual point-of-access location to the elevator car, why not create an elevator lobby that is unobstrusive, costs less and will adequately serve as an area of refuge.

Elevator Smoke & Draft

Section 3006.3

Elevator car doors are typically fire-rated but cannot comply with smoke and draft requirements. Smoke & draft rated assemblies eliminate the passage of smoke and are usually located at the point of access to an elevator car as an alternative to the elevator lobby.

Fire & Life Safety Concerns

Elevator shafts commonly represent the majority of inter-connecting vertical shafts in multi-story buildings. These shafts become conduits for heat, smoke and other toxins between the fire floor(s) and additional floors. In buildings with more than three interconnected stories, the conventional elevator lobby is designed to stop the spread of fire and smoke before it reaches the elevator shaft enclosure doors. However, if the lobby is eliminated smoke could quickly penetrate the shaft at the point of access. Thus, all fire-rated assemblies used at the point of access must maintain a smoke and draft rating. *(UL 1784)*

Code Requirements

There are two primary provisions that drive the need for elevator protection in the IBC. First, Section 3006.2 requires protection where the elevator hoistway connects more than three stories and any of the following conditions apply:

1. The building is not protected throughout with sprinklers …
2. The building contains an I-1 Condition 2 occupancy
3. The building contains an I-2 occupancy
4. The building contains an I-3 occupancy
5. The building is a hi-rise … more than 75 feet

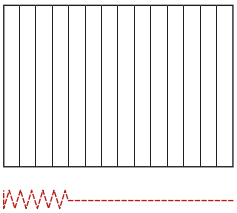
The second primary provision is found in Section 3006.2.1 requiring elevator hoistway protection when the corridors in the structure are fire-resistance rated.

ELEVATOR SEPARATION

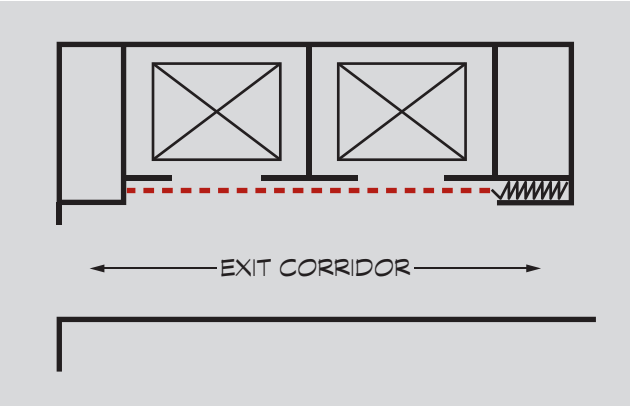
Section 3006.3, Item #3 allows the elimination of the lobby by placing a minimum UL 1784 (smoke) rated assembly at the point of access to the elevator hoistway door opening. Please note: All assemblies located at the point of access to an elevator car must be readily openable from the car side without a key, tool, special knowledge or effort. *(3002.6)*

Design Solutions

CASE 1: Side Acting Accordion with Power-assisted Egress

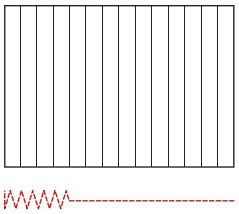


Due to the several configuration options of the McKEON door assemblies multiple or single elevator openings can easily be protected. Egress can be placed at each elevator car door opening to accommodate conforming exit requirements.

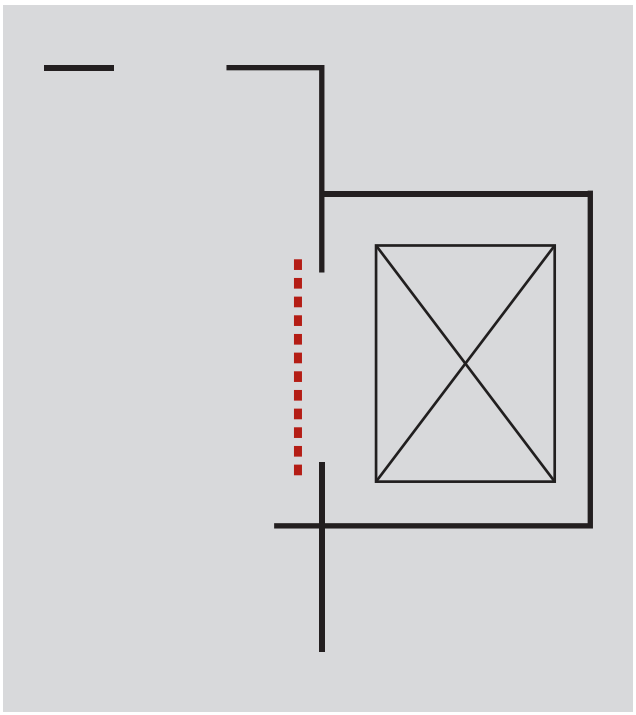


ELEVATOR SEPARATION

CASE 2: Side Acting Accordion with Manual Egress

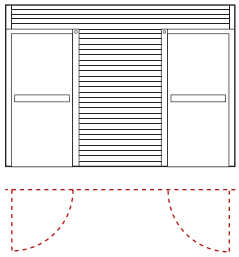


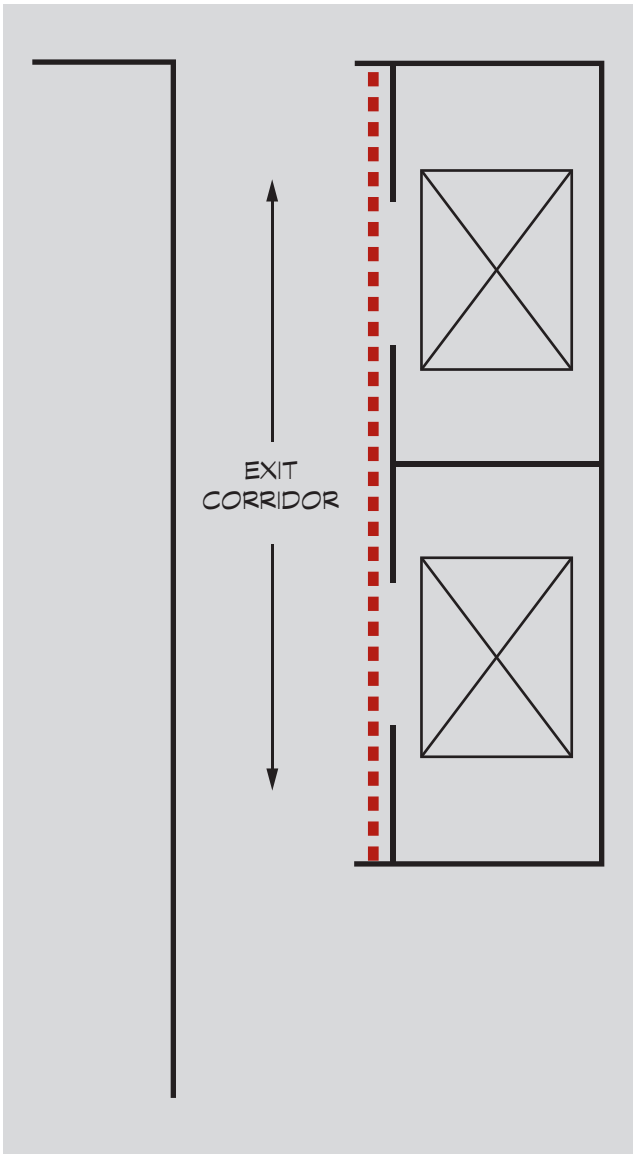
This simple, manually operated, bolt-up pre-fabricated unit can be installed at the point of access to any elevator car in a matter of hours. No pocket, stud or drywall construction is necessary. The door, held open by an electromagnet, is released at the command of a smoke detector and the fire and smoke rated assembly closes. Building occupants or first responders can pass through the opening as the door self-closes behind them.



ELEVATOR SEPARATION

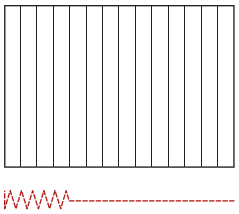
CASE 3: Vertical Coiling with Complying Swing Egress Door(s)



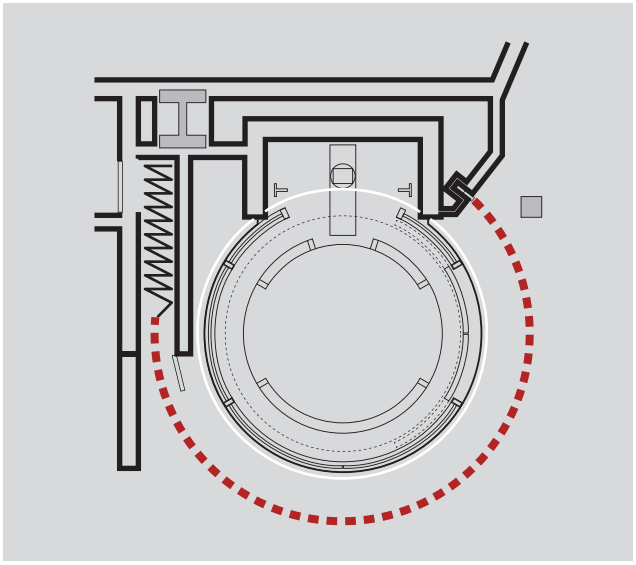


ELEVATOR SEPARATION

CASE 4: Side Acting Accordion with Power-assisted Egress

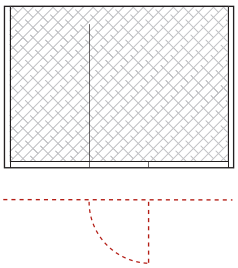


The single track 3-hour rated accordion will accommodate 18" radius to custom curves. Along with complying egress, McKEON resolved a very difficult challenge without life safety or design compromise.

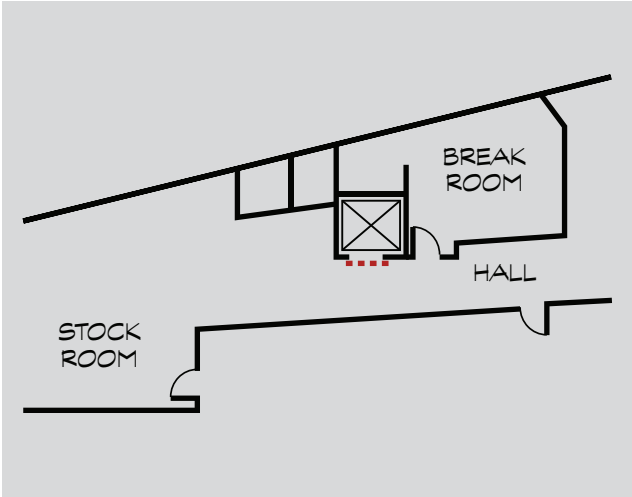


ELEVATOR SEPARATION

CASE 5: Vertical Acting with Egress

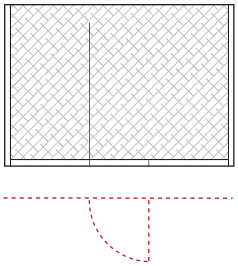


Typically, the elevator car or elevator shaft door is fire rated but does not carry a UL 1784 smoke rating. The SmokeFighter® D150E is a listed and labeled UL 1784 assembly with a complying egress feature. Located at the point of access to the elevator car, this assembly protects the opening mitigating smoke migration.

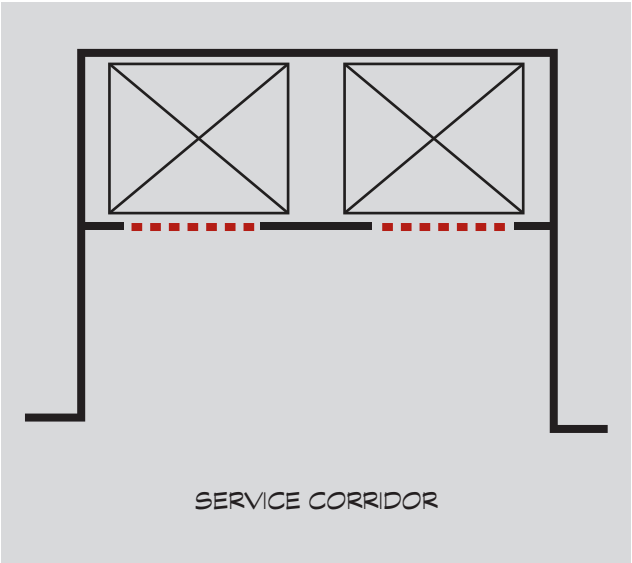


ELEVATOR SEPARATION

CASE 6: Vertical Acting with Egress



Similar to the previous case study, the elevator car or elevator shaft door is fire rated but does not carry a UL 1784 smoke rating. But on this project the design team elected to use the FireFighter® D200E which is listed and labeled as a 20-minute UL 10D & UL 1784 assembly with a complying egress feature. By applying the 20-minute fire-rated assembly in this design, McKEON provided redundancy in the fire-rated requirements. Located at the point of access to the elevator car, this assembly protects the opening mitigating smoke migration as well as fire and heat penetration.



ELEVATOR SEPARATION

Inquiry Discussion & Questions

Please consult the Inquiry Discussion & Question section of the Elevator Lobby case study.

Notes:

2 Exit Access Separation

Horizontal Exit

Exit Passageways

Pedestrian Walkways & Tunnels

Horizontal Exit

Section 1026

Horizontal exits are designed to move building occupants on a floor from any point in the exit access system to a fire and smoke protected area.

Fire & Life Safety Concerns

The horizontal exit differs fundamentally from the typical code-defined exit. The horizontal exit is meant to "defend in place" by creating an area of safe refuge for building occupants within the confines of the building structure. All other exits are designed to exit occupants out of and away from the building.

Code Requirements

Because building occupants are not being removed from the building when using the horizontal exit, specific precautionary requirements are based upon the following fundamental principles:

Principle #1: Separation. A 2-hour fire wall or fire barrier must be used to separate safe refuge areas connected with a horizontal exit *(Section 1026.2)*. The determination between the use of a wall, fire barrier or horizontal assembly is the function of the wall as it relates to other code requirements.

Principle #2: Opening Protective. The opening within the horizontal exit must be protected with a self-closing or automatic closing fire door when activated by a smoke detector. The fire rating of the door must be a minimum of 90 minutes. *(Section 1026.3)*

Principle #3: Area of Refuge Capacity. Based on a net floor allowance of 3 square feet for each person with the following guidelines:

Where the horizontal exit also forms a smoke compartment, the capacity of the refuge area for Group I-1, I-2 and I-3 occupancies and Group B ambulatory care facilities shall comply with Section 407.5.3, 408.6.2, 420.6.1 and 422.3.2 as applicable.

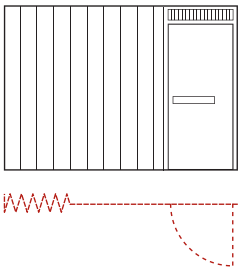
Principle #4: Number of Exits. The refuge area into which a horizontal exit leads shall be provided with exits adequate to meet the occupant requirements of this chapter, but not including the added

occupant load imposed by persons entering the refuge area through horizontal exits from other areas. Not less than one refuge area exit shall lead directly to the exterior or to an interior exit stairway or ramp.

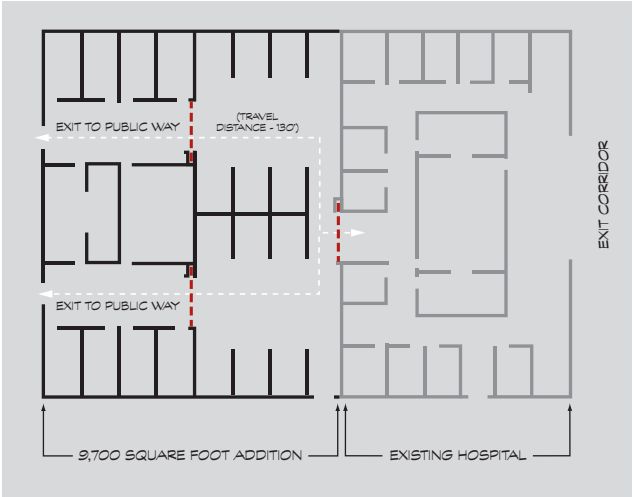
Exception: The adjoining compartment shall not be required to have a stairway or door leading directly outside, provided the area of refuge area into which a horizontal exit leads has stairways or doors leading directly outside and are so arranged that egress shall not require the occupants to return through the compartment from which egress originates.

Design Solutions

CASE 1: Side Acting Accordion with Complying Swing Egress Door



The intent is to add a 10,200 square foot critical care suite onto an existing I-2 (hospital). However code requirements come into play that affect the design dramatically:



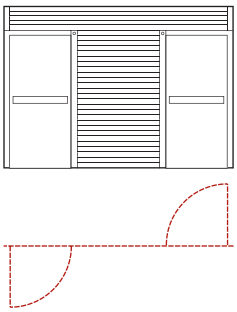
- First, suites of sleeping rooms cannot exceed 10,000 square feet in a sprinklered structure. In this case a 10,200 square foot suite is being added. *(407.4.3.5.1)*
- Second, there must be two exits from each suite. *(407.4.4.5.1)*
- Third, the travel distance between any point in a suite of sleeping rooms and an exit access exit door shall not exceed 125 feet with automatic smoke detection. *(407.4.4.3)*

By utilizing the horizontal exit concept, the following will preserve the original design intent and provide code compliance:

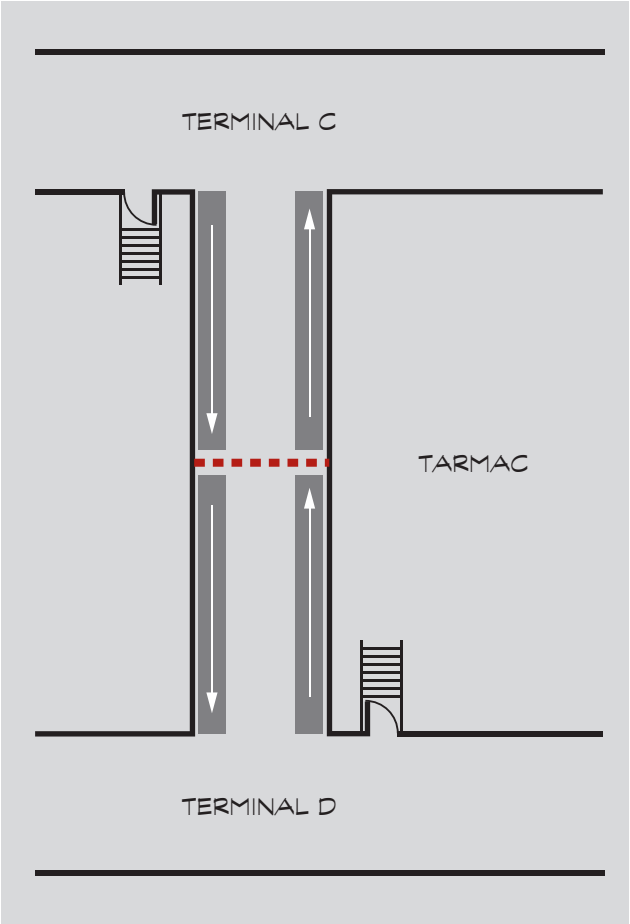
- Separate the intended 10,200 square foot space into two suites, each less than 10,000 square feet.
- Provide a 2-hour fire barrier wall as the separation. *(Section 1026.2)*
- Provide a horizontal exit in the separation as one of two required exits from each space. *(Section 407.4.4.5.2)*
- Provide a 90-minute opening protective. *(Table 716.5)*

EXIT ACCESS SEPARATION

CASE 2: Vertical Coiling with Complying Swing Egress Door(s)



McKEON offers a particularly unique resolve for this airport design. Because the concourse is located above ground level and in a TSA secure area, it is not possible to provide exiting to the exterior. Also, there is not room for build-outs or pocket spaces, therefore unique to the T2500 technology a 90-minute opening protective is provided with no side room and as little as 26 inches of head-room with conforming dual egress doors. In essence each side of a long fire and smoke rated concourse forms one of two areas of refuge.



Inquiry Discussion and Questions

It has been said by many that the horizontal exit is probably one of the least understood and least utilized concepts of the building code. The following questions may be helpful in promoting awareness:

- Do you encounter travel distance problems in areas of the code other than the standard travel distance tables? (This case study for example.)
- When designing a horizontal exit, does the 2-hour wall inhibit the openness of the space under consideration?
- In health care or prison design may I show you how a required smoke barrier can also serve as a horizontal exit?

Notes:

Exit Passageways

Section 1024

An exit passageway provides the designer with an acceptable way of connecting a required exit stair to the exit discharge. Because the code requires an exit stair to open directly into an exit discharge to the exterior of the building, this provision will allow the stair to terminate at convenient locations away from the exterior walls. Also, the exit passageway can extend the path of travel when travel distances in the exit access system have been exceeded.

Fire & Life Safety Concerns

Extending the path of egress beyond the terminated travel distance or beyond the exit vestibule increases the potential for building occupants to be exposed to fire, smoke or hot and toxic gases. For these reasons exit passageways are designed with more strict provisions.

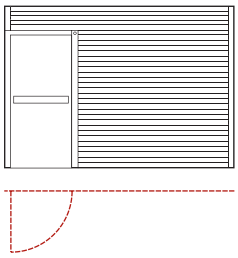
Code Requirements

1. An exit passageway shall not be used for any purpose other than as a means of egress. *(1024.1)*
2. Exit passageway enclosures shall have walls, floors and ceilings of not less than 1 hour … and be constructed as fire barriers or horizontal assemblies. *(1024.3)*
3. Elevators shall not open into an exit passageway. *(1024.5)*
4. Opening protectives shall comply with Section 716 … and shall be limited to those necessary for exit access into the exit passageway from normally occupied spaces and for egress from the exit passageway. *(1024.5)*
5. Where an interior exit stairway or ramp is extended to an exit discharge or a public way by an exit passageway, the exit passageway shall comply with Section 1023.3.1. In other words, the interior exit stair must be separated from the exit passageway by a fire barrier wall equal in rating to the requirement for the interior exit stairway.

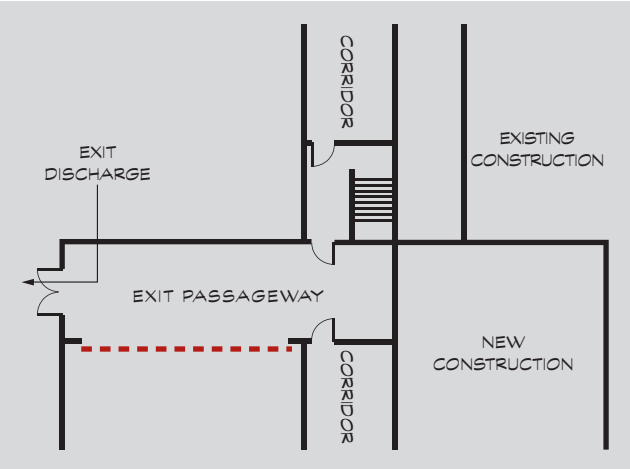
EXIT ACCESS SEPARATION

Design Solution

CASE 1: Vertical Coiling with Complying Swing Egress Door(s)



In this case study the required exit stair from the floors above terminated several feet from the exterior of the building. The McKEON opening protective forms the rated enclosure during a fire emergency, extending the exit path to exit discharge.



EXIT ACCESS SEPARATION

Inquiry Discussion and Questions

Because exit passageways are constructed under strict opening provisions, designs rarely incorporate them unless there is no other choice. With the use of the McKEON wide-span opening protectives, openings are not limited in size and little or no design compromise is noticed by building occupants. The following questions can be helpful in assisting the design professional to recognize new options:

- Have you ever desired to terminate a required exit enclosure on the interior of the building rather than at the exterior exit?
- Do you find challenges in connecting an exit enclosure with the exit to the exterior of the building?
- Did you know that solving a travel distance problem by providing an exit passageway can open your design rather than close it down?

Notes:

Pedestrian Walkways & Tunnels

Section 3014

Walkways and tunnels are designed to provide connection between buildings. They can be located at, above or below grade level and are used as a means of travel by persons.

Fire & Life Safety Concerns

Buildings located across lot lines from each other are required to have fire-rated exterior walls to prevent fire and smoke from passing between them (705; Table 602). Walkways and tunnels that connect and penetrate these rated exterior walls compromise this protection, potentially allowing heat and smoke to pass from one building to another.

Code Requirements

Section 3104 details specific requirements to ensure building occupant safety based upon the following fundamental principles:

Principle #1: Separate Structures. Connected buildings shall be considered to be separate structures *(3104.2)*. Unless the buildings are all on the same lot or exempt under specific accessibility requirements each building will be considered as a separate building when determining fire resistance, exterior wall ratings and egress.

Principle #2: Construction. The pedestrian walkway shall be of noncombustible construction *(3104.3)*. Unless each building being connected is of combustible construction the connecting element must be noncombustible to minimize the travel of heat and smoke.

Principle #3: Fire Barriers. Once the rated exterior walls have been penetrated to accommodate a noncombustible connecting walkway, the interior of each building must be further protected with fire barriers of not less than 2-hour rated construction *(3104.5.1).* In order to avoid this requirement the following criteria must be met:

A. Exterior walls - 2 hour rated, extend not less than 10' in every direction surrounding the perimeter of the pedestrian walkway.

EXIT ACCESS SEPARATION

B. Openings in exterior walls of connected buildings - opening protectives not less than 3/4 hour.

C. Supporting construction - See Section 707.5.1.

Principle #4: Alternative Separation

A Distance between connected buildings is more than 10 feet.

B. Walkway and connected buildings fully sprinklered.

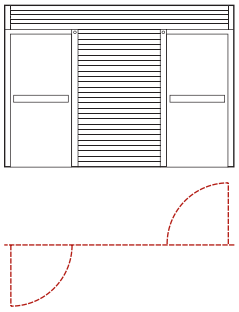
C. The wall shall be capable of resisting smoke.

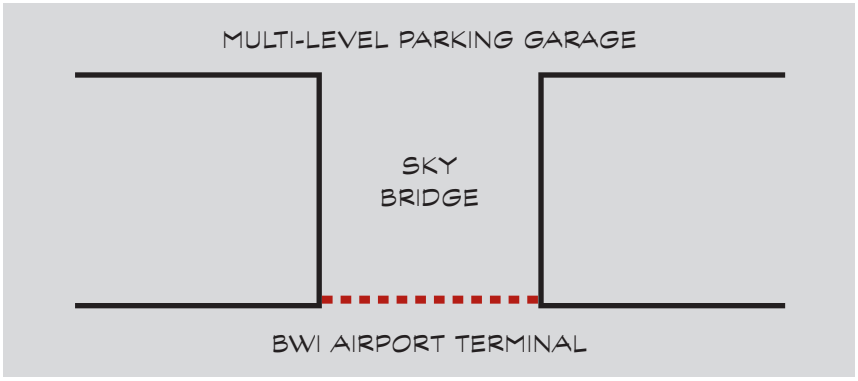
D. The wall and doors can be constructed of wired or tempered glass that is protected with sprinklers. All glass in gasketed frames.

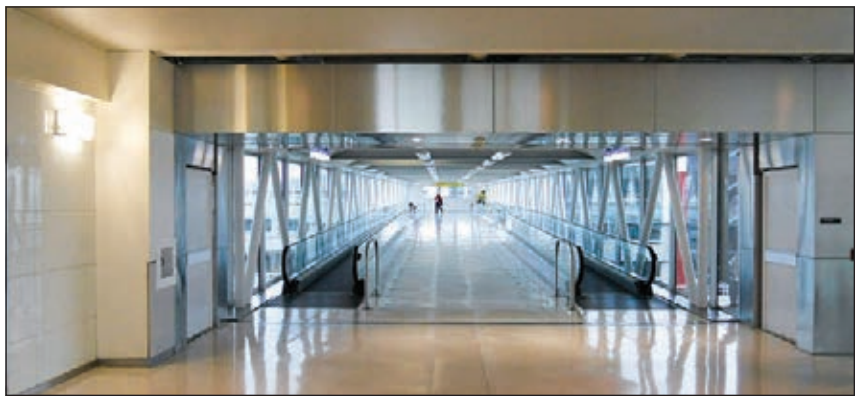
Design Solutions

The alternatives to fire barrier separations as listed above are very costly. Complying with the 2-hour separation requirement in Section 3104.5 is the least expensive option. A listed and labeled wide span McKEON assembly will easily protect any size opening. In the following case studies, McKEON showcases three distinctly different technologies to resolve the same code application problem. Diverse design requirements were not a challenge, rather routine applications of standard products.

CASE 1: Vertical Coiling with Complying Swing Egress Door(s)

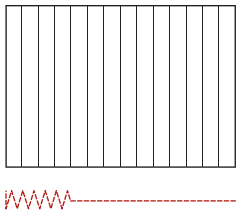


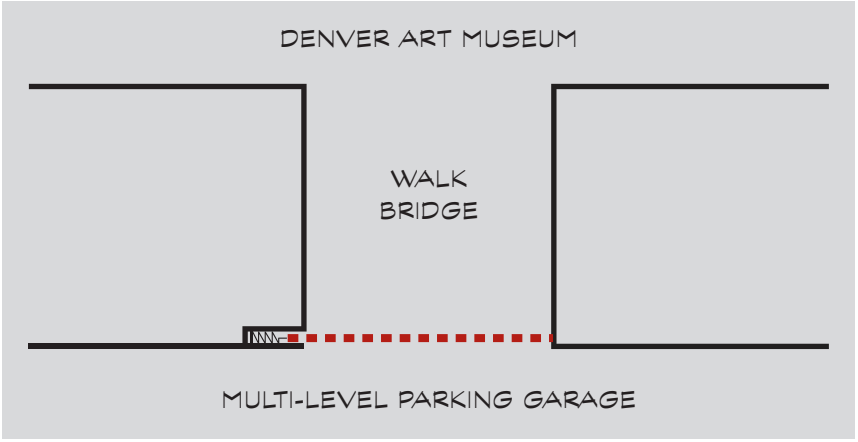




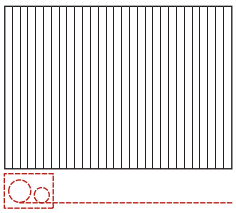
EXIT ACCESS SEPARATION

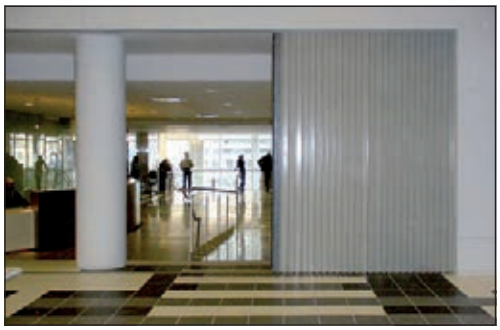
CASE 2: Side Acting Accordion with Power-assisted Egress

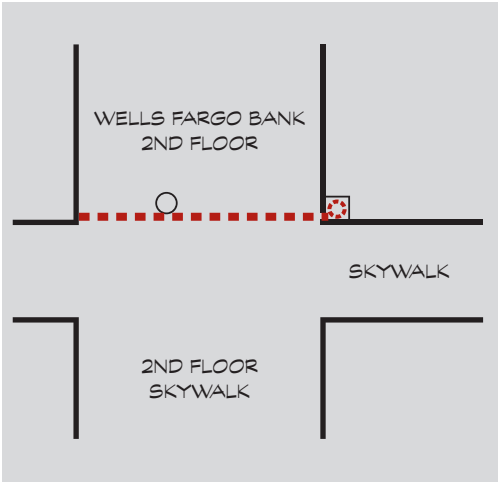




CASE 3: Side Coiling without Egress







EXIT ACCESS SEPARATION

Inquiry Discussion and Questions

Pedestrian walkways can be located overhead connecting two or more buildings or underground as tunnels connecting two or more buildings. This connecting construction is viewed as a definite threat to life safety. The code attempts to build in safety measures that are intended as substitutes for complete and optimum separation. These substitutes include extensive active wet sprinkler systems, open side walls, and tempered and/or wire glass components. It would certainly make more sense to use the "real thing" by easily providing rated barriers with wide-span opening protectives at each end eliminating any threat of fire and smoke entering the walkways.

The following questions may be helpful:

- Have you been able to run a cost comparison separating the building from the walkway as opposed to protecting the walkway?
- Even though a pedestrian walkway will most likely be constructed of non-combustible materials, would you like to avoid the cost of sprinklers, limiting interior design and costly tempered and/or wired glass components?

Notes:

3 Vertical Opening Separation

Fundamental Guidelines

Draft Curtains

Exit Access Stairways

Vertical Openings – Escalator

Interior Exit Stairways

Atriums

Vertical Compartmentation

Fundamental Guidelines

Sections 404, 712, 713, 1019, 1023 & 1027

Vertical openings between floors are designed consistently in multi-story buildings in many different shapes, heights and uses. For the purposes of code enforcement the following general categories are described in the building code:

1. **Shaft Enclosures *(713)***
   - a. **Escalators *(712.1.3)***
   - b. **Mezzanines *(712.1.11, 505)***
   - c. **Stairs *(712.1.12, 1019, 1023, 1027)***
   - d. **Elevators *(3006)***
2. **Atriums *(404)***
3. **Interior Exit Stairways and Ramps *(Section 1023)***
4. **Exit Access Stairways *(712.1.12, 1019)***

Typically anytime two or more floors are open to each other a vertical opening is created and the phrase “floors are common with each other” is used to characterize the condition.

Two fundamental principles drive the requirements of vertical opening protection. First, the migration of smoke, heat and toxic gases floor to floor. Second, egress of building occupants from upper levels to a safe level of exit discharge.

The case studies in this section illustrate the balance between these two principles in the enforcement of fire & life safety provisions for building occupants in multi-story buildings.

VERTICAL OPENING SEPARATION

Understanding Draft Curtains & Closely Spaced Sprinklers as Vertical Space Fire Protection Features

Sections 712.1.3.1 & 1019.3, #4

Draft curtains and closely spaced sprinklers, in accordance with NFPA 13, may be used in lieu of shaft enclosure construction in specific vertical opening applications.

Because of the chimney effect that can take place in vertical openings in multi-story structures, smoke, heat, toxic fumes and gases easily transfer throughout the structure. The optimum regulatory provision that prevents or mitigates this condition is the construction of solid fixed walls that are fire-rated as shaft enclosures separating vertical spaces from the remaining structure and floor areas. However, certain conditions allow the use of draft curtains in lieu of Fire Barrier walls.

Draft curtains are intended to accelerate the activation of sprinklers placed around the perimeter of vertical openings in order to provide an instant water barrier. This is a level of protection that can take the place of the rated wall construction and mitigate the transfer of smoke, heat, toxic fumes and gases which may be transferring vertically through the structure during a fire event.

The code addresses the use of draft curtains in two specific applications only. Both are penetrations through floor openings with the first being the escalator and the second, exit access stairways.

Escalator Openings

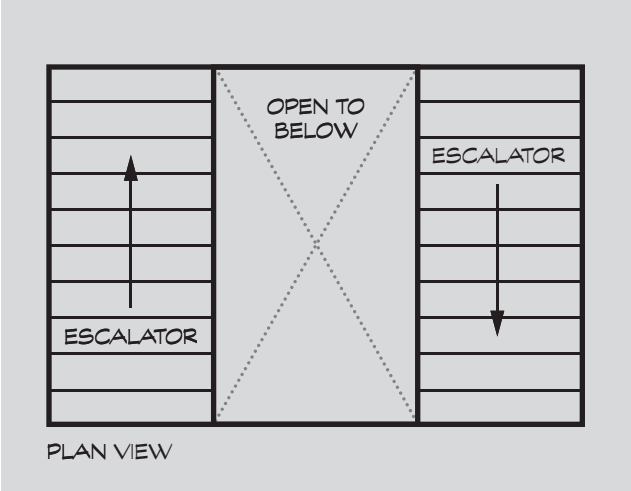
Section 712.1.3 Escalator openings. Where a building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, vertical openings for escalators shall be permitted where protected in accordance with Section 712.1.3.1 or 712.1.3.2.

Section 712.1.3.1 Opening size. Protection by a draft curtain and closely spaced sprinklers in accordance with NFPA 13 shall be permitted where the area of the vertical opening between stories does not exceed twice the horizontal projected area of the escalator. In other than Groups B and M, this application is limited to openings that do not connect more than four stories.

Section 712.1.3.2 Automatic shutters. (Please see the application study in this document titled, “Vertical Openings – Escalator.”)

The use of the draft curtains with closely spaced sprinklers in escalator openings as outlined in the aforementioned code language only applies when the area of the escalator itself obstructs at least half of the area of the opening being pen-

etrated. The following diagram illustrates a compliant application of this criteria. It is important to remember, this condition is acceptable only when the building is fully sprinklered.

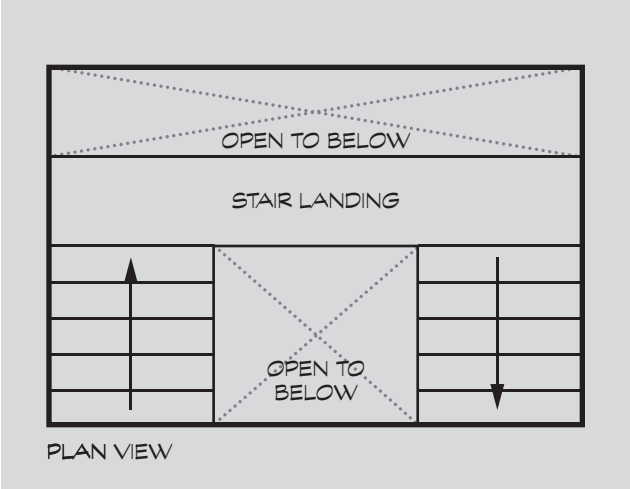


Exit Access Stairway Openings

Section 1019.3 Occupancies other than I-2 and I-3. In other than Group I-2 and I-3 occupancies, floor openings containing exit access stairways or ramps that do not comply with one of the conditions listed in this section shall be enclosed with a shaft enclosure constructed in accordance with Section 713.

Condition 4. Exit access stairways and ramps in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, where the area of the vertical opening between stories does not exceed twice the horizontal projected area of the stairway or ramp and the opening is protected by a draft curtain and closely spaced sprinklers in accordance with NFPA 13. In other than Group B and M occupancies, this provision is limited to openings that do not connect more than four stories.

Using language similar to the escalator provisions, the use of draft curtains with closely spaced sprinklers in exit access stairway openings only applies when the area of the stair, to include any landings, obstructs at least half of the area of the opening being penetrated. The diagram below illustrates a compliant application of this criteria. It is important to remember, this condition is acceptable only when the building is fully sprinklered.



A Code Discussion for Clarification

The design and code provisions governing the application and use of draft curtains do not require side-guide components or fire endurance testing and do not parallel typical opening protective acceptance criteria. Since the adoption and development of the *2015 edition of the International Building Code (IBC),* the use of draft curtains in any project are for the sole purpose of creating barriers to force heat to activate sprinkler heads in vertical openings such as escalators and exit access stairways. Draft curtains are not intended to prevent smoke from migrating floor to floor, rather their purpose is to assist in immediate activation of the closely spaced sprin-

klers, associated with them, which are intended to mitigate the migration of smoke and/or heat floor to floor.

Background

In the legacy model building codes and all editions of the IBC prior to the published 2015 edition, draft curtains were a requirement in two separate areas of the code with criteria and detailed definition in one area only. First, we will explore the use where these criteria and definitions occurred, Factory and Storage occupancies, as defined in *Chapter 9, Fire Protection Systems. Section 910.3.5.1* stated: *Construction. Draft curtains shall be constructed of sheet metal, lath and plaster, gypsum board or other approved materials which provide equivalent performance to resist the passage of smoke. Joints and connections shall be smoke tight.* In essence, draft curtains could be constructed of cardboard and duct tape … as long as they channeled smoke.

This code language was written around the stringent requirements of Group F-1 and S-1 occupancies as indicated in *Table 910.3.* In these hi-pile storage occupancies there was no requirement for draft curtains to be fire rated, only that they "resist the passage of smoke." Achieving smoke tight joints and connections were critical due to exceptions in the code section that allowed the reduction of smoke vents, their sizes and placement with the use of draft curtains. In other words, this specific language was confined to these two aforementioned occupancy types. Incidentally, this code requirement was eliminated in the 2015 edition of the IBC, the term draft curtain no longer exists for F-1 and S-1 occupancies. These particular smoke removal systems no longer require draft curtains for directing smoke.

Current Provisions

Section 712 Vertical Openings, 712.1.3.2 allows unprotected escalator openings that are protected by draft curtains. *Section 1019* addresses *Exit Access Stairways* allowing draft curtains to protect vertical openings. However, these two code sections (applications) did not reference *Section 910* prior to 2015 confirming separate and distinct uses of the provision. However, both the escalator and exit access stairway applications include a pointer to *NFPA 13* as the standard for the use of this building feature. *Section 712.1.3.1 Opening size* at the escalator opening and *Section 1091.3, Item #4* at the exit access stairway opening state the following: "… protection[ed] by a draft curtain and closely spaced sprinklers in accordance with NFPA 13 …"

Please note, there are no other definitions or criteria for the term draft curtain in the model building codes with exception of the reference to *NFPA 13.* Yet, the term draft curtain is called out in both aforementioned code sections. Further to confuse the issue the term Draft Stop is found in *IBC Section 202.* After reading this definition, clearly it is addressing a building feature located in *"… concealed areas of building components such as crawl spaces, floor/ceiling assemblies, roof/ceiling assemblies and attics."*

As if the issue is not confusing enough, *NFPA 13* addresses vertical openings such as escalator openings and stair openings with regard to this level of protection as Draft Stops rather than using the term Draft Curtain. Please note:

NFPA 13, Section 8.15.4 Vertical Openings

8.15.4.1 General. Unless the requirements of 8.15.4.4 are met, where moving stairways, stair-

cases, or similar floor openings are unenclosed and where sprinkler protection is serving as the alternative to enclosure of the vertical opening, the floor openings involved shall be protected by closely spaced sprinklers in combination with draft stops in accordance with 8.15.4.2 and 8.15.4.3.

8.15.4.2 Draft Stops. Draft stops shall meet all of the following criteria:

1. *The draft stops shall be located immediately adjacent to the opening.*
2. *The draft stops shall be at least 18 in. (457 mm) deep.*
3. *The draft stops shall be of noncombustible or limited combustible material that will stay in place before and during sprinkler operation.*

The term draft curtain does appear in *NFPA 13,* however, only in reference to the old method of channeling smoke to smoke and heat vents in "F" & "S" occupancies. Therefore, the use of draft curtains in our current model building codes is limited to escalator and exit access stairway openings only. Since NFPA 13 criteria for use of draft curtains in vertical openings does not require the channeling of smoke, rather to simply force heat and smoke against the sprinkler heads for immediate activation, the criteria does not include large depths of drop beyond 18 inches nor does it require smoke sealed corners or joints in the curtain installation.

If we examine this concept from a more pragmatic view we can see that the criteria makes sense. As mentioned above, the maximum drop in the draft stop criteria for these applications is 18 inches. If the intent of the draft curtain application was to stop the transfer of smoke or heat to other floors, this depth would have to be much greater. At some point, very quickly upon contact the smoke will easily pass over these draft curtains and the curtains become academic at that point. Hence, draft curtain applications in escalators and stairs always have gaps at the joints, are typically constructed of polymethyl methacrylates which by trade-name are better known as clear acrylics or Plexiglass. These or other materials are usually not continuous or installed in a fashion to actually prevent smoke from migrating floor to floor … their only purpose is to force enough heat against the sprinkler heads to activate them.

For this reason there is not a test standard or criteria for testing draft curtains. *NFPA 13* simply requires, *"The draft stops shall be of noncombustible or limited combustible material …"* The D100 technology significantly exceeds these basic requirements. The McKEON SmokeFighter® Model D100 is manufactured from fabric that has been tested and certified for a 3-hour UL 10D fire label. This material has also been tested and certified for a 20 minute UL 10B fire label. Both labels certify use to span unlimited widths and heights. The test criteria included side-guide components in order to maintain full integrity opening protective hose stream performance.

The D100 technology exceeds the minimum requirements, creating a substantial fire and smoke barrier to expeditiously activate the closely spaced sprinklers surrounding the vertical opening. Sprinkler activation at the unprotected shaft opening mitigates the migration of heat, smoke, toxic fumes and gases from traveling throughout the structure.

Exit Access Stairways

Sections 712, 1019

These case studies deal with a condition wherein several floors are common to each other. The floors are inter-connected with an interior exit access or communicating stairway. Previous editions of the code addressed these stair features as non-egress stairs. The code now defines Exit Access Stairways as a stairway within the exit access portion of the means of egress system. ***(202)***

Fire & Life Safety Concerns

Multiple floors open to each other is perhaps one of the most vulnerable conditions to fire danger threats in any multi-story building. Fire suppression is concerned with confining a fire to the floor of origin and preventing the fire, or the products of the fire (smoke, heat and hot/toxic gases) from spreading to other levels. Such conditions are not conducive to defend in-place strategies. Rather, it is preferable that building occupants move quickly out of harm's way. These requirements expressly demonstrate the overlap between passive, active and egress fire & life safety provisions.

Code Requirements

In occupancies other than I-2 and I-3, floor openings containing exit access stairs that do not comply with one of the following … shall be enclosed in a shaft enclosure. *(1019.3)*

- The exit access stairway must be included in the exit access travel distance measurement. *(1017.3.1)*
- Serve or atmospherically communicate between only two stories *(1019.3, Item #1)*
- Options to open four stories or more than four stories using draft curtains and closely spaced sprinklers (1019.3, Item #4, please see page 34, Draft Curtains)

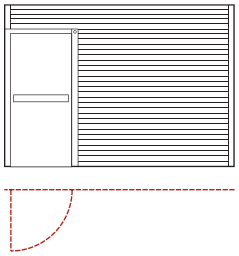
For additional code language and acceptance criteria for two-story openings please see "Inquiry Discussion & Questions" on page 42 of this application study.

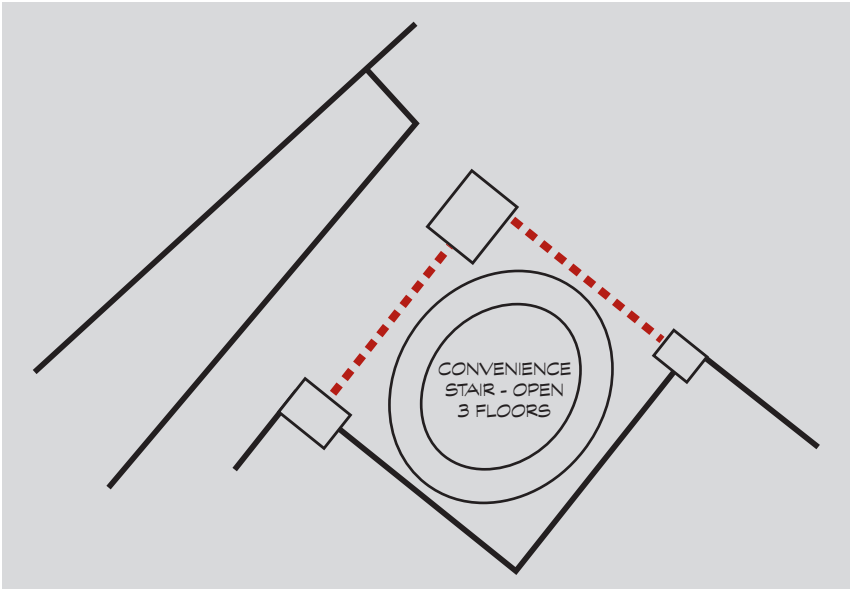
VERTICAL OPENING SEPARATION

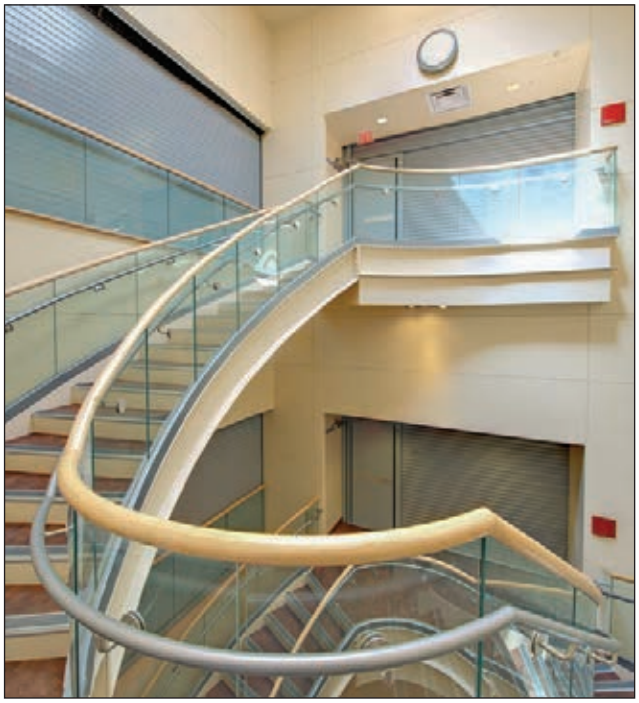
Design Solutions

Because each space contains a stair the code will allow two floors common. In the following case studies, McKEON offers different products for very diverse design needs, yet there is not a compromise in fire and life safety.

CASE 1: Vertical Coiling with Complying Swing Egress Door(s)

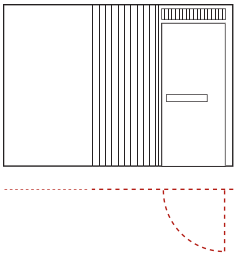




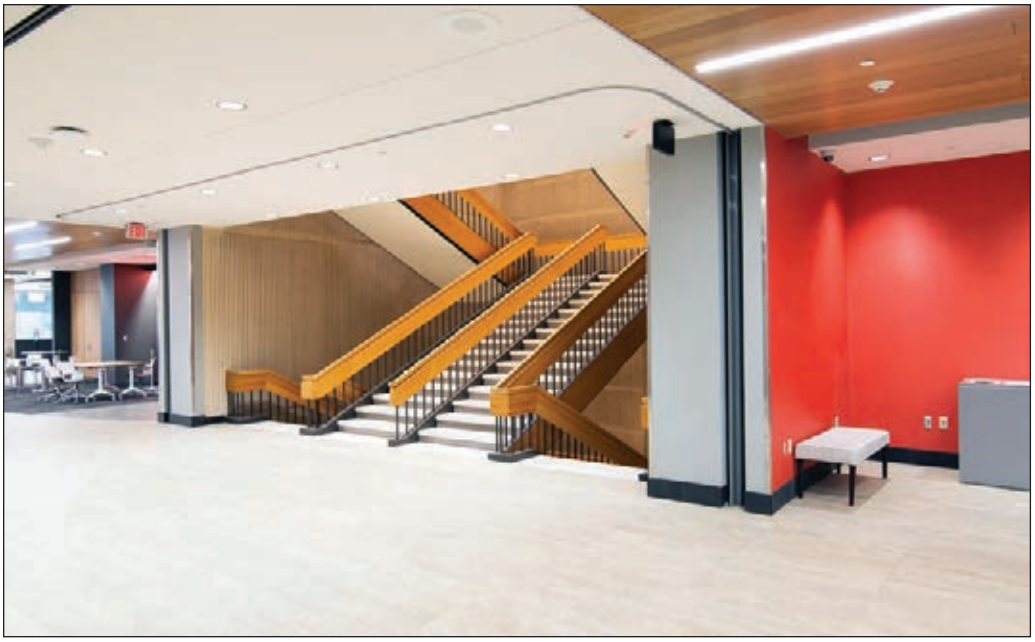


VERTICAL OPENING SEPARATION

CASE 2: Side Acting with Complying Egress Door(s)

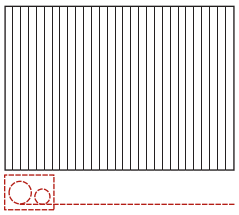


In the second case study a convenience stair within a university learning center is open to each floor it connects during normal school operation. When the building goes into alarm two McKEON 3-hour side acting assemblies, each with a conforming egress swing door and conventional fire exit hardware, combine to provide shaft enclosure protection.

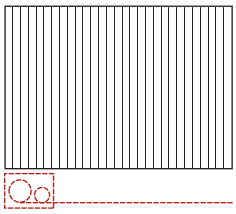


VERTICAL OPENING SEPARATION

CASE 3: Extreme Height & Width Side Coiling without Egress



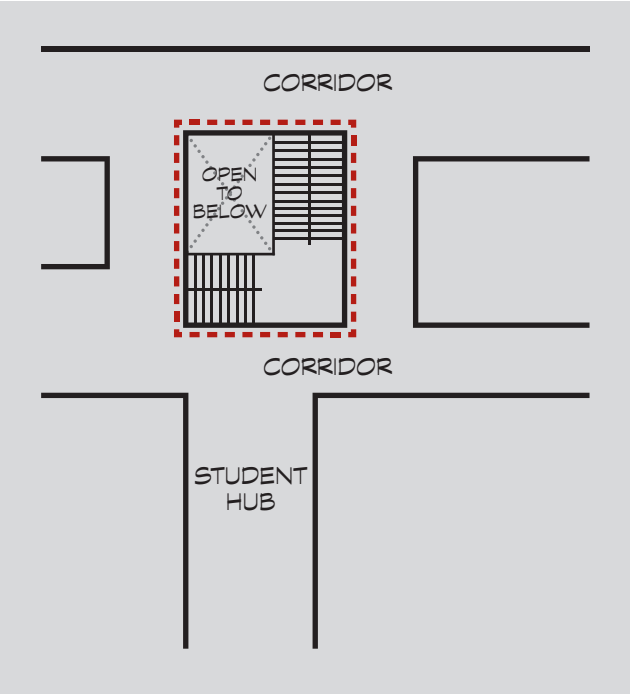
CASE 4: Side Coiling without Egress



VERTICAL OPENING SEPARATION

CASE 5: Deployable Draft Curtains & Closely Spaced Sprinklers

The McKEON D100 draft curtains deploy when there is a fire emergency. During normal hours of building occupancy, unlike conventional fixed draft curtains, the ceiling space around the vertical opening is clear of any obstacles.



VERTICAL OPENING SEPARATION

Inquiry Discussion & Questions

These applications, at first glance, would seem to fall under the atrium provisions because there are at least two floors common to each other. Notwithstanding the third floor is separated from the other two, the definition of an atrium is two or more floors interconnected. The purpose for separating floors in order to create only two floors common is to consider the space under the vertical opening provisions of Section 712 in lieu of the atrium provisions in Section 404. Aside from the exit access stairway provisions referenced in Section 712 and detailed in Section 1019, the code includes additional acceptance criteria for two-story openings. Essentially, in other than Groups I-2 and I-3 a floor opening that is not used as one of the applications already listed in Section 1019 or 712.1.9 shall be permitted if it complies with all of the following seven criteria:

1. Does not connect more than two stories.
2. Does not contain a stairway or ramp required by Chapter 10.
3. Does not penetrate a horizontal assembly that separates fire areas or smoke barriers that separate smoke compartments.
4. Is not concealed within the construction of a wall or floor/ceiling assembly.
5. Is not open to a corridor in Group I and R occupancies.
6. Is not open to a corridor on nonsprinklered floors.
7. Is separated from floor openings and air transfer openings serving other floors by construction conforming to require shaft enclosures. *(712.1.9)*

The following questions may be helpful:

- Do you have clients who wish to occupy multiple floors with a vertical common area connecting all floors?
- Can I show you how interconnecting unenclosed stairs can be incorporated into the design without creating shaft enclosures or complying with atrium provisions?
- Have you been concerned attempting vertical space separation avoiding the closed-in shaft appearance?
- Did you know there is technology available to offer a wide-span opening protective to separate vertical spaces that can also serve as the required exit from unenclosed stairways?

Notes:

Vertical Openings – Escalator

Sections 712.1.3

An escalator provides convenient movement for building occupants communicating multiple floors. However, escalators are typically not a part of the required means of egress.

Fire & Life Safety Concerns

Openings through floors allow fire – or the products of fire (smoke, heat and hot toxic gases) – to spread to other floors. Enclosing these spaces in rated shaft enclosures is certainly the most proficient method of mitigating fire and smoke migration between floors. However, the code incorporates optional provisions as exceptions to the completely sealed vertical shaft.

Code Requirements

The following exceptions are allowed in lieu of creating a shaft:

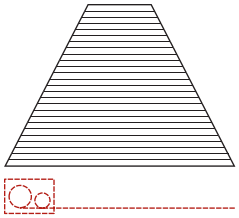
Escalators must be enclosed unless the design incorporates the following requirements: *(712.1.2)*

First, an automatic sprinkler system must be installed throughout the entire building and, secondly an escalator must NOT be in a portion of the means of egress system. If both of these issues are satisfied then the following criteria must be met:

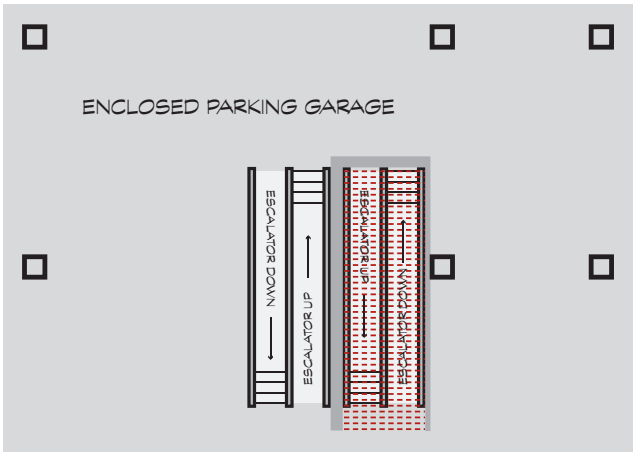
1. The area of the floor opening between stories does not exceed twice the horizontal area of the escalator. *(712.1.3.1)*
2. The opening is protected by a draft curtain and closely spaced sprinklers in accordance with NFPA 13. *(712.1.3.1)*
3. In other than Groups B and M, this application is limited to openings that do not connect more than four stories. *(712.1.3.1)*

Design Solutions

CASE 1: L-Shape Horizontal Shutter

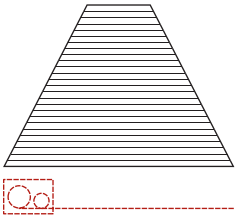


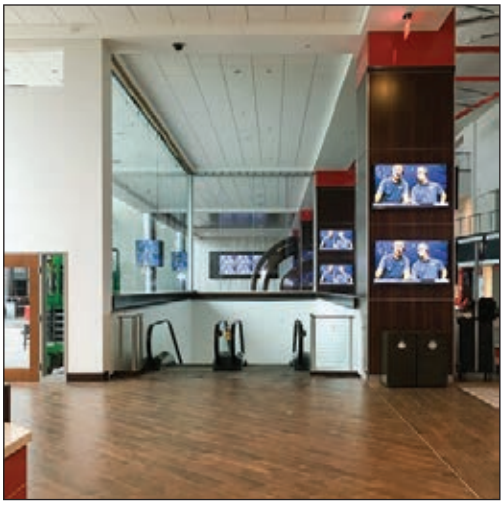
While a parking garage doesn't require an aesthetically pleasing solution, from a life safety perspective the need for fire and smoke protection is the same. A 2-hour rated horizontal shutter satisfies both the basic requirement of opening protection and enclosure of the escalator.



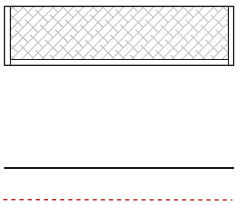
VERTICAL OPENING SEPARATION

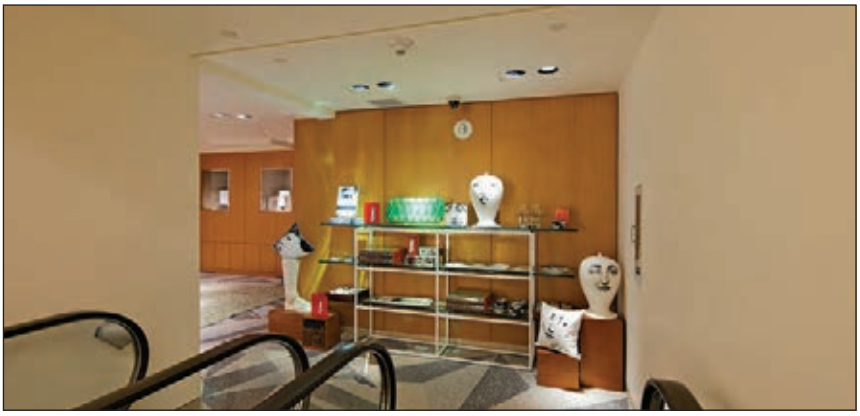
CASE 2: L-Shape Horizontal Shutter





CASE 3: Deployable Draft Curtains & Closely Spaced Sprinklers





VERTICAL OPENING SEPARATION

Inquiry Discussion & Questions

Escalators, whether in high-profile locations or low-profile parking garages, cannot be limited to the design criteria as stated above and maintain the desired ambiance of the space.

The following questions may be helpful:

- Would you like to use the escalator as a required exit?
- Have you considered the cost difference between a shaft enclosure and the open escalator design requirements?
- Have you considered wide-span opening protectives as an alternative to conventional swing doors in shaft enclosure walls?

Notes:

Interior Exit Stairways

Section 1023

Exit enclosures extend vertically through the interior of multi-story buildings in order to ensure timely and safe evacuation of occupants during an emergency. These enclosures include exit stairs and exit ramps.

Fire & Life Safety Concerns

Because exit enclosures penetrate horizontal floor and ceiling assemblies, fire, heat, smoke and toxic gases can potentially penetrate into building spaces at each floor level. Therefore, enclosures become critical barriers of protection for building occupants. The protected enclosure will be a non-contaminated exit path for at least one hour in buildings less than four stories and two hours in buildings four stories or more.

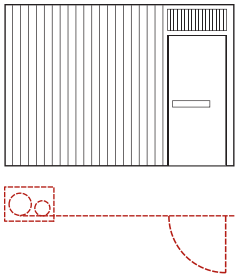
Code Requirements

1. Interior exit stairways shall be enclosed with fire barriers in accordance with Section 707. *(1023.2)*
2. Exit enclosures in buildings connecting four stories or more shall be rated at 2 hours; less than four stories at 1 hour. *(1023.2)*
3. Openings and penetrations shall be rated in accordance with Section 716. *(1023.4)*

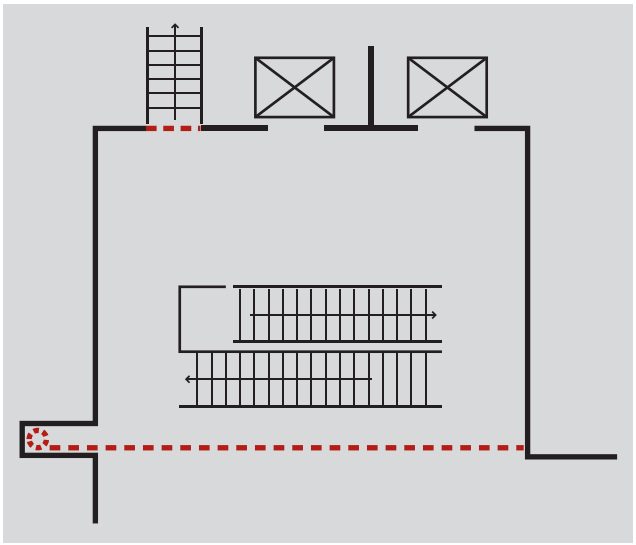
VERTICAL OPENING SEPARATION

Design Solutions

CASE 1: Side Coiling with Complying Swing Egress Door(s)

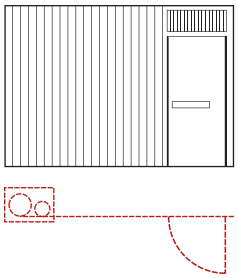


An absence of stacking space dictated use of a unique McKEON product to seal this exit enclosure. The side coiling assembly requires a small box-like space, projecting the 3-hour steel curtain with conventional egress door along a very narrow pocket entry point and header slot path. When deployed, complete compliance with shaft enclosure opening protective requirements is achieved.

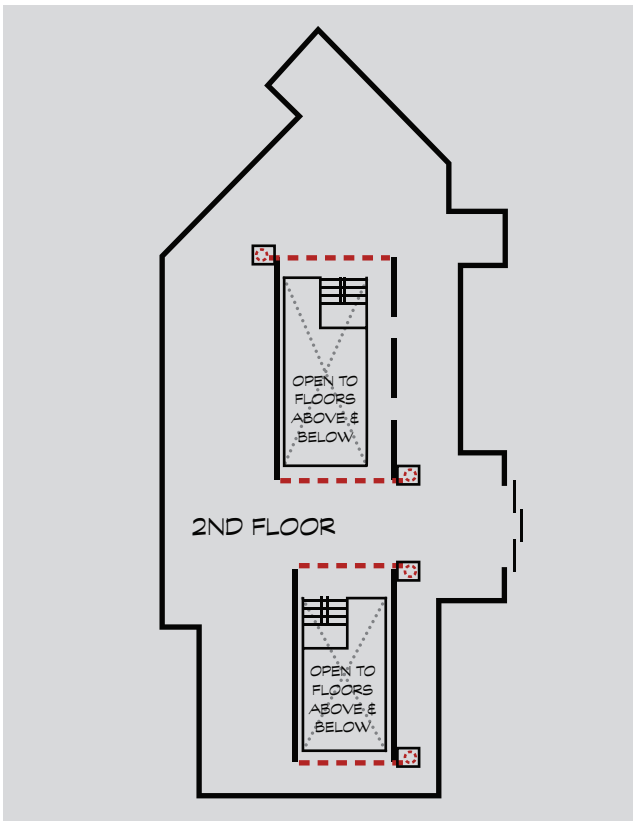


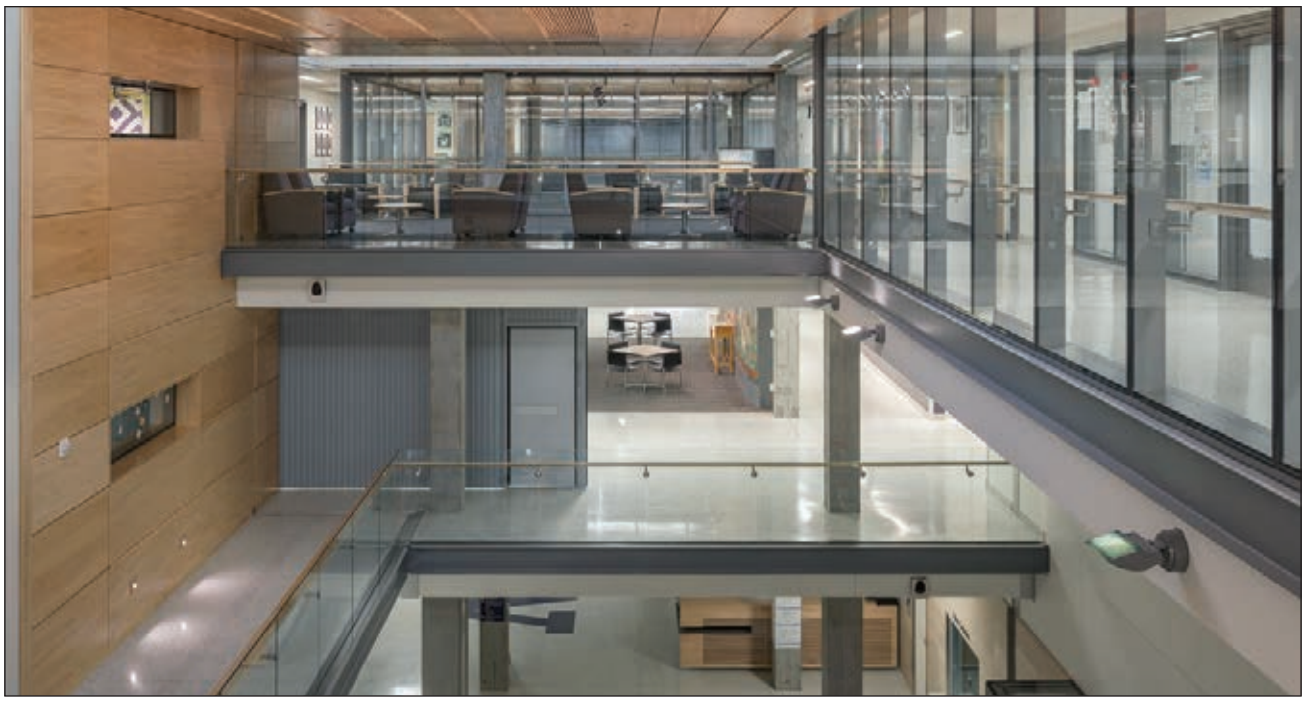
VERTICAL OPENING SEPARATION

CASE 2: Side Coiling with Egress



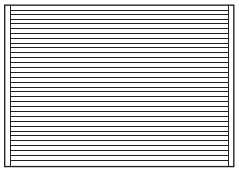
A fixed swing door within the parameters of a lengthy side coiling 3-hour assembly provides a simple resolve in a multi-floor challenge of vertical separation and egress.



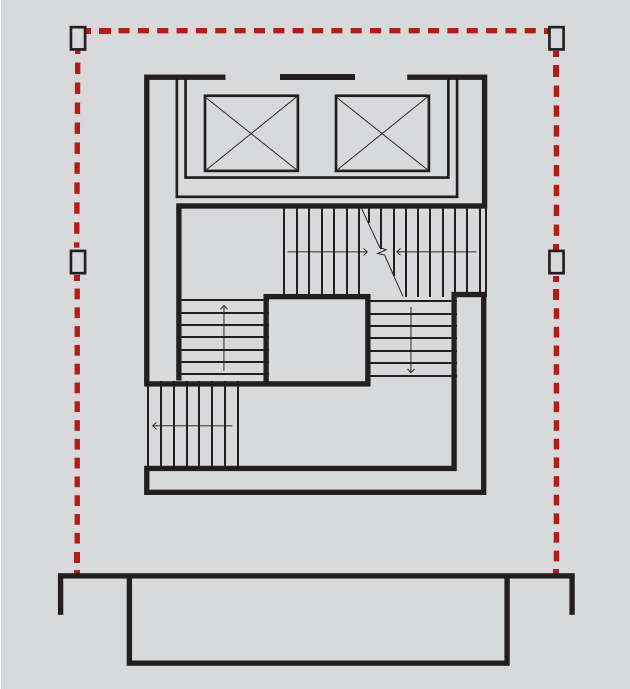


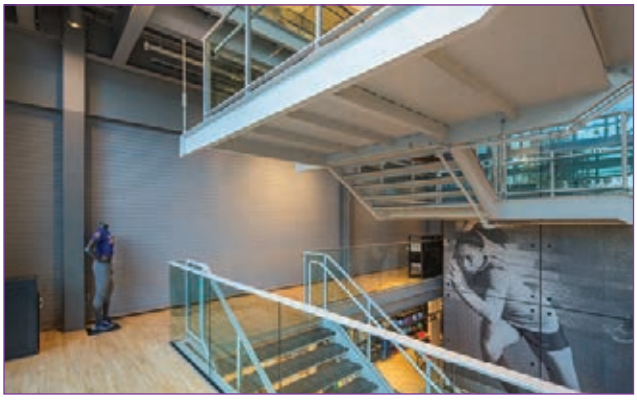
VERTICAL OPENING SEPARATION

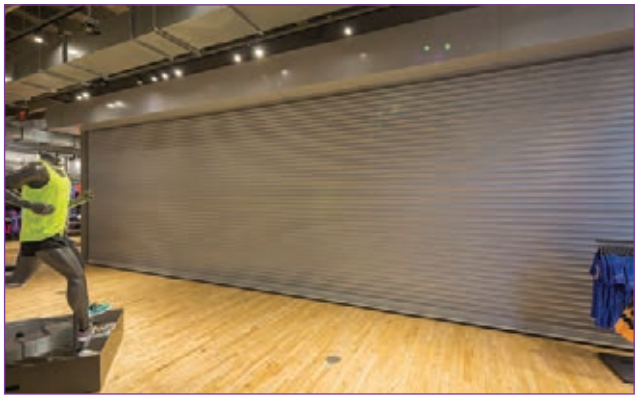
CASE 3: Vertical Coiling without Egress



Shaft enclosures that protect a required means of egress are extremely critical to the life safety of building occupants. From a design perspective it is often challenging to incorporate opening protectives in hi-profile open spaces. This extreme width vertical coiling assembly fits narrow header lines, has inconspicuous side guides, and deploys with adequate separation only when the building goes into alarm.







VERTICAL OPENING SEPARATION

Inquiry Discussion & Questions

Required exit stairs in vertical shaft enclosures ensure building occupant safe evacuation. Historically the designs of openings at the level of exit discharge have been limited to conventional side-hinged swinging doors. The acceptance of the McKEON products as both wide-span opening protectives as well as a complying egress doors provide the designer flexibility without compromising code compliance.

The following questions may be helpful:

- Do you find building owners and maintenance groups struggling with door swing and maintenance on door hardware in high-traffic spaces?
- Do you seek an open and spacious appearance at the landing area of vertical stair enclosures?
- Would you like to use a required vertical exit stair shaft as an aesthetically pleasing communicating stair by opening the enclosure area at each floor?

Notes:

Atriums

Section 404

An atrium is a floor opening, or a series of floor openings, that connects the environment of adjacent stories. By code definition an atrium is a space within a building that extends vertically and connects two or more stories. Atriums are designed to provide open and spacious vertical areas common with other building elements.

Fire & Life Safety Concerns

Unprotected vertical openings are often cited as the factor responsible for fire spread in incidents involving fire fatalities and/or extensive property damage. Section 404 addresses the need for protection of these specific building features in lieu of providing a complete floor and/or vertical shaft separation. In simple terms, the atrium provisions are extremely restrictive because a complying atrium is a shaft enclosure.

Code Requirements

Vertical common areas that comprise an atrium are not considered unprotected, rather the atrium is considered a protected space by means other than a conventional "walled-in" shaft enclosure. Listed below are the specific provisions allowing atriums to be open and spacious yet considered a conforming shaft enclosure:

1. The atrium floor area is permitted to be used only for low-hazard uses unless the individual space is provided with an automatic sprinkler system. *(Section 404.2)*
2. An approved automatic sprinkler system shall be installed throughout the entire building. *(Section 404.3)*
3. A fire alarm system shall be provided. *(Section 404.4)*
4. Engineered smoke control system – this system shall be installed in accordance with Section 909 when the atrium space exceeds more than two floors. *(Section 404.5)*
5. Atrium spaces shall be separated from adjacent spaces by 1-hour fire barrier construction unless at least one of the following exceptions are met: *(Section 404.6)*
   - A glass wall forming a smoke partition where automatic sprinklers are spaced 6 feet or less along both sides of the separation wall, or on the room side only if there is not a walkway

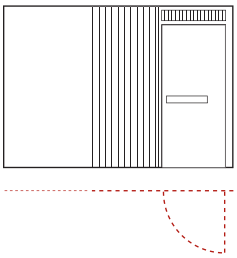
on the atrium side, and between 4 and 12 inches away from the glass … the entire glass surface must be wet upon activation … the glass shall be mounted in a gasketed frame … *(404.6)*

- Provide a glass block wall assembly in accordance with Section 2110 … *(404.6)*
- Fire barrier walls are not required between the atrium and adjoining spaces where the atrium is not required to have a smoke control system. *(404.6)*
- The adjacent spaces of any three floors of the atrium shall not be required to be separated from the atrium … if included in the smoke control calcs. *(404.6)*
- Smoke control equipment must be on a standby power system. *(Section 404.7)*
- The atrium interior finish of walls and ceilings must be not less than Class B. *(404.8)*
- With the exception of the lowest atrium level, the required means of egress in the exit access system travel distance shall not exceed 200 feet. *(404.9)*

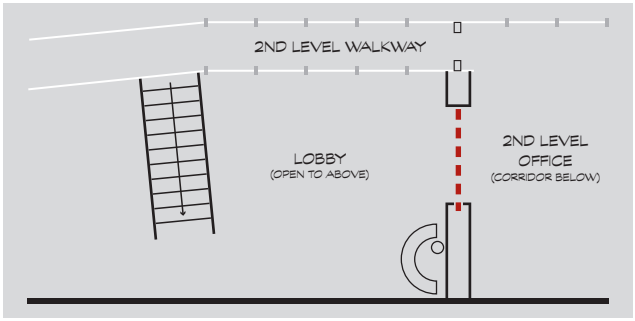
Design Solutions

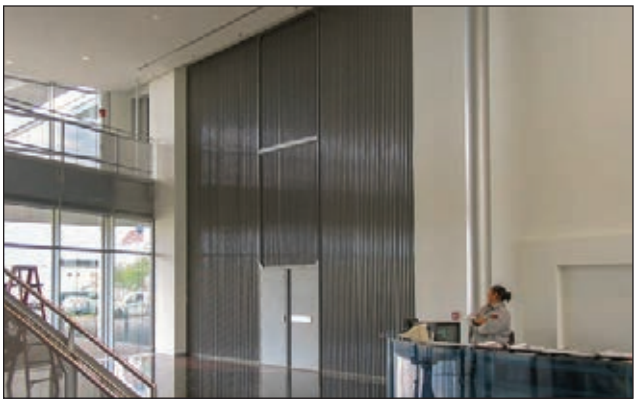
The use of deployable wide-span opening protectives in vertical atrium spaces, both vertically and horizontally, can significantly reduce construction and maintenance costs.

CASE 1: Side Acting with Complying Swing Egress Door(s)



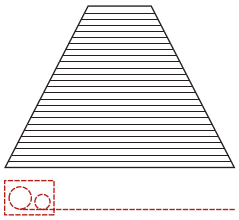
This unique case study features another McKEON product for resolving multiple design/code challenges simultaneously. The lower floor travel path is a required design feature for egress and – combined with the non-rated second floor overlook – is certainly a very creative solution. However, without the side acting, extreme height and egress conforming McKEON assembly this would not be possible!



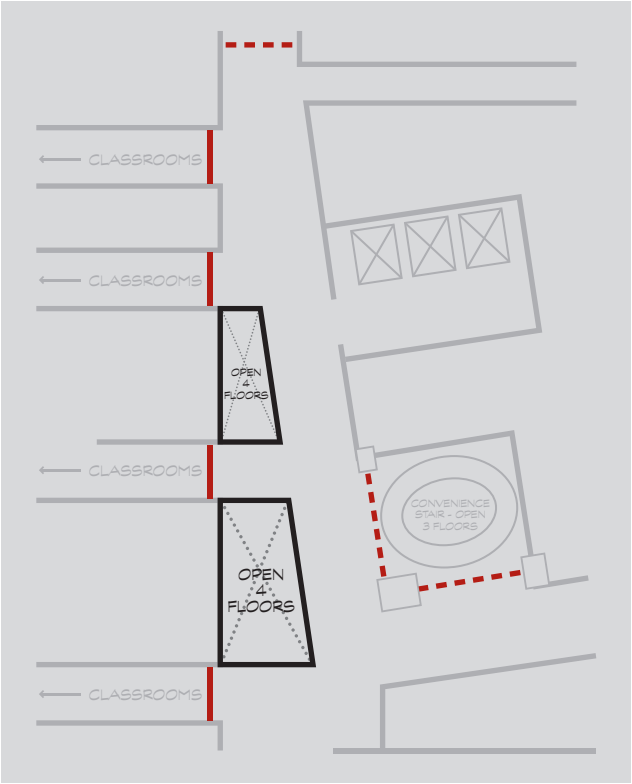


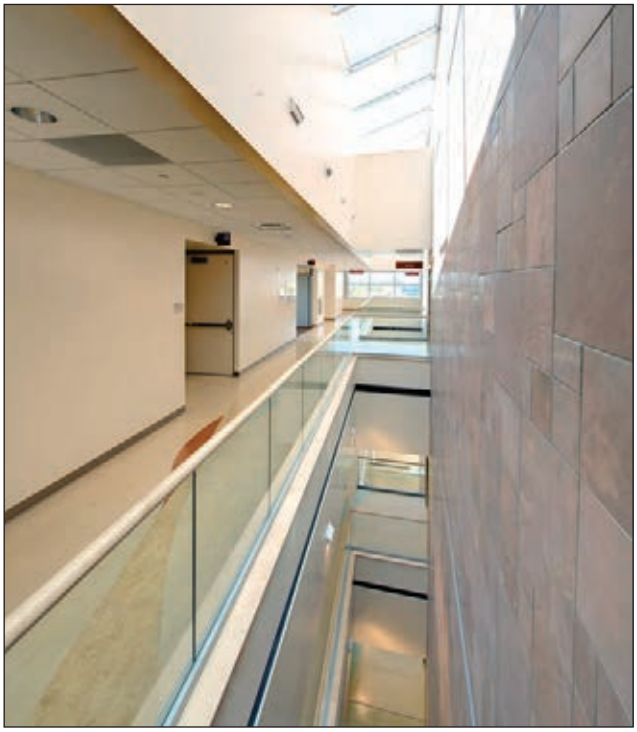
VERTICAL OPENING SEPARATION

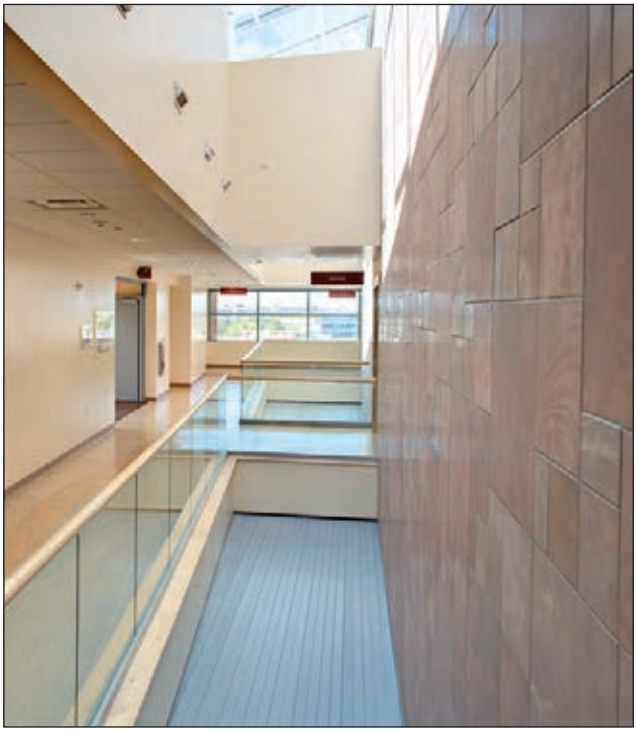
CASE 2: Horizontal (Floor) Shutter



In this case study the atrium space is essentially converted to a vertical compartment separation using the McKEON horizontal shutter. Please refer to the "vertical compartmentation" case studies at the end of this section for more information. Note the absence of any smoke evacuation systems!

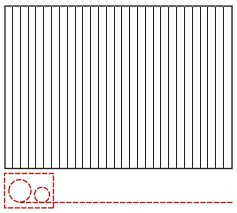


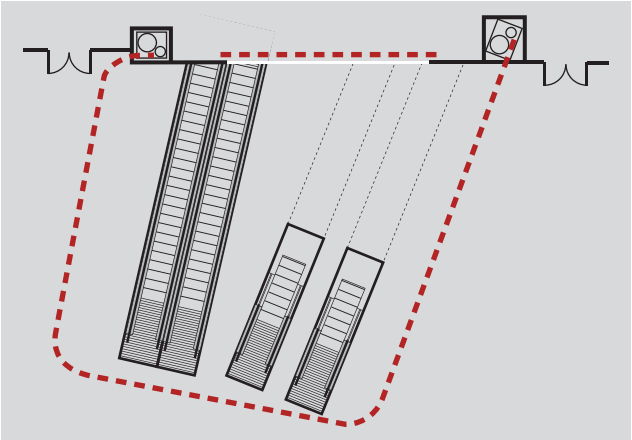




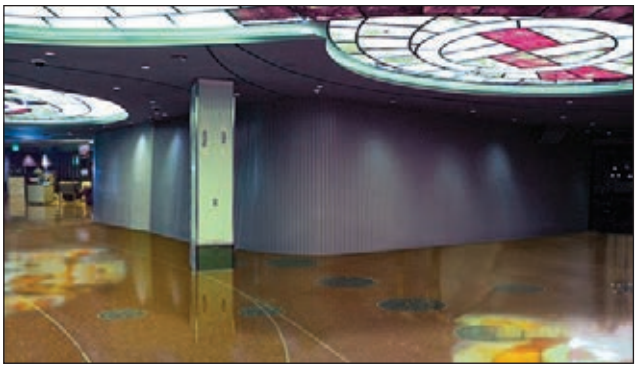
VERTICAL OPENING SEPARATION

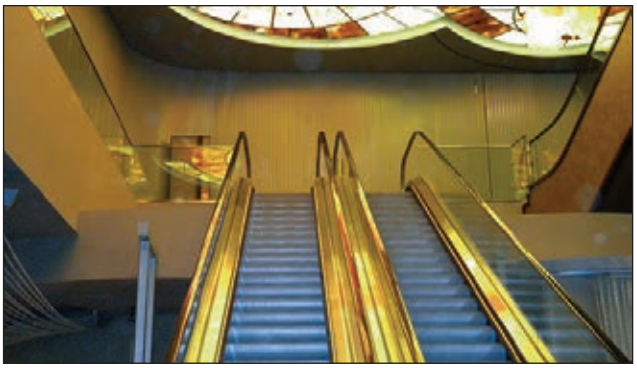
CASE 3: Side Coiling without Egress





Even though this design incorporates an escalator, Item #2.1 under Exception #2 can only be applied if the area of the floor opening between stories does not exceed twice the horizontal projected area of the escalator. Since the area in this vertical open space is greater, the next option is to explore the possibility of creating a vertical shaft enclosure allowing no more than two floors common or interconnecting. With a 2.25" head-track design, 3-hour fire listing and unlimited width capacity, McKEON easily solved the problem with a triple curve, non-floor track 140' bi-part opening protective.





VERTICAL OPENING SEPARATION

Inquiry Discussion & Questions

The following questions may be helpful:

- The size of the smoke evacuation system is based upon the calculation of total cubic footage of not only the atrium space but all spaces that open into the atrium space. Can I help you minimize this system cost by reducing the cubic footage with wide-span opening protectives at critical locations in the atrium?
- Have you considered the cost savings if eliminating all of the atrium requirements by creating a fully enclosed shaft or horizontal compartmentation in this vertical space?

Notes:

Vertical Compartmentation

Combined Code Principles from Chapters 4, 7 & 10

Protecting openings that connect multiple floors are currently addressed by the building and fire codes by way of vertical type shaft enclosures, atrium provisions or requirements relative to small floor or roof hatch type openings. In the following case studies a new technology and product application will be discussed wherein vertical compartments can be created separating any number of stories from each other. This will be accomplished by coordinating in one application the intent of the provisions found in both atrium and shaft enclosure requirements.

Fire & Life Safety Concerns

As stated in the atrium case studies, vertical spaces that are interconnected and common with each other allow heat, smoke, and hot/toxic gases to migrate throughout an entire structure.

Code Requirements

Currently the code examines vertical opening conditions in Section 712, Vertical Openings and Section 713, Shaft Enclosures. In earlier editions of the code, all vertical openings were considered under the shaft enclosure provisions only. The older Section 708.2, Shaft Enclosure included 16 exceptions, or different ways of creating vertical spaces as shaft enclosures. The 2012 edition created a new Section 712 titled Vertical Openings, wherein the old 16 exceptions in Section 708.2 were moved and edited. These items, originally written as exceptions to the shaft requirements, became stand-alone provisions defining vertical opening conditions, rather than exceptions or re-writes to strict shaft enclosure requirements. Although the fundamental content did not change, placing the shaft provisions under the title of Vertical Openings significantly affects one's perspective regarding their intended purpose. Perhaps this paradigm shift, from shaft enclosure provisions to vertical opening provisions is, in fact, a monumental shift not seen in many years! However, none of these accepted methods specifically address the exclusive use of horizontal shutters to eliminate a vertical condition. Unless an escalator opening is being protected or a door-hatch assembly is used to protect small structural openings in floors and roof assemblies, the code is vague regarding protection of vertical openings in the creation of vertical compartments.

VERTICAL OPENING SEPARATION

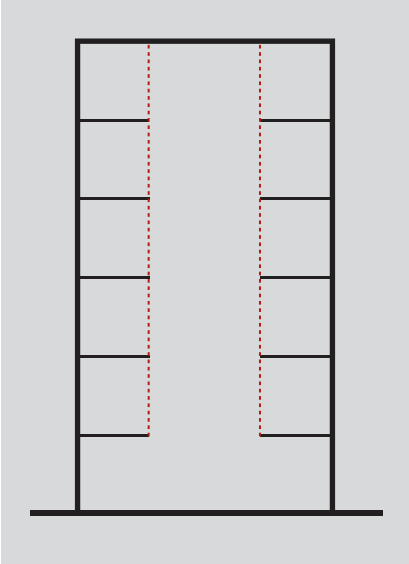


Figure 1

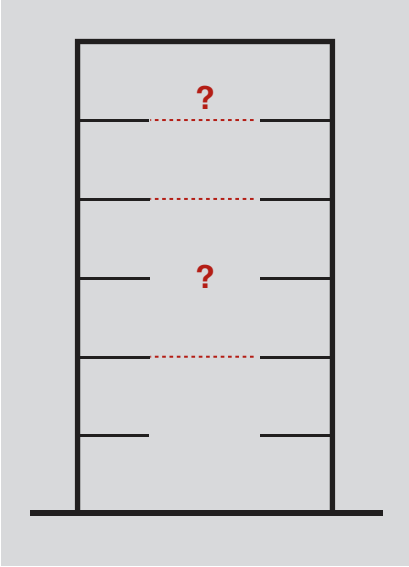


Figure 2

Figure 1, shown at the left, addresses a vertical opening condition complying with Sections 712 and 713 requirements to seal the space. Note, the atrium requirements are designed to essentially replicate this condition. By definition an atrium is a shaft enclosure.

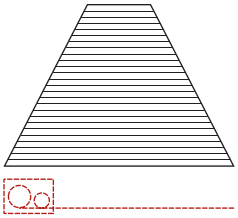
Within the current provisions set forth in Sections 712 and 713, the basic core and shell of this structure is still going to be a protected shaft. For example as shown in **Figure 2,** when one uses certain provisions of Section 404, by way of exception two floors can be common and the smoke evacuation can be eliminated from those two floors, while all the other vertical separation or atrium provisions are retained. Yet in other provisions of Sections 712 and 1019 the incorporation of an exit access stairway allows two unprotected floors common. In fact, the 2015 and 2018 editions separate exit access stairs into their own Section 1019 and in definitions in Section 202 declares exit access stairways as “a stairway within the exit access portion of the means of egress system.”

The question is, is it possible to eliminate the “vertical” open condition “horizontally” without a stair by protecting the vertical opening in the spirit of compartmentation since a structural floor was never in the original design as shown in **Figure 2,** and if so how many floors can be common? Exact code language is not found, however if the vertical opening is eliminated horizontally with a rated and hose-stream tested assembly, has the potential for migration of smoke, heat and hot/toxic gases been mitigated? The answer is a resounding yes with one important caveat. Since this configuration is defining a 2-story atrium it is critical to meet the atrium separation requirements. Section 404.6, Enclosure of atriums, specifically requires that atrium spaces be separated from adjacent spaces by 1-hour construction both vertically and horizontally. Therefore, defining atriums as 2-story spaces can be achieved with 1-hour construction only. In other words, non-hose stream tested assemblies that are limited to 20-minute ratings under UL 10B, 10C or 10D cannot be used to define an atrium in either the vertical or horizontal orientation.

VERTICAL OPENING SEPARATION

Design Solutions

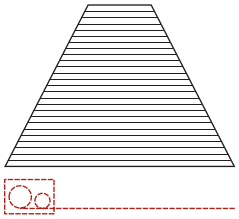
CASE 1: Horizontal (Floor) Shutter

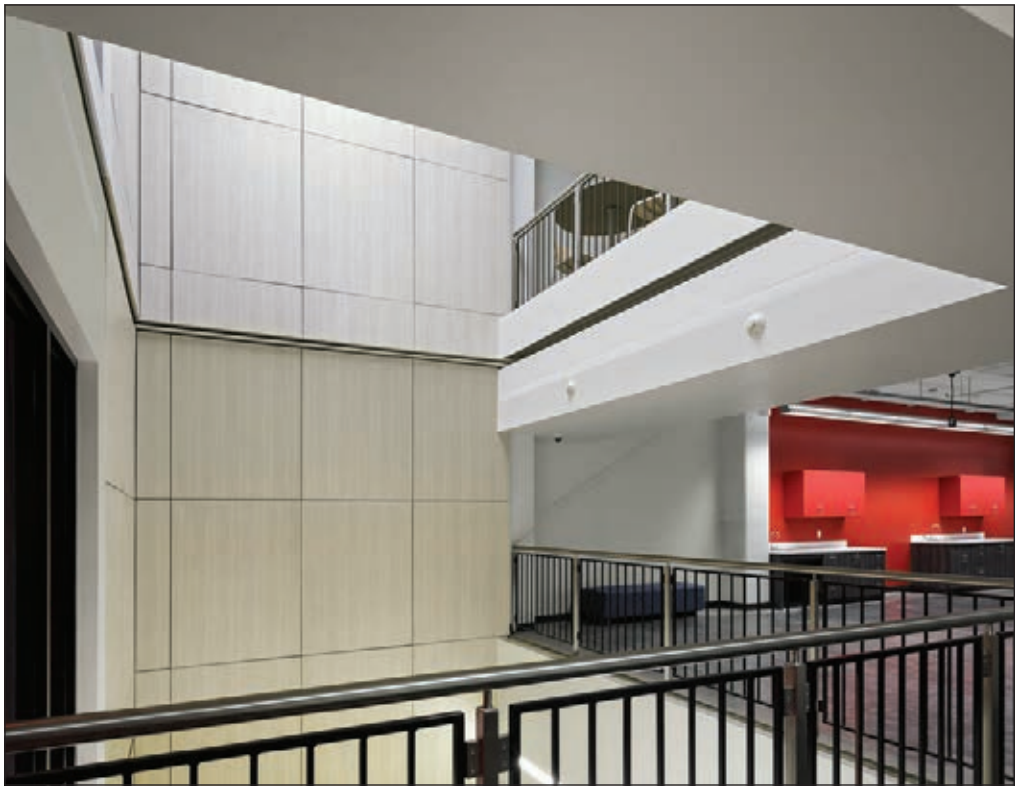


UL 10B 2-hour & UL 1784 "S" labeled, hose stream tested assembly.

VERTICAL OPENING SEPARATION

Case 2: Horizontal (Floor) Shutter

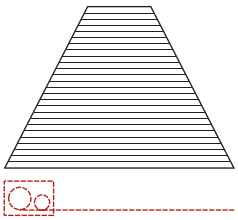


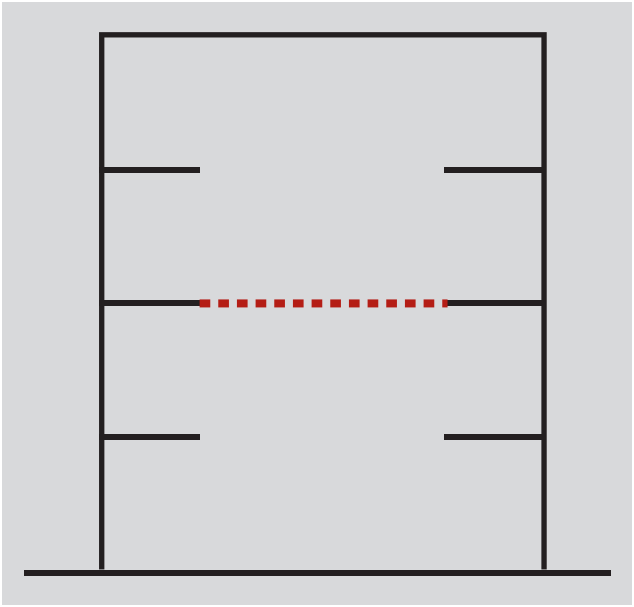


UL 10B 2-hour & UL 1784 "S" labeled, hose stream tested assembly.

VERTICAL OPENING SEPARATION

CASE 3: Horizontal (Floor) Shutter

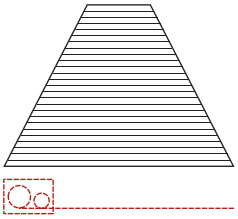


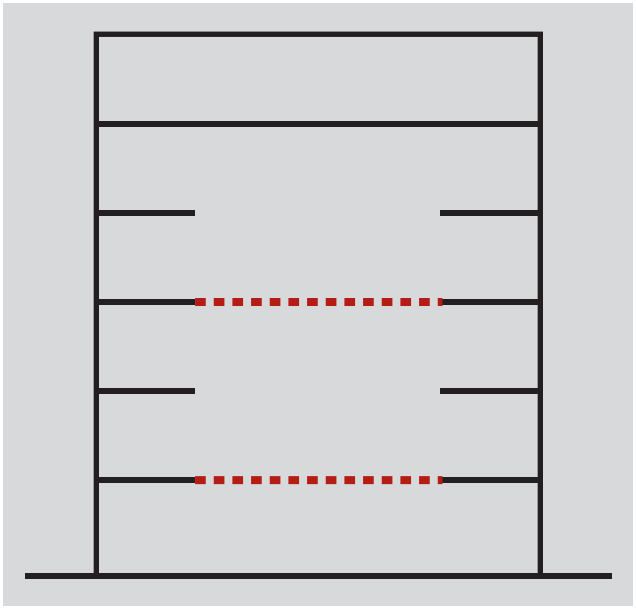


UL 10B 2-hour & UL 1784
"S" labeled, hose stream
tested assembly.

VERTICAL OPENING SEPARATION

CASE 4: Horizontal (Floor) Shutter





UL 10B 2-hour & UL 1784
"S" labeled, hose stream
tested assembly.

4 Occupancy Separation

Fundamental Guidelines

Mixed Occupancy – Accessory Use

Mixed Occupancy Use – Non-Separated vs. Separated

Fundamental Guidelines

Table 508

Most buildings are designed for multiple uses that will typically result in more than one occupancy classification. The code provides three basic options for mixed occupancies in Section 508:

1. **Accessory occupancies: Section 508.2**
2. **Non-separated occupancies: Section 508.3**
3. **Separated occupancies: Section 508.4**

Chapter 3 of the building code specifically classifies a building according to its use and occupancy. The level of fire hazard varies with specific uses and occupancies in a building. However, this level of hazard and its potential affect on the building occupants is determined not only by the use and occupancy classification by construction type, height and area size, but also the use of passive and active fire protection systems. Chapter 5 combines fire-resistance levels, construction types and occupancy types to determine size and height limitations as well as separation requirements.

Increased fire resistance of the structural members of the building along with increased active and passive fire protection systems permits greater height and area allowances. Notwithstanding, the use and occupancy of the structure will become a determining factor regarding the extent of separation and compartmentation required. For example, a “B” (business occupancy) is allowed occupant load floor area to be calculated at 100 gross sq. ft. per occupant. However, a group “I-2” occupancy (hospital) which is a similar occupant load as far as quantity of people, is required to be calculated at 240 gross sq. ft. per occupant, more than double that of a “B” occupancy. The difference between these requirements is the use of the facility. Occupants in a hospital need better protection for a greater amount of time because they are non-ambulatory and most are dependent upon others for mobility or even life support. Therefore, the fire and life safety requirements designed to help protect building occupants are very different for each of these occupancies.

When buildings are designed as mixed occupancies there is a concern because basic fire and life safety requirements are being

mixed within the same structure. Three basic options to eliminate confusion and ensure building occupant safety are outlined as follows:

Accessory Occupancy:

1. Accessory occupancies are those which are different from the main occupancy but ancillary to or a portion thereof. *(508.2)*
2. Aggregate accessory occupancies shall not occupy more than 10% of the area of the story. *(508.2.3)*
3. Aggregate accessory occupancies shall not exceed the tabular values in Table 506.2 without height and area increases. *(508.2.3)*
4. Accessory occupancies shall be individually classified in accordance with Section 302.1. *(508.2.1)*

Non-Separated Use:

To consider spaces under the Non-Separated Use requirements, the following must be met allowing NO separation between occupancies:

1. Each occupancy use shall be individually classified. *(508.3.1)*
2. Code requirements shall apply to each portion of the building based upon the occupancy classification of the space under consideration. *(508.3.1)*
3. The most restrictive applicable provisions of Section 403 and Chapter 9 shall apply to the building or portion thereof in which the non-separated occupancies are located, Section 403 in hi-rise and Chapter 9 in all others.
4. The allowable building area and height of the building or portion thereof shall be based on the most restrictive allowances for the occupancy groups under consideration for the type of construction of the building in accordance with Section 503.1. *(508.3.2)*

Separated Use:

The following requirements under the provisions of Separated Occupancies will bring these spaces into compliance without compromising design if separated with fire barrier walls according to Table 508.4:

1. Separated occupancies shall be classified in accordance with Section 302.1. *(508.4.1)*
2. Each separated space shall comply with the code based upon the occupancy classification of that portion of the building. *(508.4.1)*
3. In each story, the building area shall be such that the sum of the ratios of the actual building area of each separated occupancy divided by the allowable building area of each separated occupancy shall not exceed 1. *(508.4.2)*
4. Each separated occupancy shall comply with the building height limitations based on the type of construction of the building in accordance with Section 503.1. *(508.4.3)*

Mixed Occupancy – Accessory Use

Section 508.2

Post grade 12 educational occupancies are typically classified as "B" occupancies and usually incorporate mixed occupancies that are often considered accessory – full service kitchens and cafeterias (A-2), assembly areas (A), and dormitories (R-2) occupancies. Even though these spaces are ancillary to and a functional portion of the original larger occupancy they must be separated when they exceed the 10% rule.

Fire and Life Safety Concerns

In this case study we will examine the potential fire and life safety threats posed due to the use of open flames, combustible gases and solids, and exhaust hood extinguishing systems. These kitchens (A-2) are often common with other areas (B or R-2) in the facility potentially exposing large groups of building occupants to the associated hazards. In these cases and similar situations, where the spaces are greater than 10%, separation is required.

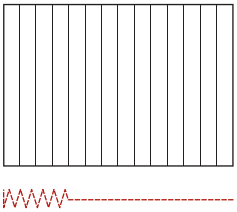
Code Requirements

Table 508.4 in Chapter 5 provides the requirements for separation of occupancy types. Should an accessory occupancy exceed the 10% rule, this table becomes the determining factor. Since the separation must be a fire barrier wall *(508.4.4.1)*, Table 508.4 requires a 1-hour separation between an "A" and "B" occupancy or "R" and "B" occupancy when the building is fully sprinklered and 2-hour in non-sprinklered buildings.

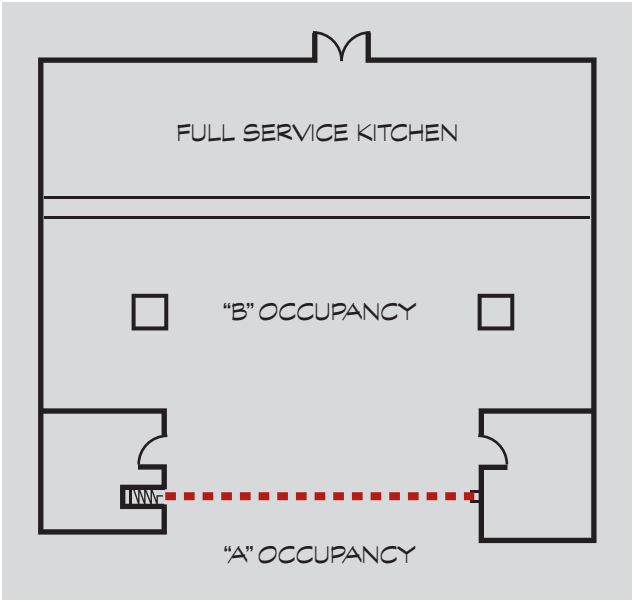
OCCUPANCY SEPARATION

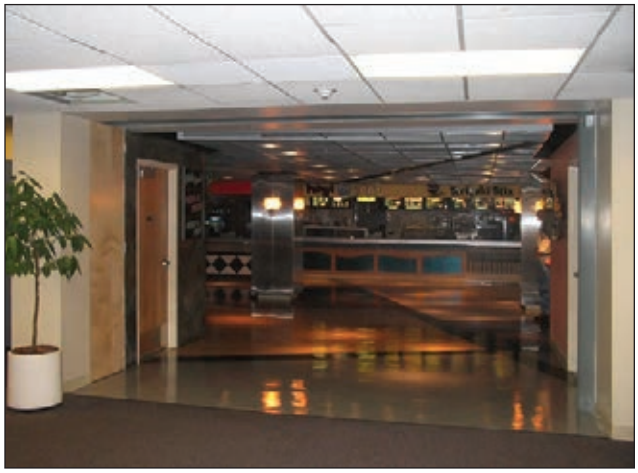
Design Solutions

CASE 1: Side Acting Accordion with Power-assisted Egress



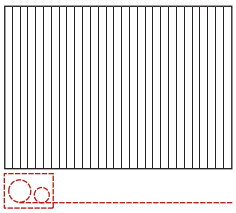
This first case study examines the use of the McKEON Side Acting Accordion fire door. The assembly is hidden from view unless there is a fire when it is activated by the smoke detector. Egress is accomplished by compliance to 1010.1.4.3.





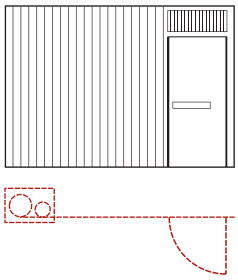
OCCUPANCY SEPARATION

CASE 2: Side Coiling without Egress

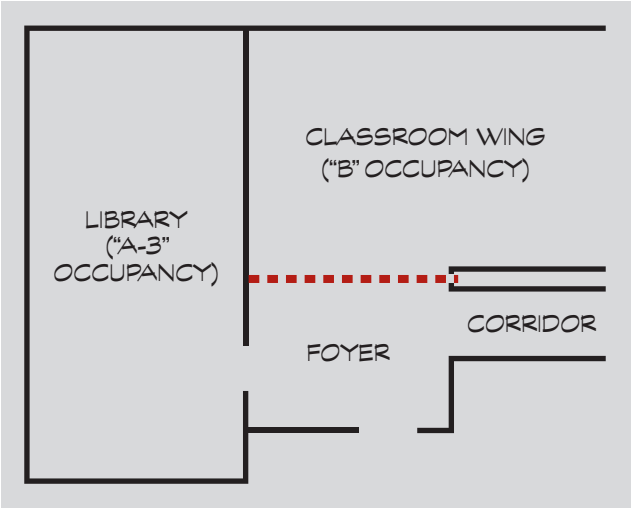


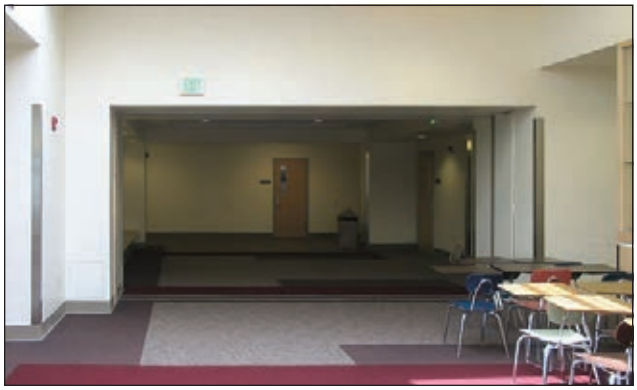
This case study is very similar to the previous application with the exception of an egress requirement. The McKEON side coiler without egress became the most economical solution without compromising life safety.

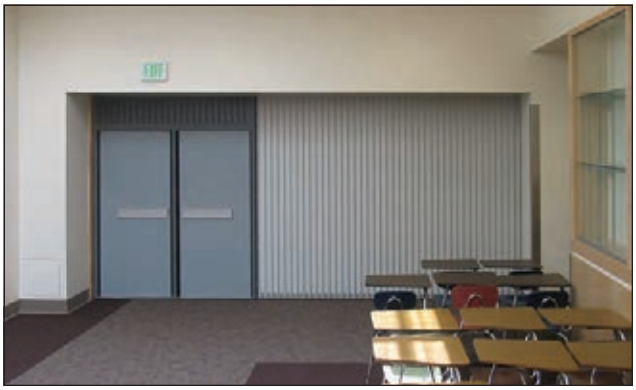
CASE 3: Side Coiling with Complying Swing Egress Door(s)



This third case study features a different product under the same code premise, the requirement to separate an “A-3” occupancy (library) from the rest of the “B” occupancy, school. The feature product is the Side Coiling with Conventional Egress Assembly due to limited width of pocket space.







Inquiry Discussion and Questions

The 10% rule mentioned before refers to an area limitation imposed upon aggregate accessory occupancies. As stated in Section 508, aggregate accessory occupancies are allowed, however specific restrictions apply as detailed on page 65 of this section.

The following questions may be helpful:

- What is the classification of a full-service kitchen within an occupancy type “B” structure?
- Do you perceive a full-service kitchen that requires a Type 1 exhaust hood extinguishing system as per the International Fire Code (IFC, Section 610.2 & IBC 904.2.1) as a potential threat to the students?
- When you are required to separate the kitchen from the rest of the space are you concerned about easy access and traffic flow in front of the serving area?
- Would it be more convenient for your client to have the wide-span opening protective located in front of the serving area, separating the kitchen space, to also act as a security door when the kitchen is not in use?

Notes:

Mixed Occupancy Use – Non-Separated vs. Separated

Section 508; Table 508.4

Complying with Table 508.4 and providing fire barrier walls to separate occupancies can be limiting to the design. Also, using non-separated provisions to eliminate restrictive fire barrier walls becomes extremely costly due to added fire and life safety requirements that affect the entire structure.

Fire & Life Safety Concerns

Building structures are classified based on their occupancy and use. The purpose for classifying structures is to configure optimum safety requirements commensurate to the need as dictated by each individual use. These areas of concern are general building limitations, means of egress, fire protection systems and interior finishes. The challenge comes when buildings contain rooms or spaces that are different than the original building occupancy classification thereby creating a mixed use or mixed occupancy structure.

Code Requirements

In this case study the Conference/Training room is 1,188 square feet with an occupant load of 79. It is classified as an A-3 occupancy located in a 5-story Group B office building of Type IIIA construction. The conference room is classified as an A-3 because it is used for gathering a large number of people for assembly purposes (Section 303.1). It cannot be considered an accessory space because it exceeds both occupant load and area square footage of the accessory use exceptions.

First, let's look at the requirements imposed if we attempt to eliminate all separations as indicated in Table 508.4, in other words non-separated use.

Non-Separated Use:

1. Each use shall be individually classified. *(508.3.1)*
    - The entire building is classified as a "B" occupancy. The

space under consideration (Conference/ Training room) is an A-3 occupancy.

2. The allowable building area and height of the building or portion thereof shall be based on the most restrictive allowances for the occupancy groups under consideration … *(508.3.2)*

3. The most restrictive applicable provisions of Section 403 and Chapter 9 shall apply to the entire building or portion thereof. *(508.3.1)*

    - Section 403 encompasses the requirements for hi-rise construction and Chapter 9 include the provisions for fire protection systems. In other words, the building will have to incorporate the most protective and restrictive requirements of these chapters. For example:

        - Standpipe system *(403.4.3)*

        - Smoke detection *(403.4.1)*

        - Fire Alarm systems *(403.4.2)*

        - Emergency voice/alarm communication system *(403.4.4)*

        - Fire command *(403.4.6)*

        - Smoke removal *(403.4.7)*

        - Emergency responder radio coverage *(403.4.5)*

        - Standby power *(403.4.8)*

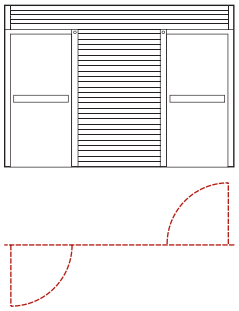
        - Emergency power systems *(403.4.8.4)*

4. The allowable height and area of the building or portion thereof shall be based on the MOST RESTRICTIVE allowances for the occupancy group under consideration for the types of construction of the building in accordance with Section 503.1. *(508.3.2)*

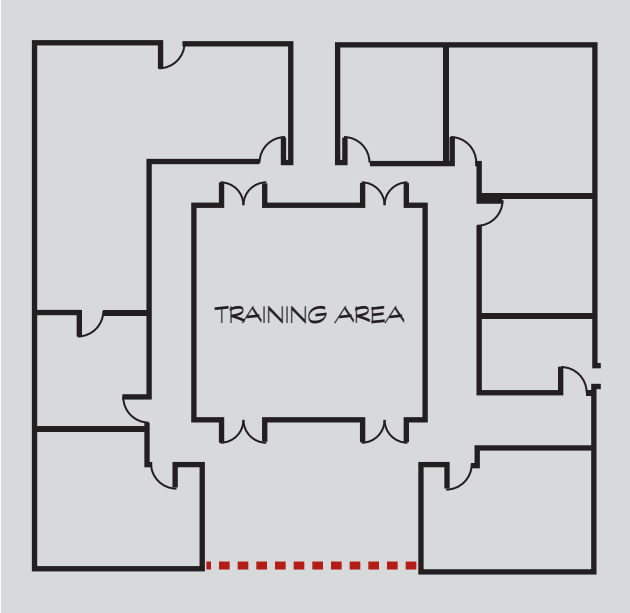
    - The height and area allowances for this requirement would not allow the building to be five stories. Most likely only three at best.

Design Solutions

CASE 1: Vertical Coiling with Complying Swing Egress Door(s)

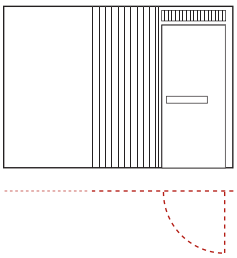


The use of wide span opening protectives enables occupancy separation without compromising open and spacious design. In this case study a simple deployable separation prevents the overall structure from being subject to the most restrictive provisions of non-separated use.

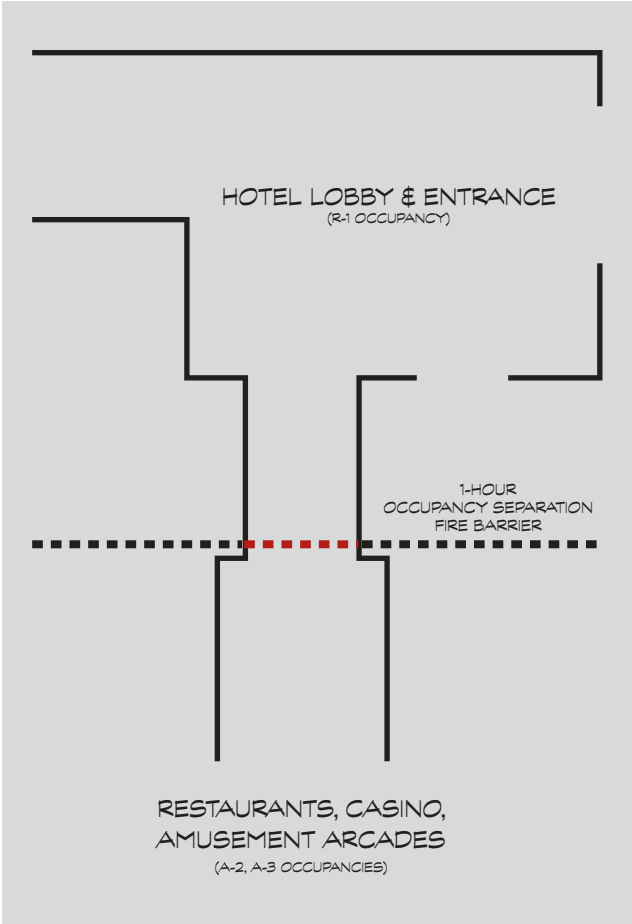


OCCUPANCY SEPARATION

CASE 2: Side Acting with Complying Swing Egress Door(s)

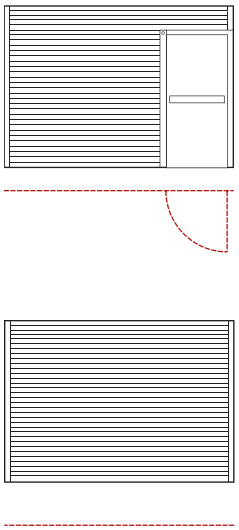


This case study is a text book example of occupancy separation, but is very unique in product application problem-solving from an architectural perspective. Pocket space was limited in width, but not depth, and headroom was extremely limited. Given the ambiance of the space, conventional swing doors on magnetic hold-opens were not an option. McKEON provided the S7000 series which requires only a 7" pocket width and no more than a 2 1/4" reveal in the ceiling for the head track. With patented side acting technology the entire assembly, incorporating four conventional swing doors, fits into a narrow space parallel to the fire barrier wall. Upon command of the smoke detector the 3-hour assembly slides into place providing occupancy separation and conforming egress.

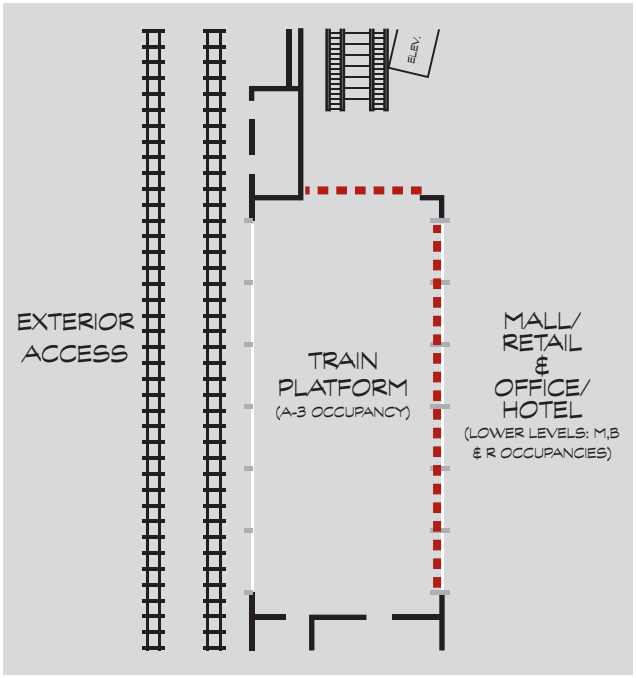


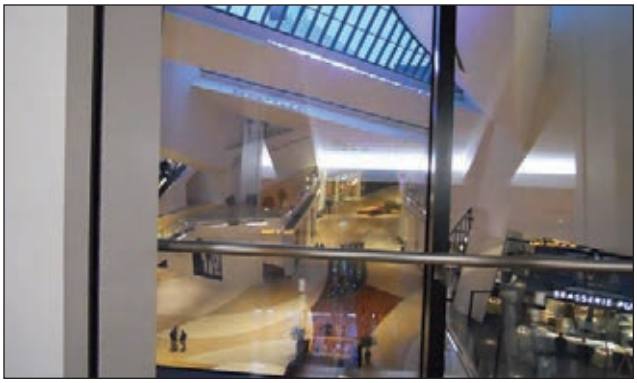
OCCUPANCY SEPARATION

CASE 3: Vertical Coiling with Complying Swing Egress Door(s) & Vertical Coiling without Egress



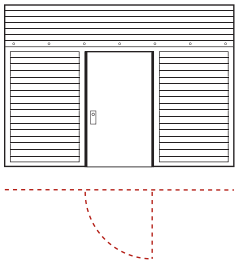
In this case study McKEON offers a solution to a difficult challenge by providing two different products within the same space. A combination of six fire-rated vertical rolling shutters installed on a diagonal path of travel and one vertical coiling assembly with conventional egress for exiting from the space. This solution preserves the beauty of the space without compromising mixed occupancy separation requirements.



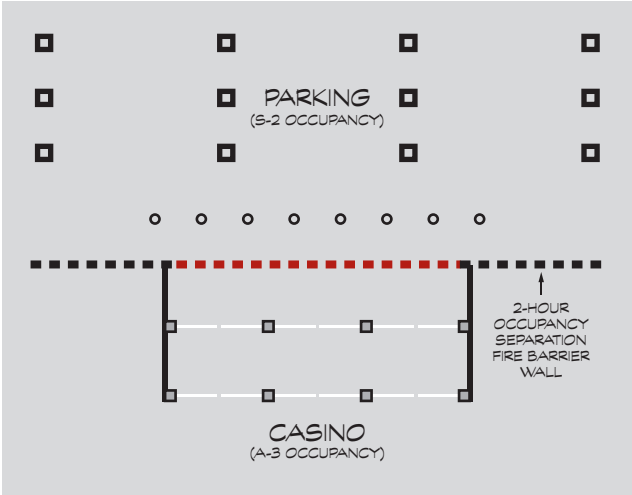


OCCUPANCY SEPARATION

CASE 4: Vertical Acting with Complying Swing Egress Door(s)



This application illustrates McKEON's capacity to provide 3-hour separation, conforming to a large occupant load exit width without occupying side stacking space. Deploying only in case of fire or emergency, both egress and fire separation requirements are satisfied without compromising design.



Inquiry Discussion and Questions

Fundamentally, separating the interior of buildings with fire barriers wherever occupancies change as required in Table 508.4 is simple and straightforward. However when designs promote mixed occupancies without separation, the code is left to create alternate means of protection to compensate for the loss of fixed barriers. Hence, in the absence of passive redundant systems, code enforcement becomes a tremendous challenge and the non-separated use provisions govern. These provisions are extremely costly.

The following questions may be helpful:

- Are you frustrated because open design is difficult when incorporating fire barrier walls as occupancy separations?
- Can I show you how wide-span opening protectives can eliminate the need to design non-separated structures?
- Have you considered the additional cost incurred by conforming to the non-separated use requirements?
- Do you really want to impose the most restrictive requirements of Chapter 4, Section 403 hi-rise provisions as well as the most restrictive requirements of Chapter 9 on the entire building?

Notes:

5 Area Separation

Allowable Area

Allowable Area

Section 706; Tables 504.3, 504.4, 506.2

The allowable height and area of a building structure is determined largely by two basic factors; first, the combustibility of its structural materials and second, occupancy type or use and purpose of the building. When a building design exceeds the established values, the intent of the code is to create another separate building structure to incorporate the increase. Since this is not always desirable, the code will allow interior fire walls to serve as separations sufficient to consider each space a separate structure within the tabular value allowance. In essence multiple compliant buildings can be created within the same structure and under a common roof.

Fire & Life Safety Concerns

Building height and area are calculated to accommodate three fundamentals principles in fire and life safety. First, the structural elements, rated or non-rated, are intended to maintain structural integrity during fire and other life threatening emergencies. This means the greater the protection of the structural elements, the larger the height and area. Second, additional height and area are allowed when active fire suppression systems such as sprinklers are used. Finally, passive redundant elements are used to compartmentalize the area and provide protection for building occupants as they egress the structure. Rated construction protects the structural elements, sprinklers protect the building contents, and egress protects building occupants by removing them from harm's way. All three principles overlap and work together to ensure a building occupant has adequate time to safely exit the structure. The reduction or absence of any of these components can compromise the safety of building occupants and cause property damage.

Another concern is the size of openings allowed in the passive redundant system, particularly in fire walls that are crucial to the area limitations. Opening size limitations are imposed to maintain the integrity of the wall during fire conditions. Opening protectives inherently accommodate strict requirements to adequately protect and maintain the integrity of the openings. The structural integrity of the fire wall must be maintained regardless of the wall opening size or its opening protective. It is critical to remember; the opening protective protecting an opening in a fire wall is not required to conform to structural integrity provisions. The opening protective is protecting the opening – NOT the wall. A fire wall used for area separation is allowed openings and opening protectives, however, a fire wall used as a party wall cannot have openings.

Code Requirements

1. The above referenced tables of Chapter 5 indicate the tabular height and area allowances for specific building construction types and occupancies.
2. Each portion of a building separated by one or more fire walls shall be considered a separate building. (*503.1)*
3. Openings in fire walls are subject to the following criteria *(706.8):*

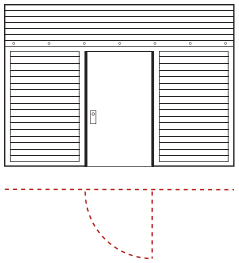
Non-sprinklered buildings – Openings shall not exceed 156 square feet and the aggregate width of openings at any floor shall not exceed 25 percent of the length of the wall.

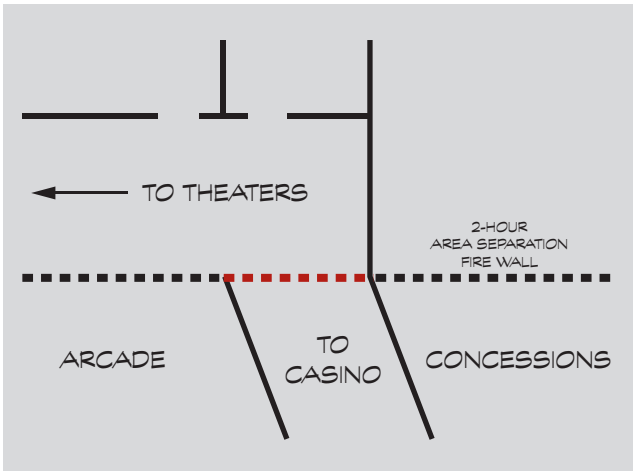
Sprinklered buildings – Openings shall not be limited to 156 square feet and the aggregate width of openings at any floor shall not exceed 25 percent of the length of the wall.

AREA SEPARATION

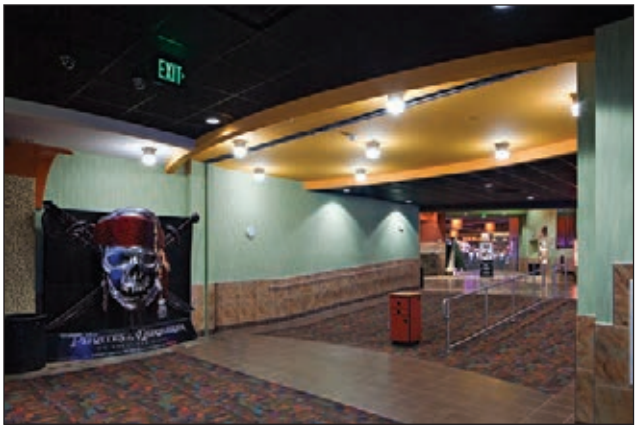
Design Solutions

CASE 1: Vertical Acting with Complying Swing Egress Door(s)



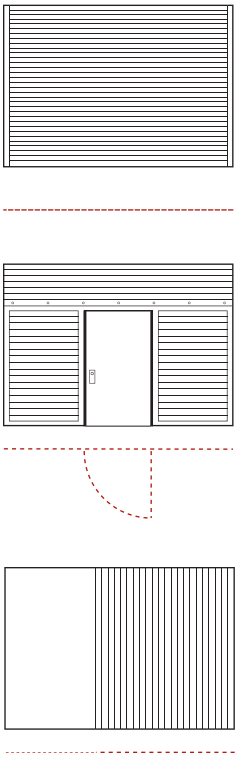


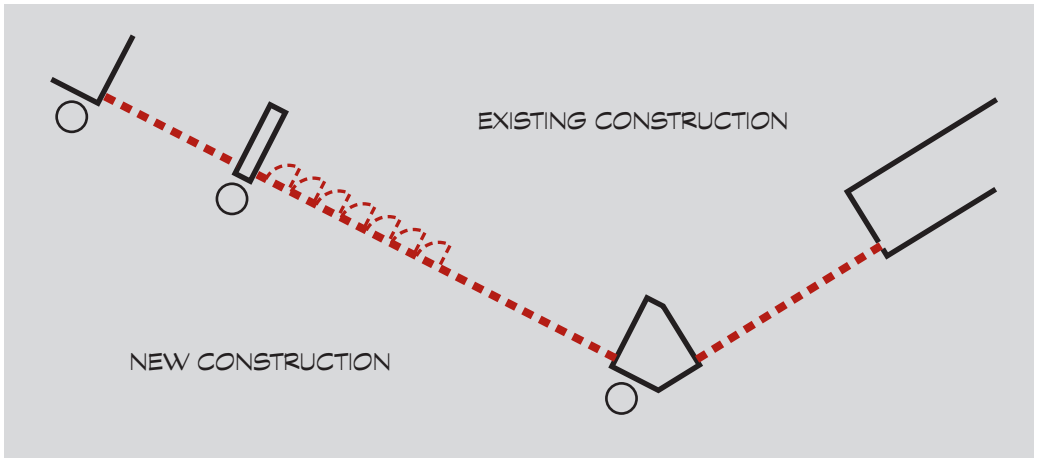
In this application McKEON resolved two significant design code compliance problems without sacrificing wide span open appearance. First, nearly the entire opening was necessary to meet the exit width requirements located in the primary means of egress system in an “A” occupancy. Using the McKEON accordion assembly would not comply because of a) the large distance to be covered and b) the length of time required to open wide enough to allow for immediate egress. Second, there was not sufficient stacking space for any of the McKEON side acting models. However, because headroom was plentiful and large occupant load egress was a necessity, the T5000 series incorporating six egress conventional swings doors, three doors set in each direction to accommodate dual egress, was the perfect fit and the only viable solution.

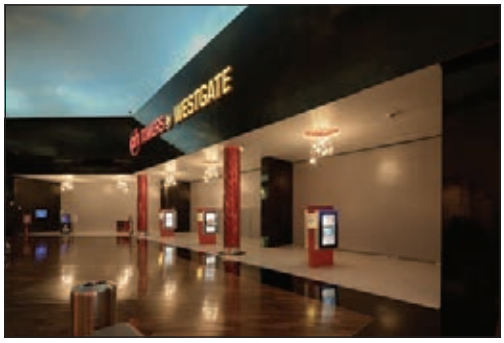


AREA SEPARATION

CASE 2: Vertical Coiling without Egress, Vertical Acting with Complying Swing Egress Door(s) & Side Acting without Egress







Inquiry Discussion and Questions

The decision to use the area separation strategy is determined early in the conceptual design phase of the project.

Resistance to incorporate fire walls may be due to the following:

- Limited understanding of the code allowances for considering one structure as multiple buildings.
- The structural integrity of the fire wall design appears costly and overwhelming compared to the basic design; i.e. parapets, return exterior walls, etc.
- Limited understanding of diverse wide-span opening protectives. Conventionally, openings in any wall seem to follow the swing door model, largely due to the perception that complying egress is limited to these kinds of doors and mullions. This traditional way of traversing throughout the building is very limiting and simply prohibitive to open design.

The following questions may be helpful:

- Have you ever been frustrated designing a structure because you exceeded the area allowances and were pushed to increase the construction type?
- When you are required to change a construction type to accommodate additional area, what is the increase in cost? How does your client feel about the increase?
- Are you hesitant to consider an area separation wall because of the limitations for openings as implied with conventional swing doors?

Notes:

6 Corridor Separation

Corridor Separation – Healthcare

Corridor Separation – Healthcare

Section 407.2.4

Gift shops focus on retail exposure to the public. Nonetheless they are located in hospitals and typically open to corridors that fall under strict provisions for life safety. Compliance with these strict provisions using conventional opening protectives can limit market exposure.

Fire & Life Safety Concerns

The corridor system in a hospital is designed to protect non-ambulatory patients and their attendants from the transfer of smoke from adjacent spaces. Gift shops and their associated storage offer a particular threat because of the potential fuel load created by large quantities of merchandise. The smaller the shop the lesser the threat of contents that are burning during a fire emergency, so the code requires no separation at the corridor opening of a gift shop if the square footage in minimal.

Code Requirements

Gift shops are allowed to be open to the corridor where the total square footage does not exceed 500 square feet. *(407.2.4)*

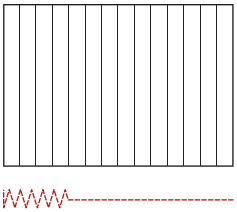
To better understand the opening protective requirements let's review the corridor provisions for I-2 occupancies (hospitals).

1. The corridor wall shall be constructed as a smoke partition. *(407.3)*
2. Smoke partitions are not required to be fire-rated. *(710.3)*
3. Doors protecting openings in smoke partitions in I-2 occupancies are as follows:
   - Non-fire-rated. *(407.3.1)*
   - Not required to be self-closing or automatic-closing. *(407.3.1)*
   - Must be positive latching. *(407.3.1)*
   - Shall provide an effective barrier to limit the transfer of smoke. *(407.3.1)*
   - Must be a smoke and draft control door listed under UL 1784. *(710.5.2)*

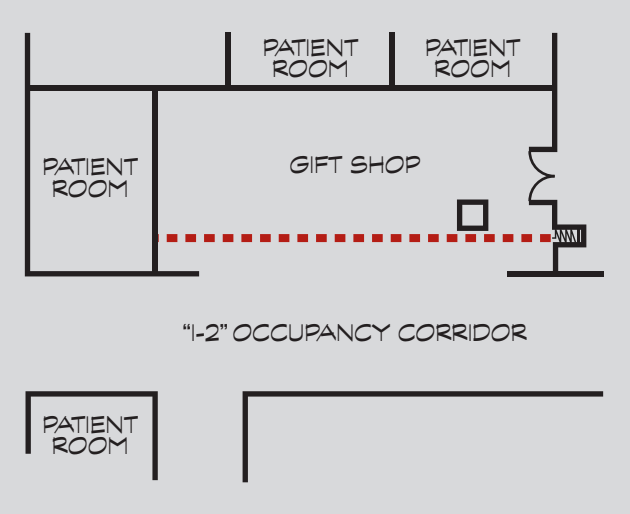
CORRIDOR SEPARATION

Design Solutions

CASE 1: Side Acting Accordion with Power-assisted Egress

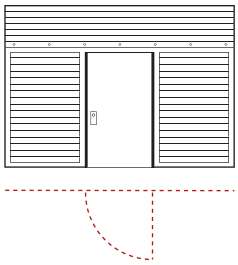


Incorporating the McKEON wide-span side acting accordion allows this space to be open for business without restricting view into the gift shop or customer access. At the command of a smoke detector the large width opening is rapidly protected and the fire and life safety corridor provisions are not compromised.



CORRIDOR SEPARATION

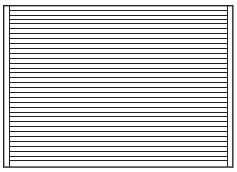
CASE 2: Vertical Acting with Complying Swing Egress Door(s)



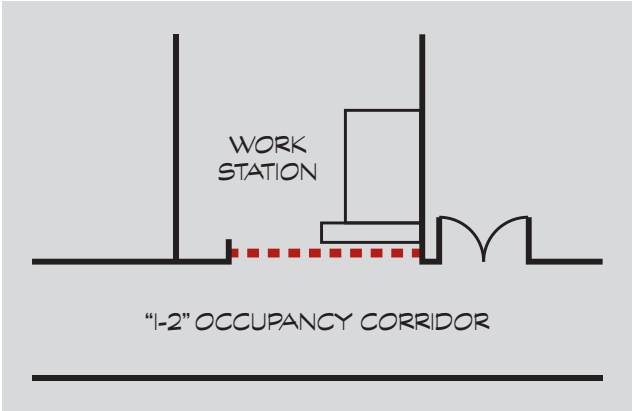
Incorporating the McKEON T5000 technology, the egress doors are completely concealed in the vertical space above, to close only in case of fire.

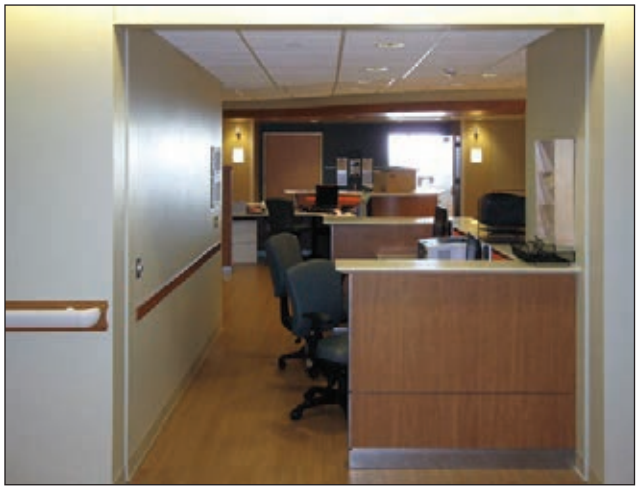
CORRIDOR SEPARATION

CASE 3: Vertical Coiling without Egress



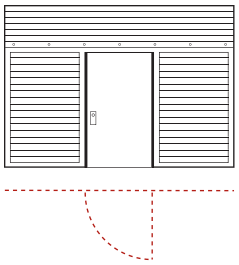
Egress is not required but a 2-hour fire rating is. This work station is left open during normal business hours. The protective assembly is easily lowered and locked after hours. Completely automated, whether in fire or security mode, any building occupant can operate the assembly.



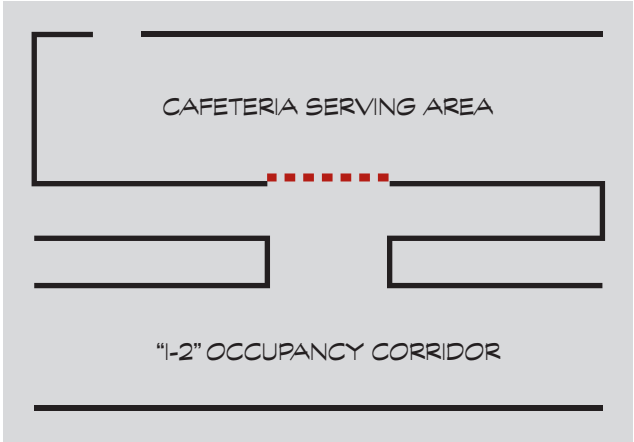


CORRIDOR SEPARATION

CASE 4: Vertical Acting with Complying Swing Egress Door(s)

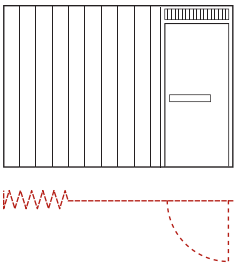


In this unique application, the McKEON T5000 technology, with integral code complying conventional egress doors, descends from the overhead space when the building goes into alarm. During normal business hours cafeteria patrons easily traverse the space from the corridor without obstruction.

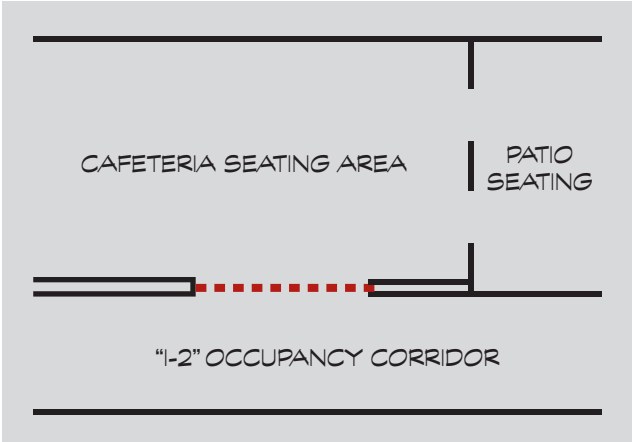


CORRIDOR SEPARATION

CASE 5: Side Acting Accordion with Complying Swing Egress Door

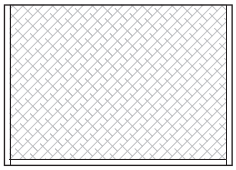


The McKEON accordion technology easily accommodates a conventional egress door.

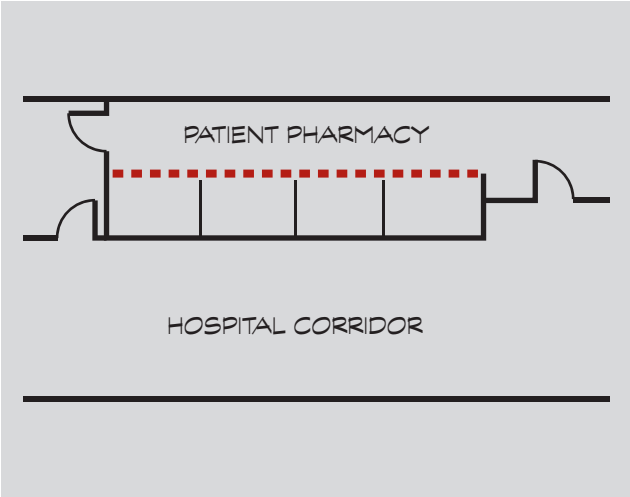


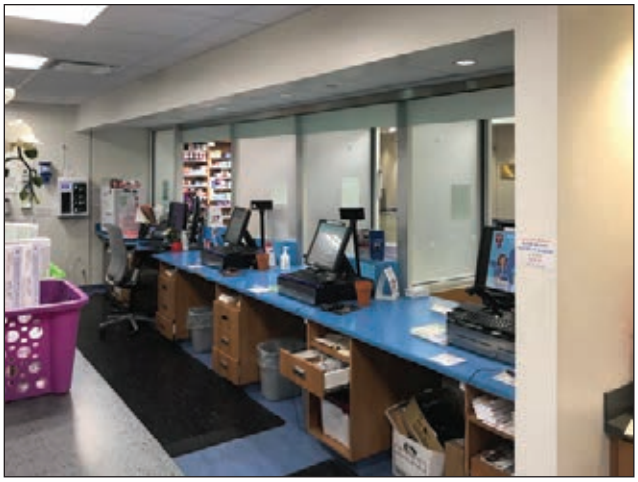
CORRIDOR SEPARATION

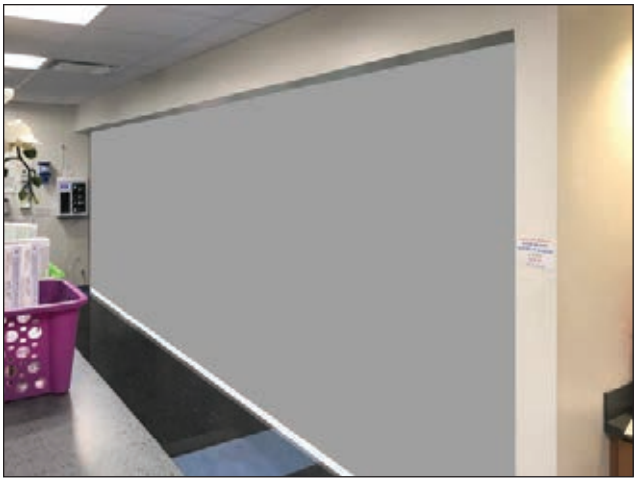
CASE 6: Vertical Acting without Egress



In I-2 occupancies corridor walls are required to be smoke rated only (Section 407.3). The SmokeFighter® D150 is an excellent resolve to minimal headroom space allowances. This hospital patient pharmacy is easily separated from the corridor with one of the latest technologies offered by McKEON.



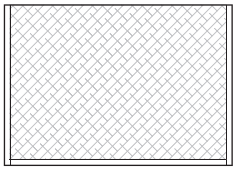




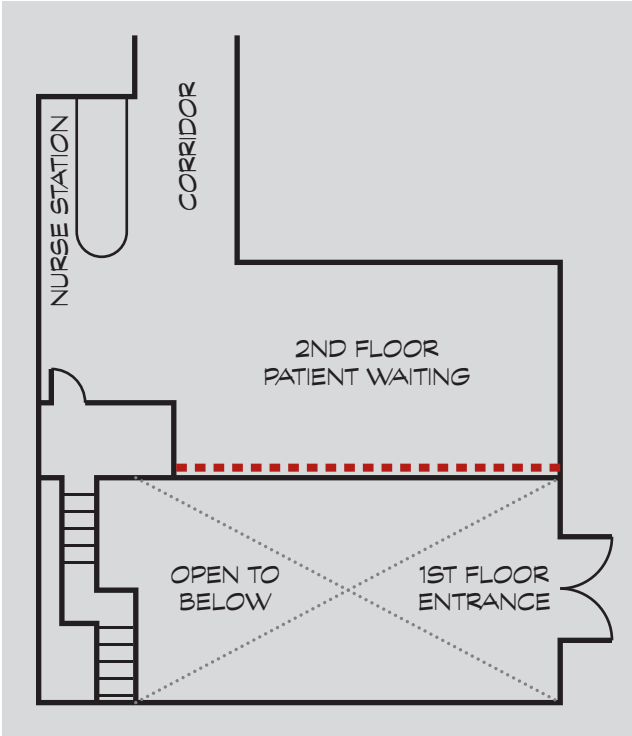
SIMULATION

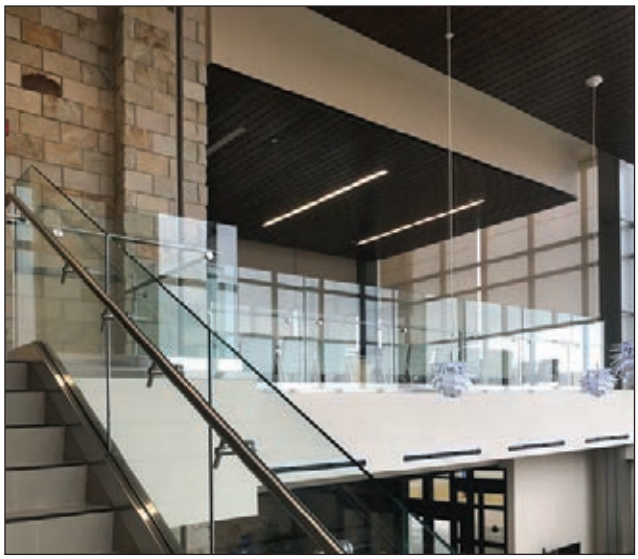
CORRIDOR SEPARATION

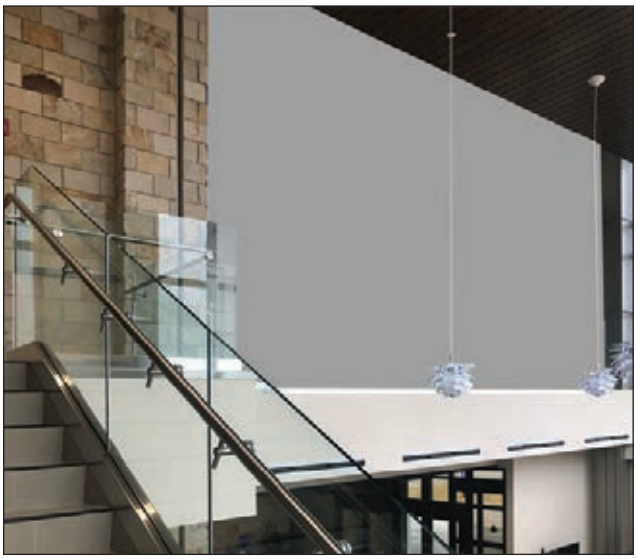
CASE 7: Vertical Acting without Egress



In I-2 occupancies the corridor walls are required to be smoke rated only (Section 407.3). Section 712.1.9 also instructs the design team that 2-story unprotected openings are not allowed in these same "I" occupancies. McKEON provides a unique solution to this challenge with the SmokeFighter® D150. This smoke rated curtain is deployable and will only close when the building goes into emergency alarm. During normal business hours the entire 2-story space is free of any visual obstacles.





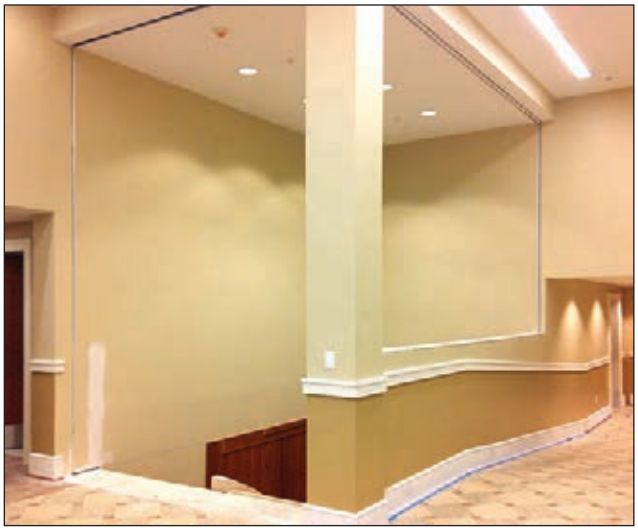


SIMULATION

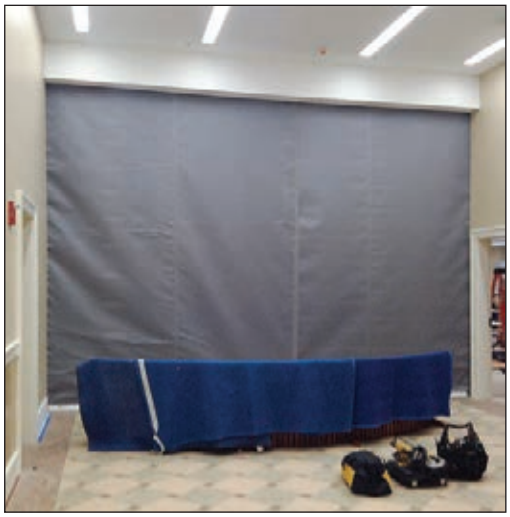
CORRIDOR SEPARATION

CASE 8: Vertical Acting without Egress

In this case study we will examine the requirements of the R-2 occupancy (congregate living facility with more than 16 occupants) pertaining to corridor rating and vertical space allowances. All corridors are required to be constructed of fire rated walls with a minimum rating of 30 minutes (1020.1). Also, these “R” occupancies cannot have unprotected 2-story openings (712.1.9, #4). These requirements can be challenging when spacious open designs are desired. Because the opening protectives for these walls can be rated 20-minutes (716.5.3), the McKEON FireFighter® D200 is the perfect solution. Take a look, too, at CASE 9. It is right across the hall!



CASE 9: Vertical Acting without Egress



Inquiry Discussion & Questions

A gift shop space is considered a potential fire hazard when it exceeds 500 square feet. Most designs will limit this space to 500 square feet or incorporate sheet rock, swing doors and wire glass to accommodate greater area spaces that open to the corridor. During a fire event, deployed wide-span opening protectives seal off large fuel load areas – such as gift shops that exceed 500 square feet – and protect building occupants who are moving through corridors. These assemblies can also serve as security doors when the gift shop is closed.

The following questions may be helpful in understanding pertinent challenges:

- Do you desire to have a gift shop larger than 500 square feet?
- Even though a gift shop, larger than 500 square feet, is not shown on Table 509 as an incidental use space … why is it required to be separated with 1-hour construction?
- May I show you how McKEON can help you eliminate a closed-in appearance at the corridor bordering gift shops exceeding 500 square feet in area?

Notes:

7 Smoke Compartmentation

Smoke Compartments – Healthcare

Smoke Barriers – Healthcare

Smoke Compartments – Healthcare

Section 407

The compartmentation requirements in these case studies are unique to hospital occupancies and are driven, for the most part, by means of egress provisions.

Fire & Life Safety Concerns

The code allows patient rooms to be arranged in open suites. However, this type of arrangement supposes a low patient-to-staff ratio where the staff is directly responsible for the safety of the patients in the event of a fire. To ensure safety, small smoke compartments with short-distance egress to protected exits become critical.

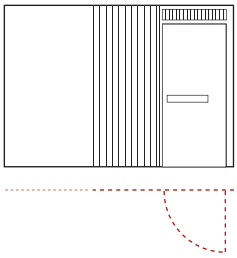
Code Requirements

1. Habitable rooms or suites in Group I-2 occupancies shall have an exit access door leading directly to a corridor. *(407.4.1)*
2. Care suites containing patient sleeping rooms shall not exceed 7,500 square feet, sprinklered areas with automatic smoke detection,10,000 square feet. *(407.4.4.5.1)*
3. Care suites containing other than patient sleeping rooms shall not exceed 12,500 square feet, sprinklered 15,000 square feet. *(407.4.4.6.1)*
4. Any patient sleeping room, or any care suite that includes patient sleeping rooms, of more than 1,000 square feet shall have at least two exit access doors remotely located from each other. *(407.4.4.5.2)*
5. Any room or suite of rooms other than patient sleeping rooms of more than 2,500 square feet shall have at least two access doors remotely located from each other. *(407.4.4.6.2)*
6. Travel distance between any point and an exit access door in a room not located in a care suite shall not exceed 50 feet. *(407.4.2)*

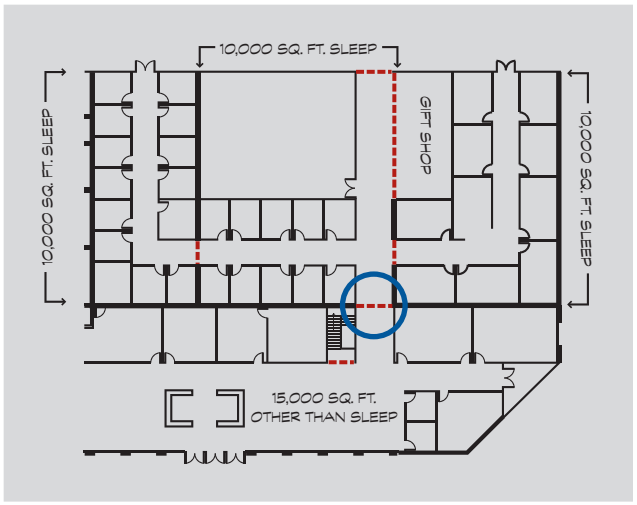
7. Travel distance between any point in a suite of sleeping rooms shall not exceed 100 feet, automatic smoke detection 125 feet. *(407.4.4.3)*
8. Vision panels are required in cross-corridor application of I-2 occupancies. *(709.5.1)*
9. Walls designed to create separate suites shall be construction as non-rated smoke partitions. *(407.4.4.2)*
10. Openings within smoke compartment walls that are not used to protect a vertical opening or an exit are not required to have a fire-rating but shall provide an effective barrier to limit the transfer of smoke. Also, these opening protectives do not have to be self-closing. *(Section 407.3.1)*

Design Solutions

CASE 1: Side Acting with Complying Swing Egress Door(s)

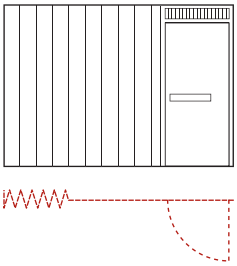


In this case study we find it difficult to maintain continuity with compartmentation when passing through corridors or other open areas with smoke partition walls. With the wide-span capabilities of the McKEON door assembly there is no compromise between building functionality and code compliance.

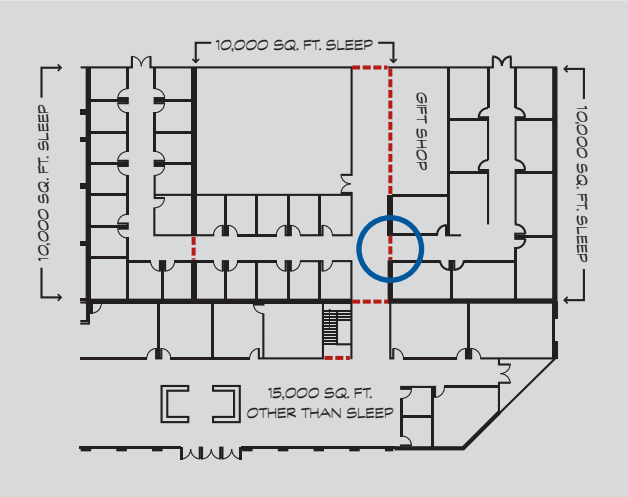


SMOKE COMPARTMENTATION

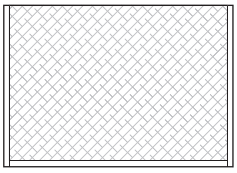
CASE 2: Side Acting Accordion with Complying Swing Egress Door



This side acting accordion offers conventional egress with a swing door attached to wide panels that provide a compact profile for less stack space.



CASE 2: Vertical Acting without Egress



Designing care suites, particularly critical units in large hospitals, can be challenging when complying with restrictive smoke compartment provisions. The maximum area limit in care suites containing patient sleeping rooms with sprinklers and automatic smoke detection is 10,000 square feet. This case study features a critical suite that far exceeds these limits. The SmokeFighter® D150 came to the rescue and provided necessary separation where head room was limited and side room would only allow for very discreet side guides.

SIMULATION

Inquiry Discussion and Questions

Often more desirable floor plans will be compromised to accommodate smoke compartmentation requirements. Rooms become smaller, corridors often inhibited with opening protectives, nurses stations altered, etc. to create life-saving smoke free spaces. Most often these adjustments become routine without an understanding of wide span opening protective technology.

The following questions may be helpful:

- May I show you how a smoke compartment separation can cross a corridor without compromising the space?
- Did you know that a side acting accordion door can be used in a means of egress across a corridor regardless of the occupant load served?
- Smoke compartments are no respecter of open spaces. Can I show you how you can span virtually any distance without compromising the space?

Notes:

Smoke Barriers – Healthcare

Section 709

Smoke barriers divide areas of a building into separate smoke compartments. These dividing walls allow building occupants time to be evacuated or relocated to other smoke compartments. In other words, smoke barriers separate portions of buildings into areas of refuge capable of resisting the passage of smoke and fire for 1 hour. ***(Section 709)***

Fire & Life Safety Concerns

Smoke barriers are specifically required in I-2 (hospital) occupancies due to the non-ambulatory status of the building occupants (Section 407.5). Usually these occupants require assistance and care when being evacuated or relocated during an emergency. There must be a protected area where these patients can be placed until safely evacuated from the building. Smoke barriers in Group I-2 occupancies provide this defend-in-place mechanism.

Code Requirements

The following five requirements designate the use of smoke barriers in Group I-2 occupancies:

1. Group I-2 occupancies are required to subdivide every story into smoke compartments with an area not more than 22,500 square feet. *(407.5)*
2. Smoke compartments are to be divided using smoke barrier walls in accordance with Section 709. *(407.5)*
3. Smoke barriers are required to subdivide every story used by patients for sleeping or treatment with an occupant load of 50 or more persons into at least two compartments. *(407.5)*
4. Travel distance in smoke compartments shall not exceed 200 feet. *(407.5)*
5. Independent egress – A means of egress shall be provided from each smoke compartment created by smoke barriers without having to return through the smoke compartment from which means of egress originated. *(Section 407.5.2)*

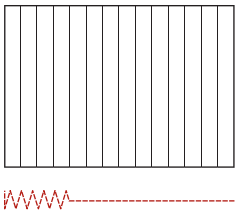
SMOKE COMPARTMENTATION

In order to accommodate an opening in a smoke barrier wall the following opening protective requirements must be met:

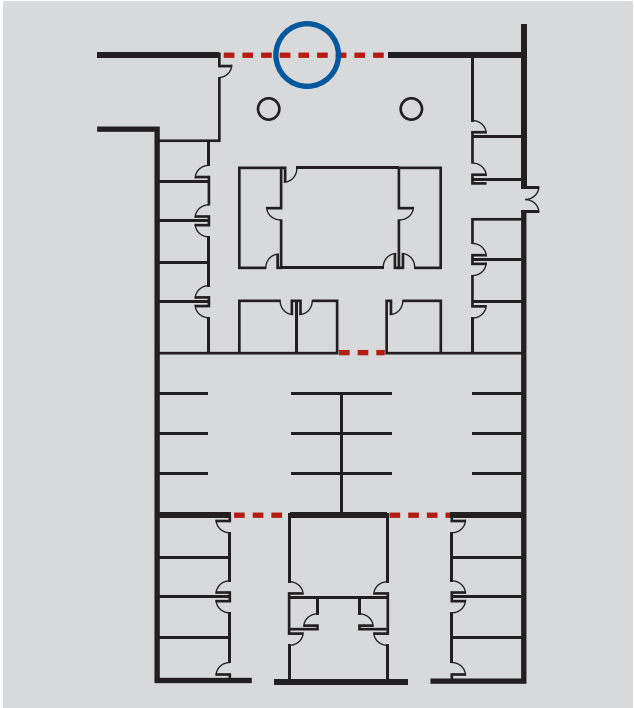
1. Minimum fire rating of 20 minutes. *(Section 716.5.3 & Table 716.5)*
2. Vision panels. *(709.5.1)*

Design Solutions

CASE 1: Side Acting Accordion with Power-assisted Egress

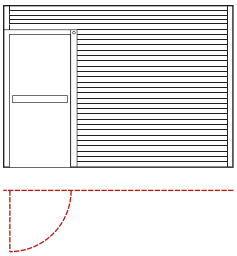


In this case study the intent is to add to an existing I-2 occupancy a 9,700 square foot Critical Care Suite. The existing building construction type is IIIA with 21,324 square feet and the desire is to have the new suite as open as possible to the existing hospital corridor system. The placement of a smoke barrier wall at this new addition connection is a specific code requirement in order to fall within the 22,500 square foot limitation. With the use of the McKEON wide-span labeled assembly approved for egress, the opening protective requirements are met without compromising the spacious clear open ambiance desired.

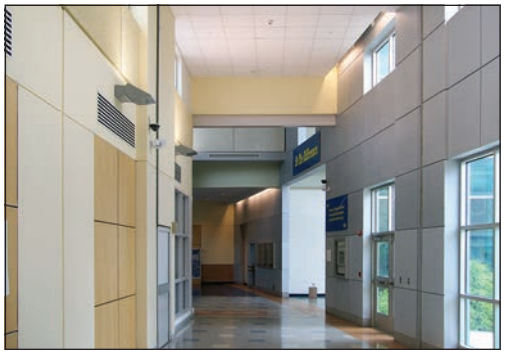


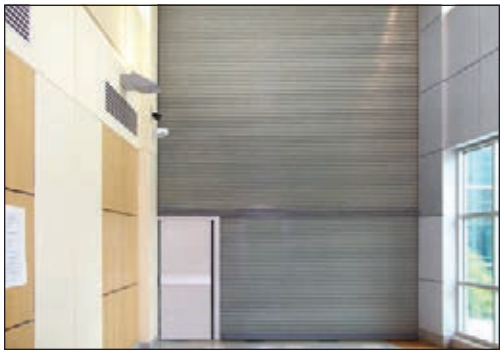
SMOKE COMPARTMENTATION

CASE 2: Vertical Coiling with Complying Swing Egress Door(s)

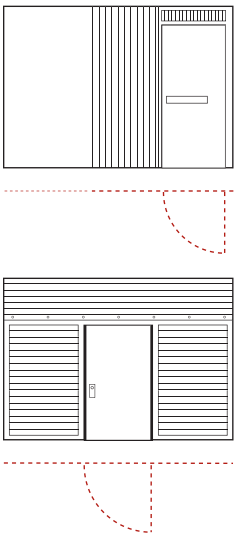


Regardless of the size of the space, smoke barriers must be maintained throughout the building. McKEON can easily protect these unusually large openings without compromising building ambiance.

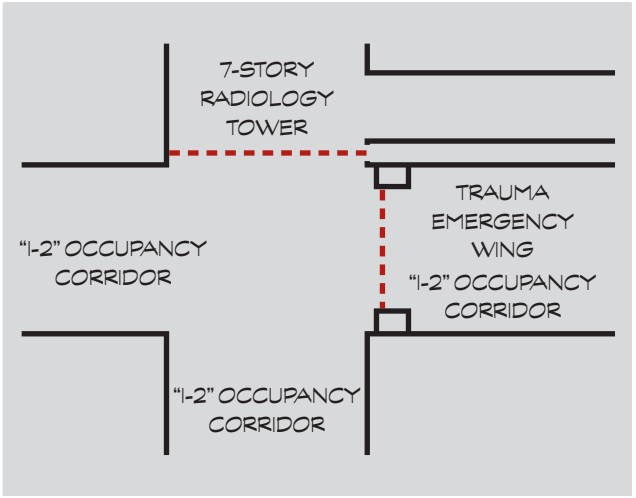


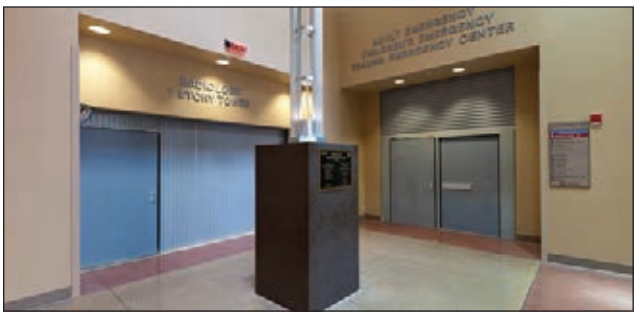


CASE 3: Side Acting with Conventional Egress Door(s) & Vertical Acting with Complying Swing Egress Door(s)



These two very different technologies converge on the inside corner of the structure to complete the smoke barrier separation creating separate refuge area compartments. Operating as duel function assemblies they are also located to separate the corridors from additional spaces.





Inquiry Discussion & Questions

In principle, smoke compartmentation and smoke barrier separation are the same with minor differences. Smoke barriers are created using 1-hour rated walls (Table 716.5) and the separations are incurred at a minimum of 22,500 square feet. Smoke compartments are created using non-rated smoke partitions and the separations are incurred at a minimum of 10,000 square feet in suites of sleeping rooms and 15,000 square feet in non-patient room areas. Smoke compartment applications occur in Group I-2 occupancies/hospitals and smoke barrier applications occur in Group I-2 and/or Group I-3 occupancies/prisons.

Helpful questions for smoke barrier applications can be found in the smoke compartmentation case study.

Notes:

8 Resilient Construction

Storm Shelters

Storm Shelters

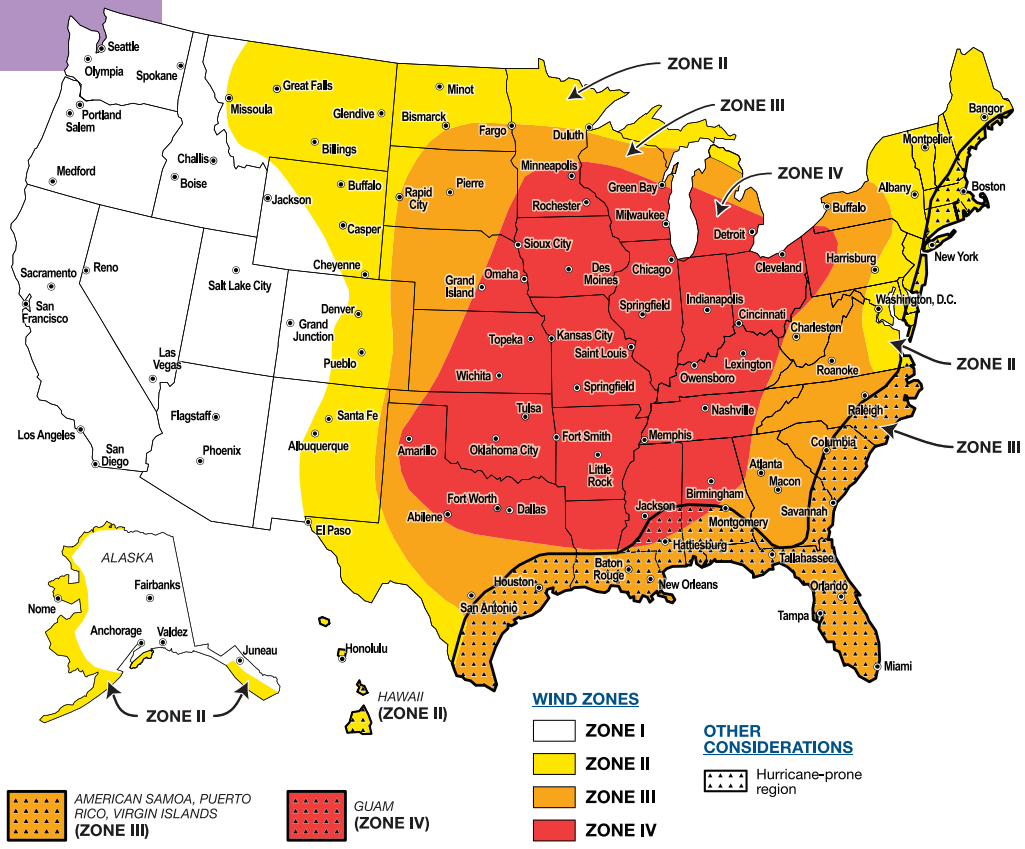
Section 423

Storm shelters can be constructed as separate detached buildings or as safe rooms within new or existing buildings. These types of structures are required to be designated hurricane shelters, tornado shelters or a combination thereof.

Fire & Life Safety Concerns

International Building Code committee staff worked closely with the Federal Emergency Management Agency (FEMA), in particular consulting the FEMA 361 Standard, when creating a formal ICC safety standard for buildings constructed in high-wind-load areas where tornadoes and hurricanes are a prevalent threat. The ICC 500 Standard has been adopted and incorporated into Section 423 of the code to provide safe areas of refuge from these storms.

WIND ZONES IN THE UNITED STATES*



* If you are uncertain of your location because of the level of detail and size of the map, or if you live on or near one of the delineation lines, use the highest adjacent wind zone.

Code Requirements

Section 423.3 Critical emergency operations. In areas where the shelter design wind speed for tornadoes in accordance with Figure 304.2(1) of ICC 500 is 250 MPH, 911 call stations, emergency operation center and fire, rescue, ambulance and police stations shall have a storm shelter constructed in accordance with ICC 500.

Exception: Buildings meeting the requirements for shelter design in ICC 500.

Section 423.4 Group E occupancies. In areas where the shelter design wind speed for tornadoes is 250 MPH in accordance with Figure 304.1(1) of ICC 500, all Group E occupancies with an aggregate occupant load of 50 or more shall have a storm shelter constructed in accordance with ICC 500. The shelter shall be capable of housing the total occupant load of the Group E occupancy.

Exceptions:

1. Group E day care facilities
2. Group E occupancies accessory to places of religious worship
3. Buildings meeting the requirements for shelter design in ICC 500

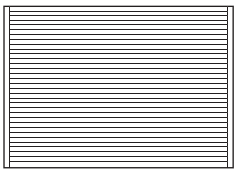
Design Solutions

In the case studies that follow the McKEON SafeSpace™ 500 is featured – an opening protective that complies with the stringent requirements of FEMA 361. Specifically passing the ASTM E1886 based missile impact test and withstanding wind pressures at 240 psf in accordance with ASTM E330, designers can now create large openings in exterior walls of ICC 500 compliant structures or compliant spaces within structures. Please note: When required the SafeSpace 500 can be labeled with a UL 10B 3-hour fire rating and UL 1784 smoke rating, the SafeSpace 500F model.

Missile impact test proves ability to withstand wind-borne debris from a hurricane or tornado.

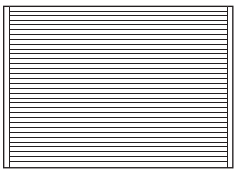
The SafeSpace 500 was subjected to both a positive and a negative 255 mph wind load.

CASE 1: Vertical Coiling without Egress

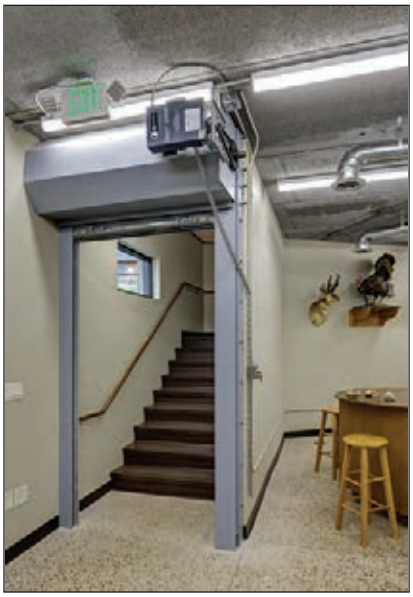


This elementary school cafeteria addition was required to comply with the FEMA 361/ICC 500 provisions. Without the SafeSpace™ 500 the three large window openings in the front of the structure would not have been possible. The cafeteria entrances would have been limited to small swing door openings and the space would have had to be artificially lit. The casual observer would not know this addition is tornado safe, it looks like a typical school multi-purpose cafeteria!

CASE 2: Vertical Coiling without Egress



Located within the 250 MPH wind zone, a two-story summer camp facility turned the lower level into a storm shelter. With SafeSpace™ 500 technology the structure is compliant without sacrificing natural light and appearance.



CASE 3: Vertical Coiling without Egress

Similar to the previous cases, this beautiful library in the Ida Freeman Elementary School is also a tornado shelter. Thanks to SafeSpace™ 500 technology large windows and storefront doors let in plenty of daylight. It is easy to imagine that this area is simply a spacious, inviting area for reading and learning.

Inquiry Discussion and Questions

Often design teams struggle with creating storm shelters because the code seems to allow openings no larger than the typical ICC 500 rated swing doors. Rolling steel assemblies that are FEMA 361/ICC 500 compliant offer design flexibility and allow the space to meet the requirements of a resilient structure. When incorporating a storm shelter into a typical non-FEMA rated structure this same design flexibility is available with the SafeSpace™ technology because in most cases the separation walls are required to be fire and smoke rated as well.

The following questions may be helpful:

- Are you concerned the structure under design will look like a “prison” when the requirements of ICC 500 or FEMA 361 are a part of your design?
- Did you know that if your jurisdiction is the recipient of FEMA funding, it is possible that associated construction may have to follow the FEMA 361 guidelines?
- Do you know if the area wherein you are designing an E occupancy or emergency operations facility structure is under the provisions of FEMA 361 or ICC 500?

Notes:

McKEON®

Appendix

Definitions

Resources

Fire Walls – Section 706

Definition

A fire-resistance-rated wall having protected openings, which restricts the spread of fire and extends continuously from the foundation to or through the roof, with sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall. *(202)*

Fire Ratings: *(Table 706.4)*

2-hour

3-hour

4-hour

Opening Protection: *(706.8)*

Non-sprinklered buildings – Openings shall not exceed 156 square feet and the aggregate width of openings shall not exceed 25 percent of the length of the wall.

Sprinklered buildings – Openings may exceed 156 square feet but the aggregate width of all openings shall not exceed 25 percent of the length of the wall.

Design Notes

- Each portion of a building separated by one or more fire walls shall be considered a separate building. *(503.1)*
- Where a fire wall separates occupancies that are required to be separated by a fire barrier wall, the most restrictive requirements of each separation shall apply. *(706.1)*
- Regardless of the rating of the opening protective, fire walls cannot have openings that exceed 25 percent of the length of the wall. *(706.8)*
- Fire walls constructed as party walls shall NOT have openings. *(706.1.1)*

Applications

- Exceeding area allowances (*Tables 504.3, 504.4, 506.2)*
- Horizontal Exits *(1026)*

Fire Barriers – Section 707

Definition

A fire-resistance-rated wall assembly of materials designed to restrict the spread of fire in which continuity is maintained. *(202)*

Fire Ratings: *(Tables 716.5; 707.3.10)*

1-hour

2-hour

3-hour

4-hour

Opening Protection

Non-sprinklered Buildings – Openings shall be limited to a maximum aggregate width of 25 percent of the length of the wall, and the maximum area of any single opening shall not exceed 156 square feet. *(707.6)*

Sprinklered Buildings – Openings may exceed 156 square feet but must be limited to a maximum aggregate width of 25 percent of the length of the wall, unless the opening protective assembly has been tested in accordance with ASTM E119 and has a minimum fire-resistance rating not less than the fire-resistance rating of the wall. *(707.6 Exceptions #1 & #3)*

Design Notes

- A fire barrier may have an opening exceed the 25 percent rule if the building is sprinklered and the opening protective assembly is tested under the provisions of ASTM E-119. As seen below, most fire-rated walls used in building design will fall under Section 707, Fire Barrier Walls.

Applications

- Shaft Enclosures *(713.4)*
- Interior Exit Stairways *(1023.1)*
- Exit Passageways *(1024.3)*
- Horizontal Exits *(1026.1)*
- Atriums *(404.6)*
- Incidental Use Areas *(Table 509)*
- Control Areas *(414.2.4)*
- Separated Occupancies *(Table 508.4)*
- Fire Areas *(Table 707.3.10)*
- Enclosures for Exit Access Stairways *(713.4)*

Fire Partitions – Section 708

Definition

A vertical assembly of materials designed to restrict the spread of fire in which openings are protected. *(202)*

Fire Ratings *(708.3)*

1-hour

1/2-hour *(708.3, Exceptions #1 & #2)*

Opening Protection

Opening protectives in fire partitions shall have a minimum fire rating of 20 minutes and a maximum of 45 minutes *(Table 716.5)* and shall be smoke tested under UL 1784. *(716.53)*

Design Notes

- Most rated corridor walls fall into this category. *(708.1 and Table 1020.1)*
- Typically corridor walls are not required to be rated unless the structure is non-sprinklered. *(Table 1020.1)*

Applications

- Separation walls as required by Section 420.2 for Groups I-1, R-1, R-2 and R-3 *(708.1, Item #1)*
- Egress balconies as required by Section 1019.2 *(708.1, Item #5)*
- Walls separating tenant spaces in covered mall buildings as required by Section 402.4.2.1 *(708.1, Item #2)*
- Corridor walls as required by Section 1020.1 *(708.1, Item #3)*
- Elevator lobby separation as required by Section 3006.2 *(708.1, Item #4)*

Smoke Barriers – Section 709

Definition

A continuous membrane, either vertical or horizontal, such as a wall, floor, or ceiling assembly that is designed and constructed to restrict the movement of smoke. *(202)*

Fire Ratings *(709.3)*

1-hour

Opening Protection

Opening protectives in smoke barriers shall have a minimum 20 minute fire rating and UL 1784 smoke test rating. *(Table 716.5)*

Design Notes

- Door assemblies in cross-corridor smoke barriers of I-2 Occupancies (Hospitals) shall have vision panels. *(709.5.1)*
- Smoke barriers constructed of minimum 0.10-inch-thick steel in I-3 Occupancies (Jails & Prisons) are not required to be 1-hour rated. *(709.3)*

Applications

In I-2 Occupancies (Hospitals) smoke barriers are required to subdivide every story used by patients for sleeping or treatment. *(407.5)* As per the following:

- 50 or more persons / minimum 2 smoke compartments
- Each compartment cannot exceed 22,500 square feet
- Travel distance shall not exceed 200 feet to a smoke barrier door

In I-3 Occupancies (Jails & Prisons) smoke barriers are required to divide every story occupied by residents for sleeping. *(408.6)* As per the following:

- 50 or more persons / minimum 2 smoke compartments
- Maximum number of residents in any smoke compartment is 200
- Travel distance to any exit access component shall not exceed 150 feet
- Travel distance to any smoke barrier door shall not exceed 200 feet

Smoke Partitions – Section 710

Definition

A partition constructed to limit the transfer or passage of smoke. *(710.4)*

Fire Ratings *(710.3)*

Non-rated

Opening Protection

Door assemblies shall be UL 1784 tested and self closing by smoke detection. *(710.5.2)*

Design Notes

- Corridor walls in an I-2 Occupancy (Hospital) shall be constructed as Smoke Partitions. *(407.3 & 710)*

Applications

- Corridor walls of I-2 Occupancies (Hospitals) *(407.3)*
- Elevator Lobbies *(3006.3, Item #2)*
- Separation of care suites in Group I-2 Occupancies *(407.4.4.2)*

International Building Code, 2018

Means of Egress (AC8800 Series)

1010.1.2 Door Swing. Egress doors shall be side-hinged swinging.

Exceptions:

6. In other than Group H occupancies, horizontal sliding doors complying with Section 1010.1.4.3 are permitted in a means of egress.

1010.1.4.3 Special purpose horizontal sliding accordion or folding doors. In other than Group H occupancies, horizontal sliding doors permitted to be a component of a means of egress in accordance with Exception 6 to Section 1008.1.2 shall comply with all of the following criteria:

1. The doors shall be power operated and shall be capable of being operated manually in the event of power failure.
2. The door shall be openable by a simple method from both sides without special knowledge or effort.
3. The force required to operate the door shall not exceed 30 pounds (133 N) to set the door in motion and 15 pounds (67 N) to close the door or open it to the minimum required width.
4. The door shall be openable with a force not to exceed 15 pounds (67 N) when a force of 250 pounds (1100 N) is applied perpendicular to the door adjacent to the operating device.
5. The door assembly shall comply with the applicable fire protection rating and, where rated, shall be self-closing or automatic closing by smoke detection in accordance with Section 716.5.9.3 and shall be installed in accordance with NFPA 80 and shall comply with Section 716.
6. The door assembly shall have an integrated standby power supply.
7. The door assembly power supply shall be electrically supervised.
8. The door shall open to the minimum required width within 10 seconds after activation of the operating device.

NFPA 101 Life Safety Code, 2018

Means of Egress

7.2.1.4 Swing and Force to Open

7.2.1.4.1.4a, b, c Special-purpose horizontally sliding accordion or folding door assemblies complying with 7.2.1.14 shall be permitted.

7.2.1.14 Special-Purpose Horizontally Sliding Accordion or Folding Door Assemblies. Special-purpose horizontally sliding accordion or folding door assemblies shall be permitted in a means of egress, provided that the following criteria are met:

1. The door leaf is readily operable from either side without special knowledge or effort.
2. The force that, when applied to the operating device in the direction of egress, is required to operate the door leaf is not more than 15 lbf (67 N).
3. The force required to operate the door leaf in the direction of door travel is not more than 30 lbf (133 N) to set the leaf in motion and is not more than 15 lbf (67 N) to close the leaf or open it to the minimum required width.
4. The door leaf is operable using a force of not more than 50 lbf (222 N) when a force of 250 lbf (1100 N) is applied perpendicularly to the leaf adjacent to the operating device, unless the door is an existing special-purpose horizontally sliding accordion or folding exit access door assembly serving an area with an occupant load of fewer than 50.
5. The door assembly complies with the fire protection rating, if required, and, where rated, is self-closing or automatic-closing by means of smoke detection in accordance with 7.2.1.8 and is installed in accordance with *NFPA 80, Standard for Fire Doors and Fire Windows.*

INTERTEK Code Compliance Research Report

CCRR 1086

For access to this report:

- Download from the Intertek website: intertek.com/building/ccrr/
- Download from the McKEON website: mckeondoor.com

International Building Code, 2021

202 Definitions, 716 Opening Protectives, Referenced Standards

The development and final vote of the following code sections have been completed and will be published in the 2021 edition of the IBC:

Section 202 Definitions

FIRE PROTECTIVE CURTAIN ASSEMBLY. An assembly consisting of a fabric curtain, bottom bar, guides, coil, operating and closing system.

Section 716 Opening Protectives

716.4 Fire protective curtain assembly. Approved fire protective curtain assemblies shall be constructed of any materials or assembly of component materials tested without hose stream in accordance with UL 10D, and shall comply with Sections 716.4.1 through 716.4.3.

716.4.1 Label. Fire protective curtain assemblies used as opening protectives in fire rated walls and smoke partitions shall be labeled in accordance with 716.2.9.

716.4.2 Smoke and draft control. Fire protective curtain assemblies used to protect openings where smoke and draft control assemblies are required shall comply with Section 716.2.1.4.

716.4.3 Installation. Fire protective curtain assemblies shall be installed in accordance with NFPA 80.

Referenced Standards

UL 10D-17, Standard for Fire Tests of Fire Protective Curtain Assemblies (shown below)

4 FIRE TESTS OF FIRE-PROTECTIVE CURTAIN ASSEMBLIES - UL 10D SEPTEMBER 29, 2017

INTRODUCTION

1 Scope

1.1 These requirements cover the evaluation of fire-protective curtain assemblies intended to provide supplemental, passive fire protection as part of an engineered fire protection system. Fire-protective curtain assemblies are horizontally or vertically oriented. Horizontally or vertically oriented fire-protective curtain assemblies provide nonstructural separation only, and are not intended to be substituted for structural hourly rated partitions or opening protectives that have been tested for fire endurance and hose stream performance.

McKEON FireFighter® Egress Feature

All FireFighter models that incorporate the egress feature can be placed in a required path of egress. Compliance with the criteria detailed in IBC Chapter 10, Means of Egress means building occupants can easily exit through this unique curtain assembly regardless of its application in the building.

Code Requirements

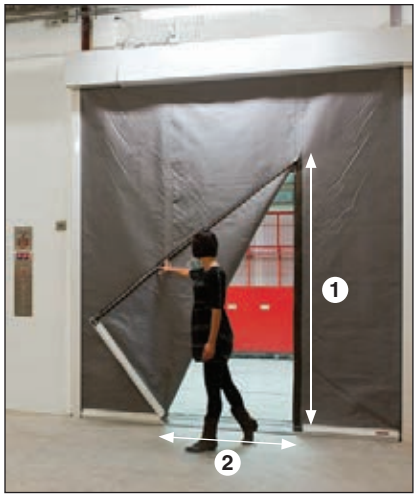
Section 1010.1.2 Door Swing. Egress doors shall be of the pivoted or side-hinged swinging type.

The FireFighter egress door includes a hinged bottom bar located at 90 degrees to the fabric so that when the fabric is pushed to the open position both bottom bar and fabric easily swing providing complying egress width to allow building occupants to exit.

RESOURCES

Section 1010.1.1 Size of doors. The required capacity of each door opening shall be sufficient for the occupant load thereof and shall provide a minimum clear opening width of 32 inches (813 mm) … The minimum clear opening height of doors shall be not less than 80 inches (2032 mm).

The following photo/dimensions and table will help you determine compliance with this code requirement.



Product	Opening Height from Floor	Opening (swing) Force (LBF)	Opening Dimensions
Fire & Smoke Curtain	18"	Less than 1/2 lbf	36"
Fire & Smoke Curtain	36"	Less than 1/2 lbf	22 1/2"
Fire & Smoke Curtain	54"	Less than 1/2 lbf	20"
Fire & Smoke Curtain	72"	Less than 1/2 lbf	12"
Fire & Smoke Curtain	84"	Less than 1/2 lbf	6"

Section 1010.1.3 Door opening force … the door latch shall release when subjected to a 15-pound (67 N) force. The door shall be set in motion when subjected to a 30-pound (133 N) force. The door shall swing to a full-open position when subjected to a 15-pound (67 N) force.

The following test data confirms that the FireFighter egress feature complies with these requirements.

Flexible Fabric Door Compliance Test	
Force A (LBF) Opening force to set egress in motion, hook & loop ripped open	26
Force B (LBF) Swing force to swing egress door to fully open position	0.5
Force C (LBF) Force required to hold egress door in the fully open 90 position	4
Height	34"

ADA Notes:

- Doors designated as fire doors must have the minimum opening force allowed by the local authority.
- Interior accessible doors should require no more than 5 lbs. of force to open.
- Threshold cannot be higher than 1/2 inch at accessible doors.

44 Sawgrass Drive
Bellport, NY 11713
Phone: 800-266-9392
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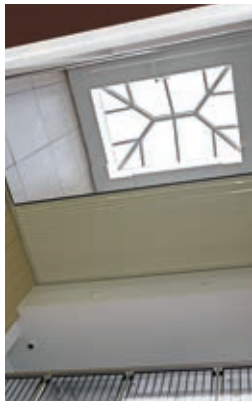
Email: info@mckeondoor.com
www.McKeonDoor.com








File Attachments for Item:

ER-2 Fire Door Systems for Vertical Opening Separations (McKeon Door - OBOA/ODPCA Conference)

All Certifications (2 hours)

Staff Notes: Slides are chapter 3 and the appendix of the attached book. Based on 2021 code, not recommended for approval.

Committee Recommendation:

Vertical Opening Protection, 2 hours, *BBS 2021-XXX*, McKeon Door, David Dodge

a. *(Certifications; BI, BO, BPE, EPE, ESI, FPI, FPPE, LPE, MPE, MI, MechPE, NRIU, PI, PPE, RBI, RBO, REPE, RIUI, RMI, RPE, RPI, application for course will be submitted by McKeon to OBBS)*
b. Outline; Course will provide building code information (updated to 2018 IBC) Perhaps the most challenging aspect of building design for both the design team and the regulatory official is that of vertical spaces in structures. These include Atriums, Interior Exit Stairways, Exit Access stairways, Escalator Openings & Draft Curtains, 2-story Openings and NFPA 101 regulated Convenience Openings and Communicating Spaces. This 2-hour session will discuss the often mis-understood principles that guide their design and approval.

CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

Instructors: Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications for which the BBS has approved the class, and fees in promotion materials and advertising. ***The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising***. Advertising shall not disclose improper approval information to the public.

Course sponsors/co-sponsors: provide participants a certificate of completion containing the following information: name of participant, title of approved courses, BBS approval #, BBS approved certifications, date of the continuing education program, number of approved credit hours awarded and signature of authorized sponsor or instructor.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

Participants: Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

Board approval: Remains in effect through the calendar year of approval. The course may be renewed administratively by sponsor application in subsequent years so long as it references current codes and standards Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

Facility/training area: Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

APPLICATION

FOR

Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.

Board of Building Standards
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax: (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: David Dodge (Contact Name)
Organization: McKeon Door Company (Organization/Company)
Address: 44 Sawgrass Drive, (Include Room Number, Suite, etc.)
City: Bellport State: NY Zip: 11713
E-Mail: ddodge@mckeondoor.com
Telephone: 801-471-7210 Fax:
Course Sponsor: McKeon Door

COURSE INFORMATION:

Course Title: Fire Door Systems for Vertical Opening Separations (Atriums &, exit stairs), and Corridor Separation for healthcare

New Course Submittal: ■ Update Course: ■ Prior Approval Number: BBS2017-138

Purpose and Objective: Provide building code information (updated to the 2018 IBC) on fire doors and their role in vertical shafts such as Atriums, Exit stairways, escalator vertical openings, and draft curtains. Provide information on fire rated doors utilized in health care corridors.

NOTE: We are simply splitting the original approved course into two 2-hour courses. Please see attached pdf workbook that each attendee will receive as party of the course materials.

The PPT slides for this course duplicate the textbook as found Chapter 3 and the Appendix pages.

Number of Instructional Contact Hours that can be obtained upon completion: (2) hour

If Multi-Session, Number of Instructional Contact Hours Per Session:

Program Applicable for the Following Participants:

Building Official ■	Master Plans Examiner ■	Building Inspector ■	Fire Protection Inspector ■	Mechanical Inspector ■
	Building Plans Exam. ✔			Plumbing Inspector ■
	Plumbing Plans Exam. ■			Non-Res IU Inspector ■
	Electrical Plans Exam. ■			
	Mechanical Plans Exam. ■			
	Fire Protect. Plans Exam. ✔			
Res Building Official ■	Res Plans Examiner ■	Res Building Inspector ■	Res Mechanical Inspector ■	Res IU Inspector ☐

Electrical Safety Inspectors X
Location of ESI Course: Date(s) of ESI Course(s):

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**:		Check Off
Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	X
	Organization sponsoring or requesting the program (if any)	X
Course Title:	Name of course (related to content)	X
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	X
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	X
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	X
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	X
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	X
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	X
Test Materials:		
Completed Application:		X

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

David L. Dodge, CSI, CDT

VICE PRESIDENT, BUSINESS AND CODE DEVELOPMENT

David has been involved in the construction industry since 1975. With an extensive background in project estimating and management and a bachelor's degree in business management, David soon realized a great deal of success in building product marketing and sales. Within this venue he found his passion – building code development and architectural design compliance. Since 1988, he has assisted architectural firms in understanding and implementing the provisions of the model codes as they pertain to fire and life safety. His particular focus is on the fire door industry, promoting cutting edge technology to resolve code compliance challenges.

David is a corporate member of the International Code Council (ICC) and earned his Construction Document Technologist (CDT) from the Construction Specifications Institute. He has served on several ICC committees, both local, regional and national, for the adoption and implementation of the International Building Code throughout the US. He is a recognized speaker and instructor, teaching the fire and life safety provisions of the model codes to design professionals and regulatory officials. David is a certified CEU instructor under the ICC Education Provider program. As part of the McKeon Door Company team David draws on his 30-plus years of experience in the building code arena when assisting design professionals and product representatives with code and design compliance challenges.

McKEON®

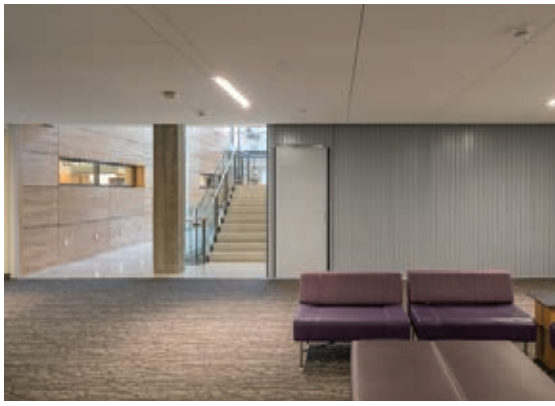
Updated! Based on the 2018 Edition of the IBC

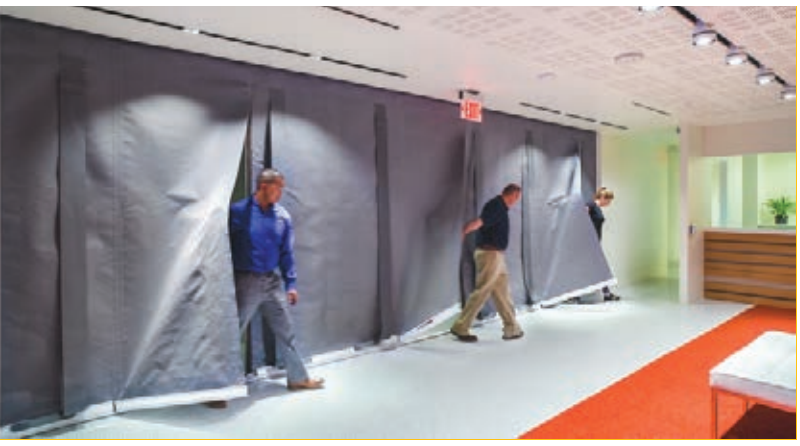
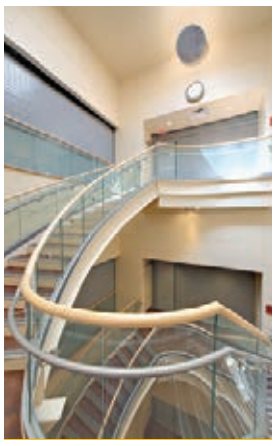
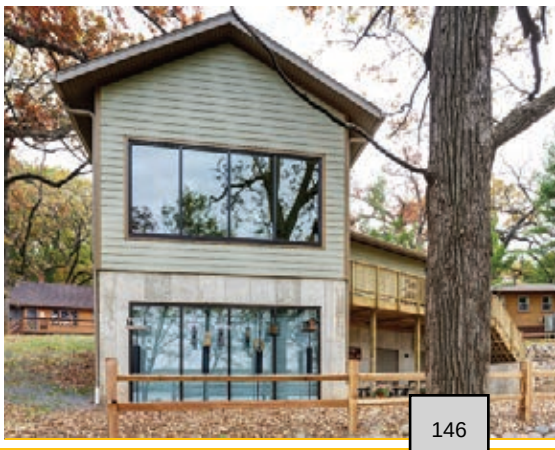
REV. 6/19

Fire Door Systems

A Guide to Code Compliance





McKEON®

Fire Door Systems

A Guide to Code Compliance

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CONTENTS

APPLICATIONS

12th Edition - June 2019

Introduction

THIS EDITION of *Fire Door Systems, A Guide to Code Compliance* is based on the 2018 IBC with inserts from the "Group A" portion of the 2021 IBC code development cycle. The insertions reflect code changes that have been approved by the voting membership in both the general sessions and the subsequent on-line voting forum, and will be published in the next printing of the IBC.

THE INTERNATIONAL BUILDING CODE has been widely accepted in the United States and is recognized as a uniform code addressing the design and installation of building systems with performance-based requirements. The current International Building Code has been developed over the last two decades through the extensive work and efforts of code enforcement personnel organized at both local and national levels under the direction of the International Code Council. A vital part of the development of the building code is the involvement of industry and nationally recognized organizations with interests in building product development and the protection of public health, safety and welfare.

McKEON develops and manufactures numerous fire and smoke rated assemblies that function as wide-span opening protectives. These building products enter the marketplace specifically to assist design professionals and code enforcement personnel in satisfying open design without compromising fire and life safety requirements. This document is formatted to present the building code as it pertains to the use of opening protectives; first, recite specific prescriptive code requirements, second, performance-based language in laymen's terms for common sense understanding, and third, illustrate product case studies presented as design solutions to frequently approached complex code application challenges. The building code interpretations found herein represent the opinion and experience of the preparer, intended only to assist the reader in recognizing and understanding the potential use and application of McKEON fire and smoke rated opening protective assembly products.

McKEON®

1 Elevator Separation

Elevator Lobbies & Hoistway Protection

Elevator Smoke & Draft

Elevator Lobbies & Hoistway Protection

Section 3006

Hoistway protection is designed to isolate fire, smoke, heat and toxic gases or fumes from migrating floor to floor through vertical hoistways in multi-story structures. There are two fundamental methods prescribed in this code section – elevator lobbies or protection at the point of access to the elevator car.

Fire & Life Safety Concerns

Elevator shafts are the most common inter-connecting vertical shafts in multi-story buildings. These shafts become conduits for fire, heat, smoke and other toxins between the fire floor(s) and additional floors.

Code Requirements

3006.1 General. Elevator hoistway openings and enclosed elevator lobbies shall be provided with the following:

1. Where hoistway opening protection is required by Section 3006.2, such protection shall be in accordance with Section 3006.3.
2. Where enclosed elevator lobbies are required for underground buildings, such lobbies shall comply with Section 405.4.3.
3. Where an area of refuge is required and an enclosed elevator lobby is provided to serve as an area of refuge, the enclosed elevator lobby shall comply with Section 1009.6.
4. Where fire service access elevators are provided, enclosed elevator lobbies shall comply with Section 3007.6.
5. Where occupant evacuation elevators are provided, enclosed elevator lobbies shall comply with Section 3008.6.

3006.2 Hoistway opening protection required. Elevator hoistway door openings shall be protected in accordance with Section 3006.3 where an elevator hoistway connects more than three stories, is required to be enclosed within a shaft enclosure in accordance with Section 712.1.1 and any of the following conditions apply:

ELEVATOR SEPARATION

1. The building is not protected throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2.
2. The building contains a Group I-1 Condition 2 occupancy.
3. The building contains a Group I-2 occupancy.
4. The building contains a Group I-3 occupancy.
5. The building is a high rise and the elevator hoistway is more than 75 feet (22 860 mm) in height. The height of the hoistway shall be measured from the lowest floor to the highest floor of the floors served by the hoistway.

Exceptions:

1. Protection of elevator hoistway door openings is not required where the elevator serves only open parking garages in accordance with Section 406.5.
2. Protection of elevator hoistway door openings is not required at the level(s) of exit discharge, provided the level(s) of exit discharge is equipped with an automatic sprinkler system in accordance with Section 903.3.1.1.
3. Enclosed elevator lobbies and protection of elevator hoistway door openings are not required on levels where the elevator hoistway opens to the exterior.

3006.2.1 Rated Corridors. Where corridors are required to be fire-resistance rated in accordance with Section 1020.1, elevator hoistway openings shall be protected in accordance with Section 3006.3.

3006.3 Hoistway opening protection. Where Section 3006.2 requires protection of the elevator hoistway door opening, the protection shall be provided by one of the following:

1. An enclosed elevator lobby shall be provided at each floor to separate the elevator hoistway shaft enclosure doors from each floor by fire partitions in accordance with Section 708. In addition, doors protecting openings in the elevator lobby enclosure walls shall comply with Section 716.5.3 as required for corridor walls. Penetrations of the enclosed elevator lobby by ducts and air transfer openings shall be protected as required for corridors in accordance with Section 717.5.4.1.
2. An enclosed elevator lobby shall be provided at each floor to separate the elevator hoistway shaft enclosure doors from each floor by smoke partitions in accordance with Section 710 where the building is equipped with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2. In addition, doors protecting openings in the smoke partitions shall comply with Sections 710.5.2.2, 710.5.2.3 and 716.5.9. Penetrations of the enclosed elevator lobby by ducts and air transfer openings shall be protected as required for corridors in accordance with Section 717.5.4.1. Note: Smoke partitions as defined in Section 710.3 are not required to be fire rated. The doors located in smoke partition walls referenced in Section 710.5.2.2 are required to be UL 1784 labeled as smoke & draft control assemblies.
3. Additional doors shall be provided at each elevator hoistway door opening in accordance with Section 3002.6. Such door shall comply with the smoke and draft control door assembly requirements in Section 716.5.3.1 when tested in accordance with UL 1784 without an artificial bottom seal.
4. The elevator hoistway shall be pressurized in accordance with Section 909.21.

3006.4 Means of egress. Elevator lobbies shall be provided with at least one means of egress

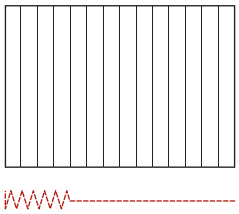
ELEVATOR SEPARATION

complying with Chapter 10 and other provisions in this code. Egress through an elevator lobby shall be permitted in accordance with Item 1 of Section 1016.2.

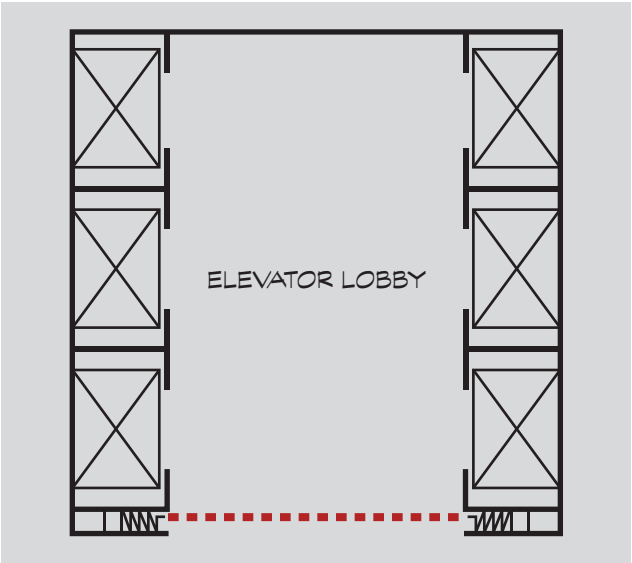
Design Solutions

A diverse line-up of McKEON door assemblies can easily accommodate wide-span openings, radius applications, and egress.

CASE 1: Side Acting Accordion with Power-assisted Egress

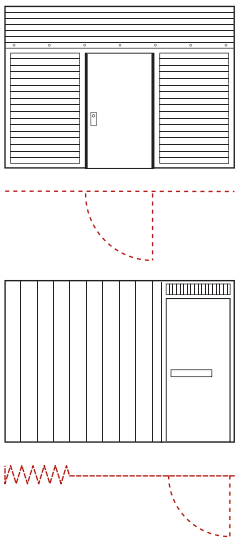


In the first case study, there is no headroom and side stacking space is limited. The McKEON bi-parting accordion fire door technology stepped up to meet the demand of hi-end design without compromising specific code requirements including conforming side acting accordion fire door egress acceptance.

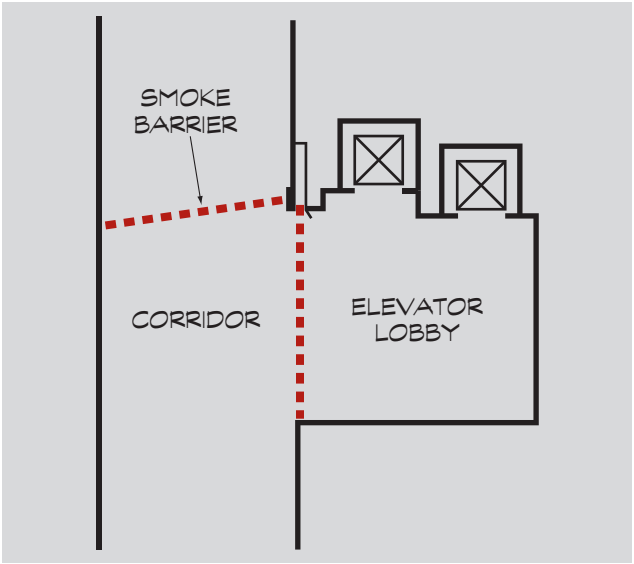


ELEVATOR SEPARATION

CASE 2: Side Acting Accordion with Complying Swing Egress Door & Vertical Acting with Complying Swing Egress Door(s)

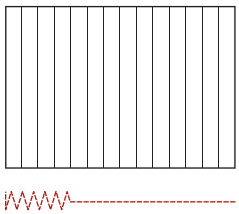


This case study includes both a side acting accordion with conventional egress elevator lobby separation and a vertical acting with conventional egress smoke barrier opening protective.

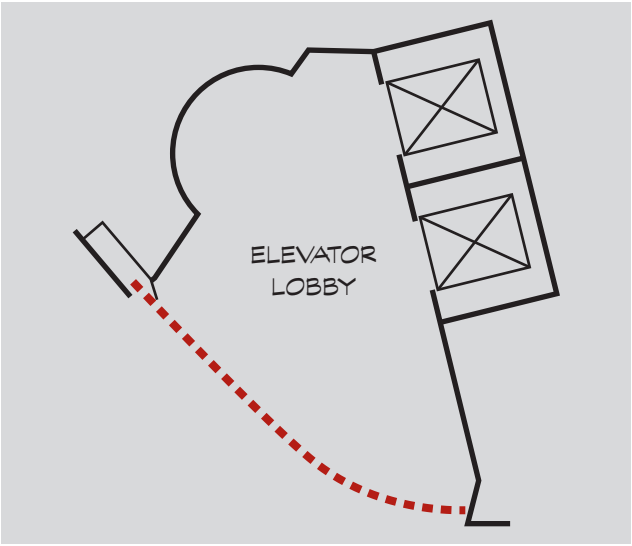


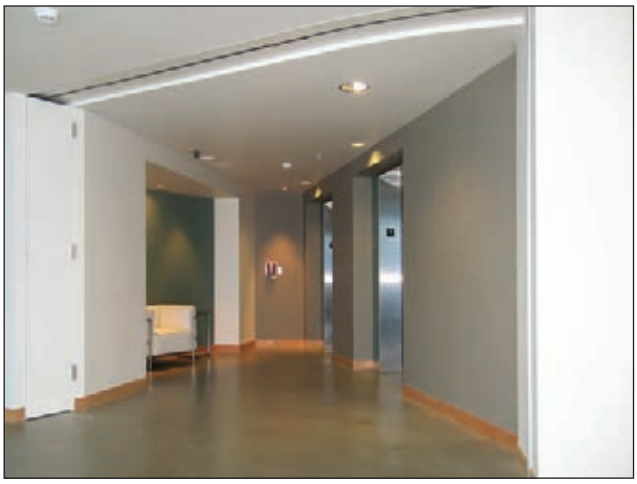
ELEVATOR SEPARATION

CASE 3: Side Acting Accordion with Power-assisted Egress

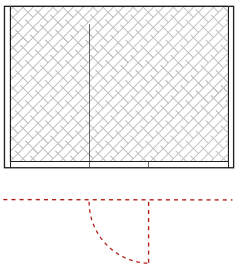


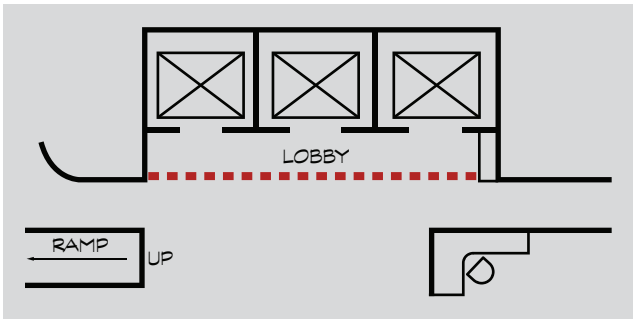
The side acting accordion technology will accommodate custom radius applications as well as serve as the primary means of egress from the space.



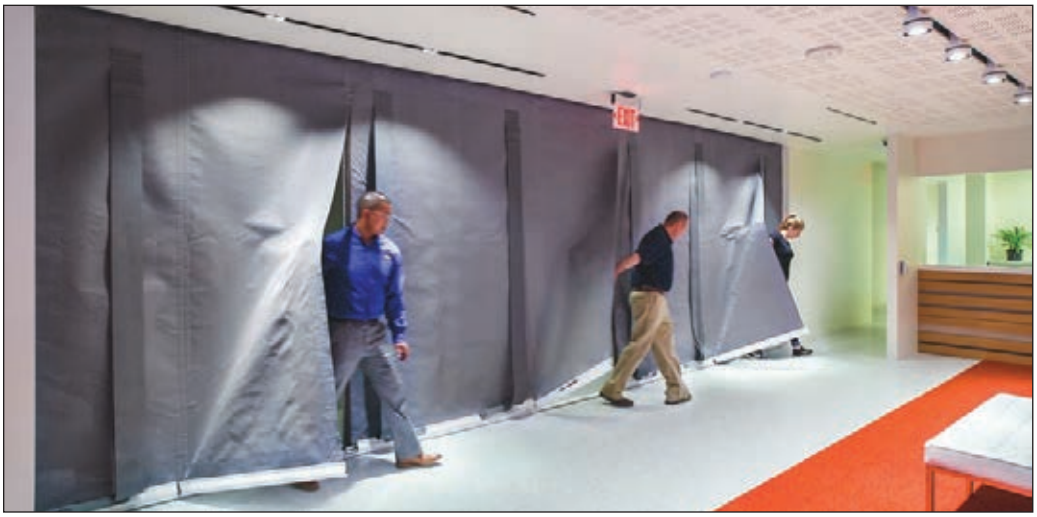


CASE 4: Vertical Acting with Multiple Complying Swing Egress Doors



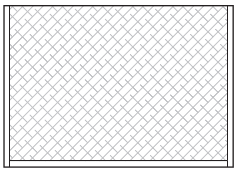


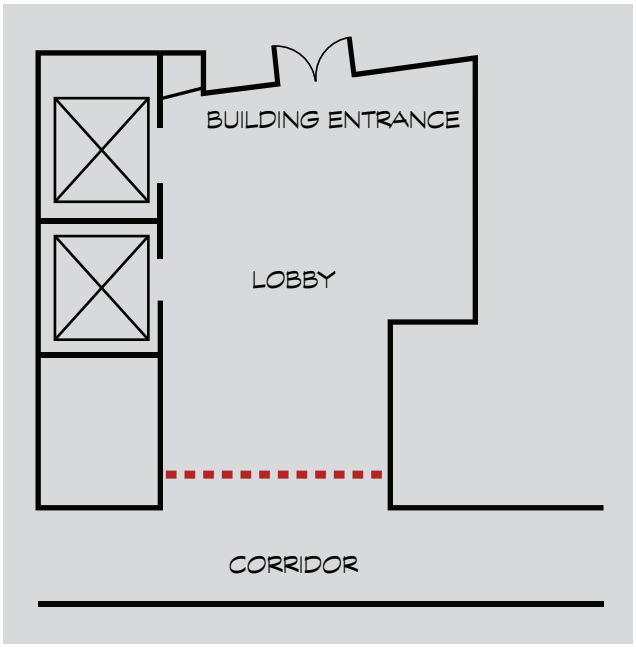
This project introduces the use of fire protective curtain assemblies that have been approved in accordance with the current editions of the model buildings codes (see IBC Section 3006.3, Item #2. Specific reference to this technology is now approved as opening protectives without hose stream performance [UL 10D 20-minute fire rated] for publication in the 2021 edition of the IBC [See Appendix, Resource IBC 2021]).



ELEVATOR SEPARATION

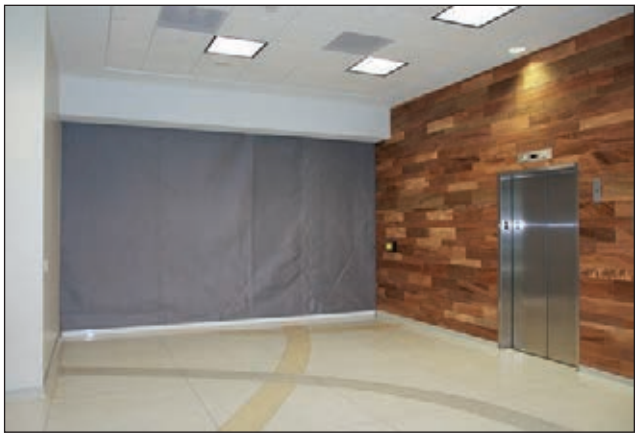
CASE 5: Vertical Acting without Egress





For the same reasons of acceptance explained in CASE 4, Fire Protective Curtain Assemblies satisfied two code compliance challenges in this design. Even though an elevator lobby is not necessarily required on the level of exit discharge in a sprinklered building, this separation takes on the form of a lobby since it protects the remaining structure from the vertical features of the building. Egress is not required though the fire protective curtain due to exiting out of the lobby or separated space through the main entrance.

Specific reference to this technology is now approved as opening protectives without hose stream performance (UL 10D 20-minute fire rated) for publication in the 2021 edition of the IBC (See Appendix, Resource IBC 2021).



ELEVATOR SEPARATION

Inquiry Discussion & Questions

There has been much discussion in the regulatory arena about the purpose and usefulness of the elevator lobby. It can be argued the lobby is a dual application fire and life safety component of the structure, a barrier against smoke migration in and out of the vertical shaft as well as an area of refuge for building occupants. These fundamental occupant safety features are tempered with sprinkler exceptions but consistently remain as salient provisions each code development cycle.

If there is a trend in preference it appears to be for more passive redundant protection surrounding the elevator shaft rather than less. For example, the code requirements outlined in this application study include several sprinkler exceptions that allow the elimination of the elevator lobby for normal-use passenger elevators in Section 3006. However, once the building goes into alarm, Section 3007 Fire Service Access Elevator and Section 3008 Occupant Evacuation Elevators do not allow the same exceptions. Not only are lobbies required in these two applications, with no exemptions, each lobby must be fully fire and smoke rated with prescribed physical size requirements. Interestingly, in a fire event the elevator often becomes an integral part of the means of egress system.

Elevator lobbies can be considered a viable choice based on three premises. Let's use the layout as diagrammed in Case Study #2 as an example. First, from a design ambiance perspective, it is cumbersome to provide independent separation at the point of each elevator car to simply eliminate the lobby. The space would certainly be interrupted at each elevator car opening. A single separation creating a full space lobby would have less impact on the overall design.

Secondly, a single separation opening protective is clearly less costly than multiple systems located at each car opening. The third and perhaps the most important consideration is fire and life safety. By creating a conforming full space lobby we stop smoke and heat from penetrating the shaft, and provide an area of refuge for building occupants. In other words, rather than provide closures at each individual point-of-access location to the elevator car, why not create an elevator lobby that is unobstrusive, costs less and will adequately serve as an area of refuge.

Elevator Smoke & Draft

Section 3006.3

Elevator car doors are typically fire-rated but cannot comply with smoke and draft requirements. Smoke & draft rated assemblies eliminate the passage of smoke and are usually located at the point of access to an elevator car as an alternative to the elevator lobby.

Fire & Life Safety Concerns

Elevator shafts commonly represent the majority of inter-connecting vertical shafts in multi-story buildings. These shafts become conduits for heat, smoke and other toxins between the fire floor(s) and additional floors. In buildings with more than three interconnected stories, the conventional elevator lobby is designed to stop the spread of fire and smoke before it reaches the elevator shaft enclosure doors. However, if the lobby is eliminated smoke could quickly penetrate the shaft at the point of access. Thus, all fire-rated assemblies used at the point of access must maintain a smoke and draft rating. *(UL 1784)*

Code Requirements

There are two primary provisions that drive the need for elevator protection in the IBC. First, Section 3006.2 requires protection where the elevator hoistway connects more than three stories and any of the following conditions apply:

1. The building is not protected throughout with sprinklers …
2. The building contains an I-1 Condition 2 occupancy
3. The building contains an I-2 occupancy
4. The building contains an I-3 occupancy
5. The building is a hi-rise … more than 75 feet

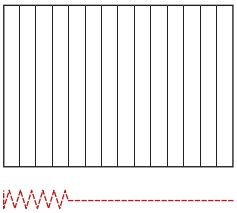
The second primary provision is found in Section 3006.2.1 requiring elevator hoistway protection when the corridors in the structure are fire-resistance rated.

ELEVATOR SEPARATION

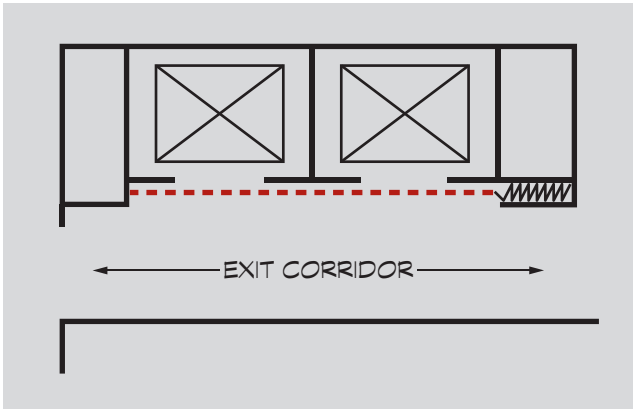
Section 3006.3, Item #3 allows the elimination of the lobby by placing a minimum UL 1784 (smoke) rated assembly at the point of access to the elevator hoistway door opening. Please note: All assemblies located at the point of access to an elevator car must be readily openable from the car side without a key, tool, special knowledge or effort. *(3002.6)*

Design Solutions

CASE 1: Side Acting Accordion with Power-assisted Egress

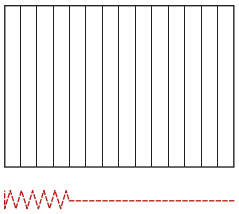


Due to the several configuration options of the McKEON door assemblies multiple or single elevator openings can easily be protected. Egress can be placed at each elevator car door opening to accommodate conforming exit requirements.

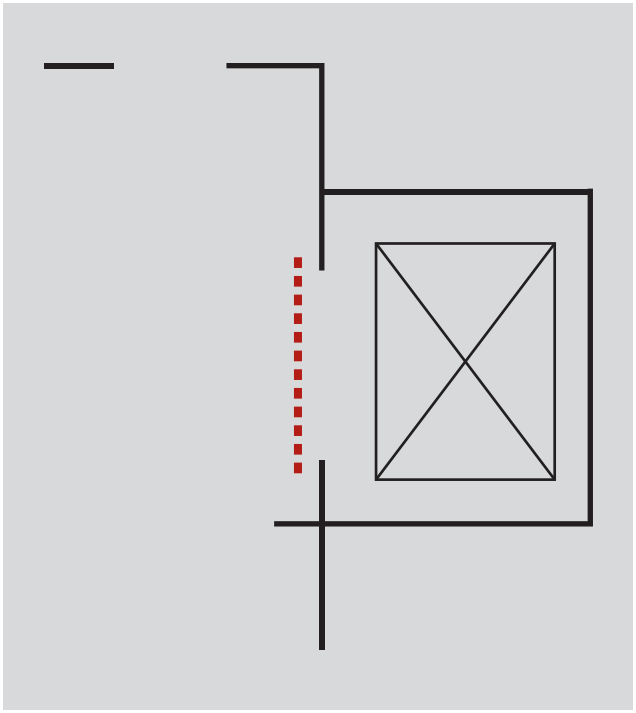


ELEVATOR SEPARATION

CASE 2: Side Acting Accordion with Manual Egress

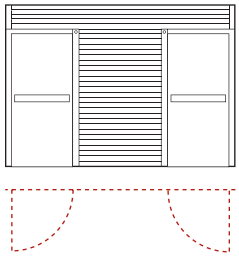


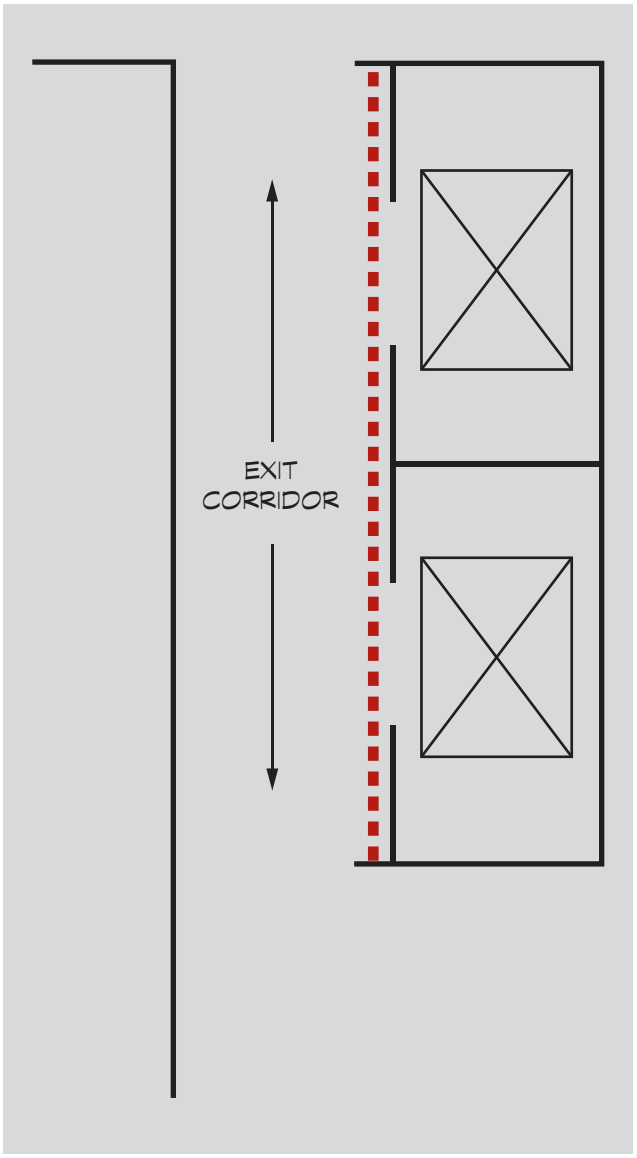
This simple, manually operated, bolt-up pre-fabricated unit can be installed at the point of access to any elevator car in a matter of hours. No pocket, stud or drywall construction is necessary. The door, held open by an electromagnet, is released at the command of a smoke detector and the fire and smoke rated assembly closes. Building occupants or first responders can pass through the opening as the door self-closes behind them.



ELEVATOR SEPARATION

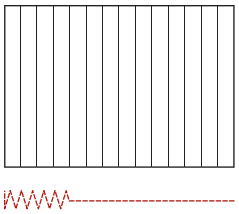
CASE 3: Vertical Coiling with Complying Swing Egress Door(s)



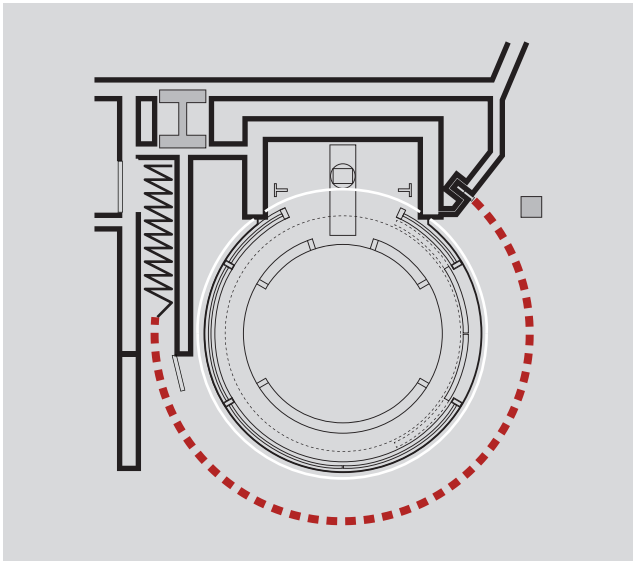


ELEVATOR SEPARATION

CASE 4: Side Acting Accordion with Power-assisted Egress

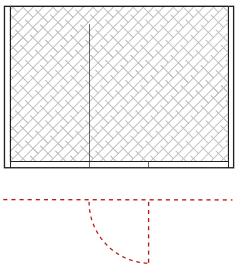


The single track 3-hour rated accordion will accommodate 18" radius to custom curves. Along with complying egress, McKEON resolved a very difficult challenge without life safety or design compromise.

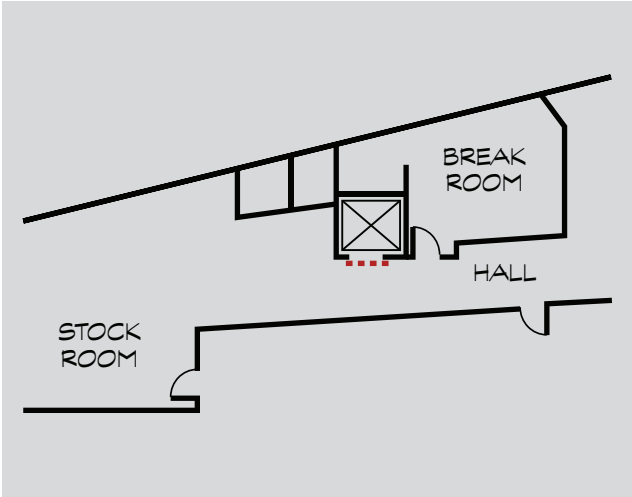


ELEVATOR SEPARATION

CASE 5: Vertical Acting with Egress

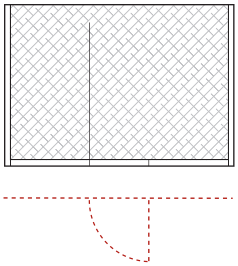


Typically, the elevator car or elevator shaft door is fire rated but does not carry a UL 1784 smoke rating. The SmokeFighter® D150E is a listed and labeled UL 1784 assembly with a complying egress feature. Located at the point of access to the elevator car, this assembly protects the opening mitigating smoke migration.

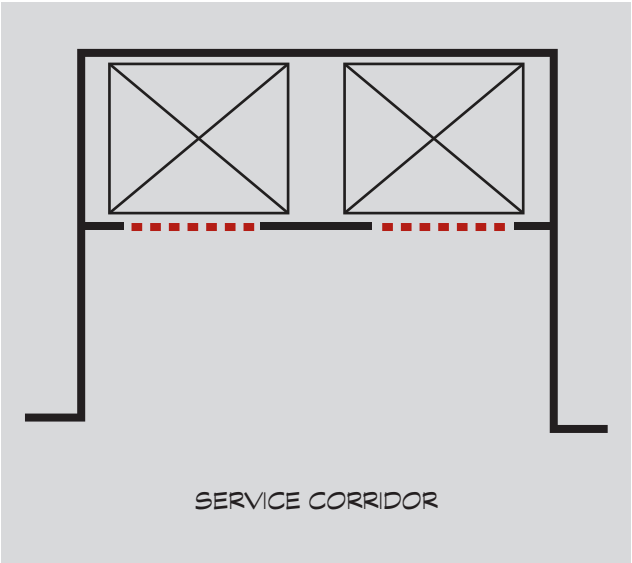


ELEVATOR SEPARATION

CASE 6: Vertical Acting with Egress



Similar to the previous case study, the elevator car or elevator shaft door is fire rated but does not carry a UL 1784 smoke rating. But on this project the design team elected to use the FireFighter® D200E which is listed and labeled as a 20-minute UL 10D & UL 1784 assembly with a complying egress feature. By applying the 20-minute fire-rated assembly in this design, McKEON provided redundancy in the fire-rated requirements. Located at the point of access to the elevator car, this assembly protects the opening mitigating smoke migration as well as fire and heat penetration.



ELEVATOR SEPARATION

Inquiry Discussion & Questions

Please consult the Inquiry Discussion & Question section of the Elevator Lobby case study.

Notes:

McKEON®

2 Exit Access Separation

Horizontal Exit

Exit Passageways

Pedestrian Walkways & Tunnels

Horizontal Exit

Section 1026

Horizontal exits are designed to move building occupants on a floor from any point in the exit access system to a fire and smoke protected area.

Fire & Life Safety Concerns

The horizontal exit differs fundamentally from the typical code-defined exit. The horizontal exit is meant to "defend in place" by creating an area of safe refuge for building occupants within the confines of the building structure. All other exits are designed to exit occupants out of and away from the building.

Code Requirements

Because building occupants are not being removed from the building when using the horizontal exit, specific precautionary requirements are based upon the following fundamental principles:

Principle #1: Separation. A 2-hour fire wall or fire barrier must be used to separate safe refuge areas connected with a horizontal exit *(Section 1026.2)*. The determination between the use of a wall, fire barrier or horizontal assembly is the function of the wall as it relates to other code requirements.

Principle #2: Opening Protective. The opening within the horizontal exit must be protected with a self-closing or automatic closing fire door when activated by a smoke detector. The fire rating of the door must be a minimum of 90 minutes. *(Section 1026.3)*

Principle #3: Area of Refuge Capacity. Based on a net floor allowance of 3 square feet for each person with the following guidelines:

Where the horizontal exit also forms a smoke compartment, the capacity of the refuge area for Group I-1, I-2 and I-3 occupancies and Group B ambulatory care facilities shall comply with Section 407.5.3, 408.6.2, 420.6.1 and 422.3.2 as applicable.

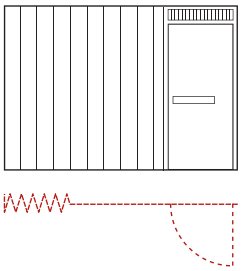
Principle #4: Number of Exits. The refuge area into which a horizontal exit leads shall be provided with exits adequate to meet the occupant requirements of this chapter, but not including the added

occupant load imposed by persons entering the refuge area through horizontal exits from other areas. Not less than one refuge area exit shall lead directly to the exterior or to an interior exit stairway or ramp.

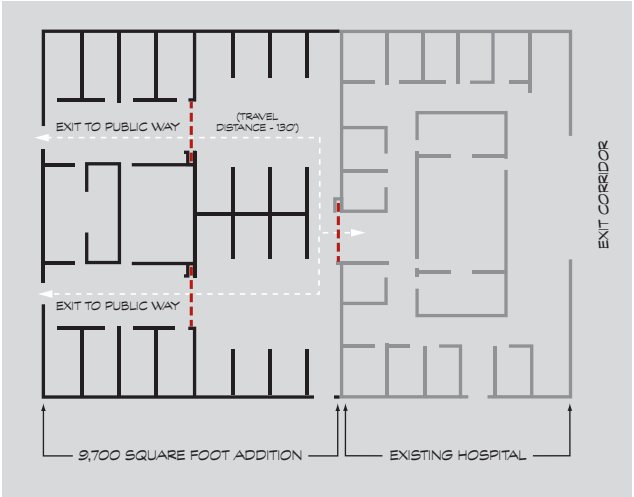
Exception: The adjoining compartment shall not be required to have a stairway or door leading directly outside, provided the area of refuge area into which a horizontal exit leads has stairways or doors leading directly outside and are so arranged that egress shall not require the occupants to return through the compartment from which egress originates.

Design Solutions

CASE 1: Side Acting Accordion with Complying Swing Egress Door



The intent is to add a 10,200 square foot critical care suite onto an existing I-2 (hospital). However code requirements come into play that affect the design dramatically:



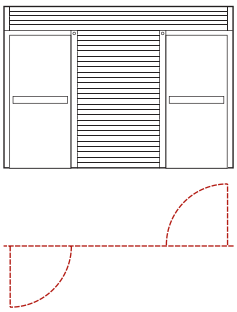
- First, suites of sleeping rooms cannot exceed 10,000 square feet in a sprinklered structure. In this case a 10,200 square foot suite is being added. *(407.4.3.5.1)*
- Second, there must be two exits from each suite. *(407.4.4.5.1)*
- Third, the travel distance between any point in a suite of sleeping rooms and an exit access exit door shall not exceed 125 feet with automatic smoke detection. *(407.4.4.3)*

By utilizing the horizontal exit concept, the following will preserve the original design intent and provide code compliance:

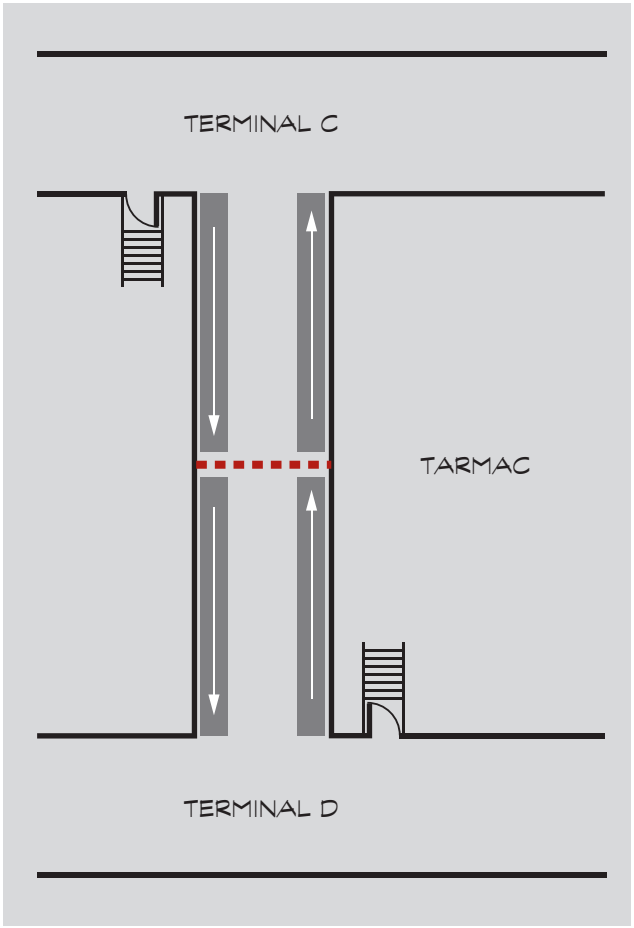
- Separate the intended 10,200 square foot space into two suites, each less than 10,000 square feet.
- Provide a 2-hour fire barrier wall as the separation. *(Section 1026.2)*
- Provide a horizontal exit in the separation as one of two required exits from each space. *(Section 407.4.4.5.2)*
- Provide a 90-minute opening protective. *(Table 716.5)*

EXIT ACCESS SEPARATION

CASE 2: Vertical Coiling with Complying Swing Egress Door(s)



McKEON offers a particularly unique resolve for this airport design. Because the concourse is located above ground level and in a TSA secure area, it is not possible to provide exiting to the exterior. Also, there is not room for build-outs or pocket spaces, therefore unique to the T2500 technology a 90-minute opening protective is provided with no side room and as little as 26 inches of head-room with conforming dual egress doors. In essence each side of a long fire and smoke rated concourse forms one of two areas of refuge.



Inquiry Discussion and Questions

It has been said by many that the horizontal exit is probably one of the least understood and least utilized concepts of the building code. The following questions may be helpful in promoting awareness:

- Do you encounter travel distance problems in areas of the code other than the standard travel distance tables? (This case study for example.)
- When designing a horizontal exit, does the 2-hour wall inhibit the openness of the space under consideration?
- In health care or prison design may I show you how a required smoke barrier can also serve as a horizontal exit?

Notes:

Exit Passageways

Section 1024

An exit passageway provides the designer with an acceptable way of connecting a required exit stair to the exit discharge. Because the code requires an exit stair to open directly into an exit discharge to the exterior of the building, this provision will allow the stair to terminate at convenient locations away from the exterior walls. Also, the exit passageway can extend the path of travel when travel distances in the exit access system have been exceeded.

Fire & Life Safety Concerns

Extending the path of egress beyond the terminated travel distance or beyond the exit vestibule increases the potential for building occupants to be exposed to fire, smoke or hot and toxic gases. For these reasons exit passageways are designed with more strict provisions.

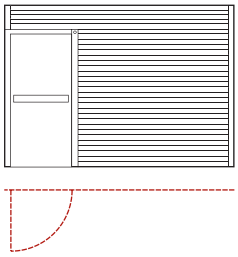
Code Requirements

1. An exit passageway shall not be used for any purpose other than as a means of egress. *(1024.1)*
2. Exit passageway enclosures shall have walls, floors and ceilings of not less than 1 hour … and be constructed as fire barriers or horizontal assemblies. *(1024.3)*
3. Elevators shall not open into an exit passageway. *(1024.5)*
4. Opening protectives shall comply with Section 716 … and shall be limited to those necessary for exit access into the exit passageway from normally occupied spaces and for egress from the exit passageway. *(1024.5)*
5. Where an interior exit stairway or ramp is extended to an exit discharge or a public way by an exit passageway, the exit passageway shall comply with Section 1023.3.1. In other words, the interior exit stair must be separated from the exit passageway by a fire barrier wall equal in rating to the requirement for the interior exit stairway.

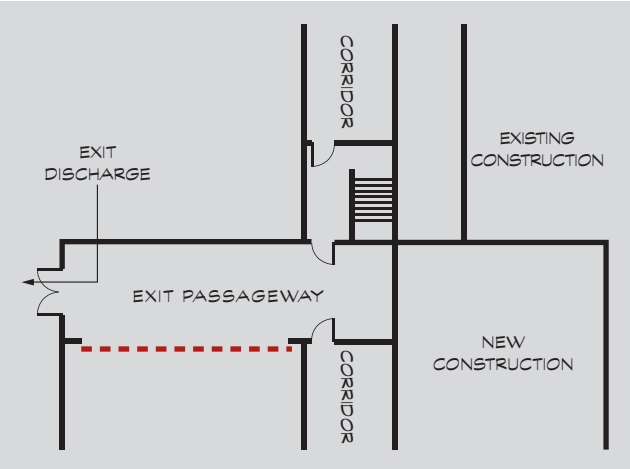
EXIT ACCESS SEPARATION

Design Solution

CASE 1: Vertical Coiling with Complying Swing Egress Door(s)



In this case study the required exit stair from the floors above terminated several feet from the exterior of the building. The McKEON opening protective forms the rated enclosure during a fire emergency, extending the exit path to exit discharge.



EXIT ACCESS SEPARATION

Inquiry Discussion and Questions

Because exit passageways are constructed under strict opening provisions, designs rarely incorporate them unless there is no other choice. With the use of the McKEON wide-span opening protectives, openings are not limited in size and little or no design compromise is noticed by building occupants. The following questions can be helpful in assisting the design professional to recognize new options:

- Have you ever desired to terminate a required exit enclosure on the interior of the building rather than at the exterior exit?
- Do you find challenges in connecting an exit enclosure with the exit to the exterior of the building?
- Did you know that solving a travel distance problem by providing an exit passageway can open your design rather than close it down?

Notes:

Pedestrian Walkways & Tunnels

Section 3014

Walkways and tunnels are designed to provide connection between buildings. They can be located at, above or below grade level and are used as a means of travel by persons.

Fire & Life Safety Concerns

Buildings located across lot lines from each other are required to have fire-rated exterior walls to prevent fire and smoke from passing between them (705; Table 602). Walkways and tunnels that connect and penetrate these rated exterior walls compromise this protection, potentially allowing heat and smoke to pass from one building to another.

Code Requirements

Section 3104 details specific requirements to ensure building occupant safety based upon the following fundamental principles:

Principle #1: Separate Structures. Connected buildings shall be considered to be separate structures *(3104.2)*. Unless the buildings are all on the same lot or exempt under specific accessibility requirements each building will be considered as a separate building when determining fire resistance, exterior wall ratings and egress.

Principle #2: Construction. The pedestrian walkway shall be of noncombustible construction *(3104.3)*. Unless each building being connected is of combustible construction the connecting element must be noncombustible to minimize the travel of heat and smoke.

Principle #3: Fire Barriers. Once the rated exterior walls have been penetrated to accommodate a noncombustible connecting walkway, the interior of each building must be further protected with fire barriers of not less than 2-hour rated construction *(3104.5.1).* In order to avoid this requirement the following criteria must be met:

A. Exterior walls - 2 hour rated, extend not less than 10' in every direction surrounding the perimeter of the pedestrian walkway.

EXIT ACCESS SEPARATION

B. Openings in exterior walls of connected buildings - opening protectives not less than 3/4 hour.

C. Supporting construction - See Section 707.5.1.

Principle #4: Alternative Separation

A Distance between connected buildings is more than 10 feet.

B. Walkway and connected buildings fully sprinklered.

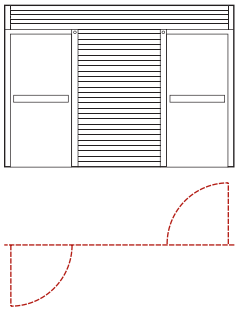
C. The wall shall be capable of resisting smoke.

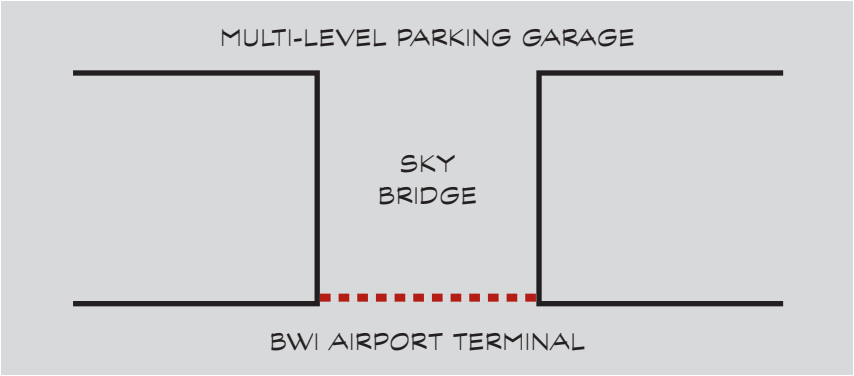
D. The wall and doors can be constructed of wired or tempered glass that is protected with sprinklers. All glass in gasketed frames.

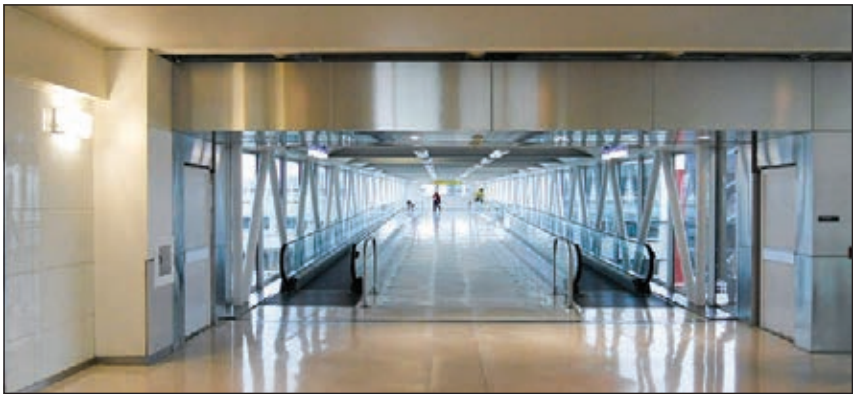
Design Solutions

The alternatives to fire barrier separations as listed above are very costly. Complying with the 2-hour separation requirement in Section 3104.5 is the least expensive option. A listed and labeled wide span McKEON assembly will easily protect any size opening. In the following case studies, McKEON showcases three distinctly different technologies to resolve the same code application problem. Diverse design requirements were not a challenge, rather routine applications of standard products.

CASE 1: Vertical Coiling with Complying Swing Egress Door(s)

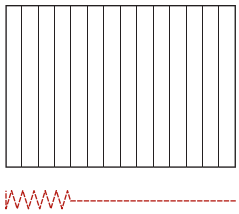


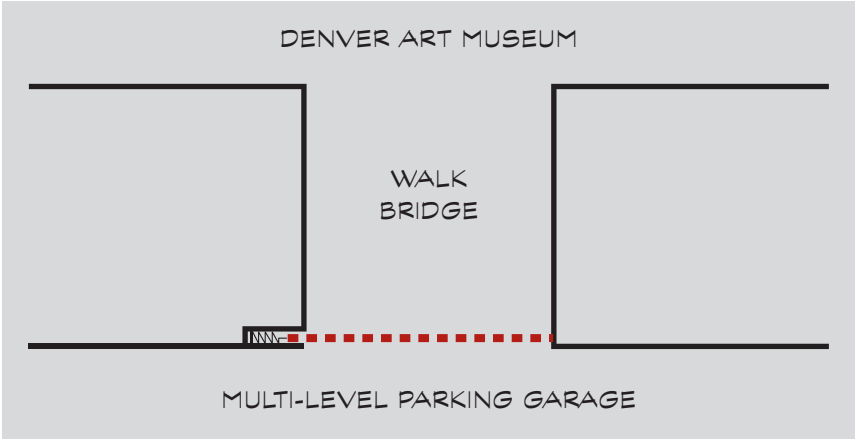




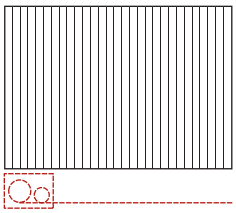
EXIT ACCESS SEPARATION

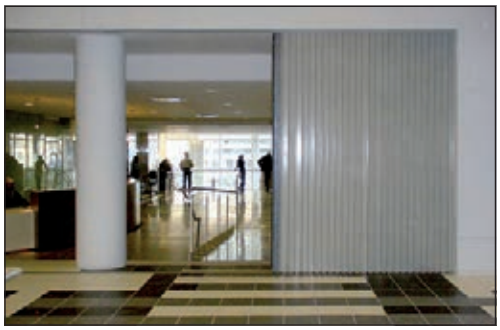
CASE 2: Side Acting Accordion with Power-assisted Egress

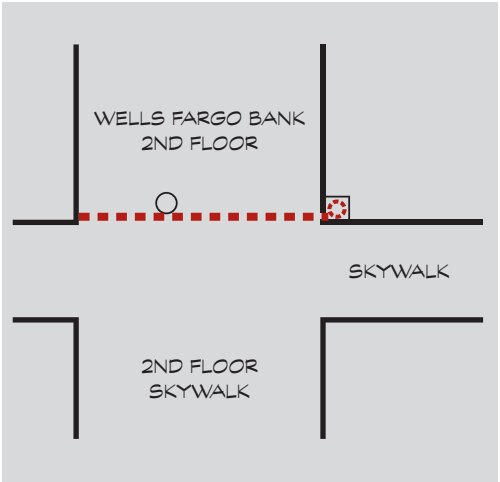




CASE 3: Side Coiling without Egress







EXIT ACCESS SEPARATION

Inquiry Discussion and Questions

Pedestrian walkways can be located overhead connecting two or more buildings or underground as tunnels connecting two or more buildings. This connecting construction is viewed as a definite threat to life safety. The code attempts to build in safety measures that are intended as substitutes for complete and optimum separation. These substitutes include extensive active wet sprinkler systems, open side walls, and tempered and/or wire glass components. It would certainly make more sense to use the "real thing" by easily providing rated barriers with wide-span opening protectives at each end eliminating any threat of fire and smoke entering the walkways.

The following questions may be helpful:

- Have you been able to run a cost comparison separating the building from the walkway as opposed to protecting the walkway?
- Even though a pedestrian walkway will most likely be constructed of non-combustible materials, would you like to avoid the cost of sprinklers, limiting interior design and costly tempered and/or wired glass components?

Notes:

3 Vertical Opening Separation

Fundamental Guidelines

Draft Curtains

Exit Access Stairways

Vertical Openings – Escalator

Interior Exit Stairways

Atriums

Vertical Compartmentation

Fundamental Guidelines

Sections 404, 712, 713, 1019, 1023 & 1027

Vertical openings between floors are designed consistently in multi-story buildings in many different shapes, heights and uses. For the purposes of code enforcement the following general categories are described in the building code:

1. **Shaft Enclosures *(713)***
   - a. **Escalators *(712.1.3)***
   - b. **Mezzanines *(712.1.11, 505)***
   - c. **Stairs *(712.1.12, 1019, 1023, 1027)***
   - d. **Elevators *(3006)***
2. **Atriums *(404)***
3. **Interior Exit Stairways and Ramps *(Section 1023)***
4. **Exit Access Stairways *(712.1.12, 1019)***

Typically anytime two or more floors are open to each other a vertical opening is created and the phrase “floors are common with each other” is used to characterize the condition.

Two fundamental principles drive the requirements of vertical opening protection. First, the migration of smoke, heat and toxic gases floor to floor. Second, egress of building occupants from upper levels to a safe level of exit discharge.

The case studies in this section illustrate the balance between these two principles in the enforcement of fire & life safety provisions for building occupants in multi-story buildings.

Understanding Draft Curtains & Closely Spaced Sprinklers as Vertical Space Fire Protection Features

Sections 712.1.3.1 & 1019.3, #4

Draft curtains and closely spaced sprinklers, in accordance with NFPA 13, may be used in lieu of shaft enclosure construction in specific vertical opening applications.

Because of the chimney effect that can take place in vertical openings in multi-story structures, smoke, heat, toxic fumes and gases easily transfer throughout the structure. The optimum regulatory provision that prevents or mitigates this condition is the construction of solid fixed walls that are fire-rated as shaft enclosures separating vertical spaces from the remaining structure and floor areas. However, certain conditions allow the use of draft curtains in lieu of Fire Barrier walls.

Draft curtains are intended to accelerate the activation of sprinklers placed around the perimeter of vertical openings in order to provide an instant water barrier. This is a level of protection that can take the place of the rated wall construction and mitigate the transfer of smoke, heat, toxic fumes and gases which may be transferring vertically through the structure during a fire event.

The code addresses the use of draft curtains in two specific applications only. Both are penetrations through floor openings with the first being the escalator and the second, exit access stairways.

Escalator Openings

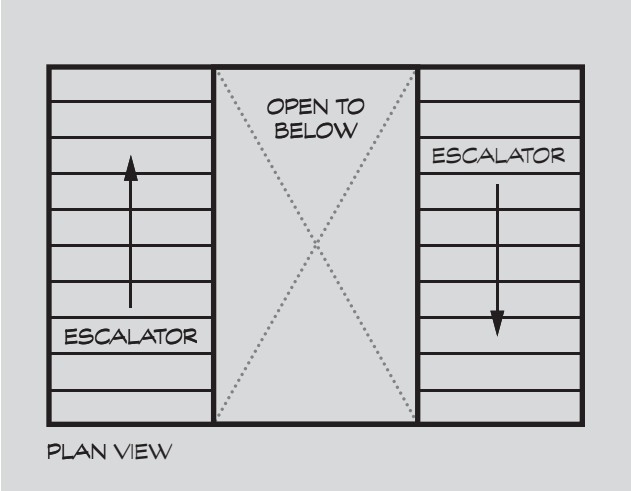
Section 712.1.3 Escalator openings. Where a building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, vertical openings for escalators shall be permitted where protected in accordance with Section 712.1.3.1 or 712.1.3.2.

Section 712.1.3.1 Opening size. Protection by a draft curtain and closely spaced sprinklers in accordance with NFPA 13 shall be permitted where the area of the vertical opening between stories does not exceed twice the horizontal projected area of the escalator. In other than Groups B and M, this application is limited to openings that do not connect more than four stories.

Section 712.1.3.2 Automatic shutters. (Please see the application study in this document titled, “Vertical Openings – Escalator.”)

The use of the draft curtains with closely spaced sprinklers in escalator openings as outlined in the aforementioned code language only applies when the area of the escalator itself obstructs at least half of the area of the opening being pen-

etrated. The following diagram illustrates a compliant application of this criteria. It is important to remember, this condition is acceptable only when the building is fully sprinklered.

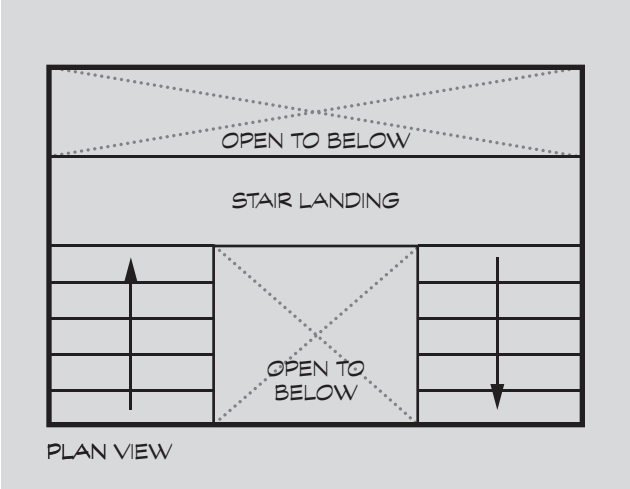


Exit Access Stairway Openings

Section 1019.3 Occupancies other than I-2 and I-3. In other than Group I-2 and I-3 occupancies, floor openings containing exit access stairways or ramps that do not comply with one of the conditions listed in this section shall be enclosed with a shaft enclosure constructed in accordance with Section 713.

Condition 4. Exit access stairways and ramps in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, where the area of the vertical opening between stories does not exceed twice the horizontal projected area of the stairway or ramp and the opening is protected by a draft curtain and closely spaced sprinklers in accordance with NFPA 13. In other than Group B and M occupancies, this provision is limited to openings that do not connect more than four stories.

Using language similar to the escalator provisions, the use of draft curtains with closely spaced sprinklers in exit access stairway openings only applies when the area of the stair, to include any landings, obstructs at least half of the area of the opening being penetrated. The diagram below illustrates a compliant application of this criteria. It is important to remember, this condition is acceptable only when the building is fully sprinklered.



A Code Discussion for Clarification

The design and code provisions governing the application and use of draft curtains do not require side-guide components or fire endurance testing and do not parallel typical opening protective acceptance criteria. Since the adoption and development of the *2015 edition of the International Building Code (IBC),* the use of draft curtains in any project are for the sole purpose of creating barriers to force heat to activate sprinkler heads in vertical openings such as escalators and exit access stairways. Draft curtains are not intended to prevent smoke from migrating floor to floor, rather their purpose is to assist in immediate activation of the closely spaced sprin-

klers, associated with them, which are intended to mitigate the migration of smoke and/or heat floor to floor.

Background

In the legacy model building codes and all editions of the IBC prior to the published 2015 edition, draft curtains were a requirement in two separate areas of the code with criteria and detailed definition in one area only. First, we will explore the use where these criteria and definitions occurred, Factory and Storage occupancies, as defined in *Chapter 9, Fire Protection Systems. Section 910.3.5.1* stated: *Construction. Draft curtains shall be constructed of sheet metal, lath and plaster, gypsum board or other approved materials which provide equivalent performance to resist the passage of smoke. Joints and connections shall be smoke tight.* In essence, draft curtains could be constructed of cardboard and duct tape … as long as they channeled smoke.

This code language was written around the stringent requirements of Group F-1 and S-1 occupancies as indicated in *Table 910.3.* In these hi-pile storage occupancies there was no requirement for draft curtains to be fire rated, only that they "resist the passage of smoke." Achieving smoke tight joints and connections were critical due to exceptions in the code section that allowed the reduction of smoke vents, their sizes and placement with the use of draft curtains. In other words, this specific language was confined to these two aforementioned occupancy types. Incidentally, this code requirement was eliminated in the 2015 edition of the IBC, the term draft curtain no longer exists for F-1 and S-1 occupancies. These particular smoke removal systems no longer require draft curtains for directing smoke.

Current Provisions

Section 712 Vertical Openings, 712.1.3.2 allows unprotected escalator openings that are protected by draft curtains. *Section 1019* addresses *Exit Access Stairways* allowing draft curtains to protect vertical openings. However, these two code sections (applications) did not reference *Section 910* prior to 2015 confirming separate and distinct uses of the provision. However, both the escalator and exit access stairway applications include a pointer to *NFPA 13* as the standard for the use of this building feature. *Section 712.1.3.1 Opening size* at the escalator opening and *Section 1091.3, Item #4* at the exit access stairway opening state the following: "… protection[ed] by a draft curtain and closely spaced sprinklers in accordance with NFPA 13 …"

Please note, there are no other definitions or criteria for the term draft curtain in the model building codes with exception of the reference to *NFPA 13.* Yet, the term draft curtain is called out in both aforementioned code sections. Further to confuse the issue the term Draft Stop is found in *IBC Section 202.* After reading this definition, clearly it is addressing a building feature located in *"… concealed areas of building components such as crawl spaces, floor/ceiling assemblies, roof/ceiling assemblies and attics."*

As if the issue is not confusing enough, *NFPA 13* addresses vertical openings such as escalator openings and stair openings with regard to this level of protection as Draft Stops rather than using the term Draft Curtain. Please note:

NFPA 13, Section 8.15.4 Vertical Openings

8.15.4.1 General. Unless the requirements of 8.15.4.4 are met, where moving stairways, stair-

cases, or similar floor openings are unenclosed and where sprinkler protection is serving as the alternative to enclosure of the vertical opening, the floor openings involved shall be protected by closely spaced sprinklers in combination with draft stops in accordance with 8.15.4.2 and 8.15.4.3.

8.15.4.2 Draft Stops. Draft stops shall meet all of the following criteria:

1. *The draft stops shall be located immediately adjacent to the opening.*
2. *The draft stops shall be at least 18 in. (457 mm) deep.*
3. *The draft stops shall be of noncombustible or limited combustible material that will stay in place before and during sprinkler operation.*

The term draft curtain does appear in *NFPA 13,* however, only in reference to the old method of channeling smoke to smoke and heat vents in "F" & "S" occupancies. Therefore, the use of draft curtains in our current model building codes is limited to escalator and exit access stairway openings only. Since NFPA 13 criteria for use of draft curtains in vertical openings does not require the channeling of smoke, rather to simply force heat and smoke against the sprinkler heads for immediate activation, the criteria does not include large depths of drop beyond 18 inches nor does it require smoke sealed corners or joints in the curtain installation.

If we examine this concept from a more pragmatic view we can see that the criteria makes sense. As mentioned above, the maximum drop in the draft stop criteria for these applications is 18 inches. If the intent of the draft curtain application was to stop the transfer of smoke or heat to other floors, this depth would have to be much greater. At some point, very quickly upon contact the smoke will easily pass over these draft curtains and the curtains become academic at that point. Hence, draft curtain applications in escalators and stairs always have gaps at the joints, are typically constructed of polymethyl methacrylates which by trade-name are better known as clear acrylics or Plexiglass. These or other materials are usually not continuous or installed in a fashion to actually prevent smoke from migrating floor to floor … their only purpose is to force enough heat against the sprinkler heads to activate them.

For this reason there is not a test standard or criteria for testing draft curtains. *NFPA 13* simply requires, *"The draft stops shall be of noncombustible or limited combustible material …"* The D100 technology significantly exceeds these basic requirements. The McKEON SmokeFighter® Model D100 is manufactured from fabric that has been tested and certified for a 3-hour UL 10D fire label. This material has also been tested and certified for a 20 minute UL 10B fire label. Both labels certify use to span unlimited widths and heights. The test criteria included side-guide components in order to maintain full integrity opening protective hose stream performance.

The D100 technology exceeds the minimum requirements, creating a substantial fire and smoke barrier to expeditiously activate the closely spaced sprinklers surrounding the vertical opening. Sprinkler activation at the unprotected shaft opening mitigates the migration of heat, smoke, toxic fumes and gases from traveling throughout the structure.

Exit Access Stairways

Sections 712, 1019

These case studies deal with a condition wherein several floors are common to each other. The floors are inter-connected with an interior exit access or communicating stairway. Previous editions of the code addressed these stair features as non-egress stairs. The code now defines Exit Access Stairways as a stairway within the exit access portion of the means of egress system. ***(202)***

Fire & Life Safety Concerns

Multiple floors open to each other is perhaps one of the most vulnerable conditions to fire danger threats in any multi-story building. Fire suppression is concerned with confining a fire to the floor of origin and preventing the fire, or the products of the fire (smoke, heat and hot/toxic gases) from spreading to other levels. Such conditions are not conducive to defend in-place strategies. Rather, it is preferable that building occupants move quickly out of harm's way. These requirements expressly demonstrate the overlap between passive, active and egress fire & life safety provisions.

Code Requirements

In occupancies other than I-2 and I-3, floor openings containing exit access stairs that do not comply with one of the following … shall be enclosed in a shaft enclosure. *(1019.3)*

- The exit access stairway must be included in the exit access travel distance measurement. *(1017.3.1)*
- Serve or atmospherically communicate between only two stories *(1019.3, Item #1)*
- Options to open four stories or more than four stories using draft curtains and closely spaced sprinklers (1019.3, Item #4, please see page 34, Draft Curtains)

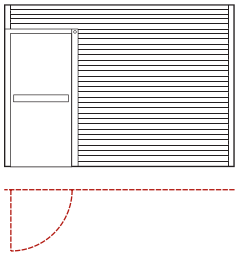
For additional code language and acceptance criteria for two-story openings please see "Inquiry Discussion & Questions" on page 42 of this application study.

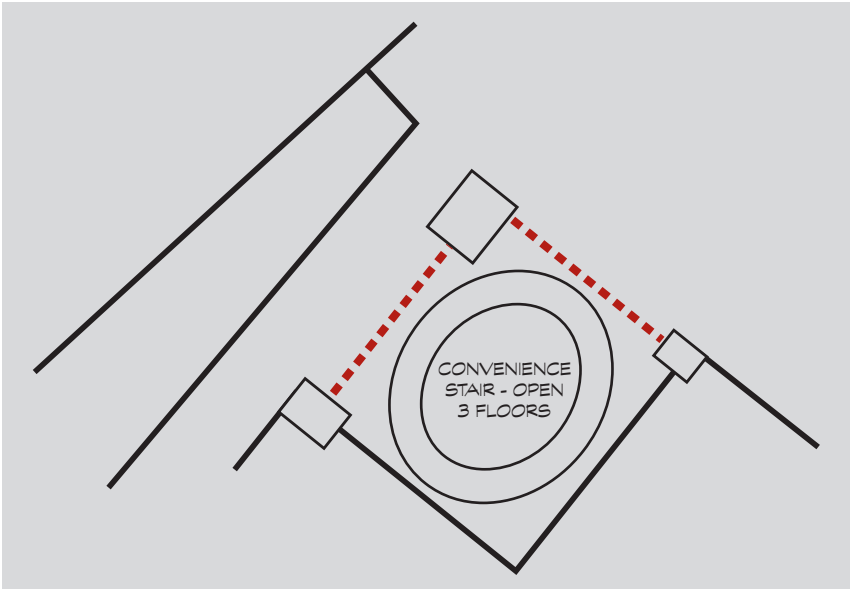
VERTICAL OPENING SEPARATION

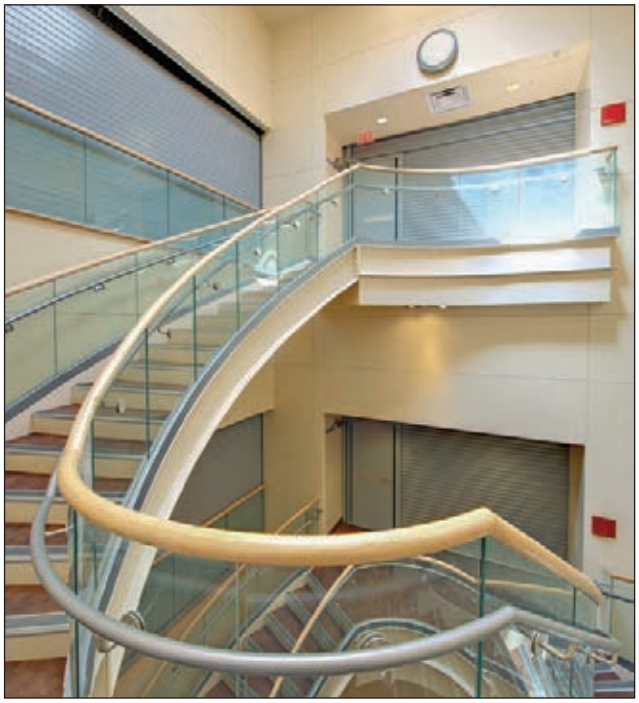
Design Solutions

Because each space contains a stair the code will allow two floors common. In the following case studies, McKEON offers different products for very diverse design needs, yet there is not a compromise in fire and life safety.

CASE 1: Vertical Coiling with Complying Swing Egress Door(s)

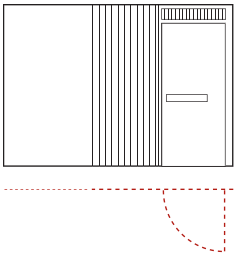




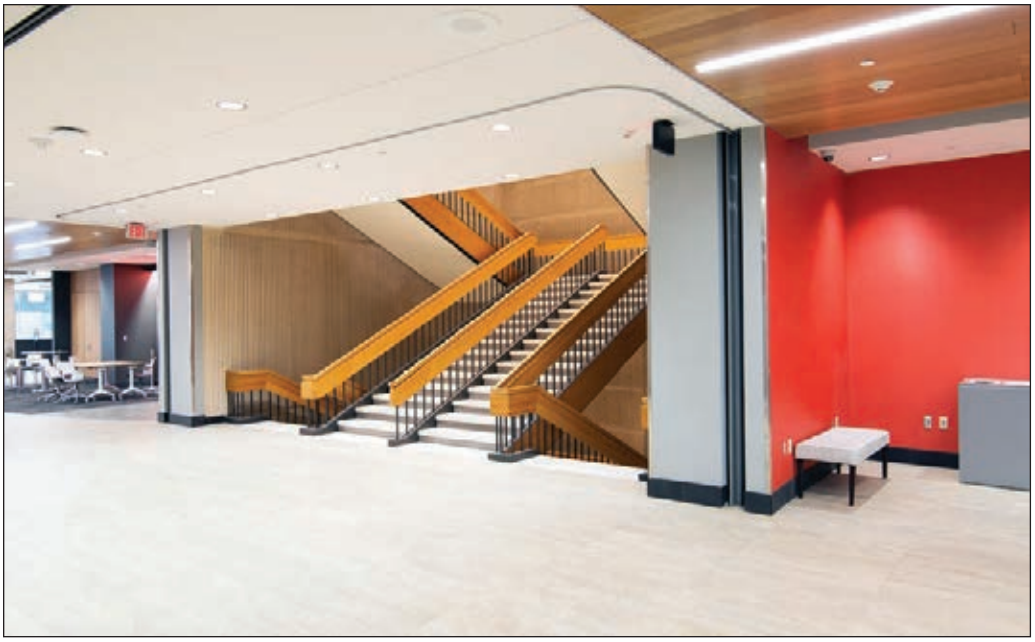


VERTICAL OPENING SEPARATION

CASE 2: Side Acting with Complying Egress Door(s)

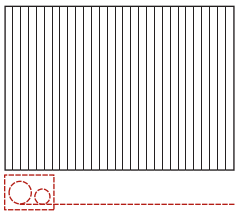


In the second case study a convenience stair within a university learning center is open to each floor it connects during normal school operation. When the building goes into alarm two McKEON 3-hour side acting assemblies, each with a conforming egress swing door and conventional fire exit hardware, combine to provide shaft enclosure protection.

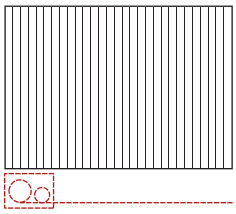


VERTICAL OPENING SEPARATION

CASE 3: Extreme Height & Width Side Coiling without Egress



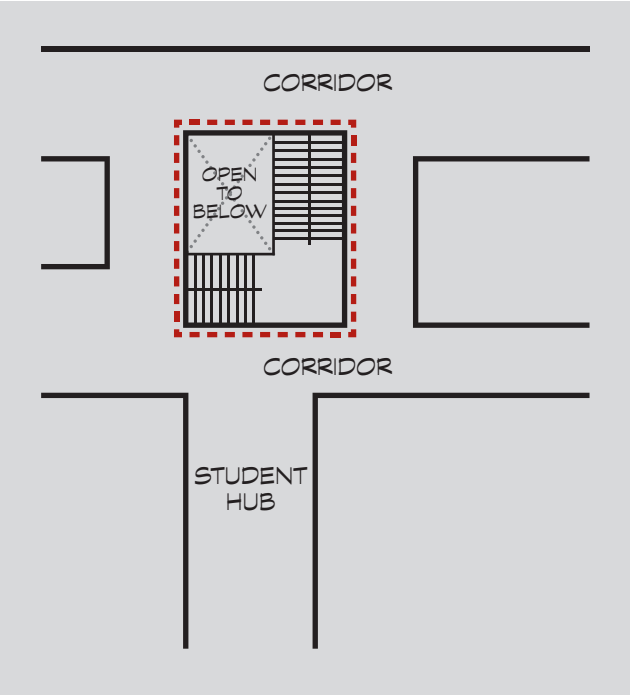
CASE 4: Side Coiling without Egress



VERTICAL OPENING SEPARATION

CASE 5: Deployable Draft Curtains & Closely Spaced Sprinklers

The McKEON D100 draft curtains deploy when there is a fire emergency. During normal hours of building occupancy, unlike conventional fixed draft curtains, the ceiling space around the vertical opening is clear of any obstacles.



VERTICAL OPENING SEPARATION

Inquiry Discussion & Questions

These applications, at first glance, would seem to fall under the atrium provisions because there are at least two floors common to each other. Notwithstanding the third floor is separated from the other two, the definition of an atrium is two or more floors interconnected. The purpose for separating floors in order to create only two floors common is to consider the space under the vertical opening provisions of Section 712 in lieu of the atrium provisions in Section 404. Aside from the exit access stairway provisions referenced in Section 712 and detailed in Section 1019, the code includes additional acceptance criteria for two-story openings. Essentially, in other than Groups I-2 and I-3 a floor opening that is not used as one of the applications already listed in Section 1019 or 712.1.9 shall be permitted if it complies with all of the following seven criteria:

1. Does not connect more than two stories.
2. Does not contain a stairway or ramp required by Chapter 10.
3. Does not penetrate a horizontal assembly that separates fire areas or smoke barriers that separate smoke compartments.
4. Is not concealed within the construction of a wall or floor/ceiling assembly.
5. Is not open to a corridor in Group I and R occupancies.
6. Is not open to a corridor on nonsprinklered floors.
7. Is separated from floor openings and air transfer openings serving other floors by construction conforming to require shaft enclosures. *(712.1.9)*

The following questions may be helpful:

- Do you have clients who wish to occupy multiple floors with a vertical common area connecting all floors?
- Can I show you how interconnecting unenclosed stairs can be incorporated into the design without creating shaft enclosures or complying with atrium provisions?
- Have you been concerned attempting vertical space separation avoiding the closed-in shaft appearance?
- Did you know there is technology available to offer a wide-span opening protective to separate vertical spaces that can also serve as the required exit from unenclosed stairways?

Notes:

Vertical Openings – Escalator

Sections 712.1.3

An escalator provides convenient movement for building occupants communicating multiple floors. However, escalators are typically not a part of the required means of egress.

Fire & Life Safety Concerns

Openings through floors allow fire – or the products of fire (smoke, heat and hot toxic gases) – to spread to other floors. Enclosing these spaces in rated shaft enclosures is certainly the most proficient method of mitigating fire and smoke migration between floors. However, the code incorporates optional provisions as exceptions to the completely sealed vertical shaft.

Code Requirements

The following exceptions are allowed in lieu of creating a shaft:

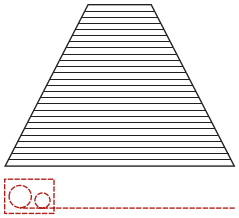
Escalators must be enclosed unless the design incorporates the following requirements: *(712.1.2)*

First, an automatic sprinkler system must be installed throughout the entire building and, secondly an escalator must NOT be in a portion of the means of egress system. If both of these issues are satisfied then the following criteria must be met:

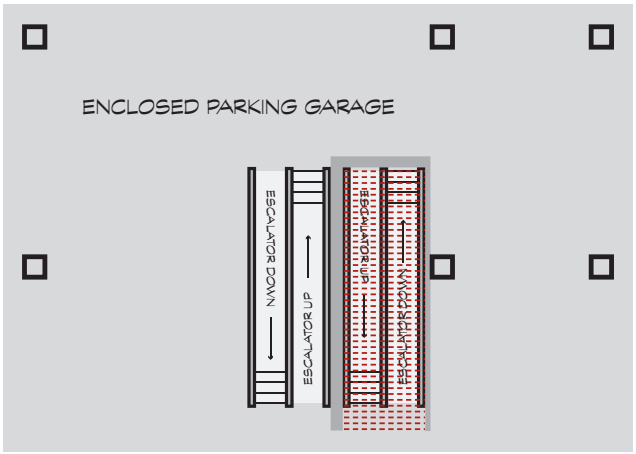
1. The area of the floor opening between stories does not exceed twice the horizontal area of the escalator. *(712.1.3.1)*
2. The opening is protected by a draft curtain and closely spaced sprinklers in accordance with NFPA 13. *(712.1.3.1)*
3. In other than Groups B and M, this application is limited to openings that do not connect more than four stories. *(712.1.3.1)*

Design Solutions

CASE 1: L-Shape Horizontal Shutter

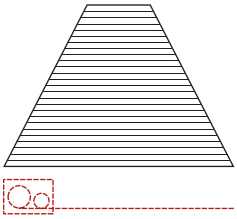


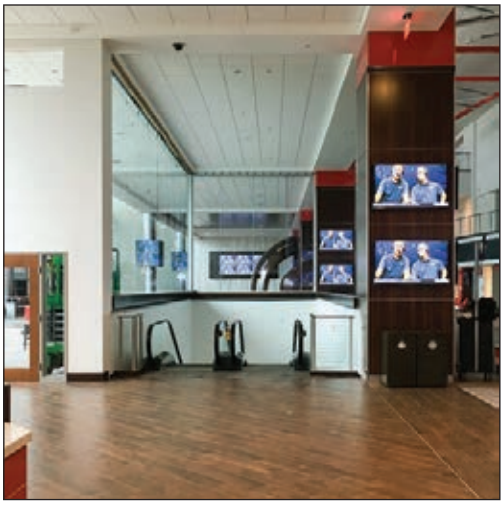
While a parking garage doesn't require an aesthetically pleasing solution, from a life safety perspective the need for fire and smoke protection is the same. A 2-hour rated horizontal shutter satisfies both the basic requirement of opening protection and enclosure of the escalator.



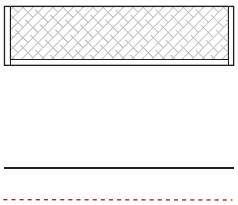
VERTICAL OPENING SEPARATION

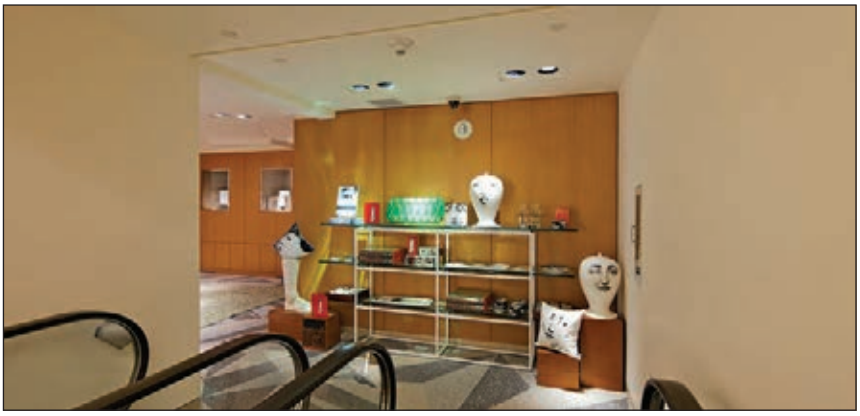
CASE 2: L-Shape Horizontal Shutter





CASE 3: Deployable Draft Curtains & Closely Spaced Sprinklers





VERTICAL OPENING SEPARATION

Inquiry Discussion & Questions

Escalators, whether in high-profile locations or low-profile parking garages, cannot be limited to the design criteria as stated above and maintain the desired ambiance of the space.

The following questions may be helpful:

- Would you like to use the escalator as a required exit?
- Have you considered the cost difference between a shaft enclosure and the open escalator design requirements?
- Have you considered wide-span opening protectives as an alternative to conventional swing doors in shaft enclosure walls?

Notes:

Interior Exit Stairways

Section 1023

Exit enclosures extend vertically through the interior of multi-story buildings in order to ensure timely and safe evacuation of occupants during an emergency. These enclosures include exit stairs and exit ramps.

Fire & Life Safety Concerns

Because exit enclosures penetrate horizontal floor and ceiling assemblies, fire, heat, smoke and toxic gases can potentially penetrate into building spaces at each floor level. Therefore, enclosures become critical barriers of protection for building occupants. The protected enclosure will be a non-contaminated exit path for at least one hour in buildings less than four stories and two hours in buildings four stories or more.

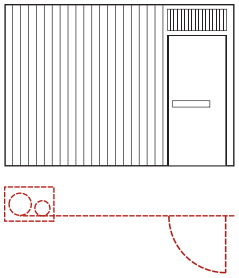
Code Requirements

1. Interior exit stairways shall be enclosed with fire barriers in accordance with Section 707. *(1023.2)*
2. Exit enclosures in buildings connecting four stories or more shall be rated at 2 hours; less than four stories at 1 hour. *(1023.2)*
3. Openings and penetrations shall be rated in accordance with Section 716. *(1023.4)*

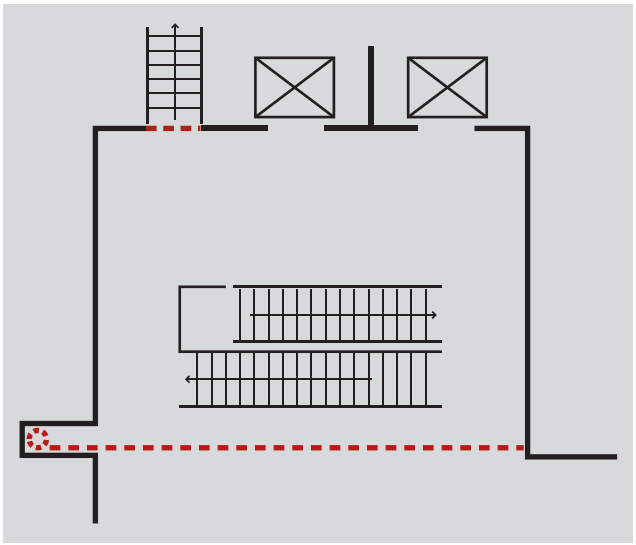
VERTICAL OPENING SEPARATION

Design Solutions

CASE 1: Side Coiling with Complying Swing Egress Door(s)

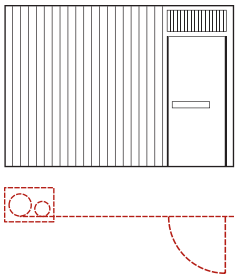


An absence of stacking space dictated use of a unique McKEON product to seal this exit enclosure. The side coiling assembly requires a small box-like space, projecting the 3-hour steel curtain with conventional egress door along a very narrow pocket entry point and header slot path. When deployed, complete compliance with shaft enclosure opening protective requirements is achieved.

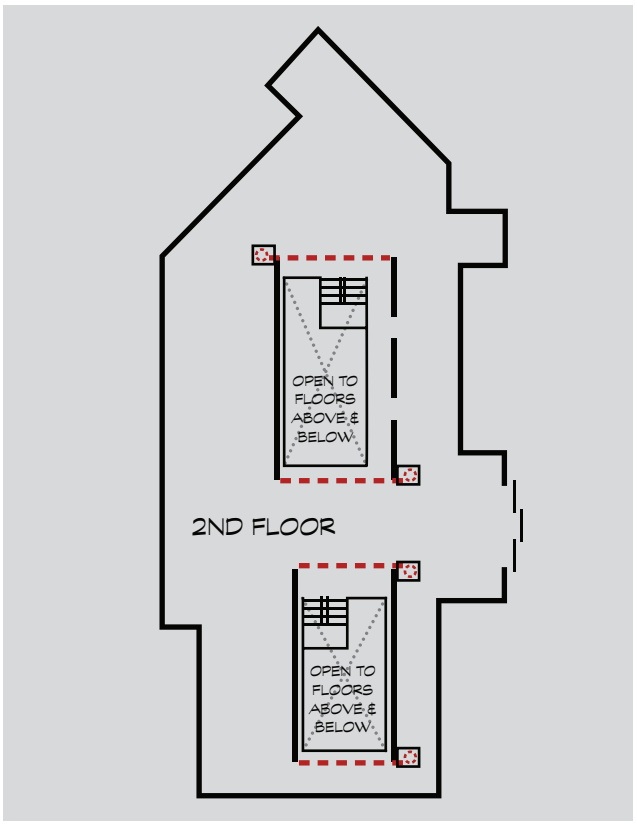


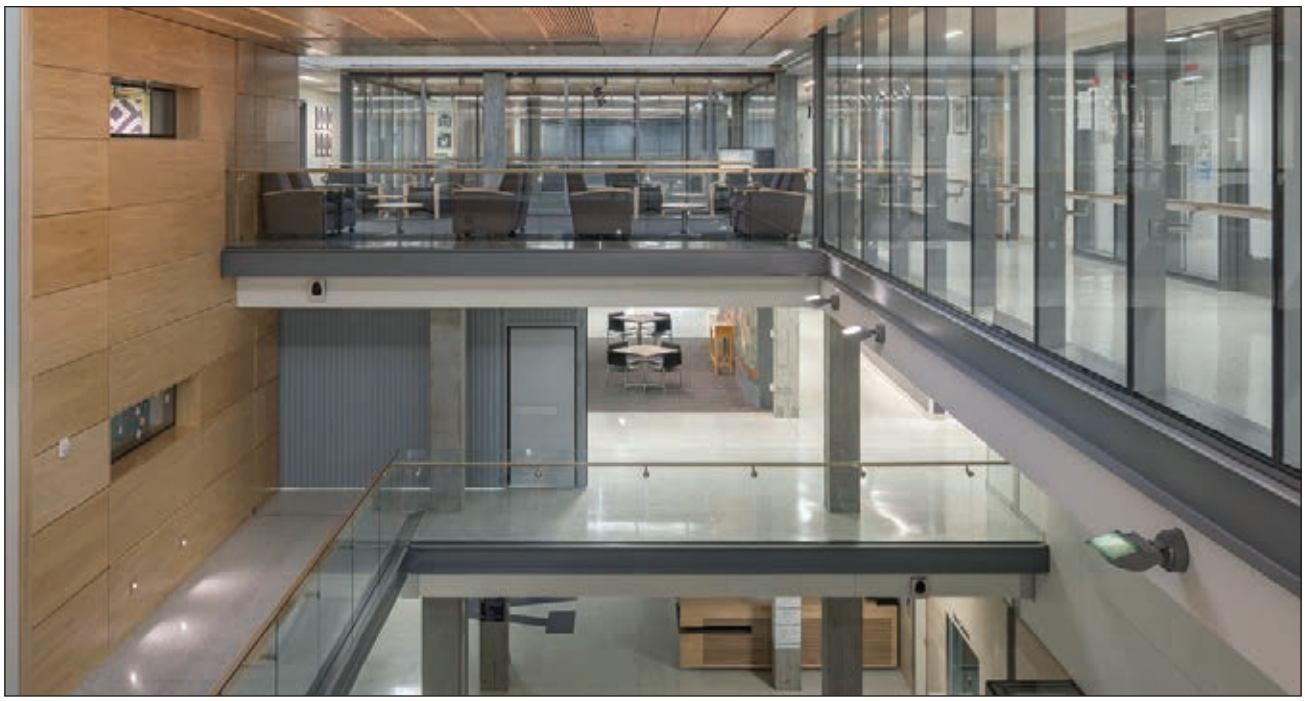
VERTICAL OPENING SEPARATION

CASE 2: Side Coiling with Egress



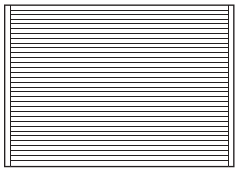
A fixed swing door within the parameters of a lengthy side coiling 3-hour assembly provides a simple resolve in a multi-floor challenge of vertical separation and egress.



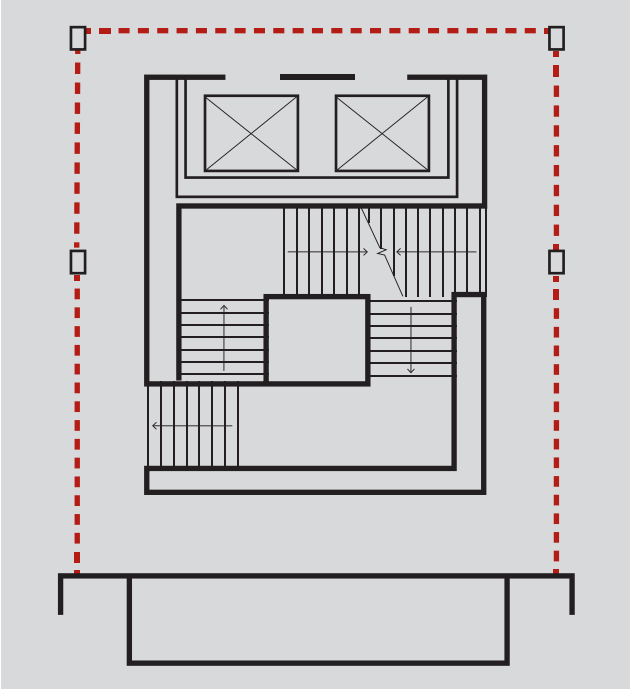


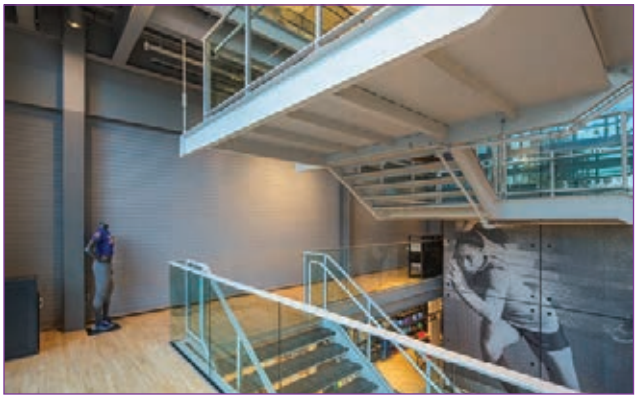
VERTICAL OPENING SEPARATION

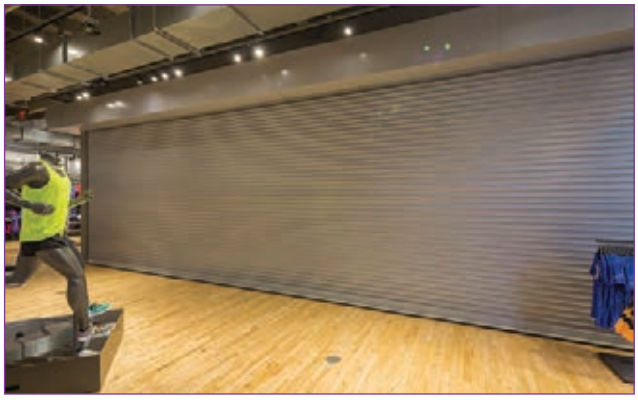
CASE 3: Vertical Coiling without Egress



Shaft enclosures that protect a required means of egress are extremely critical to the life safety of building occupants. From a design perspective it is often challenging to incorporate opening protectives in hi-profile open spaces. This extreme width vertical coiling assembly fits narrow header lines, has inconspicuous side guides, and deploys with adequate separation only when the building goes into alarm.







VERTICAL OPENING SEPARATION

Inquiry Discussion & Questions

Required exit stairs in vertical shaft enclosures ensure building occupant safe evacuation. Historically the designs of openings at the level of exit discharge have been limited to conventional side-hinged swinging doors. The acceptance of the McKEON products as both wide-span opening protectives as well as a complying egress doors provide the designer flexibility without compromising code compliance.

The following questions may be helpful:

- Do you find building owners and maintenance groups struggling with door swing and maintenance on door hardware in high-traffic spaces?
- Do you seek an open and spacious appearance at the landing area of vertical stair enclosures?
- Would you like to use a required vertical exit stair shaft as an aesthetically pleasing communicating stair by opening the enclosure area at each floor?

Notes:

Atriums

Section 404

An atrium is a floor opening, or a series of floor openings, that connects the environment of adjacent stories. By code definition an atrium is a space within a building that extends vertically and connects two or more stories. Atriums are designed to provide open and spacious vertical areas common with other building elements.

Fire & Life Safety Concerns

Unprotected vertical openings are often cited as the factor responsible for fire spread in incidents involving fire fatalities and/or extensive property damage. Section 404 addresses the need for protection of these specific building features in lieu of providing a complete floor and/or vertical shaft separation. In simple terms, the atrium provisions are extremely restrictive because a complying atrium is a shaft enclosure.

Code Requirements

Vertical common areas that comprise an atrium are not considered unprotected, rather the atrium is considered a protected space by means other than a conventional "walled-in" shaft enclosure. Listed below are the specific provisions allowing atriums to be open and spacious yet considered a conforming shaft enclosure:

1. The atrium floor area is permitted to be used only for low-hazard uses unless the individual space is provided with an automatic sprinkler system. *(Section 404.2)*
2. An approved automatic sprinkler system shall be installed throughout the entire building. *(Section 404.3)*
3. A fire alarm system shall be provided. *(Section 404.4)*
4. Engineered smoke control system – this system shall be installed in accordance with Section 909 when the atrium space exceeds more than two floors. *(Section 404.5)*
5. Atrium spaces shall be separated from adjacent spaces by 1-hour fire barrier construction unless at least one of the following exceptions are met: *(Section 404.6)*
   - A glass wall forming a smoke partition where automatic sprinklers are spaced 6 feet or less along both sides of the separation wall, or on the room side only if there is not a walkway

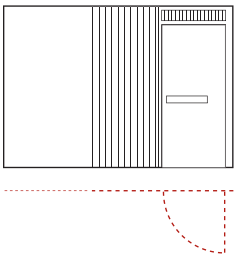
on the atrium side, and between 4 and 12 inches away from the glass … the entire glass surface must be wet upon activation … the glass shall be mounted in a gasketed frame … *(404.6)*

- Provide a glass block wall assembly in accordance with Section 2110 … *(404.6)*
- Fire barrier walls are not required between the atrium and adjoining spaces where the atrium is not required to have a smoke control system. *(404.6)*
- The adjacent spaces of any three floors of the atrium shall not be required to be separated from the atrium … if included in the smoke control calcs. *(404.6)*
- Smoke control equipment must be on a standby power system. *(Section 404.7)*
- The atrium interior finish of walls and ceilings must be not less than Class B. *(404.8)*
- With the exception of the lowest atrium level, the required means of egress in the exit access system travel distance shall not exceed 200 feet. *(404.9)*

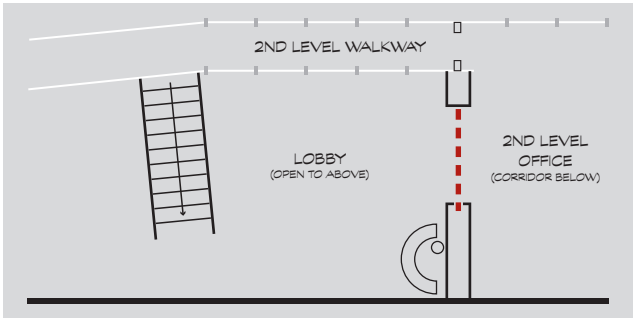
Design Solutions

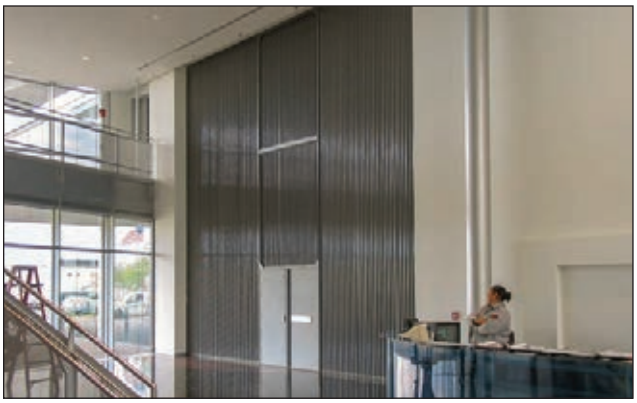
The use of deployable wide-span opening protectives in vertical atrium spaces, both vertically and horizontally, can significantly reduce construction and maintenance costs.

CASE 1: Side Acting with Complying Swing Egress Door(s)



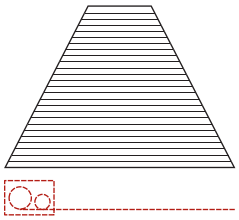
This unique case study features another McKEON product for resolving multiple design/code challenges simultaneously. The lower floor travel path is a required design feature for egress and – combined with the non-rated second floor overlook – is certainly a very creative solution. However, without the side acting, extreme height and egress conforming McKEON assembly this would not be possible!



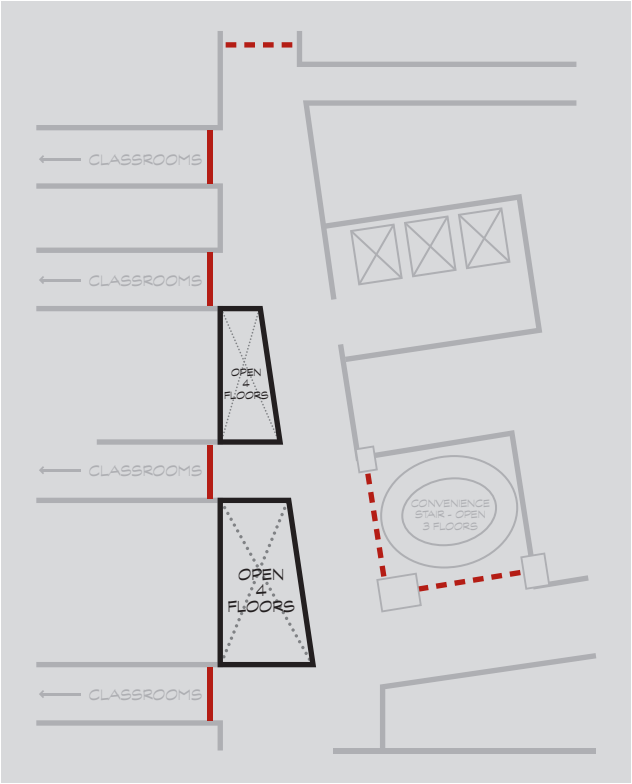


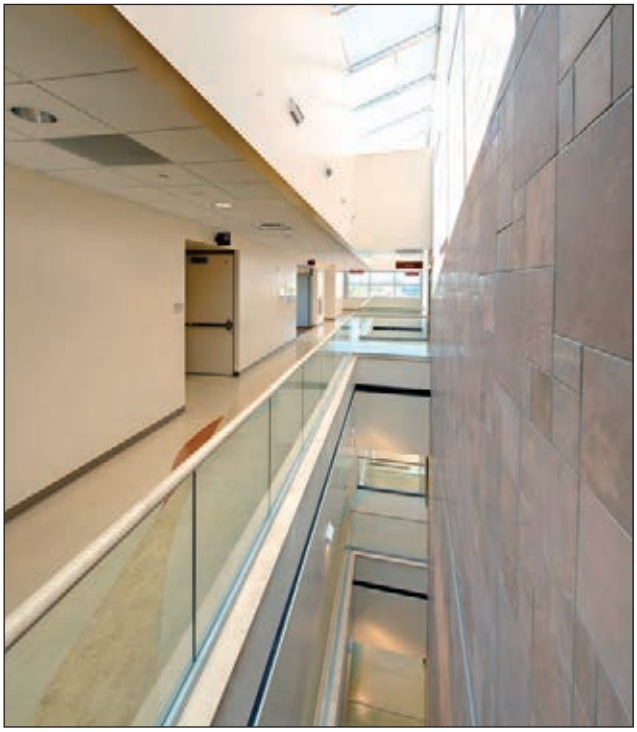
VERTICAL OPENING SEPARATION

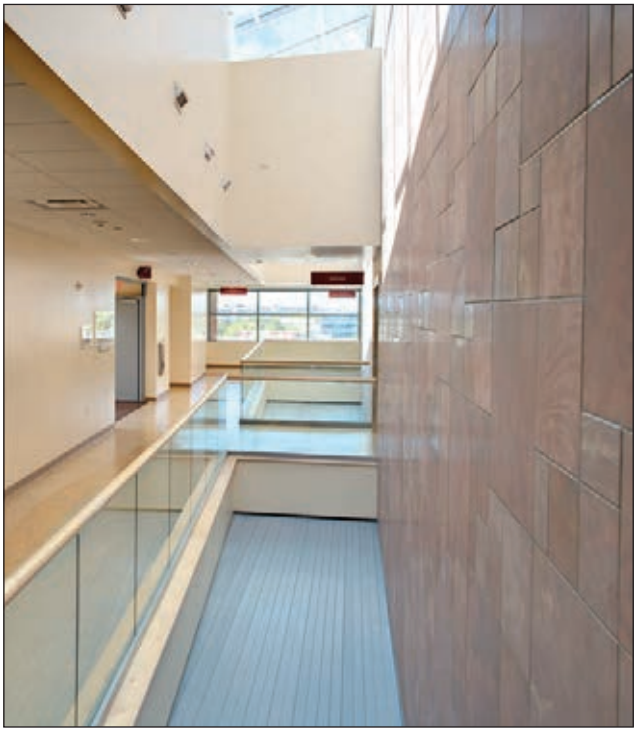
CASE 2: Horizontal (Floor) Shutter



In this case study the atrium space is essentially converted to a vertical compartment separation using the McKEON horizontal shutter. Please refer to the "vertical compartmentation" case studies at the end of this section for more information. Note the absence of any smoke evacuation systems!

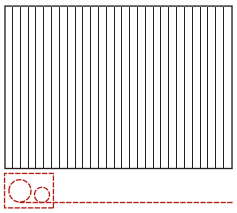


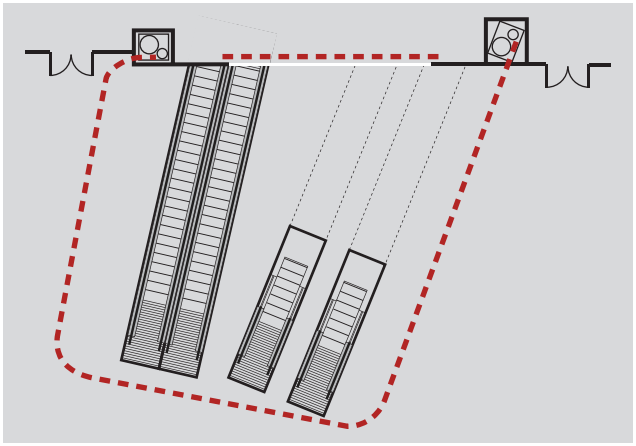




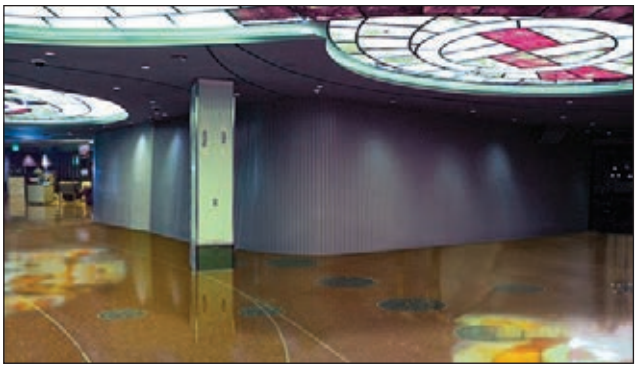
VERTICAL OPENING SEPARATION

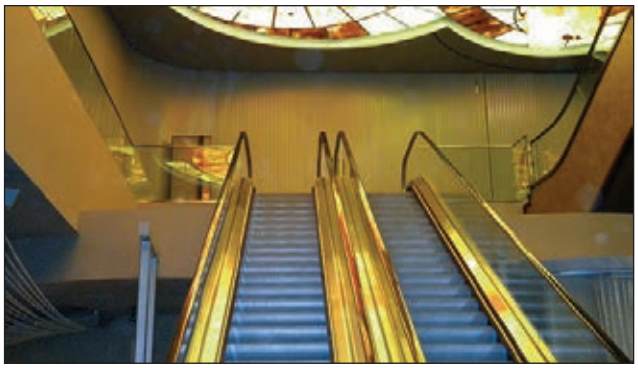
CASE 3: Side Coiling without Egress





Even though this design incorporates an escalator, Item #2.1 under Exception #2 can only be applied if the area of the floor opening between stories does not exceed twice the horizontal projected area of the escalator. Since the area in this vertical open space is greater, the next option is to explore the possibility of creating a vertical shaft enclosure allowing no more than two floors common or interconnecting. With a 2.25" head-track design, 3-hour fire listing and unlimited width capacity, McKEON easily solved the problem with a triple curve, non-floor track 140' bi-part opening protective.





VERTICAL OPENING SEPARATION

Inquiry Discussion & Questions

The following questions may be helpful:

- The size of the smoke evacuation system is based upon the calculation of total cubic footage of not only the atrium space but all spaces that open into the atrium space. Can I help you minimize this system cost by reducing the cubic footage with wide-span opening protectives at critical locations in the atrium?
- Have you considered the cost savings if eliminating all of the atrium requirements by creating a fully enclosed shaft or horizontal compartmentation in this vertical space?

Notes:

Vertical Compartmentation

Combined Code Principles from Chapters 4, 7 & 10

Protecting openings that connect multiple floors are currently addressed by the building and fire codes by way of vertical type shaft enclosures, atrium provisions or requirements relative to small floor or roof hatch type openings. In the following case studies a new technology and product application will be discussed wherein vertical compartments can be created separating any number of stories from each other. This will be accomplished by coordinating in one application the intent of the provisions found in both atrium and shaft enclosure requirements.

Fire & Life Safety Concerns

As stated in the atrium case studies, vertical spaces that are interconnected and common with each other allow heat, smoke, and hot/toxic gases to migrate throughout an entire structure.

Code Requirements

Currently the code examines vertical opening conditions in Section 712, Vertical Openings and Section 713, Shaft Enclosures. In earlier editions of the code, all vertical openings were considered under the shaft enclosure provisions only. The older Section 708.2, Shaft Enclosure included 16 exceptions, or different ways of creating vertical spaces as shaft enclosures. The 2012 edition created a new Section 712 titled Vertical Openings, wherein the old 16 exceptions in Section 708.2 were moved and edited. These items, originally written as exceptions to the shaft requirements, became stand-alone provisions defining vertical opening conditions, rather than exceptions or re-writes to strict shaft enclosure requirements. Although the fundamental content did not change, placing the shaft provisions under the title of Vertical Openings significantly affects one's perspective regarding their intended purpose. Perhaps this paradigm shift, from shaft enclosure provisions to vertical opening provisions is, in fact, a monumental shift not seen in many years! However, none of these accepted methods specifically address the exclusive use of horizontal shutters to eliminate a vertical condition. Unless an escalator opening is being protected or a door-hatch assembly is used to protect small structural openings in floors and roof assemblies, the code is vague regarding protection of vertical openings in the creation of vertical compartments.

VERTICAL OPENING SEPARATION

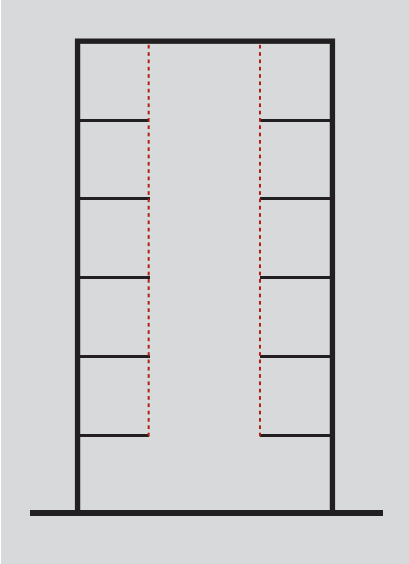


Figure 1

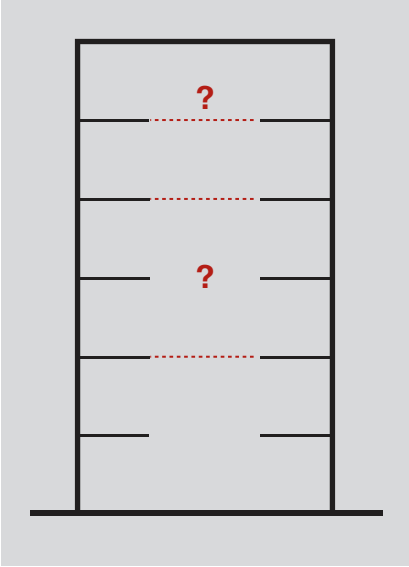


Figure 2

Figure 1, shown at the left, addresses a vertical opening condition complying with Sections 712 and 713 requirements to seal the space. Note, the atrium requirements are designed to essentially replicate this condition. By definition an atrium is a shaft enclosure.

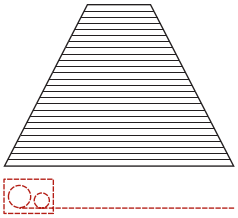
Within the current provisions set forth in Sections 712 and 713, the basic core and shell of this structure is still going to be a protected shaft. For example as shown in **Figure 2,** when one uses certain provisions of Section 404, by way of exception two floors can be common and the smoke evacuation can be eliminated from those two floors, while all the other vertical separation or atrium provisions are retained. Yet in other provisions of Sections 712 and 1019 the incorporation of an exit access stairway allows two unprotected floors common. In fact, the 2015 and 2018 editions separate exit access stairs into their own Section 1019 and in definitions in Section 202 declares exit access stairways as “a stairway within the exit access portion of the means of egress system.”

The question is, is it possible to eliminate the “vertical” open condition “horizontally” without a stair by protecting the vertical opening in the spirit of compartmentation since a structural floor was never in the original design as shown in **Figure 2,** and if so how many floors can be common? Exact code language is not found, however if the vertical opening is eliminated horizontally with a rated and hose-stream tested assembly, has the potential for migration of smoke, heat and hot/toxic gases been mitigated? The answer is a resounding yes with one important caveat. Since this configuration is defining a 2-story atrium it is critical to meet the atrium separation requirements. Section 404.6, Enclosure of atriums, specifically requires that atrium spaces be separated from adjacent spaces by 1-hour construction both vertically and horizontally. Therefore, defining atriums as 2-story spaces can be achieved with 1-hour construction only. In other words, non-hose stream tested assemblies that are limited to 20-minute ratings under UL 10B, 10C or 10D cannot be used to define an atrium in either the vertical or horizontal orientation.

VERTICAL OPENING SEPARATION

Design Solutions

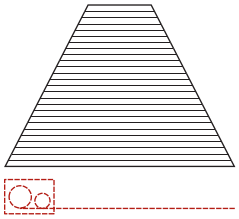
CASE 1: Horizontal (Floor) Shutter

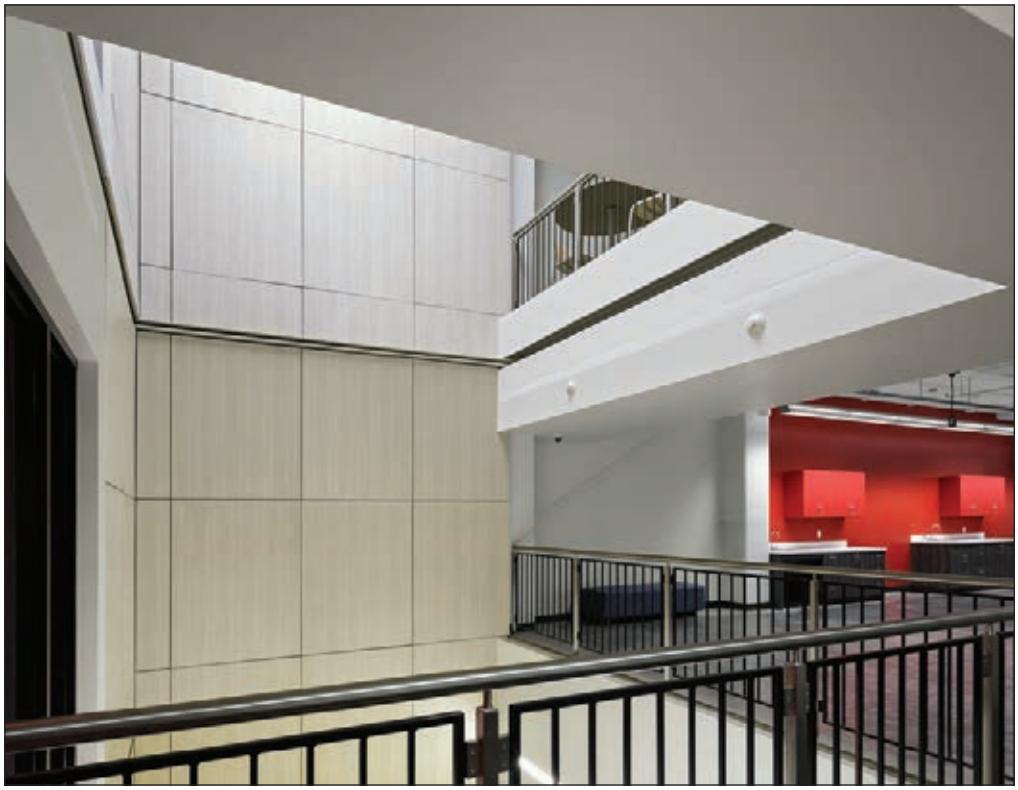


UL 10B 2-hour & UL 1784 "S" labeled, hose stream tested assembly.

VERTICAL OPENING SEPARATION

Case 2: Horizontal (Floor) Shutter

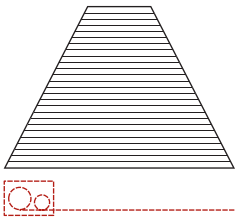


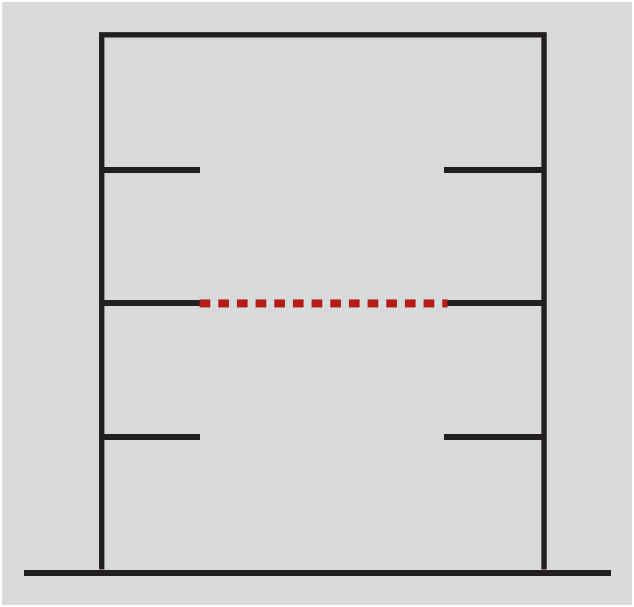


UL 10B 2-hour & UL 1784 "S" labeled, hose stream tested assembly.

VERTICAL OPENING SEPARATION

CASE 3: Horizontal (Floor) Shutter

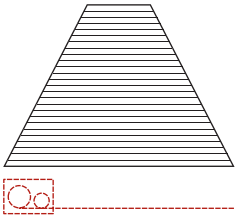


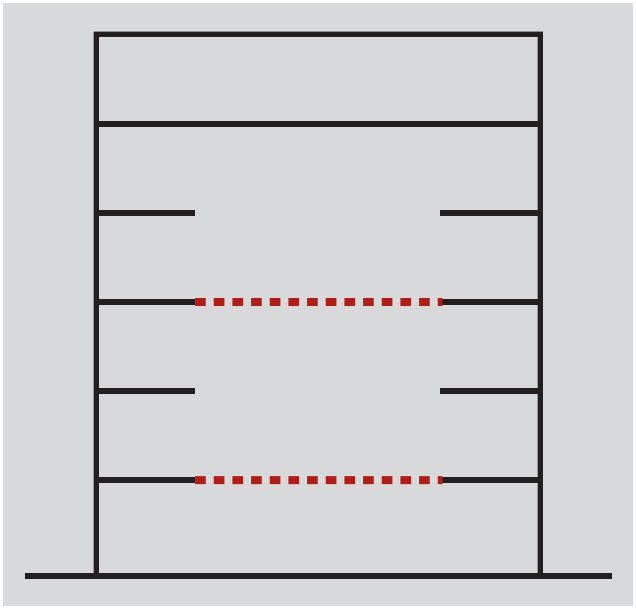


UL 10B 2-hour & UL 1784
"S" labeled, hose stream
tested assembly.

VERTICAL OPENING SEPARATION

CASE 4: Horizontal (Floor) Shutter





UL 10B 2-hour & UL 1784
"S" labeled, hose stream
tested assembly.

4 Occupancy Separation

Fundamental Guidelines

Mixed Occupancy – Accessory Use

Mixed Occupancy Use – Non-Separated vs. Separated

Fundamental Guidelines

Table 508

Most buildings are designed for multiple uses that will typically result in more than one occupancy classification. The code provides three basic options for mixed occupancies in Section 508:

1. **Accessory occupancies: Section 508.2**
2. **Non-separated occupancies: Section 508.3**
3. **Separated occupancies: Section 508.4**

Chapter 3 of the building code specifically classifies a building according to its use and occupancy. The level of fire hazard varies with specific uses and occupancies in a building. However, this level of hazard and its potential affect on the building occupants is determined not only by the use and occupancy classification by construction type, height and area size, but also the use of passive and active fire protection systems. Chapter 5 combines fire-resistance levels, construction types and occupancy types to determine size and height limitations as well as separation requirements.

Increased fire resistance of the structural members of the building along with increased active and passive fire protection systems permits greater height and area allowances. Notwithstanding, the use and occupancy of the structure will become a determining factor regarding the extent of separation and compartmentation required. For example, a “B” (business occupancy) is allowed occupant load floor area to be calculated at 100 gross sq. ft. per occupant. However, a group “I-2” occupancy (hospital) which is a similar occupant load as far as quantity of people, is required to be calculated at 240 gross sq. ft. per occupant, more than double that of a “B” occupancy. The difference between these requirements is the use of the facility. Occupants in a hospital need better protection for a greater amount of time because they are non-ambulatory and most are dependent upon others for mobility or even life support. Therefore, the fire and life safety requirements designed to help protect building occupants are very different for each of these occupancies.

When buildings are designed as mixed occupancies there is a concern because basic fire and life safety requirements are being

mixed within the same structure. Three basic options to eliminate confusion and ensure building occupant safety are outlined as follows:

Accessory Occupancy:

1. Accessory occupancies are those which are different from the main occupancy but ancillary to or a portion thereof. *(508.2)*
2. Aggregate accessory occupancies shall not occupy more than 10% of the area of the story. *(508.2.3)*
3. Aggregate accessory occupancies shall not exceed the tabular values in Table 506.2 without height and area increases. *(508.2.3)*
4. Accessory occupancies shall be individually classified in accordance with Section 302.1. *(508.2.1)*

Non-Separated Use:

To consider spaces under the Non-Separated Use requirements, the following must be met allowing NO separation between occupancies:

1. Each occupancy use shall be individually classified. *(508.3.1)*
2. Code requirements shall apply to each portion of the building based upon the occupancy classification of the space under consideration. *(508.3.1)*
3. The most restrictive applicable provisions of Section 403 and Chapter 9 shall apply to the building or portion thereof in which the non-separated occupancies are located, Section 403 in hi-rise and Chapter 9 in all others.
4. The allowable building area and height of the building or portion thereof shall be based on the most restrictive allowances for the occupancy groups under consideration for the type of construction of the building in accordance with Section 503.1. *(508.3.2)*

Separated Use:

The following requirements under the provisions of Separated Occupancies will bring these spaces into compliance without compromising design if separated with fire barrier walls according to Table 508.4:

1. Separated occupancies shall be classified in accordance with Section 302.1. *(508.4.1)*
2. Each separated space shall comply with the code based upon the occupancy classification of that portion of the building. *(508.4.1)*
3. In each story, the building area shall be such that the sum of the ratios of the actual building area of each separated occupancy divided by the allowable building area of each separated occupancy shall not exceed 1. *(508.4.2)*
4. Each separated occupancy shall comply with the building height limitations based on the type of construction of the building in accordance with Section 503.1. *(508.4.3)*

Mixed Occupancy – Accessory Use

Section 508.2

Post grade 12 educational occupancies are typically classified as "B" occupancies and usually incorporate mixed occupancies that are often considered accessory – full service kitchens and cafeterias (A-2), assembly areas (A), and dormitories (R-2) occupancies. Even though these spaces are ancillary to and a functional portion of the original larger occupancy they must be separated when they exceed the 10% rule.

Fire and Life Safety Concerns

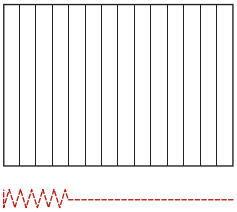
In this case study we will examine the potential fire and life safety threats posed due to the use of open flames, combustible gases and solids, and exhaust hood extinguishing systems. These kitchens (A-2) are often common with other areas (B or R-2) in the facility potentially exposing large groups of building occupants to the associated hazards. In these cases and similar situations, where the spaces are greater than 10%, separation is required.

Code Requirements

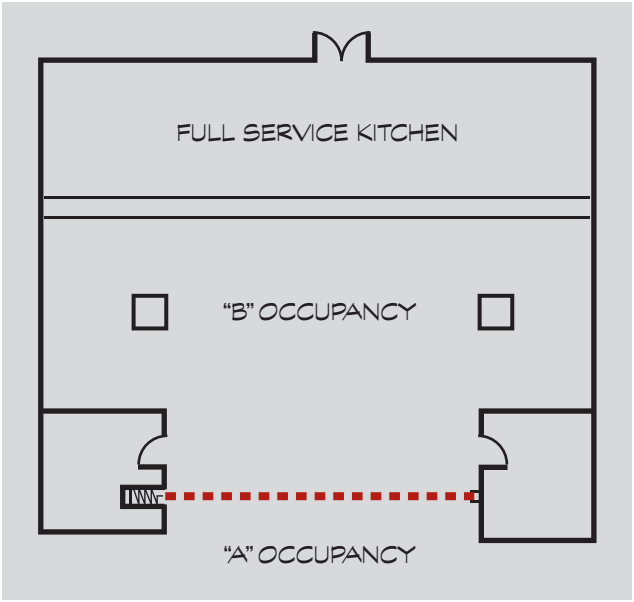
Table 508.4 in Chapter 5 provides the requirements for separation of occupancy types. Should an accessory occupancy exceed the 10% rule, this table becomes the determining factor. Since the separation must be a fire barrier wall *(508.4.4.1)*, Table 508.4 requires a 1-hour separation between an "A" and "B" occupancy or "R" and "B" occupancy when the building is fully sprinklered and 2-hour in non-sprinklered buildings.

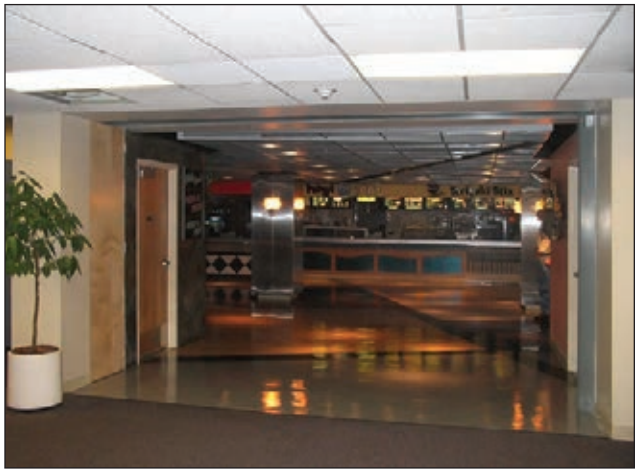
Design Solutions

CASE 1: Side Acting Accordion with Power-assisted Egress



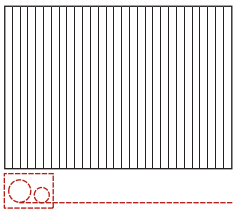
This first case study examines the use of the McKEON Side Acting Accordion fire door. The assembly is hidden from view unless there is a fire when it is activated by the smoke detector. Egress is accomplished by compliance to 1010.1.4.3.





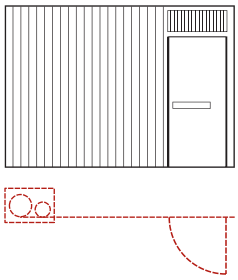
OCCUPANCY SEPARATION

CASE 2: Side Coiling without Egress

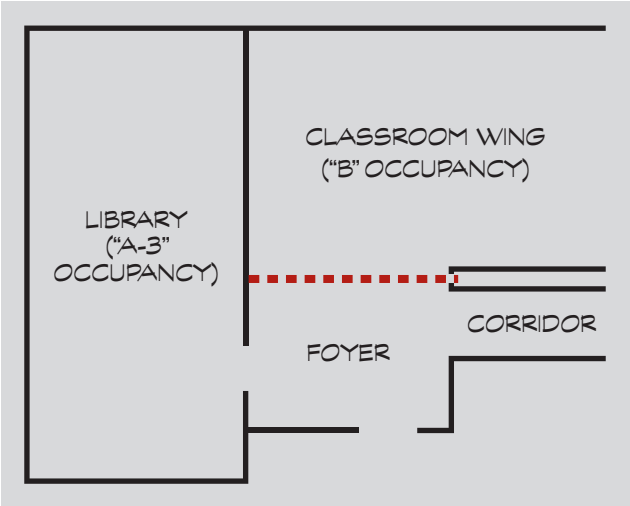


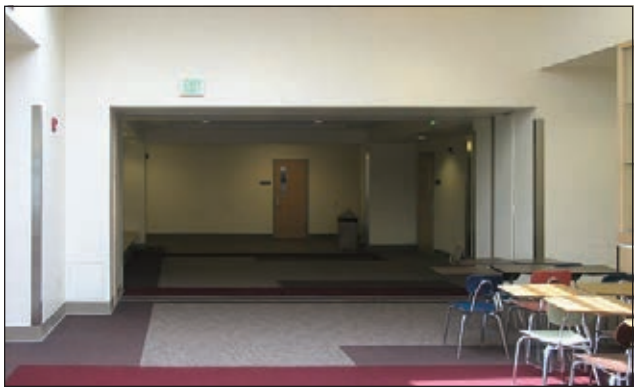
This case study is very similar to the previous application with the exception of an egress requirement. The McKEON side coiler without egress became the most economical solution without compromising life safety.

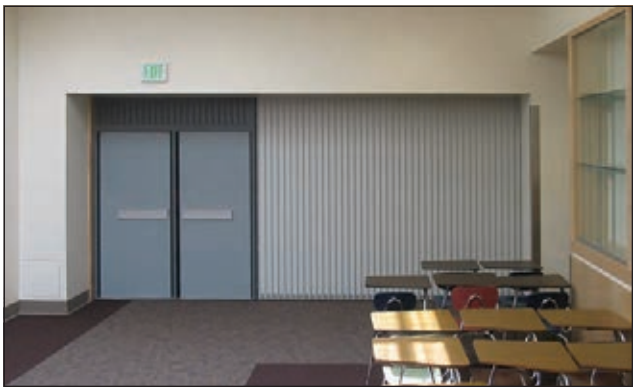
CASE 3: Side Coiling with Complying Swing Egress Door(s)



This third case study features a different product under the same code premise, the requirement to separate an “A-3” occupancy (library) from the rest of the “B” occupancy, school. The feature product is the Side Coiling with Conventional Egress Assembly due to limited width of pocket space.







Inquiry Discussion and Questions

The 10% rule mentioned before refers to an area limitation imposed upon aggregate accessory occupancies. As stated in Section 508, aggregate accessory occupancies are allowed, however specific restrictions apply as detailed on page 65 of this section.

The following questions may be helpful:

- What is the classification of a full-service kitchen within an occupancy type “B” structure?
- Do you perceive a full-service kitchen that requires a Type 1 exhaust hood extinguishing system as per the International Fire Code (IFC, Section 610.2 & IBC 904.2.1) as a potential threat to the students?
- When you are required to separate the kitchen from the rest of the space are you concerned about easy access and traffic flow in front of the serving area?
- Would it be more convenient for your client to have the wide-span opening protective located in front of the serving area, separating the kitchen space, to also act as a security door when the kitchen is not in use?

Notes:

Mixed Occupancy Use – Non-Separated vs. Separated

Section 508; Table 508.4

Complying with Table 508.4 and providing fire barrier walls to separate occupancies can be limiting to the design. Also, using non-separated provisions to eliminate restrictive fire barrier walls becomes extremely costly due to added fire and life safety requirements that affect the entire structure.

Fire & Life Safety Concerns

Building structures are classified based on their occupancy and use. The purpose for classifying structures is to configure optimum safety requirements commensurate to the need as dictated by each individual use. These areas of concern are general building limitations, means of egress, fire protection systems and interior finishes. The challenge comes when buildings contain rooms or spaces that are different than the original building occupancy classification thereby creating a mixed use or mixed occupancy structure.

Code Requirements

In this case study the Conference/Training room is 1,188 square feet with an occupant load of 79. It is classified as an A-3 occupancy located in a 5-story Group B office building of Type IIIA construction. The conference room is classified as an A-3 because it is used for gathering a large number of people for assembly purposes (Section 303.1). It cannot be considered an accessory space because it exceeds both occupant load and area square footage of the accessory use exceptions.

First, let's look at the requirements imposed if we attempt to eliminate all separations as indicated in Table 508.4, in other words non-separated use.

Non-Separated Use:

1. Each use shall be individually classified. *(508.3.1)*
    - The entire building is classified as a "B" occupancy. The

space under consideration (Conference/ Training room) is an A-3 occupancy.

2. The allowable building area and height of the building or portion thereof shall be based on the most restrictive allowances for the occupancy groups under consideration … *(508.3.2)*

3. The most restrictive applicable provisions of Section 403 and Chapter 9 shall apply to the entire building or portion thereof. *(508.3.1)*

   • Section 403 encompasses the requirements for hi-rise construction and Chapter 9 include the provisions for fire protection systems. In other words, the building will have to incorporate the most protective and restrictive requirements of these chapters. For example:

     - Standpipe system *(403.4.3)*

     - Smoke detection *(403.4.1)*

     - Fire Alarm systems *(403.4.2)*

     - Emergency voice/alarm communication system *(403.4.4)*

     - Fire command *(403.4.6)*

     - Smoke removal *(403.4.7)*

     - Emergency responder radio coverage *(403.4.5)*

     - Standby power *(403.4.8)*

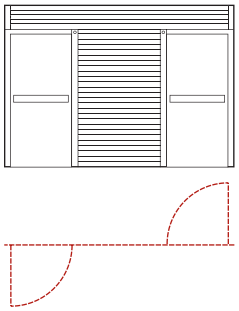
     - Emergency power systems *(403.4.8.4)*

4. The allowable height and area of the building or portion thereof shall be based on the MOST RESTRICTIVE allowances for the occupancy group under consideration for the types of construction of the building in accordance with Section 503.1. *(508.3.2)*

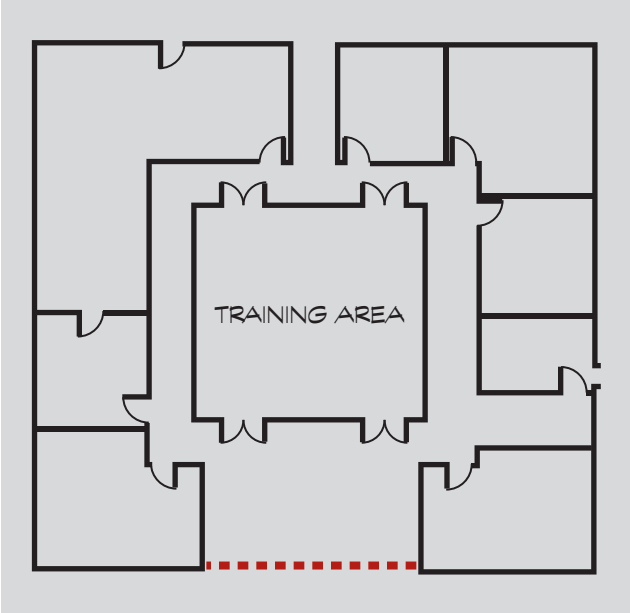
   • The height and area allowances for this requirement would not allow the building to be five stories. Most likely only three at best.

Design Solutions

CASE 1: Vertical Coiling with Complying Swing Egress Door(s)

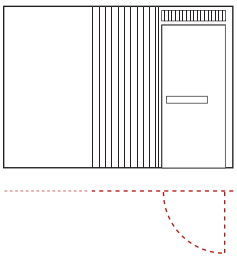


The use of wide span opening protectives enables occupancy separation without compromising open and spacious design. In this case study a simple deployable separation prevents the overall structure from being subject to the most restrictive provisions of non-separated use.

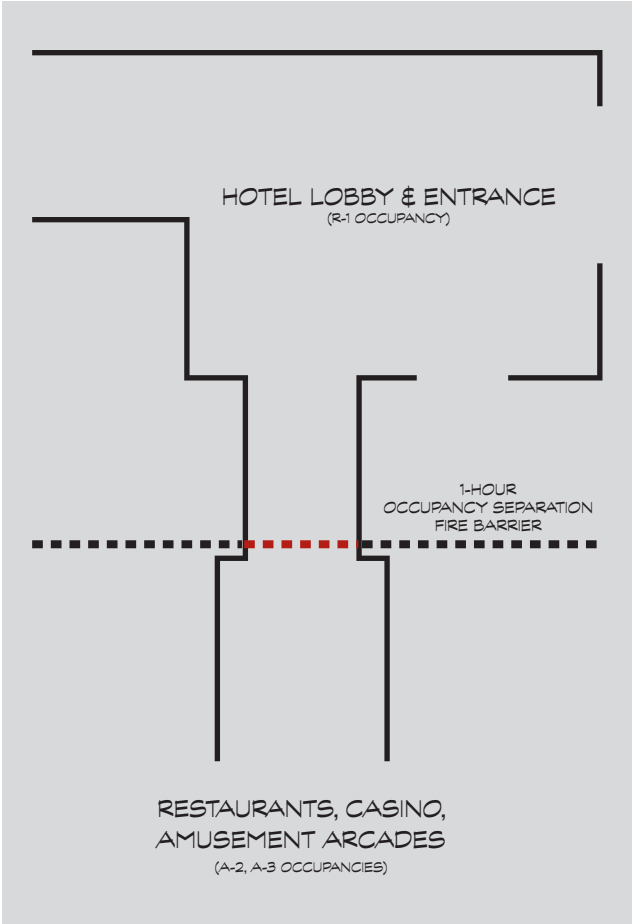


OCCUPANCY SEPARATION

CASE 2: Side Acting with Complying Swing Egress Door(s)

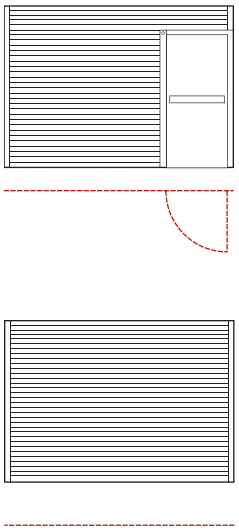


This case study is a text book example of occupancy separation, but is very unique in product application problem-solving from an architectural perspective. Pocket space was limited in width, but not depth, and headroom was extremely limited. Given the ambiance of the space, conventional swing doors on magnetic hold-opens were not an option. McKEON provided the S7000 series which requires only a 7" pocket width and no more than a 2 1/4" reveal in the ceiling for the head track. With patented side acting technology the entire assembly, incorporating four conventional swing doors, fits into a narrow space parallel to the fire barrier wall. Upon command of the smoke detector the 3-hour assembly slides into place providing occupancy separation and conforming egress.

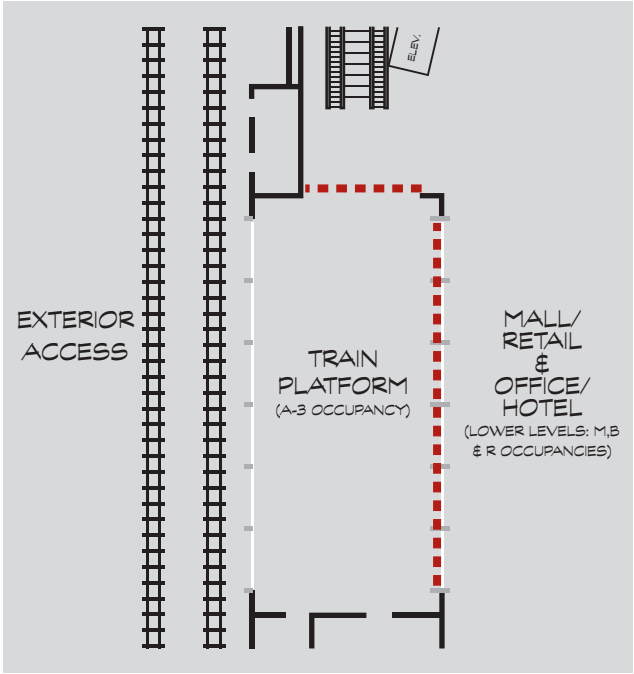


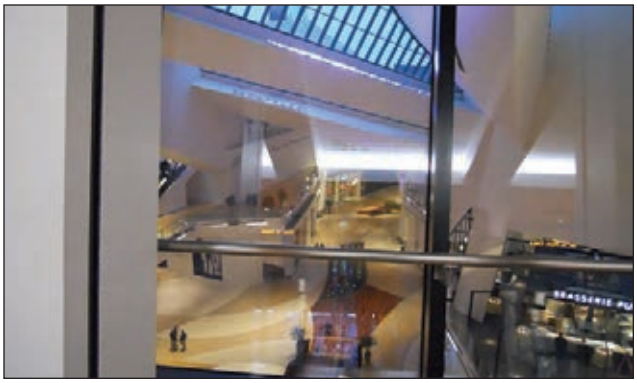
OCCUPANCY SEPARATION

CASE 3: Vertical Coiling with Complying Swing Egress Door(s) & Vertical Coiling without Egress



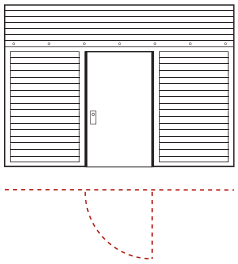
In this case study McKEON offers a solution to a difficult challenge by providing two different products within the same space. A combination of six fire-rated vertical rolling shutters installed on a diagonal path of travel and one vertical coiling assembly with conventional egress for exiting from the space. This solution preserves the beauty of the space without compromising mixed occupancy separation requirements.



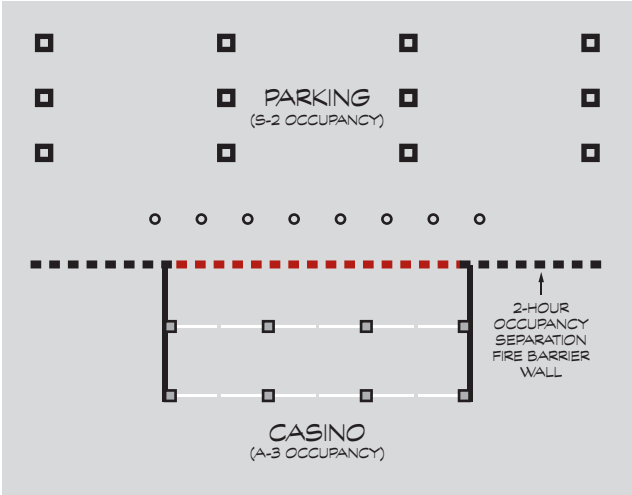


OCCUPANCY SEPARATION

CASE 4: Vertical Acting with Complying Swing Egress Door(s)



This application illustrates McKEON's capacity to provide 3-hour separation, conforming to a large occupant load exit width without occupying side stacking space. Deploying only in case of fire or emergency, both egress and fire separation requirements are satisfied without compromising design.



Inquiry Discussion and Questions

Fundamentally, separating the interior of buildings with fire barriers wherever occupancies change as required in Table 508.4 is simple and straightforward. However when designs promote mixed occupancies without separation, the code is left to create alternate means of protection to compensate for the loss of fixed barriers. Hence, in the absence of passive redundant systems, code enforcement becomes a tremendous challenge and the non-separated use provisions govern. These provisions are extremely costly.

The following questions may be helpful:

- Are you frustrated because open design is difficult when incorporating fire barrier walls as occupancy separations?
- Can I show you how wide-span opening protectives can eliminate the need to design non-separated structures?
- Have you considered the additional cost incurred by conforming to the non-separated use requirements?
- Do you really want to impose the most restrictive requirements of Chapter 4, Section 403 hi-rise provisions as well as the most restrictive requirements of Chapter 9 on the entire building?

Notes:

5 Area Separation

Allowable Area

Allowable Area

Section 706; Tables 504.3, 504.4, 506.2

The allowable height and area of a building structure is determined largely by two basic factors; first, the combustibility of its structural materials and second, occupancy type or use and purpose of the building. When a building design exceeds the established values, the intent of the code is to create another separate building structure to incorporate the increase. Since this is not always desirable, the code will allow interior fire walls to serve as separations sufficient to consider each space a separate structure within the tabular value allowance. In essence multiple compliant buildings can be created within the same structure and under a common roof.

Fire & Life Safety Concerns

Building height and area are calculated to accommodate three fundamentals principles in fire and life safety. First, the structural elements, rated or non-rated, are intended to maintain structural integrity during fire and other life threatening emergencies. This means the greater the protection of the structural elements, the larger the height and area. Second, additional height and area are allowed when active fire suppression systems such as sprinklers are used. Finally, passive redundant elements are used to compartmentalize the area and provide protection for building occupants as they egress the structure. Rated construction protects the structural elements, sprinklers protect the building contents, and egress protects building occupants by removing them from harm's way. All three principles overlap and work together to ensure a building occupant has adequate time to safely exit the structure. The reduction or absence of any of these components can compromise the safety of building occupants and cause property damage.

Another concern is the size of openings allowed in the passive redundant system, particularly in fire walls that are crucial to the area limitations. Opening size limitations are imposed to maintain the integrity of the wall during fire conditions. Opening protectives inherently accommodate strict requirements to adequately protect and maintain the integrity of the openings. The structural integrity of the fire wall must be maintained regardless of the wall opening size or its opening protective. It is critical to remember; the opening protective protecting an opening in a fire wall is not required to conform to structural integrity provisions. The opening protective is protecting the opening – NOT the wall. A fire wall used for area separation is allowed openings and opening protectives, however, a fire wall used as a party wall cannot have openings.

Code Requirements

1. The above referenced tables of Chapter 5 indicate the tabular height and area allowances for specific building construction types and occupancies.
2. Each portion of a building separated by one or more fire walls shall be considered a separate building. (*503.1)*
3. Openings in fire walls are subject to the following criteria *(706.8):*

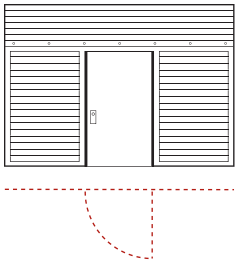
Non-sprinklered buildings – Openings shall not exceed 156 square feet and the aggregate width of openings at any floor shall not exceed 25 percent of the length of the wall.

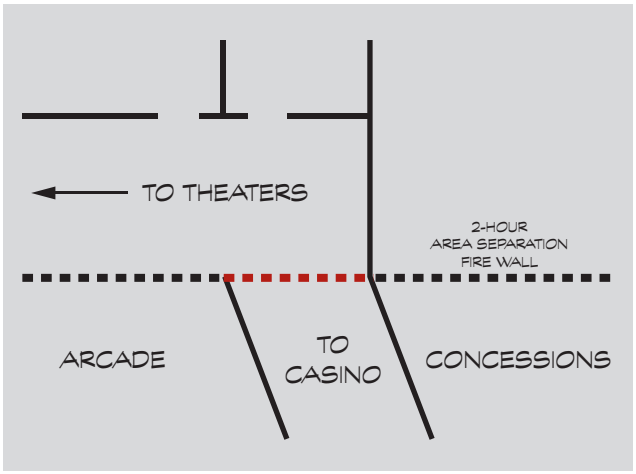
Sprinklered buildings – Openings shall not be limited to 156 square feet and the aggregate width of openings at any floor shall not exceed 25 percent of the length of the wall.

AREA SEPARATION

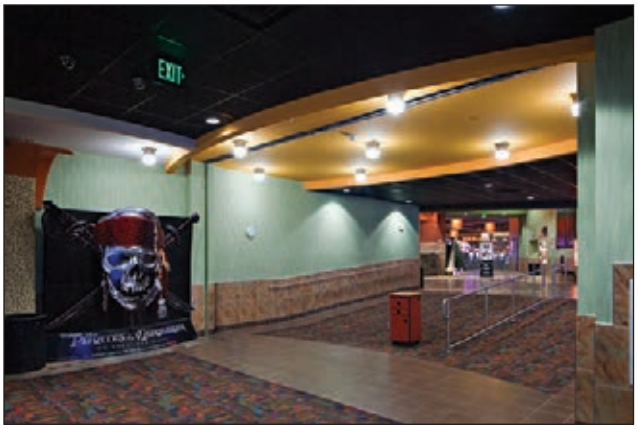
Design Solutions

CASE 1: Vertical Acting with Complying Swing Egress Door(s)



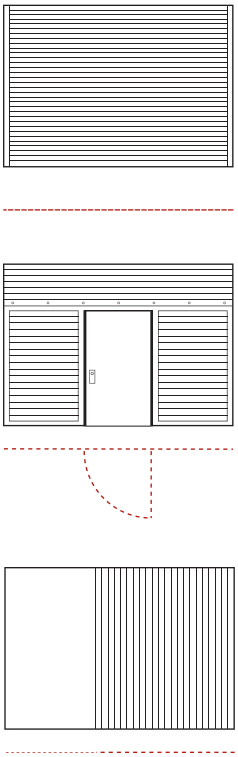


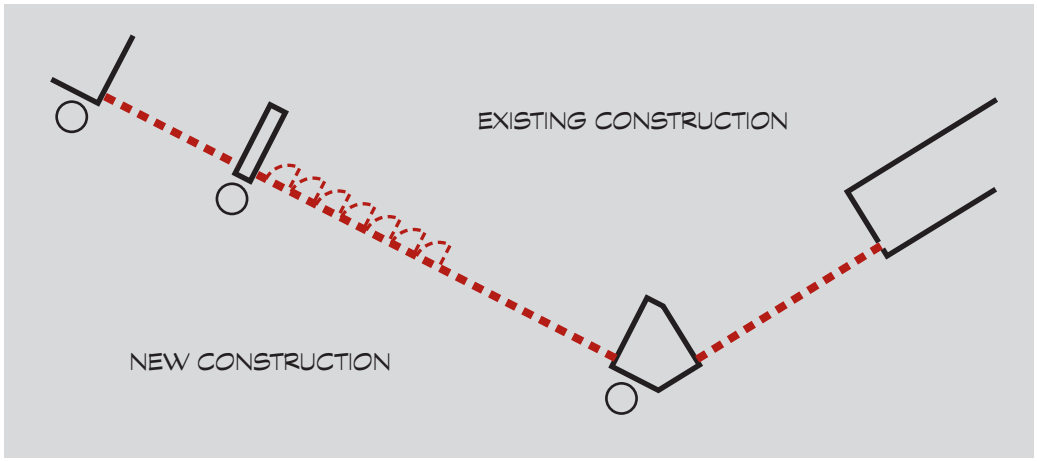
In this application McKEON resolved two significant design code compliance problems without sacrificing wide span open appearance. First, nearly the entire opening was necessary to meet the exit width requirements located in the primary means of egress system in an “A” occupancy. Using the McKEON accordion assembly would not comply because of a) the large distance to be covered and b) the length of time required to open wide enough to allow for immediate egress. Second, there was not sufficient stacking space for any of the McKEON side acting models. However, because headroom was plentiful and large occupant load egress was a necessity, the T5000 series incorporating six egress conventional swings doors, three doors set in each direction to accommodate dual egress, was the perfect fit and the only viable solution.

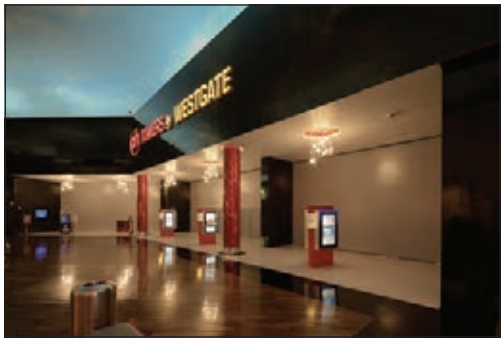


AREA SEPARATION

CASE 2: Vertical Coiling without Egress, Vertical Acting with Complying Swing Egress Door(s) & Side Acting without Egress







Inquiry Discussion and Questions

The decision to use the area separation strategy is determined early in the conceptual design phase of the project.

Resistance to incorporate fire walls may be due to the following:

- Limited understanding of the code allowances for considering one structure as multiple buildings.
- The structural integrity of the fire wall design appears costly and overwhelming compared to the basic design; i.e. parapets, return exterior walls, etc.
- Limited understanding of diverse wide-span opening protectives. Conventionally, openings in any wall seem to follow the swing door model, largely due to the perception that complying egress is limited to these kinds of doors and mullions. This traditional way of traversing throughout the building is very limiting and simply prohibitive to open design.

The following questions may be helpful:

- Have you ever been frustrated designing a structure because you exceeded the area allowances and were pushed to increase the construction type?
- When you are required to change a construction type to accommodate additional area, what is the increase in cost? How does your client feel about the increase?
- Are you hesitant to consider an area separation wall because of the limitations for openings as implied with conventional swing doors?

Notes:

6 Corridor Separation

Corridor Separation – Healthcare

Corridor Separation – Healthcare

Section 407.2.4

Gift shops focus on retail exposure to the public. Nonetheless they are located in hospitals and typically open to corridors that fall under strict provisions for life safety. Compliance with these strict provisions using conventional opening protectives can limit market exposure.

Fire & Life Safety Concerns

The corridor system in a hospital is designed to protect non-ambulatory patients and their attendants from the transfer of smoke from adjacent spaces. Gift shops and their associated storage offer a particular threat because of the potential fuel load created by large quantities of merchandise. The smaller the shop the lesser the threat of contents that are burning during a fire emergency, so the code requires no separation at the corridor opening of a gift shop if the square footage in minimal.

Code Requirements

Gift shops are allowed to be open to the corridor where the total square footage does not exceed 500 square feet. *(407.2.4)*

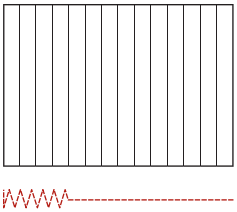
To better understand the opening protective requirements let's review the corridor provisions for I-2 occupancies (hospitals).

1. The corridor wall shall be constructed as a smoke partition. *(407.3)*
2. Smoke partitions are not required to be fire-rated. *(710.3)*
3. Doors protecting openings in smoke partitions in I-2 occupancies are as follows:
   - Non-fire-rated. *(407.3.1)*
   - Not required to be self-closing or automatic-closing. *(407.3.1)*
   - Must be positive latching. *(407.3.1)*
   - Shall provide an effective barrier to limit the transfer of smoke. *(407.3.1)*
   - Must be a smoke and draft control door listed under UL 1784. *(710.5.2)*

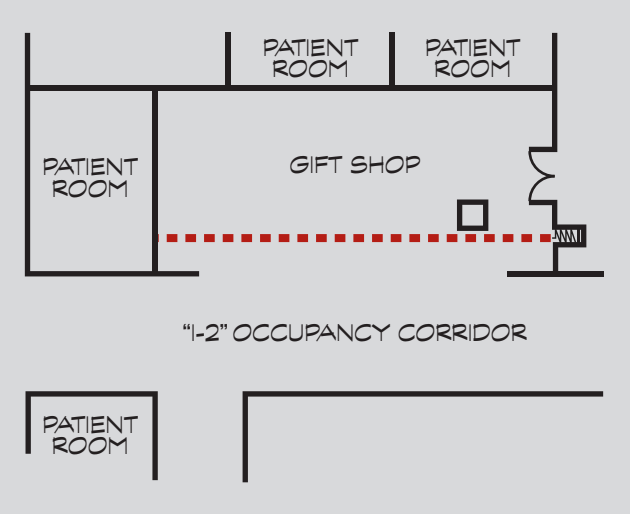
CORRIDOR SEPARATION

Design Solutions

CASE 1: Side Acting Accordion with Power-assisted Egress

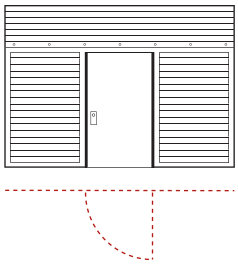


Incorporating the McKEON wide-span side acting accordion allows this space to be open for business without restricting view into the gift shop or customer access. At the command of a smoke detector the large width opening is rapidly protected and the fire and life safety corridor provisions are not compromised.

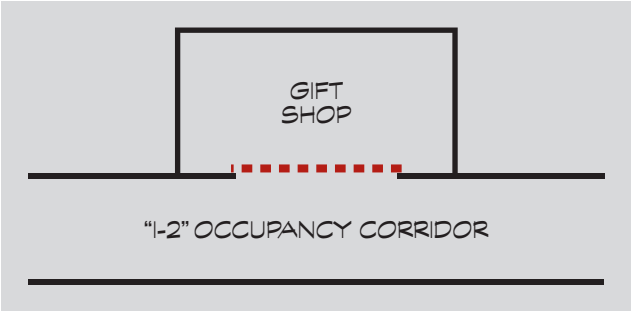


CORRIDOR SEPARATION

CASE 2: Vertical Acting with Complying Swing Egress Door(s)

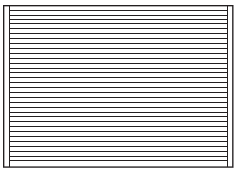


Incorporating the McKEON T5000 technology, the egress doors are completely concealed in the vertical space above, to close only in case of fire.

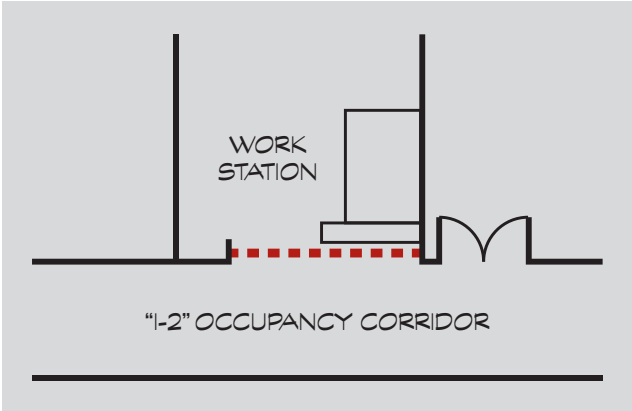


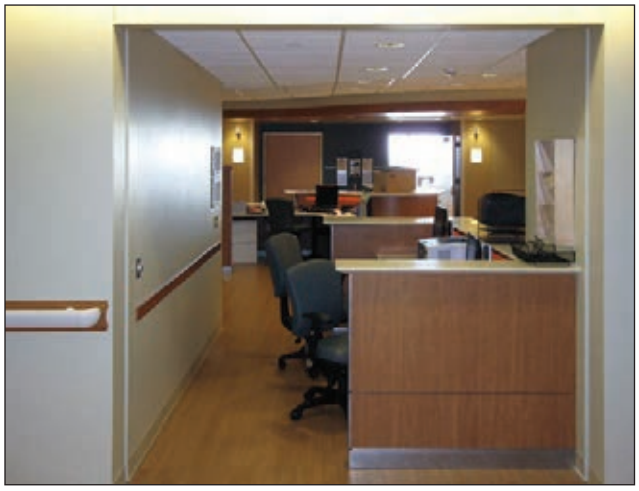
CORRIDOR SEPARATION

CASE 3: Vertical Coiling without Egress



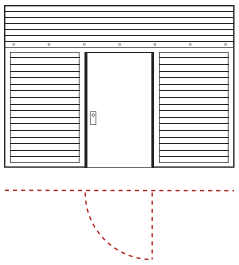
Egress is not required but a 2-hour fire rating is. This work station is left open during normal business hours. The protective assembly is easily lowered and locked after hours. Completely automated, whether in fire or security mode, any building occupant can operate the assembly.



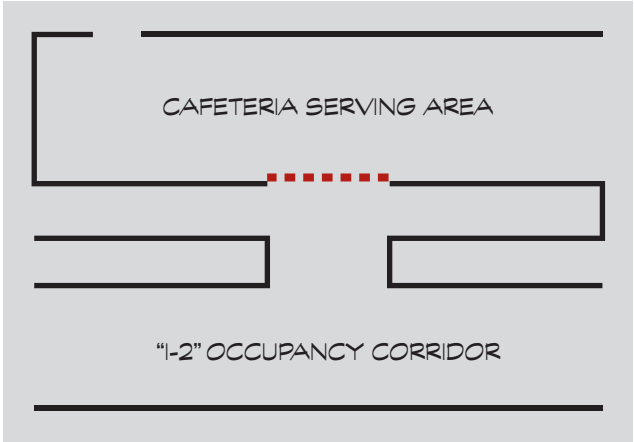


CORRIDOR SEPARATION

CASE 4: Vertical Acting with Complying Swing Egress Door(s)

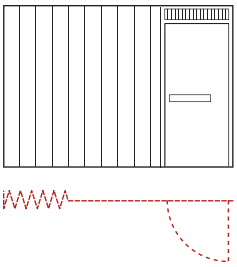


In this unique application, the McKEON T5000 technology, with integral code complying conventional egress doors, descends from the overhead space when the building goes into alarm. During normal business hours cafeteria patrons easily traverse the space from the corridor without obstruction.

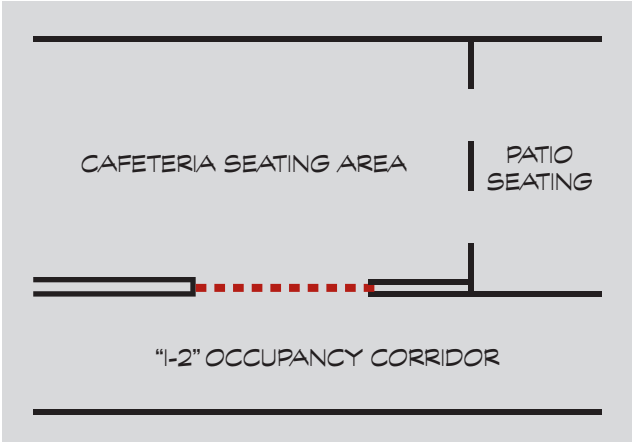


CORRIDOR SEPARATION

CASE 5: Side Acting Accordion with Complying Swing Egress Door

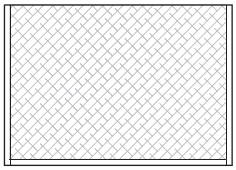


The McKEON accordion technology easily accommodates a conventional egress door.

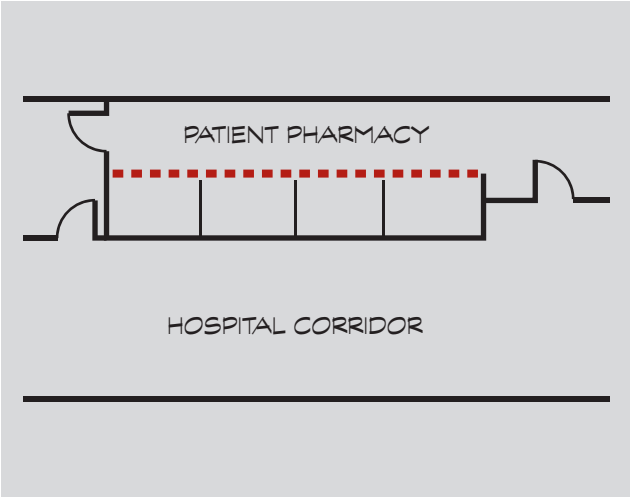


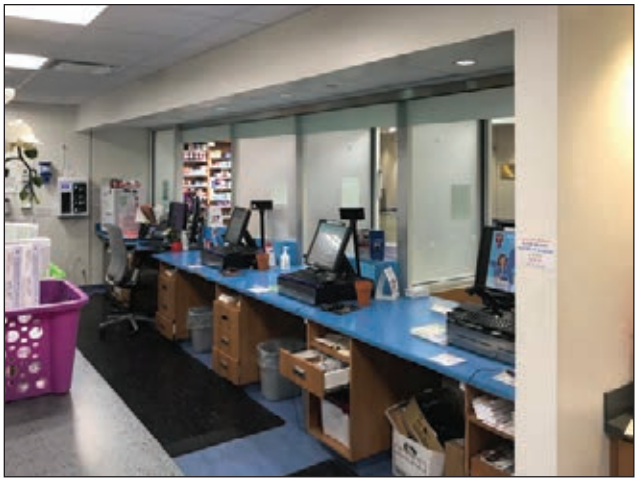
CORRIDOR SEPARATION

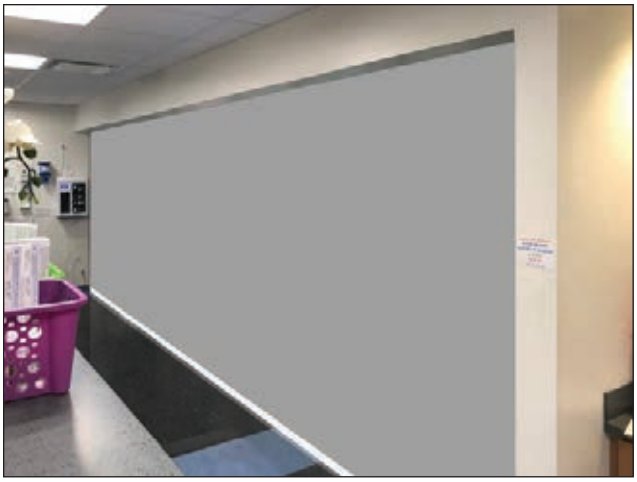
CASE 6: Vertical Acting without Egress



In I-2 occupancies corridor walls are required to be smoke rated only (Section 407.3). The SmokeFighter® D150 is an excellent resolve to minimal headroom space allowances. This hospital patient pharmacy is easily separated from the corridor with one of the latest technologies offered by McKEON.



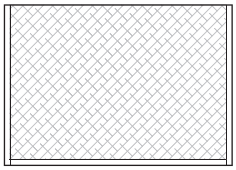




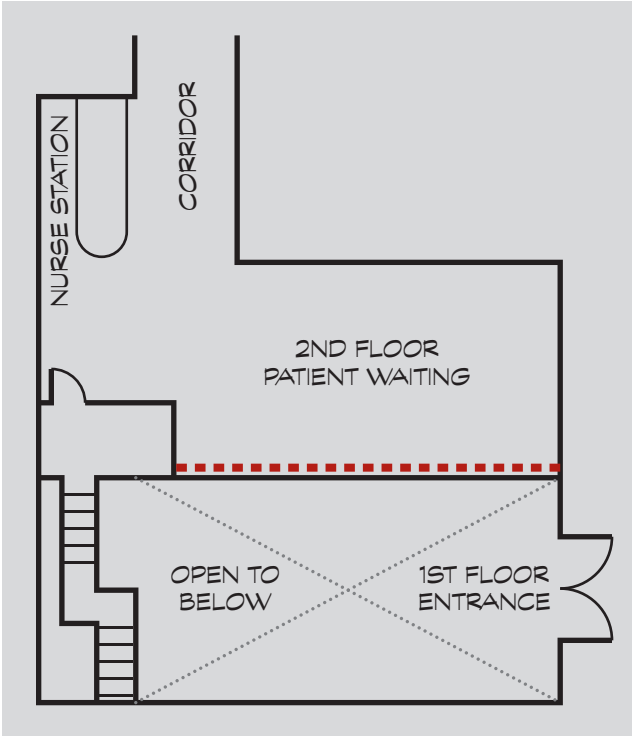
SIMULATION

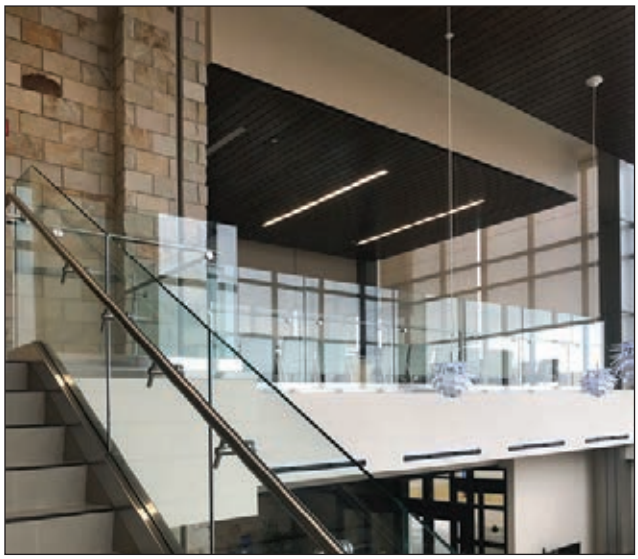
CORRIDOR SEPARATION

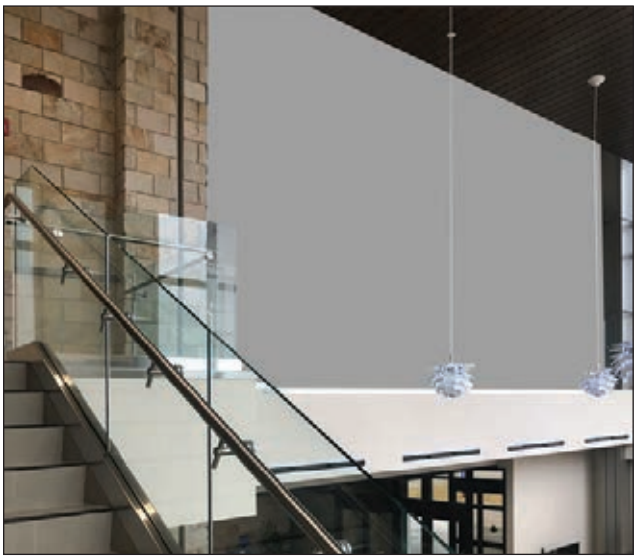
CASE 7: Vertical Acting without Egress



In I-2 occupancies the corridor walls are required to be smoke rated only (Section 407.3). Section 712.1.9 also instructs the design team that 2-story unprotected openings are not allowed in these same "I" occupancies. McKEON provides a unique solution to this challenge with the SmokeFighter® D150. This smoke rated curtain is deployable and will only close when the building goes into emergency alarm. During normal business hours the entire 2-story space is free of any visual obstacles.





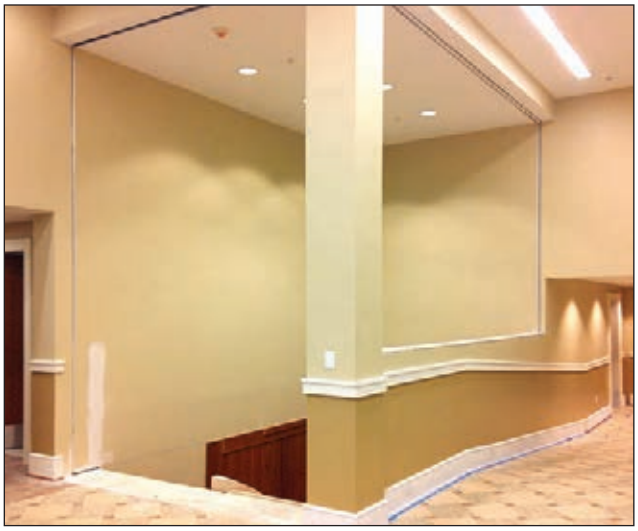


SIMULATION

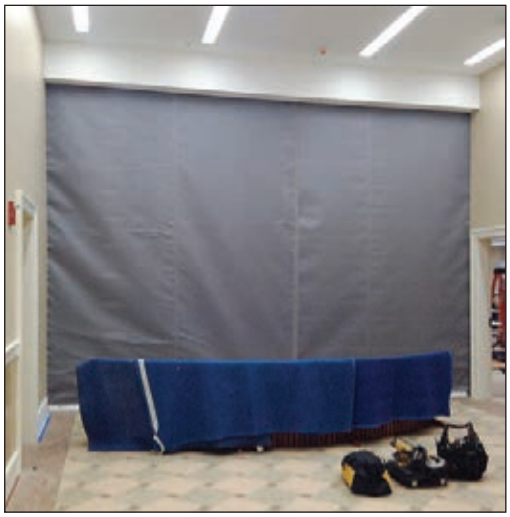
CORRIDOR SEPARATION

CASE 8: Vertical Acting without Egress

In this case study we will examine the requirements of the R-2 occupancy (congregate living facility with more than 16 occupants) pertaining to corridor rating and vertical space allowances. All corridors are required to be constructed of fire rated walls with a minimum rating of 30 minutes (1020.1). Also, these “R” occupancies cannot have unprotected 2-story openings (712.1.9, #4). These requirements can be challenging when spacious open designs are desired. Because the opening protectives for these walls can be rated 20-minutes (716.5.3), the McKEON FireFighter® D200 is the perfect solution. Take a look, too, at CASE 9. It is right across the hall!



CASE 9: Vertical Acting without Egress



Inquiry Discussion & Questions

A gift shop space is considered a potential fire hazard when it exceeds 500 square feet. Most designs will limit this space to 500 square feet or incorporate sheet rock, swing doors and wire glass to accommodate greater area spaces that open to the corridor. During a fire event, deployed wide-span opening protectives seal off large fuel load areas – such as gift shops that exceed 500 square feet – and protect building occupants who are moving through corridors. These assemblies can also serve as security doors when the gift shop is closed.

The following questions may be helpful in understanding pertinent challenges:

- Do you desire to have a gift shop larger than 500 square feet?
- Even though a gift shop, larger than 500 square feet, is not shown on Table 509 as an incidental use space … why is it required to be separated with 1-hour construction?
- May I show you how McKEON can help you eliminate a closed-in appearance at the corridor bordering gift shops exceeding 500 square feet in area?

Notes:

7 Smoke Compartmentation

Smoke Compartments – Healthcare

Smoke Barriers – Healthcare

Smoke Compartments – Healthcare

Section 407

The compartmentation requirements in these case studies are unique to hospital occupancies and are driven, for the most part, by means of egress provisions.

Fire & Life Safety Concerns

The code allows patient rooms to be arranged in open suites. However, this type of arrangement supposes a low patient-to-staff ratio where the staff is directly responsible for the safety of the patients in the event of a fire. To ensure safety, small smoke compartments with short-distance egress to protected exits become critical.

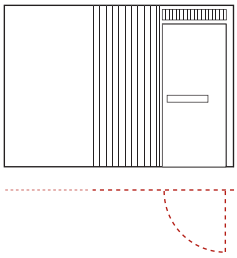
Code Requirements

1. Habitable rooms or suites in Group I-2 occupancies shall have an exit access door leading directly to a corridor. *(407.4.1)*
2. Care suites containing patient sleeping rooms shall not exceed 7,500 square feet, sprinklered areas with automatic smoke detection,10,000 square feet. *(407.4.4.5.1)*
3. Care suites containing other than patient sleeping rooms shall not exceed 12,500 square feet, sprinklered 15,000 square feet. *(407.4.4.6.1)*
4. Any patient sleeping room, or any care suite that includes patient sleeping rooms, of more than 1,000 square feet shall have at least two exit access doors remotely located from each other. *(407.4.4.5.2)*
5. Any room or suite of rooms other than patient sleeping rooms of more than 2,500 square feet shall have at least two access doors remotely located from each other. *(407.4.4.6.2)*
6. Travel distance between any point and an exit access door in a room not located in a care suite shall not exceed 50 feet. *(407.4.2)*

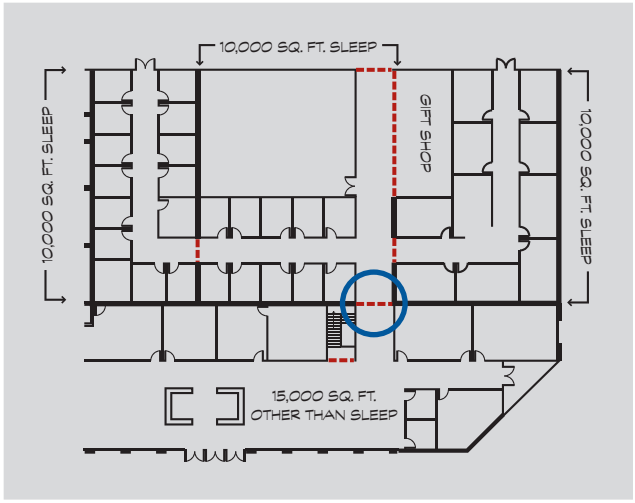
7. Travel distance between any point in a suite of sleeping rooms shall not exceed 100 feet, automatic smoke detection 125 feet. *(407.4.4.3)*
8. Vision panels are required in cross-corridor application of I-2 occupancies. *(709.5.1)*
9. Walls designed to create separate suites shall be construction as non-rated smoke partitions. *(407.4.4.2)*
10. Openings within smoke compartment walls that are not used to protect a vertical opening or an exit are not required to have a fire-rating but shall provide an effective barrier to limit the transfer of smoke. Also, these opening protectives do not have to be self-closing. *(Section 407.3.1)*

Design Solutions

CASE 1: Side Acting with Complying Swing Egress Door(s)

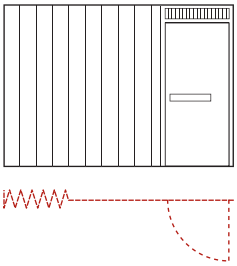


In this case study we find it difficult to maintain continuity with compartmentation when passing through corridors or other open areas with smoke partition walls. With the wide-span capabilities of the McKEON door assembly there is no compromise between building functionality and code compliance.

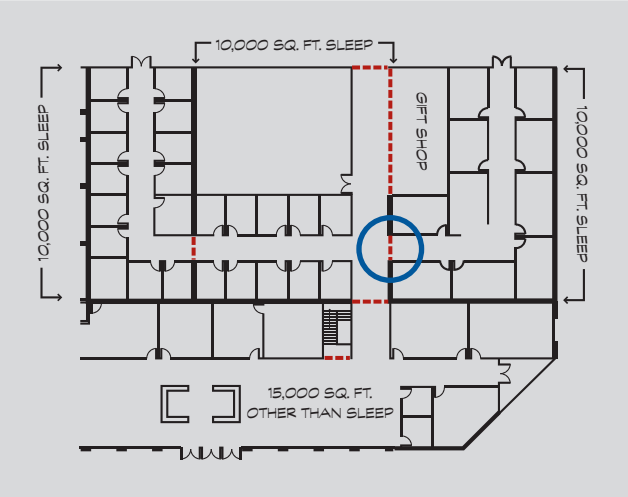


SMOKE COMPARTMENTATION

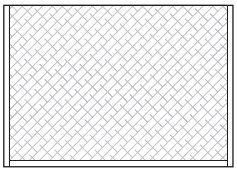
CASE 2: Side Acting Accordion with Complying Swing Egress Door



This side acting accordion offers conventional egress with a swing door attached to wide panels that provide a compact profile for less stack space.



CASE 2: Vertical Acting without Egress



Designing care suites, particularly critical units in large hospitals, can be challenging when complying with restrictive smoke compartment provisions. The maximum area limit in care suites containing patient sleeping rooms with sprinklers and automatic smoke detection is 10,000 square feet. This case study features a critical suite that far exceeds these limits. The SmokeFighter® D150 came to the rescue and provided necessary separation where head room was limited and side room would only allow for very discreet side guides.

SIMULATION

Inquiry Discussion and Questions

Often more desirable floor plans will be compromised to accommodate smoke compartmentation requirements. Rooms become smaller, corridors often inhibited with opening protectives, nurses stations altered, etc. to create life-saving smoke free spaces. Most often these adjustments become routine without an understanding of wide span opening protective technology.

The following questions may be helpful:

- May I show you how a smoke compartment separation can cross a corridor without compromising the space?
- Did you know that a side acting accordion door can be used in a means of egress across a corridor regardless of the occupant load served?
- Smoke compartments are no respecter of open spaces. Can I show you how you can span virtually any distance without compromising the space?

Notes:

Smoke Barriers – Healthcare

Section 709

Smoke barriers divide areas of a building into separate smoke compartments. These dividing walls allow building occupants time to be evacuated or relocated to other smoke compartments. In other words, smoke barriers separate portions of buildings into areas of refuge capable of resisting the passage of smoke and fire for 1 hour. ***(Section 709)***

Fire & Life Safety Concerns

Smoke barriers are specifically required in I-2 (hospital) occupancies due to the non-ambulatory status of the building occupants (Section 407.5). Usually these occupants require assistance and care when being evacuated or relocated during an emergency. There must be a protected area where these patients can be placed until safely evacuated from the building. Smoke barriers in Group I-2 occupancies provide this defend-in-place mechanism.

Code Requirements

The following five requirements designate the use of smoke barriers in Group I-2 occupancies:

1. Group I-2 occupancies are required to subdivide every story into smoke compartments with an area not more than 22,500 square feet. *(407.5)*
2. Smoke compartments are to be divided using smoke barrier walls in accordance with Section 709. *(407.5)*
3. Smoke barriers are required to subdivide every story used by patients for sleeping or treatment with an occupant load of 50 or more persons into at least two compartments. *(407.5)*
4. Travel distance in smoke compartments shall not exceed 200 feet. *(407.5)*
5. Independent egress – A means of egress shall be provided from each smoke compartment created by smoke barriers without having to return through the smoke compartment from which means of egress originated. *(Section 407.5.2)*

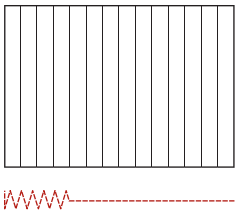
SMOKE COMPARTMENTATION

In order to accommodate an opening in a smoke barrier wall the following opening protective requirements must be met:

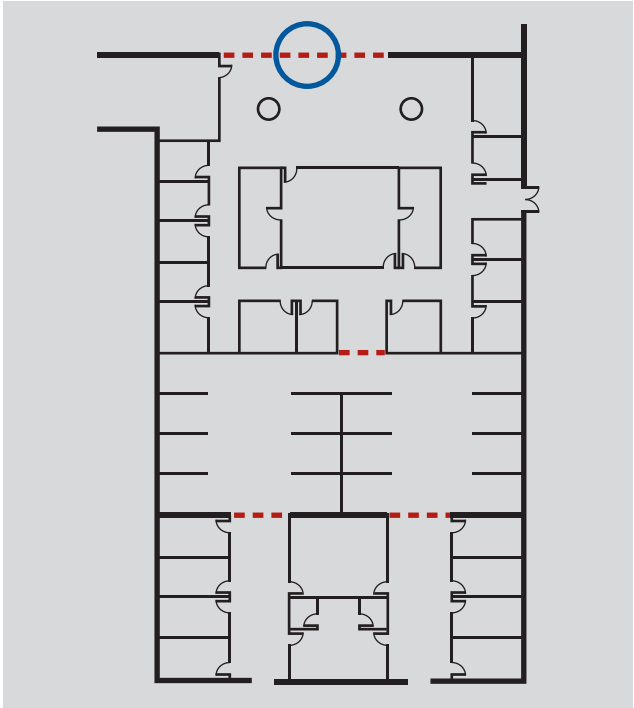
1. Minimum fire rating of 20 minutes. *(Section 716.5.3 & Table 716.5)*
2. Vision panels. *(709.5.1)*

Design Solutions

CASE 1: Side Acting Accordion with Power-assisted Egress

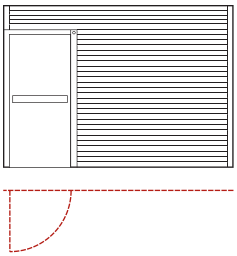


In this case study the intent is to add to an existing I-2 occupancy a 9,700 square foot Critical Care Suite. The existing building construction type is IIIA with 21,324 square feet and the desire is to have the new suite as open as possible to the existing hospital corridor system. The placement of a smoke barrier wall at this new addition connection is a specific code requirement in order to fall within the 22,500 square foot limitation. With the use of the McKEON wide-span labeled assembly approved for egress, the opening protective requirements are met without compromising the spacious clear open ambiance desired.

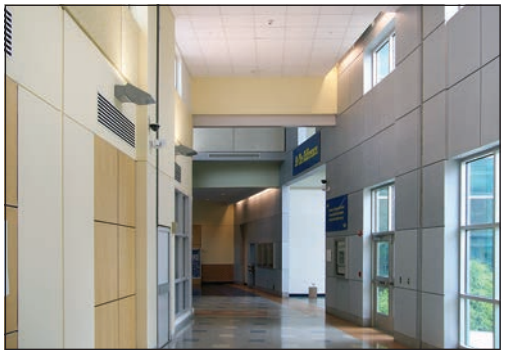


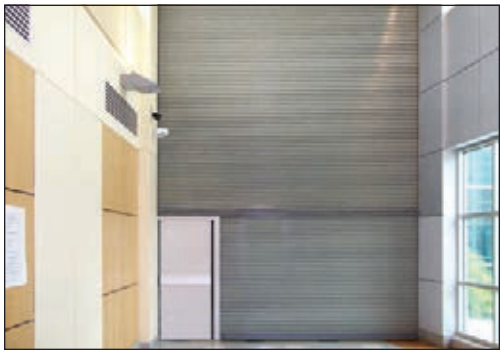
SMOKE COMPARTMENTATION

CASE 2: Vertical Coiling with Complying Swing Egress Door(s)

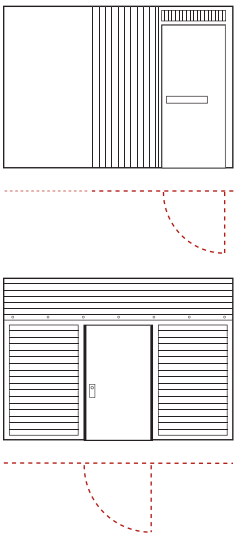


Regardless of the size of the space, smoke barriers must be maintained throughout the building. McKEON can easily protect these unusually large openings without compromising building ambiance.

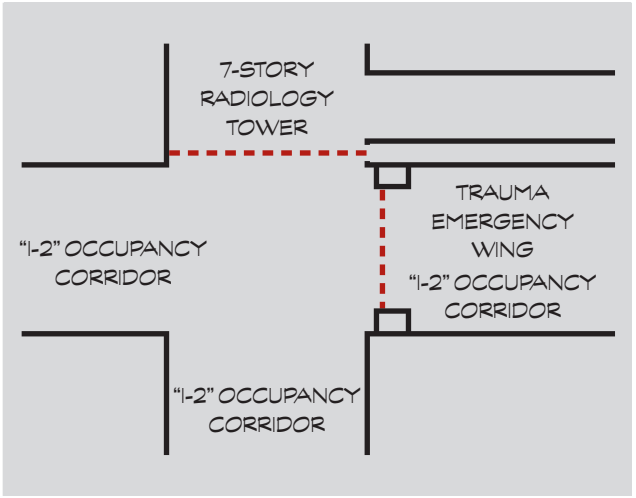


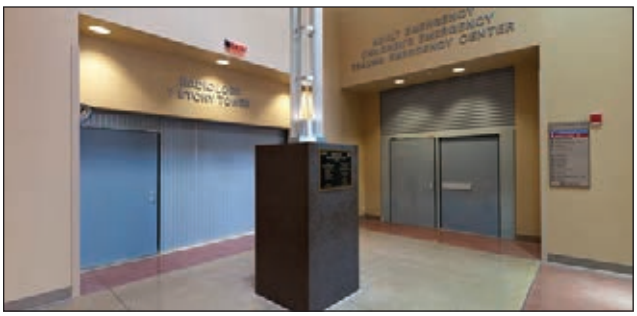


CASE 3: Side Acting with Conventional Egress Door(s) & Vertical Acting with Complying Swing Egress Door(s)



These two very different technologies converge on the inside corner of the structure to complete the smoke barrier separation creating separate refuge area compartments. Operating as duel function assemblies they are also located to separate the corridors from additional spaces.





Inquiry Discussion & Questions

In principle, smoke compartmentation and smoke barrier separation are the same with minor differences. Smoke barriers are created using 1-hour rated walls (Table 716.5) and the separations are incurred at a minimum of 22,500 square feet. Smoke compartments are created using non-rated smoke partitions and the separations are incurred at a minimum of 10,000 square feet in suites of sleeping rooms and 15,000 square feet in non-patient room areas. Smoke compartment applications occur in Group I-2 occupancies/hospitals and smoke barrier applications occur in Group I-2 and/or Group I-3 occupancies/prisons.

Helpful questions for smoke barrier applications can be found in the smoke compartmentation case study.

Notes:

8 Resilient Construction

Storm Shelters

Storm Shelters

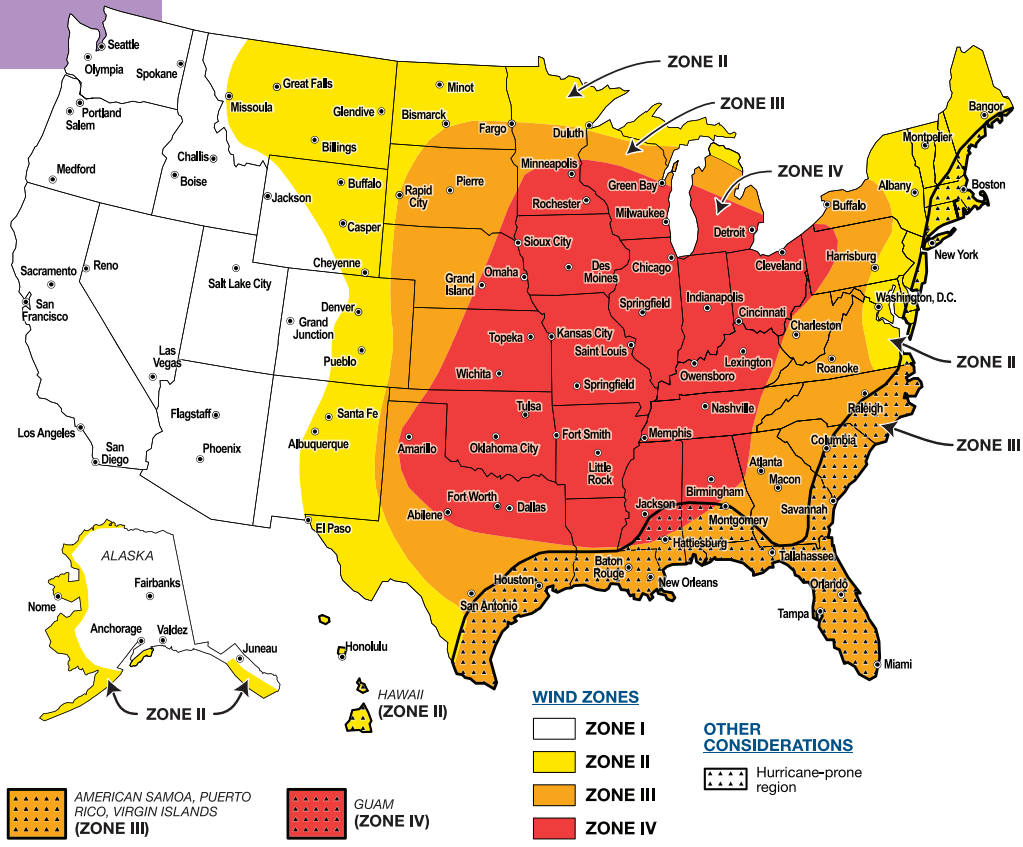
Section 423

Storm shelters can be constructed as separate detached buildings or as safe rooms within new or existing buildings. These types of structures are required to be designated hurricane shelters, tornado shelters or a combination thereof.

Fire & Life Safety Concerns

International Building Code committee staff worked closely with the Federal Emergency Management Agency (FEMA), in particular consulting the FEMA 361 Standard, when creating a formal ICC safety standard for buildings constructed in high-wind-load areas where tornadoes and hurricanes are a prevalent threat. The ICC 500 Standard has been adopted and incorporated into Section 423 of the code to provide safe areas of refuge from these storms.

WIND ZONES IN THE UNITED STATES*



* If you are uncertain of your location because of the level of detail and size of the map, or if you live on or near one of the delineation lines, use the highest adjacent wind zone.

Code Requirements

Section 423.3 Critical emergency operations. In areas where the shelter design wind speed for tornadoes in accordance with Figure 304.2(1) of ICC 500 is 250 MPH, 911 call stations, emergency operation center and fire, rescue, ambulance and police stations shall have a storm shelter constructed in accordance with ICC 500.

Exception: Buildings meeting the requirements for shelter design in ICC 500.

Section 423.4 Group E occupancies. In areas where the shelter design wind speed for tornadoes is 250 MPH in accordance with Figure 304.1(1) of ICC 500, all Group E occupancies with an aggregate occupant load of 50 or more shall have a storm shelter constructed in accordance with ICC 500. The shelter shall be capable of housing the total occupant load of the Group E occupancy.

Exceptions:

1. Group E day care facilities
2. Group E occupancies accessory to places of religious worship
3. Buildings meeting the requirements for shelter design in ICC 500

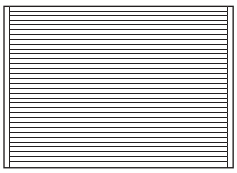
Design Solutions

In the case studies that follow the McKEON SafeSpace™ 500 is featured – an opening protective that complies with the stringent requirements of FEMA 361. Specifically passing the ASTM E1886 based missile impact test and withstanding wind pressures at 240 psf in accordance with ASTM E330, designers can now create large openings in exterior walls of ICC 500 compliant structures or compliant spaces within structures. Please note: When required the SafeSpace 500 can be labeled with a UL 10B 3-hour fire rating and UL 1784 smoke rating, the SafeSpace 500F model.

Missile impact test proves ability to withstand wind-borne debris from a hurricane or tornado.

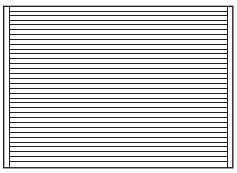
The SafeSpace 500 was subjected to both a positive and a negative 255 mph wind load.

CASE 1: Vertical Coiling without Egress

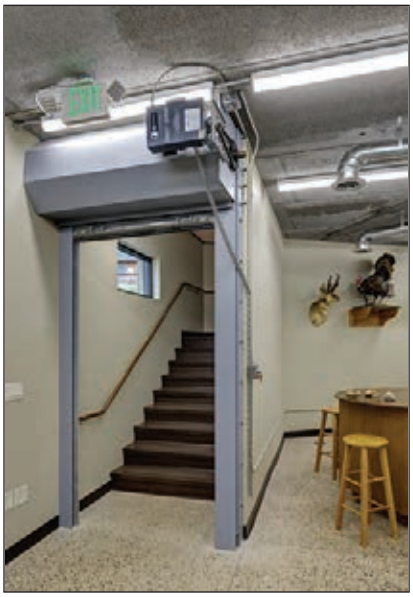


This elementary school cafeteria addition was required to comply with the FEMA 361/ICC 500 provisions. Without the SafeSpace™ 500 the three large window openings in the front of the structure would not have been possible. The cafeteria entrances would have been limited to small swing door openings and the space would have had to be artificially lit. The casual observer would not know this addition is tornado safe, it looks like a typical school multi-purpose cafeteria!

CASE 2: Vertical Coiling without Egress



Located within the 250 MPH wind zone, a two-story summer camp facility turned the lower level into a storm shelter. With SafeSpace™ 500 technology the structure is compliant without sacrificing natural light and appearance.



CASE 3: Vertical Coiling without Egress

Similar to the previous cases, this beautiful library in the Ida Freeman Elementary School is also a tornado shelter. Thanks to SafeSpace™ 500 technology large windows and storefront doors let in plenty of daylight. It is easy to imagine that this area is simply a spacious, inviting area for reading and learning.

Inquiry Discussion and Questions

Often design teams struggle with creating storm shelters because the code seems to allow openings no larger than the typical ICC 500 rated swing doors. Rolling steel assemblies that are FEMA 361/ICC 500 compliant offer design flexibility and allow the space to meet the requirements of a resilient structure. When incorporating a storm shelter into a typical non-FEMA rated structure this same design flexibility is available with the SafeSpace™ technology because in most cases the separation walls are required to be fire and smoke rated as well.

The following questions may be helpful:

- Are you concerned the structure under design will look like a “prison” when the requirements of ICC 500 or FEMA 361 are a part of your design?
- Did you know that if your jurisdiction is the recipient of FEMA funding, it is possible that associated construction may have to follow the FEMA 361 guidelines?
- Do you know if the area wherein you are designing an E occupancy or emergency operations facility structure is under the provisions of FEMA 361 or ICC 500?

Notes:

McKEON®

Appendix

Definitions

Resources

Fire Walls – Section 706

Definition

A fire-resistance-rated wall having protected openings, which restricts the spread of fire and extends continuously from the foundation to or through the roof, with sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall. *(202)*

Fire Ratings: *(Table 706.4)*

2-hour

3-hour

4-hour

Opening Protection: *(706.8)*

Non-sprinklered buildings – Openings shall not exceed 156 square feet and the aggregate width of openings shall not exceed 25 percent of the length of the wall.

Sprinklered buildings – Openings may exceed 156 square feet but the aggregate width of all openings shall not exceed 25 percent of the length of the wall.

Design Notes

- Each portion of a building separated by one or more fire walls shall be considered a separate building. *(503.1)*
- Where a fire wall separates occupancies that are required to be separated by a fire barrier wall, the most restrictive requirements of each separation shall apply. *(706.1)*
- Regardless of the rating of the opening protective, fire walls cannot have openings that exceed 25 percent of the length of the wall. *(706.8)*
- Fire walls constructed as party walls shall NOT have openings. *(706.1.1)*

Applications

- Exceeding area allowances (*Tables 504.3, 504.4, 506.2)*
- Horizontal Exits *(1026)*

Fire Barriers – Section 707

Definition

A fire-resistance-rated wall assembly of materials designed to restrict the spread of fire in which continuity is maintained. *(202)*

Fire Ratings: *(Tables 716.5; 707.3.10)*

1-hour

2-hour

3-hour

4-hour

Opening Protection

Non-sprinklered Buildings – Openings shall be limited to a maximum aggregate width of 25 percent of the length of the wall, and the maximum area of any single opening shall not exceed 156 square feet. *(707.6)*

Sprinklered Buildings – Openings may exceed 156 square feet but must be limited to a maximum aggregate width of 25 percent of the length of the wall, unless the opening protective assembly has been tested in accordance with ASTM E119 and has a minimum fire-resistance rating not less than the fire-resistance rating of the wall. *(707.6 Exceptions #1 & #3)*

Design Notes

- A fire barrier may have an opening exceed the 25 percent rule if the building is sprinklered and the opening protective assembly is tested under the provisions of ASTM E-119. As seen below, most fire-rated walls used in building design will fall under Section 707, Fire Barrier Walls.

Applications

- Shaft Enclosures *(713.4)*
- Interior Exit Stairways *(1023.1)*
- Exit Passageways *(1024.3)*
- Horizontal Exits *(1026.1)*
- Atriums *(404.6)*
- Incidental Use Areas *(Table 509)*
- Control Areas *(414.2.4)*
- Separated Occupancies *(Table 508.4)*
- Fire Areas *(Table 707.3.10)*
- Enclosures for Exit Access Stairways *(713.4)*

Fire Partitions – Section 708

Definition

A vertical assembly of materials designed to restrict the spread of fire in which openings are protected. *(202)*

Fire Ratings *(708.3)*

1-hour

1/2-hour *(708.3, Exceptions #1 & #2)*

Opening Protection

Opening protectives in fire partitions shall have a minimum fire rating of 20 minutes and a maximum of 45 minutes *(Table 716.5)* and shall be smoke tested under UL 1784. *(716.53)*

Design Notes

- Most rated corridor walls fall into this category. *(708.1 and Table 1020.1)*
- Typically corridor walls are not required to be rated unless the structure is non-sprinklered. *(Table 1020.1)*

Applications

- Separation walls as required by Section 420.2 for Groups I-1, R-1, R-2 and R-3 *(708.1, Item #1)*
- Egress balconies as required by Section 1019.2 *(708.1, Item #5)*
- Walls separating tenant spaces in covered mall buildings as required by Section 402.4.2.1 *(708.1, Item #2)*
- Corridor walls as required by Section 1020.1 *(708.1, Item #3)*
- Elevator lobby separation as required by Section 3006.2 *(708.1, Item #4)*

Smoke Barriers – Section 709

Definition

A continuous membrane, either vertical or horizontal, such as a wall, floor, or ceiling assembly that is designed and constructed to restrict the movement of smoke. *(202)*

Fire Ratings *(709.3)*

1-hour

Opening Protection

Opening protectives in smoke barriers shall have a minimum 20 minute fire rating and UL 1784 smoke test rating. *(Table 716.5)*

Design Notes

- Door assemblies in cross-corridor smoke barriers of I-2 Occupancies (Hospitals) shall have vision panels. *(709.5.1)*
- Smoke barriers constructed of minimum 0.10-inch-thick steel in I-3 Occupancies (Jails & Prisons) are not required to be 1-hour rated. *(709.3)*

Applications

In I-2 Occupancies (Hospitals) smoke barriers are required to subdivide every story used by patients for sleeping or treatment. *(407.5)* As per the following:

- 50 or more persons / minimum 2 smoke compartments
- Each compartment cannot exceed 22,500 square feet
- Travel distance shall not exceed 200 feet to a smoke barrier door

In I-3 Occupancies (Jails & Prisons) smoke barriers are required to divide every story occupied by residents for sleeping. *(408.6)* As per the following:

- 50 or more persons / minimum 2 smoke compartments
- Maximum number of residents in any smoke compartment is 200
- Travel distance to any exit access component shall not exceed 150 feet
- Travel distance to any smoke barrier door shall not exceed 200 feet

Smoke Partitions – Section 710

Definition

A partition constructed to limit the transfer or passage of smoke. *(710.4)*

Fire Ratings *(710.3)*

Non-rated

Opening Protection

Door assemblies shall be UL 1784 tested and self closing by smoke detection. *(710.5.2)*

Design Notes

- Corridor walls in an I-2 Occupancy (Hospital) shall be constructed as Smoke Partitions. *(407.3 & 710)*

Applications

- Corridor walls of I-2 Occupancies (Hospitals) *(407.3)*
- Elevator Lobbies *(3006.3, Item #2)*
- Separation of care suites in Group I-2 Occupancies *(407.4.4.2)*

International Building Code, 2018

Means of Egress (AC8800 Series)

1010.1.2 Door Swing. Egress doors shall be side-hinged swinging.

Exceptions:

6. In other than Group H occupancies, horizontal sliding doors complying with Section 1010.1.4.3 are permitted in a means of egress.

1010.1.4.3 Special purpose horizontal sliding accordion or folding doors. In other than Group H occupancies, horizontal sliding doors permitted to be a component of a means of egress in accordance with Exception 6 to Section 1008.1.2 shall comply with all of the following criteria:

1. The doors shall be power operated and shall be capable of being operated manually in the event of power failure.
2. The door shall be openable by a simple method from both sides without special knowledge or effort.
3. The force required to operate the door shall not exceed 30 pounds (133 N) to set the door in motion and 15 pounds (67 N) to close the door or open it to the minimum required width.
4. The door shall be openable with a force not to exceed 15 pounds (67 N) when a force of 250 pounds (1100 N) is applied perpendicular to the door adjacent to the operating device.
5. The door assembly shall comply with the applicable fire protection rating and, where rated, shall be self-closing or automatic closing by smoke detection in accordance with Section 716.5.9.3 and shall be installed in accordance with NFPA 80 and shall comply with Section 716.
6. The door assembly shall have an integrated standby power supply.
7. The door assembly power supply shall be electrically supervised.
8. The door shall open to the minimum required width within 10 seconds after activation of the operating device.

NFPA 101 Life Safety Code, 2018

Means of Egress

7.2.1.4 Swing and Force to Open

7.2.1.4.1.4a, b, c Special-purpose horizontally sliding accordion or folding door assemblies complying with 7.2.1.14 shall be permitted.

7.2.1.14 Special-Purpose Horizontally Sliding Accordion or Folding Door Assemblies. Special-purpose horizontally sliding accordion or folding door assemblies shall be permitted in a means of egress, provided that the following criteria are met:

1. The door leaf is readily operable from either side without special knowledge or effort.
2. The force that, when applied to the operating device in the direction of egress, is required to operate the door leaf is not more than 15 lbf (67 N).
3. The force required to operate the door leaf in the direction of door travel is not more than 30 lbf (133 N) to set the leaf in motion and is not more than 15 lbf (67 N) to close the leaf or open it to the minimum required width.
4. The door leaf is operable using a force of not more than 50 lbf (222 N) when a force of 250 lbf (1100 N) is applied perpendicularly to the leaf adjacent to the operating device, unless the door is an existing special-purpose horizontally sliding accordion or folding exit access door assembly serving an area with an occupant load of fewer than 50.
5. The door assembly complies with the fire protection rating, if required, and, where rated, is self-closing or automatic-closing by means of smoke detection in accordance with 7.2.1.8 and is installed in accordance with *NFPA 80, Standard for Fire Doors and Fire Windows.*

INTERTEK Code Compliance Research Report

CCRR 1086

For access to this report:

- Download from the Intertek website: intertek.com/building/ccrr/
- Download from the McKEON website: mckeondoor.com

International Building Code, 2021

202 Definitions, 716 Opening Protectives, Referenced Standards

The development and final vote of the following code sections have been completed and will be published in the 2021 edition of the IBC:

Section 202 Definitions

FIRE PROTECTIVE CURTAIN ASSEMBLY. An assembly consisting of a fabric curtain, bottom bar, guides, coil, operating and closing system.

Section 716 Opening Protectives

716.4 Fire protective curtain assembly. Approved fire protective curtain assemblies shall be constructed of any materials or assembly of component materials tested without hose stream in accordance with UL 10D, and shall comply with Sections 716.4.1 through 716.4.3.

716.4.1 Label. Fire protective curtain assemblies used as opening protectives in fire rated walls and smoke partitions shall be labeled in accordance with 716.2.9.

716.4.2 Smoke and draft control. Fire protective curtain assemblies used to protect openings where smoke and draft control assemblies are required shall comply with Section 716.2.1.4.

716.4.3 Installation. Fire protective curtain assemblies shall be installed in accordance with NFPA 80.

Referenced Standards

UL 10D-17, Standard for Fire Tests of Fire Protective Curtain Assemblies (shown below)

4 FIRE TESTS OF FIRE-PROTECTIVE CURTAIN ASSEMBLIES - UL 10D SEPTEMBER 29, 2017

INTRODUCTION

1 Scope

1.1 These requirements cover the evaluation of fire-protective curtain assemblies intended to provide supplemental, passive fire protection as part of an engineered fire protection system. Fire-protective curtain assemblies are horizontally or vertically oriented. Horizontally or vertically oriented fire-protective curtain assemblies provide nonstructural separation only, and are not intended to be substituted for structural hourly rated partitions or opening protectives that have been tested for fire endurance and hose stream performance.

McKEON FireFighter® Egress Feature

All FireFighter models that incorporate the egress feature can be placed in a required path of egress. Compliance with the criteria detailed in IBC Chapter 10, Means of Egress means building occupants can easily exit through this unique curtain assembly regardless of its application in the building.

Code Requirements

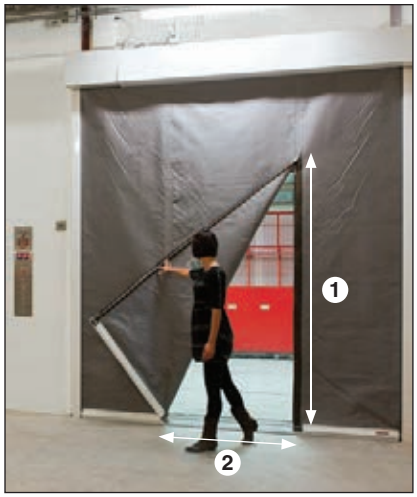
Section 1010.1.2 Door Swing. Egress doors shall be of the pivoted or side-hinged swinging type.

The FireFighter egress door includes a hinged bottom bar located at 90 degrees to the fabric so that when the fabric is pushed to the open position both bottom bar and fabric easily swing providing complying egress width to allow building occupants to exit.

RESOURCES

Section 1010.1.1 Size of doors. The required capacity of each door opening shall be sufficient for the occupant load thereof and shall provide a minimum clear opening width of 32 inches (813 mm) … The minimum clear opening height of doors shall be not less than 80 inches (2032 mm).

The following photo/dimensions and table will help you determine compliance with this code requirement.



Product	Opening Height from Floor	Opening (swing) Force (LBF)	Opening Dimensions
Fire & Smoke Curtain	18"	Less than 1/2 lbf	36"
Fire & Smoke Curtain	36"	Less than 1/2 lbf	22 1/2"
Fire & Smoke Curtain	54"	Less than 1/2 lbf	20"
Fire & Smoke Curtain	72"	Less than 1/2 lbf	12"
Fire & Smoke Curtain	84"	Less than 1/2 lbf	6"

Section 1010.1.3 Door opening force … the door latch shall release when subjected to a 15-pound (67 N) force. The door shall be set in motion when subjected to a 30-pound (133 N) force. The door shall swing to a full-open position when subjected to a 15-pound (67 N) force.

The following test data confirms that the FireFighter egress feature complies with these requirements.

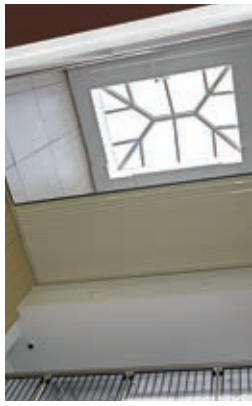
Flexible Fabric Door Compliance Test	
Force A (LBF) Opening force to set egress in motion, hook & loop ripped open	26
Force B (LBF) Swing force to swing egress door to fully open position	0.5
Force C (LBF) Force required to hold egress door in the fully open 90 position	4
Height	34"

ADA Notes:

- Doors designated as fire doors must have the minimum opening force allowed by the local authority.
- Interior accessible doors should require no more than 5 lbs. of force to open.
- Threshold cannot be higher than 1/2 inch at accessible doors.

44 Sawgrass Drive
Bellport, NY 11713
Phone: 800-266-9392
Fax: 631-803-3030
Email: info@mckeondoor.com
www.McKeonDoor.com








File Attachments for Item:

ER-3 Understanding the UL Fire Resistance Directories, Various Assemblies (National Gypsum - OBOA-ODPCA Conference)

BO, MPE, BPE, BI, FPI, MI, PI, NRIUI, RBO, RPE, RBI, RMI, RIUI (2 hours)

Staff Notes: Expansion of previously approved one-hour course. Based on Gypsum Association 2021 standard, GA600. Not recommended tor approval.

Committee Recommendation:

Mark Chapman is Senior Manager of Construction Services at National Gypsum Company. He currently oversees National Gypsum's construction services department, which provides technical support to the construction industry for NGC products, gypsum board systems and specifications. He also serves on the Gypsum Association building code and technical committee. He has been involved with the development of construction systems and in the construction field for more than 40 years.

Thad Goodman is Construction Design Manger Great Lakes & Midwest areas at National Gypsum Company. He currently calls on the Architectural Community to provide technical support and building knowledge base for gypsum board systems and specifications. He serves on the Construction Specifications Institute Board of Directors at the national level. He is a former contractor in the Central Ohio area and has been in the construction field for more than 40 years.

National Gypsum Company
Thad Goodman 4284 Loop Rd. Somerset, Oh 43783 thadg@nationalgypsum.com 614-296-5375

CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

Instructors: Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications for which the BBS has approved the class, and fees in promotion materials and advertising. ***The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising***. Advertising shall not disclose improper approval information to the public.

Course sponsors/co-sponsors: provide participants a certificate of completion containing the following information: name of participant, title of approved courses, BBS approval #, BBS approved certifications, date of the continuing education program, number of approved credit hours awarded and signature of authorized sponsor or instructor.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

Participants: Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

Board approval: Remains in effect through the calendar year of approval. The course may be renewed administratively by sponsor application in subsequent years so long as it references current codes and standards Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

Facility/training area: Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

APPLICATION

FOR

Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.

Board of Building Standards
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax: (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: Thad Goodman (Contact Name)
Organization: National Gypsum Company (Organization/Company)
Address: 4284 Loop Rd. NW (Include Room Number, Suite, etc.)
City: Somerset State: Ohio Zip: 43783
E-Mail: thadg@nationalgypsum.com
Telephone: 614-214-5666 Fax: N/A
Course Sponsor: National Gypsum Company

COURSE INFORMATION:

Course Title: Understanding the UL Fire Resistance Online Directories, Various Assemblies, Sound & Fire Protection Partition Walls

New Course Submittal: ☐ Update Course: ■ Prior Approval Number: BBS2021-204

Purpose and Objective: Prior Course:To lead to greater understanding how to navigate the Online UL Directory, Provide real world solutions to common field related questions.
To update to the 2 hour course- Introduce new tested assembly approved horizontal membrane systems, Review the 2021 GA-600 Fire Design Manual additional assemblies, released this July 2021, Review Fire and Sound Rated Assemblies for compliance in Multi family construction.

Number of Instructional Contact Hours that can be obtained upon completion: 2 Hours

If Multi-Session, Number of Instructional Contact Hours Per Session: _____

Program Applicable for the Following Participants:

Building Official ■	Master Plans Examiner ■	Building Inspector ■	Fire Protection Inspector ■	Mechanical Inspector ■
	Building Plans Exam. ✔			Plumbing Inspector ■
	Plumbing Plans Exam. ☐			Non-Res IU Inspector ☐
	Electrical Plans Exam. ☐			
	Mechanical Plans Exam. ☐			
	Fire Protect. Plans Exam. ☐			
Res Building Official ■	Res Plans Examiner ■	Res Building Inspector ■	Res Mechanical Inspector ■	Res IU Inspector ■

Electrical Safety Inspectors ☐
Location of ESI Course: _____ Date(s) of ESI Course(s): _____

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**:		Check Off
Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	x
	Organization sponsoring or requesting the program (if any)	x
Course Title:	Name of course (related to content)	x
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	x
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	x
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	x
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	x
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	x
Test Materials:		
Completed Application:		

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

NATIONAL GYPSUM COMPANY
CONTINUING EDUCATION
BUILDING KNOWLEDGE TOGETHER

AIA Continuing Education Provider

Continuing Education Program Summary
Provider: National Gypsum Company | J299

Course: **Understanding the Online UL Fire Directories & Various Assemblies**

Credits: 2 (pending)

Description: Underwriters Laboratory discontinued printing their bright orange books in 2015. The move to online has meant more current information and brought numerous changes to their website formatting and means of access.
Learn how to use this resource in an effective and efficient way. The Gypsum Association has published the 23rd Edition of the Fire Resistance and Sound Control Design Manual. Used in conjunction with the Purple Book II this course will outline the UL requirements of fire rated assemblies and review best practices for field application.

Learning Objectives: Participants will learn access and navigation of the updated UL website; Learn about the three types of fire rated gypsum wallboard; Determine the most effective gypsum IL designs for projects and review manufacturing application best practices.

Source Materials: Online instruction templates for UL review; 23rd Edition Fire Resistance and Sound Control Design Manual; National Gypsum Purple Book II, With nearly 100 pages of often asked questions and designs from architects and building code official's through-out the country, it has become a great reference tool for the Industry

AIA Continuing Education Provider

Presented with approval from the Ohio Board of Building Standards.
This course is approved for 2.0 Learning units

National Gypsum

Understanding the UL Fire Resistance Directories 101

Thad Goodman
thad@nationalgypsum.com
614-214-5666
@GoodmanThad

AIA Continuing Education Provider

1

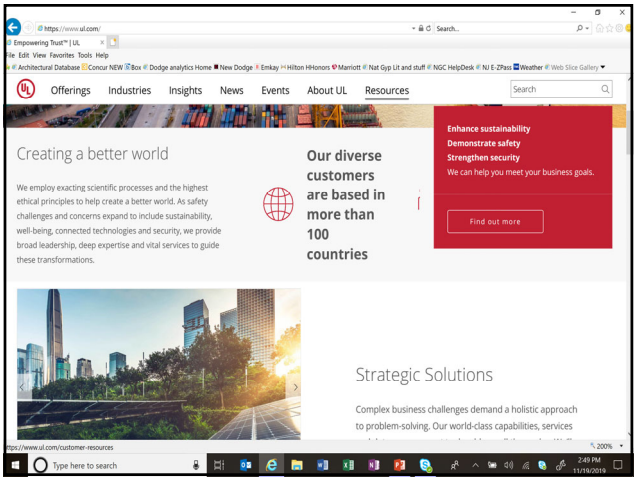
2

UL Fire Resistance Directories

All volumes available on the UL website:

- http://www.ul.com/
- UL permits the reproduction of the material contained in the Online Certification Directory subject to the following conditions:
  - 1. The Guide Information, Assemblies, Constructions, Designs, Systems, and/or Certifications (files) must be presented in their entirety and in a non-misleading manner, without any manipulation of the data (or drawings).
  - 2. The statement "Reprinted from the Online Certifications Directory with permission from UL" must appear adjacent to the extracted material. In addition, the reprinted material must include a copyright notice in the following format: "© 2020 UL LLC"

3



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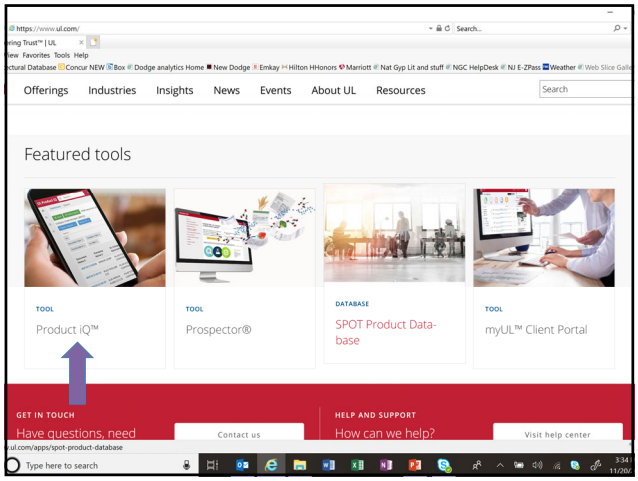
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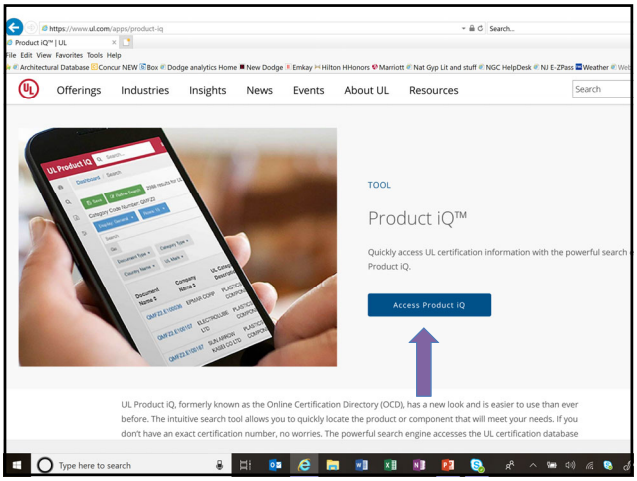
TOOL
Prospector®
DATABASE
SPOT Product Data-base
TOOL
myUL™ Client Portal
GET IN TOUCH
Have questions, need
Contact us
HELP AND SUPPORT
How can we help?
Visit help center

5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Access Product iQ
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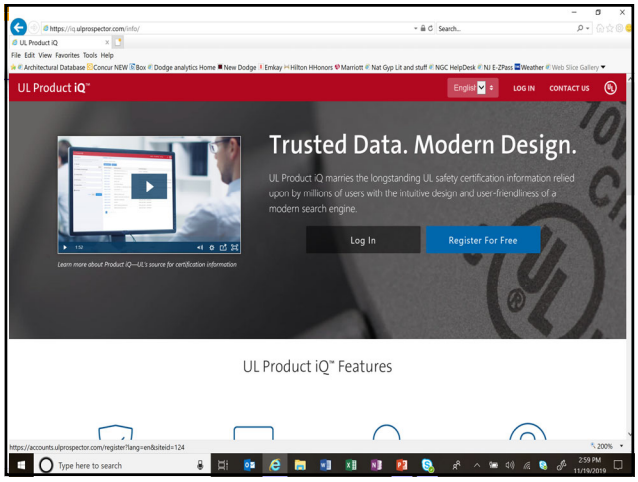
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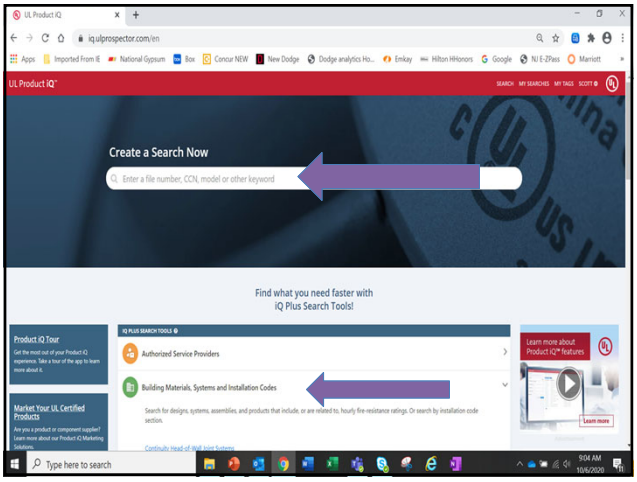
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Market Your UL Certified Products

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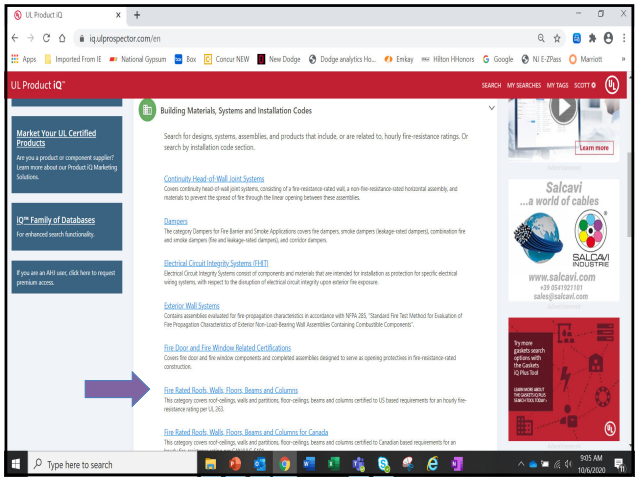
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IQ™ Family of Databases
Continuity Head-of-Wall Joint Systems
Dampers
Electrical Circuit Integrity Systems (FHIT)
Exterior Wall Systems
Fire Door and Fire Window Related Certifications
Fire Rated Roofs, Walls, Floors, Beams and Columns
Fire Rated Roofs, Walls, Floors, Beams and Columns for Canada
Salcavi ...a world of cables
Learn more

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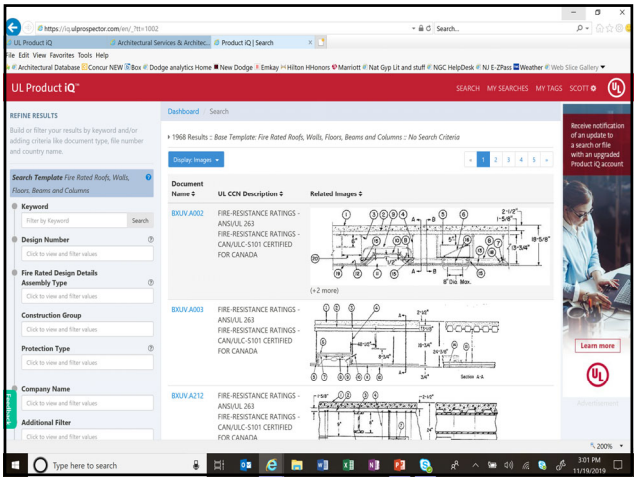
UL Product iQ
REFINE RESULTS
1968 Results : Base Template: Fire Rated Roofs, Walls, Floors, Beams and Columns :: No Search Criteria
Search Template Fire Rated Roofs, Walls, Floors, Beams and Columns
Keyword
Design Number
Fire Rated Design Details
Assembly Type
Construction Group
Protection Type
Company Name
Additional Filter
BXUV.A002
BXUV.A003
BXUV.A212
FIRE-RESISTANCE RATINGS - ANSI/UL 263
FIRE-RESISTANCE RATINGS - CAN/ULC-S101 CERTIFIED FOR CANADA
Receive notification of an update to a search or file with an upgraded Product iQ account
Learn more

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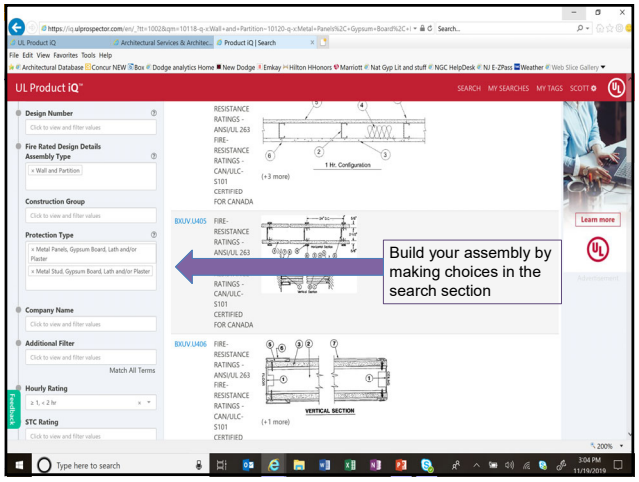
UL Product iQ
Design Number
Fire Rated Design Details
Assembly Type
Construction Group
Protection Type
Company Name
Additional Filter
Hourly Rating
STC Rating
BXUV.U405
BXUV.U406
Build your assembly by making choices in the search section
Learn more

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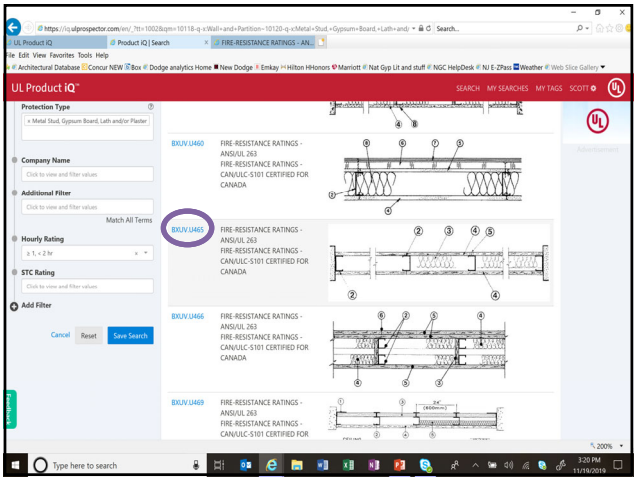
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Protection Type
Company Name
Additional Filter
Hourly Rating
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Add Filter
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BXUV.U460
BXUV.U465
BXUV.U466
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FIRE-RESISTANCE RATINGS - CAN/ULC-S101 CERTIFIED FOR CANADA

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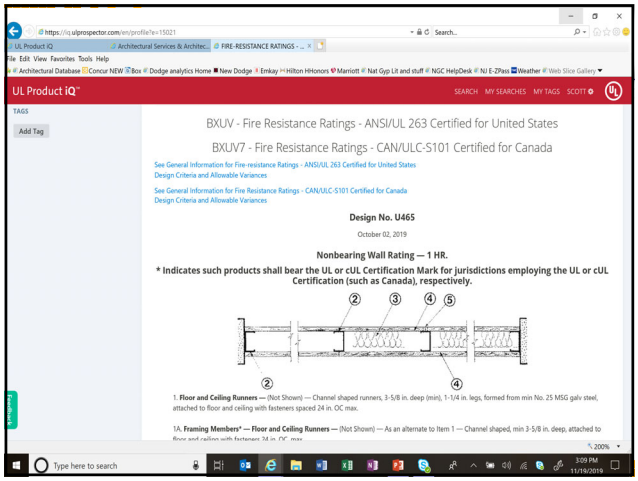
UL Product iQ
BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States
BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design No. U465
October 02, 2019
Nonbearing Wall Rating — 1 HR.
* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

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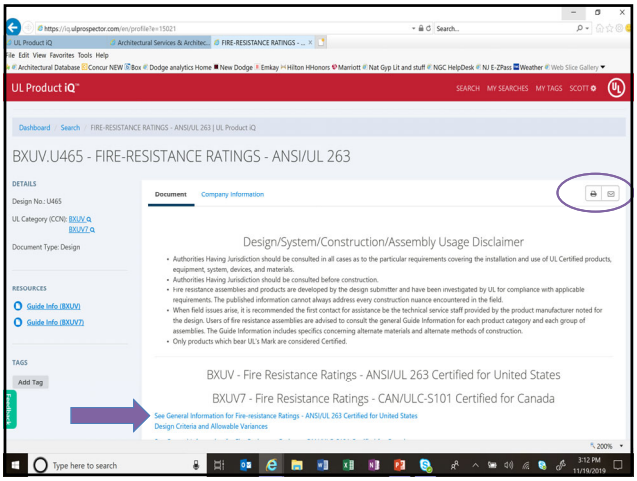
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BXUV.U465 - FIRE-RESISTANCE RATINGS - ANSI/UL 263
Design/System/Construction/Assembly Usage Disclaimer
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BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

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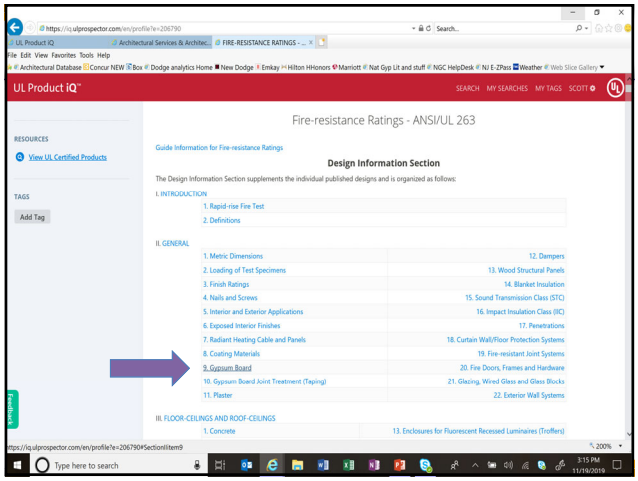
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Design Information Section

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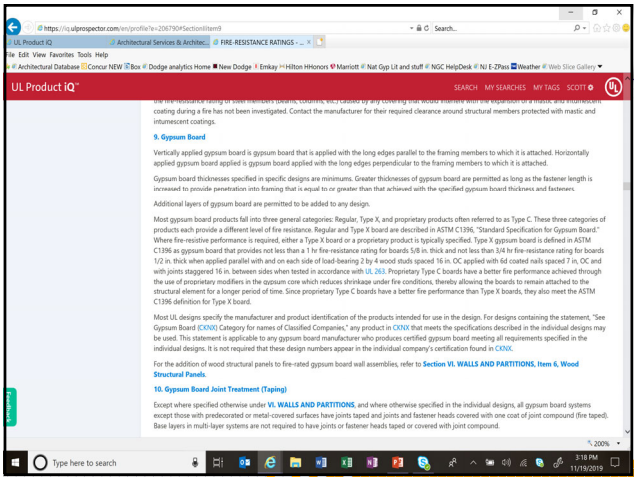
UL Product iQ
9. Gypsum Board
10. Gypsum Board Joint Treatment (Taping)

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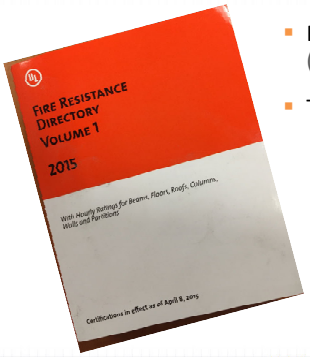
Volume 1



- First 10 pages (most important)
- Table on page 1

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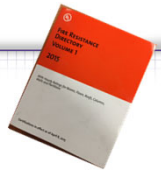
Important Key Passages



- Nails vs. screws
- Gypsum board orientation
- Gypsum board joint treatment (fire taping)
- Blanket insulation
- Wall and Partition Assemblies

18

Pg 5 - Nails vs. screws

- Screws meeting ASTM C1002 or ASTM C954 may be substituted for nails, one for one, when the head diameter, length, and spacing equal or exceed the requirements for the specified nails.

19

Pg 7 - Gypsum board orientation

- Vertically applied gypsum board is gypsum board that is applied with the long edges parallel to the framing members to which it is attached.
- Horizontally applied gypsum board applied is gypsum board applied with the long edges perpendicular to the framing members to which it is attached.

20

Pg 7 - Gypsum board joint treatment (fire taping)

- Unless otherwise specified in the specific design all gypsum board systems except those with predecorated or metal covered surfaces have joints taped and joints and fastener heads covered with one coat of joint compound (fire taped).

- Base layers in multi layer systems are not required to have joints or fastener heads taped or covered with joint compound.

21

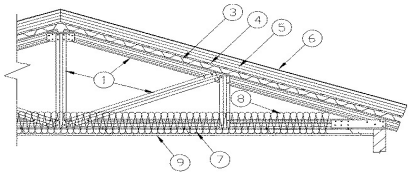
Pg 7 - Gypsum board

- Gypsum board thicknesses specified in specific designs are minimums. Greater thicknesses of gypsum board are permitted.
- Additional layers of gypsum board are permitted to be added to any design.

22

Pg 15 - Blanket Insulation

Unless specifically described in a design, the addition of insulation in the concealed space between the ceiling membrane and the floor or roof structure may reduce the hourly rating of an assembly by causing premature disruption of the ceiling membrane and/or higher temperatures on structural components under fire exposure conditions.



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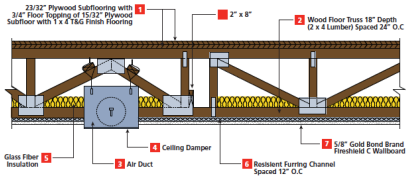
UL Design No. L558

Unrestrained Assembly Rating - 1 HR.

Finish Rating - 23 Min.



1. **Floor System**
2. **Trusses**
3. **Air Duct**
4. **Ceiling Damper**
5. **Glass Fiber Insulation**
6. **Furring Channels**
7. **Gypsum Board**

24

Floor/Ceiling Assembly

25

Wall and Partition Assemblies

- The size of studs are minimum unless otherwise stated in a Design.
- The spacing of studs is a maximum unless otherwise stated in a Design.
- Spacing between parallel rows of studs are minimums unless otherwise stated in the individual designs.

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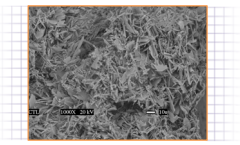
Fire Resistive Properties of Gypsum

- Gypsum is approximately 21% by weight chemically combined water
- A 5/8" Type X 4'x12' board = 22lbs of water
- This greatly contributes to its effectiveness as a fire resistive barrier



$CaSO_4 \cdot 2H_2O$

27

Pg 19 - Wall and Partition Assemblies

- The ratings for walls and partitions apply when either face of the assembly is exposed to the fire unless indicated otherwise on a specific Design...
- The hourly rating of a load bearing assembly also applies to the same assembly when it is used as a non-load bearing assembly.

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Fire Resistive Properties of Gypsum

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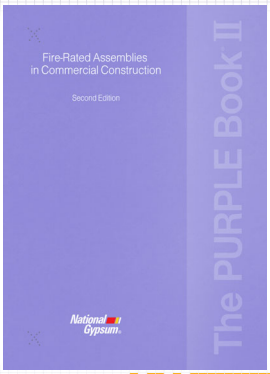
The Purple Book II



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The Purple Book II – Table of Contents

GN Series - General Information
SS Series - Steel Stud Partitions 09 29 00
SW Series - Shaftwall Assemblies 09 21 16.23
ST Series - Stair Shaftwall Details
EV Series - Elevator Shaftwall Details
SR Series - Shaftwall Repair Details
HM Series - Rated Horizontal Membranes
CR Series - Rated Corridor Assemblies
FC Series - Floor-Ceiling Assemblies
CL Series - Steel Column Assemblies
BM Series - Rated Steel Beam Assemblies
PN Series - Penetrations Through Rated Wall and Floor Assemblies
SN Series - Sound Transmission Class (STC) of Rated Partitions
RE Series - Repair Details

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Purple Book ll - ASTM Standards

ASTM Product Standards	
C475	Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board
C1177	Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
C1178	Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel
C1325	Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units
C1396	Standard Specification for Gypsum Board
C1658	Standard Specification for Glass Mat Gypsum Panels
ASTM Test Standards	
C473	Standard Test Methods for Physical testing of Gypsum Panel Products
C474	Standard Test Methods for Joint Treatment Materials for Gypsum Board Construction
C1629	Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels
D3273	Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
E84	Standard Test Method for Surface Burning Characteristics of Building Materials
E90	Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
E96	Standard Test Methods for Water Vapor Transmission of Materials
E119 (UL 263)	Standard Test Methods for Fire Tests of Building Construction and Materials
E136	Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C
G21	Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
ASTM Application Standards	
C840	Standard Specification for Application and Finishing of Gypsum Board
C1280	Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing

Gypsum Association Standards	
GA-214	Recommended Levels of Gypsum Board Finish
GA-216	Application and Finishing of Gypsum Panel Products
GA-253	Application of Gypsum Sheathing

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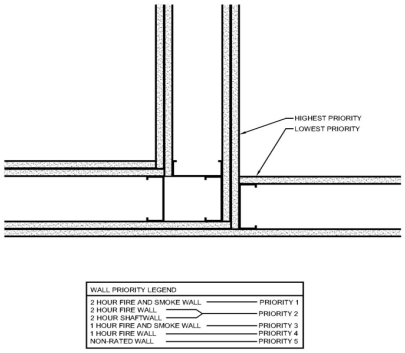
Purple Book ll – Wall Priority Legend



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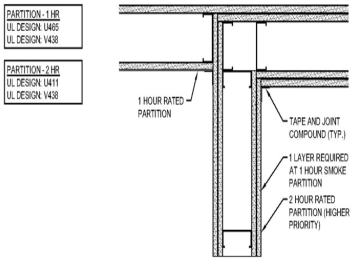
Purple Book II – Wall Priority



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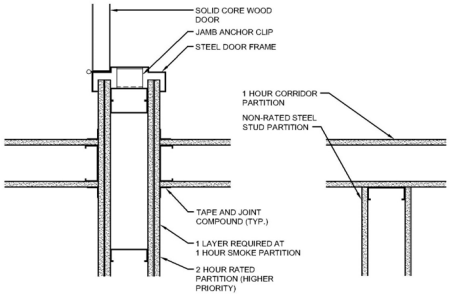
Purple Book II – Wall Priority



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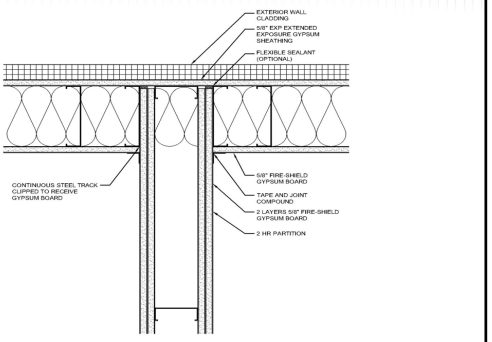
Purple Book II – Exterior Wall Priority



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GA-600 2021

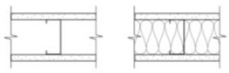
GA FILE NO. WP 1109	PROPRIETARY	1 HOUR FIRE	45 to 49 STC SOUND

GYPSUM BOARD, STEEL STUDS

Fire Design:
One layer 5/8" proprietary type X gypsum board applied parallel or at right angles to each side of 3-5/8", 15 mil steel studs 24" o.c. with 1" Type S screws 12" o.c. at vertical joints, intermediate studs, and floor and ceiling runners.
Vertical joints centered over studs and staggered one stud cavity on opposite sides. Horizontal edge and butt joints on opposite sides of studs need not be staggered or backed. **(NLB)**

Sound Design:
Sound tested with 3-1/2" glass fiber insulation friction fit in stud cavity.

PROPRIETARY GYPSUM BOARD
National Gypsum Company
– 5/8" Gold Bond® Fire-Shield® Gypsum Board



Thickness: 4-7/8" (Fire and Sound)
Approx. Weight: 6 psf (Fire) 6.2 psf (Sound)
Fire Test: UL R3501, 4786165121, 2-27-14, UL R3501, 4788164270, 3-29-18, UL R3501, 08NK09662, 6-19-08, UL Design U465, V438
Sound Test: NGC 2017107, 7-20-17

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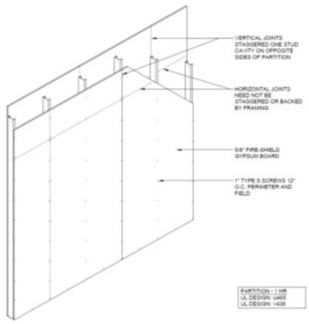
Purple Book II



39

GA-600 2021

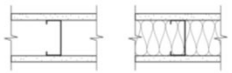
GA FILE NO. WP 1212	PROPRIETARY	1 HOUR FIRE	40 to 44 STC SOUND

GYPSUM BOARD, STEEL STUDS

Fire Design:
One layer proprietary type X gypsum board applied parallel or right angles to each side of 3-1/2", 33 mil steel studs 24" o.c. with 1" long Type S-12 screws 12" o.c. at vertical joints, intermediate studs, and floor and ceiling runners.
Vertical joints centered over studs and staggered one stud cavity on opposite sides. Horizontal joints on opposite sides need not be staggered or backed. **(LOAD-BEARING)**

Sound Design:
Sound tested with 3-1/2" glass fiber insulation in cavity.

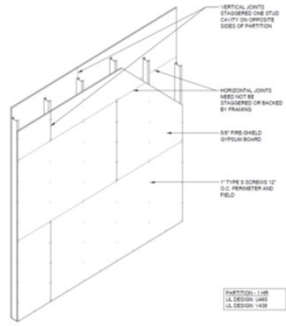
PROPRIETARY GYPSUM BOARD
National Gypsum Company
– 5/8" Gold Bond® Fire-Shield® Gypsum Board



Thickness: 6-1/8" (Fire and Sound)
Approx. Weight: 5.1 psf (Fire) 5.3 psf (Sound)
Fire Test: UL R3501, 4788757222, 2-16-19, UL Design W469
Sound Test: NGC 2020022, 1-22-20

40

Purple Book II



41

GA-600 2021

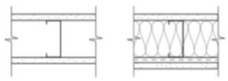
GA FILE NO. WP 1049	PROPRIETARY	1 HOUR FIRE	50 to 54 STC SOUND

GYPSUM BOARD, STEEL STUDS

Fire Design:
One layer 5/8" proprietary type X gypsum wallboard applied parallel to each side of 3-5/8", 15 mil steel studs 24" o.c. with 1" Type S screws 12" o.c. at vertical joints, intermediate studs, and floor and ceiling runners.
Joints staggered 24" on opposite sides. **(NLB)**

Sound Design:
Sound tested with resilient channels 24" o.c. and 3-5/8" glass fiber insulation friction fit in stud cavity.

PROPRIETARY GYPSUM BOARD
National Gypsum Company
– 5/8" Gold Bond® Fire-Shield® Gypsum Board



Thickness: 4-7/8" (Fire) 5-3/8" (Sound)
Approx. Weight: 6 psf (Fire and Sound)
Fire Test: UL R3501, 06NK12955, 7-18-06, UL Design V438
Sound Test: NGC 2017102, 7-17-17

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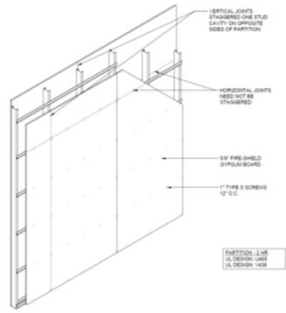
Purple Book II



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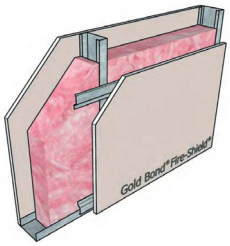
GA-600 2021

Figure 87



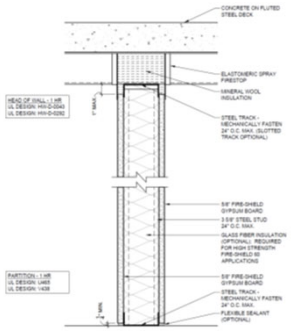
STC-53 **NGC 2017102**

Framing: 3-5/8" steel studs, 25 gauge (15 mil), 24" o.c.
Insulation: 3-1/2" glass fiber
Side 1: 5/8" Fire-Shield Gypsum Board
Side 2: 5/8" Fire-Shield Gypsum Board on RC-1

UL Design: V438, U465 - 1 hour

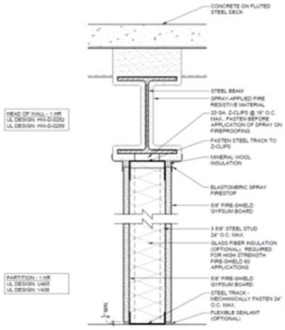
44

Purple Book II



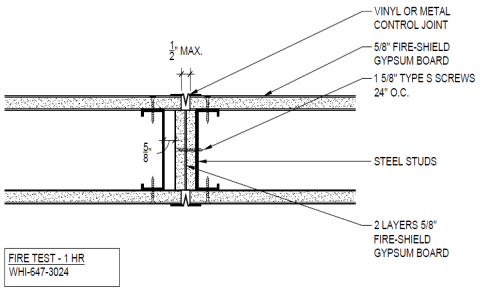
45

Purple Book II



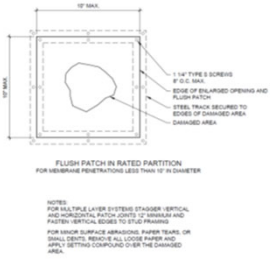
46

Purple Book II – Fire Rated Control Joint



47

Purple Book II – GA-225 2019



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GA-600 2021

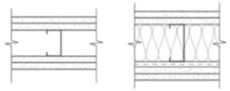
GA FILE NO. WP 1451	PROPRIETARY	2 HOUR FIRE	60 to 64 STC SOUND

GYPSUM BOARD, STEEL STUDS

Fire Design:
Base layer 5/8" proprietary type X gypsum wallboard applied parallel or at right angles to each side of 2-1/2", 15 mil steel studs 24" o.c. with 1" Type S screws 16" o.c. **Face** layer 5/8" type X gypsum wallboard applied parallel or at right angles to each side with 1-5/8" Type S screws 16" o.c.
Face layer horizontal joints offset 12" from **base** layer horizontal joints. **(NLB)**

Sound Design:
Sound tested using 3 5/8", 15 mil steel studs with resilient channels 24" o.c. on studs 3-1/2" glass fiber insulation in stud cavity.

PROPRIETARY GYPSUM BOARD
National Gypsum Company
– 5/8" Gold Bond® Fire-Shield® Gypsum Board



Thickness: 5" (Fire)
6-5/8" (Sound)
Approx. Weight: 9 psf (Fire)
9.3 psf (Sound)
Fire Test: UL R3501, 07NK12306, 8-24-07, UL Design V438
Sound Test: RAL TL05-081, 4-14-05

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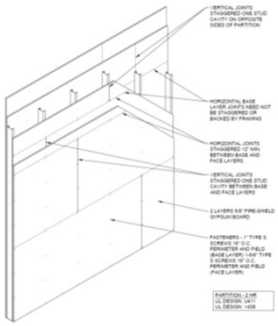
Purple Book II



50

GA-600 2021

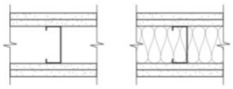
GA FILE NO. WP 1574	PROPRIETARY	2 HOUR FIRE	50 to 54 STC SOUND

GYPSUM BOARD, STEEL STUDS

Fire Design:
Base layer 5/8" proprietary type X gypsum board applied parallel or right angles to each side of 3-1/2", 33 mil steel studs 24" o.c. with 1" long Type S-12 screws 16" o.c. **Face** layer 5/8" proprietary type X gypsum board applied parallel or right angles to studs with 1-5/8" long Type S-12 screws 16" o.c.
Vertical joints centered over studs and staggered one stud cavity on opposite sides and adjacent layers. Horizontal edge joints and horizontal butt joints on opposite sides and in adjacent layers need not be staggered or backed. **(LOAD-BEARING)**

Sound Design:
Sound tested with 3-1/2" glass fiber insulation in cavity.

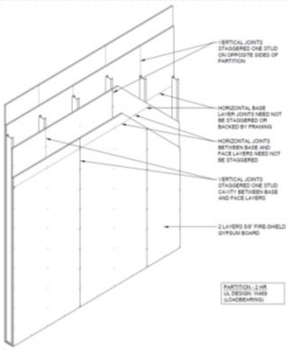
PROPRIETARY GYPSUM BOARD
National Gypsum Company
– 5/8" Gold Bond® Fire-Shield® Gypsum Board



Thickness: 6" (Fire and Sound)
Approx. Weight: 9.7 psf (Fire)
9.9 psf (Sound)
Fire Test: UL R3501, 4788757230, 2-16-19, UL Design W469
Sound Test: NGC 2020023, 1-22-20

51

Purple Book II



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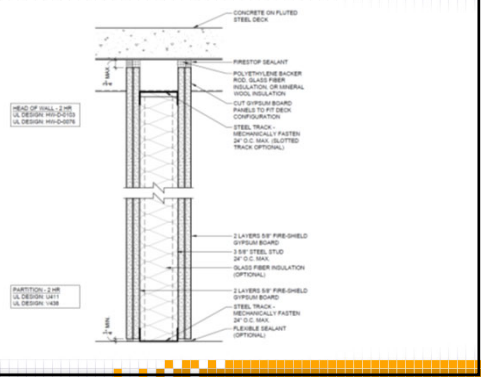
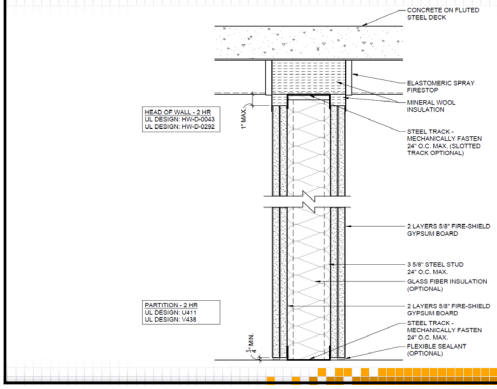
Purple Book II



53

Purple Book II



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GA-600 2021

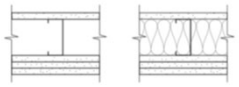
GA FILE NO. WP 1567	PROPRIETARY	2 HOUR FIRE	50 to 54 STC SOUND

GYPSUM BOARD, STEEL STUDS

Fire Design:
Base layer 5/8" proprietary type X gypsum wallboard applied parallel to each side of 3-5/8", 18 mil steel studs 24" o.c. with 1-1/8" Type S screws 8" o.c. at vertical joints and wall perimeter and 12" o.c. at intermediate studs. **Second** layer 5/8" proprietary type X gypsum wallboard applied parallel to studs with 1-5/8" Type S screws 12" o.c. **Face** layer 5/8" proprietary type X gypsum wallboard applied over second layer and parallel to studs with 2-1/4" Type S screws 8" o.c. at vertical joints and wall perimeter and 12" o.c. at intermediate studs.
Vertical joints staggered 24" each layer and side. **(NLB)**

Sound Design:
Sound tested with 3-1/2" glass fiber insulation friction fit in stud cavity.

PROPRIETARY GYPSUM BOARD
National Gypsum Company
– 5/8" Gold Bond® Fire-Shield® Gypsum Board



Thickness: 6" (Fire and Sound)
Approx. Weight: 9 psf (Fire) 9.2 psf (Sound)
Fire Test: UL R3501, 03NK13365, 10-27-03, UL Design V449
Sound Test: NGC 2016024, 4-14-16

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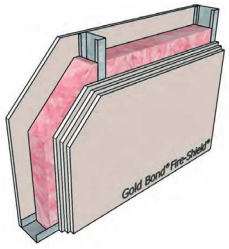
The SoundBook

Figure 104



STC-52 **NGC 2016024**

Framing: 3-5/8" steel studs, 25 gauge (18 mil), 24" o.c.
Insulation: 3" glass fiber
Side 1: 5/8" Fire-Shield Gypsum Board
Side 2: 3 layers 5/8" Fire-Shield Gypsum Board

UL Design: V449 - 2 hour

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GA-600 2021

WALLS AND INTERIOR PARTITIONS, NONCOMBUSTIBLE

GA FILE NO. WP 1297	PROPRIETARY	1 HOUR FIRE	40 to 44 STC SOUND

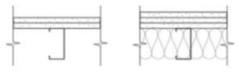
GYPSUM BOARD, STEEL STUDS

Fire Design:
Base layer 5/8" proprietary type X gypsum wallboard applied parallel to ONE SIDE of 3-5/8", 18 mil steel studs 24" o.c. with 1" Type S screws 24" o.c. Setting compound applied to surface of base layer with a 1/4" × 1/4" notched trowel. **Face** layer 5/8" proprietary type X gypsum wallboard applied parallel to studs with 1-5/8" Type S screws 12" o.c., starting with a 6" offset from the bottom of the gypsum board.

As an alternate to setting compound, a **third** (middle) layer of 5/8" proprietary type X gypsum wallboard applied parallel to studs with 1-5/8" Type S screws 24" o.c. and **Face** layer applied as described above with 2-1/4" Type S screws.

Vertical joints staggered 24" between layers. **(NLB)**

Sound Design:
Sound tested with 3-5/8", 19 mil studs, 3-1/2" glass fiber insulation in stud cavity and three layers 5/8" proprietary type X gypsum board.



Thickness: 4-7/8" (Fire) 5-1/2" (Sound)
Approx. Weight: 5 psf (Fire) 7 psf (Sound)
Fire Test: UL R3501, 09NK18004, 4-20-10, UL Design V497
Sound Test: NGC 2018048, 5-9-18

PROPRIETARY GYPSUM BOARD
National Gypsum Company
– 5/8" Gold Bond® Fire-Shield® Gypsum Board

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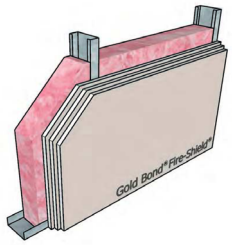
The SoundBook

Figure 77



STC-42 **NGC 2018048**

Framing: 3-5/8" steel studs, 20 gauge (19 mil), 24" o.c.
Insulation: 3-1/2" glass fiber
Side 1: None
Side 2: 3 layers 5/8" Fire-Shield Gypsum Board

UL Design: V497 - 1 hour

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GA-600 2021

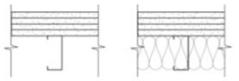
GA FILE NO. WP 1715	PROPRIETARY	2 HOUR FIRE	40 to 44 STC SOUND

GYPSUM BOARD, STEEL STUDS

Fire Design:
Base layer 5/8" proprietary type X gypsum board applied parallel or at right angles to one side of a 3-5/8", 15 mil steel studs 24" o.c. with 1" Type S screws 24" o.c. **Second** layer 5/8" proprietary type X gypsum board applied parallel or at right angles with 1-5/8" Type S screws 24" o.c. **Third** layer 5/8" proprietary type X gypsum board applied parallel or at right angles with 2-1/2" Type S screws 16" o.c. **Face** layer 5/8" proprietary type X gypsum board applied parallel or at right angles with 3" Type S screws 12" o.c.

Vertical joints offset 24" between layers; horizontal joints offset minimum 12" between layers. **(NLB)**

Sound Design:
Sound tested with 3-5/8", 19 mil studs and 3-1/2" glass fiber insulation in cavity.



Thickness: 6-1/8" (Fire and Sound)
Approx. Weight: 9.6 psf (Fire) 9.8 psf (Sound)
Fire Test: UL R3501, 4788975312, 06-26-19, UL Design V497
Sound Test: NGC 2018047, 6-6-18

PROPRIETARY GYPSUM BOARD
National Gypsum Company
– 5/8" Gold Bond® Fire-Shield® Gypsum Board

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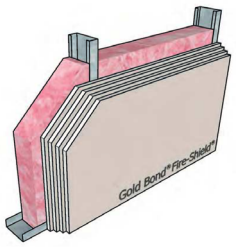
The SoundBook

Figure 79



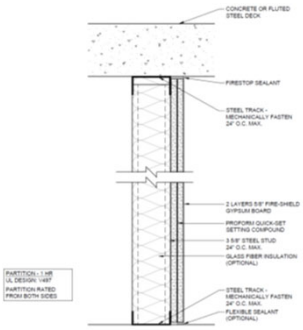
STC-44 **NGC 2018047**

Framing: 3-5/8" steel studs, 20 gauge (19 mil), 24" o.c.
Insulation: 3-1/2" glass fiber
Side 1: None
Side 2: 4 layers 5/8" Fire-Shield Gypsum Board

UL Design: V497 - 2 hour

60

Purple Book II



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GA-600 2021 – 1-Hour Horizontal Membrane

GA FILE NO. HM 7101	PROPRIETARY	1 HOUR FIRE	

INTERIOR CEILING, GYPSUM BOARD

Fire Design:

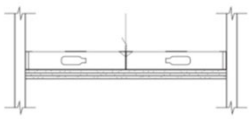
Perimeter channels 3-5/8", 33 mil with 1-1/4" legs attached to side walls 24" o.c. Steel studs, 3-5/8", 33 mil attached to top and bottom of perimeter channel with 3/8" pan head screws, and spaced 16" o.c. Flat strap 4", 33 mil secured to top of studs at centerline of span with one 3/8" pan head screw. **Base** layer 5/8" proprietary type X gypsum board applied at right angles to framing with 1" Type S screws 16" o.c. **Second** layer 5/8" proprietary type X gypsum board applied at right angles to framing with 1-5/8" Type S screws 16" o.c. **Face** layer 5/8" proprietary type X gypsum board applied at right angles to framing with 2-1/4" Type S screws 12" o.c. Maximum span 8'-1".

Edge and end joints staggered minimum 16" from each layer.

Suspension method (for spans greater than 8'-1"), 8 gauge hanger wire hung from holes punched in back-to-back channel secured 24" o.c. with 1/2" pan head screws and spaced maximum 24" o.c. **(NLB)**

PROPRIETARY GYPSUM BOARD

National Gypsum Company
– 5/8" Gold Bond® Fire-Shield® Gypsum Board

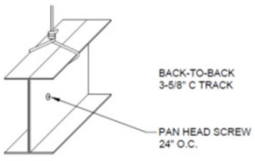


Thickness: 5-1/2" (Fire)
Approx. Weight: 7 psf (Fire)
Fire Test: UL R3501, 4787347414, 1-7-16, UL Design I504

62

1-Hour Horizontal Membrane - Framing Splice

HORIZONTAL MEMBRANE - 1 HR
UL DESIGN: I504



HANGER ASSEMBLY DETAIL
(REQUIRED FOR SPANS GREATER THAN 8'-0")

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GA-600 2021 – 2-Hour Horizontal Membrane

HORIZONTAL MEMBRANE SYSTEMS

GA FILE NO. HM 7201	PROPRIETARY	2 HOUR FIRE	

INTERIOR CEILING, GYPSUM BOARD

Fire Design:

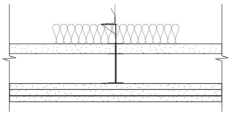
Perimeter J-Track 4", 33 mil attached to side walls 24" o.c. **One** layer 1" x 24" proprietary type X panels inserted between steel C-T studs, 4", 33 mil and each corner secured to J-Track with 1-5/8" Type S screws, studs attached to top and bottom of perimeter J-Track with 1/2" pan head screws, and spaced 24" o.c. **Base** layer 5/8" proprietary type X gypsum board applied at right angles to framing with 1" Type S screws 12" o.c. **Second** layer 5/8" proprietary type X gypsum board applied at right angles to framing with 1-5/8" Type S screws 12" o.c. **Face** layer 5/8" proprietary type X gypsum board applied at right angles to framing with 2-1/4" Type S screws 12" o.c. Maximum span 8'- 0".

Edge and end joints staggered minimum 24" from each layer.

Suspension method (for spans greater than 8'-0"), 8 gauge hanger wire hung from holes punched in back-to-back J-Track and 6" 18 mil C channel secured 24" o.c. with 1/2" pan head screws and spaced maximum 24" o.c. **One** layer 2" thick by 6" wide mineral wool batts adhesively applied on both sides of C channel. **(NLB)**

PROPRIETARY GYPSUM BOARD

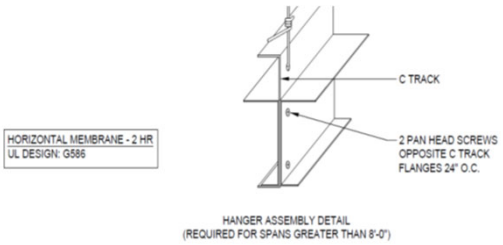
National Gypsum Company
– 1" Gold Bond® Shaftliner XP®
– 5/8" Gold Bond® Fire-Shield C™ Gypsum Board



Thickness: 5-7/8" (Fire)
Approx. Weight: 12 psf (Fire)
Fire Test: UL R3501, 11NK08563, 1-8-11, UL Design G586

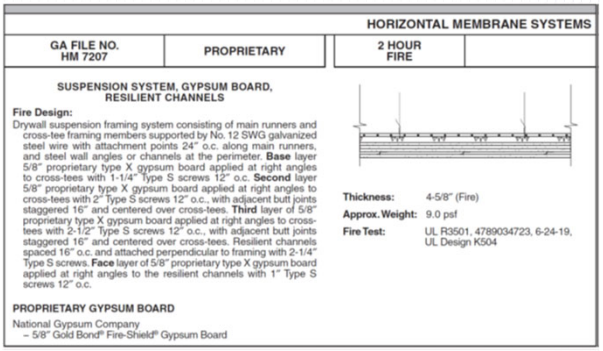
64

2-Hour Horizontal Membrane – Framing Splice



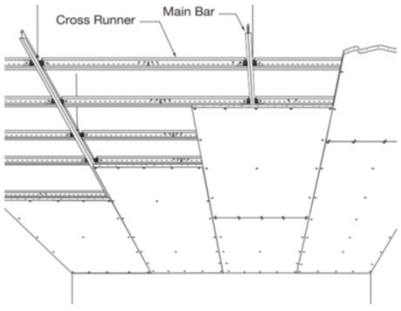
65

GA-600 2021 - 2-Hour Horizontal Membrane



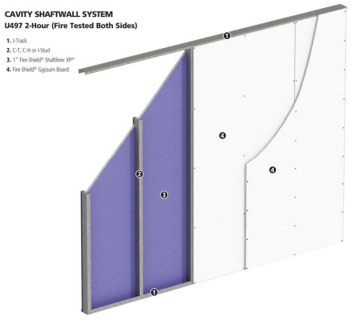
66

Drywall Suspension System



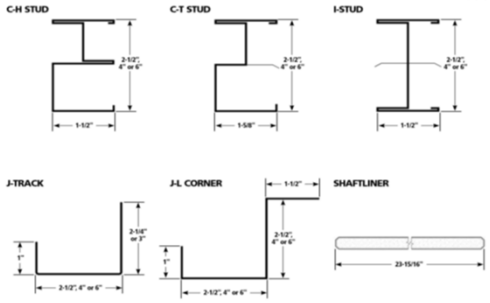
67

2-Hour Shaftwall System



68

Shaftwall Framing Components



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GA-600 2021

SHAFT WALLS

GA FILE NO. WP 7066.1	PROPRIETARY	2 HOUR FIRE	50 to 54 STC SOUND

GYPSUM BOARD, STEEL STUDS

Fire Design:
One layer 1" × 24" proprietary type X gypsum panels inserted between 2-1/2" floor and ceiling runners with tab-flange section of 2-1/2" steel C-H, C-T, or I studs between panels.

OPPOSITE SIDE: **Base** layer 5/8" proprietary type X gypsum board or gypsum veneer base applied parallel or at right angles to studs with 1" Type S screws 24" o.c. **Face** layer 5/8" proprietary type X gypsum board or gypsum veneer base applied parallel to studs with 1-5/8" Type S screws 12" o.c. **(NLB)**

Sound Design:
Sound tested with 6", 33 mil studs and 5" insulation in stud cavity.

PROPRIETARY GYPSUM BOARD

National Gypsum Company
- 5/8" Gold Bond® Fire-Shield® Gypsum Board
- 1" Gold Bond® Shaftliner XP™

Thickness: 3-3/4" (Fire) 7-1/4" (Sound)
Approx. Weight: 8.5 psf (Fire) 9.5 psf (Sound)
Fire Test: UC ES-7408, 11-21-75 (Rev. 6-76), UL Design U497, 13NK02062, 1-14-13, UL Design W419, System B
Sound Test: NGC 2019013, 2-19-19

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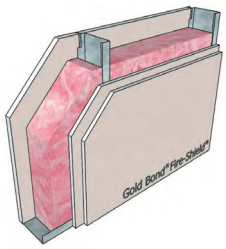
The SoundBook

Figure 185



STC-51 **NGC 2019013**

Framing:	6" steel CT studs, 20 gauge (33 mil), 24" o.c.
Insulation:	5" glass fiber
Side 1:	1" Fire-Shield Shaftliner
Side 2:	2 layers 5/8" Fire-Shield Gypsum Board

UL Design: U497, W419 - 2 hour

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GA-600 2021

SHAFT WALLS

GA FILE NO. WP 7035	PROPRIETARY	2 HOUR FIRE	60 to 64 STC SOUND

GYPSUM BOARD, STEEL STUDS

Fire Design:
One layer 1" × 24" proprietary type X gypsum panels inserted between 2-1/2" floor and ceiling runners with tab-flange section of 2-1/2" steel C-H, C-T, or I studs between panels.

OPPOSITE SIDE: **Base** layer 5/8" proprietary type X gypsum board or gypsum veneer base applied parallel to studs with 1" Type S screws 24" o.c. **Face** layer 5/8" proprietary type X gypsum board or gypsum veneer base applied parallel to studs with 1-5/8" Type S screws 12" o.c. **(NLB)**

Sound Design:
Sound tested with 6", 33 mil studs and 7/8" metal channel spaced 24" o.c., attached to studs with proprietary resilient sound isolation clips spaced 48" o.c. and 5" insulation in stud cavity.

PROPRIETARY GYPSUM BOARD

National Gypsum Company
- 5/8" Gold Bond® Fire-Shield® Gypsum Board
- 1" Gold Bond® Shaftliner XP™

Thickness: 3-3/4" (Fire) 8-7/8" (Sound)
Approx. Weight: 9 psf (Fire) 10 psf (Sound)
Fire Test: UC ES-7408, 11-21-75, (Rev 6-76), UL Design U497, 13NK02062, 1-14-13, UL Design W419, System B
Sound Test: NGC 2019016, 2-20-19

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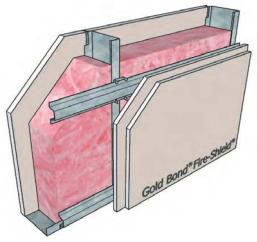
The SoundBook

Figure 187



STC-61 **NGC 2019016**

Framing: 6" steel CT studs, 20 gauge (33 mil), 24" o.c.
Insulation: 5" glass fiber
Side 1: 1" Fire-Shield Shaftliner
Side 2: 2 layers 5/8" Fire-Shield Gypsum Board on 7/8" furring channel and resilient isolation clips
UL Design: U497, W419 - 2 hour

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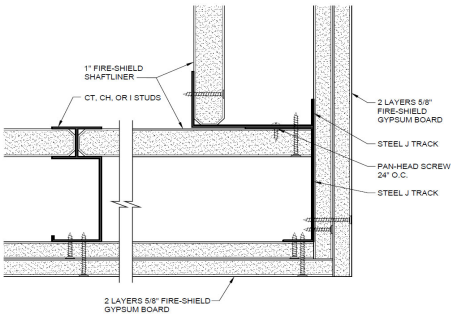
Purple Book II - Outside Shaftwall Corner



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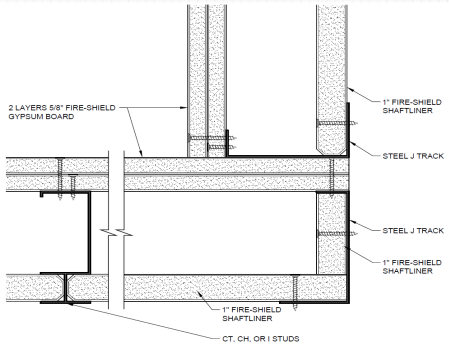
Purple Book II - Inside Shaftwall Corner



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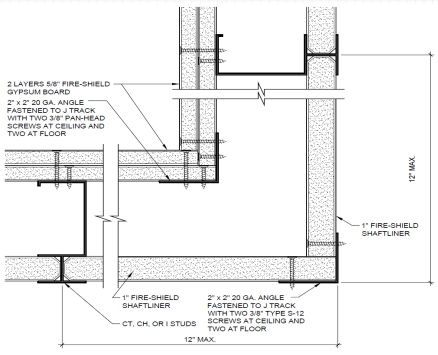
Purple Book II - Inside Shaftwall Corner



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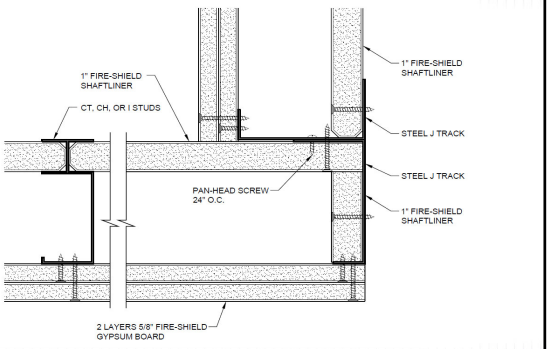
Purple Book II



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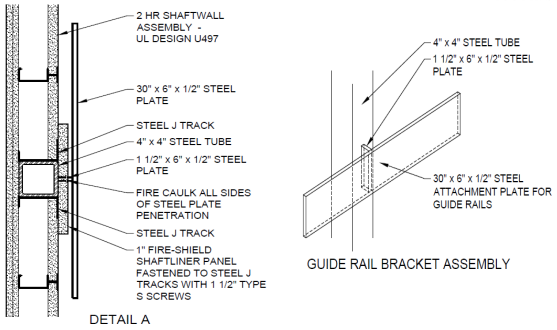
Purple Book II



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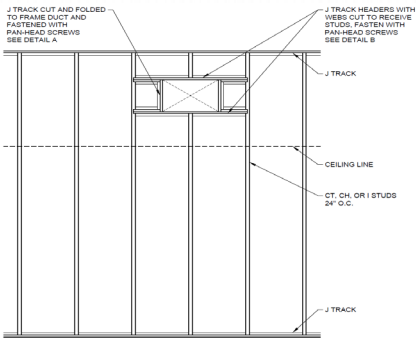
Purple Book II



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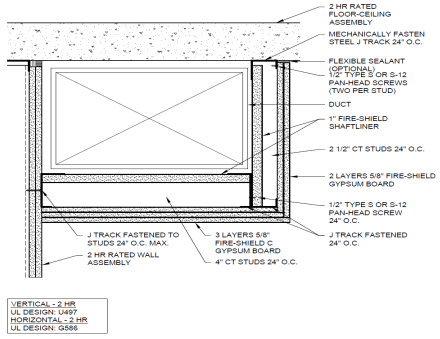
Purple Book II



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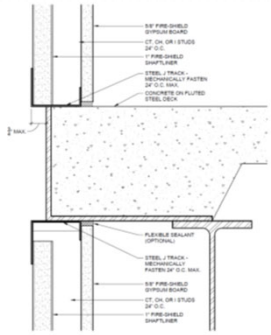
Purple Book II



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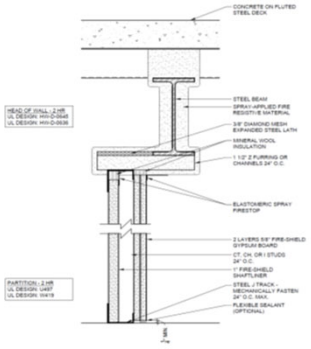
Purple Book II



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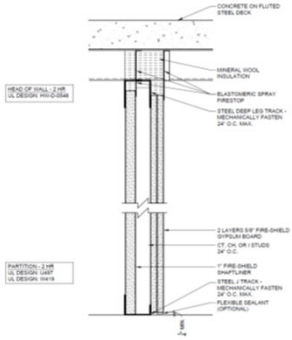
Purple Book II



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GA-600 2021

SHAFT WALLS

GA FILE NO. WP 7266	PROPRIETARY	2 HOUR FIRE	

GYPSUM BOARD, STEEL STUDS

Fire Design:

One layer 1" × 24" proprietary type X gypsum board applied parallel to 4", 33 mil steel C-H or C-T studs spaced vertically 24" o.c. Steel C-H or C-T studs oriented horizontally and supported by vertical J track at each end and screw attached with 1/2" long pan head screws. Free edge of board attached to the long leg of the top and bottom J Track with 1-5/8" long Type S screws 12" o.c. Wall width is limited by the length of the gypsum board.

OPPOSITE SIDE: **Base** layer 5/8" proprietary type X gypsum board applied vertically and attached to stud and vertical and horizontal J track with 1" long Type S screws spaced 16" o.c. **Face** layer 5/8" proprietary type X gypsum board applied vertically and attached to studs and vertical and horizontal J track with 1-5/8" long Type S screws spaced 8" o.c.

Vertical face layer joints offset 12" from base layer joints. **(NLB)**

Thickness: 5-1/4" (Fire)
Approx. Weight: 9.5 psf (Fire)
Fire Test: UL R3501, 4789285151, 2-10-20, UL Design W474

PROPRIETARY GYPSUM BOARD

National Gypsum Company
- 5/8" Gold Bond® Fire-Shield® Gypsum Board
- 1" Gold Bond® Shaftliner XP® Gypsum Board

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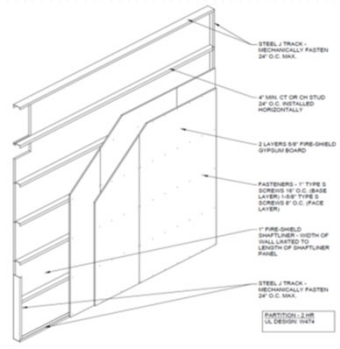
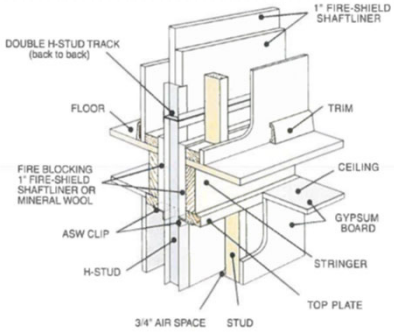
2-Hour shaftwall – Horizontal Stud Application



85

2-Hour Area Separation Wall – Floor Juncture



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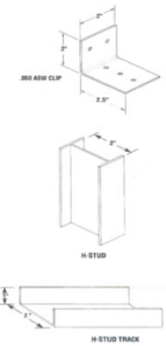
Area Separation Wall - Framing Components



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Area Separation Wall - Fasteners

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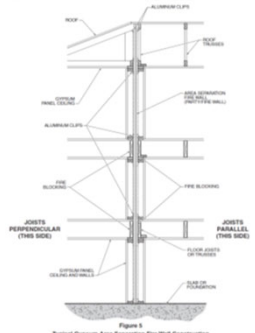
GA-600 2021 - 2-Hour Area Separation Wall



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GA-600 2021

AREA SEPARATION FIRE WALLS

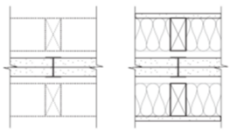
GA FILE NO. ASW 0981	PROPRIETARY	2 HOUR FIRE	60 to 64 STC SOUND

GYPSUM PANELS, STEEL STUDS

Fire Design:
Two layers 1" × 24" proprietary type X gypsum panels inserted between 2" floor and ceiling runners with 2" steel H studs between adjacent pairs of gypsum panels.
A 3/4" minimum airspace must be maintained between steel components and adjacent framing (indicated by dashed lines in sketch). As an alternate, the steel components may be covered with 6" wide battens or full sheets of 1/2" type X gypsum board.
Height limitation 66 feet. **(NLB)**
Refer to the manufacturer for the thermal protection of the framing.

Sound Design:
Sound tested with 2 × 4 stud wall faced with 1/2" regular gypsum board each side of assembly and 3-1/2" glass fiber insulation in stud cavity on both sides.

PROPRIETARY GYPSUM PANELS
National Gypsum Company
– 1" Gold Bond® eXP® Shaftliner



Thickness:	3-1/2" (Fire) 11-3/4" (Sound)
Approx. Weight:	9 psf (Fire) 14.2 psf (Sound)
Fire Test:	UL R3501, 92NK28896, 6-7-93, UL Design U347, WHI 694-200.6, 10-21 & 24-85
Sound Test:	RAL TL05-199, 11-17-05

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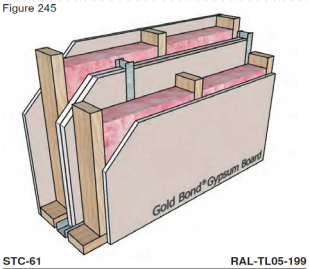
The SoundBook

Figure 245



STC-61	RAL-TL05-199
Fire Wall:	2" H-studs, 24" o.c. with 2 layers 1" Fire-Shield Shaftliner between studs; 3/4" air space
Framing:	2x4 wood studs, 16" o.c. each side
Insulation:	3-1/2" glass fiber each side
Side 1:	1/2" Gold Bond Gypsum Board
Side 2:	1/2" Gold Bond Gypsum Board
UL Design:	U347 - 2 hour

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GA-600 2021

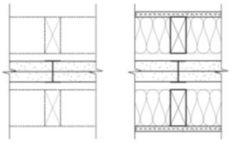
GA FILE NO. ASW 0800	PROPRIETARY	2 HOUR FIRE	65 to 69 STC SOUND

GYPSUM PANELS, STEEL STUDS

Fire Design:
Two layers 1" × 24" proprietary type X gypsum panels inserted between 2" floor and ceiling runners with 2" steel H studs between adjacent pairs of gypsum panels.
A 3/4" minimum airspace must be maintained between steel components and adjacent framing (indicated by dashed lines in sketch). As an alternate, the steel components may be covered with 6" wide battens or full sheets of 1/2" type X gypsum board.
Height limitation 66 feet. **(NLB)**
Refer to the manufacturer for thermal protection of the framing.

Sound Design:
Sound tested with 2 × 4 stud wall faced with 1/2" proprietary gypsum panel product each side of system and 3-1/2" glass fiber insulation in stud cavity.

PROPRIETARY GYPSUM PANELS
National Gypsum Company
– 1" Gold Bond® Shaftliner XP®
– 1/2" Gold Bond® SoundBreak XP Wall® Board



Thickness:	3-1/2" (Fire) 12" (Sound)
Approx. Weight:	9 psf (Fire) 14.4 psf (Sound)
Fire Test:	UL R3501, 05NK28782, 4-13-16, UL Design U347
Sound Test:	NRCC B-3451.1, 10-5-06

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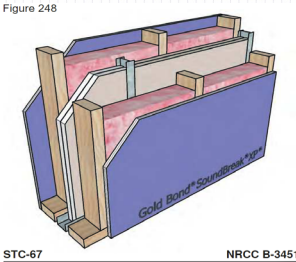
The SoundBook

Figure 248



STC-67	NRCC B-3451.1
Fire Wall:	2" H-studs, 24" o.c. with 2 layers 1" Fire-Shield Shaftliner between studs; 3/4" air space
Framing:	2x4 wood studs, 16" o.c. each side
Insulation:	3-1/2" glass fiber each side
Side 1:	5/8" SoundBreak XP Wall Board
Side 2:	5/8" SoundBreak XP Wall Board
UL Design:	U347 - 2 hour

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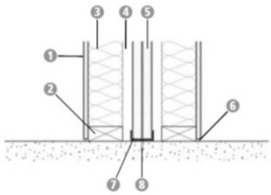
Area Separation wall – Foundation

FOUNDATION DETAIL

1. Gypsum Board
2. 2x4 Wood Plate
3. Insulation
4. Minimum 3/4" Air Space
5. 1"Fire-Shield Shaftliner
6. Sealant
7. 2" C-Track
8. Fasteners 24" o.c. Max.



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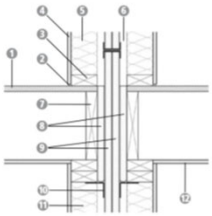
Area Separation Wall – Floor Juncture

FLOOR INTERSECTION DETAIL

1. Subfloor
2. Sealant
3. 2" Wood Plate
4. Gypsum Board
5. Insulation
6. Minimum 3/4" Air Space
7. Rim Joist
8. Gypsum Board or Mineral Wool Fire Blocking
9. 1"Fire-Shield Shaftliner
10. ASW Clip
11. 2x4 Wood Stud
12. Ceiling



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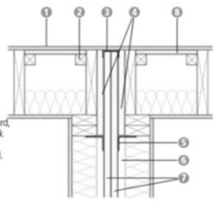
Area Separation Wall – Roof Junction

ROOF JUNCTION DETAIL

1. Roof Deck
2. 2x2 Wood Ledger
3. 2" C-Track
4. Gypsum Board or Mineral Wool Fire Blocking
5. ASW Clip
6. Minimum 3/4" Air Space
7. 1"Fire-Shield Shaftliner
8. 5/8" Fire-Shield Gypsum Board, 4' Each Side When Roof Deck is Not Constructed With Fire-Retardant Treated Wood.



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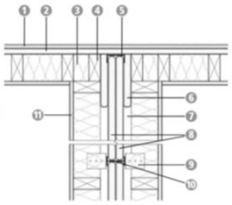
Area Separation Wall – Exterior Wall

EXTERIOR WALL JUNCTION DETAIL

1. Siding
2. 5/8" Fire-Shield Gypsum Sheathing, 4' Each Side
3. Insulation
4. 2x4 Wood Stud
5. 2" C-Track
6. Gypsum Board or Mineral Wool Fire Blocking
7. Minimum 3/4" Air Space
8. 1"Fire-Shield Shaftliner
9. ASW Clip
10. 2" H-Stud
11. Gypsum Board



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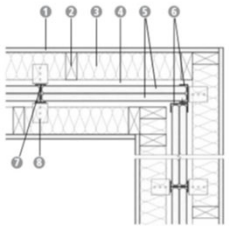
Area Separation Wall – Corner

CORNER DETAIL

1. Gypsum Board
2. 2x4 Wood Stud
3. Insulation
4. Minimum 3/4" Air Space
5. 1"Fire-Shield Shaftliner
6. 2" C-Track
7. 2" H-Stud
8. ASW Clip



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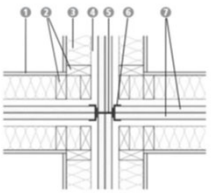
Area Separation wall – Intersection

4-WAY INTERSECTION DETAIL

1. Gypsum Board
2. 2x4 Wood Stud
3. Insulation
4. Minimum 3/4" Air Space
5. 2" H-Stud
6. 2" C-Track
7. 1"Fire-Shield Shaftliner



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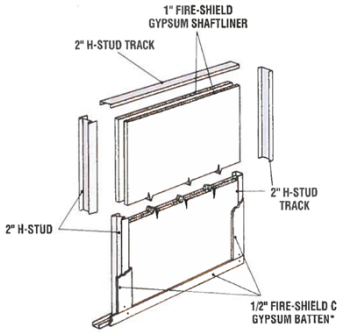
Area Separation wall – Batten Option



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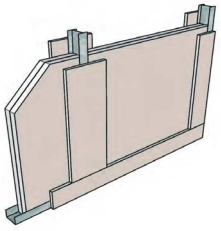
The SoundBook

Figure 244



STC-35 **NGC 2827**

Fire Wall:	2" H-studs, 24" o.c. with 2 layers 1" Fire-Shield Shaftliner between studs
Framing:	None
Insulation:	None
Side 1:	6" wide 1/2" Fire-Shield C gypsum board battens
Side 2:	6" wide 1/2" Fire-Shield C gypsum board battens
UL Design:	U347 - 2 hour

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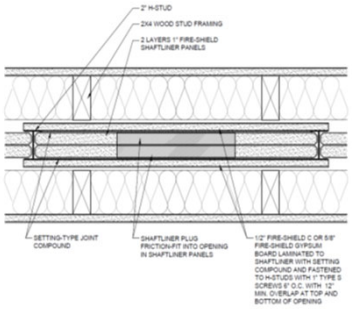
Area Separation Wall - Repair Method



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3-hour Area Separation Wall

TYPICAL FLOOR/ CEILING JUNCTURE

1. H-Stud
2. Two Layers 1" Shaftliner XP
3. 5/8" XP Fire-Shield Type C Each Side
4. Stud Framing
5. Gypsum Board
6. Double C-Track (Back to Back)
7. Bottom Plate
8. ASW Clip
9. Rim Joist
10. Top Plate
11. Subfloor

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GA-600 2021

GA FILE NO. ASW 2100	PROPRIETARY	3 HOUR FIRE	55 to 59 STC SOUND

GYPSUM PANELS, STEEL STUDS

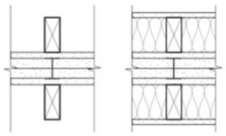
Fire Design:
Two layers 1" × 24" proprietary type X gypsum panels inserted between 2" floor and ceiling runners with 2" steel H studs between adjacent pairs of gypsum panels. **One** layer 5/8" proprietary type X gypsum board applied parallel or at right angles to each side with 1" Type S screws 16" o.c. **(NLB)**

Sound Design:
Sound tested with 2 × 4 wood studs spaced 16" o.c. faced with 1/2" regular gypsum board each side of system and 3-1/2" glass fiber insulation in stud cavity on both sides.

Height limitation 70 feet.

PROPRIETARY GYPSUM PANELS

National Gypsum Company
- 1" Gold Bond® eXP® Shaftliner
- 5/8" Gold Bond® eXP® Interior Extreme® Fire-Shield C™ Gypsum Panels

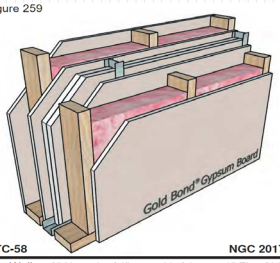


Thickness:	3-1/4" (Fire) 11-1/4" (Sound)
Approx. Weight:	13.5 psf (Fire) 17.1 psf (Sound)
Fire Test:	UL R3501, 4787714580, 1-27-17, UL Design W454
Sound Test:	NGC 2017025, 2-16-17

104

The SoundBook

Figure 259



STC-58	NGC 2017025
Fire Wall:	2" H-studs, 24" o.c. with 2 layers 1" Fire-Shield Shaftliner between studs; 1 layer 5/8" Fire-Shield C Gypsum Board each side
Framing:	2x4 wood studs, 16" o.c. each side
Insulation:	3-1/2" glass fiber each side
Side 1:	1/2" Gold Bond Gypsum Board
Side 2:	1/2" Gold Bond Gypsum Board
UL Design:	W454 - 3 hour

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GA-600 2021

AREA SEPARATION FIRE WALLS

GA FILE NO. ASW 2000	PROPRIETARY	3 HOUR FIRE	65 to 69 STC SOUND

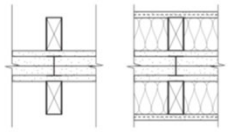
GYPSUM PANELS, STEEL STUDS

Fire Design:
Two layers 1" × 24" proprietary type X gypsum panels inserted between 2" floor and ceiling runners with 2" steel H studs between adjacent pairs of gypsum panels. **One** layer 5/8" proprietary type X gypsum board applied parallel or at right angles to each side with 1" Type S screws 16" o.c. **(NLB)**

Sound Design:
Sound tested with 2 × 4 wood studs spaced 16" o.c. faced with 5/8" proprietary type X factory-laminated gypsum panel product each side of system and 3-1/2" glass fiber insulation in stud cavity on both sides.

Height limitation 70 feet.

PROPRIETARY GYPSUM PANELS
National Gypsum Company
- 1" Gold Bond® eXP® Shaftliner
- 5/8" Gold Bond® eXP® Interior Extreme® Fire-Shield C™ Gypsum Panels
- 5/8" Gold Bond® SoundBreak XP Wall® Board

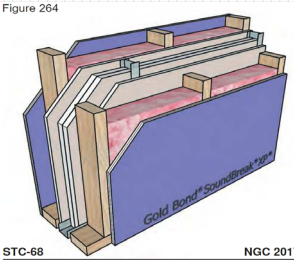


Thickness:	3-1/4" (Fire) 11-1/2" (Sound)
Approx. Weight:	13.5 psf (Fire) 18.9 psf (Sound)
Fire Test:	UL R3501, 4787714580, 1-27-17, UL Design W454
Sound Test:	NGC 2017018, 2-6-17

106

The SoundBook

Figure 264



STC-68	NGC 2017018
Fire Wall:	2" H-studs, 24" o.c. with 2 layers 1" Fire-Shield Shaftliner between studs; 1 layer 5/8" Fire-Shield C Gypsum Board each side
Framing:	2x4 wood studs, 16" o.c. each side
Insulation:	3-1/2" glass fiber each side
Side 1:	5/8" SoundBreak XP Wall Board
Side 2:	5/8" SoundBreak XP Wall Board
UL Design:	W454 - 3 hour

107

Gold Bond® Building Products

PermaBASE® Building Products

National Gypsum®

DEXcell® Roof Board

PROFORM® Finishing Products

National Gypsum Company is the exclusive service provider for products manufactured by Gold Bond Building Products, LLC, PermaBASE Building Products, LLC and ProForm Finishing Products, LLC.

108

The Purple Book II

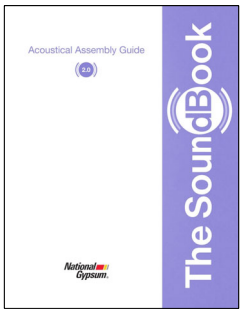
The PURPLE Book II highlights include:

- GridMarX detail
- MaX 12 detail
- New fire-rated wall and ceiling assemblies
- New corner details for steel stud partitions
- New corner details for shaftwall assemblies
- New repair details for shaft wall assemblies

UPDATED Fire Rated Assemblies
→ UL Designs

109

The SoundBook 2.0



The SoundBook 2.0 highlights include:

- 35-45 New Wall Assemblies Added
- Ceiling Assemblies Added
- Retrofit Assemblies Added

110

1-800-NATIONAL® Construction Services Department

- Mark Chapman
- Sam Halverson
- Jim Farrell
- Monday – Friday
  - 8:00 – 4:45 EST

Thad Goodman
thad@nationalgypsum.com
614-214-5666
@GoodmanThad

111

File Attachments for Item:

ER-4 Considerations of the DWV and Storm System (Ohio Assn of Plumbing Inspectors)

All certifications (1 hour)

Staff Notes: Recommend approval

Committee Recommendation:

1

Considerations of the DWV and Storm System:
What to know about Plenums and Firestopping

2 **Learning objectives**

- Plenum Spaces
  - Acceptable materials for use in DWV Systems
  - ASTM E 84 testing
  - Plenum wrap insulation
- Firestopping
  - Concerns
  - Through and Membrane Penetrations
  - Details
  - Exemptions
  - Complexities
  - Engineered Judgements
  - Issues
  - Melting Points of Piping Products
- Toxicity of piping materials
- Question and Answer

•

3 **Plenum Spaces**

4 **Acceptable Piping in Plenum Spaces**

- Criteria for acceptable piping in plenum spaces
  - Must meet 25/50 Flame and Smoke spread tested to ASTM E 84
  - Be an exempt Non-Combustible
  - Be acceptable for use as DWV pipe
  -
  - Cast Iron Soil Pipe and Fittings are acceptable

5 **ASTM E 84**

- "Standard Test Method for Surface Burning Characteristics of Building Materials"
- 10 Minute Test
- The "Thermometer" to scale and compare materials for Flame and Smoke Spread
- 25 Flame Spread and 50 Smoke Developed Index is determined by the code, not the standard

6 **Wrap Insulation**

- Misconceptions
  - Only exposed item needs to meet 25/ 50
  - Wrap Insulation can be used to cover plastic pipe in plenums
  -
- Facts
  - Many wrap insulations are tested and listed using a MODIFIED ASTM E 84 test
  - Typically they have not been tested as a composite (wrap, pipe, tapes, etc.)

- Test Labs modify tests, but ASTM E 84 does not specifically allow these modifications

7 **Firestopping**

8 **Firestop Concerns**

"Understanding what a firestop is as well as where and why it is required helps ensure that it is correctly installed.

It is important to remember that firestopping is designed to perform as tested only once in its lifetime, and to do so, it must be properly installed."

Source: Plumbing Systems & Design Nov. 2010 "Fire in its Tracks" Author: Riley Archer – National Technical Manager for RectorSeal

9 **What is firestopping? Through and Membrane Penetrations**

- It is a system, consisting of:
- Penetrating item
- Opening in resistive member
- Construction component
  - Type- wall, floor, ceiling, or floor/ ceiling
  - Material
  - Hour rating
- Material or materials used for firestopping
- Listed system detail for installing and inspection
-

10 **Exemptions**

- 6" and smaller nominal metallic pipe in penetration openings under 144 square inches may be protected by use of grout or concrete, in concrete or masonry walls, floors, or ceilings.
-
- This does not require a listed system
-
- Non-metallic pipe can not be protected in as simple a manner
-
- Combustible piping can leave a void in a fire barrier when it burns or melts away, non-combustible piping materials do not, making protection for metallic, non-combustible pipes much simpler.
-

11 **Complexities of Firestopping**

- What type of barrier is being penetrated?
- What is it made of?
- What material is penetrating the barrier?
- How big is the opening?
- What manufacturer is being used?
- What listed system fits the above criteria?
- What materials are needed?

- How is it to be installed?
- What are the inspection requirements?
-

12 ☐ **The Firestop System Listing**

- The parameters for the opening, annular space, penetrating materials and barrier type and materials
- Which manufacturer- Listings are manufacturer specific and material from manufacturer A can not be mixed with manufacturer B's materials
- What materials are need, quantities, etc.
- How it is to be applied, secured, backed, the thickness of materials, and specialty items, such as: screws, washers, anchors, tapes, wire, metal sheeting, etc.
- What the hour rating of protection is…
- Remember- mixing or exchanging one material or manufacturer for another in a listed system, makes it no longer listed, therefore not protected!!!
-

13 ☐ **Engineered Judgements**

- Should only be used where and when a listed system does not exist (Check all listings, even if under a different manufacturer)
- This is only an opinion that a certain material(s) applied and installed a certain way SHOULD work.
- May not be acceptable to Administrative Authority Having Jurisdiction
- This is not the same as a listed system, because it has not be installed and tested to rate the performance
- Provided by Firestopping Manufacturers Engineers Only

14 ☐ **Firestopping Installation Issue-**
Not a Listed system

15 ☐ **Firestop Installation issue**

16 ☐ **Firestop Installation issue**

17 ☐

18 ☐

19 ☐ **Melting Points of Common Materials**

Temperature at 10 minutes = 1300 °F

Melting Points (approximate):

- Aluminum - 1220 °F[1]
-
- PVC plastic pipe - 413 °F[2]
-
- Fiberglas® insulation - 1100 °F[3]

➢

Sources:

1. NFPA Fire Protection Handbook, 18th Ed. Table 4-16A. Pg 4-183.
2. SFPE Handbook of Fire Protection Engineering, 1st Ed. Table 1-12.1. Pg. 1-166.
3. Owens Corning SSL I or II Fiberglas Insulation specification sheet.

•

20 ☐

Product Data Sheet (From a manufacturer)

• 4. Performance & Typical Physical Properties
Color: Gray with Red Liner
Fire Resistance: 1-3 Hours (wall- or floor-rating dependent)
Activation Temperature: 550° F (288° C)
Expansion Volume: 100x

ISSUE: PVC MELTS AWAY 137 degrees F BEFORE the intumescent even begins to react!!!

21 ☐ **Firestop Test Failure**

22 ☐ **Firestop Test Failure**

23 ☐ **Toxicity of Piping Materials**

24 ☐ **Toxicity**

Many combustible products give of toxic gasses and chemicals when burned. Some items are far worse and have a higher toxicity than others. This needs to be looked at when assessing materials for piping in the DWV system.

• Resources:
• US EPA on Vinyl Chloride
• Evaluation of Fire Stop Burn Test Polyvinyl Chloride (PVC)
• Living Building Challenge
•
• Many other resources are available

25 ☐ **From the EPA**

Epa.gov
75-01-4
Hazard Summary-Created in April 1992; Revised in January 2000

Most vinyl chloride is used to make polyvinyl chloride (PVC) plastic and vinyl products. Acute (short-term) exposure to high levels of vinyl chloride in air has resulted in central nervous system effects (CNS), such as dizziness, drowsiness, and headaches in humans. Chronic (long-term) exposure to vinyl chloride through inhalation and oral exposure in humans has resulted in liver damage. Cancer is a major concern from exposure to vinyl chloride via inhalation, as vinyl chloride exposure has been shown to increase the risk of a rare form of liver cancer in humans. EPA has classified vinyl chloride as a Group A, human carcinogen.

Most of the vinyl chloride produced in the United States is used to make polyvinyl chloride (PVC), a material used to manufacture a variety of plastic and vinyl products including pipes, wire and cable coatings, and packaging materials.

Air inside new cars may contain vinyl chloride at higher levels than detected in ambient air because vinyl chloride may outgas into the air from the new plastic parts.

Drinking water may contain vinyl chloride released from contact with polyvinyl pipes.

26 **PVC is a "Red List Material" for Living Building Challenge**

- Red List Materials from Living Building Challenge:
- Polyvinyl Chloride (PVC)
  - PVC's vinyl chloride monomer building block is a known human carcinogen, according to the US Department of Health and Human Services. In addition, PVC is a Persistent Organic Pollutant Source Material. Due to its chlorine content, PVC manufacture often contains other substances of concern, such as cadmium, lead, and phthalates, and can result in the production of dioxins during production and disposal phases. Dioxins, specifically TCDD, accumulate in human and animal tissue and are associated with immune system impairment, damage to developing nervous systems, and damage to the endocrine and reproductive systems. TCDD is listed as a "known human carcinogen" by the International Agency for Research on Cancer.
- REF: (dioxins): http://www.who.int/mediacentre/factsheets/fs225/en/index.html
- REF: (vinyl chloride): http://www.atsdr.cdc.gov/tfacts20.html

27 **Questions?**

Laura Loziuk

Technical Services Regional Manager

McWane Plumbing Group (Tyler, AB&I, Wade & Husky)

www.mcwaneplumbingtechservices.com

laura.loziuk@mcwaneplbgrp.com

Laura Loziuk is a Strategic Codes & Standards Specialist for McWane Plumbing Technical Services who works with plumbing industry design professionals and enforcement agencies to provide the education and technical expertise to solve technical design issues with innovative materials/solutions.

Laura believes providing the technical education needs of the industry is essential to ensuring buildings are constructed/designed to be safe and sanitary for the occupants.Laura is an active member of Women of ASPE, IAPMO, ICC, and ASTM. She is also a Board member of the Philadelphia chapter of ASPE.

Laura has a Bachelor's degree in Civil Engineering from Florida Atlantic University and has been active in the construction industry for over 12 years.

PLUMBING TECHNICAL SERVICES

Considerations of the DWV and Storm System:

What to know about Plenums and Firestopping

Laura Loziuk
Technical Services Manager

PLUMBING TECHNICAL SERVICES

Learning objectives

- Plenum Spaces
  - Acceptable materials for use in DWV Systems
  - ASTM E 84 testing
  - Plenum wrap insulation
- Firestopping
  - Concerns
  - Through and Membrane Penetrations
  - Details
  - Exemptions
  - Complexities
  - Engineered Judgements
  - Issues
  - Melting Points of Piping Products
- Toxicity of piping materials
- Question and Answer

PLUMBING TECHNICAL SERVICES

Plenum Spaces

PLUMBING TECHNICAL SERVICES

Acceptable Piping in Plenum Spaces

- Criteria for acceptable piping in plenum spaces
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PLUMBING TECHNICAL SERVICES

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- 10 Minute Test
- The "Thermometer" to scale and compare materials for Flame and Smoke Spread
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PLUMBING TECHNICAL SERVICES

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PLUMBING TECHNICAL SERVICES

Firestopping

PLUMBING TECHNICAL SERVICES

Firestop Concerns

"Understanding what a firestop is as well as where and why it is required helps ensure that it is correctly installed.

It is important to remember that firestopping is designed to perform as tested only once in its lifetime, and to do so, it must be properly installed."

Source: Plumbing Systems & Design Nov. 2010 "Fire in its Tracks" Author: Riley Archer – National Technical Manager for RectorSeal

What is firestopping? Through and Membrane Penetrations

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  - Material
  - Hour rating
- Material or materials used for firestopping
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PLUMBING TECHNICAL SERVICES

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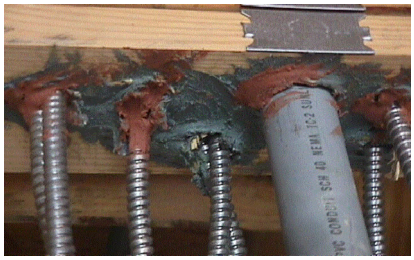
PLUMBING TECHNICAL SERVICES

Firestopping Installation Issue- Not a Listed system



Multiple Products and not installed per listing

PLUMBING TECHNICAL SERVICES

Firestop Installation issue

A Glove, colored to resemble firestopping!

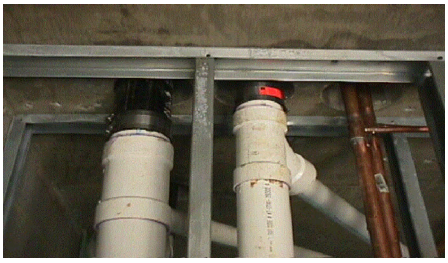
PLUMBING TECHNICAL SERVICES

Firestop Installation issue

No protection provided by firestop device if the annular space is too large…like this one

PLUMBING TECHNICAL SERVICES

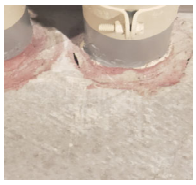
Firestop Installation issue



The plastic will melt away, allowing the fire to melt away the plastic above…no protection provided in this installation resulting in a chimney effect.

PLUMBING TECHNICAL SERVICES

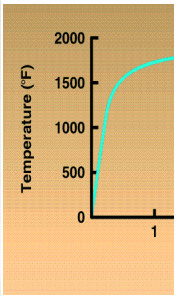
Firestop Installation issue



Left- Not tooled to ensure proper seal
Right- Tooled, but the seal has pulled away

PLUMBING TECHNICAL SERVICES

Melting Points of Common Materials



Temperature at 10 minutes = 1300 °F

Melting Points (approximate):

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3. Owens Corning SSL I or II Fiberglas Insulation specification sheet.

PLUMBING TECHNICAL SERVICES

Melting Points of Common Materials

Activation of Some Intumescent Materials

Product Data Sheet (From a manufacturer)

- 4. Performance & Typical Physical Properties

Color: Gray with Red Liner

Fire Resistance: 1-3 Hours (wall- or floor-rating dependent)

Activation Temperature: 550° F (288° C)

Expansion Volume: 100x

ISSUE: PVC MELTS AWAY 137 degrees F **BEFORE** the intumescent even begins to react!!!

PLUMBING TECHNICAL SERVICES

Firestop Test Failure

PLUMBING TECHNICAL SERVICES

Firestop Test Failure

Intumescent did not expand enough to fill the hole exposed by the melting plastic…this would allow smoke and flame to travel

PLUMBING TECHNICAL SERVICES

Toxicity of Piping Materials

PLUMBING TECHNICAL SERVICES

Toxicity

Many combustible products give of toxic gasses and chemicals when burned. Some items are far worse and have a higher toxicity than others. This needs to be looked at when assessing materials for piping in the DWV system.

- Resources:
- US EPA on Vinyl Chloride
- Evaluation of Fire Stop Burn Test Polyvinyl Chloride (PVC)
- Living Building Challenge

- Many other resources are available

PLUMBING TECHNICAL SERVICES

Toxicity

From the EPA

Epa.gov

75-01-4

Hazard Summary-Created in April 1992; Revised in January 2000

Most vinyl chloride is used to make polyvinyl chloride (PVC) plastic and vinyl products. Acute (short-term) exposure to high levels of vinyl chloride in air has resulted in central nervous system effects (CNS), such as dizziness, drowsiness, and headaches in humans. Chronic (long-term) exposure to vinyl chloride through inhalation and oral exposure in humans has resulted in liver damage. Cancer is a major concern from exposure to vinyl chloride via inhalation, as vinyl chloride exposure has been shown to increase the risk of a rare form of liver cancer in humans. EPA has classified vinyl chloride as a Group A, human carcinogen.

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PLUMBING TECHNICAL SERVICES

Toxicity

PVC is a “Red List Material” for Living Building Challenge

- Red List Materials from Living Building Challenge:
- Polyvinyl Chloride (PVC)
  - PVC’s vinyl chloride monomer building block is a known human carcinogen, according to the US Department of Health and Human Services. In addition, PVC is a Persistent Organic Pollutant Source Material. Due to its chlorine content, PVC manufacture often contains other substances of concern, such as cadmium, lead, and phthalates, and can result in the production of dioxins during production and disposal phases. Dioxins, specifically TCDD, accumulate in human and animal tissue and are associated with immune system impairment, damage to developing nervous systems, and damage to the endocrine and reproductive systems. TCDD is listed as a “known human carcinogen” by the International Agency for Research on Cancer.
- REF: (dioxins): http://www.who.int/mediacentre/factsheets/fs225/en/index.html
- REF: (vinyl chloride): http://www.atsdr.cdc.gov/tfacts20.html

PLUMBING TECHNICAL SERVICES

Questions?

Laura Loziuk
Technical Services Manager
903-941-4541
Laura.Loziuk@mcwaneplbgrp.com

CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

Instructors: Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications for which the BBS has approved the class, and fees in promotion materials and advertising. ***The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising***. Advertising shall not disclose improper approval information to the public.

Course sponsors/co-sponsors: proved participants a certificate of completion containing the following information: name of participant, title of approved courses, BBS approval #, BBS approved certifications, date of the continuing education program, number of approved credit hours awarded and signature of authorized sponsor or instructor.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

Participants: Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

Board approval: Remains in effect during the current code edition. Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

Facility/training area: Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

APPLICATION

FOR

Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.

Board of Building Standards
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax: (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: James A Richardson Jr
(Contact Name)

Organization: OAPI
(Organization/Company)

Address: 111 N. Front St.
(Include Room Number, Suite, etc.)

City: Columbus State: OH Zip: 43215

E-Mail: jarichardson@columbus.gov

Telephone: 6147744855 Fax: _____

Course Sponsor: _____

COURSE INFORMATION:

Course Title: Considerations of the DWV and Storm System: What to know about Plenums and Firestopping

New Course Submittal: ☒ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective: This course is designed to give the participant working knowledge regarding acceptable firestopping methods. The course covers plenum spaces, ASTM E 84, plenum wrap, through penetrations, membrane penetrations, exemptions, engineered judgements, and toxicity of materials.

Presenter will be Laura Loziuk - BIO sent with application

Number of Instructional Contact Hours that can be obtained upon completion: 1

If Multi-Session, Number of Instructional Contact Hours Per Session: 1

Program Applicable for the Following Participants:

Building Official ☒	Master Plans Examiner ☒	Building Inspector ☒	Fire Protection Inspector ☒	Mechanical Inspector ☒
	Plumbing Plans Exam. ☒			Plumbing Inspector ☒
	Electrical Plans Exam. ☒			Non-Res IU Inspector ☒
	Mechanical Plans Exam. ☒			

Res Building Official ☒ Res Plans Examiner ☒ Res Building Inspector ☒ Res Mechanical Inspector ☒ Res IU Inspector ☒

Electrical Safety Inspectors ☒

Location of ESI Course: _____ Date(s) of ESI Course(s): _____

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**:		Check Off
Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	✔
Course Sponsor:	Organization sponsoring or requesting the program (if any)	✔
Course Title:	Name of course (related to content)	✔
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	✔
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	✔
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	✔
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	✔
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	✔
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	✔
Test Materials:	Copy of quizzes or tests to be given	✔
Completed Application:		✔

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

File Attachments for Item:

ER-5 Hangers and Restraints for Cast Iron Soil Pipe DWV Systems (Ohio Assn of Plumbing Inspectors)

All certifications (1 hour)

Staff Notes: Recommend approval for conference use only.

Committee Recommendation:

1 **Hangers and Restraint for Cast Iron Soil Pipe DWV Systems**

Laura Loziuk
Technical Services Manager
McWane Plumbing Group

2 **Learning Objectives**

3 **Hangers**

4 **Hangers**

5 **Hangers**

6 **Hangers**

7 **Hanger Spacing**

- Code also provides the intervals that hangers must be placed at.
- This is done by material type.
- 2018 IPC Table 308.5 provides this information.

8 **Hanger Spacing**

- Cast iron hanger requirements are 5 feet or 10 feet where 10 foot lengths of pipe are used (see footnote a. in IPC table)
  - Stainless Steel requirements are 10 feet.
- 2018 UPC uses Table 313.3

9 **Hanger Spacing**

PVC requirements vary by pipe size in DWV applications

-
-

10 **Hanger Spacing**

PVC requirements become even more complex in pressure applications

11 **Hanger Spacing**

Examples:

- PVC requirements start at 3 feet (depending on the pipe diameter)
- Cast Iron requirements are 5 feet or 10 feet where 10 foot lengths of pipe are used (see footnote a. in IPC table)
- Stainless Steel requirements are 10 feet.
- 2018 UPC uses Table 313.3

12 **CISPI Handbook**

- Provides guidance on hanging, specific to cast iron soil pipe and fittings.
- From the CISPI Handbook: *"(1) Cast iron soil pipe installed in the horizontal position shall be supported at every hub (hub and spigot) or coupling (hubless). The hanger shall be placed within 18" of the hub or coupling. Joints used for connecting cast iron soil pipe possess sufficient shear strength to require one hanger per joint or hub."*
-

13 **Alternative Materials**

- Rigid piping materials, like cast iron require less hangers for support.
- Flexible piping materials, like ABS or PVC require more design consideration and hangers for support.
- Steel, copper and stainless steel are similar to cast iron, as they can support their length, when used in a DWV system.
-

14 **Restraints**

15 **Types of Restraint**

- Thrust Restraint
- Sway Bracing
- Seismic Restraint
-
- All 3 fall under Chapter 3 General Regulations of the IPC and UPC
-

16 **Types of Restraint**

Thrust Restraint - bracing, blocks, rodding, and other suitable methods to resist thrust forces in a piping system

17 **Types of Restraint**

Sway Bracing - rigid bracing or other rigid support arrangements installed to resist movement of the upstream pipe in the direction of flow (2018 IPC)

-
-

18 **Types of Restraint**

Seismic Restraint - Piping Seismic Supports- plumbing piping supports designed and installed for the seismic forces in accordance with the International Building Code. (2018 IPC)

-
-

19 **Thrust Restraint**

- 2018 IPC Chapter 3, section 308.7.1 describes thrust restraint, and states "For pipe sizes greater than 4 inches (102 mm), restraints shall be provided for drain pipes at all changes of in direction and at all changes in diameter greater than two pipe sizes."

20 **Thrust Restraint**

Thrust Forces - The Reason for the Restraints!

21 **Thrust Restraint**

Case Study: MGM National Harbor Casino

22 **CISPI Thrust Restraint Example**

23 **Manufacturer's Installation Instructions**

- Manufacturers of cast iron soil pipe and fittings include similar language as CISPI for thrust

restraint. It is applicable to both Hub and Spigot and Hubless (No-Hub) pipe and fittings.

- Simply stated:

ALL HORIZONTAL PIPE AND FITTINGS, 5 INCH AND LARGER. SHOULD BE BRACED TO PREVENT MOVEMENT AT EVERY BRANCH OR CHANGE OF DIRECTION,

24 **Sway Bracing**

25 **CISPI Handbook- Sway Bracing**

26 **Seismic Restraint System**

- An engineering system to resist seismic movement.
- As each installation is different, so must be the system used for restraint.
- Building Codes and plumbing codes require that seismic movement be restrained.
- Consult with the engineer for specific installation and design to meet this requirement.

27 **Example**

28 **Example**

29 **Items to Remember**

- Hangers and their requirements are defined by the plumbing code.
- Hanging support intervals vary by piping material.
- Thrust forces and restraint of those forces are keys to a properly installed system.
- The plumbing codes address restraint (thrust, sway and seismic).
- Manufacturers of cast iron soil pipe and fittings, CISPI, and the codes have similar language to deal with restraint.

30 **Questions?**

31 **Knowledge Assessment**

Laura Loziuk

Technical Services Regional Manager

McWane Plumbing Group (Tyler, AB&I, Wade & Husky)

www.mcwaneplumbingtechservices.com

laura.loziuk@mcwaneplbgrp.com

Laura Loziuk is a Strategic Codes & Standards Specialist for McWane Plumbing Technical Services who works with plumbing industry design professionals and enforcement agencies to provide the education and technical expertise to solve technical design issues with innovative materials/solutions.

Laura believes providing the technical education needs of the industry is essential to ensuring buildings are constructed/designed to be safe and sanitary for the occupants.Laura is an active member of Women of ASPE, IAPMO, ICC, and ASTM. She is also a Board member of the Philadelphia chapter of ASPE.

Laura has a Bachelor's degree in Civil Engineering from Florida Atlantic University and has been active in the construction industry for over 12 years.

Hangers and Restraint for Cast Iron Soil Pipe DWV Systems

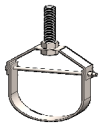
Laura Loziuk
Technical Services Manager
McWane Plumbing Group

Learning Objectives

- Types of Hangers
- Hanging Requirements
- Types of restraint
  - Thrust Restraint
  - Sway Bracing
  - Seismic Restraint (Bracing)

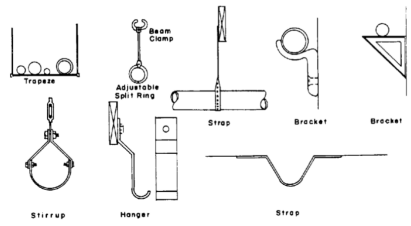
Hangers

Example of a clevis hanger which is commonly used to suspend cast iron soil pipe and fittings



Hangers

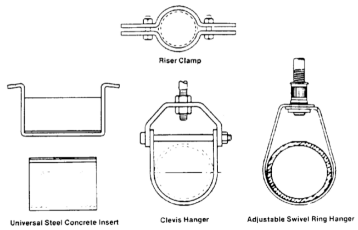
A Multitude of Other Hanger Types are Used



Source: CISPI Handbook

Hangers

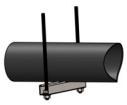
A Multitude of Other Hanger Types are Used



Source: CISPI Handbook

Hangers

- All-Thread Rod is used to suspend many of these hangers from beams by use of beam clamps or other devices directly into concrete structures or beams.
- The 2018 UPC section 313.6 and Table 313.6 provides guidance on hanger rod sizes



Hanger Spacing

- Code also provides the intervals that hangers must be placed at.
- This is done by material type.
- 2018 IPC Table 308.5 provides this information.

TABLE 308.5
HANGER SPACING

PIPING MATERIAL	MAXIMUM HORIZONTAL SPACING (feet)	MAXIMUM VERTICAL SPACING (feet)
Acrylonitrile butadiene styrene (ABS) pipe	4	10[b]
Aluminum tubing	10	15
Brass pipe	10	10
Cast-iron pipe	5[a]	15
Chlorinated polyvinyl chloride (CPVC) pipe and tubing, 1 inch and smaller	3	10[b]
Chlorinated polyvinyl chloride (CPVC) pipe and tubing, 1 1/4 inches and larger	4	10[b]
Copper or copper-alloy pipe	12	10

Hanger Spacing

- Cast iron hanger requirements are 5 feet or 10 feet where 10 foot lengths of pipe are used (see footnote a. in IPC table)
  - Stainless Steel requirements are 10 feet.
- 2018 UPC uses Table 313.3

Source: CISPI Handbook

Hanger Spacing

PVC requirements vary by pipe size in DWV applications

Table 8-B: PVC-DWV Pipe Support Spacing

SIZE (in)	MAXIMUM SPACING (ft)
1¼ - 2	3
3 - 4	4
6 - 8	5
10 - 12	6

Source: PPFA website

Hanger Spacing

PVC requirements become even more complex in pressure applications

Table 8-C: PVC Pressure Pipe Support Spacing (ft)

Pipe Size (in)	Schedule 40 Temperature (°F)					Schedule 80 Temperature (°F)				
	60	80	100	120	140	60	80	100	120	140
¼	4	3 ½	3 ½	2	2	4	4	3 ½	2 ½	2
⅜	4	4	3 ½	2 ½	2 ½	4 ½	4 ½	4	2 ½	2 ½
½	4 ½	4 ½	4	2 ½	2 ½	5	4 ½	4 ½	3	2 ½
¾	5	4 ½	4	2 ½	2 ½	5 ½	5	4 ½	3	2 ½
1	5 ½	5	4 ½	3	2 ½	6	5 ½	5	3 ½	3
1 ¼	5 ½	5 ½	5	3	3	6	6	5 ½	3 ½	3
1 ½	6	5 ½	5	3 ½	3	6 ½	6	5 ½	3 ½	3 ½
2	6	5 ½	5	3 ½	3	7	6 ½	6	4	3 ½
2 ½	7	6 ½	6	4	3 ½	7 ½	7 ½	6 ½	4 ½	4
3	7	7	6	4	3 ½	8	7 ½	7	4 ½	4
3 ½	7 ½	7	6 ½	4	4	8 ½	8	7 ½	5	4 ½
4	7 ½	7	6 ½	4 ½	4	9	8 ½	7 ½	5	4 ½
6	8 ½	8	7 ½	5	4 ½	10	9 ½	9	6	5
8	9	8 ½	8	5	4 ½	11	10 ½	9 ½	6 ½	5 ½
10	10	9	8 ½	5 ½	5	12	11	10	7	6
12	11 ½	10 ½	9 ½	6 ½	5 ½	13	12	10 ½	7 ½	6 ½
14	12	11	10	7	6	13 ½	13	11	8	7
16	12 ½	11 ½	10 ½	7 ½	6 ½	14	13 ½	11 ½	8 ½	7 ½
18	13 ½	12	11	8	7	14 ½	14	12	11	9
20	14	12 ½	11 ½	10	9 ½	15 ½	14 ½	12 ½	11 ½	9 ½

Source: PPFA website

Hanger Spacing

Examples:

- PVC requirements start at 3 feet (depending on the pipe diameter)
- Cast Iron requirements are 5 feet or 10 feet where 10 foot lengths of pipe are used (see footnote a. in IPC table)
- Stainless Steel requirements are 10 feet.

- 2018 UPC uses Table 313.3

CISPI Handbook

- Provides guidance on hanging, specific to cast iron soil pipe and fittings.
- From the CISPI Handbook: *"(1) Cast iron soil pipe installed in the horizontal position shall be supported at every hub (hub and spigot) or coupling (hubless). The hanger shall be placed within 18" of the hub or coupling. Joints used for connecting cast iron soil pipe possess sufficient shear strength to require one hanger per joint or hub."*

Alternative Materials

- Rigid piping materials, like cast iron require less hangers for support.
- Flexible piping materials, like ABS or PVC require more design consideration and hangers for support.
- Steel, copper and stainless steel are similar to cast iron, as they can support their length, when used in a DWV system.

Restraints

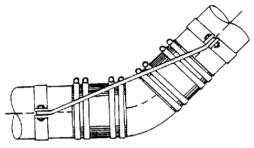
Types of Restraint

- Thrust Restraint
- Sway Bracing
- Seismic Restraint

- All 3 fall under Chapter 3 General Regulations of the IPC and UPC

Types of Restraint

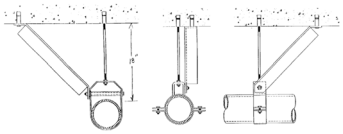
Thrust Restraint - bracing, blocks, rodding, and other suitable methods to resist thrust forces in a piping system



Source: CISPI Handboook

Types of Restraint

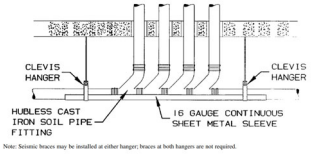
Sway Bracing - rigid bracing or other rigid support arrangements installed to resist movement of the upstream pipe in the direction of flow (2018 IPC)



Source: CISPI Handboook

Types of Restraint

Seismic Restraint - Piping Seismic Supports- plumbing piping supports designed and installed for the seismic forces in accordance with the International Building Code. (2018 IPC)



Source: CISPI Handboook, Figure 16—Method of Supporting "Multi-Fitting" Installations (Hanger Spacing 10 Ft. Max.).

Thrust Restraint

- 2018 IPC Chapter 3, section 308.7.1 describes thrust restraint, and states "For pipe sizes greater than 4 inches (102 mm), restraints shall be provided for drain pipes at all changes of in direction and at all changes in diameter greater than two pipe sizes."

Thrust Restraint

Thrust Forces - The Reason for the Restraints!

Thrust or Displacement Forces Encountered in Hydrostatic Testing of Cast Iron Soil Pipe

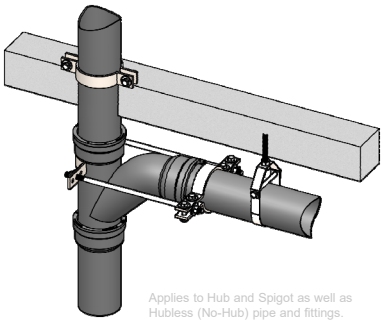
Pipe Size		1.5"	2"	3"	4"	5"	6"	8"	10"	12"	15"
Head, Feet of Water	Pressure PSI	Thrust lb.	Thrust lb.	Thrust lb.	Thrust lb.	Thrust lb.	Thrust lb.	Thrust lb.	Thrust lb.	Thrust lb.	Thrust lb.
10	4.3	12	19	38	65	95	134	237	377	538	847
20	8.7	25	38	77	131	192	271	480	762	1088	1714
30	13.0	37	56	115	196	287	405	717	1139	1626	2562
40	17.3	49	75	152	261	382	539	954	1515	2164	3409
50	21.7	62	94	191	327	479	676	1197	1900	2714	4276
60	26.0	74	113	229	392	574	810	1434	2277	3252	5124
70	30.3	86	132	267	457	668	944	1671	2654	3790	5971
80	34.7	99	151	306	523	765	1082	1914	3039	4341	6838
90	39.0	111	169	344	588	860	1216	2151	3416	4879	7685
100	43.4	123	188	382	654	957	1353	2394	3801	5429	8552
110	47.7	135	207	420	719	1052	1487	2631	4178	5967	9400
120	52.0	148	226	458	784	1147	1621	2868	4554	6505	10247
Area, OD		2.84	4.34	8.81	15.07	22.06	31.17	55.15	87.58	125.09	197.06

Source: CISPI Handboook

Thrust Restraint

Case Study: MGM National Harbor Casino

CISPI Thrust Restraint Example



Applies to Hub and Spigot as well as Hubless (No-Hub) pipe and fittings.

Manufacturer's Installation Instructions

- Manufacturers of cast iron soil pipe and fittings include similar language as CISPI for thrust restraint. It is applicable to both Hub and Spigot and Hubless (No-Hub) pipe and fittings.
- Simply stated:

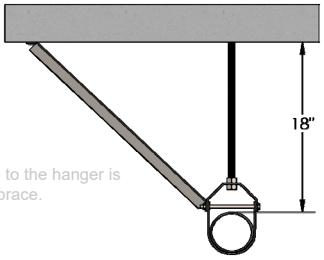
ALL HORIZONTAL PIPE AND FITTINGS, 5 INCH AND LARGER. SHOULD BE BRACED TO PREVENT MOVEMENT AT EVERY BRANCH OR CHANGE OF DIRECTION.

Sway Bracing

308.6 Sway bracing. Where horizontal pipes 4 inches (102 mm) and larger convey drainage or waste, and where a pipe fitting in that piping changes the flow direction greater than 45 degrees (0.79 rad), rigid bracing or other rigid support arrangements shall be installed to resist movement of the upstream pipe in the direction of pipe flow. A change of flow direction into a vertical pipe shall not require the upstream pipe to be braced.

Source: 2018 IPC Section 308.6

CISPI Handbook-Sway Bracing

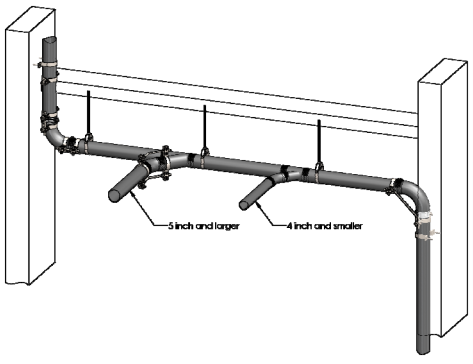


The brace to the hanger is the sway brace.

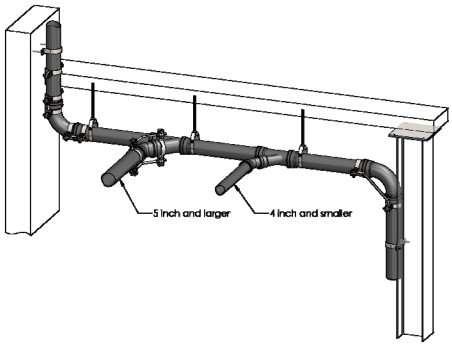
Seismic Restraint System

- An engineering system to resist seismic movement.
- As each installation is different, so must be the system used for restraint.
- Building Codes and plumbing codes require that seismic movement be restrained.
- Consult with the engineer for specific installation and design to meet this requirement.

Example



Example



Items to Remember

- Hangers and their requirements are defined by the plumbing code.
- Hanging support intervals vary by piping material.
- Thrust forces and restraint of those forces are keys to a properly installed system.
- The plumbing codes address restraint (thrust, sway and seismic).
- Manufacturers of cast iron soil pipe and fittings, CISPI, and the codes have similar language to deal with restraint.

Questions?

Knowledge Assessment

Laura Loziuk
Technical Services Manager
903-941-4541
Laura.Loziuk@mcwaneplbgrp.com

CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

Instructors: Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications for which the BBS has approved the class, and fees in promotion materials and advertising. ***The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising***. Advertising shall not disclose improper approval information to the public.

Course sponsors/co-sponsors: proved participants a certificate of completion containing the following information: name of participant, title of approved courses, BBS approval #, BBS approved certifications, date of the continuing education program, number of approved credit hours awarded and signature of authorized sponsor or instructor.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

Participants: Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

Board approval: Remains in effect during the current code edition. Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

Facility/training area: Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

APPLICATION

FOR

Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.

Board of Building Standards
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax: (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: James A Richardson Jr
(Contact Name)

Organization: OAPI
(Organization/Company)

Address: 111 N. Front St.
(Include Room Number, Suite, etc.)

City: Columbus State: OH Zip: 43215

E-Mail: jarichardson@columbus.gov

Telephone: 6147744855 Fax: _____

Course Sponsor: _____

COURSE INFORMATION:

Course Title: Hangers and Restraints for Cast Iron Soil Pipe DWV Systems

New Course Submittal: ☒ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective: This course is designed to give the participant an understanding of the hanger and restraint requirements for the varying materials used in piping systems. Specifics covered will be - types of hangers, hanger spacing requirements, and types of restraints.

Presenter will be Laura Loziuk - BIO sent with application

Number of Instructional Contact Hours that can be obtained upon completion: 1

If Multi-Session, Number of Instructional Contact Hours Per Session: 1

Program Applicable for the Following Participants:

Building Official ☒	Master Plans Examiner ☒	Building Inspector ☒	Fire Protection Inspector ☒	Mechanical Inspector ☒
	Plumbing Plans Exam. ☒			Plumbing Inspector ☒
	Electrical Plans Exam. ☒			Non-Res IU Inspector ☒
	Mechanical Plans Exam. ☒			

Res Building Official ☒ Res Plans Examiner ☒ Res Building Inspector ☒ Res Mechanical Inspector ☒ Res IU Inspector ☒

Electrical Safety Inspectors ☒

Location of ESI Course: _____ Date(s) of ESI Course(s): _____

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**:		Check Off
Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	✔
Course Sponsor:	Organization sponsoring or requesting the program (if any)	✔
Course Title:	Name of course (related to content)	✔
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	✔
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	✔
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	✔
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	✔
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	✔
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	✔
Test Materials:	Copy of quizzes or tests to be given	✔
Completed Application:		✔

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

File Attachments for Item:

ER-6 Joining Methods for Cast Iron Soil Pipe and Fittings (Ohio Assn of Plumbing Inspectors)

All certifications (1 hour)

Staff Notes: Recommend approval pending changes to course to comply with OPC: conference only.

Committee Recommendation:

1 **Joining Methods for Cast Iron Soil Pipe and Fittings**

Laura Loziuk
Technical Services Regional Manager
McWane Plumbing Group

2 **Learning Objectives**

3 **Hub and Spigot**
Joining Methods

4 **Code Sections for Hub and Spigot Joints- IPC**

- The 2018 International Plumbing Code (IPC) sections are:
  - 705.3.1 Caulked Joints (Lead and Oakum)
  - Section is prescriptive- explains what is to be done
  - 705.3.2 Compression Gasket Joints
  - This section cites ASTM C 564 for gasket material and ASTM C 1563 for testing of the gasket.

5 **Code Sections for Hub and Spigot Joints- UPC**

- The 2018 Uniform Plumbing Code (UPC) sections are:
  - 705.2.1 Caulked Joints (Lead and Oakum)
  - Section is prescriptive- explains what is to be done
  - 705.2.2 Mechanical Joints and Compression Joints
  - This sections combines couplings for hubless and gaskets for hub and spigot, cites both ASTM C 564 and ASTM C 1563, along with prescriptive language for both types of joints
-

6 **Lead and Oakum**

- Can be used for Service Weight and Extra Heavy Pipe and Fittings.
- Still used today for repair and some new construction
- Completed by “packing” Oakum into the hub and around the pipe
- Then pouring the proper amount of lead for the joint, based on pipe size
- “Caulking” the lead into the hub and around the spigot of the pipe
-
-

7 **Compression Gaskets**

- Available for both Service Weight and Extra Heavy Pipe and Fittings
- Material standard- ASTM C 564 for elastomer and ASTM C 1563 for the test method
- Uses either a lubricant or an adhesive lubricant for installation, based on pipe size.
- Used above and below grade all over the US

-

8 **Code Sections for Transitions of Dissimilar Materials- IPC**

- The 2018 IPC section 705.16 Joints Between Different Materials addresses the different standards that apply and how to transition between materials.

- Sections 705.16.1, 705.16.2, 705.16.3, 705.16.4, 705.16.5, 705.16.6, 705.16.7 all address different, specific transitions of dissimilar materials.

9 **Code Sections for Transitions of Dissimilar Materials- UPC**

- The 2018 UPC section 705.10 Joints Between Various Materials address the different standards that apply and how to transition between materials.
- Sections 705.10.1, 705.10.2, 705.10.3, and 705.10.4 all address specific transitions of dissimilar materials.
-

10 **Transitions between Dissimilar Materials**

- Transitions from Hub and Spigot to other materials, by code, should be completed using an approved transition
- Lead and Oakum is effective as a transition method as it conforms to each joint specifically
- Temperatures, as it applies to the "other" materials will need to be considered.
- There are compression gaskets that are available for transitioning between materials.

11 **Hubless**
Joining Methods

12 **Code Sections for Hub and Spigot Joints- IPC**

- The 2018 International Plumbing Code (IPC) sections are:
  - 705.3.3 Mechanical Joint Coupling this section specifically cites CISPI 310, ASTM C 1277, and ASTM C 1540. It also cites ASTM C 564 and CSA B 602 for the elastomeric sleeve of the coupling.

13 **Code Sections for Hub and Spigot Joints- UPC**

- The 2018 Uniform Plumbing Code (UPC) sections are:
  - 705.2.2 Mechanical Joints and Compression Joints
  - This sections combines couplings for hubless and gaskets for hub and spigot, cites ASTM A 1056, ASTM C 1277, ASTM C 1540, or CISPI 310 for the coupling and ASTM C 564 for elastomeric sleeve of the coupling. This section also provides prescriptive installation information of the couplings.

14 **Standard Couplings**

- Standards that cover these couplings are:
  - CISPI 310 (The Original)
  - ASTM C 1277
- Require ASTM C 564 elastomer gaskets, stainless steel shields, etc
- Both standards are listed in the codes as an approved joining method for hubless pipe and fittings
- Does not cover transitions of dissimilar materials
- Basis for NSF-CISPI 310 program and other listings
-
  -
-

15 **Heavy Duty Couplings**

- ASTM C 1540- Standard that covers Heavy Duty Couplings

- Written AFTER the couplings were being produced
- Allows for a wide variation in permissible designs and configurations
- Cited by all major plumbing codes
- Not for Transition of dissimilar materials
- Sub-categories (not defined by the standard) are Mid-Duty and Heavy Duty.

16 **Other Couplings**

- Other coupling configurations exist
- Must meet the standards that are applicable to them
- Shield materials can vary…even cast iron shielded couplings exist with the ASTM A 1056 standard
- While there are many options, Standard and Heavy Duty couplings are the vast majority in use

17 **Code Sections for Transitions of Dissimilar Materials- IPC**

- The 2018 IPC section 705.16 Joints Between Different Materials addresses the different standards that apply and how to transition between materials. It lists ASTM C1173, C 1460, C 1461 for the product and ASTM C 425, C 443, c 564, C 1440, , F 477, CSA A 257.3M or B 602 for the elastomer seal.
- Sections 705.16.1, 705.16.2, 705.16.3, 705.16.4, 705.16.5, 705.16.6, 705.16.7 all address different, specific transitions of dissimilar materials.

18 **Code Sections for Transitions of Dissimilar Materials- UPC**

- The 2018 UPC section 705.10 Joints Between Various Materials address the different standards that apply and how to transition between materials. It lists ASTM C 1173 for below ground use, ASTM C 1460 for above ground use, or ASTM C 1461 for above and below ground use.
- Sections 705.10.1, 705.10.2, 705.10.3, and 705.10.4 all address specific transitions of dissimilar materials.
-

19 **Hubless Transitions of Dissimilar Materials**

- Code refers to products being listed to multiple standards for transition purposes
- Shielded and unshielded varieties exist, depending on standard
- Gasket materials may or may not be ASTM C 564 compliant, depending on standard.
- Some may be configured similar to Standard Couplings, Heavy Duty Couplings, or something entirely different
- Dependent on piping materials, location of use (above or below grade), and even size differentials

20 **Installation Considerations**

21 **Applications by Joining Method**

- A few questions can lead to the best choice of joining method available for the application.
  - What occupancy is the structure?
    - Healthcare typically use Heavy Duty couplings, like the Husky SD 4000 (orange shield) as the joining method of choice.
  - What does code allow?
  - What parameters does the structure have?
    - Deflection issues?
    - Pipe Type- Hub and Spigot or Hubless
    - Storm Water systems with large floor spacing

- Extra protection or security desired or needed
- By asking and considering these questions and other specifics, joining methods can be chosen to best suite each project's specific needs.

22 **Installation**

- The 2018 UPC has prescriptive language for installation of a standard hubless coupling.
- CISPI 310 contains an annex detailing installation of standard hubless couplings.
- The CISPI Cast Iron Soil Pipe and Fittings Handbook provides installation information of lead and oakum, compression gaskets, and standard couplings.
- Manufacturers of all of these joining methods have specific installation instructions that should be followed.

23 **Manufacturer's Installation Instructions**

- Regardless of joining method employed, the manufacturers of cast iron soil pipe and fittings all suggest similar language to the below. The plumbing codes of our country all state similar requirements as well.
- Simply stated:

ALL HORIZONTAL PIPE AND FITTINGS, 5 INCH AND LARGER. SHOULD BE BRACED TO PREVENT MOVEMENT AT EVERY BRANCH OR CHANGE OF DIRECTION,

- This is regardless of joining method employed!!!

24 **Conclusion**

- There are multiple methods for joining cast iron soil pipe and fittings. It is based on:
  - Type of cast iron pipe and fittings
  - Method of joining specified or employed
  - Code allowable methods
  - Plumber Preference
- Both the 2018 IPC and UPC Codes cite allowable standards and methods in various sections
- ASTM C 1540 Heavy Duty Couplings vary a great deal by manufacturer and model.
- Other couplings exist, but not in as much use as Standard and Heavy Duty Couplings

25 **Conclusion Continued**

- Transitions of dissimilar materials to cast iron is governed by the codes and standards and is dependent upon the dissimilar material.
  - There are many methods and products that can be employed, but they must be code listed for the purpose.
- Regardless of joining method employed, proper installation like restraint and hangers still need to be followed, per pipe and fittings manufacturer installation instructions and the code sections applicable.
-

26 **Questions?**

Joining Methods for Cast Iron Soil Pipe and Fittings

Laura Loziuk
Technical Services Regional Manager
McWane Plumbing Group

Learning Objectives

- Hub and Spigot Joining Methods
  - Lead and Oakum
  - Compression Gaskets
  - Transitions for Dissimilar Materials
- Hubless Joining Methods
  - Standard Couplings
  - Heavy Duty Couplings
  - Other Types of Couplings
  - Transitions for Dissimilar Materials
- Installations Considerations
- Conclusion

Hub and Spigot Joining Methods

Code Sections for Hub and Spigot Joints- IPC

- The **2018 International Plumbing Code (IPC)** sections are:
  - **705.3.1 Caulked Joints** (Lead and Oakum)
  - Section is prescriptive- explains what is to be done
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  - This sections combines couplings for hubless and gaskets for hub and spigot, cites both ASTM C 564 and ASTM C 1563, along with prescriptive language for both types of joints

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- Material standard- ASTM C 564 for elastomer and ASTM C 1563 for the test method
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- Sections **705.16.1, 705.16.2, 705.16.3, 705.16.4, 705.16.5, 705.16.6, 705.16.7** all address different, specific transitions of dissimilar materials.

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  - **705.3.3 Mechanical Joint Coupling** this section specifically cites CISPI 310, ASTM C 1277, and ASTM C 1540. It also cites ASTM C 564 and CSA B 602 for the elastomeric sleeve of the coupling.

Code Sections for Hub and Spigot Joints- UPC

- The **2018 Uniform Plumbing Code (UPC)** sections are:
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Conclusion Continued

- Transitions of dissimilar materials to cast iron is governed by the codes and standards and is dependent upon the dissimilar material.
  - There are many methods and products that can be employed, but they must be code listed for the purpose.
- Regardless of joining method employed, proper installation like restraint and hangers still need to be followed, per pipe and fittings manufacturer installation instructions and the code sections applicable.

Questions?

Laura Loziuk

Technical Services Regional Manager

McWane Plumbing Group (Tyler, AB&I, Wade & Husky)

www.mcwaneplumbingtechservices.com

laura.loziuk@mcwaneplbgrp.com

Laura Loziuk is a Strategic Codes & Standards Specialist for McWane Plumbing Technical Services who works with plumbing industry design professionals and enforcement agencies to provide the education and technical expertise to solve technical design issues with innovative materials/solutions.

Laura believes providing the technical education needs of the industry is essential to ensuring buildings are constructed/designed to be safe and sanitary for the occupants.Laura is an active member of Women of ASPE, IAPMO, ICC, and ASTM. She is also a Board member of the Philadelphia chapter of ASPE.

Laura has a Bachelor's degree in Civil Engineering from Florida Atlantic University and has been active in the construction industry for over 12 years.

CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

Instructors: Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications for which the BBS has approved the class, and fees in promotion materials and advertising. ***The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising***. Advertising shall not disclose improper approval information to the public.

Course sponsors/co-sponsors: proved participants a certificate of completion containing the following information: name of participant, title of approved courses, BBS approval #, BBS approved certifications, date of the continuing education program, number of approved credit hours awarded and signature of authorized sponsor or instructor.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

Participants: Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

Board approval: Remains in effect during the current code edition. Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

Facility/training area: Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

APPLICATION

FOR

Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.

Board of Building Standards
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax: (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: James A Richardson Jr
(Contact Name)
Organization: OAPI
(Organization/Company)
Address: 111 N. Front St.
(Include Room Number, Suite, etc.)
City: Columbus State: OH Zip: 43215
E-Mail: jarichardson@columbus.gov
Telephone: 6147744855 Fax: _____
Course Sponsor: _____

COURSE INFORMATION:

Course Title: Joining Methods for Cast Iron Soil Pipe and Fittings

New Course Submittal: ☒ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective: This course is designed to give the participant an understanding of various joining methods for cast iron pipe and fittings. Joining methods for hub and spigot including - lead and oakum, compression gaskets, and transitions for dis-similar materials. Joining methods for hubless cast iron including - standard couplings, heavy duty couplings, and transitions for dis-similar materials.

Presenter will be Laura Loziuk - BIO sent with application

Number of Instructional Contact Hours that can be obtained upon completion: 1

If Multi-Session, Number of Instructional Contact Hours Per Session: 1

Program Applicable for the Following Participants:

Building Official ☒	Master Plans Examiner ☒	Building Inspector ☒	Fire Protection Inspector ☒	Mechanical Inspector ☒
	Plumbing Plans Exam. ☒			Plumbing Inspector ☒
	Electrical Plans Exam. ☒			Non-Res IU Inspector ☒
	Mechanical Plans Exam. ☒			

Res Building Official ☒ Res Plans Examiner ☒ Res Building Inspector ☒ Res Mechanical Inspector ☒ Res IU Inspector ☒

Electrical Safety Inspectors ☒
Location of ESI Course: _____ Date(s) of ESI Course(s): _____

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**:		Check Off
Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	✔
Course Sponsor:	Organization sponsoring or requesting the program (if any)	✔
Course Title:	Name of course (related to content)	✔
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	✔
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	✔
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	✔
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	✔
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	✔
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	✔
Test Materials:	Copy of quizzes or tests to be given	✔
Completed Application:		✔

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

File Attachments for Item:

ER-7 Underground Installation Benefits of Cast Iron (Ohio Assn of Plumbing Inspectors)

All certifications (1 hour)

Staff Notes: Recommend approval for conference use only.

Committee Recommendation:

CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

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APPLICATION

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Board of Building Standards
6606 Tussing Road, P.O. Box 4009
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(614) 644-2613 Fax: (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: James A Richardson Jr
(Contact Name)
Organization: OAPI
(Organization/Company)
Address: 111 N. Front St.
(Include Room Number, Suite, etc.)
City: Columbus State: OH Zip: 43215
E-Mail: jarichardson@columbus.gov
Telephone: 6147744855 Fax: _____
Course Sponsor: _____

COURSE INFORMATION:

Course Title: Underground Installation Benefits of Cast Iron

New Course Submittal: ☒ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective: This course is designed to give the participant an understanding of the differing requirements for specific materials used in underground sanitary and storm piping systems, trenching requirements for each material, bedding and compaction requirements for each material, and how soil conditions can affect the installation and the most proper material to use for the condition.

Presenter will be Laura Loziuk - BIO sent with application

Number of Instructional Contact Hours that can be obtained upon completion: 1

If Multi-Session, Number of Instructional Contact Hours Per Session: 1

Program Applicable for the Following Participants:

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1 **Underground Installation Benefits of Cast Iron**

2 **You Will Learn About:**

- The Benefits of Cast Iron in an Underground Application
- Types of Piping Materials
- Code Requirements
- Trenching Comparisons
- Bedding, Compaction and Soil Conditions

3 **Benefits of Cast Iron Underground Installation**

Flexible vs. Rigid Piping Materials

4 **Benefits of Cast Iron Underground Installation**

- Define flexible and rigid piping
- Trenching
- Loading recommendations
- Compaction, bedding & soil types
- Water control / special conditions
- Testing procedures

5 **Typical Piping Materials Used for Underground DWV Installations**

Plastic

6 **Flexible DWV Piping (Plastics)**

Flexible Piping:

- Type of piping / fittings that rely on the side-fill stiffness of trench construction and compaction to limit outward deflection which contributes to failure
- Considered failed at 3-5% deflection

7 **Flexible DWV Piping Materials**

Flexible Piping Materials:

8 **Rigid DWV Piping**

Rigid Piping:

- Type of piping / fittings expected to support the anticipated earth and live loads with little to no deflection
- Failure occurs when pipe and fittings are loaded to the point where they crush

9 **Rigid DWV Piping Materials**

Rigid Piping:

10 **Code Requirements Indicate Approved Underground Materials**

Plumbing Codes:

- Sanitary Drainage
- Storm Drainage

IPC Table 702.2
UPC Table 701.2

UPC- 314.4.1 for
Installation of Thermoplastic Pipe and Fittings

11 **Codes, Standards & Manufacturer Installation Instructions**

PLUMBING CODES:
Chapter 3
(General Regulations)

12 **Codes, Standards & Manufacturer Installation Instructions**

Material Standards with Recommended Installation Instructions:

- ASTM D2321
  Dominant standard for plastic underground installations
- CISPI 301
  Recommended installation procedures for cast iron
-
- Check Manufacturer's Installation Instructions

13 **Benefits of Cast Iron Underground Installation**

Trenching Recommendations

14 **Underground Trenching Comparison**

15 **Underground Trenching**
Benefits of Cast Iron

1 Cast Iron

2
- Burial of cast iron soil pipe is often regarded as a simple task due to its inherent strength. Failure determined when pipe fractures
- Trench Width Cast Iron Pipe:
  As narrow as installer needs to make joint connections
- Trench Bottom: Pipe should be continuously supported, with hub / coupling holes excavated

3 Plastic

4
- Plastic piping failure is considered at 3-5% deflection
- Trench Width: Determined by soil type, depth of trench and the excavation equipment used
- Trench Width Flexible Pipe: Must be wide enough to allow for compaction to limit pipe defection. Per ASTM D2321, 3-5% deflection is considered failure
-

16 **Trenching for Thermo-**
plastic Piping Per ASTM D2321

1 OPTION 1:

2 Pipe Outside Diameter,
plus 16"
Pipe OD + 16" = Trench Width

Example:
4" PVC-4.50 (OD) + 16 = 20.5" trench width

▪

3 OPTION 2:

4 Pipe Outside Diameter multiplied by 1.25, plus 12"
(Pipe OD x 1.25) + 12" = Trench Width

Example:
4" PVC - (4.50 OD x 1.25) = 5.625 + 12 = 17.625" trench width

•

17 **Types of Loads on Underground DWV Pipe Materials**

- Non-pressure, underground DWV pipe materials are subjected to external loads - Earth and Live Loads
- Earth Load = Backfill Weight
- Live Load (Truck Load) = Traffic and Impact
- Total Load = Earth Load + Live Load (external)

18 **Benefits of Cast Iron Underground Installation**

Bedding, Compaction & Soil Conditions

19 **Bedding of Plastic Pipe**

- Minimum 4" bedding material required
- Engineer or soil conditions could require more
- If "quick" soil conditions exist, extensive items and steps maybe required
- Soil conditions is first step in bedding and backfilling
- Identification of native soil and if additional soils must be brought on site to satisfy ASTM D 2321 requirements
- Soil types and installations are indicated in Tables 1 and 2 of ASTM D 2321
- Soil materials must be brought on site to satisfy and installations are indicated in Tables 1 and 2 of ASTM D2321

20 **ASTM D2321 Table 1**

Classes of Embedment and Backfill Materials

21 **ASTM D2321 Table 2**

Recommendations for Installation and Use of Soils and Aggregates for Foundations, Embedment and Backfill

22 **Compaction – ASTM D 2321 for Plastic Pipe**

- Based on Tables 1 and 2 of ASTM D2321
- Bedding: Continuous Support, Graded and Compacted
- Haunch (sides) area of pipe backfilled and compacted
- Lifts of backfill to be installed and compacted in lifts not exceeding 6"
- No heavy duty equipment used until suitably backfilled

23 **Stainless Steel Piping**

- 316L are suitable for direct burial, not 304 material
- Soil conditions could pose issues, that soil tests would identify
- 2"- 4" leveling course, free of frozen material
- No large or sharp stones, properly graded, continuous support
- End of pipe and change of directions must be braced

- 4″ Sand or crushed stone surrounding pipe
- Fill material carefully applied and compacted to 93 proctor density

24 **Cast Iron Soil Pipe Underground**

- No special bedding required
- Pipe should be continuously supported, with hub / coupling holes excavated
- Backfill should be clean earth free of large rocks (greater than 1.5″), stones, and frozen fill material
- Normal compaction to be done to appropriate levels. No special process is required as it is for flexible materials

25

26 **Benefits of Cast Iron Underground Installation**

Water Control

27 **Water Control for ASTM D2321 of Plastic Pipe**

ASTM D2321 Requires water control measures if these two conditions exist, because plastic pipe is flexible and will move or shift, floatation, washout, or disturbances of the pipe and embedment

- Ground Water Conditions
- Running Water Conditions

28 **Water Control for ASTM D2321 of Plastic Pipe**

Ground Water

- Water must be kept below bottom of trench
- Use of pumps, well points, and other suitable means
- Until trench is dug, bedding installed, pipe installed and compacted with sufficient bedding installation to prevent floatation of the pipe

29 **Water Control for ASTM D2321 of Plastic Pipe**

Running Water

- All running, ground, drainage and surface water must be controlled
- Dams, cutoffs or other barriers during installation of pipe, bedding, backfill through compaction to prevent disturbance of the pipe and embedment

30 **Benefits of Cast Iron Underground Installation**

Differences in Testing Methods

31 **Ground Preparation**

1 Cast Iron

- No sampling of soil needed
- No special leveling of the ground needed
- No specific compaction methods

32 **Ground Preparation**

Stainless Steel Tubing

- No sampling needed
- Soil conditions could pose issues, that soil tests would identify

- 2″- 4″ leveling course, free of frozen material
- No large or sharp stones, properly graded, continuous support
- Must verify the product is installed/buried per the engineers specification

33 ☐ **Ground Preparation**

Plastic (PVC / ABS)

- Soil must be sampled for compaction levels
- Must inspect bedding to meet engineers specification
- Per ASTM D2321 the engineer should inspect the following at necessary intervals:
  trench depth
  water conditions
  foundations
  embedment / backfill materials

•
•

34 ☐ **Joining Methods**

Cast Iron

- Can verify the materials used without removal
- Can verify the correct torque on couplings without removal
- Can remove sections without damaging the product to test by floor/section, etc.
- Any defective items can be removed and replaced without disturbing the installation
- Additional methods: standard couplings, medium duty and heavy duty

35 ☐ **Joining Methods**

Stainless Steel

- No way to verify the strength of the joint
- No way to verify if the pipe was damaged/distorted before assembly
- Only one joining method

36 ☐ **Joining Methods**

Plastic (PVC / ABS)

- No way to verify cements used for joints once assembled
- Must inspect bedding to meet engineers specification
- Defective products cannot be removed without destroying the joint

37 ☐ **Why Cast Iron Soil Pipe is a great choice for underground DWV piping?**

1 • Strength & durability
- No infiltration or exfiltration
- Ease of installation
- Design of compatibility
- Meets or exceeds codes

2 • Easy to verify proper installation
- Corrosion resistance
- Nonflammable
•

38 **What You Learned**

1 As a flexible material, PVC is dependent on side-fill stiffness and compaction to limit deflection. ASTM D2321 recommends a trench width of the pipe outside diameter plus 16″ or pipe outside diameter multiplied by 1.25 plus 12″

•

2 The rigid material of cast iron pipe does not depend on sidefill stiffness, so the trench can be as narrow as the installer needs to make joint connections

•

3 • Cast Iron Soil Pipe

4 • PVC Soil Pipe

Laura Loziuk

Technical Services Regional Manager

McWane Plumbing Group (Tyler, AB&I, Wade & Husky)

www.mcwaneplumbingtechservices.com

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Laura Loziuk is a Strategic Codes & Standards Specialist for McWane Plumbing Technical Services who works with plumbing industry design professionals and enforcement agencies to provide the education and technical expertise to solve technical design issues with innovative materials/solutions.

Laura believes providing the technical education needs of the industry is essential to ensuring buildings are constructed/designed to be safe and sanitary for the occupants.Laura is an active member of Women of ASPE, IAPMO, ICC, and ASTM. She is also a Board member of the Philadelphia chapter of ASPE.

Laura has a Bachelor's degree in Civil Engineering from Florida Atlantic University and has been active in the construction industry for over 12 years.

Underground Installation Benefits of Cast Iron

Laura Loziuk
Technical Services Manager
McWane Plumbing Group

You Will Learn About:

- The Benefits of Cast Iron in an Underground Application
- Types of Piping Materials
- Code Requirements
- Trenching Comparisons
- Bedding, Compaction and Soil Conditions

Benefits of Cast Iron Underground Installation

Flexible vs. Rigid Piping Materials

Benefits of Cast Iron Underground Installation

- Define flexible and rigid piping
- Trenching
- Loading recommendations
- Compaction, bedding & soil types
- Water control / special conditions
- Testing procedures

Typical Piping Materials Used for Underground DWV Installations

Plastic

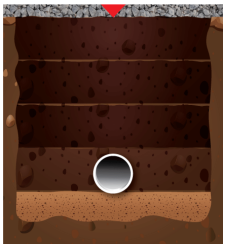
Cast Iron

Stainless Steel Tubing

Flexible DWV Piping (Plastics)

Flexible Piping:

- Type of piping / fittings that rely on the side-fill stiffness of trench construction and compaction to limit outward deflection which contributes to failure
- Considered failed at 3-5% deflection



Flexible DWV Piping Materials

Flexible Piping Materials:

Plastic

Stainless Steel Tubing

Rigid DWV Piping

Rigid Piping:

- Type of piping / fittings expected to support the anticipated earth and live loads with little to no deflection
- Failure occurs when pipe and fittings are loaded to the point where they crush

Rigid DWV Piping Materials

Rigid Piping:

Cast Iron

Vitrified Clay

Concrete

Code Requirements Indicate Approved Underground Materials

Plumbing Codes:

- Sanitary Drainage
- Storm Drainage

IPC Table 702.2
UPC Table 701.2

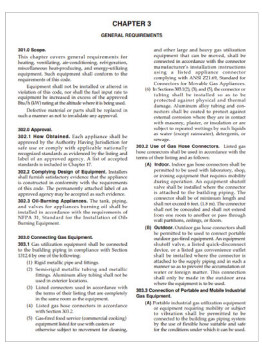
UPC- 314.4.1 for Installation of Thermoplastic Pipe and Fittings

Codes, Standards & Manufacturer Installation Instructions

PLUMBING CODES:

Chapter 3
(General Regulations)

- Covers General Requirements of trenching and backfilling.
- 2018 UPC section 314.4.1 covers the Underground installation requirements for Thermoplastic Pipe and fittings.
- UPC Table 701.2 and IPC Table 702.2 provides approved materials for underground installation.
- Storm Drainage chapters for underground materials refer back to these tables.



Codes, Standards & Manufacturer Installation Instructions

Material Standards with Recommended Installation Instructions:

- ASTM D2321
  Dominant standard for plastic underground installations
- CISPI 301
  Recommended installation procedures for cast iron
- Check Manufacturer's Installation Instructions

Benefits of Cast Iron Underground Installation

Trenching Recommendations

Underground Trenching Comparison

Underground Installations	CISP	PVC ASTM D2321
Failure Mode	Rigid-Crush	Flexible
		5% Deflection
		Infiltration / Exfiltration
		Dependent upon side fill
Trench Width	Minimum width	O.D. + 16" or O.D. x 1.25 + 12"
		6" pipe – 20" trench
Trench Bottom	Flat w/ hub or coupling holes	Dependent upon soil type
	Uniform support	4" bedding standard
	No special bedding	6" in rock
Compaction	No special requirements	6" layers to spring line
		Hand compact around pipe
		85% - 95% compaction

Underground Trenching Benefits of Cast Iron

Cast Iron

- Burial of cast iron soil pipe is often regarded as a simple task due to its inherent strength. Failure determined when pipe fractures
- Trench Width Cast Iron Pipe: As narrow as installer needs to make joint connections
- Trench Bottom: Pipe should be continuously supported, with hub / coupling holes excavated

Plastic

- Plastic piping failure is considered at 3-5% deflection
- Trench Width: Determined by soil type, depth of trench and the excavation equipment used
- Trench Width Flexible Pipe: Must be wide enough to allow for compaction to limit pipe defection. Per ASTM D2321, 3-5% deflection is considered failure

Trenching for Thermo-plastic Piping Per ASTM D2321

OPTION 1:

Pipe Outside Diameter, plus 16"
Pipe OD + 16" = Trench Width

Example:
4" PVC-4.50 (OD) + 16 = 20.5" trench width

OPTION 2:

Pipe Outside Diameter multiplied by 1.25, plus 12"
(Pipe OD x 1.25) + 12" = Trench Width

Example:
4" PVC - (4.50 OD x 1.25) = 5.625 + 12 = 17.625" trench width

Types of Loads on Underground DWV Pipe Materials

- Non-pressure, underground DWV pipe materials are subjected to external loads - Earth and Live Loads
- Earth Load = Backfill Weight
- Live Load (Truck Load) = Traffic and Impact
- Total Load = Earth Load + Live Load (external)

Benefits of Cast Iron Underground Installation

Bedding, Compaction & Soil Conditions

Bedding of Plastic Pipe

- Minimum 4" bedding material required
- Engineer or soil conditions could require more
- If "quick" soil conditions exist, extensive items and steps maybe required
- Soil conditions is first step in bedding and backfilling
- Identification of native soil and if additional soils must be brought on site to satisfy ASTM D 2321 requirements
- Soil types and installations are indicated in Tables 1 and 2 of ASTM D 2321
- Soil materials must be brought on site to satisfy and installations are indicated in Tables 1 and 2 of ASTM D2321

ASTM D2321 Table 1

Classes of Embedment and Backfill Materials

D 2321 – 05

TABLE 1 Classes of Embedment and Backfill Materials

Class	Type	Soil Group Symbol D 2487	Description	Percentage Passing Sieve Sizes 1½ in. (40 mm)	No. 4 (4.75 mm)	No. 200 (0.075 mm)	Atterberg Limits LL	PI	Coefficients Uniformity C_u	Curvature C_c
IA	Manufactured Aggregates: open-graded, clean.	None	Angular, crushed stone or rock, crushed gravel, broken coral, crushed slag, cinders or shells; large void content, contain little or no fines.	100 %	≤10 %	<5 %	Non Plastic			
IB	Manufactured, Processed Aggregates; dense-graded, clean.	None	Angular, crushed stone (or other Class 1A materials) and stone/sand mixtures with gradations selected to minimize migration of adjacent soils; contain little or no fines (see X1.8).	100 %	≤50 %	<5 %	Non Plastic			
II	Coarse-Grained Soils, clean	GW	Well-graded gravels and gravel-sand mixtures; little or no fines.	100 %	<50 % of "Coarse Fraction"	<5 %	Non Plastic		>4	1 to 3
		GP	Poorly-graded gravels and gravel-sand mixtures; little or no fines.						<4	<1 or >3
		SW	Well-graded sands and gravelly sands; little or no fines.		>50 % of "Coarse Fraction"				>6	1 to 3
		SP	Poorly-graded sands and gravelly sands; little or no fines.						<6	<1 or >3
	Coarse-Grained Soils, borderline clean to w/fines	e.g. GW-GC, SP-SM.	Sands and gravels which are borderline between clean and with fines.	100 %	Varies	5 % to 12 %	Non Plastic		Same as for GW, GP, SW and SP	
III	Coarse-Grained Soils With Fines	GM	Silty gravels, gravel-sand-silt mixtures.	100 %	<50 % of "Coarse Fraction"	12 % to 50 %		<4 or <"A" Line		
		GC	Clayey gravels, gravel-sand-clay mixtures.					<7 and >"A" Line		
		SM	Silty sands, sand-silt mixtures.		>50 % of "Coarse Fraction"			>4 or <"A" Line		
		SC	Clayey sands, sand-clay mixtures.					>7 and >"A" Line		
IVA[A]	Fine-Grained Soils (inorganic)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, silts with slight plasticity.	100 %	100 %	>50 %	<50	<4 or <"A" Line		
		CL	Inorganic clays of low to medium plasticity, gravely clays, sandy clays, silty clays, lean clays.					>7 and >"A" Line		
IVB	Fine-Grained Soils (inorganic)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.	100 %	100 %	>50 %	>50	<"A" Line		
		CH	Inorganic clays of high plasticity, fat clays.					>"A" Line		
V	Organic Soils	OL	Organic silts and organic silty clays of low plasticity.	100 %	100 %	>50 %	<50	<4 or <"A" Line		
		OH	Organic clays of medium to high plasticity, organic silts.				>50	<"A" Line		
	Highly Organic	PT	Peat and other high organic soils.							

[A]Includes Test Method D 2487 borderline classifications and dual symbols depending on plasticity index and liquid limits.
Note—"Coarse Fraction" as used in this table is defined as material retained on a No. 200 sieve.

ASTM D2321 Table 2

Recommendations for Installation and Use of Soils and Aggregates for Foundations, Embedment and Backfill

D 2321 – 05

TABLE 2 Recommendations for Installation and Use of Soils and Aggregates for Foundation, Embedment and Backfill

	Soil Class (see Table 1)[A]				
	Class IA	Class IB	Class II	Class III	Class IV-A
General Recommendations and Restrictions	Do not use where conditions may cause migration of fines from adjacent soil and loss of pipe support. Suitable for use as a drainage blanket and underdrain in rock cuts where adjacent material is suitably graded (see X1.8).	Process materials as required to obtain gradation which will minimize migration of adjacent materials (see X1.8). Suitable for use as drainage blanket and underdrain.	Where hydraulic gradient exists check gradation to minimize migration. "Clean" groups suitable for use as drainage blanket and underdrain.	Do not use where water conditions in trench may cause instability.	Obtain geotechnical evaluation of proposed material. May not be suitable under high earth fills, surface applied wheel loads, and under heavy vibratory compactors and tampers. Do not use where water conditions in trench may cause instability.
Foundation	Suitable as foundation and for replacing over-excavated and unstable trench bottom as restricted above. Install and compact in 6-in. maximum layers.	Suitable as foundation and for replacing over-excavated and unstable trench bottom. Install and compact in 6-in. maximum layers.	Suitable as a foundation and for replacing over-excavated and unstable trench bottom as restricted above. Install and compact in 6-in. maximum layers.	Suitable as foundation and for replacing over-excavated trench bottom as restricted above. Do not use in thicknesses greater than 12 in. total. Install and compact in 6-in. maximum layers.	Suitable only in undisturbed condition and where trench is dry. Remove all loose material and provide firm, uniform trench bottom before bedding is placed.
Bedding	Suitable as restricted above. Install in 6-in. maximum layers. Level final grade by hand. Minimum depth 4 in. (6 in. in rock cuts).	Install and compact in 6-in. maximum layers. Level final grade by hand. Minimum depth 4 in. (6 in. in rock cuts).	Suitable as restricted above. Install and compact in 6-in. maximum layers. Level final grade by hand. Minimum depth 4 in. (6 in. in rock cuts).	Suitable only in dry trench conditions. Install and compact in 6-in. maximum layers. Level final grade by hand. Minimum depth 4 in. (6 in. in rock cuts).	Suitable only in dry trench conditions and when optimum placement and compaction control is maintained. Install and compact in 6-in. maximum layers. Level final grade by hand. Minimum depth 4 in. (6 in. in rock cuts).
Haunching	Suitable as restricted above. Install in 6-in. maximum layers. Work in around pipe by hand to provide uniform support.	Install and compact in 6-in. maximum layers. Work in around pipe by hand to provide uniform support.	Suitable as restricted above. Install and compact in 6-in. maximum layers. Work in around pipe by hand to provide uniform support.	Suitable as restricted above. Install and compact in 6-in. maximum layers. Work in around pipe by hand to provide uniform support.	Suitable only in dry trench conditions and when optimum placement and compaction control is maintained. Install and compact in 6-in. maximum layers. Work in around pipe by hand to provide uniform support.
Initial Backfill	Suitable as restricted above. Install to a minimum of 6 in. above pipe crown.	Install and compact to a minimum of 6 in. above pipe crown.	Suitable as restricted above. Install and compact to a minimum of 6 in. above pipe crown.	Suitable as restricted above. Install and compact to a minimum of 6 in. above pipe crown.	Suitable as restricted above. Install and compact to a minimum of 6 in. above pipe crown.
Embedment Compaction[B]	Place and work by hand to insure all excavated voids and haunch areas are filled. For high densities use vibratory compactors.	Minimum density 85 % Std. Proctor.[C] Use hand tampers or vibratory compactors.	Minimum density 85 % Std. Proctor.[C] Use hand tampers or vibratory compactors.	Minimum density 90 % Std. Proctor.[C] Use hand tampers or vibratory compactors. Maintain moisture content near optimum to minimize compactive effort.	Minimum density 95 % Std. Proctor.[C] Use hand tampers or impact tampers. Maintain moisture content near optimum to minimize compactive effort.
Final Backfill	Compact as required by the engineer.	Compact as required by the engineer.	Compact as required by the engineer.	Compact as required by the engineer.	Suitable as restricted above. Compact as required by the engineer.

[A] Class IV-B (MH-CH) and Class V (OL, OH, PT) Materials are unsuitable as embedment. They may be used as final backfill as permitted by the engineer.
[B] When using mechanical compactors avoid contact with pipe. When compacting over pipe crown maintain a minimum of 6 in. cover when using small mechanical compactors. When using larger compactors maintain minimum clearances as required by the engineer (See X1.7).
[C] The minimum densities given in the table are intended as the compaction requirements for obtaining satisfactory embedment stiffness in most installation conditions (see 7.5.1).

Compaction – ASTM D 2321 for Plastic Pipe

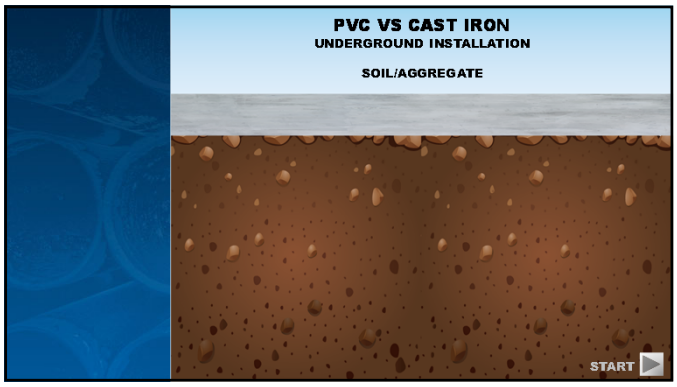
- Based on Tables 1 and 2 of ASTM D2321
- Bedding: Continuous Support, Graded and Compacted
- Haunch (sides) area of pipe backfilled and compacted
- Lifts of backfill to be installed and compacted in lifts not exceeding 6"
- No heavy duty equipment used until suitably backfilled

Stainless Steel Piping

- 316L are suitable for direct burial, not 304 material
- Soil conditions could pose issues, that soil tests would identify
- 2"- 4" leveling course, free of frozen material
- No large or sharp stones, properly graded, continuous support
- End of pipe and change of directions must be braced
- 4" Sand or crushed stone surrounding pipe
- Fill material carefully applied and compacted to 93 proctor density

Cast Iron Soil Pipe Underground

- No special bedding required
- Pipe should be continuously supported, with hub / coupling holes excavated
- Backfill should be clean earth free of large rocks (greater than 1.5"), stones, and frozen fill material
- Normal compaction to be done to appropriate levels. No special process is required as it is for flexible materials



Benefits of Cast Iron Underground Installation

Water Control

Water Control for ASTM D2321 of Plastic Pipe

ASTM D2321 Requires water control measures if these two conditions exist, because plastic pipe is flexible and will move or shift, floatation, washout, or disturbances of the pipe and embedment

- Ground Water Conditions
- Running Water Conditions

Water Control for ASTM D2321 of Plastic Pipe

Ground Water

- Water must be kept below bottom of trench
- Use of pumps, well points, and other suitable means
- Until trench is dug, bedding installed, pipe installed and compacted with sufficient bedding installation to prevent floatation of the pipe

Water Control for ASTM D2321 of Plastic Pipe

Running Water

- All running, ground, drainage and surface water must be controlled
- Dams, cutoffs or other barriers during installation of pipe, bedding, backfill through compaction to prevent disturbance of the pipe and embedment

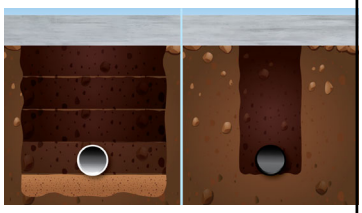
Benefits of Cast Iron Underground Installation

Differences in Testing Methods

Ground Preparation

Cast Iron

- No sampling of soil needed
- No special leveling of the ground needed
- No specific compaction methods



Ground Preparation

Stainless Steel Tubing

- No sampling needed
- Soil conditions could pose issues, that soil tests would identify
- 2”- 4” leveling course, free of frozen material
- No large or sharp stones, properly graded, continuous support
- Must verify the product is installed/buried per the engineers specification

Ground Preparation

Plastic (PVC / ABS)

- Soil must be sampled for compaction levels
- Must inspect bedding to meet engineers specification
- Per ASTM D2321 the engineer should inspect the following at necessary intervals:
  - trench depth
  - water conditions
  - foundations
  - embedment / backfill materials

Joining Methods

Cast Iron

- Can verify the materials used without removal
- Can verify the correct torque on couplings without removal
- Can remove sections without damaging the product to test by floor/section, etc.
- Any defective items can be removed and replaced without disturbing the installation
- Additional methods: standard couplings, medium duty and heavy duty

Joining Methods

Stainless Steel

- No way to verify the strength of the joint
- No way to verify if the pipe was damaged/distorted before assembly
- Only one joining method

Joining Methods

Plastic (PVC / ABS)

- No way to verify cements used for joints once assembled
- Must inspect bedding to meet engineers specification
- Defective products cannot be removed without destroying the joint

Why Cast Iron Soil Pipe is a great choice for underground DWV piping?

- Strength & durability
- No infiltration or exfiltration
- Ease of installation
- Design of compatibility
- Meets or exceeds codes
- Easy to verify proper installation
- Corrosion resistance
- Nonflammable

What You Learned

- PVC Soil Pipe

As a flexible material, PVC is dependent on side-fill stiffness and compaction to limit deflection. ASTM D2321 recommends a trench width of the pipe outside diameter plus 16" or pipe outside diameter multiplied by 1.25 plus 12"

- Cast Iron Soil Pipe

The rigid material of cast iron pipe does not depend on sidefill stiffness, so the trench can be as narrow as the installer needs to make joint connections

File Attachments for Item:

EC-1 2017 vs 2020 NEC Analysis of Changes (International Association of Electrical Inspectors)

All certifications except plumbing and IU certifications (30 hours - four 7.5-hour sessions)

APPLICATION

FOR

Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.

Board of Building Standards
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax: (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: Lorenzo Adam (Contact Name)
Organization: Ohio Chapter IAEI (Organization/Company)
Address: 27 Penbrooke Ct (Include Room Number, Suite, etc.)
City: Monroe State: Ohio Zip: 45050
E-Mail: ladam@masonoh.org
Telephone: 513-229-8520 Fax:
Course Sponsor: Ohio Chapter IAEI

COURSE INFORMATION:

Course Title: 2017 vs 2020 NEC Analysis of Changes ~~- Ch. 1 and 2~~

New Course Submittal: ■ Update Course: ☐ Prior Approval Number:

Purpose and Objective: To provide attendees with an overview and explanation of the subjects presented and to provide a level of uniformity among inspectors, contractors, professional designers and jurisdictions

Instructors: Various IAEI and NFPA members

Number of Instructional Contact Hours that can be obtained upon completion: 30 hrs - 7.5 hours per session

If Multi-Session, Number of Instructional Contact Hours Per Session: chaps 1-2; 2-4; 5-6; 6-8

Program Applicable for the Following Participants:

Building Official ☑	Master Plans Examiner ☑	Building Inspector ☑	Fire Protection Inspector ☑	Mechanical Inspector ☑	
	Building Plans Exam. ☑			Plumbing Inspector ☐	
	Plumbing Plans Exam. ☐			Non-Res IU Inspector ☐	
	Electrical Plans Exam. ☑				
	Mechanical Plans Exam. ☑				
	Fire Protect. Plans Exam. ☑				

Res Building Official ☑ Res Plans Examiner ☑ Res Building Inspector ☑ Res Mechanical Inspector ☑ Res IU Inspector ☐

Electrical Safety Inspectors ☑
Location of ESI Course: Mason, Ohio Date(s) of ESI Course(s): September 11, 2021

SUBMITTAL CHECKLIST: **Make Sure all of the Following Information is Submitted.**		Check Off
Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	
	Organization sponsoring or requesting the program (if any)	
Course Title:	Name of course (related to content)	
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	
Test Materials:		
Completed Application:		

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

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BOARD OF BUILDING

2017 vs 2020 NEC Analysis of Changes
Course outline for September 11th, 2021

This first Saturday will cover **Changes in Chapters 1 and 2** of the 2017 and 2020 NEC Analysis of Changes. The instruction will include the proper use and limitations for material and equipment used for electrical installations and the requirements for compliance with the NEC.

The instructor will also emphasize the importance of the changes and it affects future code proposals.

- Chapter 1. General
  - Articles 100 and 110
- Chapter 2. Wiring and Protection.
  - Articles 210 – 220 – 225 - 230

The presentation will be in Power Point format. Contractors and ESIs will benefit as well as Plans Examiners and Professional Designers by getting first hand information on these changes. Both, the Ohio Building Code and the Residential Code of Ohio, in chapters 27 and 33 respectively refers to **2017 NFPA 70** as the standard to comply with electrical installations. Even though the State of Ohio has not adopted the 2020 NFPA 70 version, the purpose of this class is to update the attendees on the code changes and not on the enforcement.

2017 vs 2020 NEC Analysis of Changes
Course outline for October 9th, 2021

This second Saturday will cover **Changes in Chapter 2 through 4** of the 2017 and 2020 NEC Analysis of Changes. The instruction will include the proper use and limitations for material and equipment used for electrical installations and the requirements for compliance with the NEC.

The instructor will also emphasize the importance of the changes.

- Chapter 2. Wiring and Protection.
  - Articles 240 – 250
- Chapter 3. Wiring Methods and Materials.
  - Article 300
- Chapter 4. Equipment.
  - Articles 400 – 404 – 406 – 410 – 422 – 440 – 445 - 450

The presentation will be in Power Point format. Contractors and ESIs will benefit as well as Plans Examiners and Professional Designers by getting first hand information on these changes. Both, the Ohio Building Code and the Residential Code of Ohio, in chapters 27 and 33 respectively refers to **2017 NFPA 70** as the standard to comply with electrical installations. Even though the State of Ohio has not adopted the 2020 NFPA 70 version, the purpose of this class is to update the attendees on the code changes and not on the enforcement.

2017 vs 2020 NEC Analysis of Changes

Course outline for November 13th, 2021

This third Saturday will cover **Changes in Chapter 5 and 6** of the 2017 and 2020 NEC Analysis of Changes. The instruction will include the proper use and limitations for material and equipment used for electrical installations and the requirements for compliance with the NEC.

The instructor will also emphasize the importance of the changes.

- Chapter 5. Special Occupancies.
  - Articles 500 – 511 – 514 – 517 – 525 - 590
- Chapter 6. Special Equipment.
  - Article 600 - 625

The presentation will be in Power Point format. Contractors and ESIs will benefit as well as Plans Examiners and Professional Designers by getting first hand information on these changes. Both, the Ohio Building Code and the Residential Code of Ohio, in chapters 27 and 33 respectively refers to **2017 NFPA 70** as the standard to comply with electrical installations. Even though the State of Ohio has not adopted the 2020 NFPA 70 version, the purpose of this class is to update the attendees on the code changes and not on the enforcement.

2017 vs 2020 NEC Analysis of Changes
Course outline for December 11th, 2021

This second session will cover **Changes in Chapter 6 through 8** of the 2017 and 2020 NEC Analysis of Changes. The instruction will include the proper use and limitations for material and equipment used for electrical installations and the requirements for compliance with the NEC.

The instructor will also emphasize the importance of the changes.

- Chapter 6. Special Equipment.
  - Articles 680 – 682 - 690 - 695
- Chapter 7. Special Conditions.
  - Articles 700 – 701 – 702 – 725 – 760
- Chapter 8. Communications Systems.
  - Article 800

The presentation will be in Power Point format. Contractors and ESIs will benefit as well as Plans Examiners and Professional Designers by getting first hand information on these changes. Both, the Ohio Building Code and the Residential Code of Ohio, in chapters 27 and 33 respectively refers to **2017 NFPA 70** as the standard to comply with electrical installations. Even though the State of Ohio has not adopted the 2020 NFPA 70 version, the purpose of this class is to update the attendees on the code changes and not on the enforcement.

INSTRUCTOR QUALIFICATIONS

Lorenzo M. Adam

Lorenzo started his electrical training in 1983. In 1988, he started his own electrical company. In 1996, he obtained the State Electrical Inspector certification. In 1997, he joined the City of Troy as a Building/Electrical Inspector. Currently, he works for the City of Mason. Lorenzo has an Electrical Plans Examiner, Residential Building Official, Building Inspector, Building Official interim certification from the State of Ohio. Lorenzo is currently the secretary/treasurer for the SW Division of IAEI, Ohio Chapter, secretary/treasurer for the Ohio Chapter IAEI and Treasurer and Past President of the Southwestern Ohio Building Officials Association (SWOBOA).

Address: 27 Penbrooke Ct., Monroe, Ohio 45050

Gaylord K. Poe

Gaylord Poe started his longstanding career in the electrical industry in 1969. He earned his Electrical Safety Inspector Certificate (#592) in 1978. He continued to work as an electrician until 1983 when he joined the IBI team as a commercial/industrial field inspector. He was promoted to Commercial Coordinator in 1986, to Assistant Chief Electrical Inspector in 1994, and to Chief Electrical Inspector and President in 2000. He earned his Ohio Electrical Plan Examiner and IAEI Electrical Inspector-Plan Review certificates in 2005. He is the only Ohio ESI certified by the IAEI as a Master Electrical Inspector (2009).
Gaylord is a member of the UL Electrical Council, the NFPA, the Cincinnati Business Development and Permit Center Advisory Committee, the Board of Trustees for the GCEA, the Electrical Trades Advisory Committee for Scarlet Oaks JVS, and is actively involved in course development and training classes for the continuing education programs of the IAEI, IEC, GCEA, and NECA. Gaylord has been involved with the IAEI since the early 1980's. He currently has become the Past-President of the IAEI SW Division, in which he served for 17 years combine.

Address: Suite 125-W, 250 West Court Street, Cincinnati, OH 45202

Caty Robinson

Caty Robinson began her electrical career working as an apprentice in the Dayton, Ohio area. As a member of IBEW Local 82 Caty served a full apprenticeship and worked in the field as a journeyman wireman for Kastle Electric. Caty's Ohio certification #2647 is for ESI (2004) and EPE (2013). Caty joined Inspection Bureau, Inc. (IBI) in 2008 as a commercial Electrical Safety Inspector. Caty currently serves as IBI's Commercial Coordinator and inspects in IBI's commercial territories and Kentucky. Caty is also a member of the IAEI Ohio Chapter SW Division

Address: Suite 125-W, 250 West Court Street, Cincinnati, OH 45202

Peter M. Baldauf

Peter has been in the electrical industry for over 15 years. He began his electrical career working through a trade school in Dayton, Ohio. After graduation, he enrolled in the Associated Builders and Contractors State certified electrical apprenticeship program. Peter attended the program for the full four years and upon completion of the program, he relocated to Tacoma, Washington. In Tacoma, he sat for a State administered test and received State of Washington certification as a journeyman electrician, which is required by the Division of Labor and Industry in that State to perform work as an electrician. Upon his return to the State of Ohio, Peter sat for and was issued a license by the State of Ohio to perform duties associated with the installation and servicing of fire alarm systems. He also applied and sat for the test to become a State Certified Electrical Safety Inspector. He was awarded this Certification in September of 1998. Peter began his career in public service with Montgomery County Building Regulations as an Electrical Inspector in August of 1999. He is currently employed with the City of Vandalia as an Electrical Inspector. Peter also instructs classes for the Master Electrical Contractors Association, Adequate Wiring Committee, and International Association of Electrical Inspectors. He also has certification through the City of Dayton Board of Education as an Adult Education Instructor.

Address: 3600 Shroyer Road, Kettering, OH 45429

Daniel Dewayne Jenkins

Dewayne started his career in the electrical field in 1982 in Dayton, Ohio and several years of experience in the electrical industry both as a contractor and inspector. He served 4 years in an electrical apprenticeship program and has over 8 years in the field as a journeyman electrician and he has 4 years, to his credit, as an electrical estimator and project manager.

Dewayne has been a licensed electrical contractor and a certified electrical safety inspector since 1996. He also holds Ohio certifications as building inspector (1998), electrical plans examiner (2006) and residential building official (2007) and chief building official (2008). He is currently employed by the City of Kettering in the position as an electrical plans examiner, electrical safety inspector and building inspector.

Dewayne is an adjunct lecturer II for Sinclair Community College in the electrical trades for several years. A technical presenter for the Ohio Board of Building Standards (OBBS), International Association of Electrical Inspectors (IAEI), Master Electrical Contractors Association (MECA), Adequate Wiring Committee (AWC) & Greater Cincinnati Electrical Association (GCEA). He has served as President for the Ohio Chapter IAEI (2010). Dewayne has also served as President of the Miami Valley Building Officials Council (2002 & 2003). He currently is the President of the Southwest Division, IAEI and serves on the Electrical Safety Inspector Advisory Committee for the Ohio Board of Building Standards.

Address: 3600 Shroyer Road, Kettering, OH 45429

2021 30-Hour Course
Sponsored by Southwest Division Ohio IAEI

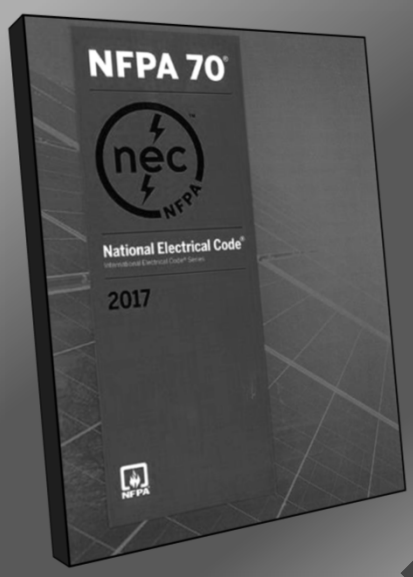
Facility

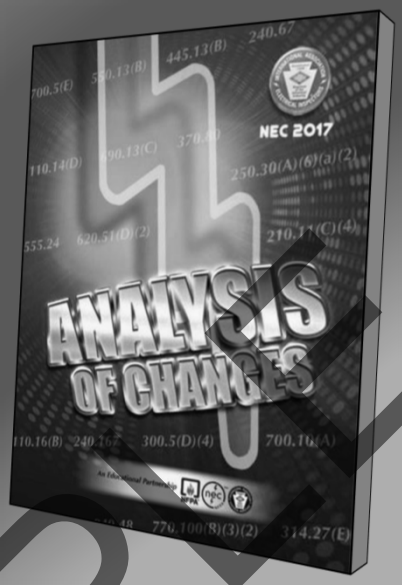
The facility is conveniently located in Mason, about 1mile from I-71 and 3 miles from I-75. Classes are held at the **City of Mason, Community Room, 6000 Mason-Montgomery Rd., Mason, Ohio.** The room occupancy is good for 100 students comfortably with tables and chairs. There are provisions for audio-visual equipment (screen, microphone, and speakers). Restrooms are located nearby the room for females and males. Refreshments are served during the morning. Duration of the instruction is 7.5 hours. 7:30am – 4:00pm.

Course Materials

Every attendee is responsible for bringing an edition of the 2017 and 2020 NEC. The instructors will also have on hand the necessary references to answer questions about other codes or standards. Most of the presentations are on a slide-format (Power Point).

Analysis of Changes-2017 NEC





4

Code-Wide Changes: (5) New Articles

Article 425 Fixed Resistance and Electrode Industrial Process Heating Equipment. This article covers fixed industrial process heating employing electric resistance or electrode heating technology (boilers, electrode boilers, duct heaters, strip heaters, immersion heaters, process air heaters, or other approved fixed electric equipment used for industrial process heating).

Article 691 Large-Scale Photovoltaic (PV) Electric Power Production Facility. This article covers the installation of large-scale PV electric power production facilities operated for the sole purpose of providing electric supply to a system operated by a regulated utility for the transfer of electrical energy with a generating capacity of no less than 5,000 kW (generating stations, substations, associated generator, storage battery, transformer, and switchgear areas).

Article 706 Energy Storage Systems . This article applies to all permanently installed energy storage systems (ESS) operating at over 50 volts ac or 60 volts dc that may be stand-alone or interactive with other electric power production sources.

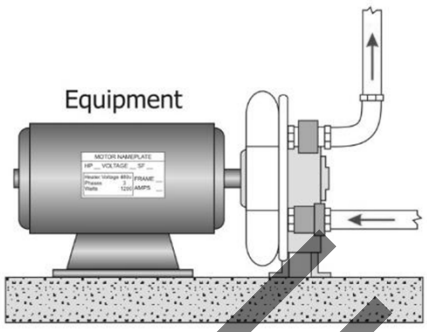
Article 710 Stand-Alone Systems. This article covers electric power production sources operating in stand-alone mode.

Article 712 Direct Current Microgrids (DC Microgrids). This article applies to direct current microgrids, which is a power distribution system consisting of more than one interconnected dc power sources, supplying dc-dc converters(s), dc loads(s), and/or ac loads(s) powered by dc-ac inverters(s).

10

Article 100 Definitions: Building and Structure

Building



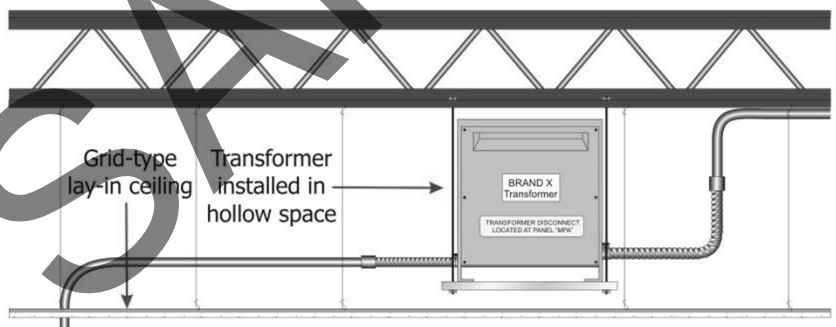
Structure

Building - A structure that stands alone or that is ~~cut off~~ separated from adjoining structures by fire walls ~~with all openings therein protected by approved fire doors~~.

Structure - That which is built or constructed, other than equipment.

24

110.26(A)(4) Limited Access Working Space



Equipment installed above a lay-in ceiling to have accessible opening not smaller than 22 in. × 22 in. *(crawl space, not smaller than 22 in. × 30 in.)*

Width of working space to be width of the equipment enclosure or a minimum of 30 in., whichever is greater

Table 110.26(A)(1) depth requirements to apply in front of enclosure

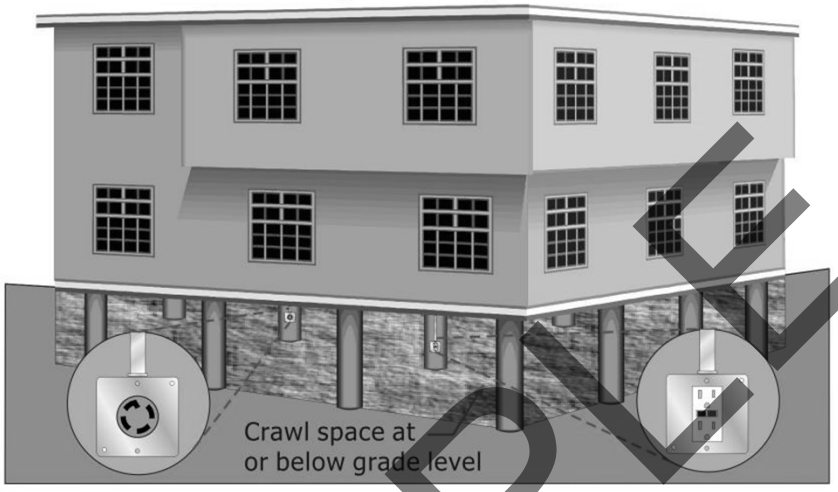
Height of the working space to be the height necessary to install the equipment in the limited space

Horizontal ceiling structural member/access panel permitted in space

52

210.8(B)(9) GFCI for Non-Dwelling Unit *(Commercial, Industrial)* Crawl Spaces

All single-phase receptacles (150 volts to ground or less, 50 amperes or less) and three-phase receptacles (150 volts to ground or less, 100 amperes or less) installed in non-dwelling unit crawl spaces requires GFCI protection



78

Table 240.6(A) Standard Ampacity Ratings for Fuses and Inverse Time Circuit Breakers

The standard ampere ratings for fuses and inverse time circuit breakers shall be considered as shown in Table 240.6(A)

15	20	25	30	35
40	45	50	60	70
80	90	100	110	125
150	175	200	225	250
300	350	400	450	500
600	700	800	1000	1200
1600	2000	2500	3000	4000
5000	6000			

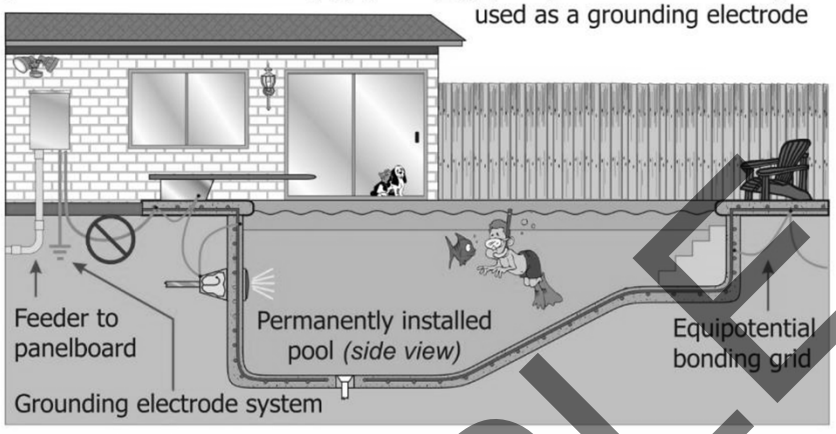
Additional standard ampere ratings for fuses shall be 1, 3, 6, 10, and 601

The use of fuses and inverse time circuit breakers with nonstandard ampere ratings shall be permitted

138

250.52(B)(3) Not Permitted for Use as Grounding Electrodes

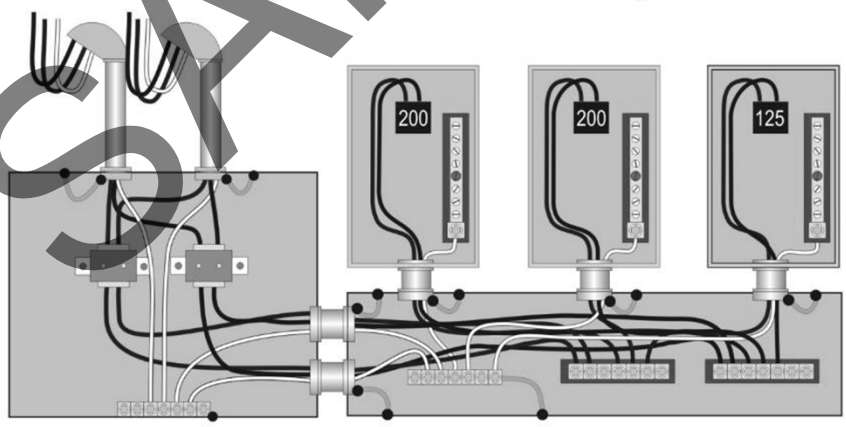
The structures and structural reinforcing steel of an in-ground swimming pool as described in 680.26(B)(1) and (B)(2) are prohibited from being used as a grounding electrode



The provisions of 680.26 for equipotential bonding are to reduce voltage gradients *(difference of voltage potential between two conducting objects)*, not to establish a grounding electrode system for a building or structure

154

250.102 Grounded Conductor, Bonding Conductors and Jumpers



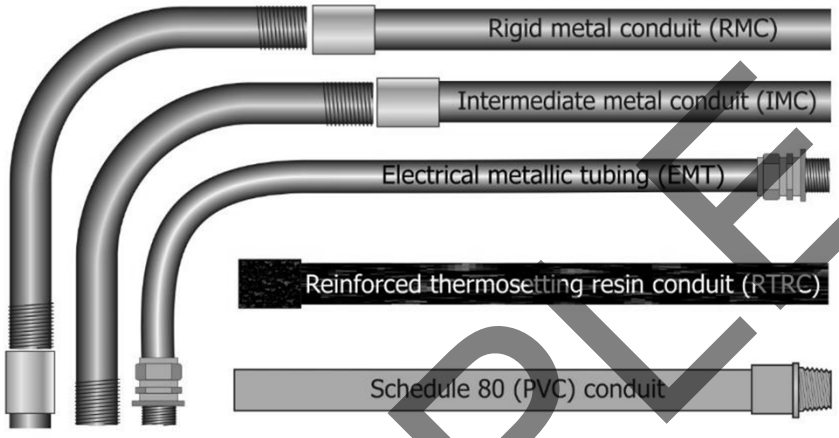
Grounded conductors, bonding conductors, and bonding jumpers of copper, aluminum, copper-clad aluminum, or other corrosion-resistant material are to be sized in accordance with 250.102 and Table 250.102(C)(1)

Supply-side bonding jumpers installed in parallel in two or more raceways or cables to comply with 250.102(C)(2)

166

300.5(D)(4) Protection from Physical Damage

Where direct-buried conductors and cables are installed in enclosures or raceways and are subject to physical damage, electrical metallic tubing (EMT), rigid metal conduit (RMC), intermediate metal conduit (IMC), reinforced thermosetting resin conduit (RTRC) (Type RTRC-XW), Schedule 80 rigid polyvinyl chloride (PVC) conduit, or equivalent is allowed to be used to provide protection from physical damage

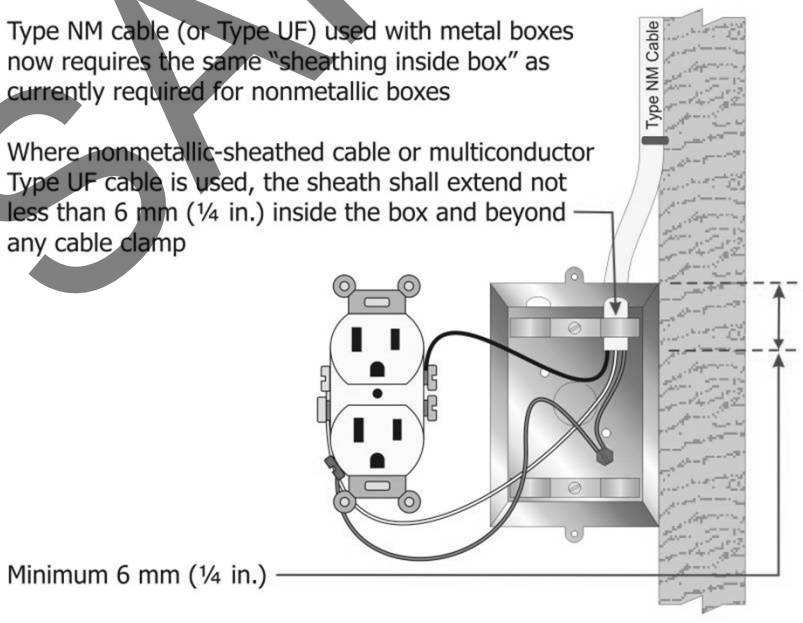


182

314.17(B) Type NM Cable Entering Metal Boxes

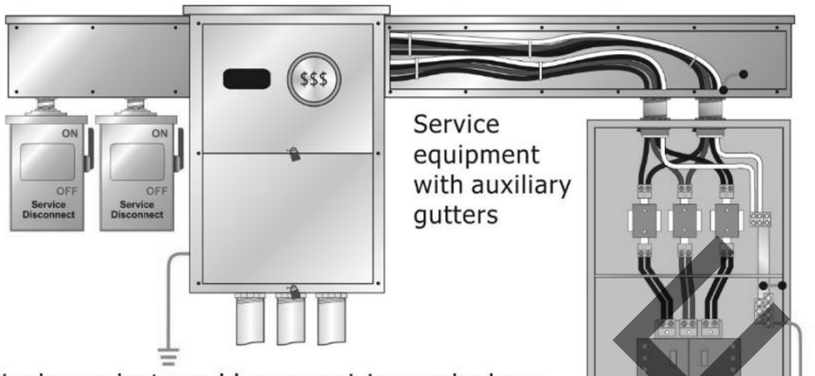
Type NM cable (or Type UF) used with metal boxes now requires the same "sheathing inside box" as currently required for nonmetallic boxes

Where nonmetallic-sheathed cable or multiconductor Type UF cable is used, the sheath shall extend not less than 6 mm (¼ in.) inside the box and beyond any cable clamp



201

366.20 Parallel Conductors in Auxiliary Gutters



Service equipment with auxiliary gutters

Single conductor cables comprising each phase, neutral, or grounded conductor of an ac circuit are permitted to be connected in parallel

Conductors to be installed in groups consisting of not more than one conductor per phase, neutral, or grounded conductor to prevent current imbalance in the paralleled conductors due to inductive reactance

226

404.2(C) Grounded Conductor at Switch Locations

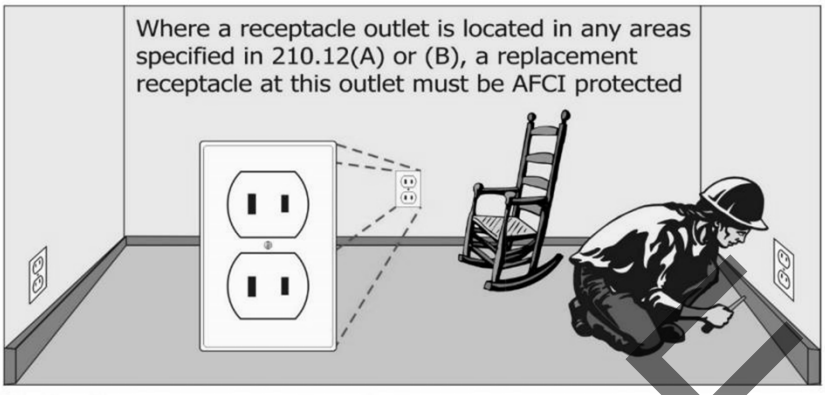
A grounded conductor is generally required to be installed and connected to the switching device at locations where switches control lighting loads that are supplied by a grounded general-purpose branch circuit

Grounded conductor is generally **NOT** required at the following locations:

Where multiple switch locations control the same lighting load such that the entire floor area of the room or space is visible from the single or combined switch locations, the grounded circuit conductor shall only be required at one location

233

406.4(D)(4) Replacement Receptacles (AFCI)



Ex. No. 1: AFCI protection not required where all of the following apply:

(1) Replacement complies with 406.4(D)(2)(b) *(two-wire system-GFCI)*

(2) Impracticable to provide an EGC as provided by 250.130(C)

(3) Listed combination type AFCI circuit breaker not commercially available

(4) GFCI/AFCI dual function receptacles not commercially available

Ex. No. 2: Exception at 210.12(B) shall not apply to replacement of receptacles

248

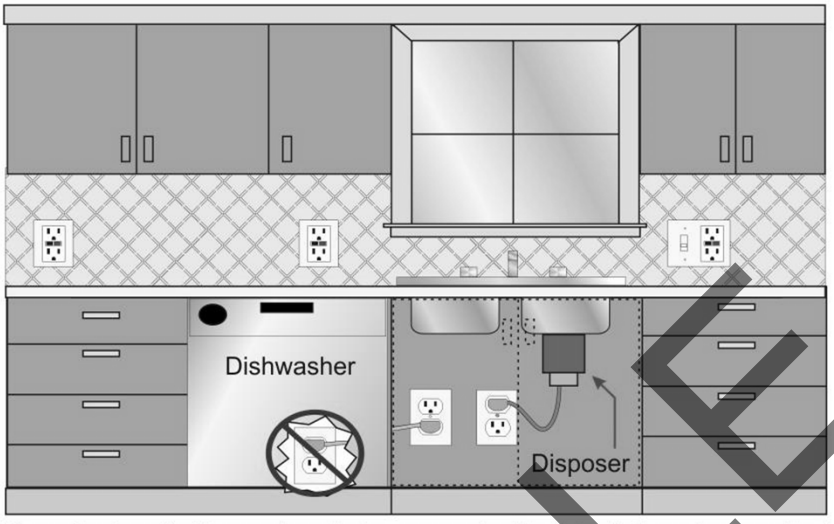
406.12 Tamper-Resistant Receptacles

All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles in areas specified in 406.12(1) through (7) must be listed tamper-resistant receptacles: (1) Dwelling units in all areas specified in 210.52 and 550.13; (2) Guest rooms and guest suites of hotels and motels; (3) Child care facilities

Tamper-resistant receptacle requirements have been expanded to include: all areas specified in 550.13 at mobile and manufactured homes

260

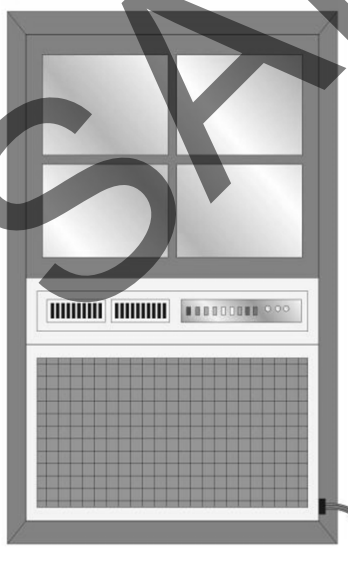
422.16(B)(2) Built-In Dishwashers



Receptacle outlet for cord-and-plug connected built-in dishwasher required to be located in the space adjacent to the space containing the dishwasher only with the length of a cord for a built-in dishwasher lengthened from 1.2 m (4 ft) to 2.0 m (6½ ft)

296

440.65 Protection Devices for Room AC Units

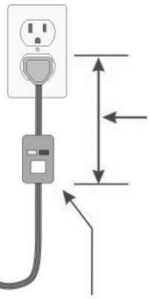


Single-phase cord- and plug-connected room air conditioners shall be provided with one of the following factory-installed devices:

(1) Leakage-current detector-interrupter (LCDI)

(2) Arc-fault circuit interrupter (AFCI)

(3) Heat detecting circuit interrupter (HDCI)



LCDI, AFCI, or HDCI to be located within 300 mm (12 in.) of attachment plug

The protection device shall be an integral part of the attachment plug or be located in the power supply cord within 300 mm (12 in.) of the attachment plug

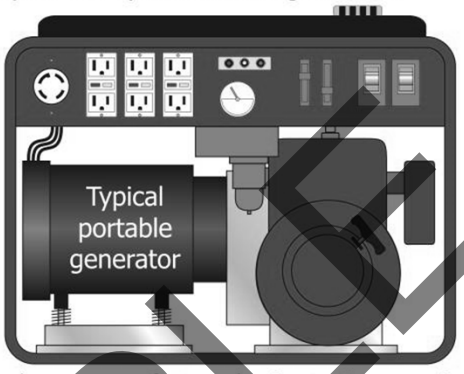
332

445.20 GFCI Protection for Receptacles on 15-kW or Smaller Portable Generators

Receptacle outlets that are a part of a 15-kW or smaller portable generator shall have listed GFCI for personnel integral to the generator or receptacle

445.20(A): Unbonded (floating neutral) generators with both 125-volt and 125/250-volt receptacle outlets require GFCI protection integral to the generator or receptacle on all 125-volt and 15- and 20-ampere receptacle outlets

See exception where the 125-volt receptacle outlets(s) is interlocked such that it is not available for use when any 125/250-volt receptacle(s) is in use)



If the generator was manufactured or remanufactured prior to January 1, 2015, listed cord sets or devices incorporating listed GFCI protection for personnel identified for portable use shall be permitted

342

500.5(A) ~~Classifications of Locations~~ General

The title of 500.5(A) was changed to "General" as it applies to all of 500.5

Refrigerant machinery rooms containing ammonia refrigeration may be classified as "unclassified" locations based on the use of gas detection and adequate ventilation *(concentration not exceeding 150 ppm)*

Class I, II, and III Locations and Groups

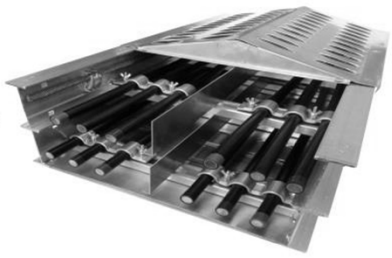
Substance	Gas	Dust	Fibers/Flyings
Class	Class I [500.5(B)]	Class II [500.5(C)]	Class III [500.5(D)]
Division 1 (Normally Hazardous)	Flammable or combustible concentrations exist under normal operating conditions	Group E, Groups F & G Normally in air in ignitible concentrations	Where they are manufactured
Division 2 (Normally Hazardous)	Confined within closed systems and closed containers	Groups F & G Not normally in air in ignitible quantities	Where they are stored
Groups	A, B, C, and D *NEC* 500.6(A)	E, F, and G *NEC* 500.6(B)	No Groups
NEC Article	501	502	503

10

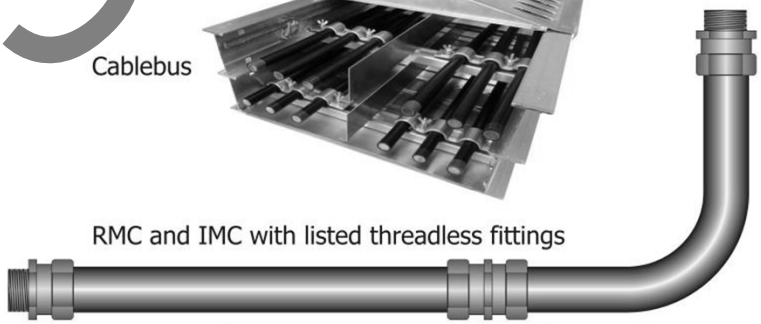
501.10(B)(1) Class I, Division 2

Rigid metal conduit (RMC) and intermediate metal conduit (IMC) with listed threadless fittings have been added to the allowable wiring methods in a Class I, Division 2 location

Cablebus also added to permitted wiring methods in a Class I, Division 2 location



Cablebus

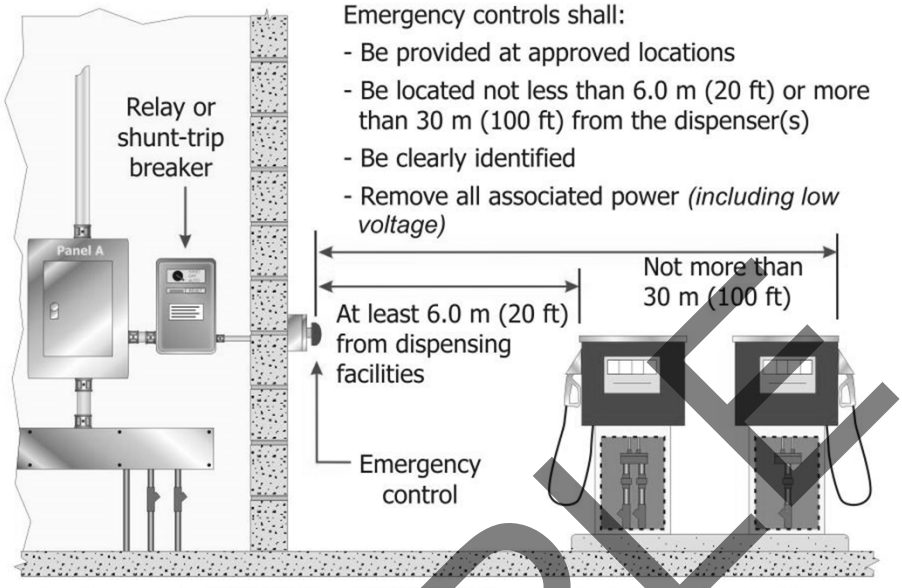


RMC and IMC with listed threadless fittings

Class I, Division 2 location

14

514.11 Emergency Controls for Fuel Dispensers



Applies to both Attended and Unattended motor fuel dispensing facilities

33

517.2 Definitions (Health Care Facilities)

Health Care Facilities. Buildings, portions of buildings, or mobile enclosures in which human medical, dental, psychiatric, nursing, obstetrical, or surgical care are provided. [99: 3.3.67]

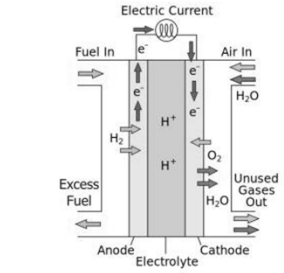
Informational Note: Examples of health care facilities include, but are not limited to, hospitals, nursing homes, limited care facilities, clinics, medical and dental offices, and ambulatory care centers, whether permanent or movable.

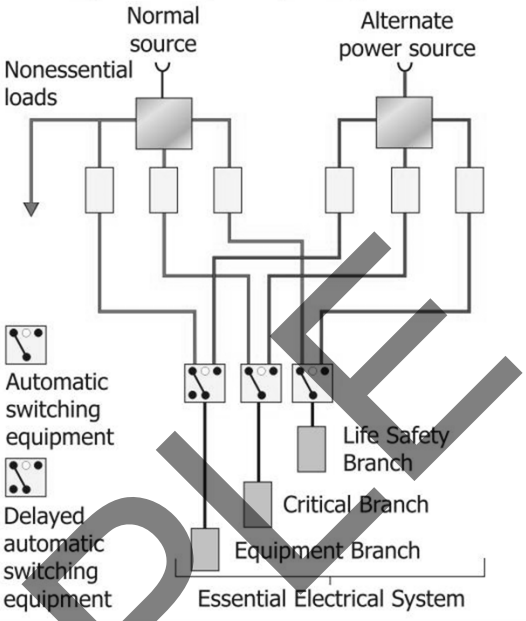
41

517.30(B) Sources of Power
Essential Electrical System (Hospital)

Requirements for two independent sources of power and an alternate source of power for the essential electrical system for hospitals and other health care facilities were revised and relocated to 517.30 *(was 517.35)*

Fuel cell systems will now be permitted to serve as the alternate source for all or part of an essential electrical system

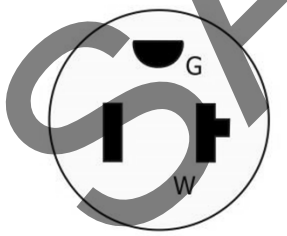




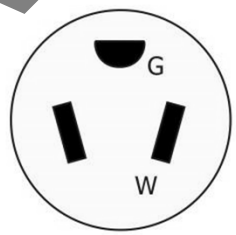
51

551.71 Type Receptacles Provided at RV Parks

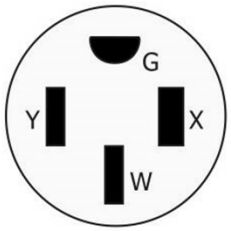
Every RV site (with electrical power provided) must be equipped with a certain number and type of receptacles *[see 551.71(A) through (F)]*



20-A, 125-V, 2-pole, 3-wire, grounding type



30-A, 125-V, 2-pole, 3-wire, grounding type



50-A, 125/250-V, 3-pole, 4-wire, grounding type

551.71 has been broken into six separate first level subdivisions with titles

The number of RV sites required to be equipped with 50-ampere, 125/250-volt receptacles has increased from 20 percent to 40 percent for all new RV sites

GFCI devices used in RV site electrical equipment not required to be weather or tamper resistant in accordance with 406.9 and 406.12

80

555.19(B) GFCI Protection for Personnel

GFCI protection required for all 125-volt, single-phase, 15- and 20-ampere receptacles installed outdoors, in boathouses, and in buildings or structures used for storage, maintenance, or repair regardless of the intended use

The term, "where portable electrical hand tools, electrical diagnostic equipment, or portable lighting equipment are to be used" was deleted

The removal of this portable electrical hand tool, etc. conditional language will aid the AHJ in enforcement of the GFCI requirements at these locations

95

605.9(C) Receptacles at Office Furnishings

An individual office furnishing or groups of interconnected individual office furnishings shall not contain more than (13) 15-ampere, 125-volt receptacles

For purposes of this requirement, a receptacle is considered:
(1) Up to two (simplex) receptacles provided within a single enclosure and that are within 0.3 m (1 ft) of each other or...
(2) One duplex receptacle

128

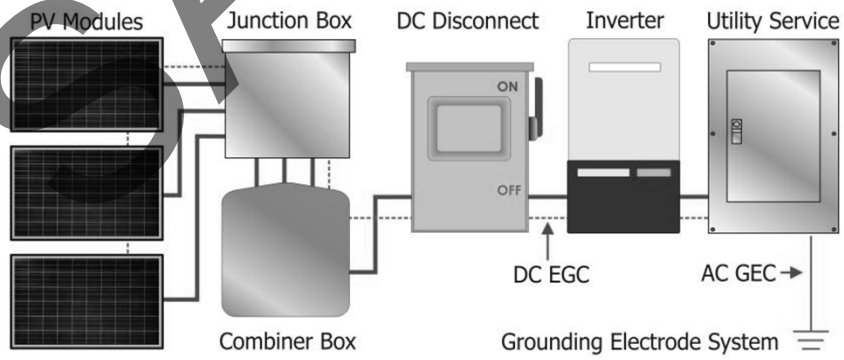
680.2 Definitions - Electrically Powered Pool Lift

Electrically Powered Pool Lift. An electrically powered lift that provides accessibility to and from a pool or spa for people with disabilities.

162

690.2 Definition: Functional Grounded PV System

Functional Grounded PV System. A PV system that has an electrical reference to ground that is not solidly grounded.

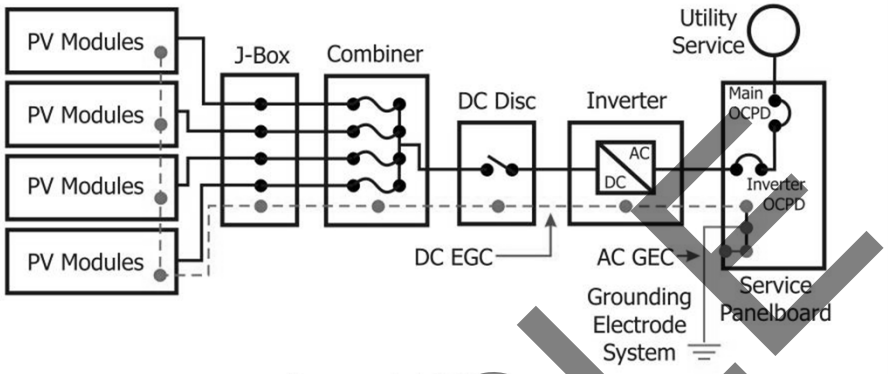


Informational Note: A functional grounded PV system is often connected to ground through a fuse, circuit breaker, resistance device, non-isolated grounded ac circuit, or electronic means that is part of a listed ground-fault protection system. Conductors in these systems that are normally at ground potential may have voltage to ground during fault conditions.

201

690.35 Ungrounded PV System (Deleted)

Provisions for Ungrounded Photovoltaic (PV) Power System have been deleted as the issues and topics previously covered at 690.35 are addressed in other locations within Article 690

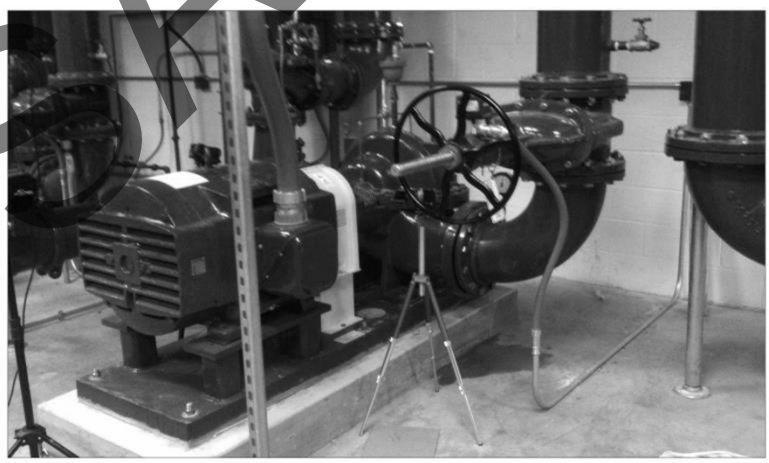


Ungrounded PV System
(now referred to as a Functional Grounded PV System)

224

695.6(G) Fire Pumps (GFP Prohibited)

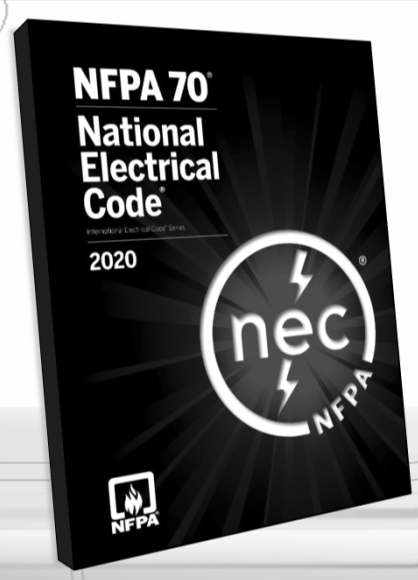
Ground-fault protection of equipment shall not be installed in any fire pump power circuit



Revision changed 695.6(G) from "ground-fault protection of equipment shall not be permitted for fire pumps" to "ground-fault protection of equipment shall not be installed in any fire pump power circuit"

249

Analysis of Changes – 2020 *NEC*



4

New Articles for the 2020 *NEC*

Article 242 Overvoltage Protection (CMP-10) This article provides the general requirements, installation requirements, and connection requirements for overvoltage protection and overvoltage protective devices. Part II covers surge-protective devices (SPDs) permanently installed on premises wiring systems of not more than 1000 volts, nominal, while Part III covers surge arresters permanently installed on premises wiring systems over 1000 volts, nominal.

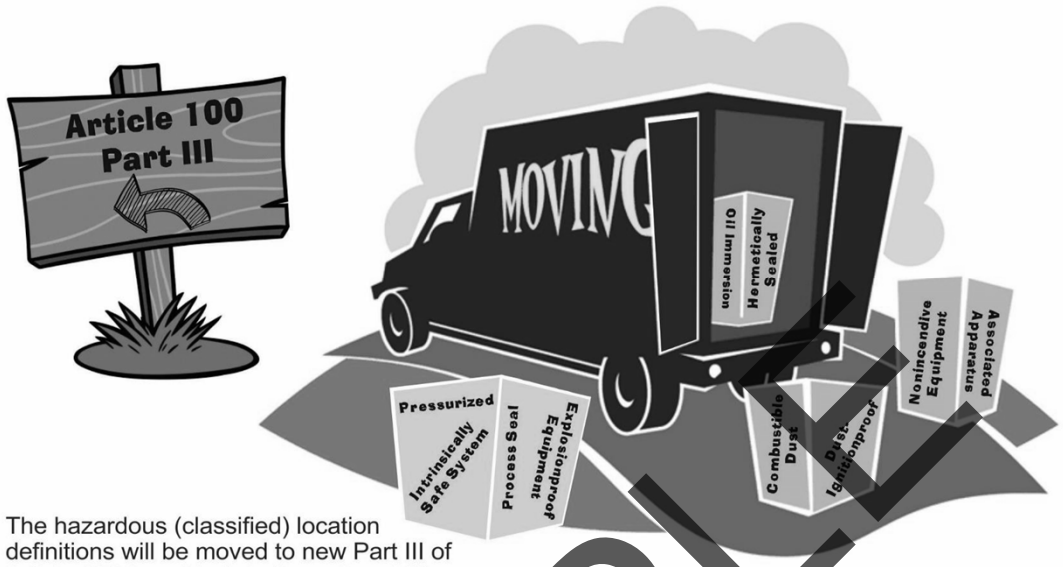
Article 337 Type P Cable (CMP-6) This article covers the use, installation, and construction specifications for up through 2000 volt Type P cable (armored and unarmored). Type P cable is a factory assembly of one or more insulated flexible tinned copper conductors, with associated equipment grounding conductor(s), with or without a braided metallic armor and with an overall nonmetallic jacket.

Article 311 Medium Voltage Conductors and Cable (CMP-6) This article covers the use, installation, construction specifications, and ampacities for Type MV medium voltage conductors and cable. Type MV conductor and cable requirements that were previously found in Articles 310 (Conductors or General Use) and 328 (Medium Voltage Cable) were consolidated into one article.

Article 800 General Requirements for Communications Systems (CMP-16) This article covers general requirements for communications systems. These general requirements apply to communications circuits, community antenna television and radio distribution systems, network-powered broadband communications systems, and premises-powered broadband communications systems, unless modified by Articles 805, 820, 830, and or 840. **[Previous Article 800 (Communication Circuits) is now Article 805]*

10

Article 100 Part III Hazardous (Classified) Locations (CMP-14)

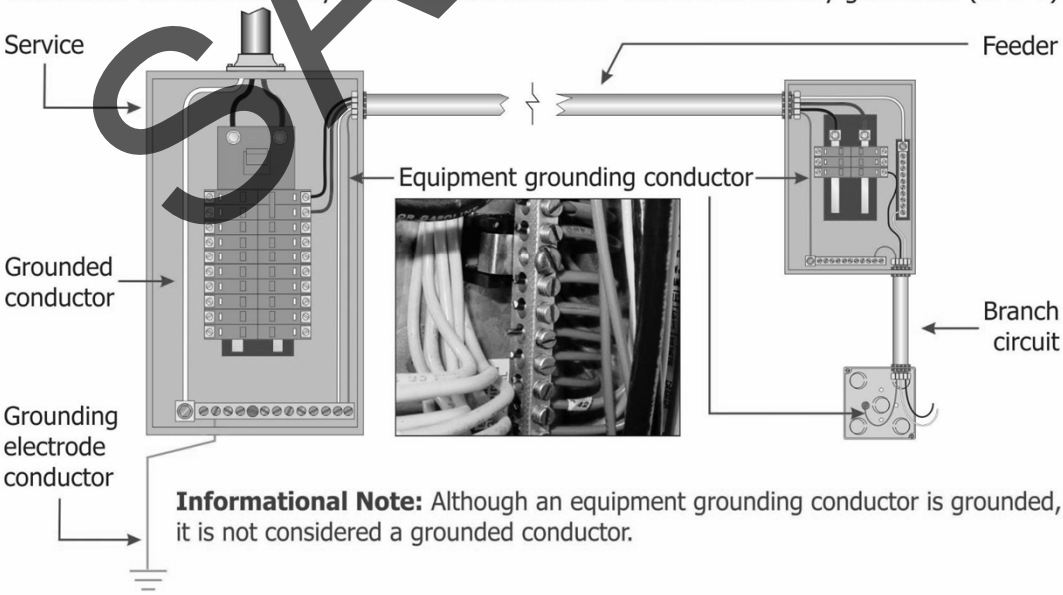


The hazardous (classified) location definitions will be moved to new Part III of Article 100 for added clarity and usability

18

Article 100 Definitions: Grounded Conductor (I-Note)

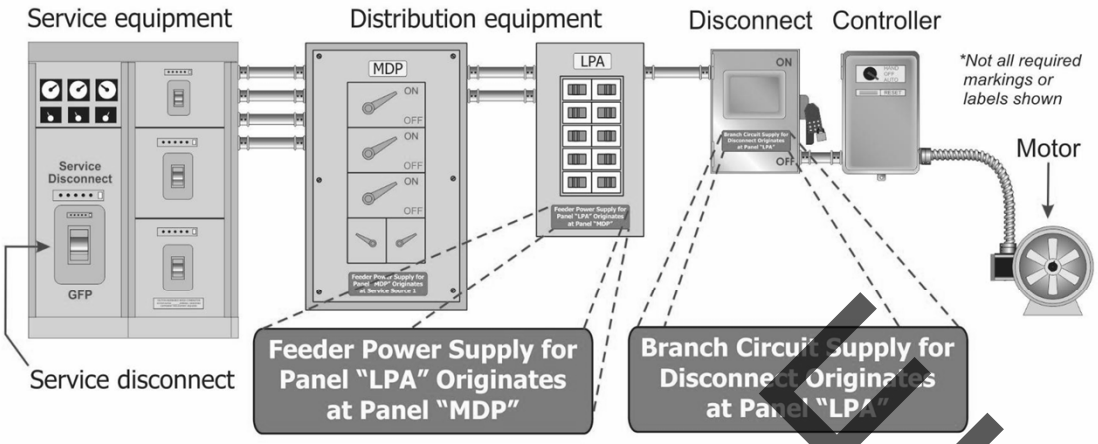
Grounded Conductor. A system or circuit conductor that is intentionally grounded. (CMP-5)



Informational Note: Although an equipment grounding conductor is grounded, it is not considered a grounded conductor.

34

110.22(A) Identification of Disconnecting Means



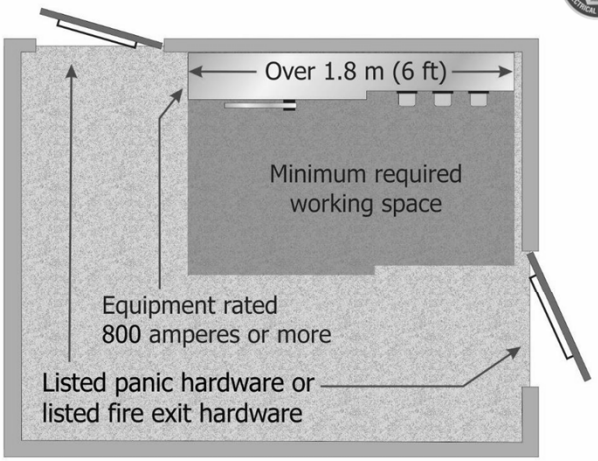
Each disconnecting means shall be legibly marked to indicate its purpose unless located and arranged so the purpose is evident

In other than one- or two-family dwellings, the marking shall include the identification of the circuit source that supplies the disconnecting means

The marking shall be of sufficient durability to withstand the environment involved

52

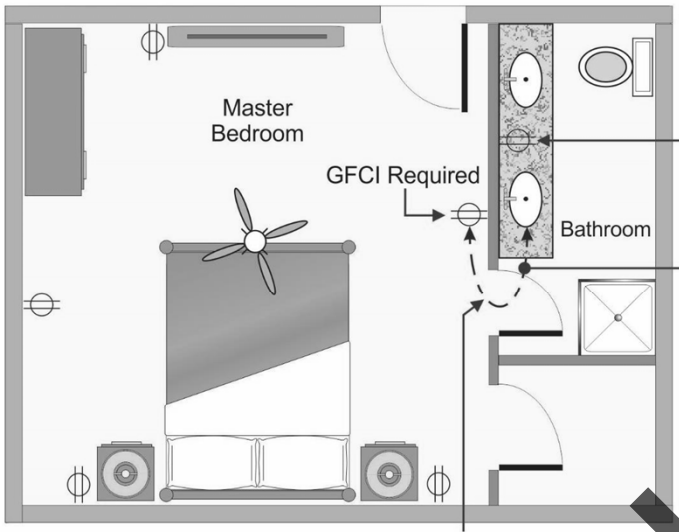
110.26(C)(3) Personnel Doors



Where equipment rated 800 amperes or more that contains overcurrent devices, switching devices, or control devices is installed and there is a personnel door(s) intended for entrance to and egress from the working space less than 7.6 m (25 ft) from the nearest edge of the working space, the door(s) shall open in the direction of egress and be equipped with listed panic hardware or listed fire exit hardware.

56

210.8 Measurements for GFCI Protection



When determining if GFCI protection for personnel is required and a measurement is involved, the distance from a receptacle is required to be measured as the shortest path the supply cord of an appliance connected to the receptacle would follow without piercing a floor, wall, ceiling, or fixed barrier, or the shortest path without passing through a ~~door, doorway, or~~ window *[210.8]*

64

Table 220.12 General Lighting Loads by Non-Dwelling Occupancy *(Part 1)*

Type of Occupancy	Unit Load Volt-amperes/m^2	Unit Load Volt-amperes/ft^2
Automotive facility	16	1.5
Convention Center	15	1.4
Courthouse *(was Courtrooms)*	15 ~~22~~	1.4 ~~2.0~~
Dormitory	16	1.5
Exercise center	15	1.4
Fire station	14	1.3
Gymnasium[a] *(was Armories and auditoriums)*	18 ~~11~~	1.7 ~~1.0~~
Health care clinic *(was Hospitals)*	17 ~~22~~	1.6 ~~2.0~~
Hospital	17	1.6
Hotels and motels, including apartment houses without provisions for cooking by tenants[b]	18 ~~22~~	1.7 ~~2.0~~
Library	16	1.5
Manufacturing facility[c] *(was Industrial commercial (loft) bldg)*	24 ~~22~~	2.2 ~~2.0~~
Motion picture theater	17	1.6
Museum	17	1.6
Office[d] *(was Office buildings)*	14 ~~39~~	1.3 ~~3.5~~

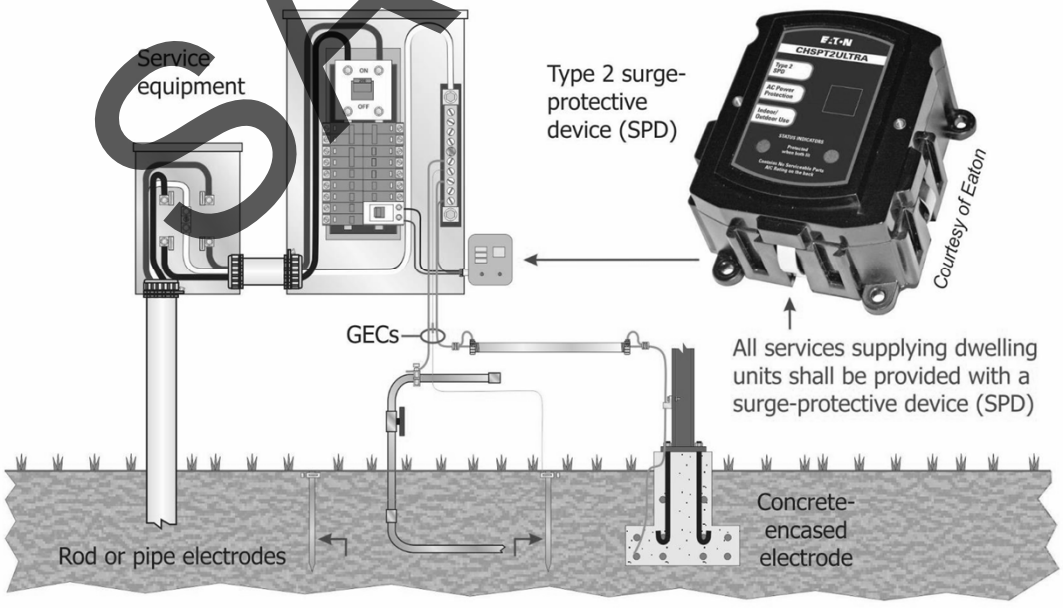
113

Table 220.12 General Lighting Loads by Non-Dwelling Occupancy *(Part 2)*

Type of Occupancy	Unit Load Volt-amperes/m^2	Unit Load Volt-amperes/ft^2
Parking garage[e] *[was Garages-commercial (storage)]*	3 ~~6~~	0.3 ~~0.5~~
Penitentiary	13	1.2
Performing arts theater	16	1.5
Police station	14	1.3
Post office	17	1.6
Religious facility *(was Churches)*	24 ~~11~~	2.2 ~~1.0~~
Restaurant[f] *(was Restaurants and Clubs)*	16 ~~22~~	1.5 ~~2.0~~
Retail[g, h] *(was Barber shops and beauty parlors and Stores)*	20 ~~33~~	1.9 ~~3.0~~
School/university *(was Schools)*	33	3.0
Sports arena	33	3.0
Town hall	15	1.4
Transportation	13	1.2
Warehouse	13 ~~3~~	1.2 ~~0.25~~
Workshop	18	1.7

114

230.67 Surge Protection for Dwelling Units

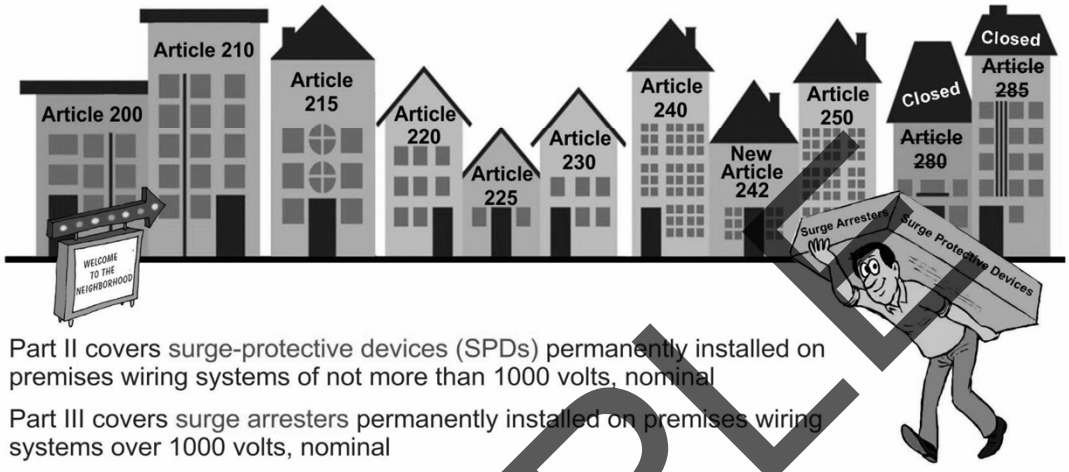


131

Article 242 Overvoltage Protection

New Article 242 added to provide the general, installation, and connection requirements for overvoltage protection and overvoltage protective devices

Relocates previous Articles 280 and 285 into a new Article 242

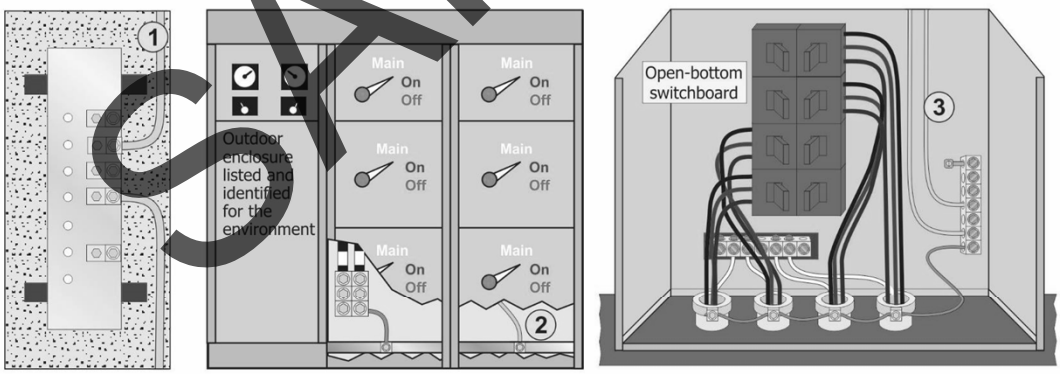


Part II covers surge-protective devices (SPDs) permanently installed on premises wiring systems of not more than 1000 volts, nominal

Part III covers surge arresters permanently installed on premises wiring systems over 1000 volts, nominal

147

250.64(A) Aluminum or Copper-Clad Aluminum GECs



Grounding electrode conductors (GEC) of bare, covered, or insulated aluminum or copper-clad aluminum shall comply with the following:

1. Bare or covered GECs ***not permitted*** to be installed where subject to corrosive conditions or be installed in direct contact with concrete *(without an extruded polymeric covering)*
2. Terminations made within outdoor enclosures that are listed and identified for the environment are ***permitted*** within 450 mm (18 in.) of bottom of the enclosure
3. Aluminum or copper-clad aluminum GECs installed external to buildings or equipment enclosures ***not permitted*** to be terminated within 450 mm (18 in.) of the earth

152

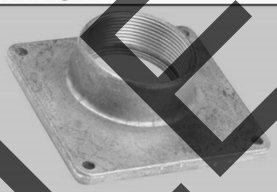
300.4(G) Protection Against Physical Damage - ~~Insulated~~ Fittings

Where raceways contain 4 AWG or larger insulated circuit conductors, and conductors enter a cabinet, a box, an enclosure, or a raceway, conductors shall be protected by any of the following:

(1) Identified fitting providing a smoothly rounded insulating surface

(2) A listed metal fitting that has smoothly rounded edges

(3) Separation from the fitting or raceway by using an identified insulating material that is securely fastened in place



(4) Threaded hubs or bosses (integral part of cabinet, box, enclosure, or raceway) with smoothly rounded or flared entry

178

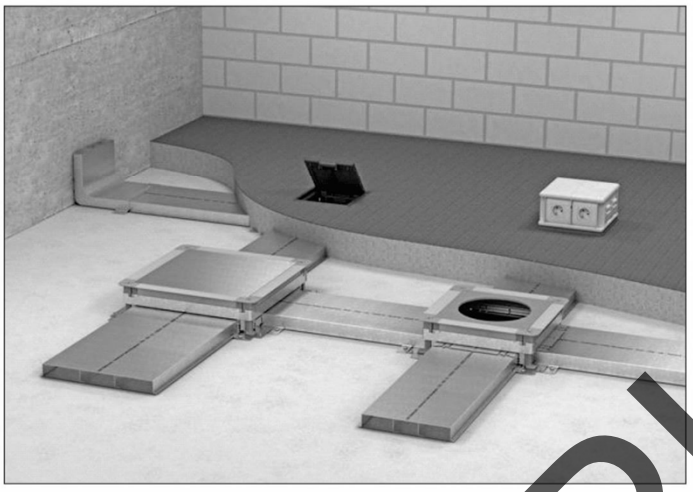
334.2 Nonmetallic-Sheathed Cable - Type NMS Deleted

All references to Type NMS cable has been deleted from Article 334 as this cable construction is no longer manufactured

228

374.6 Listing Requirements for Cellular Metal Floor Raceways

A new 374.6 was added to Article 374 requiring all cellular metal floor raceways to be listed



Cellular Metal Floor Raceway

248

404.9 General-Use Snap Switches, Dimmers, and Control Switches

Faceplates provided for snap switches, dimmers, and control switches mounted in boxes and other enclosures required to be installed so as to completely cover the opening and, where the switch is flush mounted, seat against the finished surface

Metal faceplates are required to be bonded to an equipment grounding conductor (EGC)

Listed kits or listed assemblies are not required to be connected to an EGC if (4) conditions are met, including if the device is provided with a nonmetallic faceplate and the device is designed such that no metallic faceplate replaces the one provided

Snap Switches

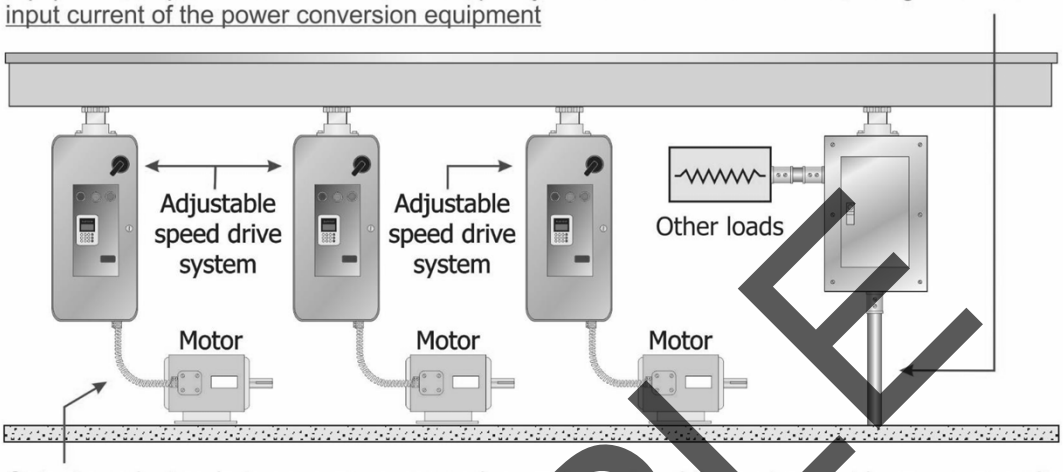
Dimmers

Control Switches

274

430.122(D) Several Motors or Motor(s) and Other Load(s)- Adjustable-Speed Drive Systems With Power Conversion Equipment

Conductors supplying several motors or motor(s) and other load(s), including power conversion equipment, required to have calculated ampacity in accordance with 430.24, using the rated input current of the power conversion equipment



Output conductors between power conversion equipment and the motor must have an ampacity equal to or larger than 125 percent of the motor full-load current (w/ exception) [430.122(B)]

355

445.18(D) Emergency Shutdown Device at Dwelling Units

Can be *(but not required to be)* this

An outdoor emergency generator shutdown device is required for generators installed at one- and two-family dwelling units *(other than cord-and-plug-connected generators)*

366

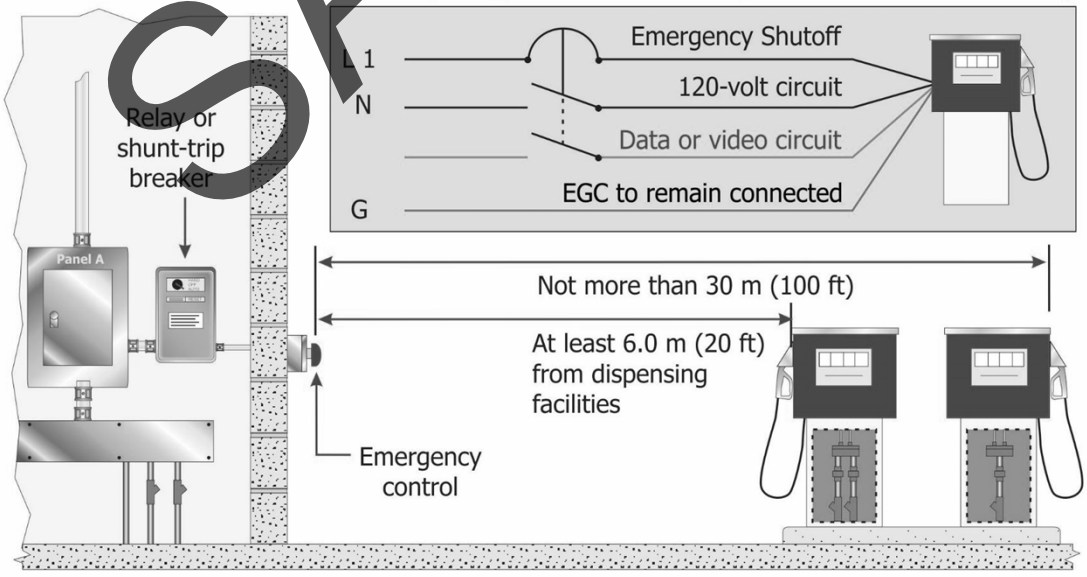
500.7(K) Combustible Gas Detection System

These requirements surrounding a combustible gas detection system as a protection technique were appropriately revised and expanded to provide more sufficient detail to install and operate a gas detection system

8

514.11(A) Emergency Controls for Fuel Dispensers

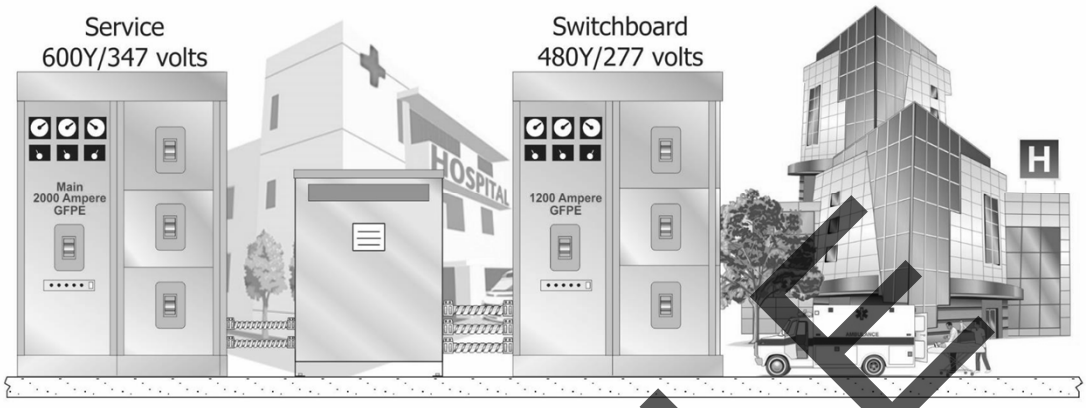
Emergency shutoff device shall disconnect simultaneously from the source of supply, all conductors of the circuits, including the grounded conductor *(EGCs to remain connected)*



26

517.17(D) Performance Testing of GFP Systems at Health Care Facilities

When ground-fault protection of equipment is first installed, each level required to be performance tested to ensure compliance with 517.17(C) *(selectively coordinated)*



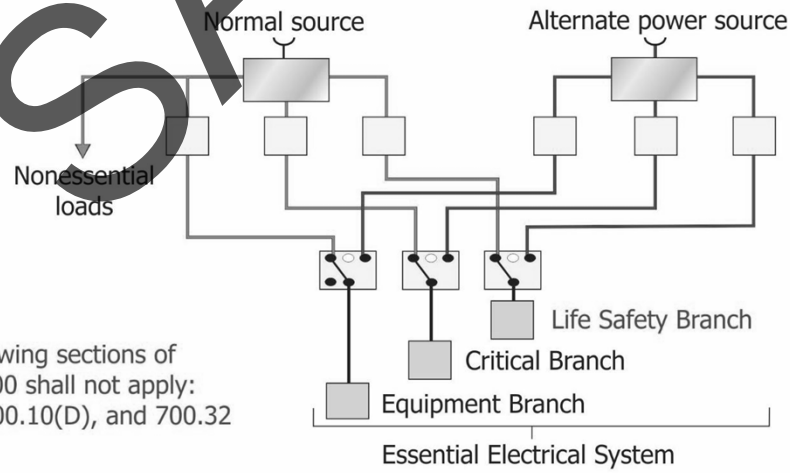
Testing to be conducted by a qualified person(s) using a test process in accordance with the instruction provided with the equipment

Written record of this testing to be kept and made available to the authority having jurisdiction

32

517.26 Application of Other Articles (Health Care Facilities)

Life safety branch of the essential electrical system shall meet the requirements of Article 700, except as amended by Article 517



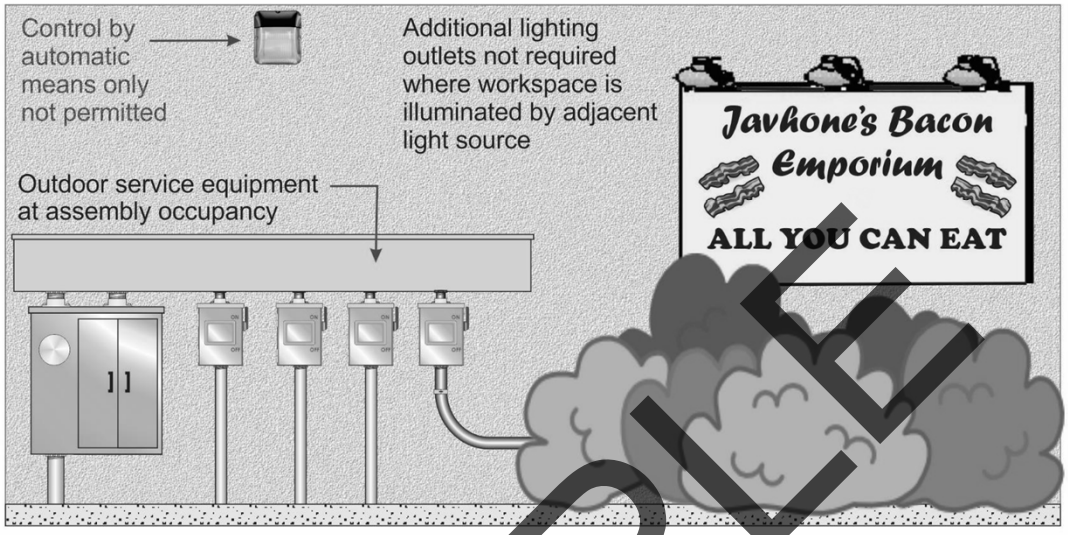
The following sections of Article 700 shall not apply: 700.4, 700.10(D), and 700.32

Branch circuits that supply emergency lighting shall be installed to provide service from a source complying with 700.12 when normal supply for lighting is interrupted or where single circuits supply luminaires containing secondary batteries (amended from 700.17)

35

518.6 Outdoor Illumination - Assembly Occupancies

Illumination required for working spaces about fixed service equipment, switchboards, switchgear, panelboards, or motor control centers installed outdoors that serve assembly occupancies



41

525.20(G) Protection of Flexible Cords or Cables

Flexible cords or cables accessible to the public shall be arranged to minimize tripping hazards

Flexible cords or cables permitted to be covered with nonconductive matting secured to the walkway surface *or* protected with another approved cable protection method

The matting or other protection method cannot constitute a greater tripping hazard than the uncovered cables

48

550.32(E) Supply Receptacles for Mobile or Manufactured Homes

Receptacles located outside mobile or manufactured homes required to be provided with GFCI protection as specified by 210.8(A)

Receptacles providing power to mobile or manufactured homes in accordance with 550.10, are not required to be provided with GFCI protection

62

555.35(B) Leakage Current Measurement Device at Marinas, Etc.

Where more than three receptacles supply shore power to boats, a leakage current measurement device shall be available and be used to determine leakage current from each boat that will utilize shore power

Photo courtesy of Marina Electrical Equipment (MEE)

Leakage current measurement will provide the capability to determine when an individual boat has defective wiring or other problems contributing to hazardous voltage and current

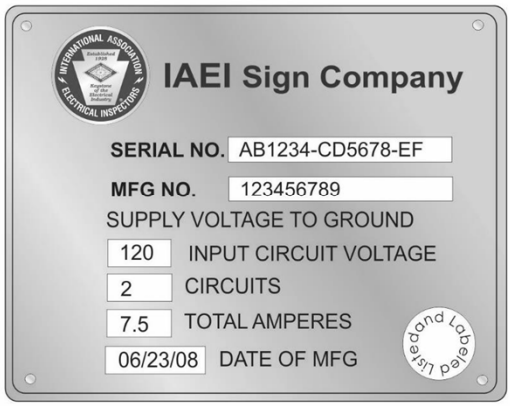
The use of a test device will allow the facility operator to identify a boat that is creating problems

The use of a test device will also help the facility operator prevent a particular boat from contributing to hazardous voltage and current in the marina area

77

600.4(D) Visibility of Markings - Electric Signs and Outline Lighting

Signs and outline lighting systems required to be marked with such things as manufacturer's name, trademark, input voltage and current rating, maximum allowable lamp wattage per lampholder, and other means of identification [600.4(A) and (C)]



Markings and listing labels are required to be visible after installation and must be permanently applied in a location visible prior to servicing

Marking permitted to be installed in a location not viewed by the public

91

600.35 Retrofit Kits

New 600.35 gives specific installation instructions for retrofit kits for signs and outline lighting systems

General-use or sign-specific retrofit kits for sign or outline lighting systems to include installation instructions and requirements for field conversion of a host sign

Retrofit kits shall be listed and labeled

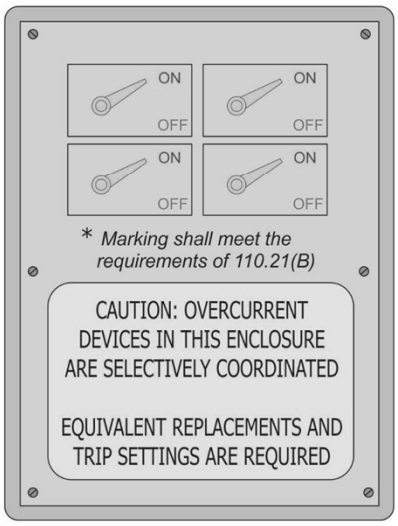
All parts that are not replaced by a retrofit kit shall be inspected for damage

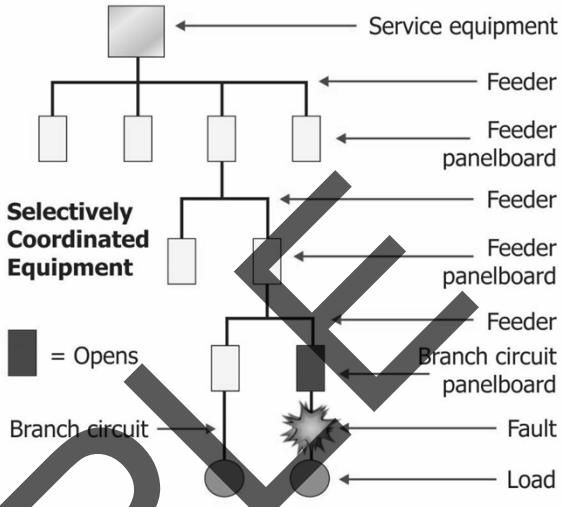
99

620.65 Signage for Selective Coordination

(Elevators, Dumbwaiters, Escalators, Moving Walks, Platform Lifts, and Stairway Chairlifts)

Equipment enclosures containing selectively coordinated overcurrent devices required to be legibly marked in the field to indicate that the overcurrent devices are selectively coordinated

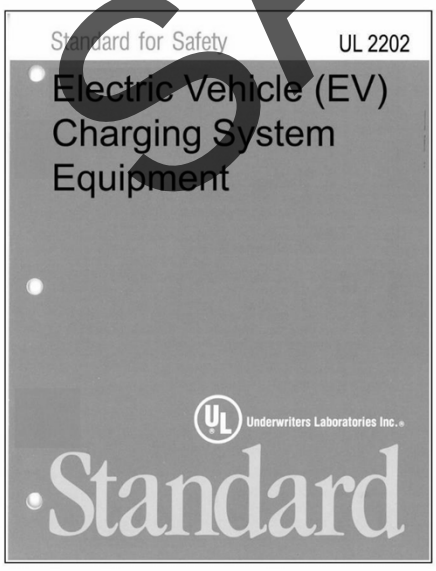


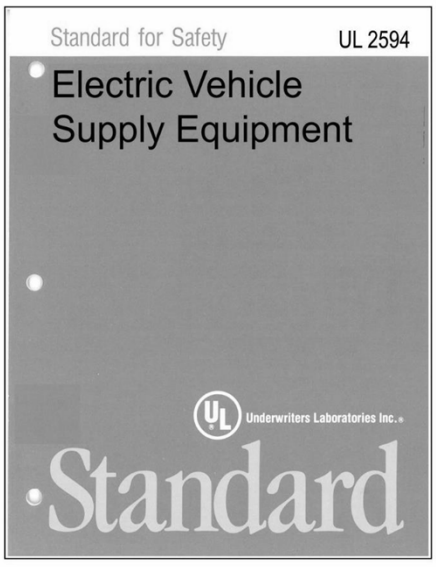


106

Article 625 - Part II EV Equipment Construction

All product construction requirements in Part II of Article 625 addressing product features that are an integral part of the listing requirements for EV product were removed from Article 625





113

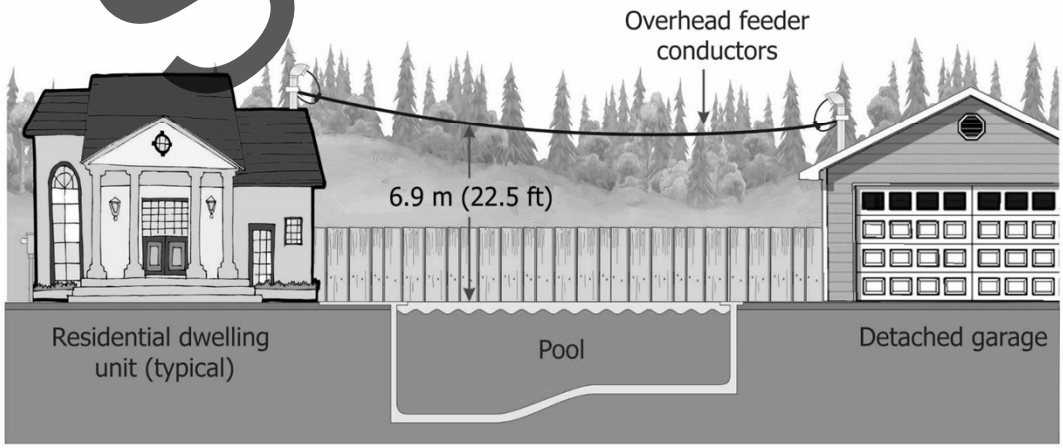
680.2 and 680.14 Corrosive Environments

Corrosive Environment. Areas where pool sanitation chemicals are stored, handled, or dispensed, and confined areas under decks adjacent to such areas, as well as areas with circulation pumps, automatic chlorinators, filters, open areas under decks adjacent to or abutting the pool structure, and similar locations.

131

680.9(A) Overhead Power Conductor Clearances

The minimum clearances for overhead power conductors *(not just service conductors)* from pools, fountains, etc. shall comply with the provisions in Table 680.9(A) for conductors operating at 0 to 750 volts to ground [6.9 m (22.5 ft)] *(typical)*

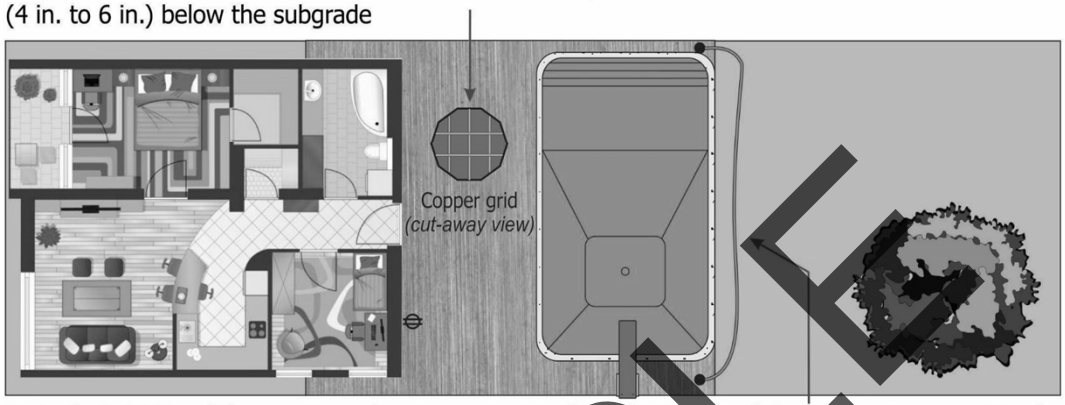


143

680.26(B)(2)(c) Copper Grid for Perimeter Surfaces

Where structural reinforcing steel is not available or encapsulated, an 8 AWG copper grid system is permitted to be utilized arranged in a 300-mm (12-in.) by 300-mm (12-in.) network of conductors in a uniformly spaced perpendicular grid pattern with a tolerance of 100 mm (4 in.)

Required to be secured within or under the deck or unpaved surfaces between 100 mm to 150 mm (4 in. to 6 in.) below the subgrade



A single 8 AWG solid copper conductor or structural reinforcing steel *(rebar or wire mesh)* in the concrete is also permitted as the bonding grid for the perimeter surface

160

690.4(B) PV Equipment Listing and Evaluation

Equipment intended for use in PV systems required to be listed or be evaluated for the application and have a field label applied

- Equipment required to be listed or evaluated:
- Inverters
- Motor generators
- PV modules
- ac modules and ac module systems
- dc combiners
- dc-to-dc converters
- Rapid shutdown equipment
- dc circuit controllers
- Charge controllers

178

690.31 Wiring Methods for Solar Photovoltaic (PV) Systems

690.31 was revised and re-organized for clarity and to bring PV wiring methods for PV source and output circuits to one location

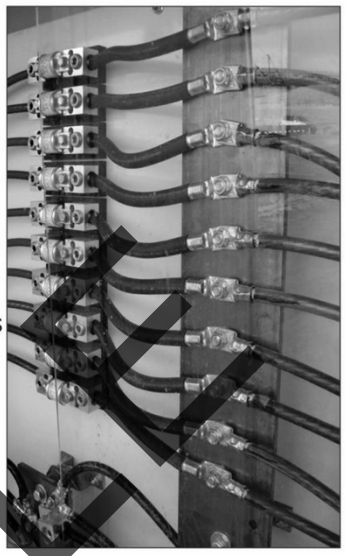
(A) Wiring Systems

(B) Identification and Grouping
- (1) Identification
- (2) Grouping

(C) Cables
- (1) Single-Conductor Cables
- (2) Cable Tray
- (3) Multiconductor Jacketed Cables
- (4) Flexible Cords and Cables Connected to Tracking PV Arrays
- (5) Flexible, Fine Stranded Cables
- (6) Small-Conductor Cables

(D) Direct-Current on or in Buildings
- (1) Flexible Wiring Methods
- (2) Marking and labeling Required

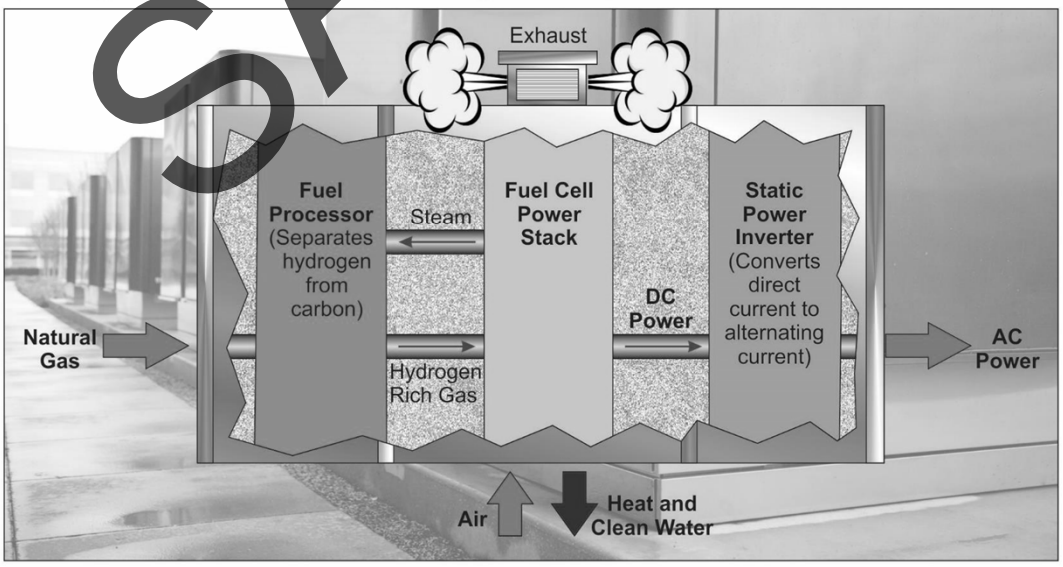
(E) Bipolar Photovoltaic Systems



203

692.4(B) Identification of Power Sources (Fuel Cell Systems)

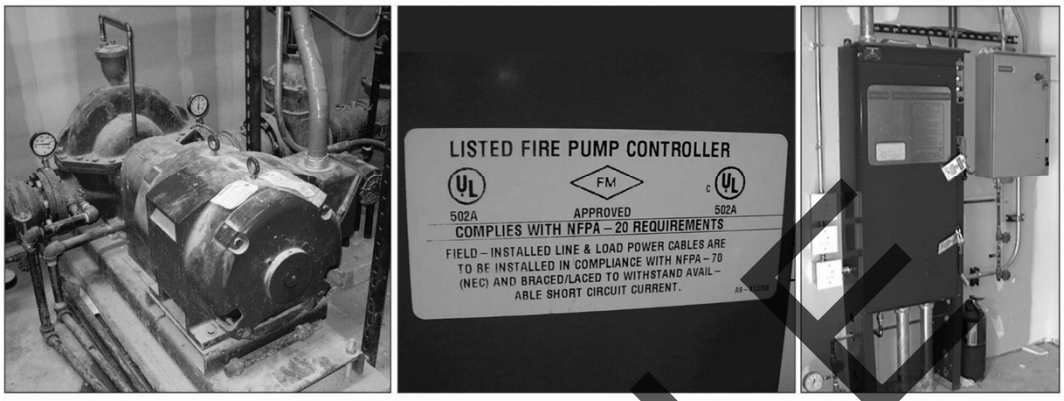
Three separate List Items where created to clearly identify the requirements for different fuel cell system types to add clarity to the placarding of these systems



223

695.3(C)(3) Selective Coordination (Fire Pumps)

Fire pumps in multibuilding campus-style complexes require all overcurrent protective device(s) to be selectively coordinated with all supply-side overcurrent protective device(s)

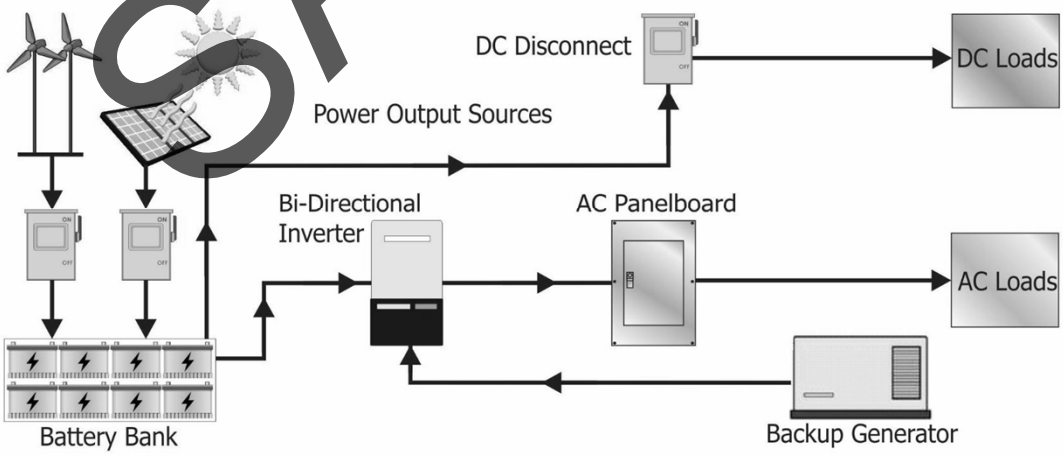


Selective coordination required to be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems

226

710.15 General Requirements for Stand-Alone Systems

New provisions added to 710.15 to recognize that stand-alone systems can deliver power to three-phase applications as well as single-phase systems

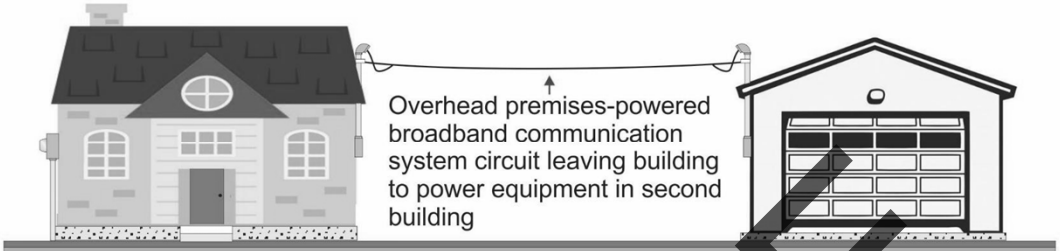


710.15(D): Three-phase Supply. Stand-alone and microgrid systems are permitted to supply three-phase, 3-wire or 4-wire systems

267

840.94 and 840.102 Premises Circuits Leaving the Building

840.94: Requires circuits leaving a building to power equipment remote to that building or outside the exterior zone of protection defined by a 46 m (150 ft) radius rolling sphere, to comply with 805.90 *(Protective Devices)* and 805.93 *(Grounding, Bonding, or Interruption of Non-Current-Carrying Metallic Sheath Members of Communications Cables)*



If coaxial cables are present, required to comply with 820.100 *(Cable Bonding and Grounding) (which references 800.100)* and 800.106

840.102: Requires communications wires and cables circuits leaving the building to power equipment remote to the building or outside the exterior zone of protection defined by a 46 m (150 ft) radius rolling sphere to comply with 800.100 *(Cable and Primary Protector Bonding and Grounding)* and 800.106 *(Primary Protector Grounding and Bonding at Mobile Homes)*

313

File Attachments for Item:

EC-2 Building Enclosures Detailing and Evaluation (Wiss Janney Elstner - OBOA-ODPCA Conference)

BO, MPE, BPE, BI, NRIUI, RBO, RPE, RBI, RIUI (1 hour)

WJE

OBBS CE COURSE OUTLINE AND OBJECTIVES

Host Organization: OBOA / ODPCA Joint Conference

Presentation Forum: In-Person

Presentation Date: November 7, 2021

Anticipated Presentation Duration: 1 Hour

Presenter Name(s): Nathan Gamber, PE and Michael Kotheimer, PE

Presenting Organization: Wiss, Janney, Elstner Associates, Inc.

Session Title: Building Enclosure Detailing and Evaluation

Session Description: The performance of a building enclosure and its ability to resist air and water infiltration is critical to maintaining a healthy interior environment and an energy efficient building. A structure's building enclosure system (i.e. facade, roofing, fenestration, and waterproofing) must meet challenging standards, beginning at the time of design and construction and continuing through its service life. Vulnerabilities in the building enclosure may become exposed, either as a result of deficiencies stemming from original design/construction or normal and expected age related deterioration of building materials. Water infiltration, air leakage, thermal discontinuities, and condensation are four conditions commonly encountered that result in problems ranging from occupant discomfort to moisture-related damage to building enclosure materials and interior finishes. The complexities of modern building enclosure designs, coupled with today's various new and traditional building enclosure materials and methods of construction, present unique challenges for building designers. This presentation will draw on WJE's extensive experience with wall, window, and roofing/waterproofing failure investigations to introduce basic building science concepts and enclosure detailing methods. Several case studies will be presented that to illustrate concepts related to maintaining continuity of the primary building enclosure control layers, such as air, water, thermal, and vapor barriers.

Learning Objectives:

1. **At the end of this presentation, attendees will be able to:** Identify the fundamental building enclosure control layers
2. **At the end of this presentation, attendees will be able to:** Understand requirements outlined in Chapter 13 and 14 of the 2017 Ohio Building code related to energy efficiency and exterior walls
3. **At the end of this presentation, attendees will be able to:** Describe the primary differences and characteristics between air and vapor barriers and identify challenges associated with maintaining continuous insulation
4. **At the end of this presentation, attendees will be able to:** Recognize challenges associated with building enclosure design and construction of exterior wall assemblies, window-to-wall interfaces, parapets, and canopy projections

PERSONNEL QUALIFICATIONS

Michael J. Kotheimer | Senior Associate

EDUCATION

- Ohio University
  - Bachelor of Science, Civil Engineering, 2001
  - Master of Science, Civil Engineering, 2003

PRACTICE AREAS

- Construction Observation and Troubleshooting
- Curtain Wall Systems
- Facade Assessment and Performance Testing
- Leakage Investigation and Field Testing
- Repair and Rehabilitation Design
- Roofing and Waterproofing

REGISTRATIONS

- Professional Engineer in OH

PROFESSIONAL AFFILIATIONS

- American Concrete Institute
- National Institute of Building Sciences - Building Enclosure Council

CONTACT

mkotheimer@wje.com
216.642.2300
www.wje.com

EXPERIENCE

Since joining WJE in 2004, Michael Kotheimer has gained extensive experience on a broad range of projects, including construction observation, condition surveys, field testing, and investigations of new and existing structures. Additionally, Mr. Kotheimer has gained considerable knowledge in the evaluation of the design, construction, and as-built performance of a wide range of above- and below-grade building enclosure materials, components, and systems, including: glazed aluminum windows, curtain walls, and skylights; architectural metal panels; self-adhering and fluid-applied air barrier membranes; clay brick and concrete masonry cavity and mass wall construction; EIFS; and hot and cold fluid-applied, modified bitumen roofing and waterproofing and similar systems. In addition, he has worked with the proper integration of each of these systems at building enclosure interface conditions and has assisted with the development of interface detailing to ensure proper air/moisture barrier continuity and performance.

REPRESENTATIVE PROJECTS

Construction Observation and Troubleshooting

- Constitution Center - Washington, D.C.: Construction of new exterior envelope on existing structure, including curtain wall, metal panels, precast concrete, waterproofing, and roofing
- 1875 Pennsylvania Avenue - Washington, D.C.: On-site construction observation and field testing during installation of new shop-structurally glazed aluminum curtain wall, skylight, metal panels, EIFS, and roofing

Curtain Wall Systems

- Tower II Office Building - Rockville, MD: Construction observation of prefabricated, shop-structurally glazed aluminum curtain wall; quality assurance observation and testing during implementation of repairs
- Charles Center - Baltimore, MD: Evaluation and field testing of glazed aluminum curtain wall to address in-service glass displacement and leakage

Facade Assessment

- Self Regional Hospital - Greenfield, SC: Building-wide envelope evaluation, including curtain wall, metal panels, and roofing
- 1111 Eleventh Street - Washington, D.C.: Building-wide envelope evaluation, including masonry, through-wall flashing, and punched windows

Leakage Investigation and Field Testing

- 1101 K Street - Washington, D.C.: Leakage investigation of below-grade waterproofing and roofing
- Old Chinese Legation Building - Washington, D.C.: Leakage investigation of facade and roofing

Repair and Rehabilitation Design

- Blair House - Silver Spring, MD: Masonry facade stabilization and development of repair documents for roof replacement
- 1210 Massachusetts Avenue - Washington, D.C.: Facade and terrace waterproofing remediation

Roofing and Waterproofing

- Monument IV Office Building - Reston, VA: Quality assurance observations during reroof repairs
- Marriott Wardman Park Garage - Washington, D.C.: Construction observation and quality assurance testing of below-grade and plaza waterproofing
- House of Sweden - Washington, D.C.: Evaluation and repair design to address water loss in interior reflecting pool

PERSONNEL QUALIFICATIONS

Nathan K. Gamber | Senior Associate

EDUCATION

- Ohio University
  - Bachelor of Science, Civil Engineering, 2001
  - Master of Science, Civil Engineering, 2004

PRACTICE AREAS

- Facade Assessment
- Construction Observation Services
- Repair and Rehabilitation Design
- Water Penetration Testing
- Peer Review
- Building Enclosure Commissioning
- Curtain Wall Systems
- Roofing and Waterproofing

REGISTRATIONS

- Professional Engineer in OH

PROFESSIONAL AFFILIATIONS

- Building Enclosure Council - Cleveland Chapter, co-chair

CONTACT

ngamber@wje.com
216.642.2300
www.wje.com

EXPERIENCE

Nathan Gamber has extensive experience in building enclosure condition assessments, design peer reviews, field testing, investigations of new and existing structures, and repair design for various building types to address moisture-related deterioration of above- and below-grade building enclosure materials, components, and systems. Since joining WJE in 2005, he has also been actively involved in construction observation of numerous high-rise multifamily residential buildings, medical facilities, and museums, including preconstruction mock-up performance testing, design refinement, and field quality assurance services. Mr. Gamber has knowledge of a wide range of building enclosure components and systems that comprise curtain walls and other aluminum window cladding components, skylights, metal wall panels, brick masonry, air and vapor barriers, and roofing systems. He has also contributed to the investigation of several moisture-related roof system failures and to the investigation and design of a new, multi-ply modified bitumen roof assembly for a high-rise structure.

REPRESENTATIVE PROJECTS

Facade Assessment

- Ritz Carlton Hotel - Cleveland, OH: Facade condition assessment and water infiltration testing of precast panels and fenestration systems
- Ohio State University, 700 Ackerman Road - Columbus: Facade condition assessment and water infiltration testing of brick masonry, cavity flashings, single-ply roofing, and fenestration systems
- 500 East Main Street - Columbus, OH: Evaluation of water infiltration at fenestration and masonry systems
- Decker Engineering Building - Corning, NY: Condition assessment and water infiltration testing of custom skylight system
- UPMC Sports Performance Complex - Pittsburgh, PA: Water penetration testing of aluminum curtain wall and polycarbonate glazing systems
- Ohio State University, Longaberger Alumni House - Columbus: Investigation of water leakage through aluminum curtain walls and building enclosure air leakage testing

Repair and Rehabilitation Services

- Cleveland Museum of Art - OH: Condensation investigation of exterior gallery walls and investigation of rainwater penetration into below-grade interior space, leading to development of repair contract documents for plaza waterproofing systems
- The Carlyle on the Lake - Lakewood, OH: Building-wide fenestration assessment, water infiltration testing, development of window replacement contract documents, field quality assurance observations, and field testing of repairs
- Ohio State University, Davis Heart and Lung Research Institute - Columbus: Investigation of rainwater penetration through an aluminum curtain wall system, metal wall panels, and brick masonry, development of sealant repair contract documents, construction observation, and quality assurance field testing of repairs
- Mylan Building - Canonsburg, PA: Investigation of rainwater penetration, construction observation, and quality assurance field testing of brick masonry cavity flashing repairs at window heads
- Lubrizol Headquarters - Wickliffe, OH: Evaluation of water leakage through curtain walls and development of curtain wall rehabilitation contract documents

Peer Review and Commissioning

- Corning Museum of Glass - Corning, NY: Construction observation and quality assurance field testing of building envelope, including custom glass rain screen and skylight systems, air and vapor barriers, curtain walls, and roofing systems
- UPMC East - Monroeville, PA: Peer review, construction observation, and quality assurance field testing of aluminum curtain wall, metal wall panel, and brick masonry systems, including interface detailing of cladding components
- Dayton Children's Hospital - Dayton, OH: Peer review, construction observation, roof systems value engineering support, and quality assurance field testing of aluminum curtain wall, skylight, brick masonry, air and vapor barrier, and roofing systems, including interface detailing of cladding components

CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

Instructors: Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications for which the BBS has approved the class, and fees in promotion materials and advertising. ***The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising***. Advertising shall not disclose improper approval information to the public.

Course sponsors/co-sponsors: provide participants a certificate of completion containing the following information: name of participant, title of approved courses, BBS approval #, BBS approved certifications, date of the continuing education program, number of approved credit hours awarded and signature of authorized sponsor or instructor.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

Participants: Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

Board approval: Remains in effect through the calendar year of approval. The course may be renewed administratively by sponsor application in subsequent years so long as it references current codes and standards Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

Facility/training area: Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

APPLICATION

FOR

Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.

Board of Building Standards
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax: (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: Nathan Gamber (Contact Name)
Organization: Wiss, Janney, Elstner Associates (Organization/Company)
Address: 9655 Sweet Valley Drive (Include Room Number, Suite, etc.)
City: Cleveland State: Ohio Zip: 44125
E-Mail: Ngamber@wje.com
Telephone: 216-642-2300 Fax: _____
Course Sponsor: WJE

COURSE INFORMATION: The performance of a building enclosure and its ability to resist air and water infiltration is critical to maintaining a healthy interior environment and an energy efficient building. This presentation will draw on WJE's extensive experience with wall, window, an

Course Title: Building Enclosure Detailing and Evaluation

New Course Submittal: ■ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective: Provide building code information on energy efficiency and exterior wall systems and chapter 13 and 14 OBC code requirements
Identify the fundamental building enclosure control layers, such as air, water, thermal, and vapor barriers
Describe the primary differences and characteristics between air and vapor barriers and identify challenges associated with maintaining continuous insulation
Recognize challenges associated with building enclosure design and construction of exterior wall assemblies, window-to-wall interfaces, parapets, and canopy projections
Review case studies related to exterior wall, window, and roofing/waterproofing failure investigations

Number of Instructional Contact Hours that can be obtained upon completion: (1) hour

If Multi-Session, Number of Instructional Contact Hours Per Session: _____

Program Applicable for the Following Participants:

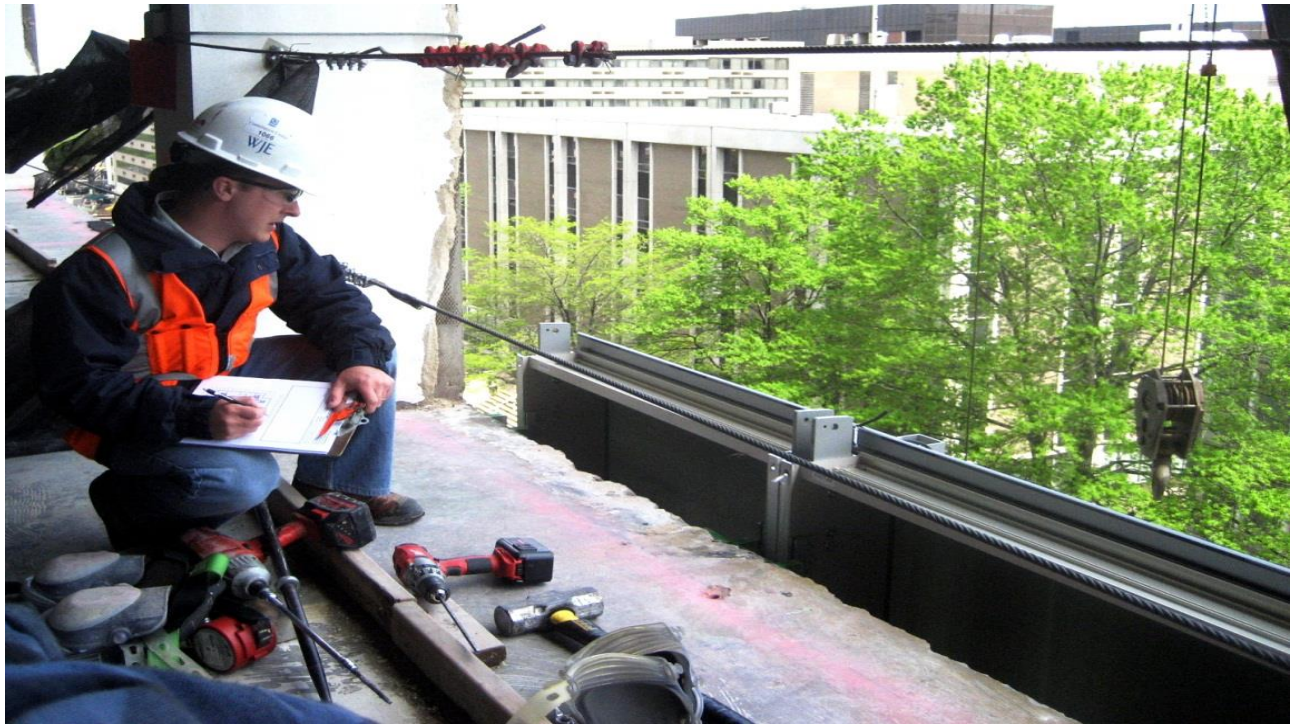
Building Official ■	Master Plans Examiner ■	Building Inspector ■	Fire Protection Inspector ☐	Mechanical Inspector ☐	
	Building Plans Exam. ✔			Plumbing Inspector ☐	
	Plumbing Plans Exam. ☐			Non-Res IU Inspector ☐	
	Electrical Plans Exam. ☐				
	Mechanical Plans Exam. ☐				
	Fire Protect. Plans Exam. ☐				
Res Building Official ■	Res Plans Examiner ■	Res Building Inspector ■	Res Mechanical Inspector ☐	Res IU Inspector ☐	

Electrical Safety Inspectors ☐
Location of ESI Course: _____ Date(s) of ESI Course(s): _____

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**:		Check Off
Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	
	Organization sponsoring or requesting the program (if any)	
Course Title:	Name of course (related to content)	
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	
Test Materials:		
Completed Application:		

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

Building Enclosure Detailing and Evaluation



OBOA / ODPCA Joint Conference 2021

Copyright Materials

WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

Wiss, Janney, Elstner Associates, Inc.

Program Description

The performance of a building enclosure and its ability to resist air and water infiltration is critical to maintaining a healthy interior environment and an energy efficient building. A structure's building enclosure system (i.e. facade, roofing, fenestration, and waterproofing) must meet challenging standards, beginning at the time of design and construction and continuing through its service life. Vulnerabilities in the building enclosure may become exposed, either as a result of deficiencies stemming from original design/construction or normal and expected age related deterioration of building materials. Water infiltration, air leakage, thermal discontinuities, and condensation are four conditions commonly encountered that result in problems ranging from occupant discomfort to moisture-related damage to building enclosure materials and interior finishes.

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Learning Objectives

At the end of this program, participants will be able to:

1. Identify the fundamental building enclosure control layers
2. Understand requirements outlined in Chapter 13 and 14 of the 2017 Ohio Building code related to energy efficiency and exterior walls
3. Describe the primary differences and characteristics between air and vapor barriers and identify challenges associated with maintaining continuous insulation
4. Recognize challenges associated with building enclosure design and construction of exterior wall assemblies, window-to-wall interfaces, parapets, and canopy projections

Exterior Enclosure Basics

Building Enclosures – Water, Air, Vapor, and Thermal Control Layers

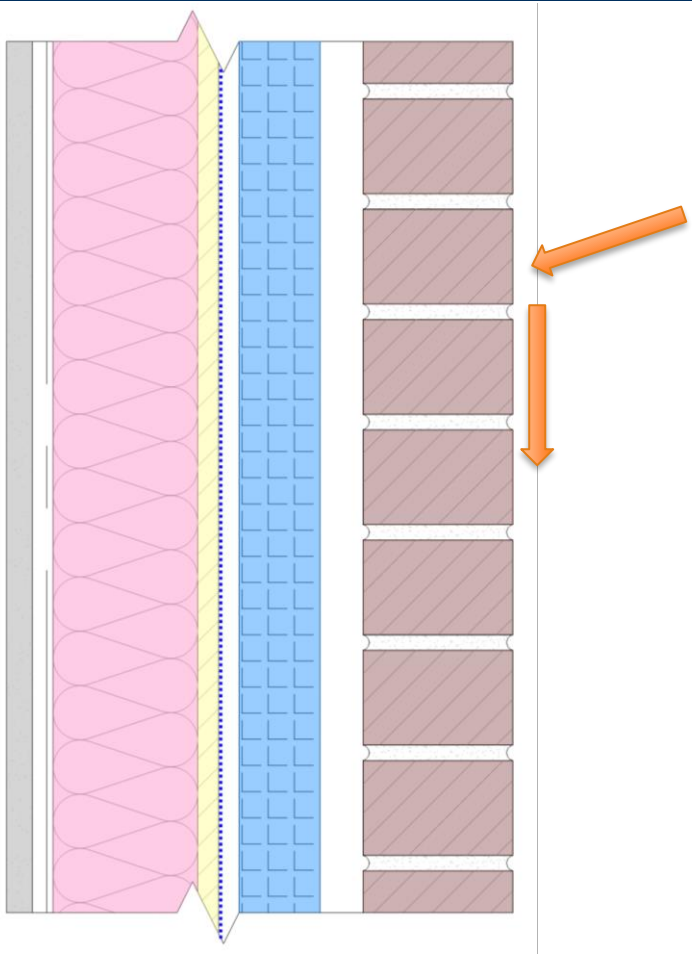
Primary Differences and Characteristics Between Air and Vapor Barriers

Exterior Enclosure Basics

OBC Chapter 13 – Energy Efficiency & Chapter 14 – Exterior Walls

Fundamental Control Layers

1. Water Shedding Surface
2. Water Resistive Barrier
3. Thermal Barrier
4. Air Barrier
5. Vapor Barrier



Typical Exterior Wall Section with Brick Veneer

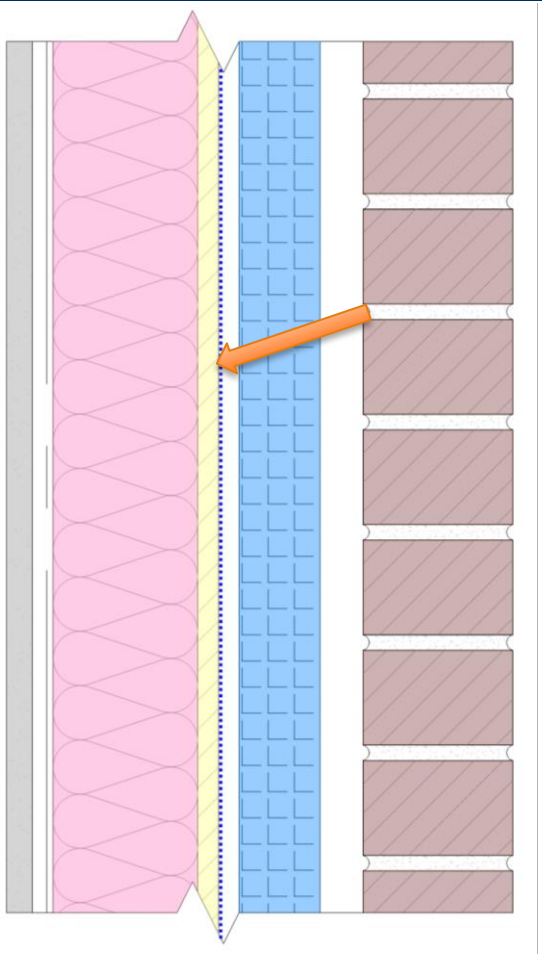
Exterior Enclosure Basics

OBC Chapter 13 – Energy Efficiency & Chapter 14 – Exterior Walls

Fundamental Control Layers

1. Water Shedding Surface
2. Water Resistive Barrier
3. Thermal Barrier
4. Air Barrier
5. Vapor Barrier

OBC 1404.2



Typical Exterior Wall Section with Brick Veneer

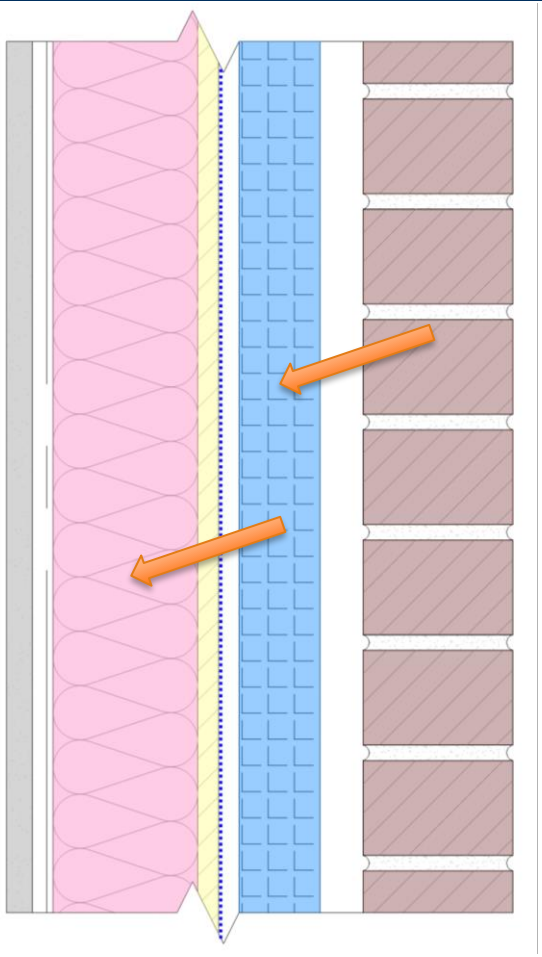
Exterior Enclosure Basics

OBC Chapter 13 – Energy Efficiency & Chapter 14 – Exterior Walls

Fundamental Control Layers

1. Water Shedding Surface
2. Water Resistive Barrier
3. Thermal Barrier
4. Air Barrier
5. Vapor Barrier

OBC 1301, IECC C402, and ASHRAE 90.1



Typical Exterior Wall Section with Brick Veneer

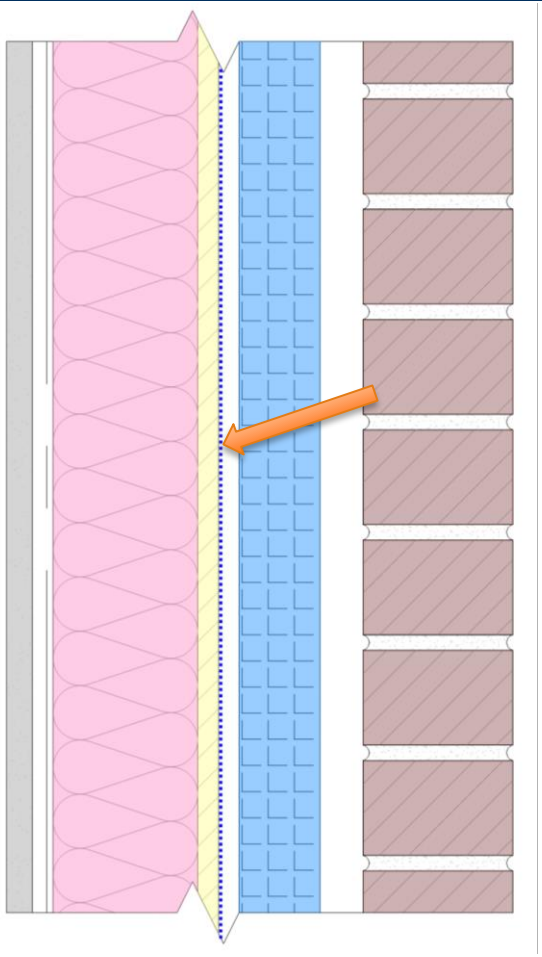
Exterior Enclosure Basics

OBC Chapter 13 – Energy Efficiency & Chapter 14 – Exterior Walls

Fundamental Control Layers

1. Water Shedding Surface
2. Water Resistive Barrier
3. Thermal Barrier
4. Air Barrier
5. Vapor Barrier

OBC 1301 and IECC C402.4



Typical Exterior Wall Section with Brick Veneer

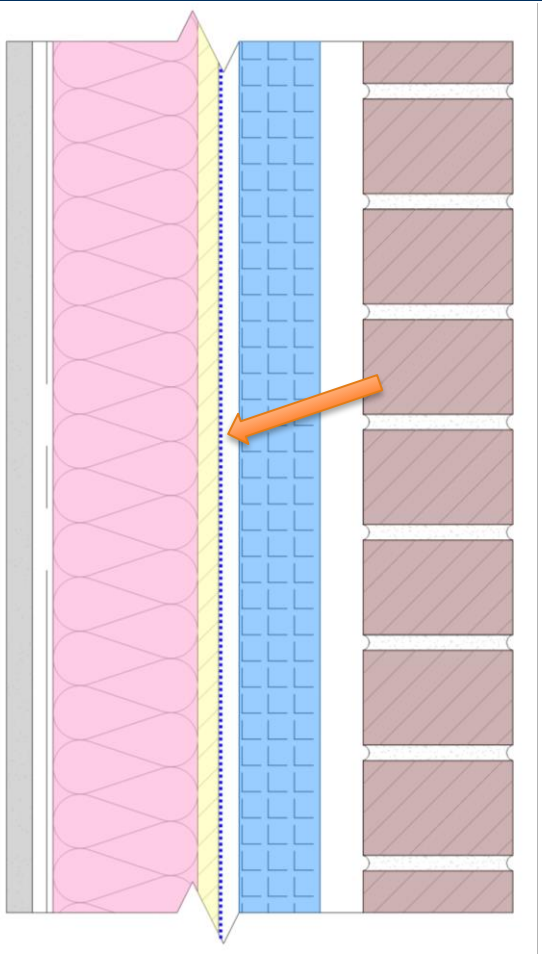
Exterior Enclosure Basics

OBC Chapter 13 – Energy Efficiency & Chapter 14 – Exterior Walls

Fundamental Control Layers

1. Water Shedding Surface
2. Water Resistive Barrier
3. Thermal Barrier
4. Air Barrier
5. Vapor Barrier

OBC 1405.3



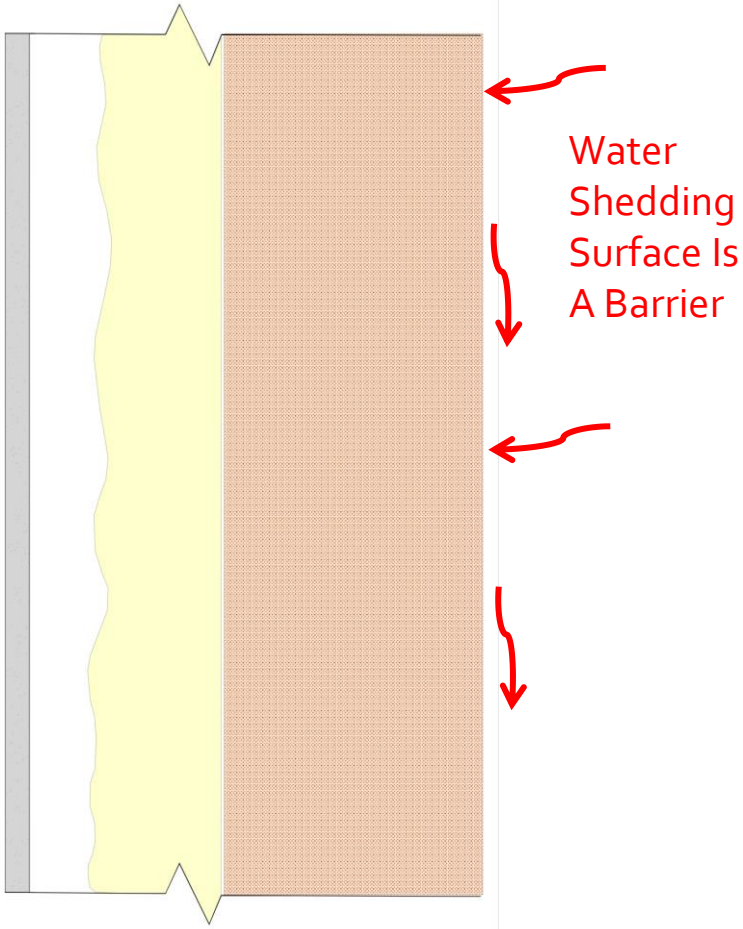
Typical Exterior Wall Section with Brick Veneer

Exterior Enclosure Basics

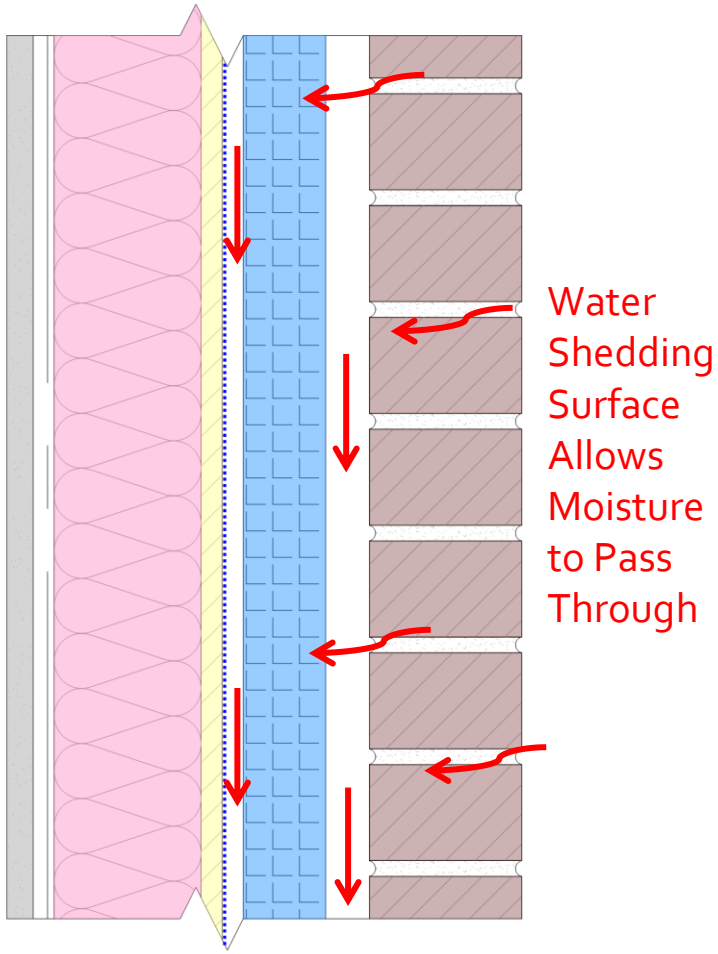
OBC Chapter 13 – Energy Efficiency & Chapter 14 – Exterior Walls

Fundamental Control Layers

Barrier Wall Design (e.g. Precast Concrete Panel with SPF)



Drainage Wall Design (e.g. Brick Veneer Cavity Wall)

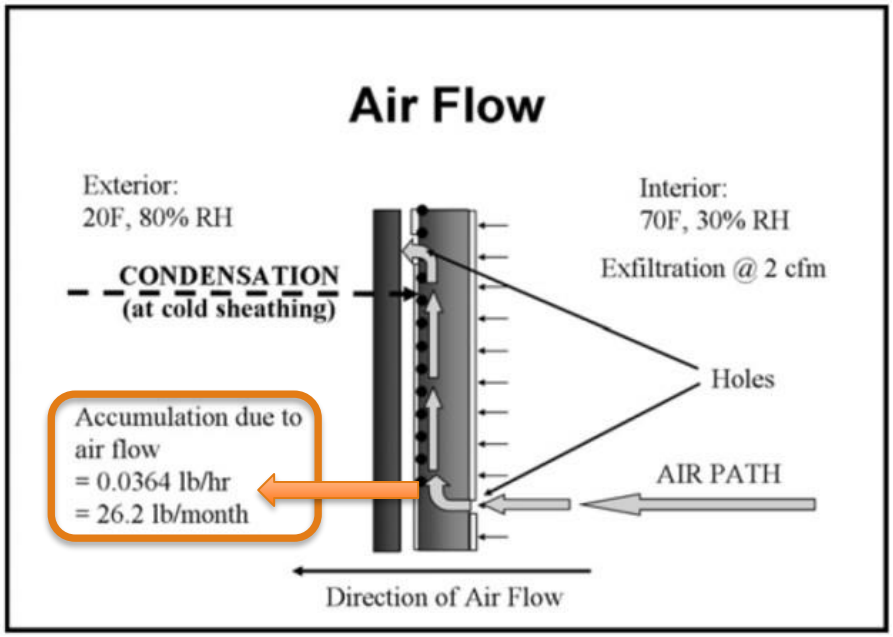


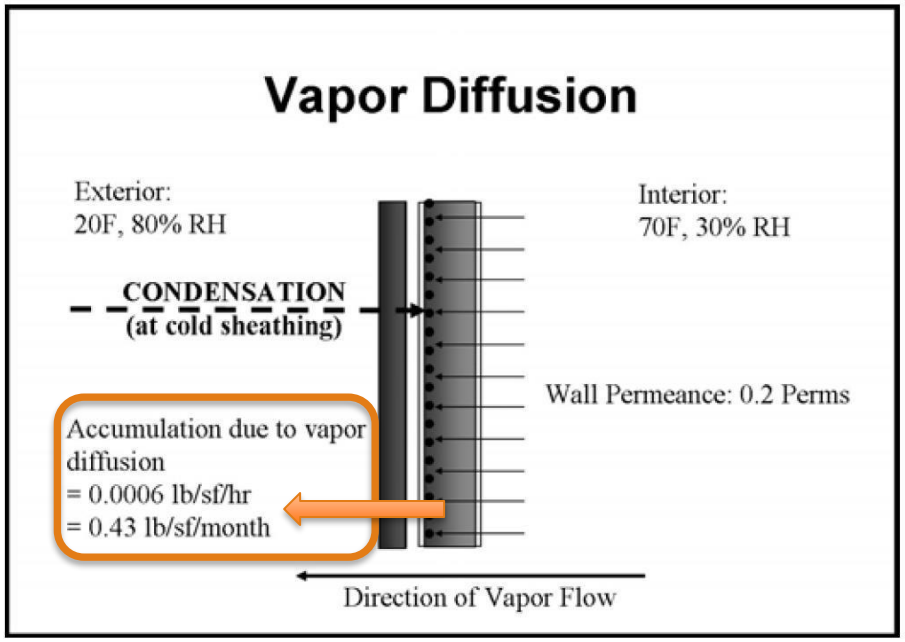
Exterior Enclosure Basics

OBC Chapter 14 – Exterior Walls

Air Flow and Vapor Diffusion

Moisture Transport Mechanisms





Exterior Enclosure Basics

OBC Chapter 13 – Energy Efficiency & IECC C402.3

Basic Definitions

- **Air Barrier** – Layer that controls the unintended movement of air into and out of a building enclosure. Comprised of a number of materials which are assembled together to provide a complete barrier to air leakage through the building enclosure. Barrier against air leakage caused by wind, stack, and mechanical equipment pressures. Barrier can be permeable or impermeable.

AABA (www.airbarrier.org)

Exterior Enclosure Basics

OBC Chapter 13 – Energy Efficiency & IECC C402.3

Basic Definitions

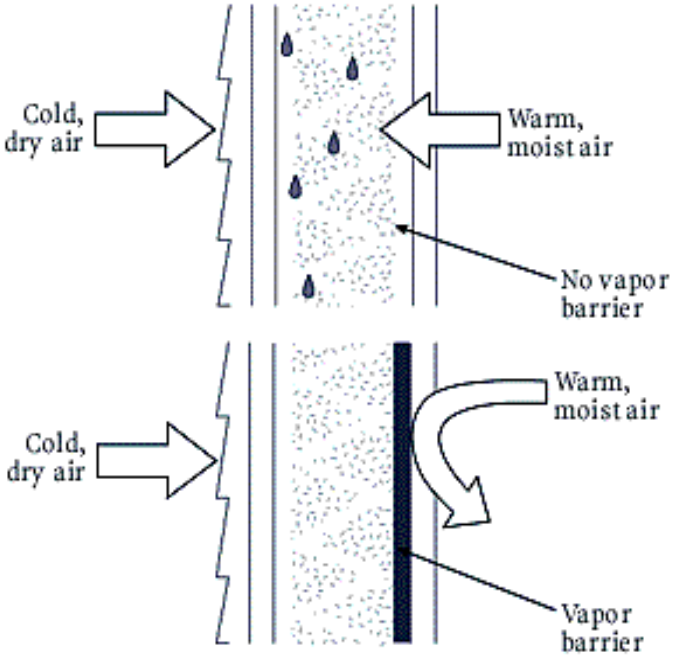
Air Infiltration Requirements	Materials (ASTM E2178)		Assemblies (ASTM E2357 or E1677)		Whole Building Testing (ASTM E779)
	[cfm/ft2 @ 0.3 in w.g., 75Pa]				
NBC (National Model Building Code of Canada)	0.004		--		--
ASHRAE 90.1 (2010)	0.004	or	0.04		--
IECC (2012)	0.004	or	0.04	or	0.4
USACE*(2008) NAVFAC(2011)	0.004		--	and	0.25
Massachusetts State (2012)	0.004	or	0.04	or	0.4
Washington State (2012)	0.004	and	0.04	and	0.4
GSA (2010) USAF (2011)	0.004	or	0.04	and	0.4
ASHRAE 189.1 (2009)	0.004	or	0.04	or	**0.25
IgCC (2012) (** or Building Enclosure Commissioning)	--		--		0.25

Exterior Enclosure Basics

OBC Chapter 14 – Exterior Walls

Basic Definitions

- **Vapor Retarder** – A material or assembly designed to retard the movement of water by vapor diffusion:
  - Class 1 (vapor Impermeable)
    - ≤ 0.1 Perm
  - Class II (vapor semi-impermeable)
    - >0.1 Perm; ≥1.0 Perms
  - Class III (Vapor semi-permeable)
    - >1.0 Perm; ≤ 10 Perms



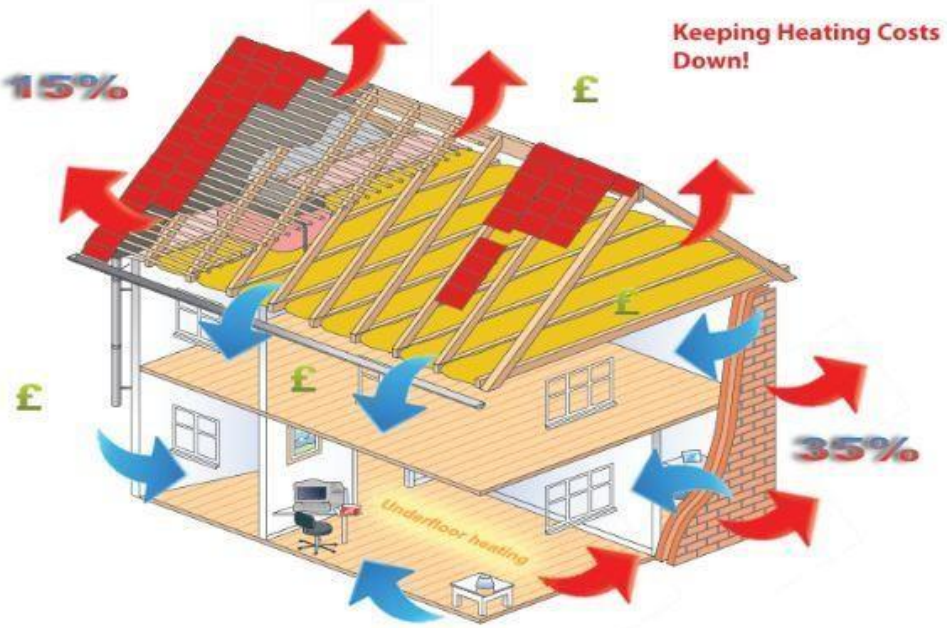
A vapor barrier is a Class 1 vapor retarder

Exterior Enclosure Basics

OBC Chapter 13 – Energy Efficiency, IECC C402, & ASHRAE 90.1

Basic Definitions

- **Thermal Control Layer –** The component or components that are designed and installed in an assembly to control the transfer of thermal energy (heat). Typically, these are comprised of insulation products, radiant barriers, or trapped gaps filled with air or other gases.



Building Science Corporation

Exterior Enclosure Basics

Challenges Associated with Design and Construction of the Fundamental Control Layers

- Continuous Air Barrier: According to ASHRAE 90.1 (2010), the Entire Building Envelope Shall be Designed and Constructed with a Continuous Air Barrier.
- Continuous Thermal Barrier: According to ASHRAE 90.1 (2010), Insulation is to be Continuous Across All Structural Members without Thermal Bridges. It is Installed on the Interior or Exterior or is Integral to Any Opaque Surface of the Building Envelope.
- Continuous Control Layer Substrate (Primarily at Interface Conditions)
- Continuity of Control Layers at Interface Conditions

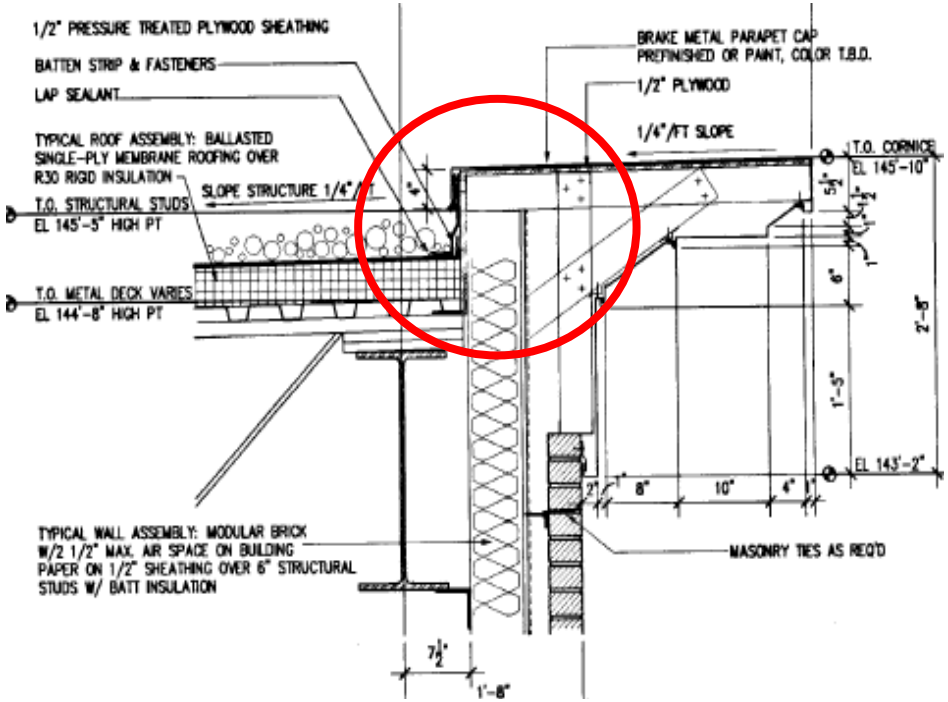
Typical Air/Moisture/Thermal Barrier Continuity Challenges

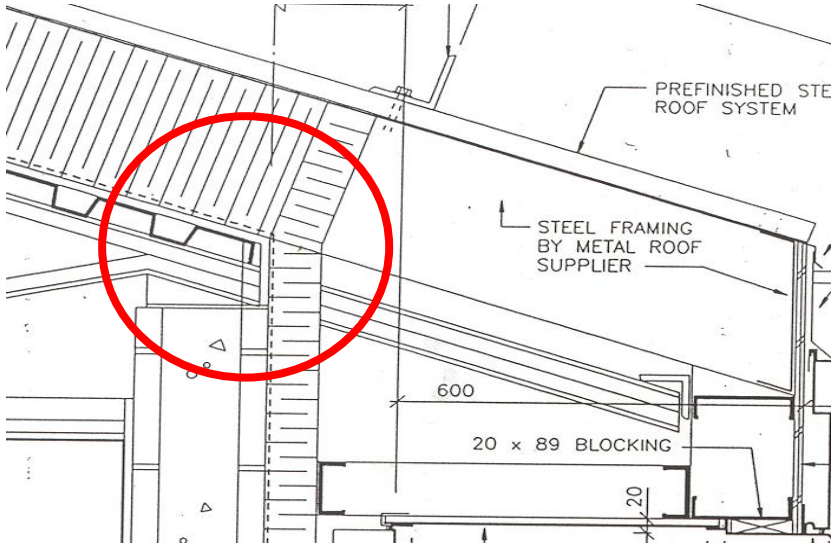
Control Layer Continuity

- ❑ **Parapet and Wall-to-Roof Interfaces**
- ❑ **Window and Door Interfaces**
- ❑ **Base of Wall Transitions Details**
- ❑ **Canopies and Vestibules**

Typical Air/Moisture Barrier Discontinuities at Design

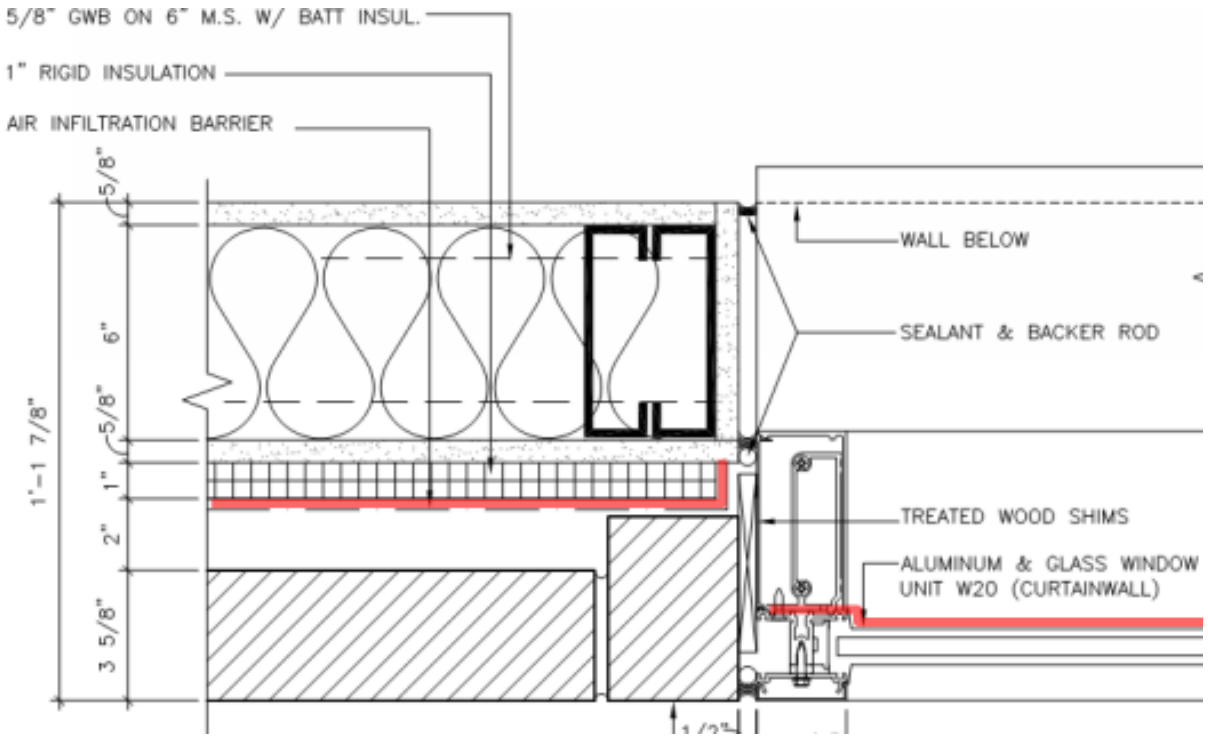
Parapet and Wall-to-Roof Interfaces





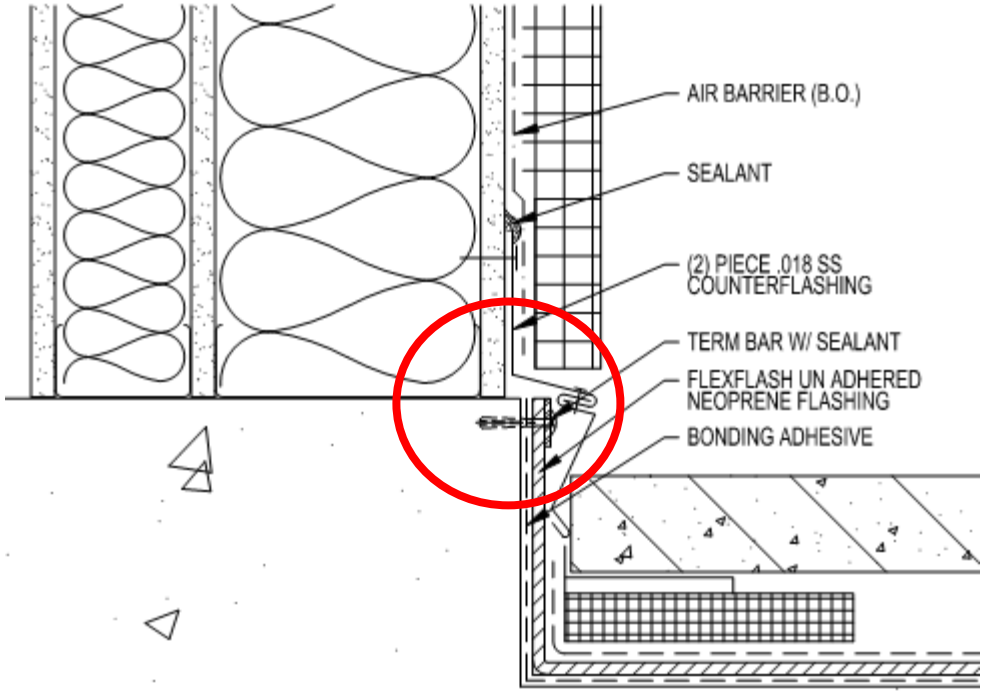
Typical Air/Moisture Barrier Discontinuities at Design

Window and Door Interfaces



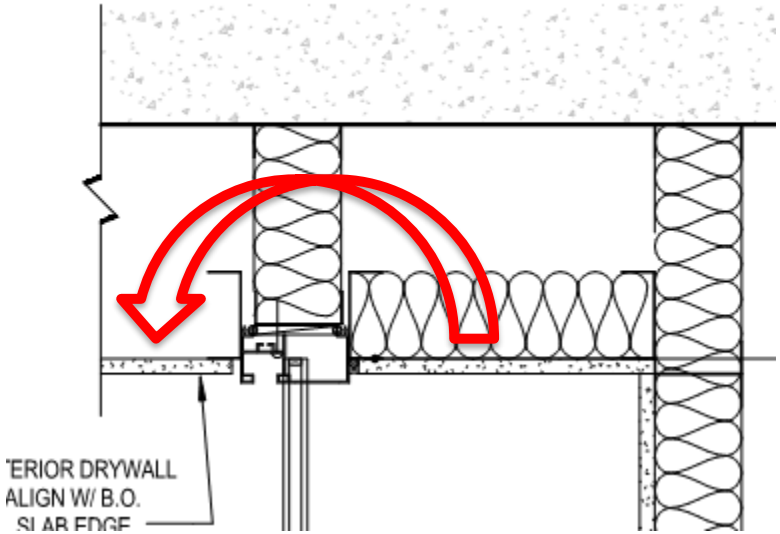
Typical Air/Moisture Barrier Discontinuities at Design

Base of Wall Transition Details



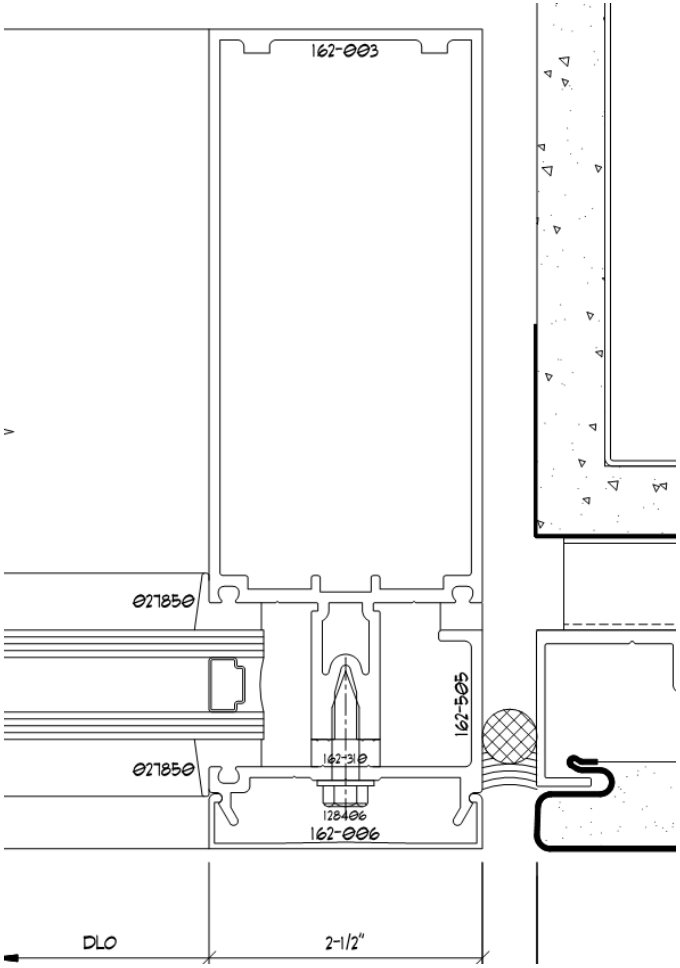
Typical Air/Moisture Barrier Discontinuities at Design

Canopies and Vestibules



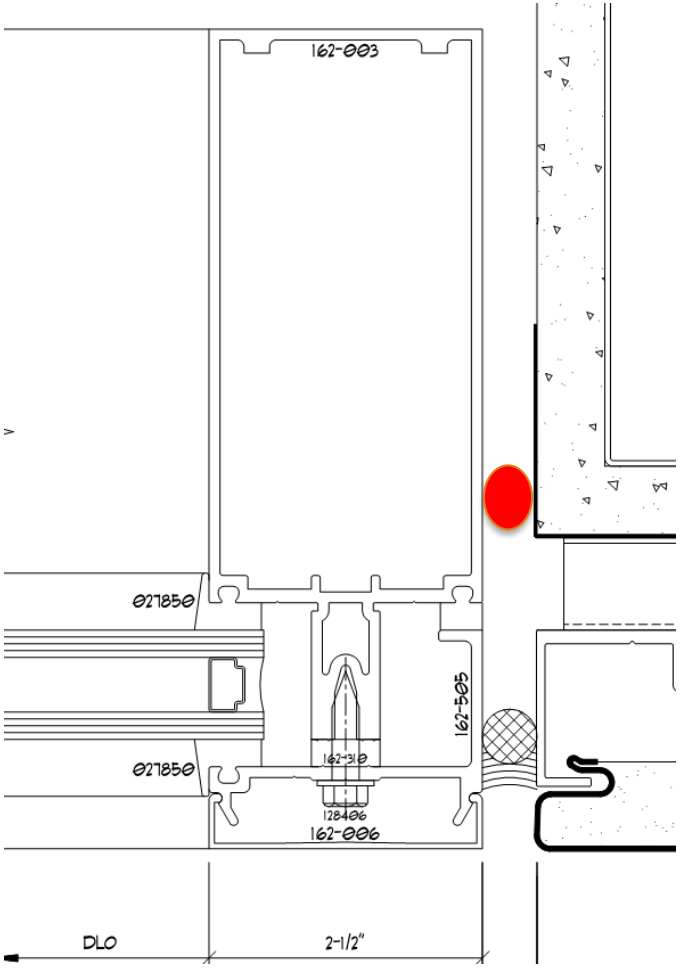
Interface Details - Control Layer Continuity

Jamb: Water Resistive and Air Barrier Continuity



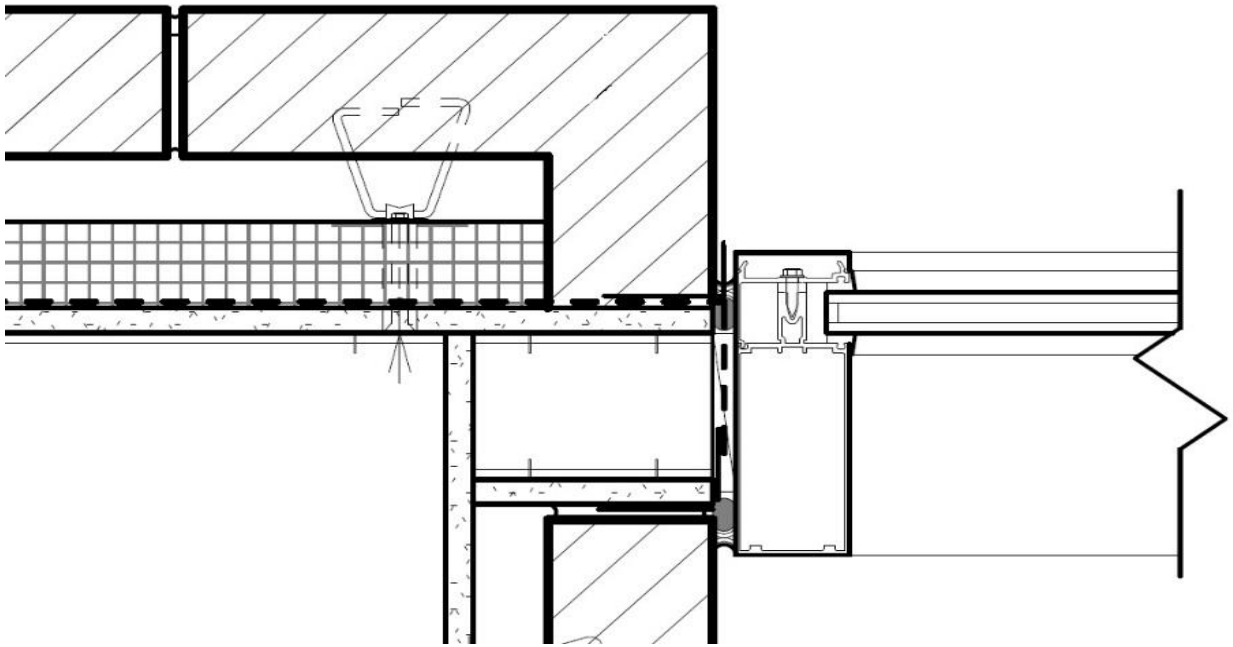
Interface Details - Control Layer Continuity

Jamb: Water Resistive and Air Barrier Continuity



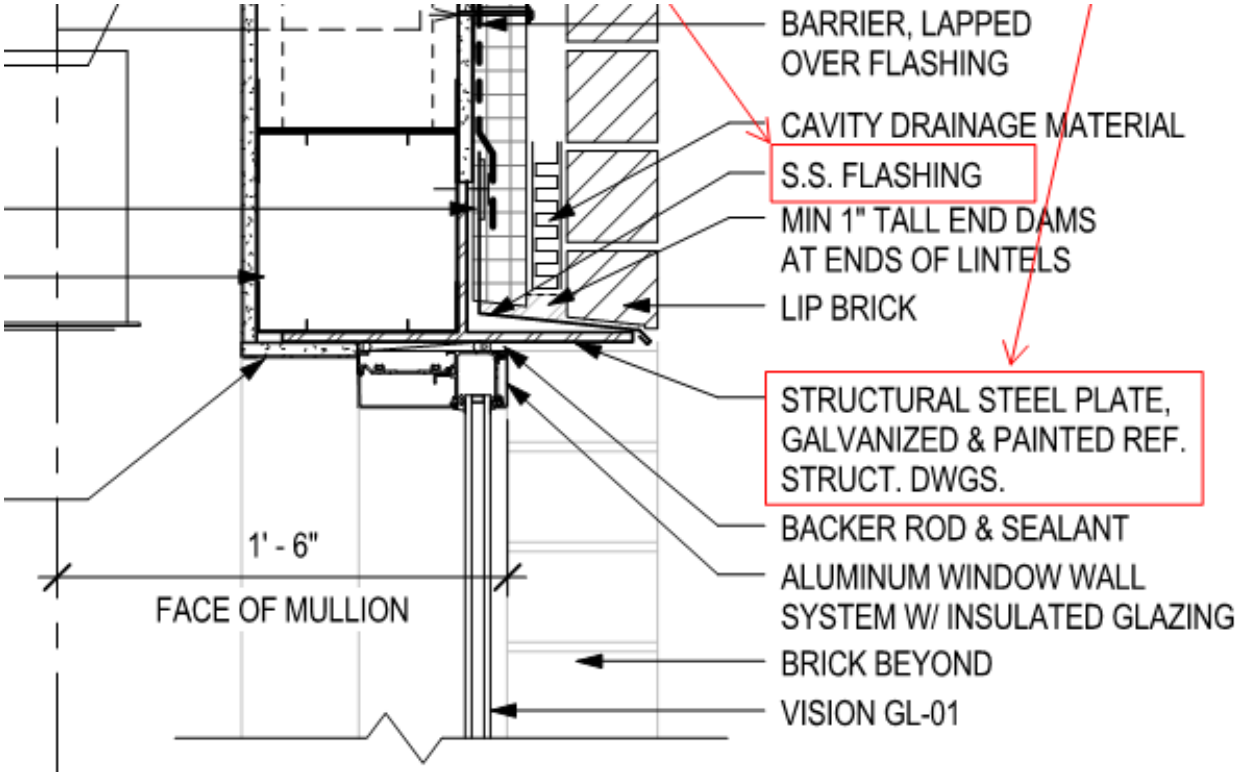
Interface Details - Control Layer Continuity

Jamb: Water Resistive, Air, and Thermal Barrier Continuity



Interface Details - Control Layer Continuity

Head: Thermal Barrier Continuity

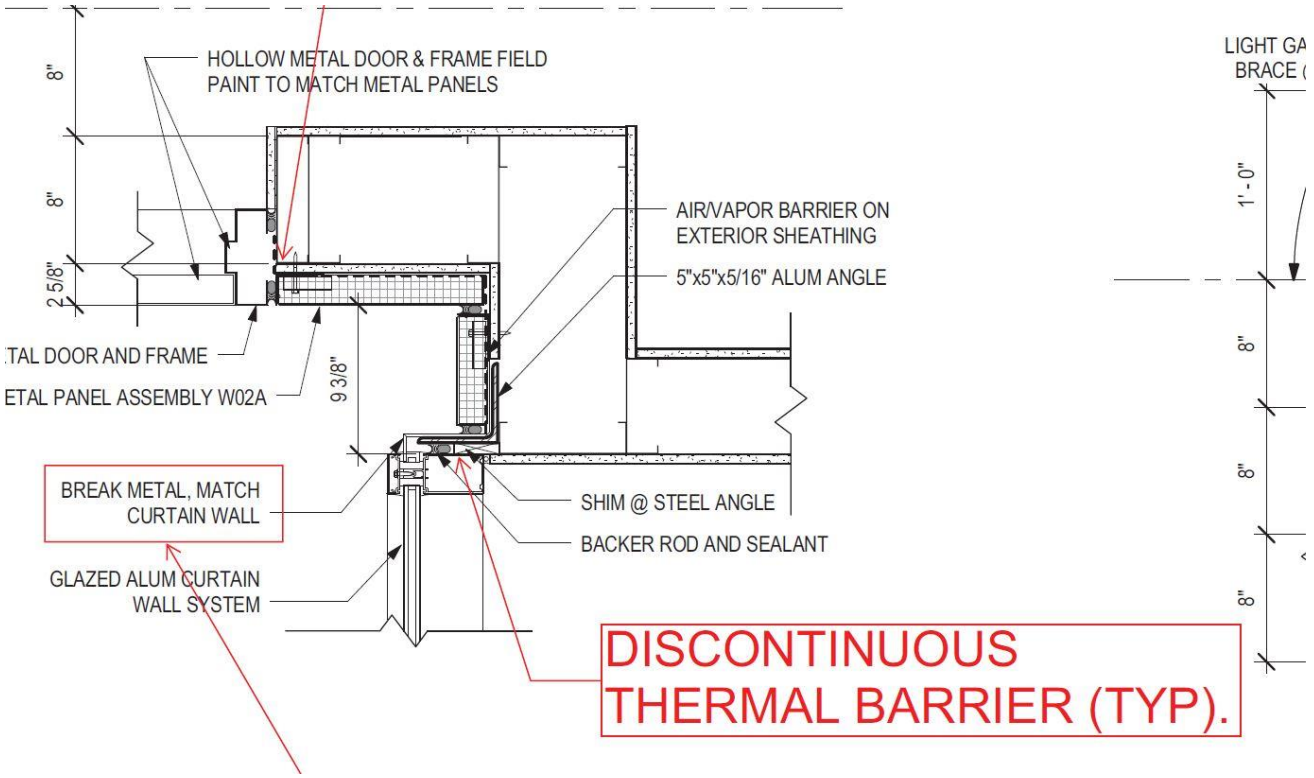


Interface Detail Case Studies - Control Layer Continuity

Sill: Thermal Barrier Continuity

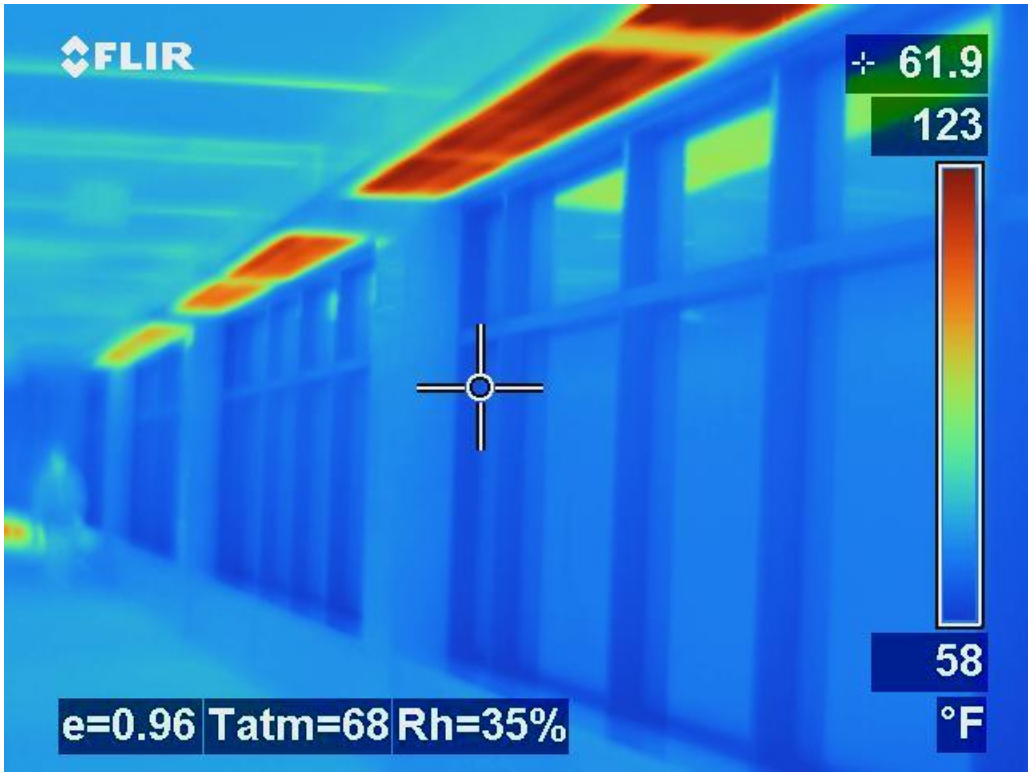
Interface Details - Control Layer Continuity

Jamb: Thermal Barrier Continuity



Interface Details - Control Layer Continuity

Head: Thermal Barrier Continuity and Mechanical System Coordination



Case Study 1: Investigation of Exterior Envelope Condensation

Building Science Concepts

- ❑ **Exterior Walls**
- ❑ **Fenestration**
- ❑ **Penetrations and Canopies**

Case Study - Building Science Concepts

Condensation Risk in Humidified Buildings

Case Study - Building Science Concepts

Pertinent Building Science Terminology

ASHRAE Design Temperature: Data from the *2009 ASHRAE Handbook of Fundamentals*

Meaning of acronyms:
DB: Dry bulb temperature, °F *WB: Wet bulb temperature, °F* *Lat: Latitude, °* *DP: Dew point temperature, °F*
MCWB: Mean coincident wet bulb temperature, °F *MCDB: Mean coincident dry bulb temperature, °F*

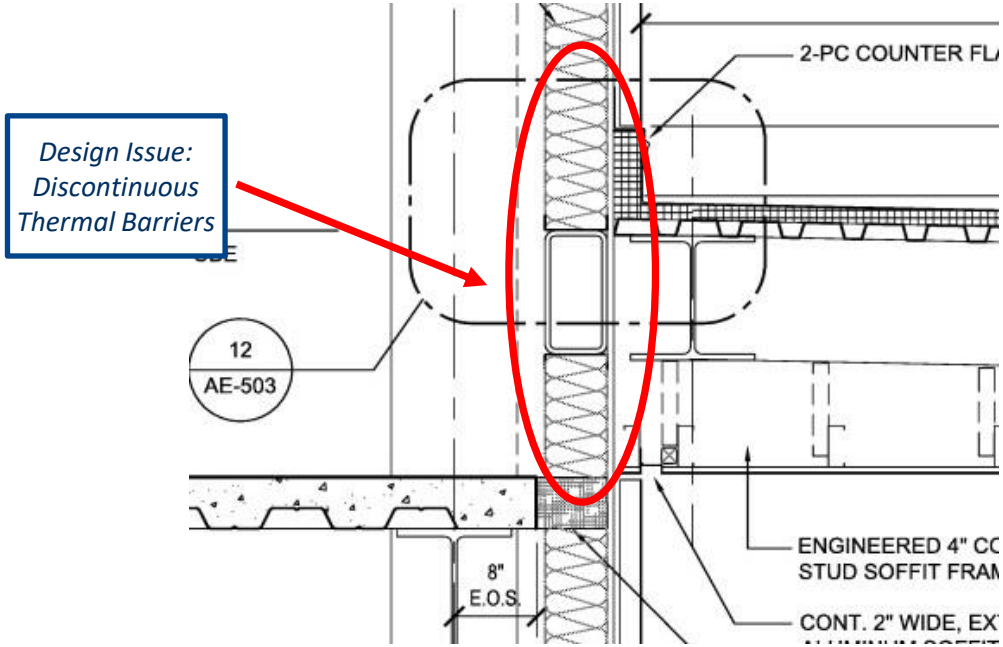
Station	Lat	Long	Elev	Heating DB		Cooling DB/MCWB						Evaporation	
						0.4%		1%		2%		0.4%	
				99.6%	99%	DB / MCWB		DB / MCWB		DB / MCWB		WB / MCDB	
North Dakota													
BISMARCK MUNICIPAL ARPT	46.77N	100.75W	1660	-20.0	-13.9	93.9	69.4	90.3	68.6	86.8	67.4	74.3	85.8
FARGO HECTOR INTERNATIONAL AP	46.93N	96.81W	899	-20.4	-15.2	91.0	72.1	87.7	70.3	84.7	68.8	75.4	85.4
GRAND FORKS AFB	47.97N	97.40W	906	-20.4	-15.8	90.8	71.3	87.7	70.1	84.2	68.3	76.2	84.4
GRAND FORKS INTERNATIONAL AP	47.95N	97.18W	833	-22.2	-17.2	90.0	71.0	86.6	69.4	83.7	68.0	75.0	84.7
MINOT AFB	48.42N	101.35W	1631	-22.2	-17.3	93.2	68.6	89.3	67.8	85.6	66.5	73.1	86.3
MINOT FAA AP	48.26N	101.28W	1713	-19.9	-15.0	91.4	68.9	88.0	68.1	84.3	66.2	73.6	84.4
Ohio													
AKRON AKRON-CANTON REG AP	40.92N	81.44W	1237	1.8	7.1	88.7	72.9	85.9	71.7	83.3	70.2	75.4	84.6
CINCINNATI MUNICIPAL AP LUNKI	39.10N	84.42W	499	6.3	12.4	92.8	74.9	90.2	74.4	87.9	73.2	77.9	88.0
CLEVELAND HOPKINS INTL AP	41.41N	81.85W	804	2.5	8.5	89.4	73.9	86.7	72.5	84.1	71.1	76.3	85.6
COLUMBUS PORT COLUMBUS INTL A	39.99N	82.88W	817	3.2	9.1	91.1	73.8	88.7	72.8	86.3	71.6	76.7	86.8
DAYTON INTERNATIONAL AIRPORT	39.91N	84.22W	1004	0.6	6.9	90.3	73.6	87.9	72.8	85.4	71.3	76.5	86.2
FINDLAY AIRPORT	41.01N	83.67W	814	-0.4	5.6	90.4	73.5	87.8	72.6	84.8	70.8	76.8	86.2
LANCASTER\FAIRFIEL	39.75N	82.65W	866	3.1	9.9	90.5	74.0	88.3	73.5	85.6	71.9	76.8	86.6
MANSFIELD LAHM MUNICIPAL ARPT	40.82N	82.52W	1312	0.1	5.7	88.0	73.0	85.5	71.7	83.1	70.4	75.8	84.6
OHIO STATE UNIVERSI	40.07N	83.07W	928	6.9	11.7	90.4	73.7	88.2	73.1	85.3	71.9	76.4	86.1
RICKENBACKER ANGB	39.82N	82.93W	755	4.3	10.3	92.5	75.7	90.1	74.9	87.7	73.9	79.8	86.7

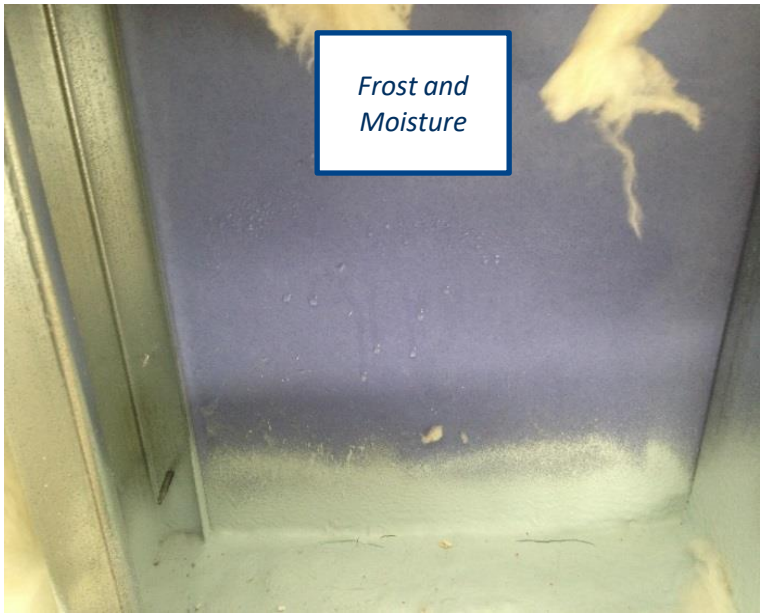
- ASHRAE 99.6% dry bulb design exterior winter temperature is 2.5 degrees F for Cleveland.
- Measured interior conditions of 71 degrees Fahrenheit and 37.5% RH was used in our analysis

Case Study - Building Science Concepts

Fundamental Exterior Envelope Control Layers

1. Water shedding surface
2. Water resistive barrier
3. **Thermal barrier**
4. Air barrier
5. Vapor Barrier





Case Study - Building Science Concepts

Fundamental Exterior Envelope Control Layers

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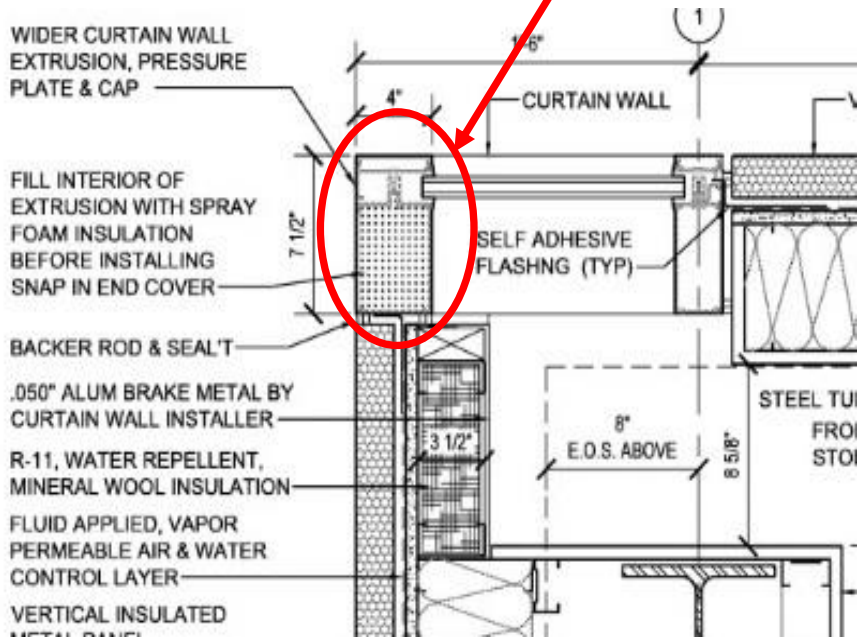

Case Study - Building Science Concepts

Fundamental Exterior Envelope Control Layers

1. Water shedding surface
2. Water resistive barrier
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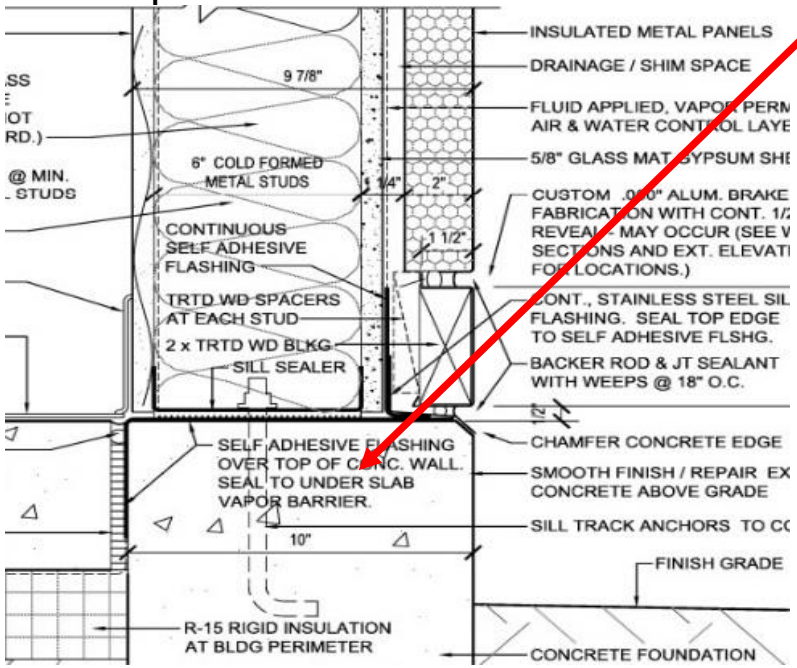
5. Vapor Barrier

Partial Design/Construction Issue: Discontinuous Thermal Barrier

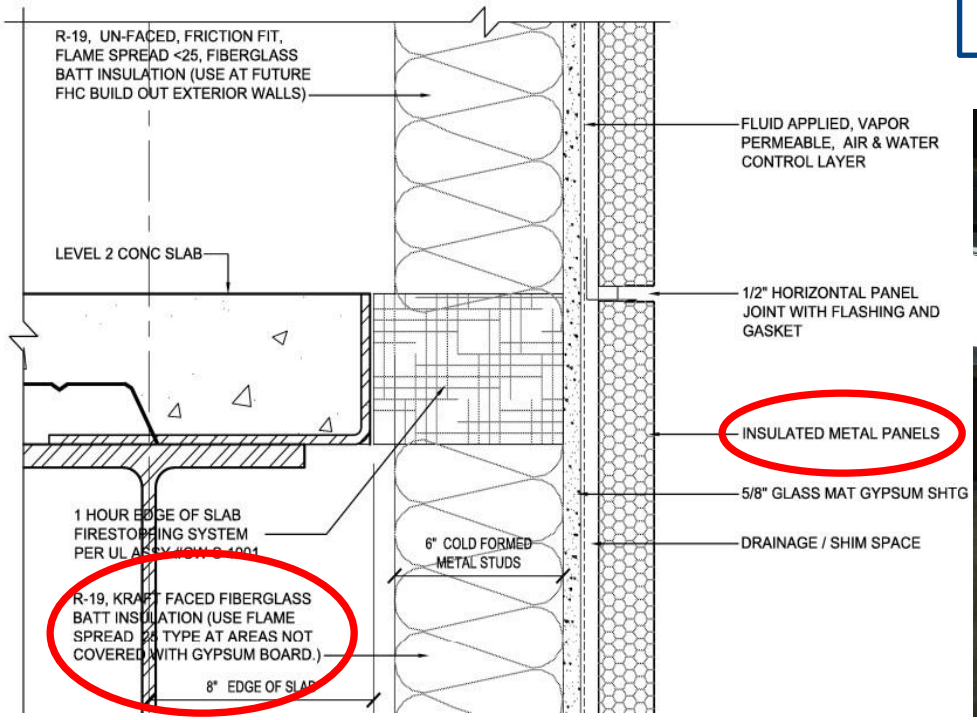


Case Study - Building Science Concepts

Components and Concepts

Insulation

Design Issue: Significant Batt Insulation in Cavity Space



Case Study - Building Science Concepts

Hygrothermal Analyses - Diffusion

Hygrothermal Analysis - Winter Conditions

Layer	Material	Thickness	Conductivity	Conductance	Resistance	ΔT	Temperature	Permeability	Permeance	Resistance	ΔP_v	P_v	P_{vs}	RH
		in	Btu·in/(hr·ft²·°F)	Btu/(hr·ft²·°F)	(hr·ft²·°F)/Btu	°F	°F	ng/(Pa·s·m)	ng/(Pa·m²·s)	(Pa·m²·s)/ng	Pa	Pa	Pa	%
	Interior Air Temperature						71					976	2601	38
1	Interior Film	-	-	1.46	0.68	1.26		-	15000.00	0.000067	0.00			
							69.74					976	2492	39
2	Latex Paint	-	-	-	0.00	0.00		-	378.00	0.0026	0.02			
							69.74					976	2492	39
3	Gypsum Wallboard	0.625	0.67	1.07	0.93	1.72		118.00	7433.07	0.0001	0.00			
							68.02					976	2350	42
4	Kraft Paper	0.03	-	-	0.00	0.00		-	62.43	0.02	0.13			
							68.02					975	2350	42
5	Batt Insulation	6	0.32	0.05	19.00	35.01		172.00	1128.61	0.00	0.01			
							33.01					975	640	152
6	Exterior Gypsum Sheathing	0.625	0.67	1.07	0.93	1.72		-	970.00	0.0010	0.01			
							31.29					975	597	163
7	Fluid-applied Air Barrier	-	-	-	0.00	0.00		-	1201.00	0.0008	0.01			
							31.29					975	597	163
8	Air Space	0.625	-	-	1.17	2.16		174.00	10960.63	0.0001	0.00			
							29.13					975	547	178
	Metal Panel	2.000	0.14	0.07	14.29	26.32		-	0.01	100.000	838.10			
							2.81					137	174	79
	Exterior Film (Winter)	-	-	6.00	0.17	0.31		-	75000.00	0.000013	0.00			
	Exterior Air Temperature						2.5					137	172	80
				ΣR	37.17				ΣR_v	100.02				

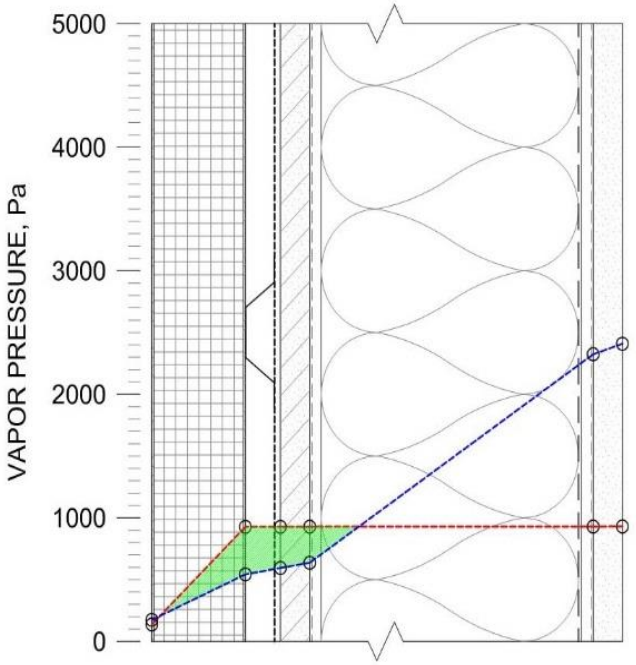
Gypsum Wall Board

Design Issue: Dew point study indicates condensation

- The presence of the batt insulation has shifted the dew point plane of the exterior wall assembly into the interior metal stud cavity

Case Study - Building Science Concepts

Vapor Transport Mechanism: Diffusion



Case Study - Building Science Concepts

Hygrothermal Analyses - Diffusion

Hygrothermal Analysis - Winter Conditions

Layer	Material	Thickness	Conductivity	Conductance	Resistance	ΔT	Temperature	Permeability	Permeance	Resistance	ΔP_w	P_w	P_{ws}	RH
		in	Btu·in/(hr·ft²·°F)	Btu/(hr·ft²·°F)	(hr·ft²·°F)/Btu	°F	°F	ng/(Pa·s·m)	ng/(Pa·m²·s)	(Pa·m²·s)/ng	Pa	Pa	Pa	%
	Interior Air Temperature						71					976	2601	38
1	Interior Film	-	-	1.46	0.68	1.91		-	15000.00	0.000067	0.00			
							69.09					976	2437	40
2	Latex Paint	-	-	-	0.00	0.00		-	378.00	0.0026	0.02			
							69.09					976	2437	40
3	Gypsum Wallboard	0.625	0.67	1.07	0.93	2.61		118.00	7433.07	0.0001	0.00			
							66.48					976	2228	44
4	Kraft Paper	0.03	-	-	0.00	0.00		-	62.43	0.02	0.13			
							66.48					975	2228	44
5	Batt Insulation	2	0.32	0.16	6.33	17.70		172.00	3385.83	0.00	0.00			
							48.78					975	1179	83
6	Exterior Gypsum Sheathing	0.625	0.67	1.07	0.93	2.61		-	970.00	0.0010	0.01			
							46.17					975	1069	91
7	Fluid-applied Air Barrier	-	-	-	0.00	0.00		-	1201.00	0.0008	0.01			
							46.17					975	1069	91
8	Air Space	0.625	-	-	1.17	3.27		174.00	10960.63	0.0001	0.00			
							42.90					975	943	103
9	Metal Panel	2.000	0.14	0.07	14.29	39.93		-	0.01	100.000	838.11			
							2.97					137	175	78
10	Exterior Film (Winter)	-	-	6.00	0.17	0.47		-	75000.00	0.000013	0.00			
	Exterior Air Temperature						2.5					137	172	80
				ΣR	24.51				ΣR_v	100.02				

Gypsum Wall Board

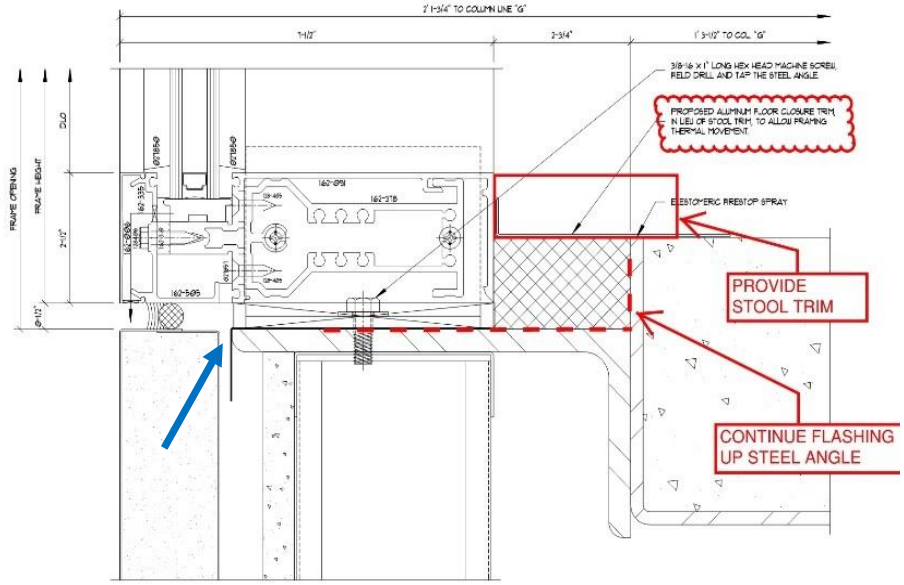
- Reduction of the batt insulation has shifted the dew point plane of the exterior wall assembly out of the interior metal stud cavity

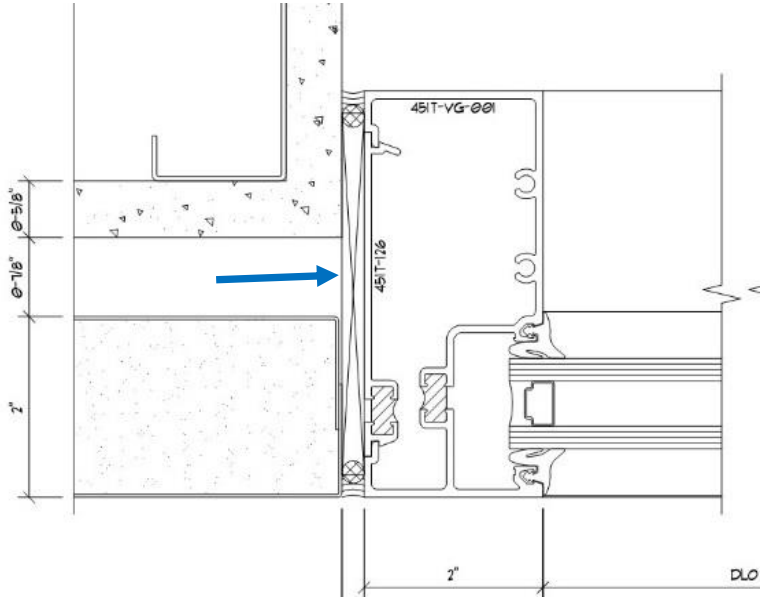
Case Study - Building Science Concepts

Components and Concepts

Location of Fenestration System within Rough Opening

Design Issue: Alignment of Thermal Barrier





- Alignment of thermal break with exterior wall insulation is critical to thermal barrier continuity

Penetrations and Canopies

Air Barrier Continuity not Maintained

Construction Issue: Discontinuous Air Barrier

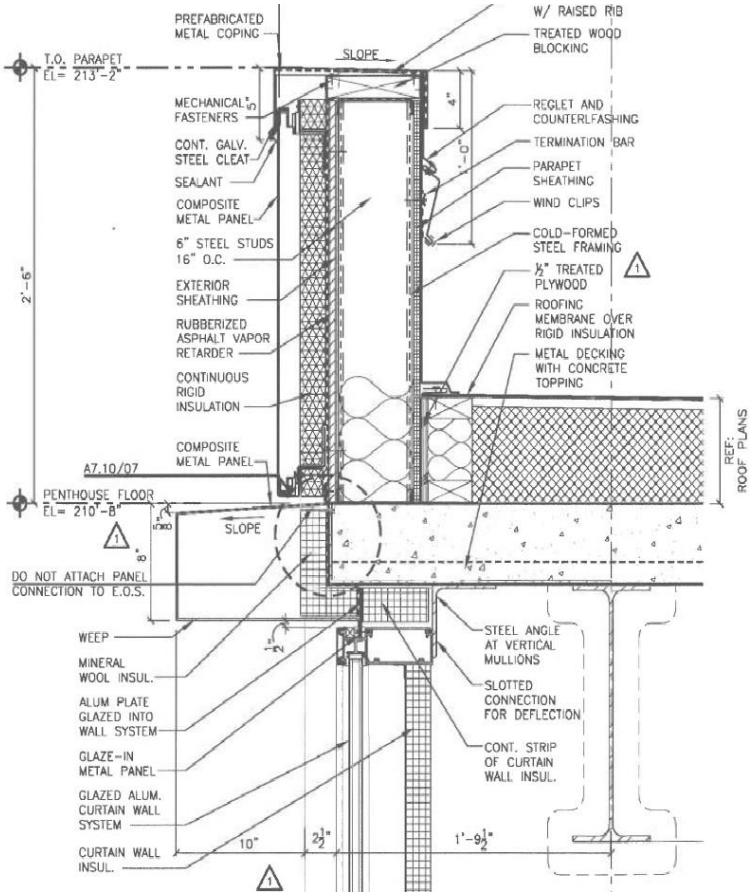
Case Study 2: Air/Moisture Barrier Continuity

Condensation Resulting from Discontinuous Air/Moisture Barrier

Case Study

Condensation Resulting from Discontinuous Air/Moisture Barrier

Issue: Water Infiltration Observed at Glazing Head Conditions at Regular Time Intervals



Case Study

Condensation Resulting from Discontinuous Air/Moisture Barrier

Issue: Water Infiltration Observed at Glazing Head Conditions at Regular Time Intervals

Water Infiltration Occurs Only During Coldest Winter Months

Air Exfiltration Observed at Opaque Wall-to-Glazing System Interface

Case Study

Condensation Resulting from Discontinuous Air/Moisture Barrier

Issue: Water Infiltration Observed at Glazing Head Conditions at Regular Time Intervals

Condensation Observed at Inboard Face of Metal Panel Cladding Elements

Case Study

Condensation Resulting from Discontinuous Air/Moisture Barrier

Issue: Water Infiltration Observed at Glazing Head Conditions at Regular Time Intervals

Air/Moisture Barrier Tie-in Found to be Discontinuous at Opaque Wall-to-Glazing System Interface

Discontinuous Glazing System Substrate

Case Study

Condensation Resulting from Discontinuous Air/Moisture Barrier

Issue: Water Infiltration Observed at Glazing Head Conditions at Regular Time Intervals

Air/Moisture Barrier Tie-in Made Continuous at Opaque Wall-to-Glazing System Interface

Glazing System Substrate Made Continuous

File Attachments for Item:

EC-3 Choices of Air Barriers for Commercial Enclosures (Parksite - OBOA-ODPCA Conference)

All certifications except ESI (1 hour)

Course Agenda

Choices of Air Barriers for Commercial Enclosures

Time: 1 Hour – 62 sildes

Outline:

Related Codes: Chapter 14/OBC, 2012 IECC C402.4; 2010 ASHREA 5.4.3 (covering Air Barriers, Materials & Installation)

Section 1: Air Leakage & Air Barriers

- What is air leakage and why it matters in a sustainable envelope
- Review fundamentals of air leakage and air barriers: what is a continuous air barrier for air leakage control

Sections 2-5 describe the main characteristics of different types of Air Barrier Systems:

The following characteristics are covered for each air barrier type in sections 2-5:

- Brief Description
- Typical Properties
- Surface Preparation
- Application Methods/Common Mistakes
- Inspection and Testing
- Examples of Products and Manufacturers
- Advantages & Limitations

Section 2: Fluid Applied (FA) Air Barrier Systems

Section 3: Self-Adhered (SA) Air Barrier Systems

Section 4: Mechanically Fastened Air Barrier Systems (Building Wraps)

Section 5: Boardstock – Rigid Cellular Thermal Insulation Board & Other Air Barrier Systems

Summary & Questions

Presenter: Samantha Kambo
Field Development Specialist, Multi-Family Construction
DuPont Building Knowledge Center
DuPont Performance Building Solutions

- Location: Austin, TX
- Joined the DuPont BKC in 2019. Focus is on development on new Installation Guidelines/Bulletins and assisting with technical inquiries from the field within the Multi-Family Construction segment
- Prior to role worked for Dow Chemical as Architectural Demand Creator in CO/NM/WY territory educating and assisting architects, GCs and installers on thermal portfolio of products
- B.S. Architectural Engineering-The University of Texas at Austin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Choices of Air Barriers for
Commercial Building Enclosures

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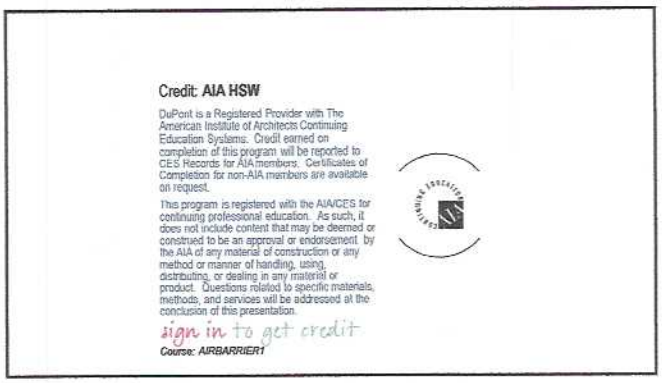
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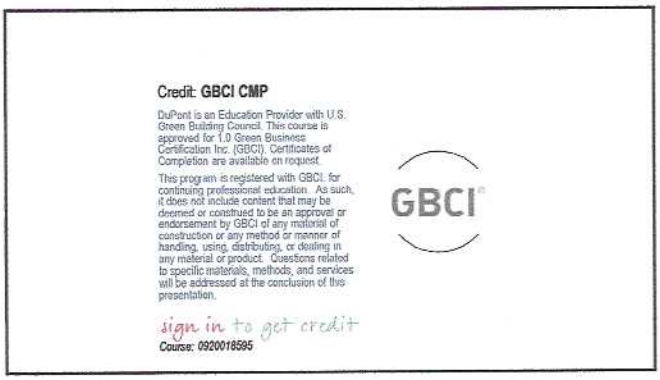
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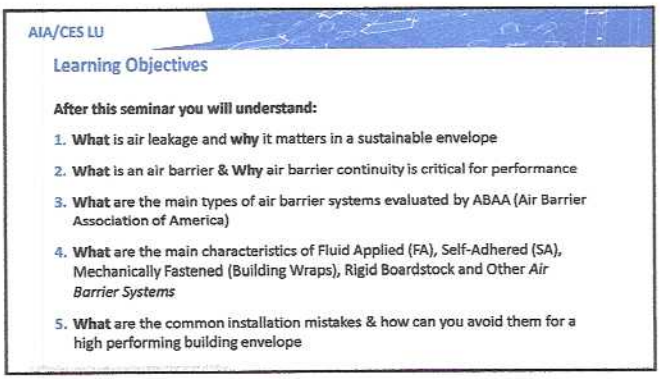
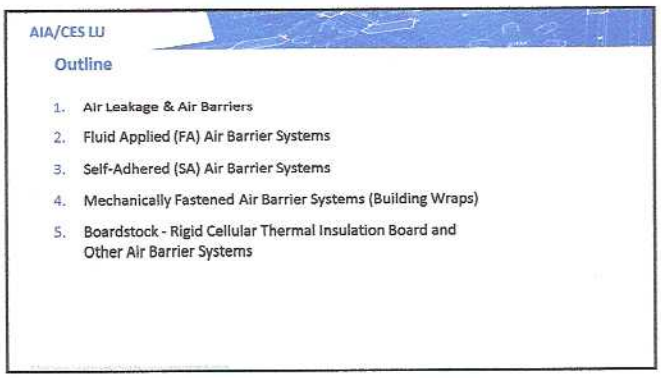

AIA/CES LU
Learning Objectives
After this seminar you will understand:
1. What is air leakage and why it matters in a sustainable envelope
2. What is an air barrier & Why air barrier continuity is critical for performance
3. What are the main types of air barrier systems evaluated by ABAA (Air Barrier Association of America)
4. What are the main characteristics of Fluid Applied (FA), Self-Adhered (SA), Mechanically Fastened (Building Wraps), Rigid Boardstock and Other Air Barrier Systems
5. What are the common installation mistakes & how can you avoid them for a high performing building envelope

4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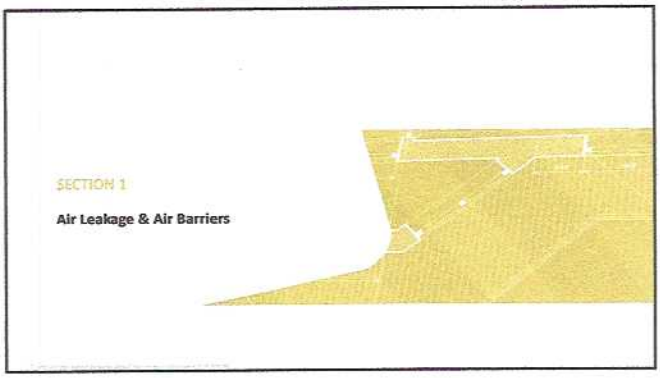
Outline
1. Air Leakage & Air Barriers
2. Fluid Applied (FA) Air Barrier Systems
3. Self-Adhered (SA) Air Barrier Systems
4. Mechanically Fastened Air Barrier Systems (Building Wraps)
5. Boardstock - Rigid Cellular Thermal Insulation Board and Other Air Barrier Systems

5


SECTION 1
Air Leakage & Air Barriers

6

SECTION 1

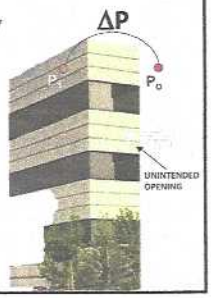
What is Air Leakage?

Unplanned/Unpredictable/Unintentional Airflow

Two conditions are required for air leakage to occur:

1. ***A Driving Force*** *(A Pressure Difference across the Building Envelope, ΔP)*
2. ***A Pathway*** *(Unintended Opening)*

In order to prevent air leakage, one of the two conditions must be removed. The pressure difference can not be removed, so the strategy for air leakage control is to eliminate the building envelope discontinuities.



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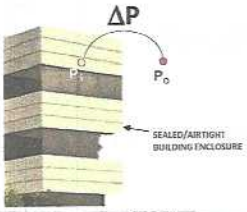
SECTION 1

What are Air Barrier Systems?

A ***Continuous Air Barrier System*** protects against air leakage by sealing the **"unintended openings" of the building enclosure**



A building enclosure comprises all six sides of a building, including all transitions between envelope systems

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SECTION 1

Air Barrier System Components

A Continuous Air Barrier System is comprised of all elements necessary to form a *continuous plane of airtightness in order to* achieve an airtight building enclosure:

- **Primary** Air Barrier Material
- **Installation and Continuity Accessories:** adhesives, primers, mechanical fasteners, flashing, tapes, caulks & sealants, etc...

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SECTION 1

Airtight Building Enclosure

The function of a ***continuous air barrier system*** is to provide an airtight building enclosure

- The Air Barrier Association of America (ABAA) and National Air Barrier Association (of Canada) (NABA) require air barrier evaluation.
- **ABAA** requires testing of *air barrier materials* and *air barrier assemblies* for consistency across the industry
  - *Air barrier assembly testing is essential to determine performance of an **"Installed Air Barrier System"**.*

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SECTION 1

ABAA & NABA Evaluated Air Barriers

Installed Air Barrier Performance

- Manufacturers must submit 3rd party test reports to demonstrate that the following performance requirements are met:
  - Air barrier materials *(per ASTM E2178)*
  - Air barrier assemblies *(per ASTM E2357)*
- Manufacturers that have completed **BOTH** air barrier materials and assemblies testing and meet the standard requirements are listed on the ABAA & NABA websites and can use the "ABAA Evaluated" or "NABA Evaluated" logo on their products.

http://www.airbarrier.org

http://www.naba.ca/index.php

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SECTION 1

ABAA-Evaluated Air Barriers

- **Fluid Applied** Membranes -- *Sections 072726 and 072800*
- **Self-Adhered** Membranes -- *Section 072713*
- **Mechanically Fastened** (Building Wraps) -- *Section 072708*
- **Boardstock** - Rigid Cellular Thermal Insulation Board -- *Section 072723*
- **Others** (*e.g.* SPF -- *Section 072703*, Factory-Bonded Membranes to Sheathing & Adhesive Backed Commercial Building Wraps – *No Master Specs Available*)

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SECTION 1

Common Types of Air Barrier Systems

Self-Adhered Membranes
12 PRODUCTS

Numbers represent the quantity of ABAA Evaluated products listed in each category (Dec. 2018)

Mechanically Fastened Membranes
5 PRODUCTS

Fluid Applied Membranes
50 PRODUCTS

Fluid Applied WRBs have experienced the most significant growth since the introduction of mandatory continuous air barrier requirement by ASHRAE 90.1-2010

Rigid Foam Boards/Others
28 PRODUCTS

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SECTION 1

ABAA-Evaluated Air Barriers

The next sections will review the characteristics of the main types of ABAA-evaluated Air Barrier Systems:

- Brief Description
- Typical Properties
- Surface Preparation
- Application Methods/Common Mistakes
- Inspection and Testing
- Examples of Products and Manufacturers
- Advantages & Limitations

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SECTION 2

Fluid Applied Air Barrier Systems

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SECTION 2

Fluid Applied Air Barriers

- Asphalt or polymer formulations
- Organic solvents or water based
- Brush, Spray or Roller applied

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SECTION 2

Fluid Applied Air Barriers: *Typical Properties*

- Air Infiltration Rate:
  - **Air Barrier Materials:** <0.004 cfm/ft² @ 1.57 psf (0.02 L/s-m² @ 75 Pa)
    Fluid applied air barriers must meet these requirements when tested to ASTM E2178.
  - **Air Barrier Assemblies:** <0.04 cfm/ft² @ 1.57 psf (0.2 L/s-m²@ 75 Pa)
    Fluid Applied Air Barriers meet the assembly requirements when tested to ASTM E2357 or ASTM E1677 pressure loads, when properly installed.
- Water Vapor Permeability:
  - Most fluid-applied formulations are **Class I Vapor Retarders,** per IBC 2015 (< 0.1 Perm*)
  - Some fluid-applied are **Class III Vapor Retarders,** per IBC 2015 (1- 10 Perms*)
  - New fluid-applied technologies provide FA membranes with high vapor permeance (>20-25 Perms*)

* When tested to ASTM E96

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SECTION 2

Fluid Applied Air Barriers: *Common Chemistry Types**

Modified Asphaltic Formulations	Acrylic-Based Polymers	Modified Silicones and Silicones
Mostly solvent-based Low solids	Mostly water-based Low solids	Solvent- or water-based High solids
• Older technology derived from waterproofing below ground	• Many products, wide variation in thickness & properties	• Newer formulations (STPE, STPU, Silicone)
• Typical permeability: < 10 perms	• Typical permeability: 0-20 perms	• Permeability varies (from very high to very low)
• Typical application thickness (wet): ~ 90 mils - 120 mils	• Typical application thickness (wet): 10 mils - 90 mils	• Typical application thickness (wet): 12 mils - 60 mils

Organic solvents or water based

* The impact of chemistry to the FA Air Barrier performance is discussed in Fluid1 CEU

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SECTION 2

Fluid Applied Air Barriers: *Surface Preparation*

- Surfaces must be clean, dry, & free of oil, dust & contaminants
- Free of gaps (> 1/16" must be treated), voids, loose aggregates & protrusions
- Proper detailing & integration with flashing, openings, penetrations & transitions is key

Surface prep & detailing will vary among manufacturers

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SECTION 2

Fluid Applied Air Barriers: *Surface Preparation*

Proper Sealing of Sheathing Joints (>1/16")

Self-adhesive mesh

Flexible joint compound applied over the mesh

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SECTION 2

Fluid Applied Air Barriers: *Application Methods*

Brush, Spray and Roller Application

Over CMU back-up wall

Over Sheathing

Over CMU back-up wall

Photos: Bryan Tomlinson

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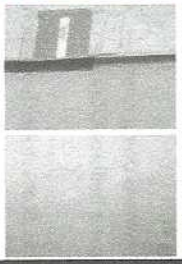
SECTION 2

Fluid Applied Air Barriers: *Common Mistakes*

Uneven Thickness



CONTINUITY IS COMPROMISED

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SECTION 2

Fluid Applied Air Barriers: *Common Mistakes*

SOLUTION: Mil Gauge used to check for thickness uniformity

Photos: Bryan Tomlinson

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SECTION 2

Fluid Applied Air Barriers: *Common Mistakes*

Sealing of Penetrations

Pinholes

NOTE: high solids content helps minimize pinholes and shrinkage

Shrinkage-Cracking

CONTINUITY IS COMPROMISED

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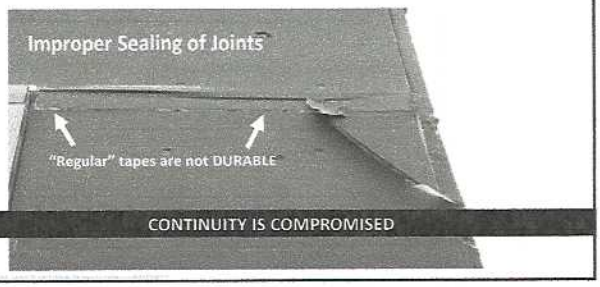
SECTION 2

Fluid Applied Air Barriers: *Common Mistakes*



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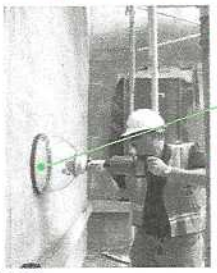
SECTION 2

Fluid Applied Air Barriers: *Best Practices*

26

SECTION 2

Fluid Applied Air Barriers: *Inspection & Testing*



- Visually inspect if membrane was correctly installed per manufacturer instruction
- **Field Test membrane for air leakage (pinholes, junctions)**
- Visually inspect membrane for continuity before covering

Photo: Kevin Knight

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SECTION 2

Fluid Applied Air Barriers: *Advantages & Limitations*

Advantages

- \+ Vapor Permeability is possible with some new chemical formulations
- \+ Fully adhered to substrate: high structural integrity under pressure differential
- \+ More easily applied over CMU or complex, irregular surfaces
- \+ Offer limited self-sealing capabilities
- \+ More cost effective than self-adhered wraps and peel & stick membranes

Limitations

- — Field Installation: System performance highly dependent on workmanship
- — Higher Cost: 2-3X higher than commercial building wraps
- — Shrinkage-Cracking during cure: Many unable to withstand building movement
- — Environmental: New VOC compliance laws per state

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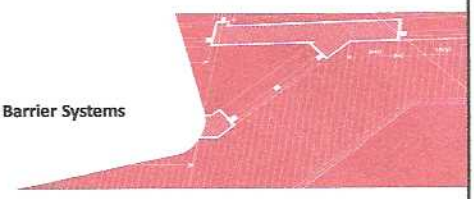
SECTION 3

Self-Adhered Air Barrier Systems



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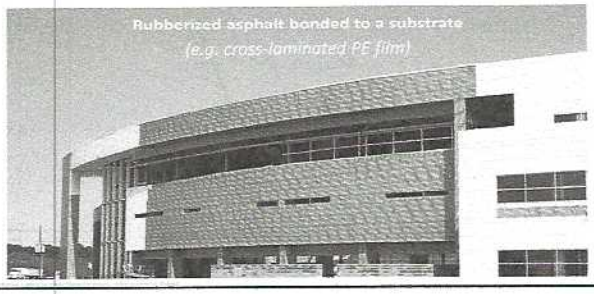
SECTION 3

Self-Adhered Air Barriers



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SECTION 3

Self-Adhered Air Barriers: *Typical Properties*

- **Air infiltration rate:**
  - **Air Barrier Materials:** <0.004 cfm/ft² @ 1.57 psf (0.02 L/s-m² @ 75 Pa)
    Self-Adhered Air Barriers must meet the material requirements when tested to ASTM E2178
  - **Air Barrier Assemblies:** <0.04 cfm/ft² @ 1.57 psf (0.2 L/s-m² @ 75 Pa)
    Self-Adhered Air Barriers must meet the assembly requirements when tested to ASTM E2357 or ASTM E1677 pressure loads, when properly installed
- **Water Vapor Permeability**
  - Most *Self-Adhered* Air Barrier Membranes are less than 0.1 Perm per ASTM E96 (Class I Vapor Barriers)

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SECTION 3

Self-Adhered Air Barriers: *Surface Preparation*

Surfaces must be:

- **Dry, clean and free** from contaminants
- **Smooth, even plane**
  (spalled areas must be filled)
- **Apply primer** at recommended coverage rate
- **Allow primer to dry**
  (from 1 to 24 hrs. depending on weather conditions, per manufacturers instructions)

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SECTION 3

Self-Adhered Air Barriers: *Application Method*

- Remove paper back or protective film
- Press firmly into place (avoid trapping air underneath)
- Press down with a roller for good adhesion
- Repair wrinkles by re-rolling the affected areas
- Terminate sheets per manufacturer recommendations such as with sealant or mastic

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SECTION 3

Self-Adhered Air Barriers: *Common Mistakes*

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SECTION 3

Self-Adhered Air Barriers: *Inspection & Testing*

- Visually inspect if self adhered membrane was correctly installed
- **Test membrane adhesion to substrate**
- Inspect membrane for continuity before covering

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SECTION 3

Self-Adhered Air Barriers: *Advantages and Limitations*

Advantages

+ **SA membranes** offer some self-sealing capabilities
+ **SA membranes** offer high structural integrity under pressure differential when properly installed

Limitations

– **Vapor Impermeable:** can only be used in certain climates and wall designs
– **Difficult to install:** compared to other air barriers
– **Pre-Installation:** Requires surface preparation
– **Weather limitations:** humidity, temperature, wet surfaces, etc.
– **Cost:** 2-3X higher installed cost (product and labor) than commercial building wraps.
– **Environmental:** VOC's, Solvent-Based Primers, etc.

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SECTION 4

Mechanically Fastened Air Barrier Systems (Building Wraps)

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SECTION 4

Mechanically Fastened Air Barriers *(Building Wraps)*

38

SECTION 4

Building Wraps: *Typical Properties*

- Air Infiltration Rates
  - **Air Barrier Materials:** <0.004 cfm/ft² @ 1.57 psf (0.02 L/s-m² @ 75 Pa) Some Building Wraps meet the air barrier materials requirements for air infiltration rates of when tested per ASTM E2178
  - **Air Barrier Assemblies:** <0.04 cfm/ft² @ 1.57 psf (0.2 L/s-m²@ 75 Pa) Some Building Wraps meet the installed air barrier assembly requirements when tested per ASTM E2357 or ASTM E1677 pressure loads
- Water Vapor Permeability
  - Most Building wraps are vapor permeable (>10 Perms*)
  - Few Building Wraps have > 20 Perms* and allow for effective drying of incidental moisture intrusion while providing effective control of air and water penetration

* When tested to ASTM E96

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SECTION 4

Building Wraps: *Surface Preparation*

- No cleaning
- No taping
- No priming
- Unroll, tape the overlaps, and secure in place with proper caps and mechanical fasteners

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SECTION 4

Building Wraps: *Fastener Spacing*

FASTENER TYPE AND SPACING ARE CRITICAL FOR STRUCTURAL INTEGRITY

Screw Fasteners and 16" O.C. Steel Stud Spacing

Washer Size	Fastener Spacing	Allowable Pressure	
		Pounds per sq. inch [psf]	Miles per Hour [mph]
2" Metal	12"	90 psf	188 mph
	18"	60 psf	153 mph
2" Plastic	12"	70 psf	165 mph
	18"	45 psf	133 mph
1.25" Metal	12"	60 psf	153 mph
	18"	40 psf	125 mph

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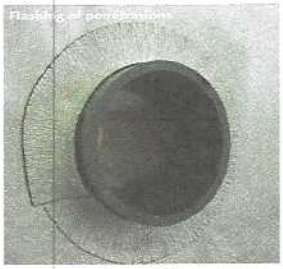
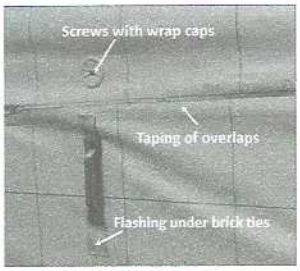
SECTION 4

Building Wraps: *Continuity at Penetrations*





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SECTION 4

Building Wraps: *Common Installation Mistakes*

Continuity at Window/Wall Interface

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SECTION 4

Building Wraps: *Continuity at Transitions*

Maintain Continuity at Transitions:

e.g. Between Building Wraps and Fluid Applied Membranes

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SECTION 4

Building Wraps: *Common Installation Mistakes*

Reverse shingle and WRB flaps not secured to interior framing

NO Sealing at penetrations

NO Window flashing

45

SECTION 4

Building Wraps: *Inspection*

- Visually inspect if WB system was correctly installed per manufacturer's installation instructions
  - *Requires periodic field observation reports for quality assurance and special warranty documentation*
- Visually inspect building wrap air barrier for proper
  - Continuity,
  - Overlap,
  - Flashing and
  - Fastening

  prior to covering it with cladding

COFF

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SECTION 4

Types of Building Wraps

- **Spunbonded Polyolefins**
  - 3D Non-woven structures

- **Microporous Films**
  - Microperforated film on course non-woven support

- Perforated Films
  - Perforated film laminated on course non-woven support
- Asphalt Impregnated Papers & Felt

These materials are Not Air Barriers

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SECTION 4

Mechanically Fastened Air Barriers: *Advantages and Limitations*

Advantages

- + **Vapor Permeable:** *most can be used in a variety of climates and wall designs*
- + **Structural Integrity:** *Commercial-grade wraps offer high structural integrity/Pass ASTM E2357*
- + **Installation:**
  - *Wide range weather conditions*
  - *No surface prep or priming required*
- + **Cost:** *Building wraps are the most cost-effective air barriers*
- + **Environmental:** *No VOCs*

Limitations

- – **Fastener type and spacing** critical for structural integrity *(Not all building wrap systems will meet ASTM E2357)*
- – **UV resistance** varies by product and manufacturer (from 4 to 12 mos.)
- – Not all building wraps are "Air Barriers"
- – Not well suited for irregular surfaces, concrete or CMU

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SECTION 5

Boardstock and Other Air Barrier Systems

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SECTION 5

Boardstock - Rigid Cellular Thermal Insulation Board

Products:

- Rigid insulation boards that are water and air resistant
- Seam treatment & flashing to make continuous across opaque surface

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SECTION 5

Rigid Cellular Thermal Insulation Board Air Barriers: *Typical Properties*

- Air Infiltration Rates
  - **Air Barrier Materials:** <0.004 cfm/ft² @ 1.57 psf (0.02 L/s-m² @ 75 Pa) must meet the material requirements when tested to ASTM E2178
  - **Air Barrier Assemblies:** <0.04 cfm/ft² @ 1.57 psf (0.02 L/s-m² @ 75 Pa) must meet the assembly requirements when tested to ASTM E2357 or ASTM E1677 pressure loads, when properly installed
- Vapor Control
  - Rigid polymeric insulation sheathings can help control condensation by moving the dewpoint outside of the stud cavity.

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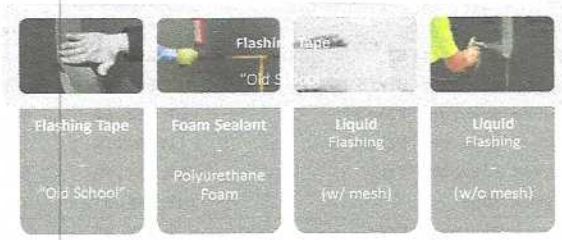
SECTION 5

Rigid Cellular Thermal Insulation Board Air Barriers: *Typical Properties*



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SECTION 5

Rigid Cellular Thermal Insulation Board Air Barriers: *Surface Preparation*

- No cleaning
- No priming
- Fasten insulation boards to CMU or the exterior face of the stud framing
- Tape or spray or trowel-apply the flashing over the joints

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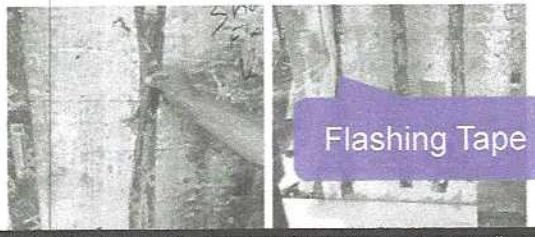
SECTION 5

Rigid Cellular Thermal Insulation Board Air Barriers: *Common Mistakes*



Installation challenges: must clean, prime, pressure install & ensure no wrinkles or fishmouths

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SECTION 5

Rigid Cellular Thermal Insulation Board Air Barriers:
Continuity at Joints & Penetrations

55

SECTION 5

Rigid Cellular Thermal Insulation Board Air Barriers:
Continuity at Joints & Penetrations

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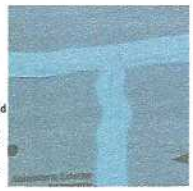
SECTION 5

Rigid Cellular Thermal Insulation Board Air Barriers: *Typical Properties*

"It is the BSC team's judgment that the lowest cost, highest performing rainwater management technology is rigid polymeric foam sheathing with sealed joints (Baker 2006, BSC 2007). The challenge that remains with this approach is to reliably and durably seal the joints. Taping joints in noninsulating and insulating sheathing has been shown to work, but is by no means an ideal solution. Several liquid (or fluid) applied rainwater management barriers could be used in place of tapes and other self-adhering membranes if applied correctly to increase the long-term durability and effectiveness of the rainwater management system, especially around penetrations in the enclosure. Many of the liquid applied membranes also function as air barrier materials that can be integrated with other components to provide an air barrier system."



Water Management of Noninsulating and Insulating Sheathings
J. Smegal and J. Lstiburek | Building Science Corporation | April 2012

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SECTION 5

Rigid Cellular Thermal Insulation Board Air Barriers: *Typical Properties*

"It is the BSC team's judgment that the lowest cost, highest performing rainwater management technology is rigid polymeric foam sheathing with sealed joints (Baker 2006, BSC 2007). The challenge that remains with this approach is to reliably and durably seal the joints. Taping joints in noninsulating and insulating sheathing has been shown to work, but is by no means an ideal solution. Several liquid (or fluid) applied rainwater management barriers could be used in place of tapes and other self-adhering membranes if applied correctly to increase the long-term durability and effectiveness of the rainwater management system, especially around penetrations in the enclosure. Many of the liquid applied membranes also function as air barrier materials that can be integrated with other components to provide an air barrier system."

Many of the liquid applied membranes also function as air barrier materials that can be integrated with other components to provide an air barrier system."

Make sure assembly tested with **ASTM E2357** for air barrier

Water Management of Noninsulating and Insulating Sheathings
J. Smegal and J. Lstiburek | Building Science Corporation | April 2012

59

SECTION 5

Rigid Cellular Thermal Insulation Board Air Barriers:
Advantages and Limitations

Advantages	*Limitations*
+ Pass ASTM E2357 if properly installed	– **Fastener type and spacing:** Critical for structural integrity *(essential to meet ASTM E2357 pressure loads)*
+ **Installation:** Wide range weather conditions, No surface prep or priming required	– **Taped Joint durability:** Installation challenges – clean, prime, pressure, no wrinkles, no fishmouths
+ **Reduced Cost:** performs multiple functions (thermal, air, water barrier); requires fewer installation steps	– **No separate membrane:** No "belt and suspenders" protection.
+ **Environmental:** No VOCs	
+ Reduced Dry-in Time (no exterior gypsum)	
+ Warranties	
+ Drainage	
+ Move dewpoint outwards with CI	

60

SUMMARY

Learning Objectives

- ☑ What is air leakage and why it matters in a sustainable envelope
- ☑ What is an air barrier & Why air barrier continuity is critical for performance
- ☑ What are the main types of air barrier systems evaluated by ABAA (Air Barrier Association of America)
- ☑ What are the main characteristics of Fluid Applied (FA), Self-Adhered (SA), Mechanically Fastened (Building Wraps), Rigid Boardstock and Other Air Barrier Systems
- ☑ What are the common installation mistakes & how can you avoid them for a high performing building envelope

61

THANK YOU!

Questions?

Presenter's Name:
Company:
Phone:
Email:

DUPONT

GBCI

62

CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

Instructors: Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications for which the BBS has approved the class, and fees in promotion materials and advertising. ***The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising***. Advertising shall not disclose improper approval information to the public.

Course sponsors/co-sponsors: provide participants a certificate of completion containing the following information: name of participant, title of approved courses, BBS approval #, BBS approved certifications, date of the continuing education program, number of approved credit hours awarded and signature of authorized sponsor or instructor.

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Participants: Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

Board approval: Remains in effect through the calendar year of approval. The course may be renewed administratively by sponsor application in subsequent years so long as it references current codes and standards Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

Facility/training area: Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

APPLICATION

FOR

Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.

Board of Building Standards
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax: (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: Ann Misiolek (Contact Name)

Organization: Parksite (Organization/Company)

Address: 3732 Tulane Ave. (Include Room Number, Suite, etc.)

City: Louisville State: Ohio Zip: 44641

E-Mail: AMisiolek@parksite.com

Telephone: 614-204-8033 Fax: 330-875-1700

Course Sponsor: DuPont

COURSE INFORMATION:

Course Title: Choices of Air Barriers for Commercial Enclosures

New Course Submittal: ■ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective: Provide a deeper understanding of air leakage, air barriers and air barrier systems as a whole for commercial buildings. Participants will learn the main evaluations performed on air barriers and air barrier systems, as well as characteristics of fluid-applied, mechanically-fastened (wraps), rigid boardstock, and other air barrier systems. This presentation will also identify real world issues, addresses why air barrier continuity is critical for performance, reviews common installation mistakes and how to avoid them for a high-performing air barrier in the building envelope.

Number of Instructional Contact Hours that can be obtained upon completion: (1) hour

If Multi-Session, Number of Instructional Contact Hours Per Session: _____

Program Applicable for the Following Participants:

Building Official ■	Master Plans Examiner ■	Building Inspector ■	Fire Protection Inspector ■	Mechanical Inspector ■	
	Building Plans Exam. ✔			Plumbing Inspector ■	
	Plumbing Plans Exam. ■			Non-Res IU Inspector ■	
	Electrical Plans Exam. ■				
	Mechanical Plans Exam. ■				
	Fire Protect. Plans Exam. ✔				
Res Building Official ■	Res Plans Examiner ■	Res Building Inspector ■	Res Mechanical Inspector ■	Res IU Inspector ☐	

Electrical Safety Inspectors ☐

Location of ESI Course: _____ Date(s) of ESI Course(s): _____

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**:		Check Off
Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	X
	Organization sponsoring or requesting the program (if any)	X
Course Title:	Name of course (related to content)	X
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	X
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	X
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	X
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	X
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	X
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	X
Test Materials:		N/A
Completed Application:		X

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

File Attachments for Item:

EC-4 Electrified Hardware Facts and Myths (Allegion - OBOA/ODPCA Conference)

All Commercial Certifications (1 hour)

Course Outline:
Locate the 2018 IBC & NFPA 101 model code requirements that affect electrified hardware product choices,
List factors that need to be considered before choosing electrified hardware products,
Ask informed question to help determine the best electrified products for the rated openings,
Specify compatible electrified hardware products to create a will-functioning opening.
Course has multiple question and answer sessions that will help lead the class to follow the electrified hardware options.

Course updated to 2018 IBC, looking for (1) hour, this course is on electrified hardware, something we all could use some information on to specify and inspect correctly inspect.

Allegion Architectural Services Consultant
RSO Midwest

Mike Fox

Architectural Services Consultant, DHT

Door and Hardware Technician (DHT) Door and Hardware Technician (DHT) Specialist in the door hardware industry since 2006

https://www.linkedin.com/in/mike-fox-90685513/

https://twitter.com/AllegionUS

www.idighardware.com

Contact

Office: 877.238.2022

Mobile: 614.493.8404

Email: mike.fox@allegion.com

Bio

Mike Fox, is currently an Architectural Consultant with Allegion, a leading manufacturer of doors and hardware. Prior to this current role Mike was an End User Sales Consultant for Allegion for 13 years in Central Ohio. As an architectural consultant, Mike's main role is to assist architects with development of a specification that meets the building owners needs. And to work as a consultant to the architect concerning hardware applications related to fire, egress and ADA codes. Mike has been in the commercial door and hardware industry for 20 years and got his start in the business as a solutions engineer & installation technician.

Key projects worked on

The Ohio State University NRDT – Columbus, Ohio; The Ohio State University Advance Materials Corridor, Columbus, Ohio; South-Western City Schools – Elementary School Replacement(11 new elementary schools & 2 Renovations), Grove City, Ohio; Mt. Carmel Grove City New Hospital, Grove City, Ohio; Mt. Carmel East New Tower & Renovation, Columbus, Ohio; Franklin County Corrections Center, Columbus, Ohio; Franklin County Forensic Science Center, Columbus, Ohio; Nationwide Children's Hospital Livingston Ambulatory Center, Columbus, Ohio; Nationwide Children's Hospital Behavioral Health Pavilion, Columbus, Ohio

Personal Achievements

Eagle Scout – Boy Scouts of America – May 1999

Bachelor of Science in General Business from The Ohio State University – 2004

Ingersoll Rand Security Technologies President's Club – 2008

ASIS Member – January 2009 – Present Ingersoll Rand Security Technologies Playmaker Award – 2013

Location

3405 York Road
Pataskala, OH 43062

CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS

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Board of Building Standards
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax: (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: Michael Fox
(Contact Name)
Organization: Allegion, PLC
(Organization/Company)
Address: 11819 North Pennsylvania Street
(Include Room Number, Suite, etc.)
City: Carmel State: Indiana Zip: 46032
E-Mail: Mike.Fox@allegion.com
Telephone: 614-493-8404 (Cell) Fax: _____
Course Sponsor: Ohio Design Professionals & Code Analysts

COURSE INFORMATION:

Course Title: Electrified Hardware - Facts and Myths

New Course Submittal: ■ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective: Provide Data information on electrified hardware and the requirements per the OBC/IBC & NFPA 101 Where is electrified hardware allowed? What IBC code sections provide rules to govern type and installation of electrified hardware. Why would you use electrified hardware? Is electrified hardware "fail safe" where is non- fail safe hardware allowed? Is battery back-up allowed? What switches are required? These questions and others are answered with this course. Several test questions.

Number of Instructional Contact Hours that can be obtained upon completion: (1) hour

If Multi-Session, Number of Instructional Contact Hours Per Session: _____

Program Applicable for the Following Participants:

Building Official	■	Master Plans Examiner	■	Building Inspector	■	Fire Protection Inspector	■
		Building Plans Exam.	✔				
		Plumbing Plans Exam.	■				
		Electrical Plans Exam.	■				
		Mechanical Plans Exam.	■				
		Fire Protect. Plans Exam.	✔				

Mechanical Inspector	■	Plumbing Inspector	■	Non-Res IU Inspector	☐				

Res Building Official	☐	Res Plans Examiner	☐	Res Building Inspector	☐	Res Mechanical Inspector	☐	Res IU Inspector	☐

Electrical Safety Inspectors X
Location of ESI Course: _____ Date(s) of ESI Course(s): _____

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**:		Check Off
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	Organization sponsoring or requesting the program (if any)	
Course Title:	Name of course (related to content)	
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	
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Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	
Test Materials:		
Completed Application:		

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

Copyright Materials

ALLEGION™

AIA Continuing Education Provider

“Allegion” is a Registered Provider with The American Institute of Architects Continuing Education Systems (AIA/CES). Credit(s) earned on completion of this program will be reported Allegion to AIA/CES for AIA members.

Certificates of Completion for both AIA members and non-AIA members are available upon request.

AIA Continuing Education Provider

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Program Title: Electrified Hardware – Facts and Myths

Program Number: PEG21002

Provider Name: Allegion

AIA Provider #: J247

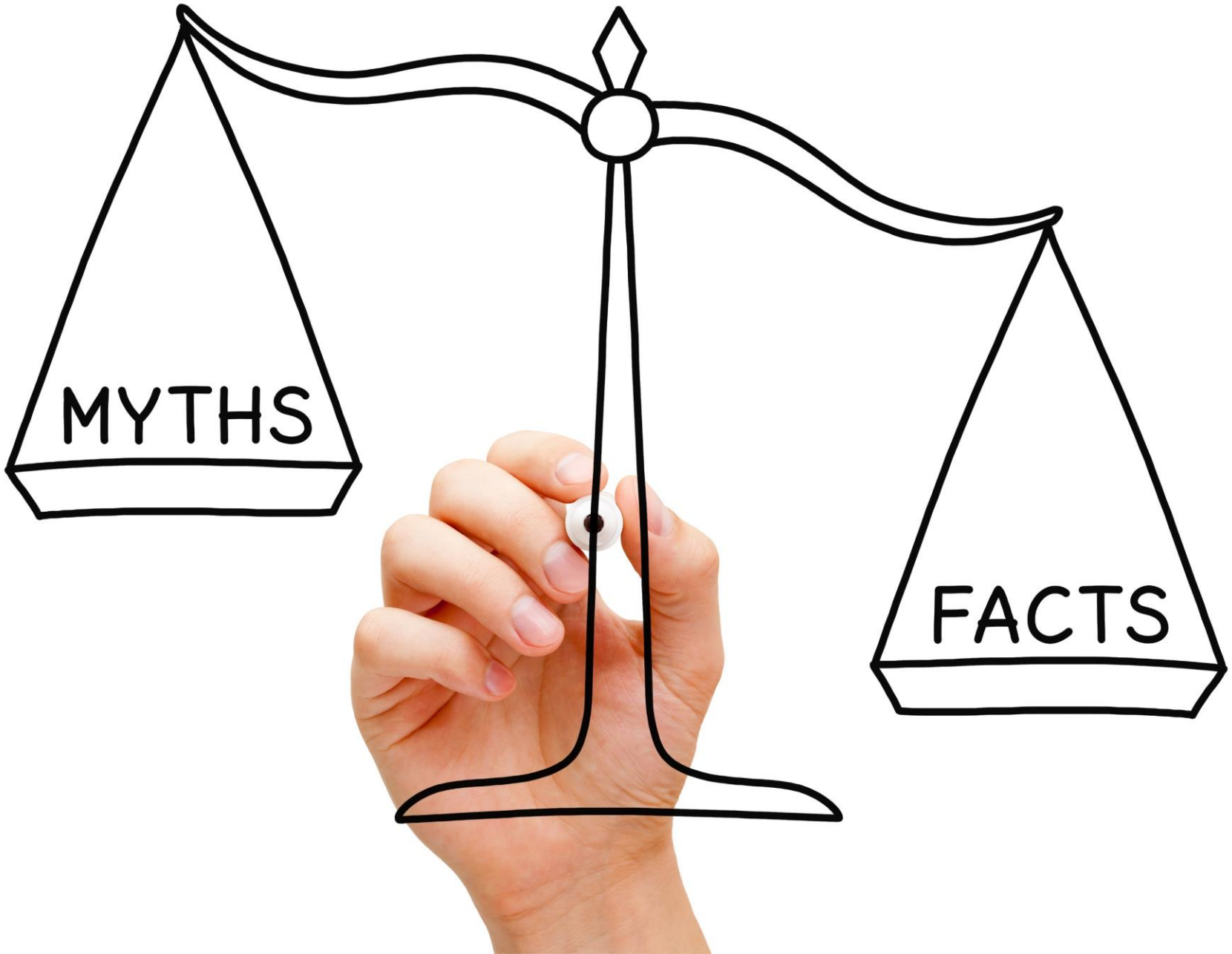
Learning Units: 1 HSW

Course Description:

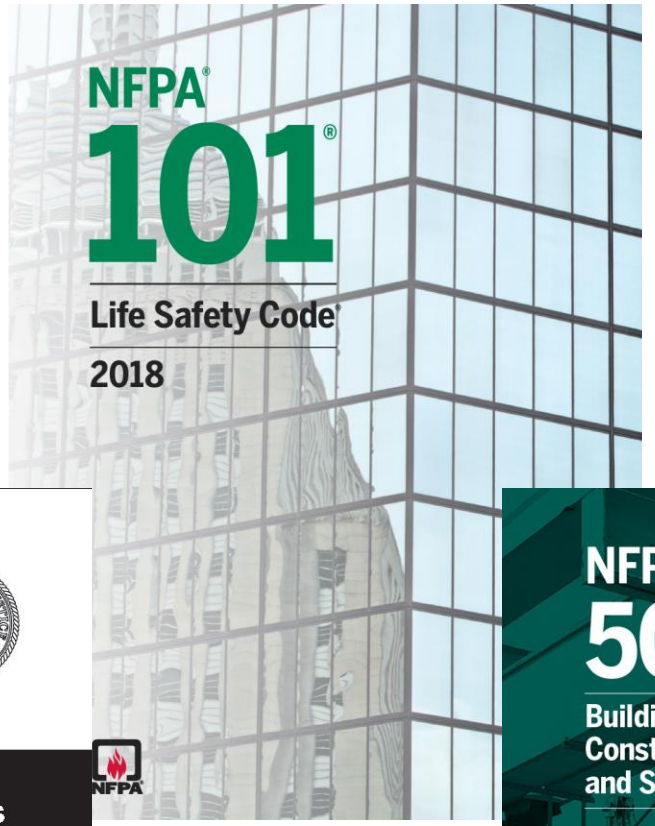
Do you look at all the options in electrified hardware and wonder what to choose? Electrified door hardware can be the answer to many opening needs, but what do you need to know to properly specify that hardware for the opening? This fun and interactive course covers the operation, features, and functionality of popular electrified products, codes that affect your choices and factors to consider before hardware decisions are made.

Upon successful completion of this course participants will be able to:

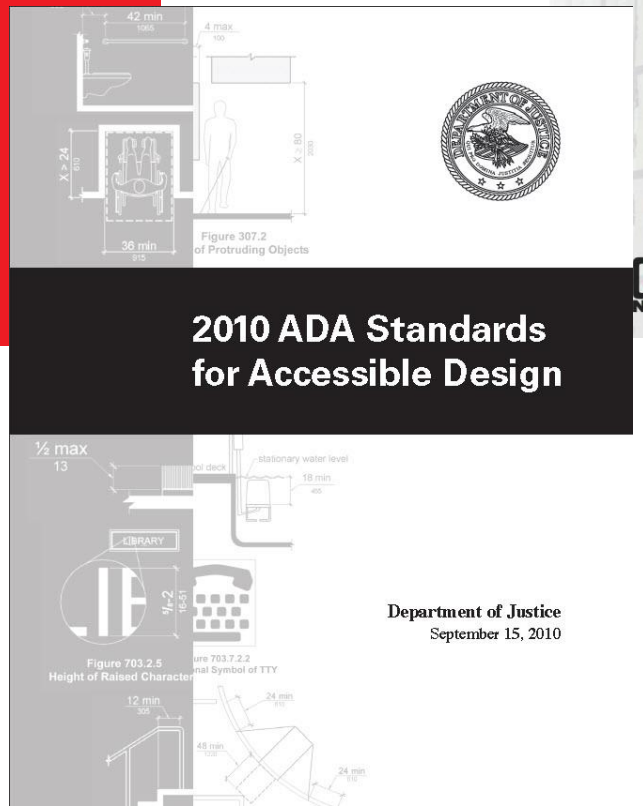
- Locate the IBC & NFPA101 model code requirements that affect electrified hardware product choices
- List factors that need to be considered before choosing electrified hardware products.
- Ask informed questions to help determine the best electrified products for the opening
- Specify compatible electrified hardware products to create a well-functioning opening.

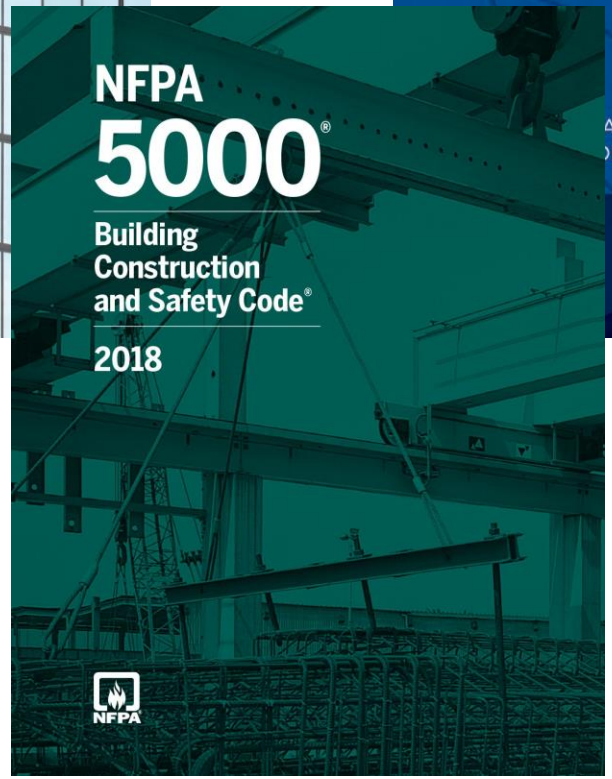

MYTHS
FACTS

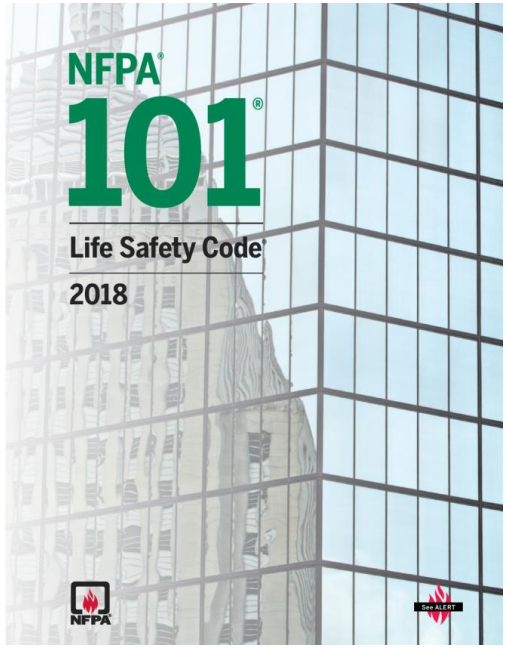

NFPA
80
Standard for
Fire Doors and Other
Opening Protectives
2019
NFPA


NFPA
101
Life Safety Code
2018
NFPA


2018
INTERNATIONAL CODES
IBC
A Member of the International Code Family
ICC
INTERNATIONAL CODE COUNCIL


42 min
4 max
X ≥ 24
X ≤ 60
36 min
Figure 307.2
of Protruding Objects
2010 ADA Standards
for Accessible Design
½ max
13
stationary water level
18 min
LIBRARY
Figure 703.2.5
Height of Raised Character
12 min
24 min
48 min
Department of Justice
September 15, 2010


NFPA
5000
Building
Construction
and Safety Code
2018
NFPA



Chapter(s):

7	Means of Egress
8	Features of Fire Protection
12-42	Occupancy Chapters
7	Fire & Smoke Protection Features
10	Means of Egress

Which code reference about electrified hardware is not correct?

A

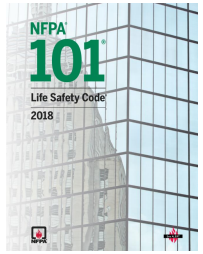
An electric strike used on a fire door assembly must be fail safe.

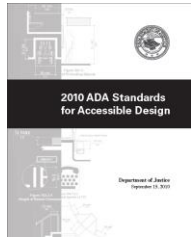
B

In most cases, required electronically controlled egress doors must allow egress at all times.

C

Delayed egress openings must be fail safe.





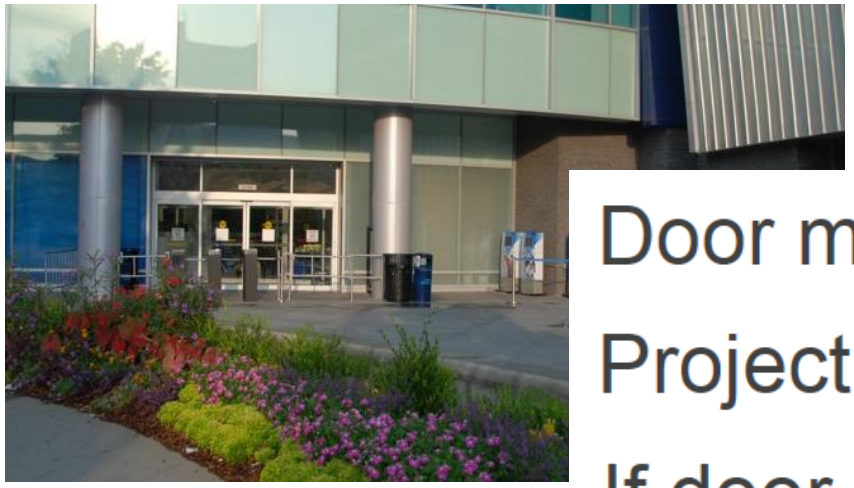
EMERGENCY EXIT ONLY

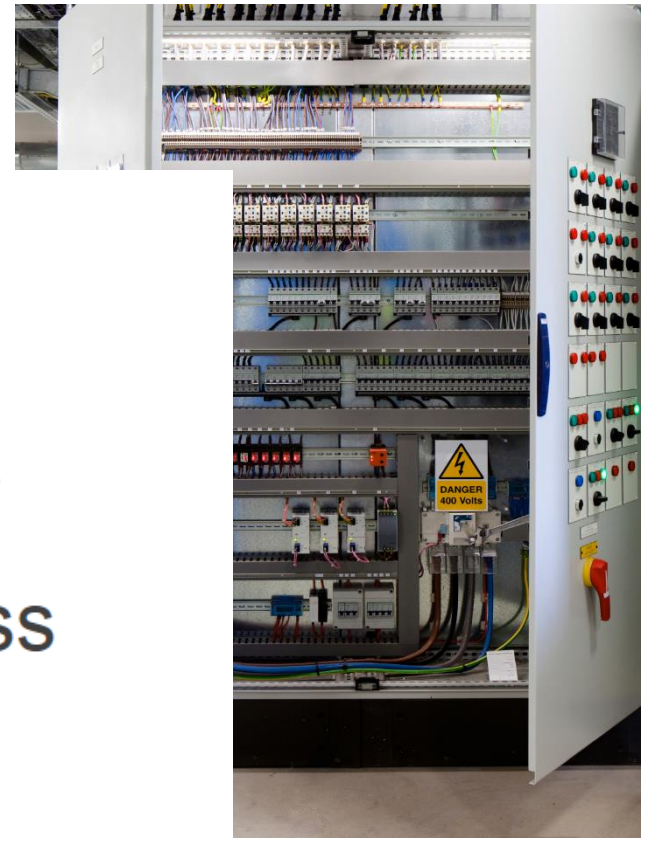
PICK UP PHONE FOR EMERGENCY EXIT

In addition to codes there are many other factors that determine what products get specified for an opening.
Choose all that may determine what electrified products can be used:

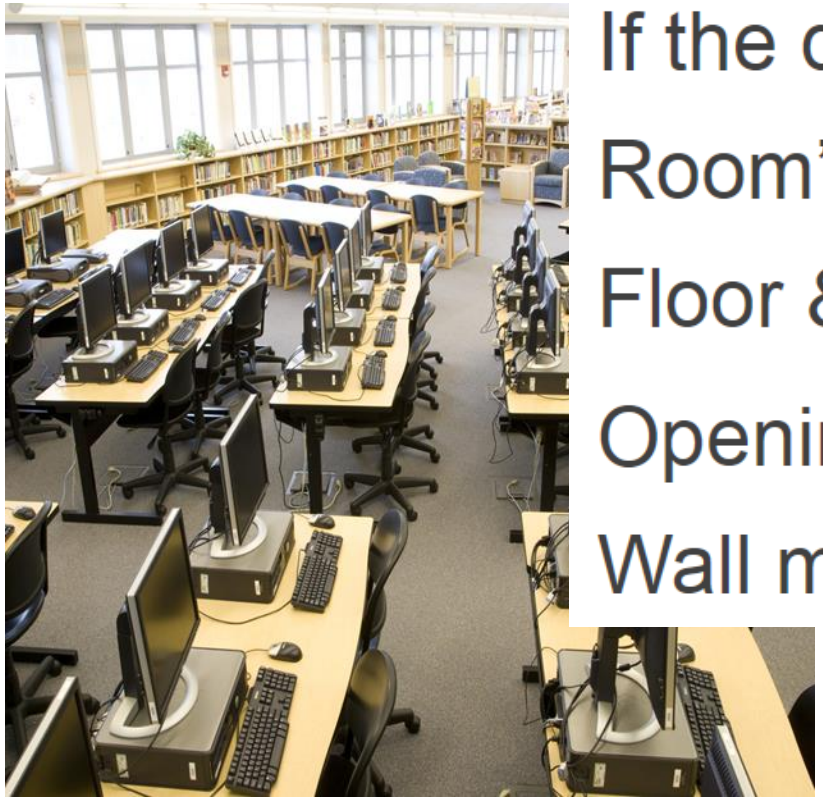
1. Door material (steel/wood)
2. Project's budget
3. Single or double door
4. If door is in a means of egress
5. Room's use
6. Floor & ceiling material at the opening
7. Opening's frame type
8. Wall material
9. Expected room temps

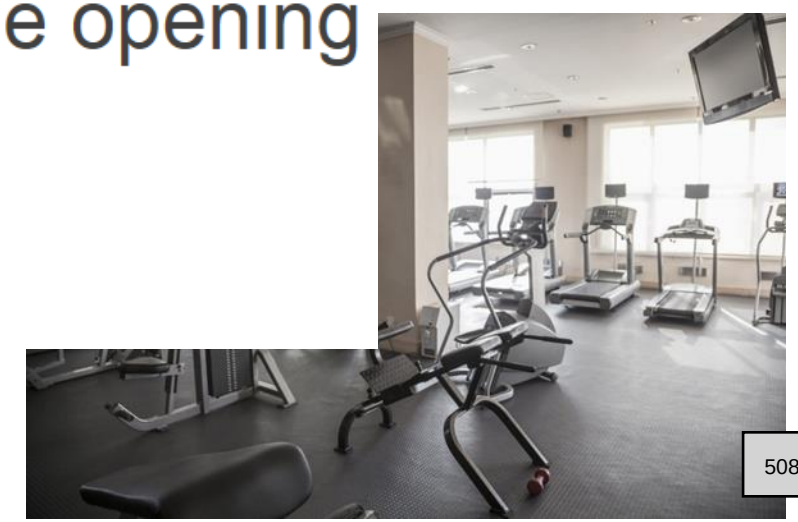
Needs





- Door material (steel/wood)
- Project's budget
- If door is a single or double door
- If the door is in a means of egress
- Room's use
- Floor & Ceiling material at the opening
- Opening's frame type
- Wall material





Basic Electrical Circuit:

Power Source
Provides electricity to operate the load

Switch
Used to control the follow of electricity

Conductor
The path the electricity follows

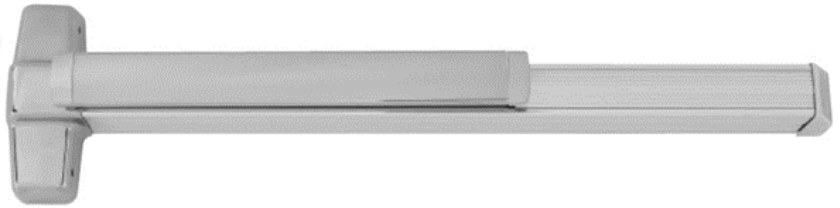
Load
Products that operate to lock/unlock, open/close the door when electricity is applied

Loads

1

2

3



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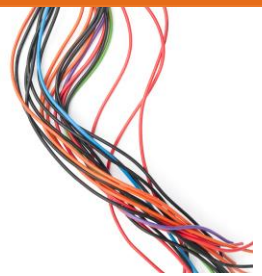


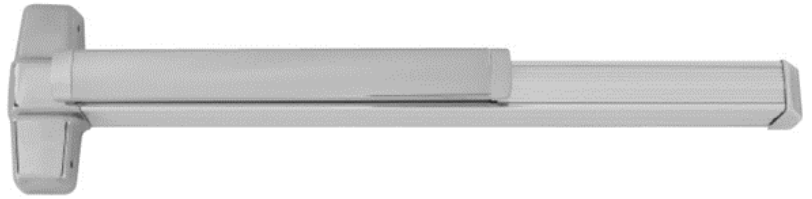
13

14

Switches

1 

2 

3 

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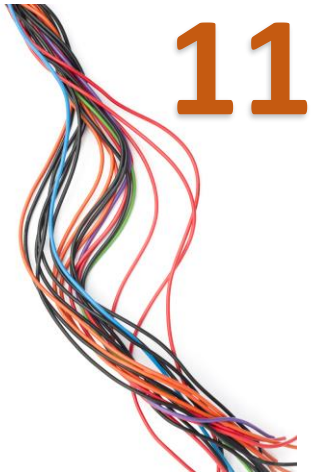
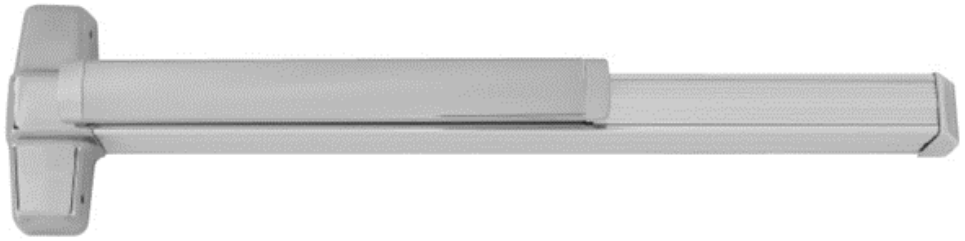
11 

13 

14 

Loads -Why specify electrified locking products?



Advantages of specifying electrified locking products.

A

They can eliminate problems with unauthorized entry.

B

Some can provide time and attendance capabilities.

C

They can help meet code requirements of providing free egress while maintaining security.

Strikes

A

Electric strikes can be fail safe or fail secure.

B

They work with standard mortise and cylindrical locks.

C

They can be used on a fire rated door as long as they are fail safe.

Exit Devices can be specified:

A

with delayed egress in all occupancies, but must open within 15 sec of power loss & bear required signage.

B

as rim, mortise, vertical rods, or with concealed vertical cables.

C

with electric latch retraction, quiet latch retraction, monitoring, & dogging.

Electro Magnetic Locks

A

Have no moving parts

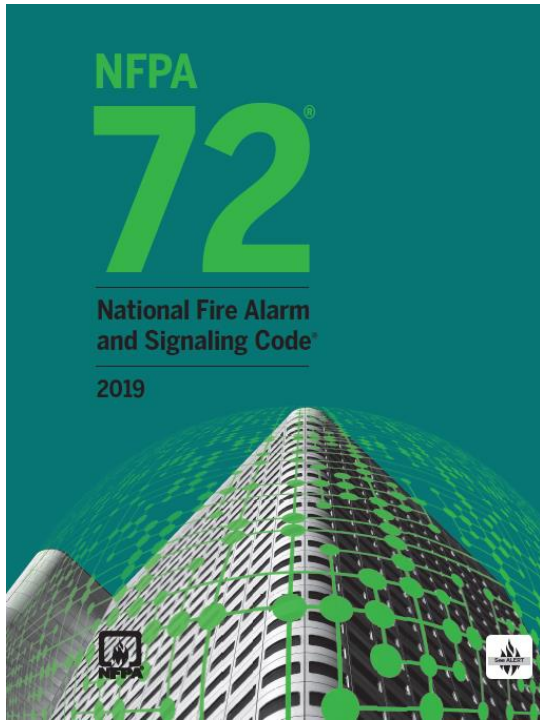
B

Are not good for high use doors

C

Are inherently fail safe

Is battery backup allowed?



- Codes require mag-locks to unlock upon loss of power, but “loss of power” is not defined.
- NFPA 72 Interpretation - if the fire alarm system and mag-locks are on the same back-up power, this would meet the intent of the code.
- Do not specify separate battery back-up in the power supply for the locks.

Types of Auto Operators

A

Low Energy

B

High Energy

C

Sustained Energy

Automatic Operators

Low Energy

Minimum 3 seconds to backcheck & 4 seconds to fully open

No more than 15 lbs. of force to stop door movement

Does not require guard rails, safety mats, canceling scanners

Must comply with ANSI/BHMA A156.19

High Energy

1.5 seconds to backcheck

No more than 40 lbs. of force to stop door movement

ALWAYS requires guard rails, safety mats or canceling scanners

Must comply with ANSI/BHMA A156.10

Auto Operators

A

If an opening will have to deal with high winds, specify an auto operator with a positive latching feature which increases the latch force.

B

To help eliminate install issues, auto operators are field reversible for different handings.

C

The size of the frame reveal changes depending on which side of the door the auto operator is installed.

What info do you need to know about all electrified locks you are specifying

A

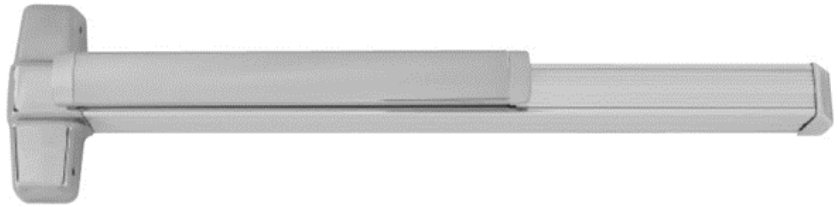
Keying requirements for the cylinder

B

Product manufacturer's wiring requirements

C

Product's amp and voltage requirements



Power Supply

A

You must match the voltage of the products to the voltage of the power supply.

B

To specify the power supply you'll need to know the hardware's wire requirements.

C

You can connect multiple electrified products to 1 power supply as long as the products' amps are < that what the power supply provides.

Power Supply

Golden Rule

- **Match Up Volts** - VOLTAGE RATINGS on ALL components in an electrical circuit **MUST** BE THE SAME
- **Add Up Amps** – Total number of ALL components must be ≤ than the output of the power supply
- Need to have more amps than needed

One power supply is to operate two single openings.

Which group of electrified products will not work with a 1 amp power supply?

A

Opening 1:
Electromagnetic lock .333 amps
Indicator panel .05 amps
Opening 2:
Electric strike .25

B

Opening 1:
Electrically locked mortise lock .25 amps
Opening 2:
Electromagnetic lock 0.333 amps,
a horn 0.50 amps

C

Opening 1:
Electrified holder/ closer .12 amps
Auto operator 1.5 amps
Opening 2:
Electric strike .25

Switch

When used with electrified hardware, a switch controls the flow of electricity to either apply or remove electricity to the hardware.

Momentary

Maintained

Which isn't an electrified hardware switch

A

B

C

Switches

Access Controls

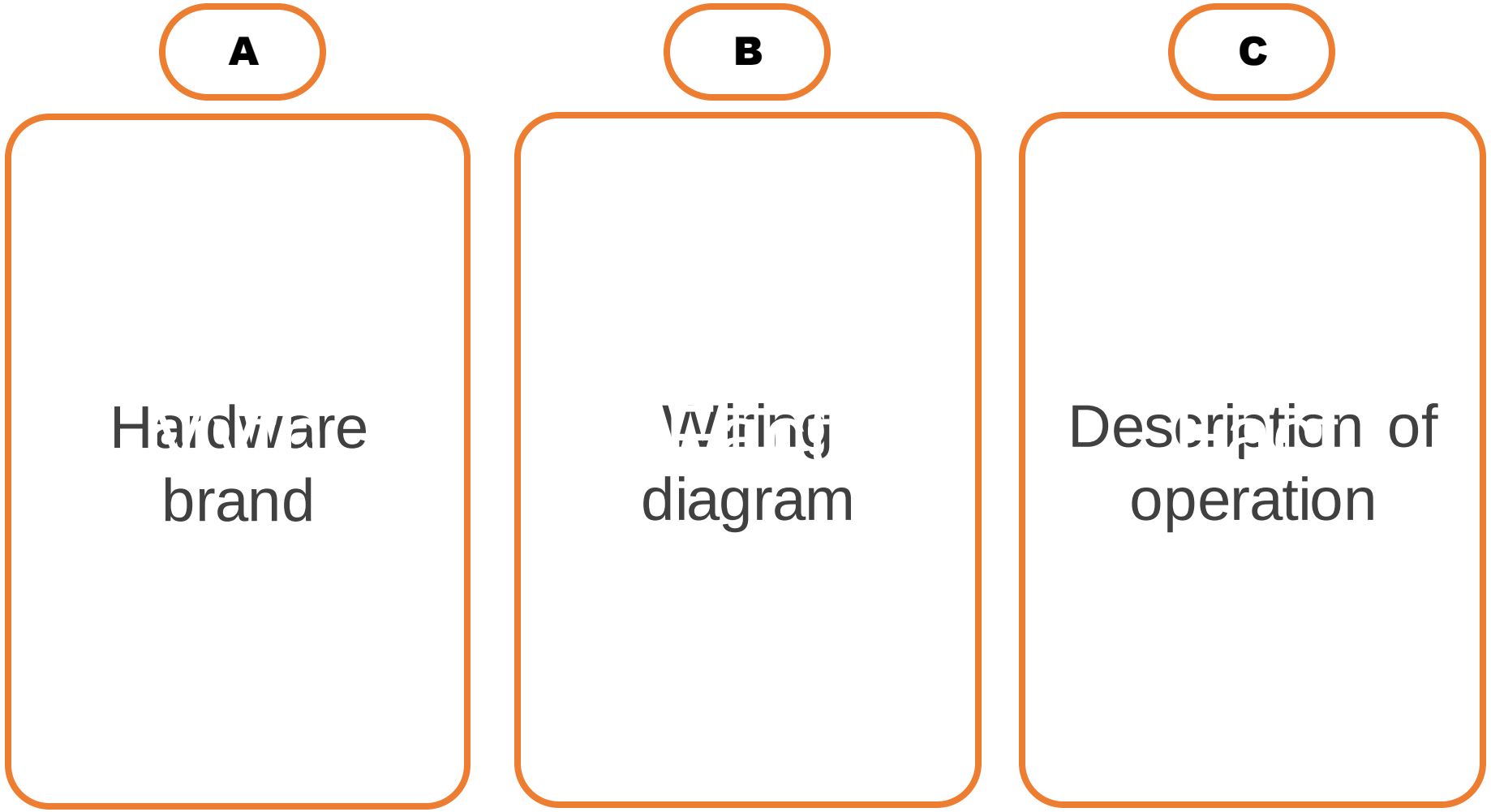
- Key Switch
- Keypads
- Card Reader
- Biometrics

Readers

Access Controls

- Key Switch
- Keypads
- Card Reader
- Biometrics

What needs to be included in an electrified hardware set?



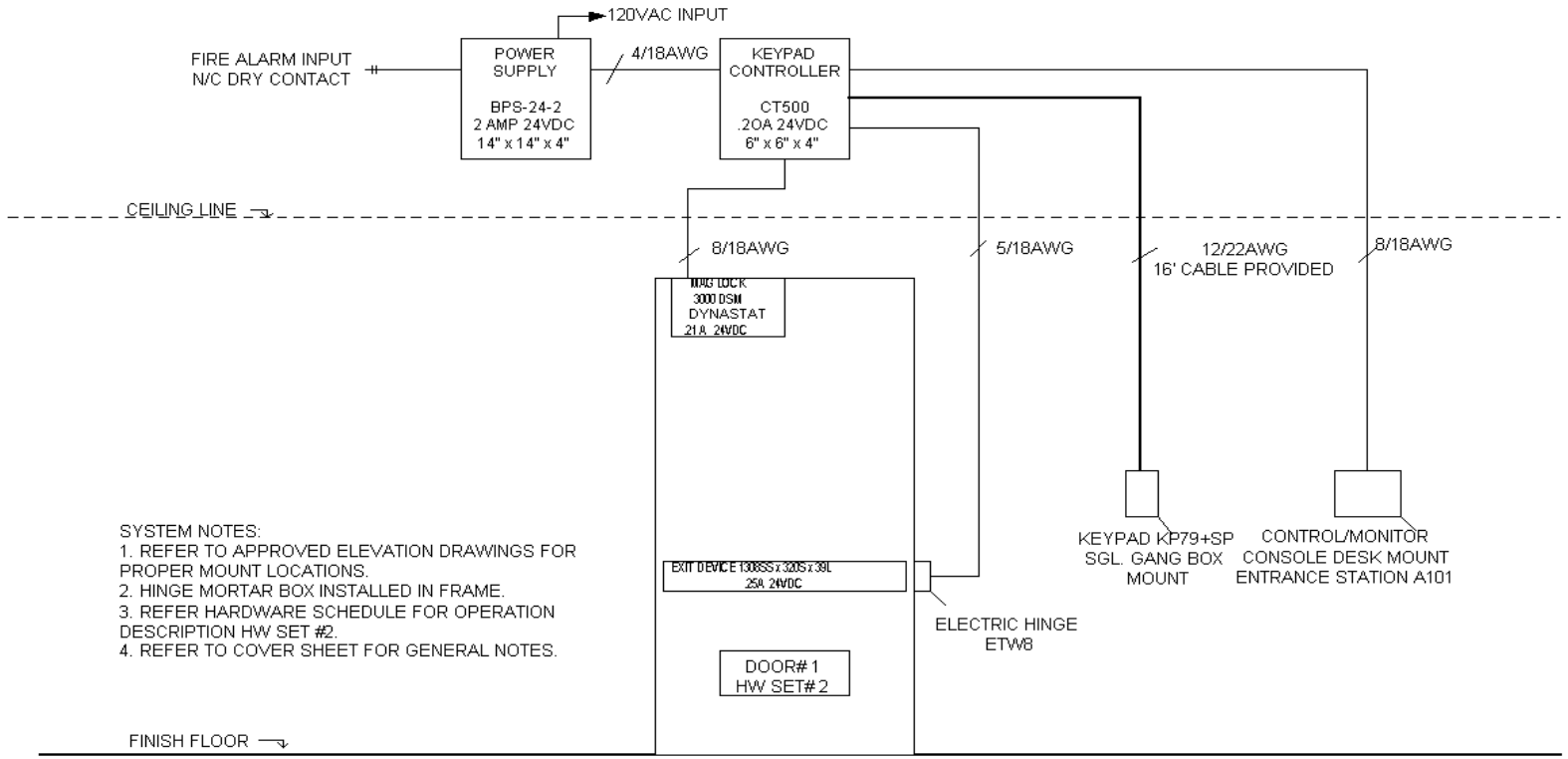
Additional Scope

- Include Description of Operation
- Separate Miscellaneous Hardware Set to include:
  - Wiring Diagrams (Riser/Point to Point)
  - Training
  - Operations Manuals
  - Monitor Panels/Consoles
  - Computer Hardware/Software Type

Elevation/Riser Diagram

Include Operation Description

Place on Blue Prints in Architectural/Electrical/Security Section



Hardware Set Example

HARWARE SET #1

SGL.		DOOR #1	3’-0” X 7’0” X 1 ¾”	HMD/HMF	RHR
3 EA	HINGES		5BB1 4-1/2” X 4-1/2” NRP	630	IVE
1 EA	POWER TRANSFER		EPT10	SP28	VON
1 EA	EXIT DEVICE		RX-QEL-98-L-NL-996-06	630	VON
1 EA	RIM CYLINDER		20-057-ICX	626	SCH
1 EA	CORE		20-740	626	SCH
1 EA	CLOSER		4111 EDA	689	LCN
1 EA	POWER SUPPLY		PS902-2RS		VON
1 EA	STOP		WS496CCV	630	IVE
3 EA	SILENCERS		SR64	GRY	IVE
1 EA	CONTROLLER		CT5000		SCE
1 EA	SMART CARD READER		SM10		SCE
1 EA	POWER SUPPLY		PS902-8F		SCE
1 EA	DOOR CONTACT		679-05HM		SCE

ALL WIRING AND CONNECTIONS BY DIVISION 28.

OPERATIONAL DESCRIPTION:

IMMEDIATE EGRESS ALWAYS ALLOWED. ACCESS BY KEY OR BY CARD READER. AUTHORIZED CREDENTIAL WILL RETRACT EXIT DEVICE LATCHBOLT AND ALLOW ACCESS. REQUEST TO EXIT AND DOOR CONTACT CONNECTED TO ACCESS CONTROL SYSTEM.

MISCELLANEOUS SET #2

1 EA	HAND HELD DEVICE	HHD-KIT	SCE
1 EA	OWNER TRAINING		
1 EA	OPERATION MANUAL		
1 EA	WIRING DIAGRAM		

Related Work

Division 1 General Requirements

- 01210 Allowances
- 01270 Unit Prices
- 01330 Submittals
- 01640 Owner Furnished - Access Control
- 01780 Closeout Submittals, Maintenance, Spare Parts, Product Warranties
- 01820 Demonstrations and Training

Related Work

- Section 02200 - Site Preparation
- Section 02400 - Tunneling, Boring & Jacking
- Section 02500 - Utility Services
- Section 08110 - Steel Doors and Frames
- Section 08200 - Wood Doors
- Section 08400 - Aluminum Storefront
- Section 11020 - Security and Vault Equipment
- Section 11150 - Parking Control Equipment
- Section 11190 - Detention Equipment
- Section 13700 - Security Access & Surveillance
- Section 13850 - Detection & Alarm
- Section 14200 - Elevators
- Section 16000 - Electrical/Fire Alarm


THE
WINNER
IS...

Questions?

Thank You!

This concludes the American Institute of Architects Continuing Education Systems Program

The following slides contain project information that might be of interest to the architect and can be printed if you give handouts of the course after the class.
These are not part of the class presentation.

Project Management

- Low Voltage Meeting
- Submittals
  - Wire Sizes/AWG As Required
  - Special Installation Requirements
  - Special Mounting Requirements
- Delivery, Storage, & Handling
- After Installation Support

Low Voltage Meeting – Who Attends?

People that should attend:

- General Contractor
- Contract Hardware Distributor
- Hardware Installer
- Architect
- Owner
- Security Contractor
- Electrical Contractor
- Fire Alarm Contractor
- All Door/Frame Suppliers

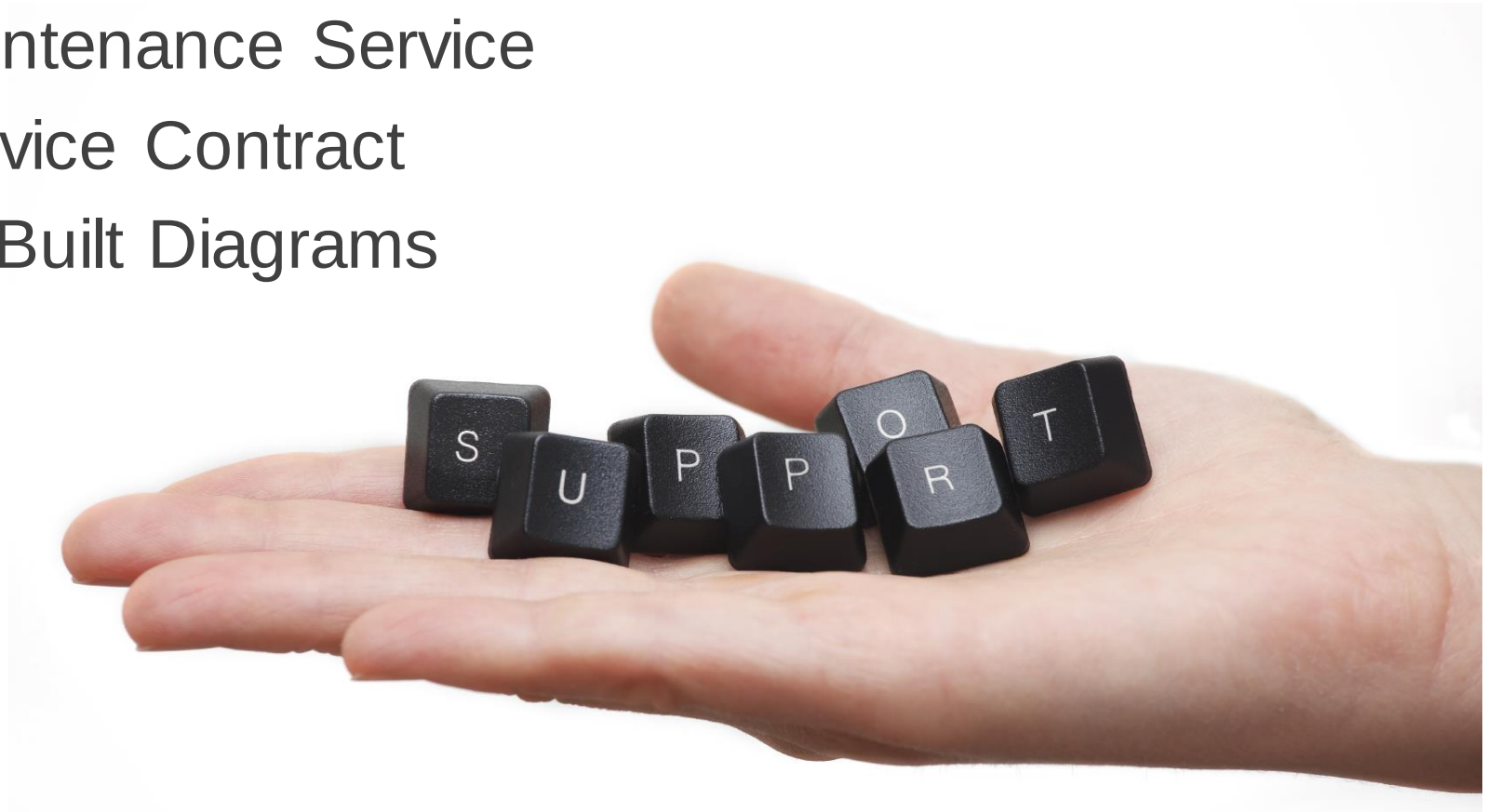
Delivery, Storage & Handling

- Delivery of:
  - Electronic Hardware Products: prior to ceiling install, ductwork & electrical piping
  - Computer Equipment & Software Programs: at system startup
- Handling of:
  - Controller & PC: Secure storage facility with limited access and dry climate

Power supplies, junction boxes, controllers, timers and other products with junction boxes shall be delivered prior to ceiling installation, ductwork and electrical piping.
Computer equipment and software programs shall be delivered to owner representation at time of system startup.
Storage facility for controller and PC boards shall be secure with limited access and dry climate.

After Installation Support

- Schedule Owner Training
- Submit Operation Manuals
- Maintenance Service
- Service Contract
- As Built Diagrams



System Startup

- Software Training/Programming Training
- Owner Instructions
- Maintenance Service
- Service Contracts
- Operation Manuals

File Attachments for Item:

EC-5 Firewall Solutions for Wood-Framed Construction (Simpson Strong-Tie)

BO, MPE, BPE, BI, NRIUI, RBO, RPE, RBI, RIUI (1 hour)

Presenter Biography

Jim Mailey, Training Manager, Simpson Strong-Tie
Jim Mailey is the Midwest, Northeast and Mid-Atlantic market training manager for Simpson Strong-Tie – a company that for more than 50 years has developed structural products to help people build safer and stronger buildings, homes and decks. Joining Simpson Strong-Tie in 1992, Jim has given hundreds of presentations to more than 20,000 design professionals, building officials, builders, contractors and dealers. He has developed numerous programs designed to educate industry professionals about how to install Simpson Strong-Tie® products as well as how these products meet various building code requirements. Jim is considered an expert in safe, outdoor wood deck construction and provides economical product solutions to satisfy structural code requirements for wood decks. He has written articles about deck safety and has been quoted in deck contractor and home inspector publications. His program entitled "Deck Framing Connections Seminar" reviews the correct and incorrect structural methods for building a deck, shows why commonly accepted practices should not be used and provides informative tips that the novice to the most experienced deck builder will find useful. Jim earned a B.A. from Bloomsburg University in Bloomsburg, Pennsylvania, in 1980.

Greg Wujcik, Territory Manager, Simpson Strong-Tie
Greg Wujcik is the Territory Manager for the state of Ohio for Simpson Strong-Tie - – a company that for more than 50 years has developed structural products to help people build safer and stronger buildings, homes and decks. Greg has been with Simpson Strong-Tie since 2000, and has given numerous presentations to design professionals, building officials, builders, contractors, and dealers. Greg also works with these same groups educating them on the proper use and installation of Simpson Strong-Tie products in order to provide economic solutions to satisfy building code requirements. Greg earned a B.A. from Baldwin-Wallace College in Berea, Ohio in 2000.

Simpson Strong-Tie is committed to helping customers succeed by providing exceptional products, full-service engineering and field support, product testing and training. For more information, visit the company's website at www.strongtie.com.

CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

Instructors: Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications for which the BBS has approved the class, and fees in promotion materials and advertising. ***The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising***. Advertising shall not disclose improper approval information to the public.

Course sponsors/co-sponsors: provide participants a certificate of completion containing the following information: name of participant, title of approved courses, BBS approval #, BBS approved certifications, date of the continuing education program, number of approved credit hours awarded and signature of authorized sponsor or instructor.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

Participants: Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

Board approval: Remains in effect through the calendar year of approval. The course may be renewed administratively by sponsor application in subsequent years so long as it references current codes and standards Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

Facility/training area: Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

APPLICATION

FOR

Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.

Board of Building Standards
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax: (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: Greg Wujcik
(Contact Name)

Organization: Simpson Strong-Tie
(Organization/Company)

Address: 2600 International St.
(Include Room Number, Suite, etc.)

City: Columbus State: OH Zip: 43228

E-Mail: gwujcik@strongtie.com

Telephone: 440-263-2490 Fax: 614-876-0636

Course Sponsor: _____

COURSE INFORMATION:

Course Title: Firewall Solutions for Wood Framed Construction

New Course Submittal: ■ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective:

We will discuss firewall code requirements as they relate to multi-story wood frame construction. We will also address the challenges associated with floor to firewall connections and provide solutions to those challenges

Number of Instructional Contact Hours that can be obtained upon completion: 1

If Multi-Session, Number of Instructional Contact Hours Per Session: _____

Program Applicable for the Following Participants:

Building Official	■	Master Plans Examiner	■	Building Inspector	■	Fire Protection Inspector	☐
		Building Plans Exam.	☐				
		Plumbing Plans Exam.	☐				
		Electrical Plans Exam.	☐				
		Mechanical Plans Exam.	☐				
		Fire Protect. Plans Exam.	☐				

Mechanical Inspector	☐	Plumbing Inspector	☐	Non-Res IU Inspector	☐				

Res Building Official	■	Res Plans Examiner	■	Res Building Inspector	■	Res Mechanical Inspector	☐	Res IU Inspector	☐

Electrical Safety Inspectors ☐

Location of ESI Course: _____ Date(s) of ESI Course(s): _____

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**:		Check Off
Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	x
	Organization sponsoring or requesting the program (if any)	
Course Title:	Name of course (related to content)	x
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	x
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	x
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	x
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	x
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	x
Test Materials:		
Completed Application:		

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

Firewall Solutions for Wood-Frame Construction

Presentation Description:

During this presentation, we will discuss firewall code requirements as they relate to multi-story wood-frame construction. We will also address the challenges associated with floor-to-firewall connections and provide solutions to those challenges.

Presentation Outline:

I. Resources for Firewall-Related Information

II. Fire-Resistive Rated Walls & Fire-Resistance Ratings
- a. Types of Fire-Resistance Rated Walls
- b. Methods for Establishing Fire-Resistance Designs
- c. Evaluation of Penetrations in Fire-Resistance-Rated Assemblies

III. Fire-Resistance Requirements & Design Considerations
- a. Fire-resistance Requirements vs. Type of Construction
- b. Fire-resistance Requirements for Type IIIA Construction
- c. Design Considerations Related to FRT Lumber
- d. Continuity Considerations Related to Floor-to-Wall Connections in Type IIIA Construction

IV. Floor-to-Firewall Details (where 1-hr floor assemblies intersect 2-hr wall assemblies)
- a. Standard Platform Framing
- b. Solid Header/Rim Board On Top of Wall
- c. Hanger over 1 Layer of Gypsum
- d. Continuous Ledger (Ledger-to-Stud)
- e. Ledger Over Gypsum
- f. Hanger Over 2 Layers of Gypsum

V. Firewall Hangers (Hangers Designed for 2 Layers of Gypsum)
- a. Hangers that require installation after vs. before the drywall
- b. Effect of Drywall Notches on Fire Resistance of Rated Assembly
- c. Fire Testing per ASTM E814
- d. Additional Design Considerations Related to Firewall Hangers
- e. Alternative Hanger Solutions for Stair Landings & Corridor Joists

Presenter Bio:

Greg Bundy, P.E. – Greg joined Simpson Strong-Tie in 2003 as a Branch Engineer providing support to 24 states throughout the Northeast, Midwest and Mid-Atlantic regions of the United States. Prior to joining Simpson, Greg acquired almost twenty years of experience at two structural engineering firms in Columbus, Ohio. He is a registered Professional Engineer in nine states and received certification in the practice of structural engineering from the Structural Engineering Certification Board (SECB). Over the years, he has presented on a wide variety of topics. These programs focus on presenting structural design concepts in an easy to understand format.

Firewall Solutions for Wood-Frame Construction

Course Outline

1	Resources for Firewall-Related Information
2	Fire-Resistive Rated Walls & Fire-Resistance Ratings
3	Fire-Resistance Requirements & Design Considerations
4	Floor-to-Firewall Details
5	Firewall Hangers

Resources for Firewall-Related Information

• STRUCTURAL ENGINEERING

Firewalls for Wood Construction

What is a firewall? A firewall is a term that is used in the construction wall or fire-stop system, which is an element in a building that separa fire and smoke within a building or between separate buildings. A fire

Related Posts by Guest Blogger Bruce Lindsey, South Atlantic Regional Director for WoodWorks

Fire Protection Considerations with Five-Story Wood-Frame Buildings Part 1

Fire Protection Considerations with Five-Story Wood-Frame Buildings: Part 2

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Resources for Firewall-Related Information

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Webinar Archive

Free online seminars related to wood design.

Show only: Fire Resistance

- Fire and Sound Detailing for Mid-Rise Wood-Frame Buildings
- Exposed Wood in Fire-Resistive Applications
- Shaft Wall Solutions for Wood-Frame Structures
- Code-Compliant Fire-Resistance Design for Wood Construction
- Fire Retardant-Treated Wood: The Basics
- The Evolution of Fire Life Safety in Building Codes
- Fire-resistive Design of Exposed Timber Structures

A "firewall" is one of 3 different types of Fire-Resistance Rated Walls: Firewalls, Fire Barriers and Fire Partitions

Most Stringent

Code Requirements

Least Stringent

Firewalls - party walls

Fire barriers - shaft enclosures, occupancy separations

Fire partitions - corridor walls

Requirements	Wall Types		
	Firewalls	Fire Barriers	Fire Partitions
Fire-resistance-rated materials	X	X	X
Protected openings	X	X	X
Wall assembly	X	X	X
Vertical continuity	X	X	
Structural stability	X		

Fire Wall Hangers

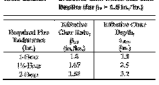
Fire-Resistance Rated Wall

229–233

All fire-resistance rated walls have a required fire rating & there are various methods for establishing fire-resistance designs that meet this

Prescriptive tables

Calculations



Testing

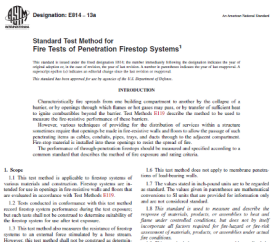
Underwriters Laboratories

intertek
Total Quality. Assured.

FM
APPROVED

Approved Sources

But when a fire-rated assembly is modified, there must be proof that the fire-resistance rating is not reduced



Designation: E814 – 13a

Standard Test Method for
Fire Tests of Penetration Firestop Systems

INTRODUCTION

1. Scope

1.1 This test method is applicable to firestop systems of various materials and construction. Firestop systems are intended for use in openings in fire-resistive walls and floors that are evaluated in accordance with Test Methods E119.

1.2 Tests conducted in conformance with this test method record firestop system performance during the test exposure; they do not indicate the continuing structural stability of the firestop system for use after test exposure.

1.3 This test method also measures the resistance of firestop systems to an external force stimulated by a hose stream. However, this test method shall not be construed as determin-

1.6 This test method does not apply to membrane penetrations of load-bearing walls.

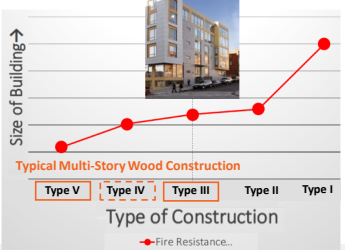
1.7 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.8 *This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire-hazard or fire risk assessment of materials, products, or assemblies under actual fire conditions.*

2015 IBC 703.2.4

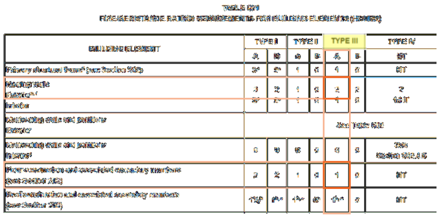
"Where materials, systems or devices that have not been tested as part of a fire-resistance-rated assembly are incorporated into the building element, sufficient data shall be made available to the building official to show that the required fire-resistance rating is not reduced"

Fire-resistance requirements vary by the type of construction, and the more fire-resistant the building, the larger it can be



Source: woodworks.org
Presentation by Weyerhaeuser

Type IIIA Construction requires 1-hr rated floor assemblies & 2-hr rated exterior walls constructed with FRT lumber

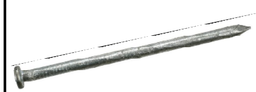


602.3 Type III.

Type III construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of any material permitted by this code. *Fire-retardant-treated wood* framing complying with Section 2303.2 shall be permitted within *exterior wall* assemblies of a 2-hour rating or less.

There are some special design considerations that go along with using fire-retardant-treated wood

Design Value Adjustments for FRT Lumber

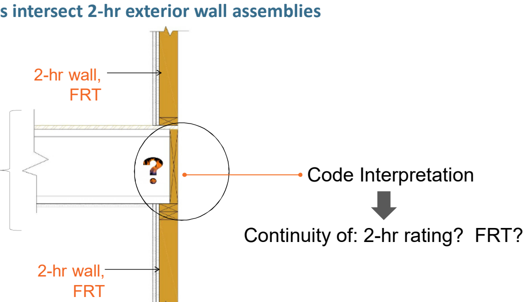


Physical Property	[redacted] Wall/Floor Service Temperature to 100°F		
	Douglas Fir	Southern Pine	Other Species
Extreme Fiber Stress in Bending, F_b	0.97	0.91	0.88
Tension Parallel to Grain, F_t	0.95	0.88	0.83
Compression Parallel to Grain, F_c	1.00	0.94	0.94
Horizontal Shear, F_v	0.96	0.95	0.93
Modulus of Elasticity, E	0.96	0.95	0.94
Compression Perpendicular to Grain, $F_{c\perp}$	0.95	0.95	0.95
Fasteners/Connections	0.90	0.90	0.90

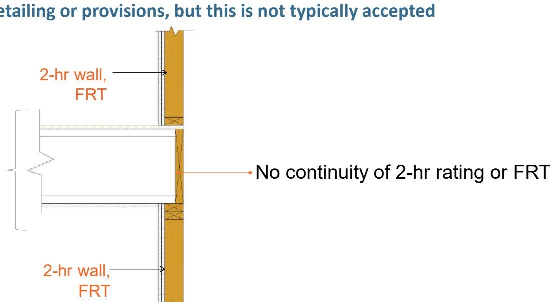
2304.10.5.4 Fasteners for fire-retardant-treated wood used in interior applications.

Fasteners, including nuts and washers, for *fire-retardant-treated wood* used in interior locations shall be in accordance with the manufacturer's recommendations. In the absence of manufacturer's recommendations, Section 2304.10.5.3 shall apply. ➡ use hot-dip galvanized, stainless steel, silicon bronze or copper

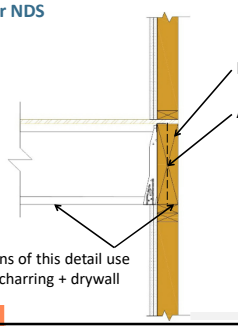
Type IIIA construction presents detailing challenges where 1-hr floor assemblies intersect 2-hr exterior wall assemblies



Some jurisdictions might accept standard platform framing without any special detailing or provisions, but this is not typically accepted



Option 1 (for continuity): A solid header can provide a 2-hr rating using charring per NDS



May need to be FRT

Alternately, use built-up rim board

Variations of this detail use header charring + drywall

Table 16.2.1.5 Effective Char Rates and Char Depths (for β_n = 1.5 in./hr.)

Required Fire Endurance (hr.)	Effective Char Rate, β_{ef} (in./hr.)	Effective Char Depth, a_{ef} (in.)
1.5-hour	1.8	1.3
1.5-1-hour	1.87	2.5
2-hour	1.82	3.2

AWC's DCA3 document gives details for code-compliant exterior wall-floor intersections using header charring + drywall

Design for Code Acceptance 3

Fire-Resistance-Rated Wood-Frame Wall and Floor/Ceiling Assemblies

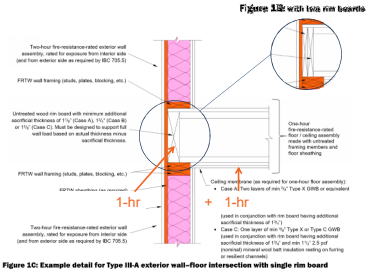


Figure 1C with 1x4s rim boards

1-hr + 1-hr

Figure 1C: Example detail for Type III-A exterior wall–floor intersection with single rim board

AWC's DCA3 document gives details for code-compliant exterior wall-floor intersections using header charring + drywall

Design for Code Acceptance 3

Fire-Resistance-Rated Wood-Frame Wall and Floor/Ceiling Assemblies

…, based on the NDS-calculated time for the char depth to reach the inner rim board/outer rim board interface,…

…plus 40 minutes for the 5/8 in. Type X GWB (per IBC Table 722.6.2(1)),..

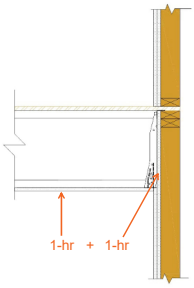
Methodology:

Fire-resistance for exposure from interior side:

- Case A: Minimum 1⅛-inch-thick inner rim board plus two layers of minimum ⅝ in. Type X GWB in the ceiling membrane provides 2 hours of protection to the outer rim board, based on the NDS-calculated time for the char depth to reach the inner rim board / outer rim board interface plus 40 minutes for each layer of ⅝ in. Type X GWB (per IBC Table 722.6.2(1)).
- Case B: Minimum 1⅛-inch-thick inner rim board plus two layers of minimum ½ in. Type X GWB in the ceiling membrane provides 2 hours of protection to the outer rim board, based on the NDS-calculated time for the char depth to reach the inner rim board / outer rim board interface plus 25 minutes for each layer of ½ in. Type X GWB (per IBC Table 722.6.2(1)).
- Case C: Minimum 1½-inch-thick inner rim board plus one layer of minimum ⅝ in. Type X GWB in the ceiling membrane plus minimum 1½-inch-thick, 2.5 pcf (nominal) mineral wool batt insulation provides 2 hours of protection to the outer rim board, based on the NDS-calculated time for the char depth to reach the inner rim board / outer rim board interface, plus 40 minutes for the ⅝ in. Type X GWB (per IBC Table 722.6.2(1)), plus 15 minutes for the mineral wool backing.

The outer rim board must be designed to support the load from the wall above.

Option 2: Use 1 layer of drywall behind the floor framing/hanger, plus drywall on the underside of the floor to get a total of 2 hours

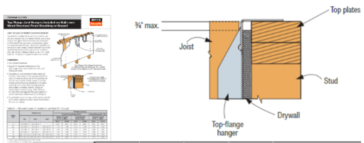


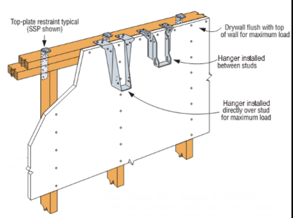
1-hr + 1-hr

Sequencing challenge

Concern of fire starting in floor cavity

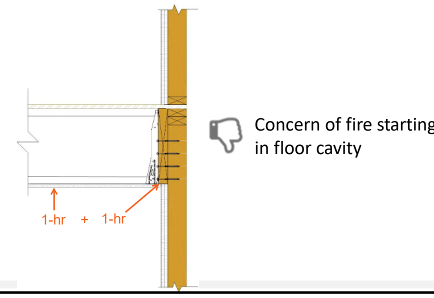
Standard top-flange hangers can be installed on walls covered by drywall, but load reductions apply





Model No.	Allowable Loads (lb.)					
	Drywall Flush with Top of Wall				Drywall Dropped ⅛" Max.	
	Between 2x Studs @ 16" o.c. (Max.)		2x Stud Directly Below Hanger		Between 2x Studs @ 16" o.c. (Max.)	
	DF/SP	SPF/HF	DF/SP	SPF/HF	DF/SP	SPF/HF
ITS	835	580	835	680	870	545
MIT	1,735	1,390	1,735	1,390	1,335	1,325
HIT	1,735	1,390	2,075	1,905	1,335	1,325
BA	1,735	1,390	2,335	1,835	1,335	1,325
B	1,735	1,390	2,725	2,725	1,335	1,325
HB	2,815	2,080	2,810	2,010	2,815	2,090

Option 3: Use a continuous ledger (in place of 1 layer of drywall) plus drywall on the underside of the floor to get a total of 2 hours



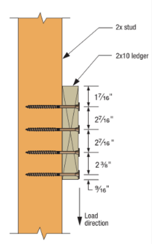
Screws used for attaching ledgers to studs require small edge distances (standard published shear loads may not apply)

TABLE 16 – CONNECTION GEOMETRY FOR THE SDWS22 SCREWS

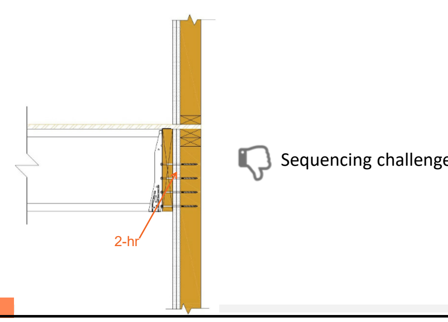
CONDITION[1]		MINIMUM DISTANCE OR SPACING (in.)
Edge Distance	Perpendicular to grain loading	1 7/16
	Parallel to grain loading	1 7/16
End Distance	Perpendicular to grain loading	6
	Parallel to grain loading	6
Spacing	Between fasteners in a row	8
	Between non-staggered rows	4
	Between staggered rows	5/8

SDWS Timber Screw – Allowable Shear Loads for Ledger Attachment to Studs

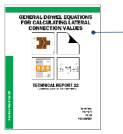
Model No.	Length (in.)	Ledger Nominal Size (in.)	Number of Screws per Stud	Allowable Shear Load (lb.)		
				DF	SPF/HF	SP
SDWS22400DB	4	2x6	2	630	565	785
		2x8	3	890	855	1,060
		2x10	4	1,040	1,040	—



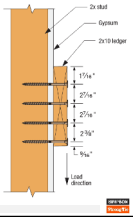
Option 4: Use a continuous ledger over 1 or 2 layers of gypsum



Screws that are used to attach ledgers over 1 or 2 layers of gypsum must be tested (or calculated) to account for the gap



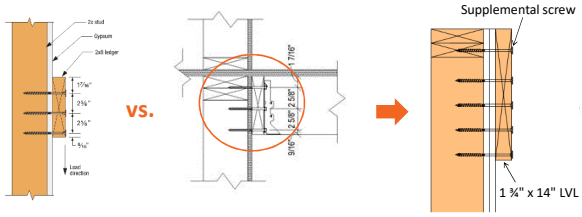
- American Wood Council's Technical Report 12 includes equations that can account for a gap between the main and side member
- But tested values can be much higher



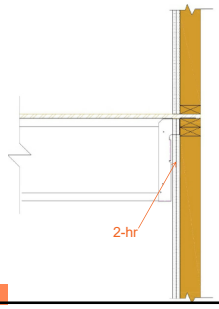
SDWS Timber Screw – Allowable Shear Loads for Ledger Attachment to Studs with One or Two Layers of Gypsum Board

Model No.	Length (in.)	Ledger Size	Number of Screws per Stud	Allowable Shear Load (lb.)	
				DF	SPF/HF
SDWS22600DB	6	2x6	2	410	365
		2x8	3	580	555
		2x10	4	675	675

Placement of the ledger at the top of the wall presents some detailing issues

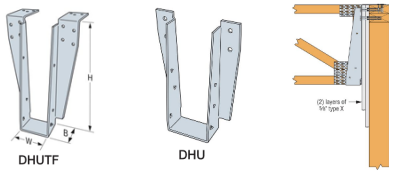


Option 5: Run 2 layers of drywall up behind the floor framing/hanger



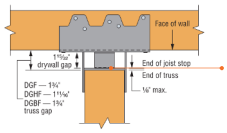
Sequencing challenge for some hangers, not for others

Some firewall hangers are designed for installation over 2 layers of 5/8" gypsum (drywall must be installed before the hanger)



Sequencing challenge

Other firewall hangers are designed to accommodate 2 layers of 5/8" gypsum and can be installed before the drywall



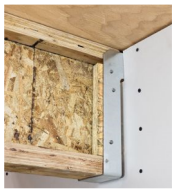
Joist Stop feature

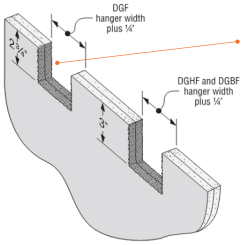
DGF
1,420-
1,705 lbs.

DGHF
1,855-
2,135 lbs.

DGBF
2,280-
3,015 lbs.

When the hanger is installed before the drywall, the drywall must be notched to slide up around the hanger → ASTM E814





No fire caulk required if testing per **ASTM E814** shows the 2-hr rating is not reduced

If over-notched, fill with intumescent fire caulk

Fire Testing per ASTM E814

(2) layers of 5/8" USG Type X gypsum on each side,
U-notch cut into drywall to fit around hangers as specified

Typical Vertical Furnace

Source: Furnace Construction

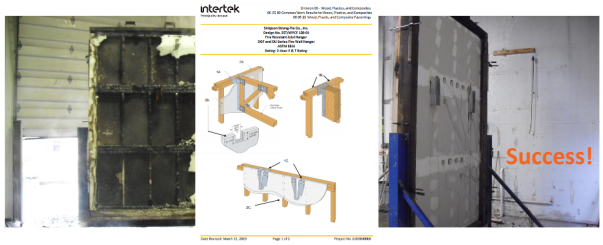
Before the Test (Exposed Face)

Fire Testing per ASTM E814

Unexposed Face After the Test

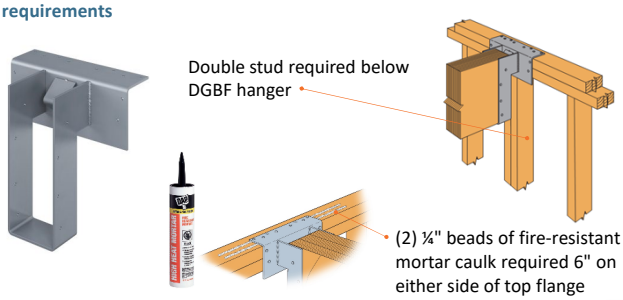
Exposed Face After the Test

Fire Testing per ASTM E814

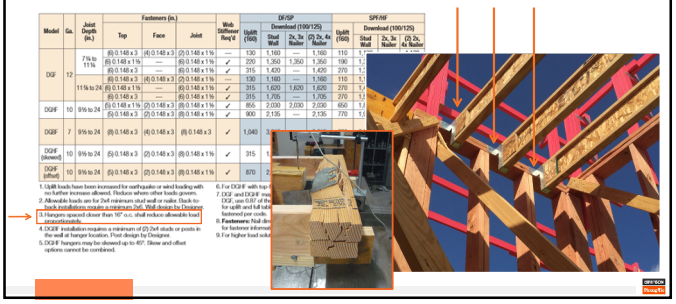


Exposed Face After Hose Stream Test | Unexposed Face After the Hose Stream Test

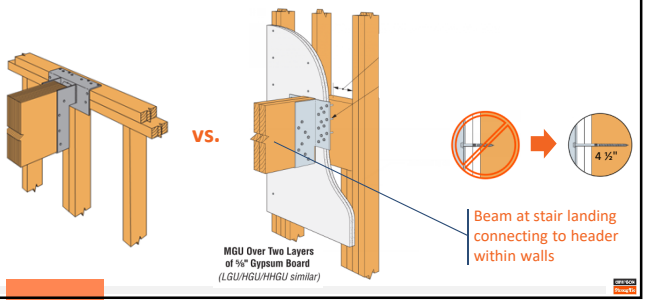
High capacity firewall hangers may have some additional design requirements



For firewall hangers spaced closer than 16" o.c., the allowable load should be reduced proportionately (if testing was based on 16" stud spacing)

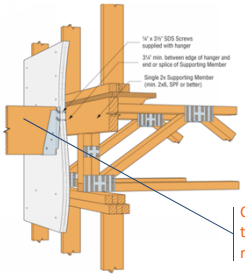


Some floor-to-firewall applications require alternative hanger solutions (Ex: Beams at stair landings)



Another floor-to-firewall application that requires an alternative hanger solution is a corridor joist connecting to a single 2x supporting member

DU/DHU Hangers over Two Layers of ⅝" Gypsum Board into a Single 2x



Corridor joist connecting to rim joist or floor truss ribbon board

In conclusion, each floor-to-firewall connection solution has different pros/cons, design considerations, and jurisdictional requirements

- Local Jurisdiction Requirements
- Effects on Fire-Rating
- Framing Preferences
- Firewall Hanger Design Limitations/Requirements
- Load Reductions
- Available Resources

Thank you!

SIMPSON StrongTie

File Attachments for Item:

EC-6 The Future of Fire-Rated Glass and Framing (Allegion - OBOA/ODPCA Conference)

BO, MPE, BPE, PPE, EPE, MechPE, FPPE, BI, FPI, MI, PI, NRIUI (1 hour)

THE FUTURE OF FIRE-RATED GLASS & FRAMING

PROVIDER NUMBER: K067
PROGRAM NUMBER: 00TGP6 (in-person)
TGPWEB6 (webinar)

LEARNING UNITS: This program is registered with AIA / CES for 1.0 Learning Unit Hour and qualifies for a Health Safety Welfare (HSW) credit.

This course will primarily focus on fire-resistive glass and framing, their performance, how they help meet stringent safety codes, and ways in which five of the latest innovations are changing the future of fire-rated glass and framing from both safety and aesthetic standpoints.

Topics covered:

- Fire-resistive glass and framing performance
- Aesthetics, performance and how it meets stringent building codes
- How product innovations are changing the future of fire-rated glazing
- Fire-rated glazing product terminology
- Case studies: Product innovations

By completing this course, participants will be able to:

- Explain the differences between fire-protective and fire-resistive glass and framing
- Describe five main innovations in fire-resistive glass and framing and how they are expanding design freedom in areas with stringent fire and life safety code requirements
- Discuss performance, fire-rated building codes and how innovative fire-resistive glazing products can help meet more stringent codes
- Identify misconceptions and potential misuse of fire-resistive glazing products and discuss solutions to ensure maximum benefits

This presentation includes a discussion, PowerPoint presentation and question and answer time. In addition to the material presented, TGP provides a free lunch for all participants. **Note: We also offer a live webinar option for this program. Please contact us for more information.**

Technical Glass Products (TGP), a division of Allegion, is the North American and Middle East distributor of a wide range of fire-rated glazing and framing products including: the FireLite® family of fire-rated glazing products, Pilkington Pyrostop® safety-rated glass firewalls, Fireframes® fire-rated framing and more. For more detailed information about TGP or its products, visit **fireglass.com**. We will follow up with you soon to answer any questions you may have. In the meantime, to schedule a presentation for your firm, please contact Hope Steel at **1.888.397.3473** or **hsteel@brandner.com.**

On behalf of Technical Glass Products, we look forward to working with you.

CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

Instructors: Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications for which the BBS has approved the class, and fees in promotion materials and advertising. ***The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising***. Advertising shall not disclose improper approval information to the public.

Course sponsors/co-sponsors: provide participants a certificate of completion containing the following information: name of participant, title of approved courses, BBS approval #, BBS approved certifications, date of the continuing education program, number of approved credit hours awarded and signature of authorized sponsor or instructor.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

Participants: Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

Board approval: Remains in effect through the calendar year of approval. The course may be renewed administratively by sponsor application in subsequent years so long as it references current codes and standards Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

Facility/training area: Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

APPLICATION

FOR

Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.

Board of Building Standards
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax: (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: Jonathan Edly (Contact Name)
Organization: Techincal Glass Products (Organization/Company)
Address: 8107 Bracken Place SE (Include Room Number, Suite, etc.)
City: Snoqualmie State: Wash Zip: 98065
E-Mail: Jonathan.Edly@allegion.com
Telephone: 412-780-5470 (Cell) Fax:
Course Sponsor: Ohio Design Professionals & Code Analysts

COURSE INFORMATION:

Course Title: The Future of Fire Rated Glass & Framing

New Course Submittal: ■ Update Course: ☐ Prior Approval Number:

Purpose and Objective: Provide Data on Fire rated glass and framing used in fire rated partitions and shafts, where is fire rated glass allowed? What are the size limitations of the fire rated glass in rated partitions? What is required of the glass frames for the fire rated glass? These and other criteria will be provided by Mr. Edly of TGP. There are many questions on fire rated shafts and partitions, this course will supply answers to many of those questions concerning the use of glass.

Number of Instructional Contact Hours that can be obtained upon completion: (1) hour

If Multi-Session, Number of Instructional Contact Hours Per Session:

Program Applicable for the Following Participants:

Building Official	■	Master Plans Examiner	■	Building Inspector	■	Fire Protection Inspector	■
		Building Plans Exam.	✔				
		Plumbing Plans Exam.	■				
		Electrical Plans Exam.	☐				
		Mechanical Plans Exam.	■				
		Fire Protect. Plans Exam.	✔				

Mechanical Inspector	■	Plumbing Inspector	■	Non-Res IU Inspector	☐				

Res Building Official	☐	Res Plans Examiner	☐	Res Building Inspector	☐	Res Mechanical Inspector	☐	Res IU Inspector	☐

Electrical Safety Inspectors ☐
Location of ESI Course: Date(s) of ESI Course(s):

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**:		Check Off
Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	
	Organization sponsoring or requesting the program (if any)	
Course Title:	Name of course (related to content)	
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	
Test Materials:		
Completed Application:		

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

Good Morning Michael,

Please find my short bio, below!

Jonathan Edly is a Territory Account Manager with Technical Glass Products, serving Ohio, Kentucky, Indiana, Michigan and Western Pennsylvania. He has been working with architects, metal fabricators and glazing contractors throughout the United States for 12+ years.

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fireglass.com | tgpamerica.com

TGP | TECHNICAL GLASS PRODUCTS®
#1 – North America's Most Specified Fire-Rated Glass Company


THE FUTURE OF FIRE-RATED GLASS AND FRAMING
SPONSORED BY TECHNICAL GLASS PRODUCTS
ALLEGION
TGP
TECHNICAL GLASS PRO
one source. many solutions.
563

Copyright Materials

Topics Covered

Topics will include:

- Fire-resistive glass and framing performance
- Aesthetics, performance and how it meets stringent building codes
- How product innovations are changing the future of fire-rated glazing
- Fire-rated glazing product terminology
- Case studies: Product innovations

Fire-Rated Glazing

- Specialized glass designed to prevent the spread of flames and smoke
- Glass earns fire ratings through rigorous testing processes at independent laboratories such as Underwriters Laboratories, Inc.® (UL)
- Fire-rated glazing for door and window assemblies are rated from 20 minutes to 3 hours
- The rating reflects the amount of time the material has been tested to remain in place to help stop the spread of fire and smoke: “compartmentation”

fireglass.com

Fire Test

Measures the amount of time, in minutes or hours, that materials or assemblies can withstand fire exposure in a test furnace.

- Standard time-temperature curve
- The test itself:
  - Large furnace heats window frames or doors
  - Assembly remains in the wall for the duration of the test
  - No flaming on the exposed surface of the assembly or openings

Key Testing Components

fireglass.com

Hose Stream Test

Measures the ability of the glass to stay in the frame when exposed to a stream of water from a fire hose.

- Heated glass and frames are subjected to water from a fire hose at specified pressures
- The cooling, impact and erosion created by the hose stream tests eliminates inadequate materials
- In the U.S, the hose stream test is required for fire ratings in excess of 20 minutes
- In Canada, all fire-rated glass products must pass the test

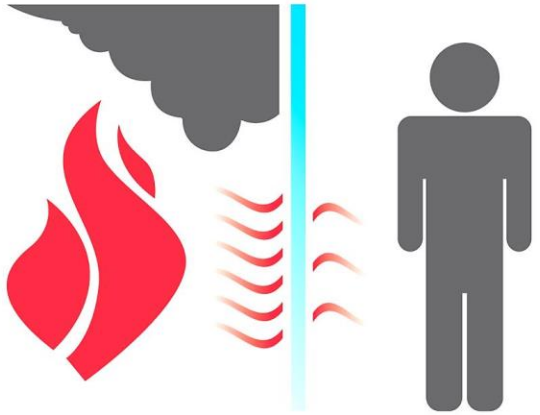
5 Things to Know About Fire-Rated Codes

1. **Fire-protective** glazing may be limited to 25% of the wall area (2015 IBC Section 707.6)
2. **Fire-resistive** glazing provides a barrier to heat and is typically the only type of glazing that can exceed 156ft^2 (2015 IBC Section 707.6)
3. Assembly components must have the **same or greater ratings** than the code minimums for the location (2015 IBC)
4. Specifying the **appropriate product** is critical to life safety (especially when there are such a wide variety of performance characteristics)
5. As of the 2012 IBC (Section 703.4), fire ratings must be established based solely on a material's **own performance**

Fire-Protective vs. Fire-Resistive

Fire Protective

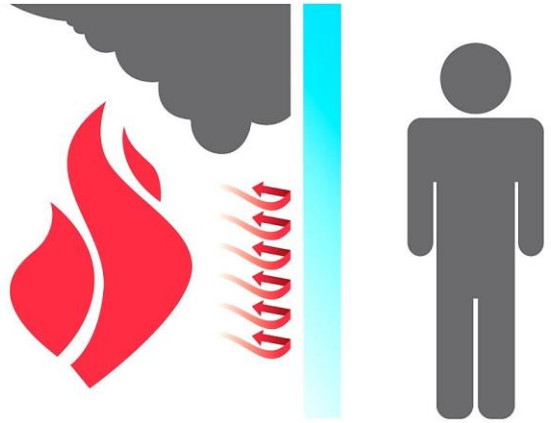
- Sec 716 Opening Protectives
- 20-90min & 180min Doors
- “Thin” glazing of wired glass, glass ceramic, specially tempered
- Hollow metal frames & doors
- Fire partitions, smoke barriers, smoke partitions, exterior walls
- May not exceed 25% of the aggregate length of the wall
- Elevations typically 13’ or less, per test chamber
- May not exceed 156ft^2
- Transoms & sidelites not permitted in stairwells, exit enclosures, fire barriers
  - *Narrow door lites less than 100SqIn



FIRE PROTECTIVE GLASS

Fire-Protective vs. Fire-Resistive

Fire Resistive



- Rating as a **wall**, rather than an opening; ASTM E119 & UL 263
- Stops flames, smoke, **AND** radiant heat (both glass and frames)
- 'Thick glazing'
- Glass + frame *assembly*
  - Solidified multi-laminate or gel filled unit
- Not limited by 25% rule, 13' elevations, 156ft^{2,}
- Used in stairwells, fire barriers, atriums, enclosures, temp-rise doors

Fire-Rated Glass Systems

- Specified to improve fire and life safety and meet building code criteria
- Glazing and framing options may differ depending on factors such as:
  - Building height
  - Occupancy group
  - Location
  - Manufacturer limitations
- Other challenges include significant variance in codes and frequent updates

Note: The main criteria in this category is the 2015 International Building Code (IBC)

Innovations Changing the Future

THEN

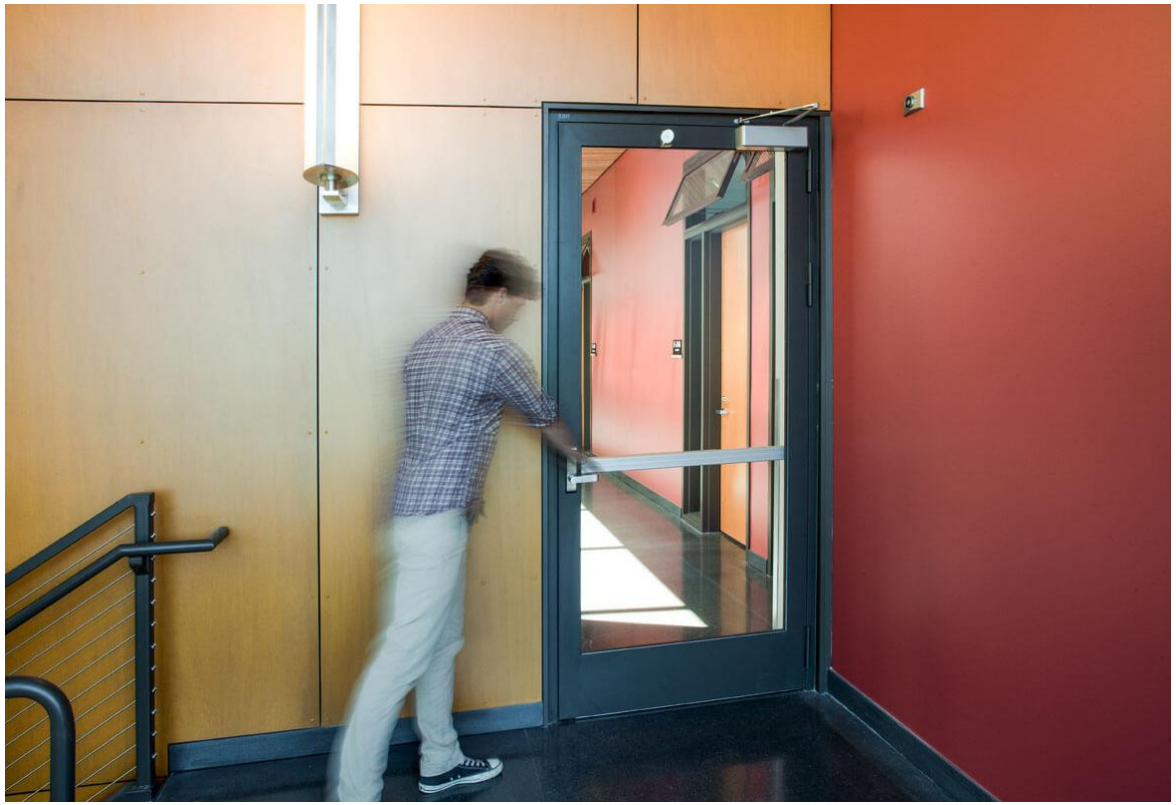
- Wide-stile doors
- Bulky wrap-around hollow-metal frames
- Small vision lites
- Limited openings

NOW

1. Narrow Frame Profiles
2. Frame Cover Caps and Finishes
3. Silicone-Glazed (SG) Fire-Rated Curtain Wall Systems
4. Butt-Glazed Systems
5. Fire-Rated Glass Floors

Frame Cover Caps and Finishes

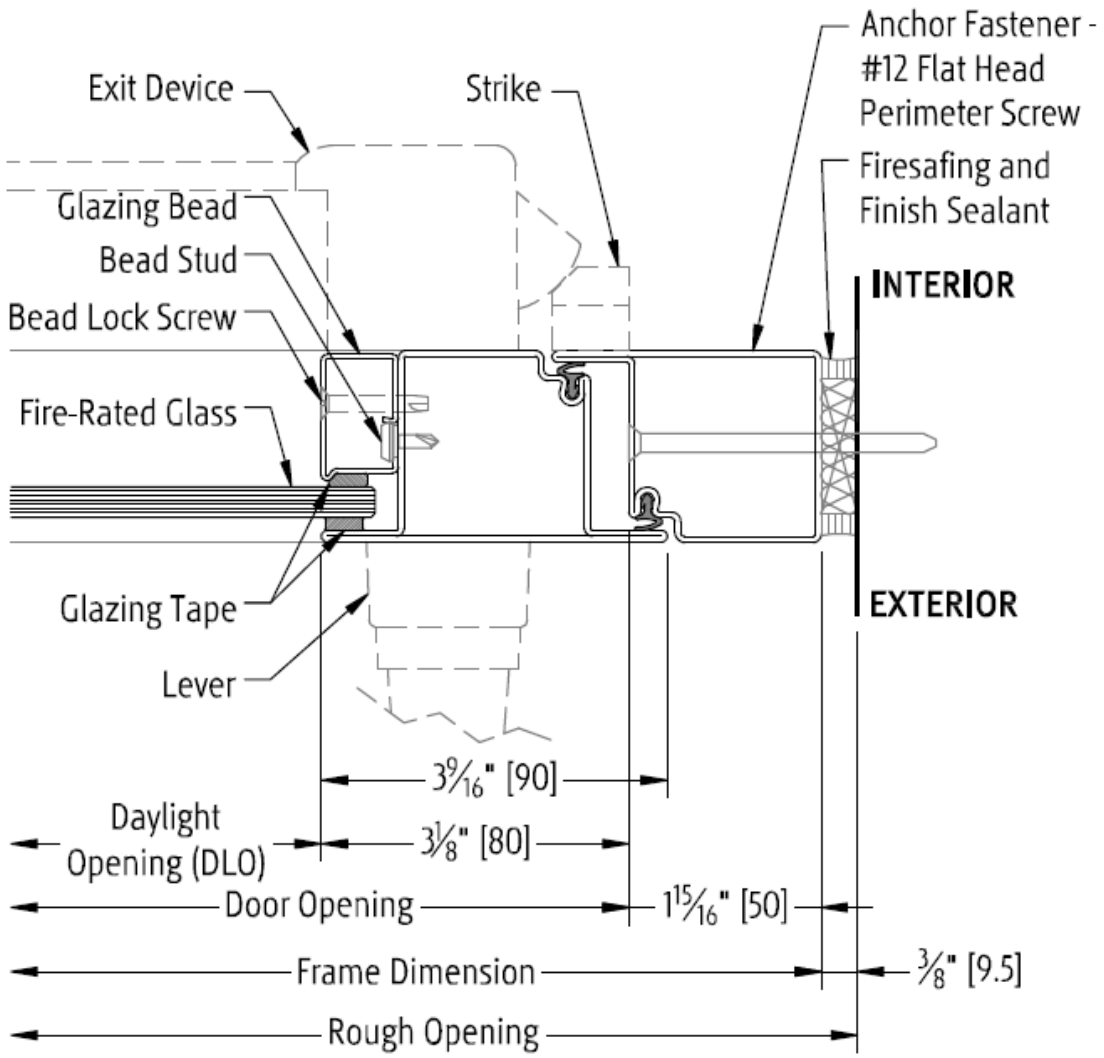
- Seamless transitions between rated and non-rated frames used in other parts of the building
- Achieve greater design freedom through:
  - Custom paints or powder coats
  - Custom materials
    - Aluminum, steel, stainless steel
  - Custom profiles



Full Lite Doors

- Narrow profile & sightlines
- 20-90min (temp-rise when required)
- Secure access & auto operators
- Entrances w/ Fireframes
- Fully-welded steel construction; high-traffic areas
- Interior & exterior

Innovations Changing the Future



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Case Study:

Johnson & Wales University Center, Providence, RI

Challenge:

- Original building had tall ribbon windows five feet above the floor, restricting visibility and daylight
- Existing exterior had little curb appeal
- Lack of openness and accessibility to the street was a concern for the design team

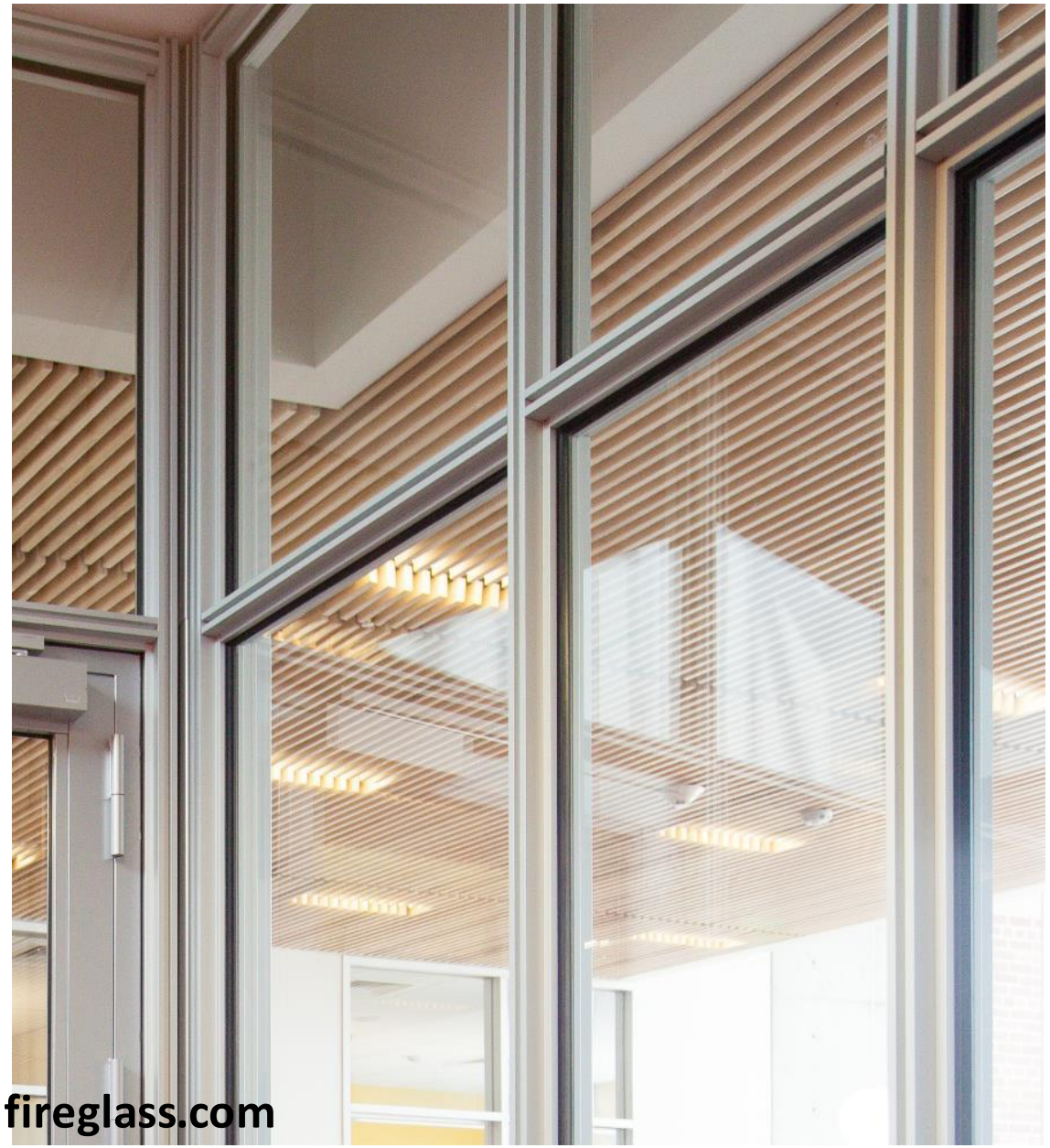
Innovations Changing the Future

Case Study:

Johnson & Wales University Center, Providence, RI

Solution:

- Opened up the building's exterior walls
- Included a new, porous entry with floor-to-ceiling glass
- Selected a narrow profile, fire-rated glazing system that satisfied building codes and connected the lobby and stairs for a clear circulation path



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Case Study:

Johnson & Wales University Center, Providence, RI

Solution (cont.):

- The flexibility to use custom aluminum face caps allowed the design team to further match the building's clean, open aesthetic
- Architect selected custom, H-shaped aluminum cover caps, creating a framing system with sleek, linear profiles

Custom Aluminum Clad Systems

- True wood veneer
  - Multiple species
- Match adjacent millwork
- Create your own cover caps
  - H-Cap, sphere, tapered, etc

Butt-Glazed Systems

- Sleek monolithic look
- Achieve longer spans of uninterrupted glass:
  - Free of vertical mullions
  - Improved views
  - Enhanced light transmission
- Virtually unobstructed transitions between adjoining pieces of fire-resistive glass
- Eliminate the need for internal spacers and edge sealants

Innovations Changing the Future

Case Study:

The University of Kansas – Earth, Energy, & Environment Center

Challenge:

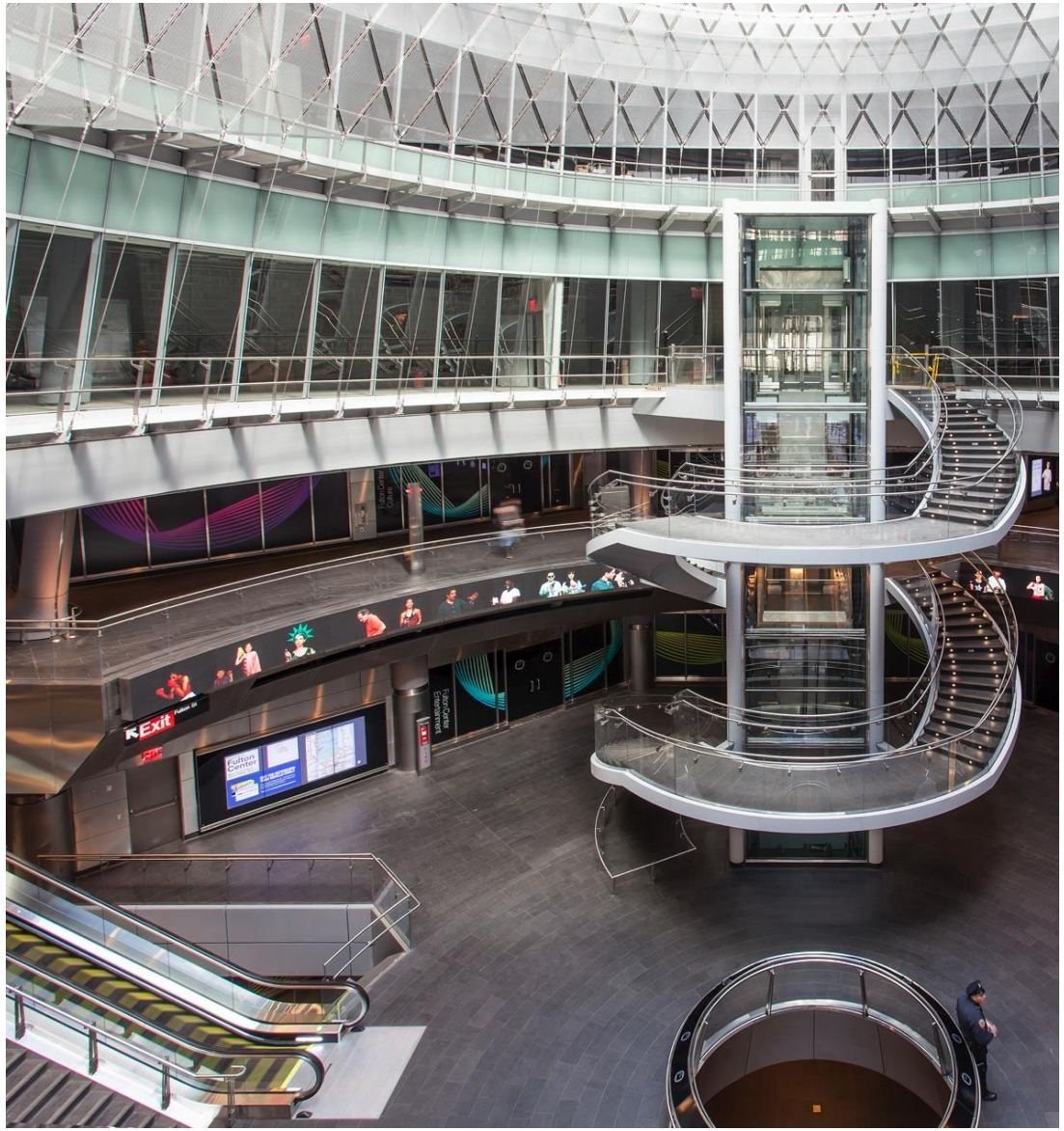
- Create a seamless glass aesthetic while providing critical fire resistance in the main entrance and second-floor corridor overlooking the main stairway
- Complement non-rated butt-glazed systems elsewhere in the building

Case Study:

The University of Kansas – Earth, Energy, & Environment Center

Solution:

- Install butt-glazed fire-resistive-rated glass with a fire-resistive-rated perimeter frame
- A single source supplier helped ensure the system has a consistent fire-rating



Case Study:

Fulton Center Transit Hub, New York, NY

Challenge:

- Match the aesthetics of the fire-rated curtain walls (doughnut's upper level and in a prominent elevator core) with the non-fire-rated curtain wall system (doughnut's lower level)

Innovations Changing the Future

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Case Study:

Fulton Center Transit Hub, New York, NY

Solution:

To achieve a seamless aesthetic, the designers chose a matched curtain wall system.

- Allows for a wide range of narrow mullion profiles
- The same manufacturing method can be applied to fire-rated frames using steel back members
- The fire-rated curtain walls match the slender frame profiles of system used

Case Study:

Carnegie Science Center, Pittsburgh PA

Challenge:

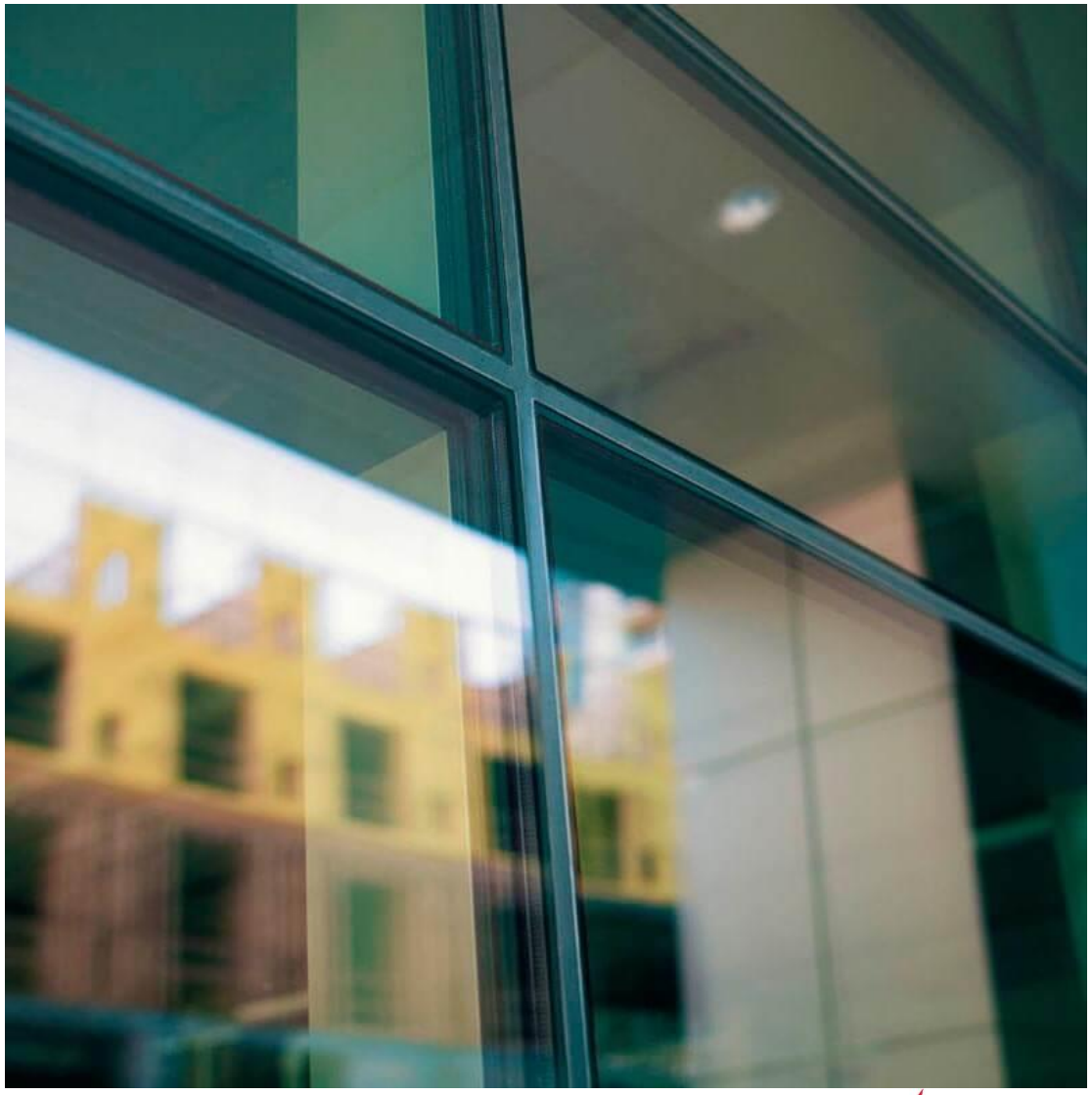
- Proximity of fire-rated & non-rated curtain wall systems
- Avoid unwanted structural steel / anchor system
- Clarity of glass

Solution:

- Match profiles, back-member and finish
- Steel curtain wall allows 23’ free span
- Solidified multi-laminate glazing

Silicone-Glazed (SG) Fire-Rated Curtain Wall

- Features the smooth, monolithic appearance of SG curtain walls
- Silicone-sealed and requires no pressure plates or caps (patented toggle retention system)
- Can accommodate full-lite doors
- Available with up to 120-minute fire ratings



Innovations Changing the Future

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Case Study:

929 Office Tower, Bellevue, WA

Challenge:

- To attract big-name tech tenants, LMN Architects desired a stylish glass-clad exterior with the frame-free look of silicone glazing
- Building codes required that portions of the upscale building's ground floor exterior be fire-rated

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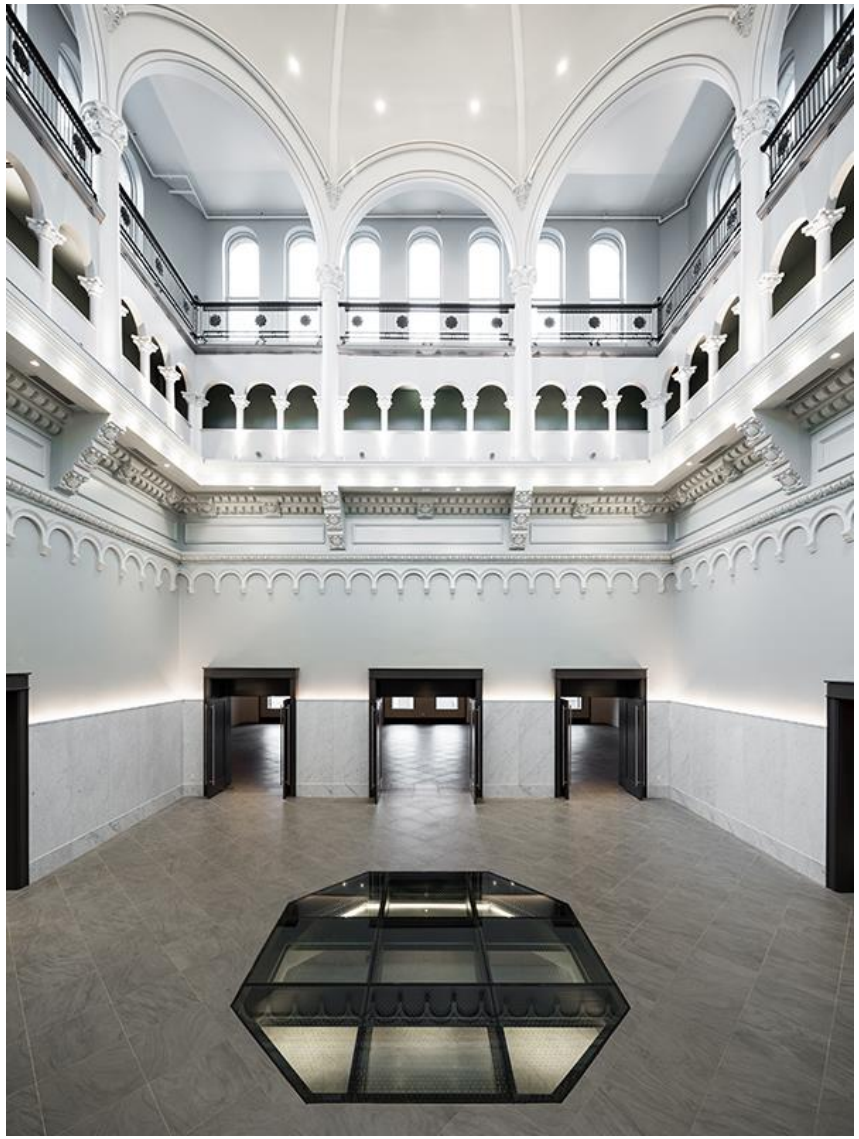
Case Study:

929 Office Tower, Bellevue, WA

Solution:

- Used the monolithic aesthetic of a silicone-glazed fire-rated curtain wall system
- Helped ensure smooth visual transitions at junctions between the rated and non-rated systems
- Provided critical protection against the spread of fire between adjacent structures

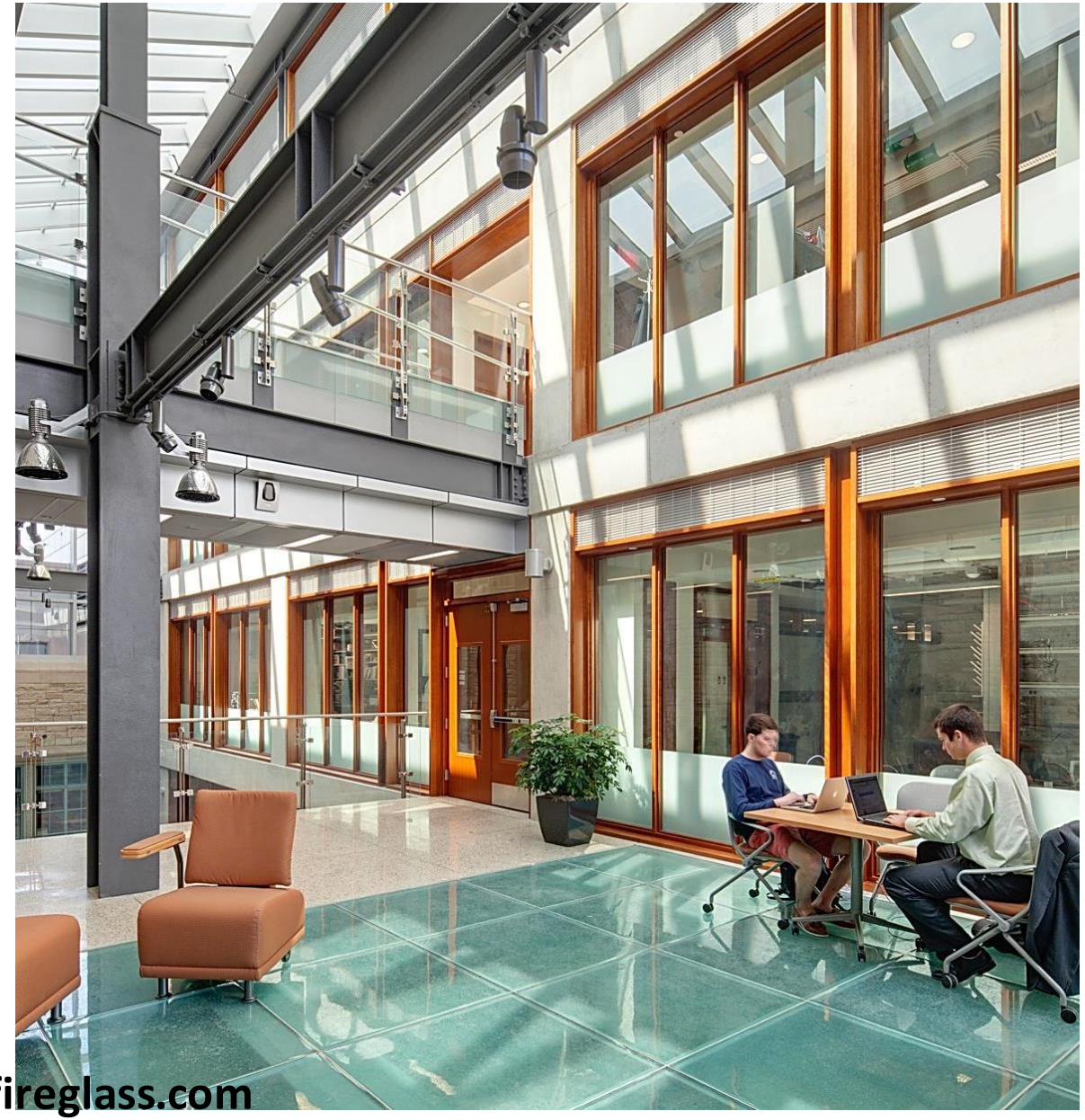


Fire-Rated Glass Floors

Traditional, opaque materials limit views and light transfer through building levels

Fire-rated glass floor systems can:

- Provide fire resistance while transmitting light deep into a building's core
- Facilitate views and increase admissible daylight
- Support structural loads
- Block flames, smoke and heat



Case Study:

Northwestern University Engineering Life Sciences, Evanston, IL

Challenge:

To allow for light penetration, the design team desired a large, central atrium, which would:

- Allow light to spill down and throughout the building
- Promote student wellbeing

Innovations Changing the Future

Case Study:

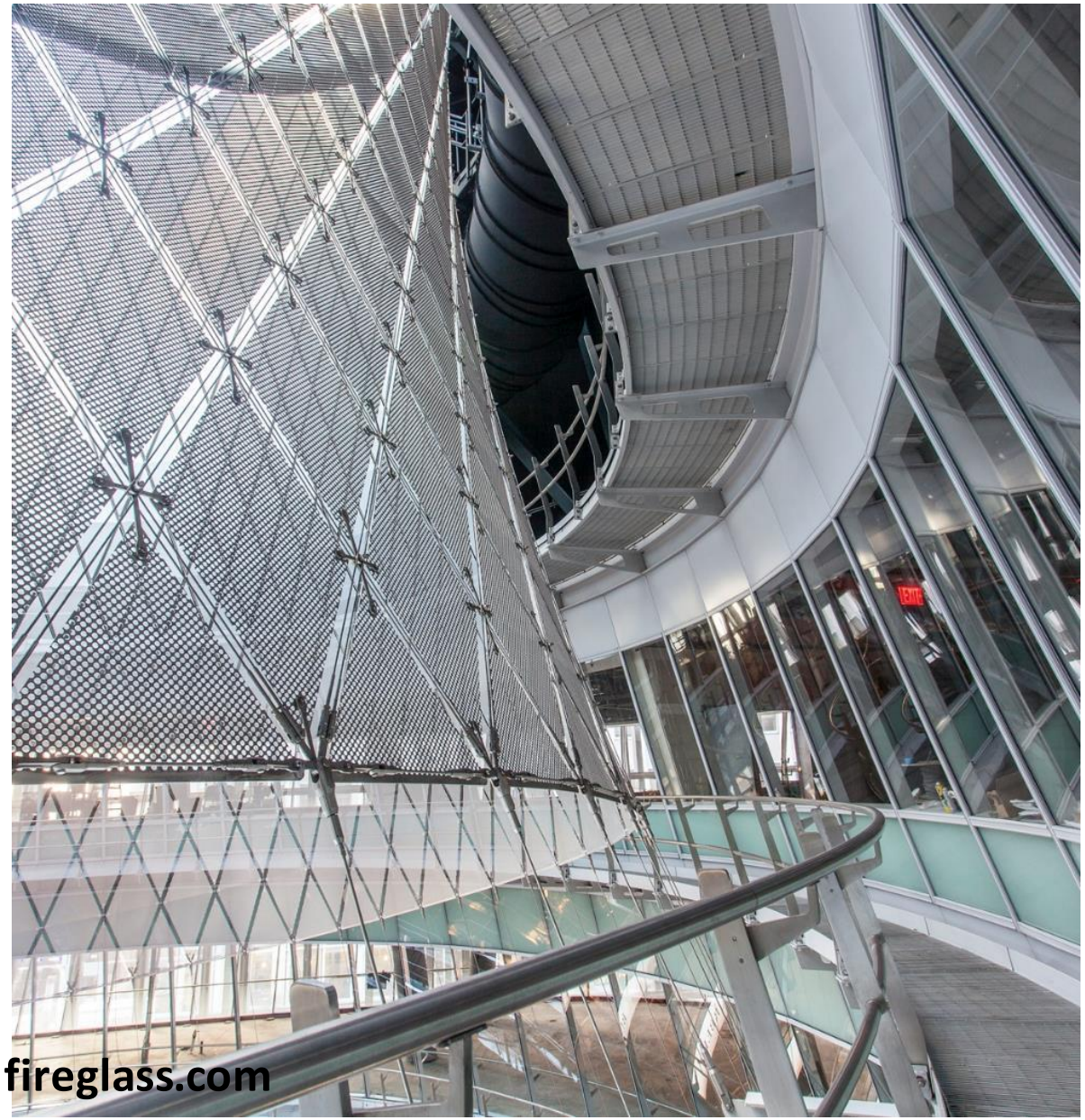
Northwestern University Engineering Life Sciences, Evanston, IL

Solution:

To satisfy fire and life safety codes and help illuminate the infill, the design team used a fire-rated glass floor system that consisted of:

- Two-hour fire-rated heat barrier glass
- Tempered, laminated walking surface glass
- Steel framing grid

Misconceptions of Fire-Resistive Glazing



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The primary misconception is: Fire-rated glazing is a barrier to good design.

The truth is: Although design teams must work within code parameters and accurately specify fire and life safety products, there is almost always a product that can meet their design goals.

Understanding Misuse and Proper Use

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Proper Use

- Fire-rated glass systems must use the specific supplied components (e.g., glass, framing, exterior caps, back framing members, seals, fire-safing, etc.) in order to work properly and maximize benefits
- If the design professional needs to find a more custom solution, contact the manufacturer or supplier during the design process

Conclusion

- Unfortunately, thousands of commercial building fires occur each year in the United States
- Innovations in fire-resistive products are providing code-compliant fire and life safety for these structures
- New product solutions eliminate the need to compromise aesthetic, daylighting or safety goals
- Contact manufacturers for the latest specifications and uses

Since 1980, Technical Glass Products (TGP) has been supplying the architectural and commercial industry with innovative fire-rated and architectural solutions for specialized glazing and framing needs.

Let us know how we can help with your next fire-rated glazing project.

800.426.0279
sales@fireglass.com

File Attachments for Item:

EC-7 Solar Photovoltaics and the NEC (Full Course) (Matthews Electrical Services)

All Certifications Except Plumbing (8 hours)

Staff Notes: This is the full version of this course. Also on this agenda are submissions for Part 1 and Part 2 separately. The full version is intended for the classroom, the two-part version is intended for a webinar. The slides and instructor bio for both versions are the same.

APPLICATION

FOR

Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.

Board of Building Standards
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER HENRY PETER MATTHEWS

Course Submitter: HENRY PETER MATTHEWS
(Contact Name)

Organization: MATTHEWS ELECTRICAL SERVICES
(Organization/Company)

Address: 1203 MCKINLEY PLACE
(Include Room Number, Suite, etc.)

City: FOSTORIA State: OHIO Zip: 44830

E-Mail: hpmatthews@matthewselectrical.net

Telephone: 419-575-3488 Fax: _____

Course Sponsor: _____

COURSE INFORMATION

Course Title: SOLAR PHOTOVOLTAICS AND THE NEC SESSION 1 - CLASSROOM

New Course Submittal: ■ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective: In this 8-hour classroom session, this course will explore the major requirements of a solar PV installation. NEC articles 690, 691, 705 and others will be reviewed to provide the attendee concepts and how to interpret and apply NEC requirements.

Number of Instructional Contact Hours that can be obtained upon completion: 8

If Multi-Session, Number of Instructional Contact Hours Per Session: _____

Program Applicable for the Following Participants:

Building Official	■	Master Plans Examiner	■	Building Inspector	■	Fire Protection Inspector	■
		Building Plans Exam.	✔				
		Plumbing Plans Exam.	☐				
		Electrical Plans Exam.	■				
		Mechanical Plans Exam.	■				
		Fire Protect. Plans Exam.	✔				

Mechanical Inspector	■	Plumbing Inspector	☐	Non-Res IU Inspector	■				
Res Building Official	■	Res Plans Examiner	■	Res Building Inspector	■	Res Mechanical Inspector	■	Res IU Inspector	■

Electrical Safety Inspectors [X]

Location of ESI Course: www.matthewselectrical.net Date(s) of ESI Course(s): August 28, 2021

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**		Check Off
Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	X
	Organization sponsoring or requesting the program (if any)	
Course Title:	Name of course (related to content)	X
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	X
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	X
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	X
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	X
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	X
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	X
Test Materials:	Quizzes and polls will be used throughout the course	X
Completed Application:		X

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

PV Solar Training and the NEC – Classroom Outline

1. Purpose
   Interest in solar photovoltaics, energy storage, microgrids, interconnected power sources and other emerging technologies is increasing due to the focus on climate impacts and green energy. However, there are NEC code requirements that many designers, installers and even inspectors may not be familiar with. Part of this due to the ever-changing developments in technology and products, and also to the evolving NEC requirements and other industry standards that try to keep up with the developments.

   This webinar is structured towards giving the participants an understanding of solar photovoltaics and related topics. This includes introducing the participants to terminology, the different types of PV systems, applicable codes and standards, types of equipment used, safety considerations for DC/AC systems and more.

   Specifically, this course will help clarify the various solar PV-related requirements in the NEC with a focus on articles 690, 691, 705, 250 and others. Attention will also be placed on batteries and energy-storage systems that can be an integral part of the PV installation.

   The intent of the solar PV series of training by Matthews Electrical Services is to provide the attendee with a series of related webinars and in-person sessions. The webinars and classes are intentionally broken up into 4 hour and 8-hour sessions to focus on specific PV-related topics that promote understanding of certain topics.

   These courses are also designed to be applicable to future NABCEP certification credit if the attendee desires.

2. Structure
   a. Duration: 2,4, 8, 10 hours
   b. Format
      i. In person classroom: 2,4, 8, 10 hours
   c. Resources
      i. 2020 National Electrical Code
         1. Article 250 Grounding and Bonding
         2. Article 685 Integrated Electrical Systems
         3. Article 690 Solar Photovoltaic Systems
         4. Article 691 Large Scale Photovoltaic Electric Supply Stations
         5. Article 705 Interconnected Electric Power Production Sources
         6. Article 706 Energy Storage Systems
      ii. 2021 NFPA 70E Electrical Safety in the Workplace

iii. PowerPoint Slides Developed by Matthews Electrical Services
iv. Solar Energy International – website
v. IAEI.org website
vi. NFPA website
vii. Various PV equipment manufacturers
viii. Various PV publications: Home Power e.g.

3. Curriculum
    a. PV Basics
        i. History
        ii. Energy outlook
    b. Definitions
    c. Basic PV Math
        i. Ohms Law
        ii. Series and parallel connections
            1. Resistance, voltage and current calculations
            2. Solar arrays
            3. batteries
        iii. AC and DC differences
        iv. Power: kilowatts, KVA, kVAR, power factor
    d. Types of systems
        i. Stand-alone
        ii. Grid-direct
        iii. multimode
    e. Components
        i. Modules, arrays
        ii. Wires, cables, connectors
        iii. Inverters
        iv. Microinverters
        v. Dc converters
        vi. Batteries
        vii. Charge controllers
        viii. Utility meters
        ix. Panels
        x. Generators
    f. Solar PV safety
    g. How to read and interpret solar modules labels
    h. How to read and interpret inverter labels
    i. Relevant NEC Articles
        i. Article 250 Grounding and Bonding
        ii. Article 690 Solar Photovoltaic Systems
        iii. Article 691 Large Scale Photovoltaic Electric Supply Stations
        iv. Article 705 Interconnected Electric Power Production Sources
        v. Article 706 Energy Storage Systems
    j. Article 690 requirements

i. Overcurrent protection
ii. Grounding and bonding
iii. Ground fault protection
iv. Arc fault protection
v. Rapid shutdown

Special Training

Solar Energy International (SEI), Paonia, Colorado

- Solar Electric and Design and Installation Course, April 2021, 60 hours
- PV Systems Fundamentals (Battery-Based), June 2021, 40 hours
- Advanced PV System Design and the NEC, June-July 2021, 60 hours

Affiliations

Institute of Electrical and Electronics Engineers (IEEE) – Senior Member
International Association of Electrical Inspectors (IAEI)
NFPA Section Member for Architects, Engineers and Building Officials
Illumination Engineering Society of North America (IESNA)
API RP 545 former Co-Chair, American Petroleum Institute, Lightning Protection for Above Ground Storage Tanks (2017- 2018)

Business Ownership

Matthews Electrical Services, Owner
Designer Cuts Hair Salon, LLC; Co-owner

Biography

Henry has worked in the electrical, power, electronics, instrumentation, controls and communication fields for over 30 years. He earned his Bachelor of Science degree in Electrical Engineering from Penn State University in 1989. Henry worked as a consultant for Toledo Engineering Company in Toledo, Ohio as a drafter and field technician.

In 1993 he started working for Cooper Standard Automotive Company in Bowling Green, Ohio in 1993 as a Plant Electrical Engineer. He was then promoted to Plant Engineering Manager in 2000. During this time, he earned his Professional Engineering License in Ohio.

In 2003, Henry earned his MBA at Bowling Green State University.

In 2006, Henry joined Marathon Petroleum Company in Findlay, Ohio. He then went on to obtain his Professional Engineers license in Electrical Engineering for Michigan, Indiana, Illinois, West Virginia, Kentucky, Minnesota and Wisconsin. During his tenure at Marathon, Henry has had several roles including Electrical Design Engineer, Project Engineer and Electrical Supervisor. He is currently an Advanced Senior Engineer where he writes electrical standards for the company and conducts a community of practice for all the company's electrical engineers and safety professionals.

During his time at Cooper Standard Automotive and Marathon Petroleum, Henry developed a passion for teaching, learning and applying Electrical Construction Codes. At Cooper, he trained the entire non-electrical maintenance staff to perform basic electrical tasks.

At Marathon, Henry works with the Learning and Development Department to conduct multiple training sessions for new hires and seasoned engineers on various topics including Electrical Safety, Grounding and Bonding, Hazardous Area Location, Electrical Inspection, Motors, Lightning protection Static Electricity Mitigation, Reading and Understanding Electrical Diagrams, Programmable Logic Controllers and more.

Henry also works very closely with the Talent Acquisition Teams and visits numerous college campuses to deliver presentations on Engineering, Career Development, Networking and other topics.

Henry recently served as the Co-chair of the API Recommended Practice 545 Task Group for Lightning Mitigation for Above Ground Storage Tanks. In this role, he works with engineers, scientists and manufacturers from all over the world to evaluate the impacts of lightning and static electricity on metal above ground storage tanks.

His passion for teaching and Electrical Safety has motivated him to earn the Certified Electrical Safety Compliance Professional Certification (CESCP) from NFPA. He also regularly attends numerous electrical and safety conferences and training sessions conducted by NFPA, IEEE, API.

Previously, Henry was the President of the Fostoria, Ohio area Toastmasters team.

Henry is also a member of the International Association of Electrical Inspectors.

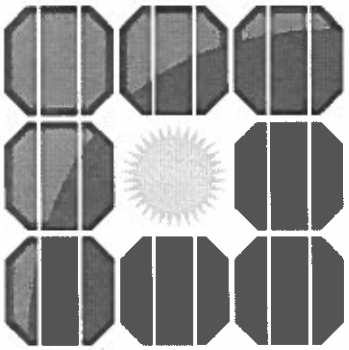
Henry also owns two small businesses:

Matthews Electrical Services - that performs mainly limited residential and small commercial electrical services and conducts training for licensed electricians in the state of Ohio.

Designer Cuts Hair Salon, LLC – Henry co-owns the beauty salon with his wife.

Solar PV Systems and the NEC

Solar PV Code Training



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Relevant NEC and NFPA Resources

- 2020 National Electrical Code
  - Article 250 Grounding and Bonding
  - Article 685 Integrated Electrical Systems
  - Article 690 Solar Photovoltaic Systems
  - Article 691 Large Scale Photovoltaic Electric Supply Stations
  - Article 705 Interconnected Electric Power Production Sources
  - Article 706 Energy Storage Systems
- 2021 NFPA 70E Electrical Safety in the Workplace
- Applicable UL standards

Article 690: Solar Photovoltaic (PV) Systems

- Part I: General (definitions)
- Part II: Circuit Requirements
  - Maximum voltage: no greater than 1000V (690.7)
    - One and two-family dwelling units limited to 600V.
    - Limited to 1500VDC when not located on or in buildings
- Good reference:
  - Photovoltaic Array Performance Model (SAND 2004-3535)
  - Sandia National Laboratories

Safety

- Can generate high levels of DC current
- Solar panels can generate power with low levels of light.
- AFCIs required for DC circuits over 80V (690.11) – note exception
- Rapid shutdown requirements for systems on buildings (690.12)
  - Goal – protect firefighters, note exception
- External disconnect requirements
- DC current can be harder to interrupt than AC current
  - Bulkier disconnects and equipment
- PPE requirements

Solar PV Electrical Safety

According to the U.S. Bureau of Labor Statistics, solar photovoltaic installer jobs are expected to grow 51% between 2019 and 2029, increasing at a much higher rate than the average of all occupations. Learn how to stay safe while working with or around solar panels.

Statistics*

51% expected growth in solar PV installer jobs by 2029 making it the 3rd fastest growing occupation.

650 Between 2011 and 2019, 650 solar PV installers were injured on the job.

1-5 YEARS 51% of injured solar PV installers were employed for 1-5 years.

PV Installation Electrical Safety

Locate all overhead power lines.

Consider all overhead lines to be live, energized and dangerous.

10ft

Keep self and equipment 10 feet away from all overhead lines.

Carry ladders and other equipment horizontally when on the ground to avoid overhead lines.

PV Panel Electrical Safety

Solar disconnects only disconnect building from PV panels. Panels can still generate power.

Never walk or climb on a solar PV panel.

Beware of bi-directional power, mark all bi-directional meters.

10ft

Stay at least 10 feet away from solar installations.

In Case of Emergency Involving Solar Panels

911

Call 911 and notify first responders that PV are involved.

ON

If possible, turn off AC side of solar panels. Solar panels may still generate DC power.

Remind first responders of the PV system.

Please share this free resource to save lives.

ESFI.org www.facebook.com/ESFI.org www.twitter.com/ESFIdotorg www.youtube.com/ESFIdotorg

*U.S. Bureau of Labor Statistics

Battery PPE


Black Diamond


Pure
BAKING
SODA
MULTIPURPOSE
HOUSEHOLD HELPER

Insulated Tools

Considerations

- Location
- Shading
- Utility Company structure and restrictions
- Electric Bill and rate structure
- Insurance Company Policies
- Government Incentives: credits
- Local and State incentives: rebates, credits
- Utility incentives
- Grid-connected, stand-alone or hybrid
- Aesthetics
- Neighbors and neighborhood associations
- Cost and financing

Interesting Facts

- Solar modules lose efficiency with increasing temperature
- Solar modules are more efficient in cooler temperatures
  - However, duration of sunlight generally less in cooler climates
- Solar modules are inherently current-limited
  - Short circuit current is dramatically less than other sources
  - Reason why fuses are not normally needed with one or two strings
    - Not enough current to trip CB or blow fuses
  - Backfeeding from a shorted panel is a major concern
    - Current from multiple shorted parallel strings can add up and be dangerous
- Batteries on the other hand can have thousands of short circuit amps

PV Components

- Photovoltaic cell
- Module
- Panel
- Array
- Charge Controller
- Battery
- Inverter

PV Components Continued

- Combiner Box
- DC Loads
- AC Loads
- Meters
- Panels

Listing, Marking, Identification, Labeling

- Nationally Recognized Testing Laboratory (NRTL)
- ANSI Z535 standards
- NEC 690 requirements

Applied Research Laboratories of South Florida, LLC

More >

Bay Area Compliance Laboratories

More >

Bureau Veritas Consumer Products Services, Inc. (BVCPS)

More >

CSA Group Testing and Certification Inc.

More >

Nemko North America, Inc. (NNA)

More >

NSF International (NSF)

More >

QAI Laboratories, LTD (QAI)

More >

QPS Evaluation Services Inc.

More >

FM Approvals (FM)

More >

International Association of Plumbing and Mechanical Officials EGS (IAPMO)

More >

Intertek Testing Services NA, Inc. (ITSNA)

More >

MET Laboratories, Inc. (MET)

More >

SGS North America, Inc.

More >

SolarPTL, LLC

More >

Southwest Research Institute

More >

TUV Rheinland of North America, Inc.

More >

TUV SUD America Inc

More >

TUV SUD Product Services GmbH

More >

Underwriters Laboratories Inc.

More >

Organizations or Sites No Longer Recognized

More >

Source: OSHA

DC Math

- V = I x R
- Volts = Amps x Resistance

- P = V X I
- Power = Volts x Amps
- Watts = Volts x Amps

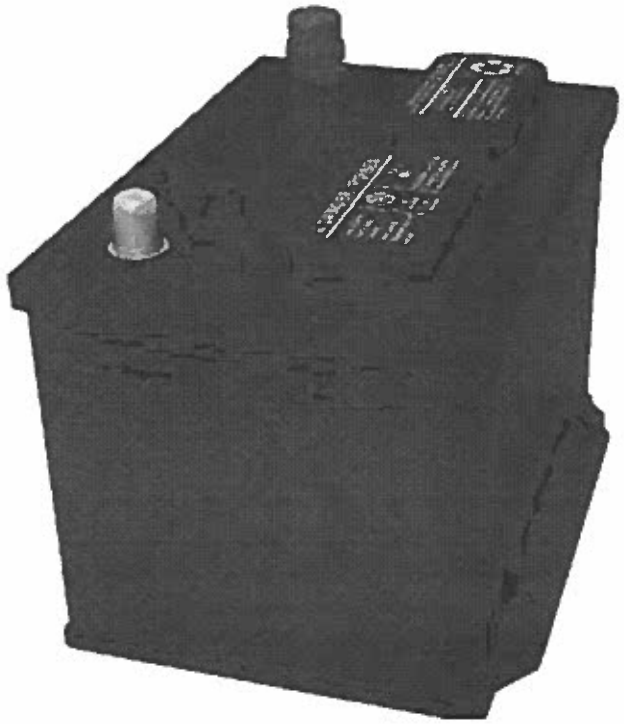
DC Math

- Example:
- 12V solar module
- Rated 100 watts

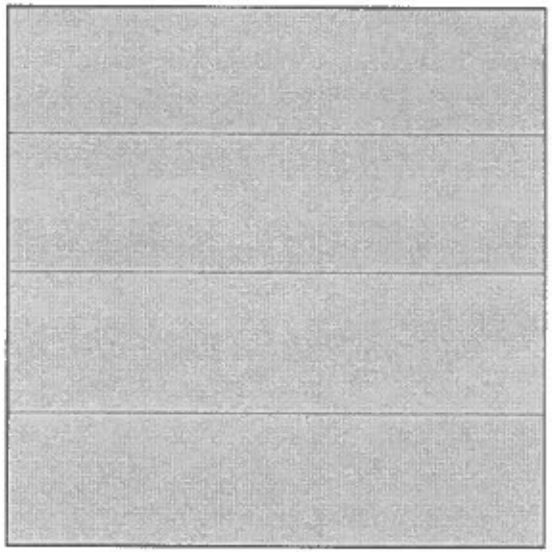
- P = V x I
- I = P/V
- I = 100 watts/12 volts
- I = 8.33 Amps

Battery Ratings

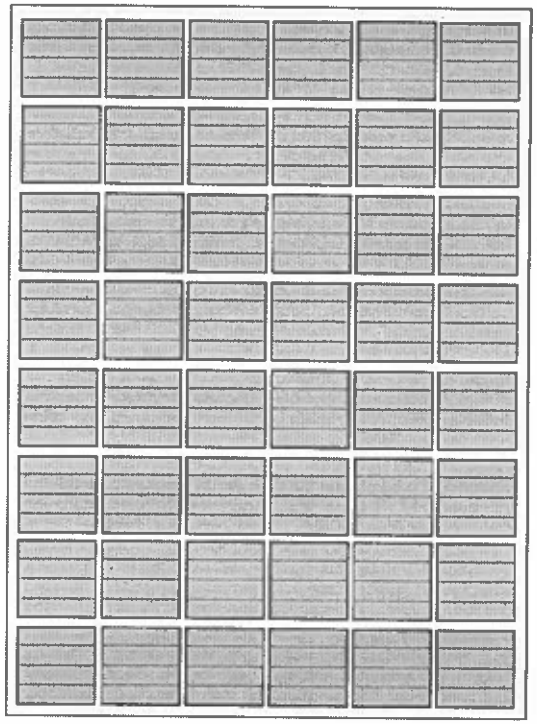
- Amps x Hours = Amp-Hour
- For example: 100 amp-hours
  - A battery can provide 1 amp for 100 hours, or
  - A batter can provide 100 amps for 1 hour



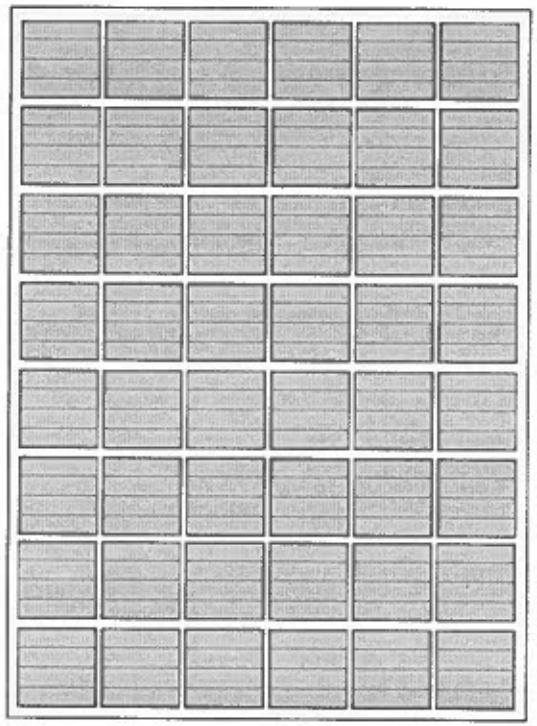
PV Cell



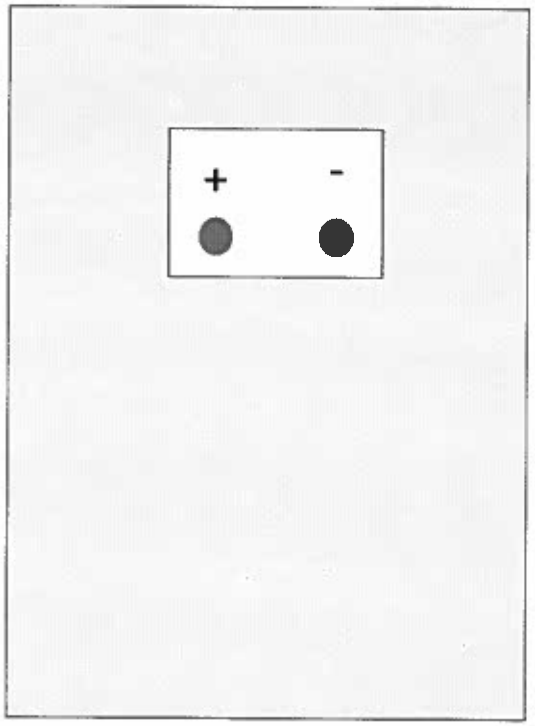
PV Module



PV Module

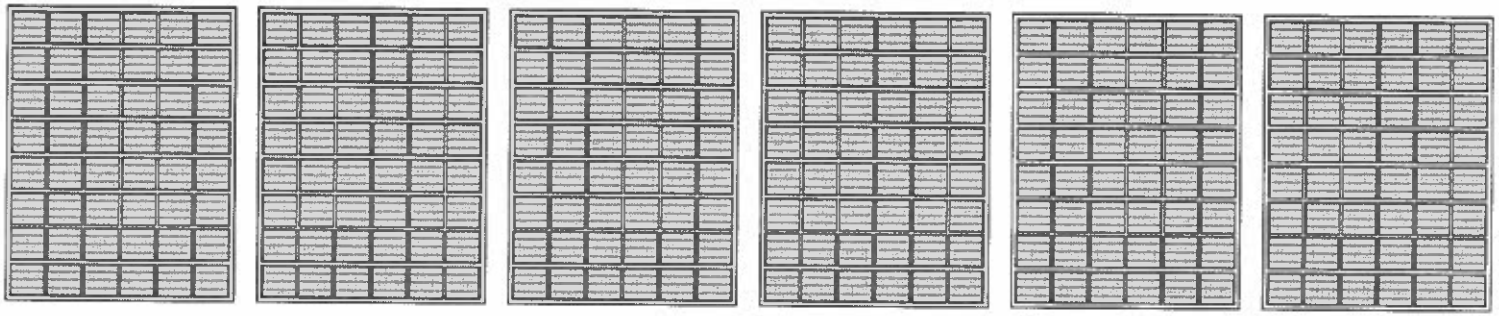


Front

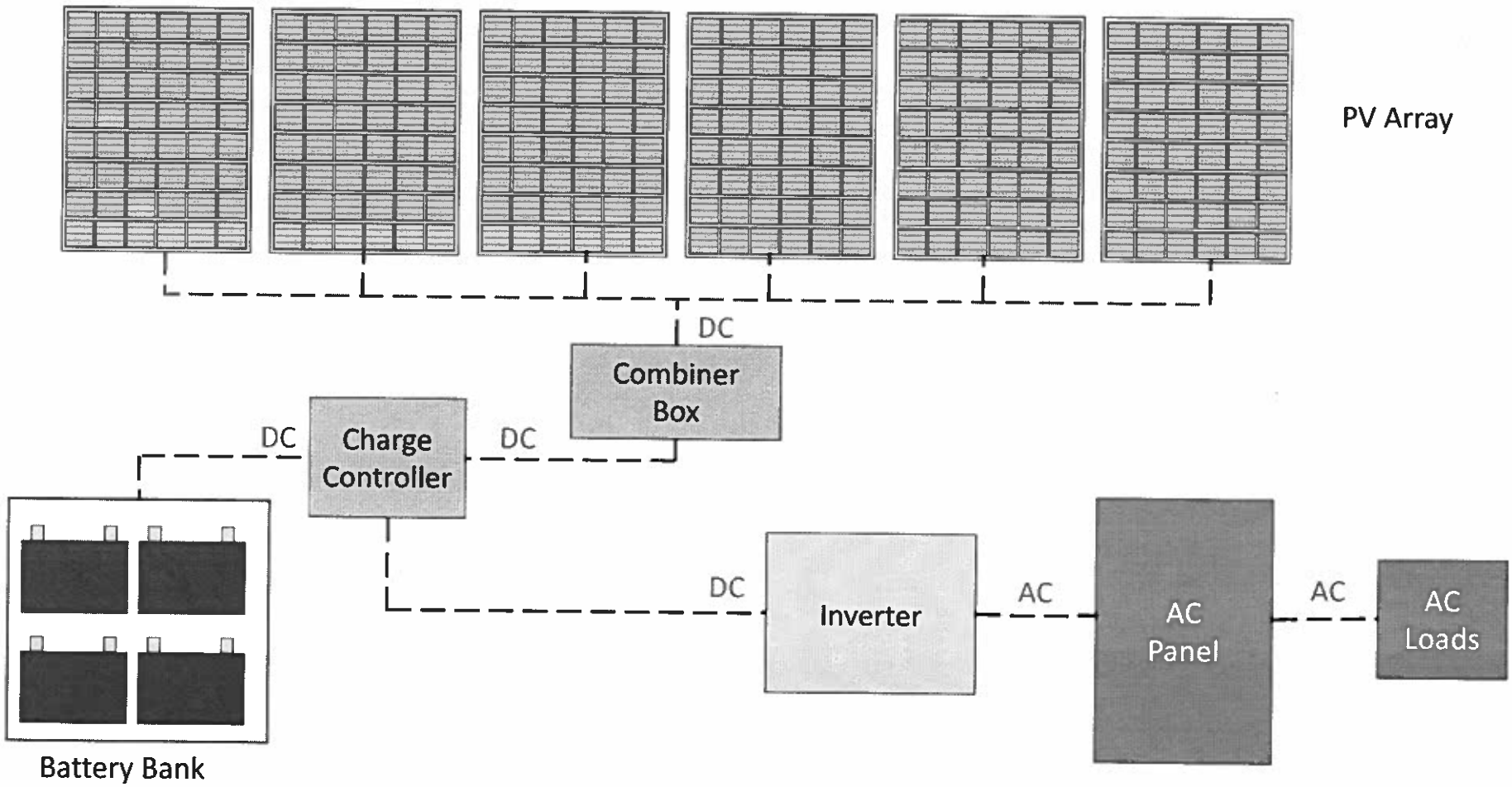


Back

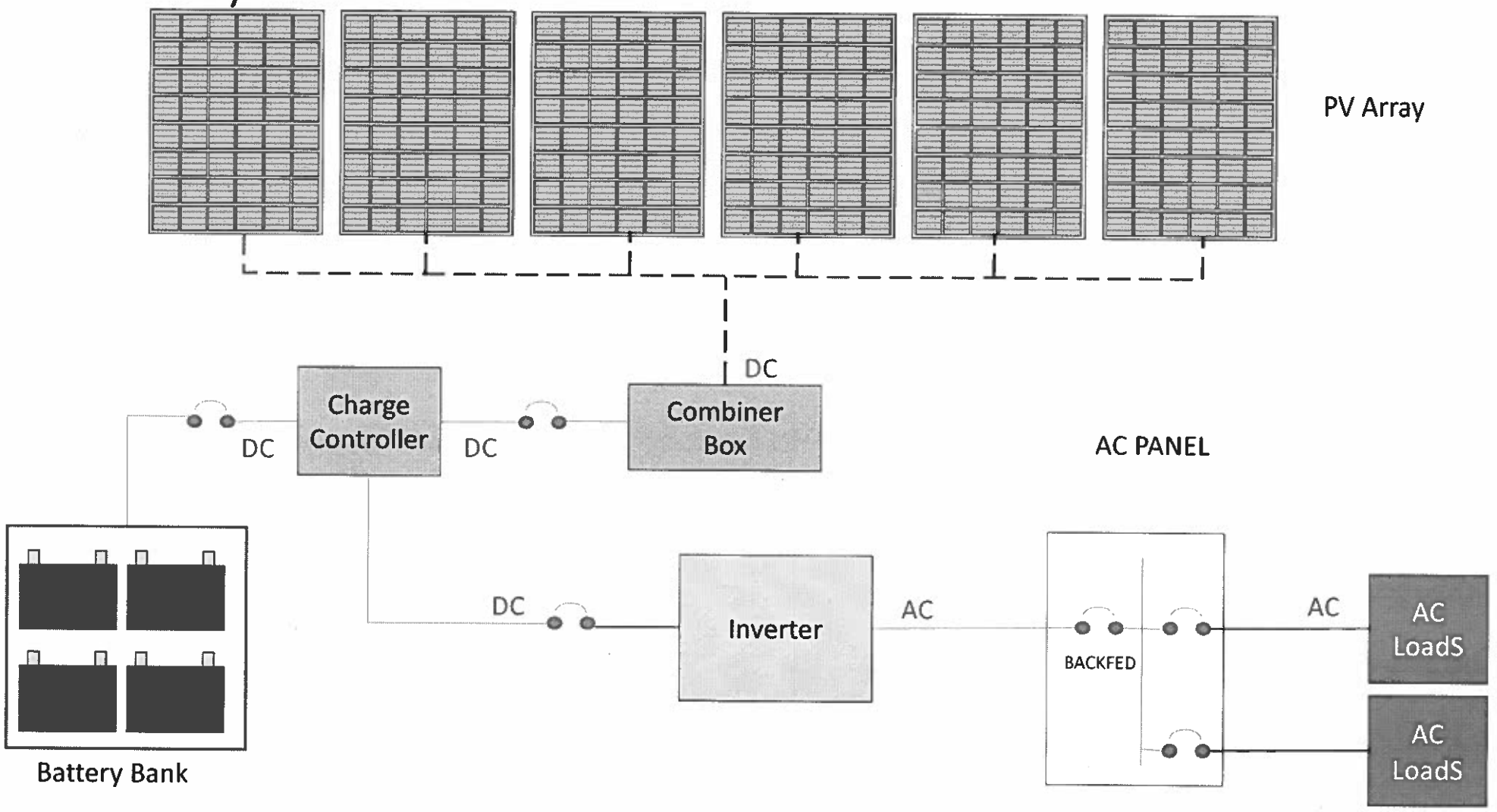
PV Array



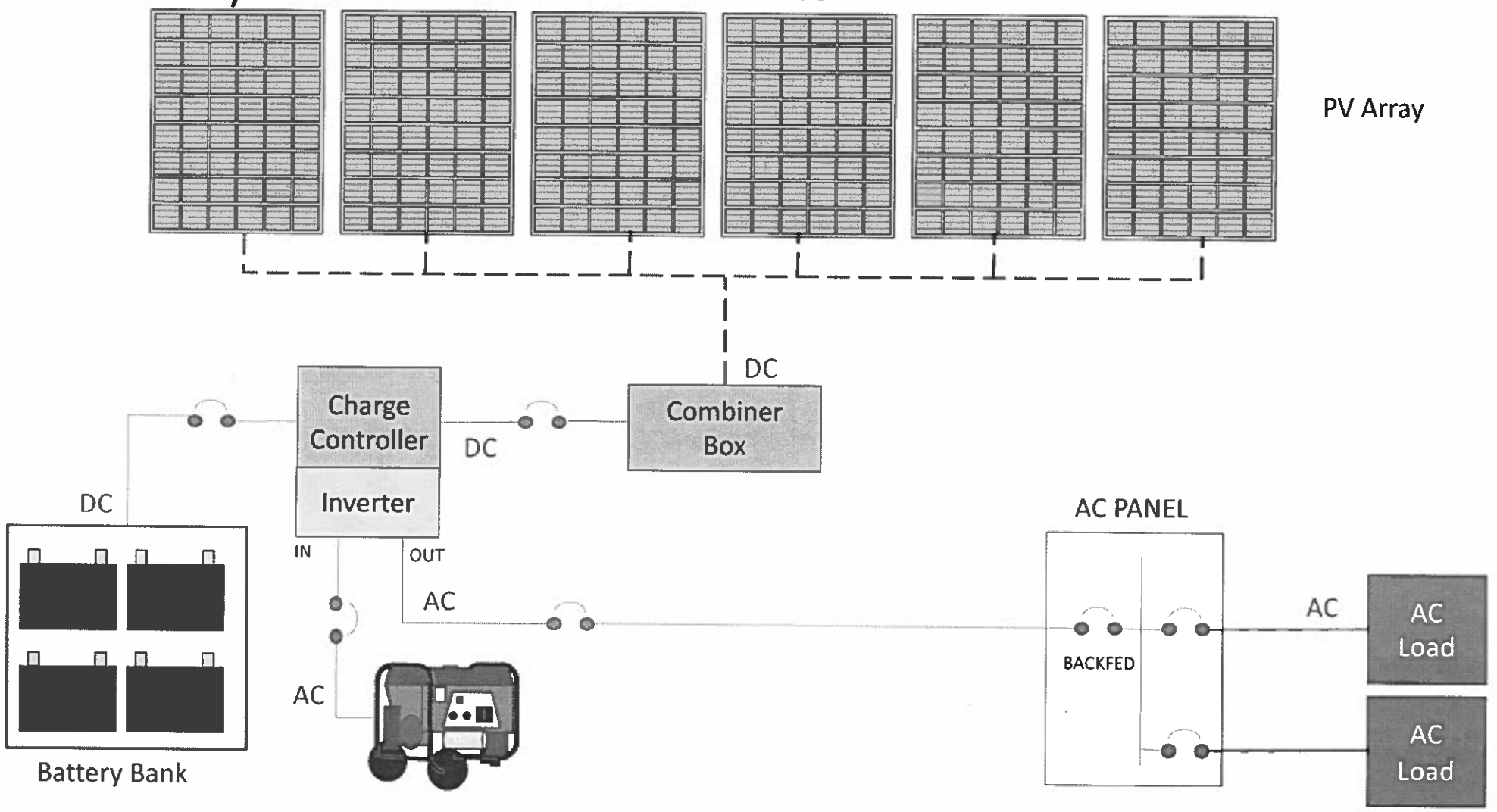
PV System


PV Array
DC
Combiner Box
DC
Charge Controller
DC
Battery Bank
DC
Inverter
AC
AC Panel
AC
AC Loads

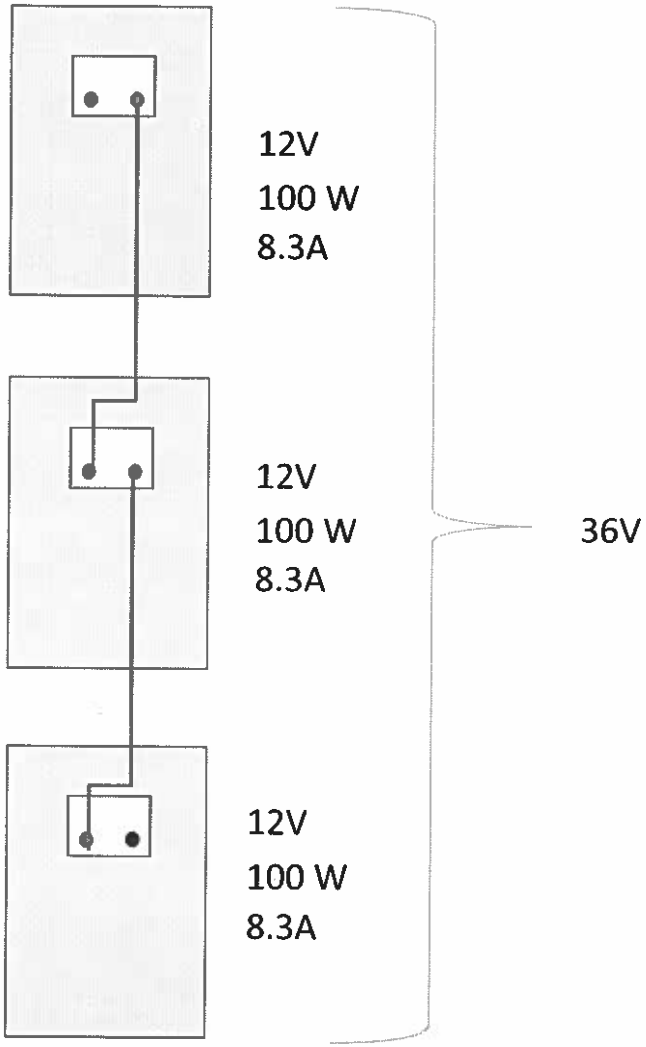
PV System with Disconnects



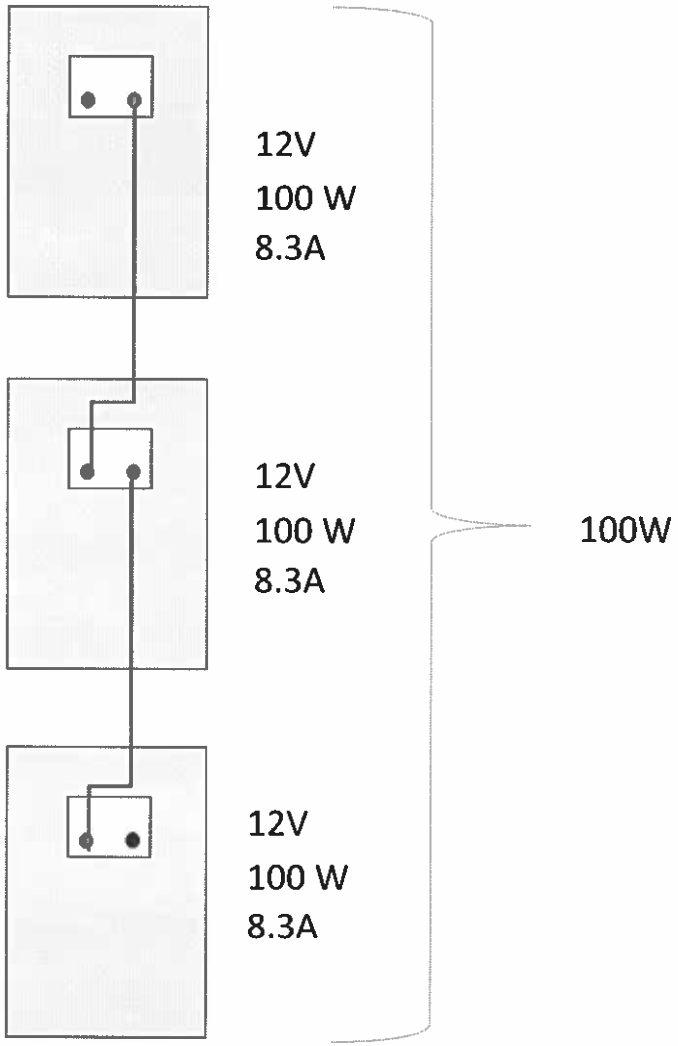
PV System with Disconnects



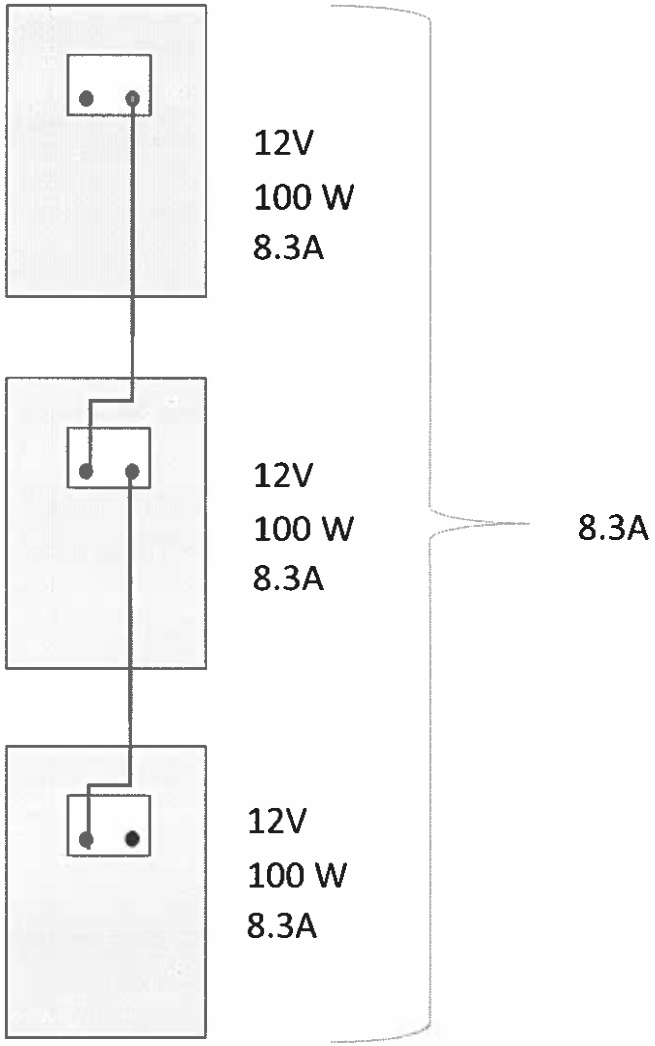
Series Connected



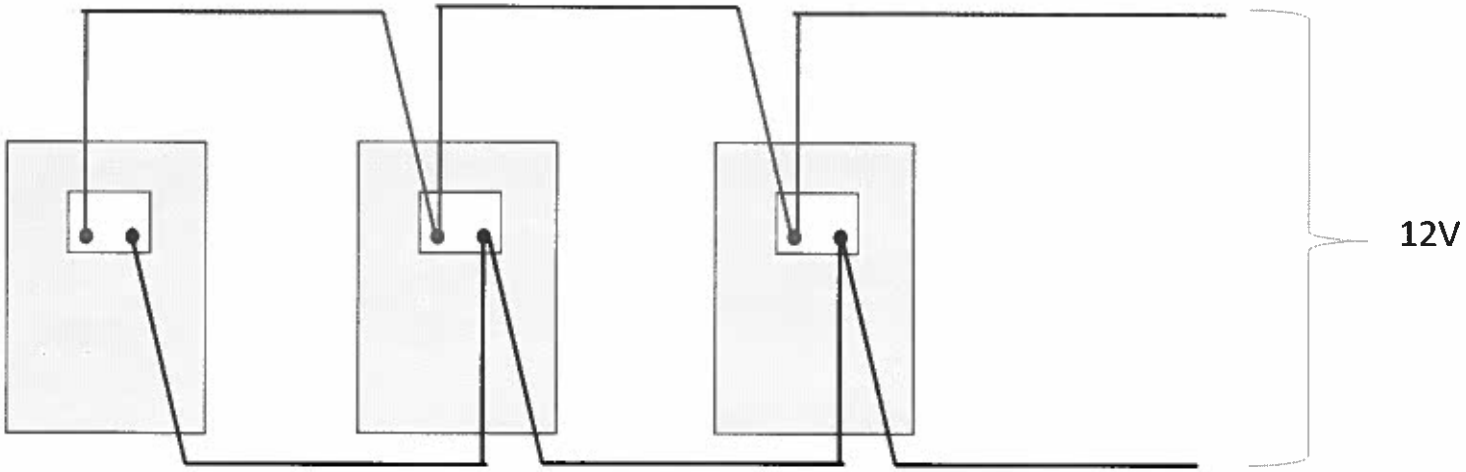
Series Connected



Series Connected

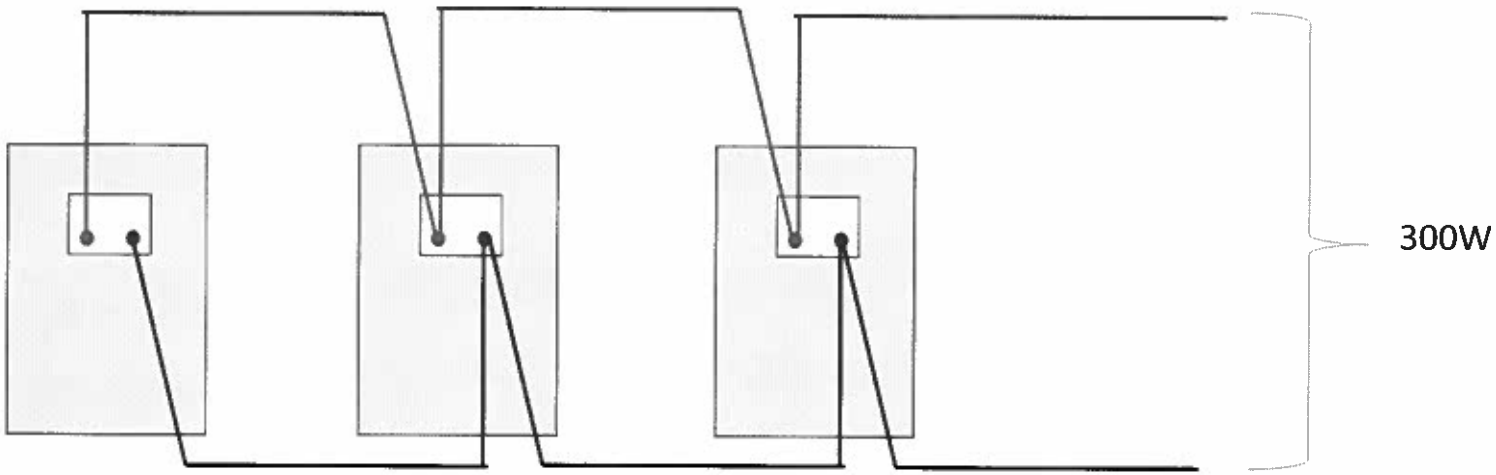


Parallel Connected



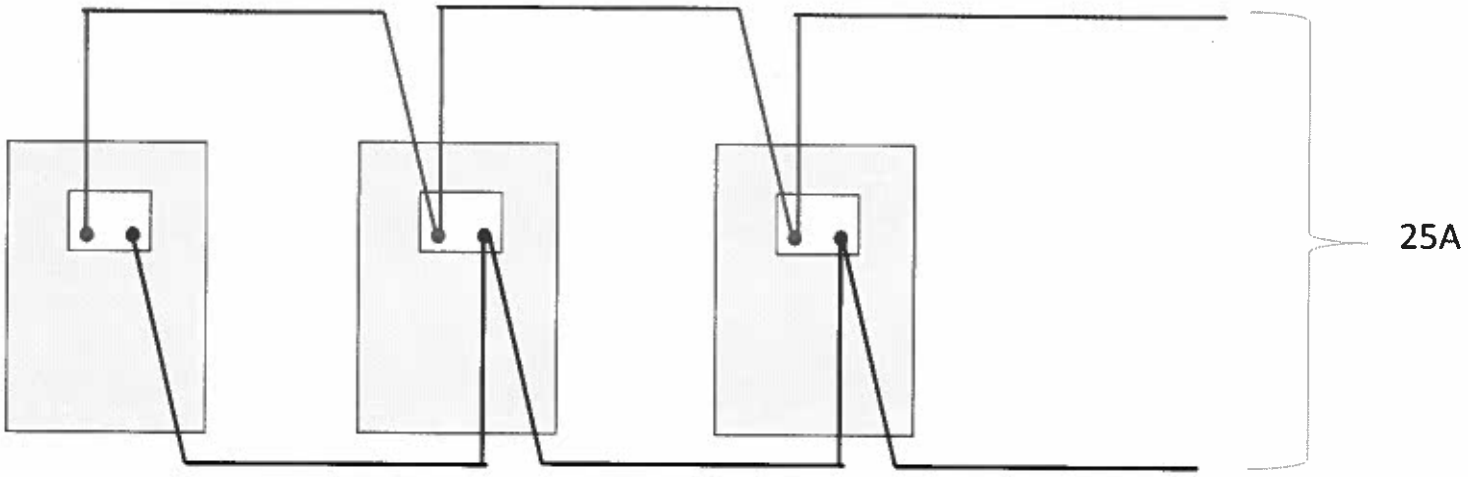
12V	12V	12V
100 W	100 W	100 W
8.3A	8.3A	8.3A

Parallel Connected



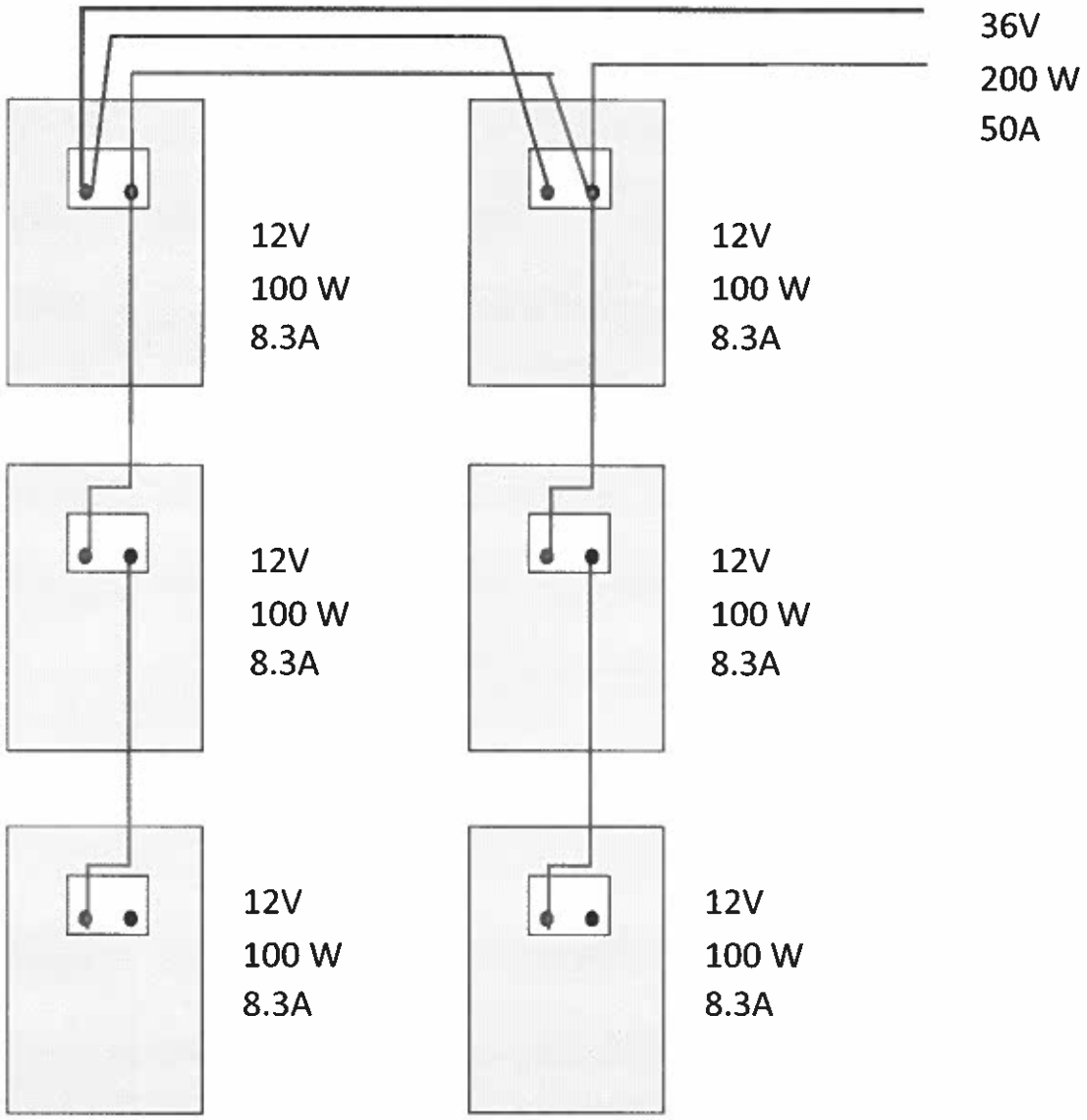
12V	12V	12V
100 W	100 W	100 W
8.3A	8.3A	8.3A

Parallel Connected



12V	12V	12V
100 W	100 W	100 W
8.3A	8.3A	8.3A

Series And Parallel Connected

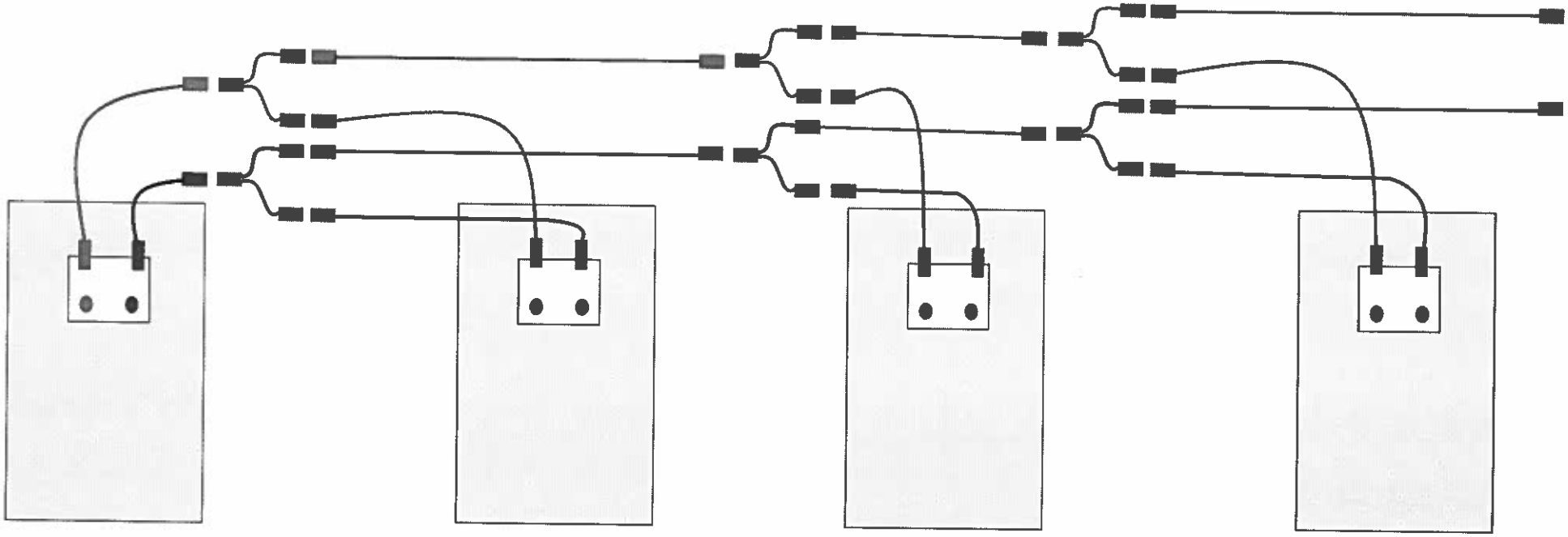


Positive:

- Straight connectors: 7
- Y-adapters: 3

Negative:

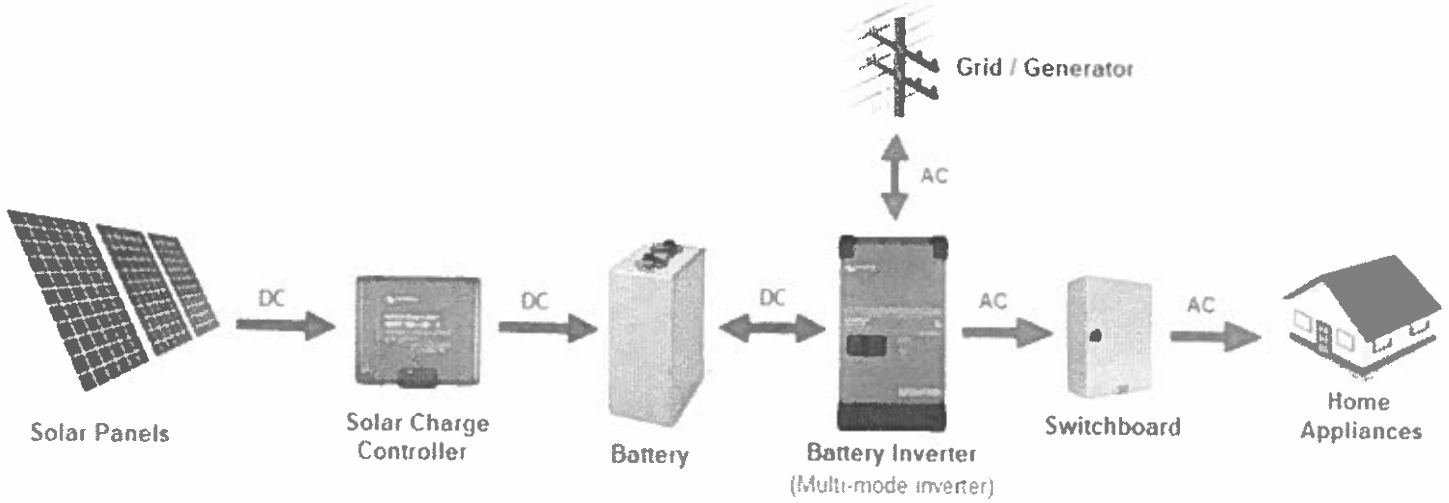
- Straight connectors: 7
- Y-adapters: 3



Definitions

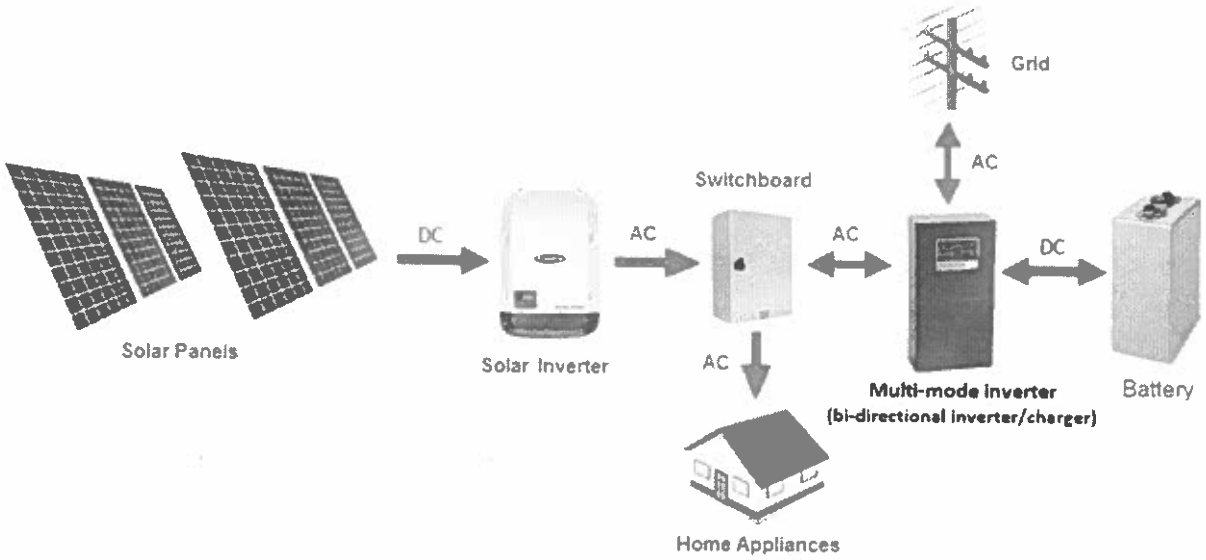
- Coupling
  - Refers to the way solar panels (modules) are coupled or linked to an energy storage or battery system
- 4-types
  - DC coupled systems: Off – grid
  - AC coupled systems: Off – grid
  - AC coupled Battery Systems: Grid-tie
  - DC coupled Hybrid Systems: Grid-tie

DC - Coupled



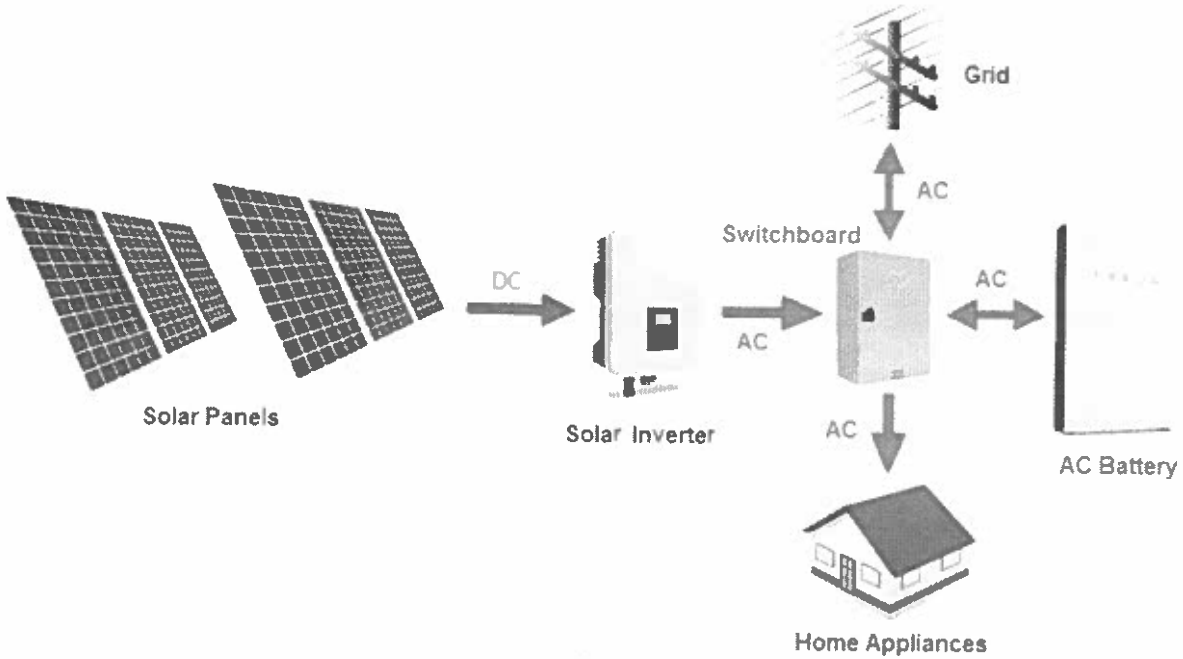
Basic layout diagram of a DC coupled (off-grid) solar battery system using an MPPT solar charge controller

AC - Coupled



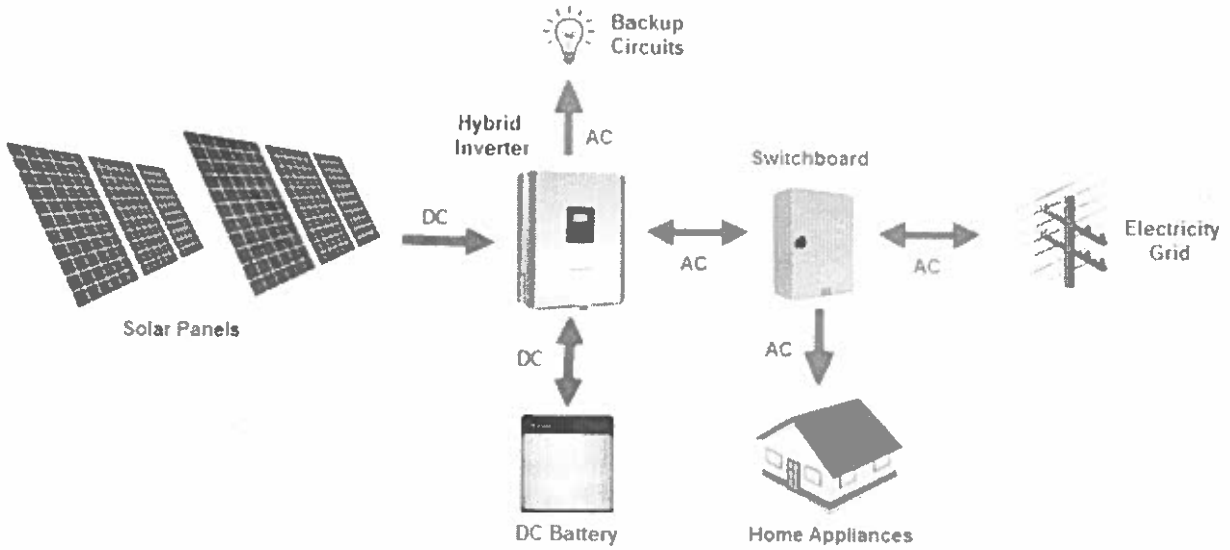
Basic layout diagram of an AC coupled solar battery system - Grid-tie (hybrid) setup

AC – Coupled Batteries
Grid-Tie



Basic layout diagram of a AC battery coupled with a AC solar system - Grid-tie (no backup shown)

DC – Coupled Hybrid



Basic layout diagram of a hybrid solar inverter with DC battery system

Solar Module Facts

- Solar modules (panels) are less efficient as temperature increases
- As temperature of the module increases:
  - Current output increases
  - Voltage output decreases

Temperature Coefficient (P_{max})

- How much the power the panel will lose when the temperature rises 1 degree C above STD of 25 degrees C

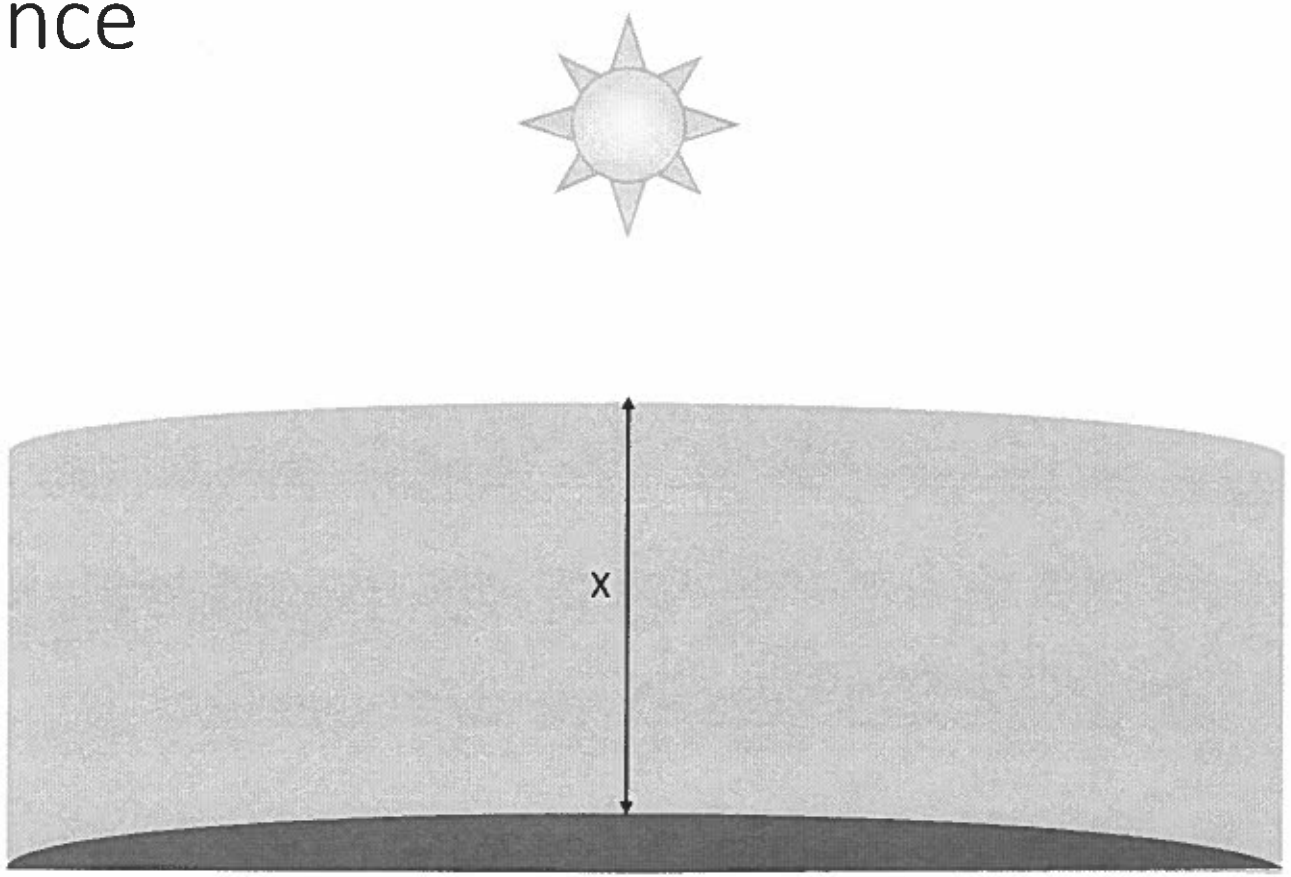
Module Standard Test Conditions (STC)

- Irradiance: 1000 W/m^2
- Module cell temperature: 25°C (77°F)
- Mass of Air: 1.5

Irradiance

- Irradiance: 1000 W/m^2
  - Intensity of solar radiation striking the earth
  - Ranges from 0 to 1250 W/m^2
  - 1000 W/m^2 represents "Full Sun"

Irradiance



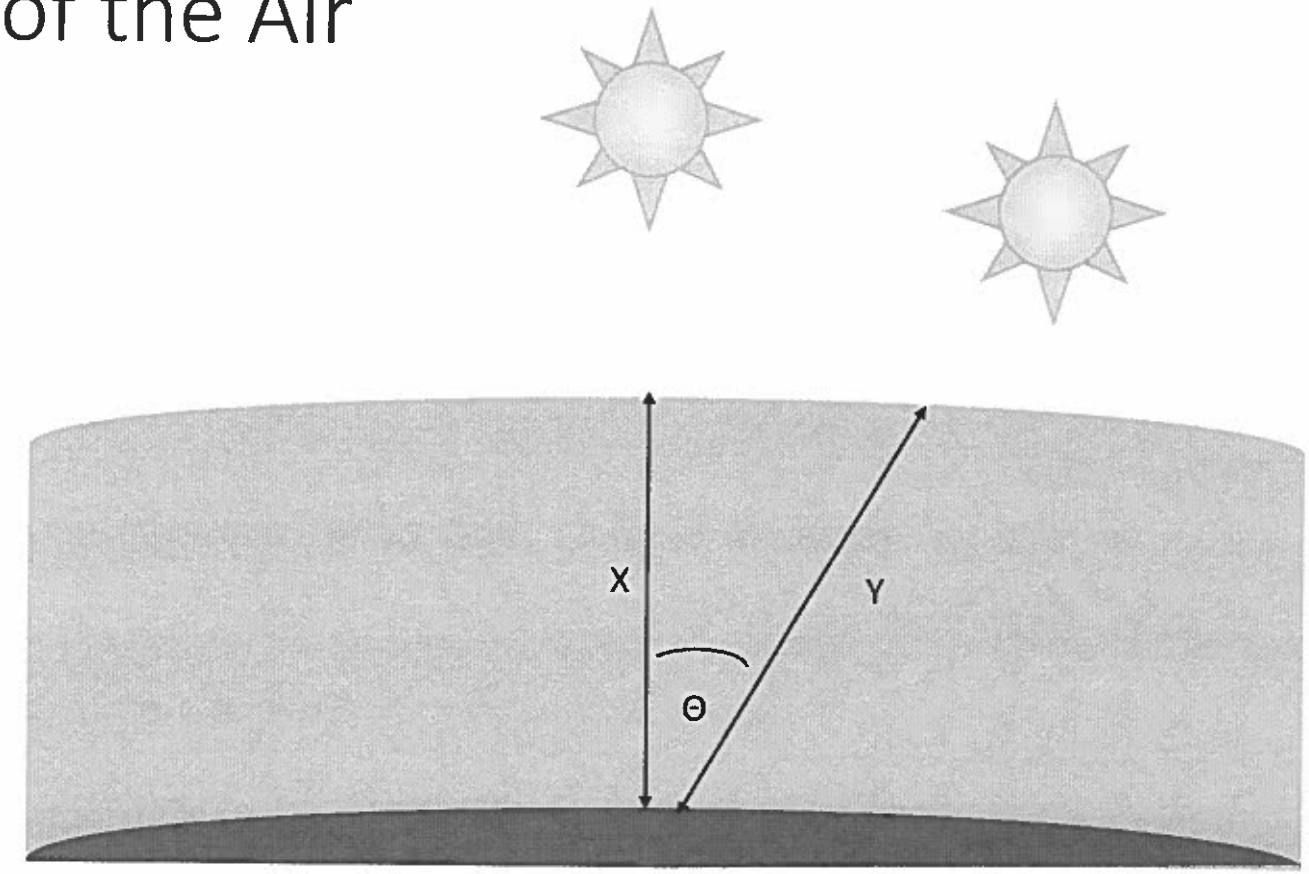
Module Cell Temperature

- Module cell temperature: 25°C (77°F)
- Not a maximum
- Can reach 75°C or more if sitting in full sun

Mass of Air

- Mass of Air: 1.5 or (AM 1.5)
  - Amount of light that that to pass through Earth's atmosphere before it can hit earth's surface
  - Has to do with angle of the sun relative to a reference point on the surface
  - Minimized when sun is directly above
  - Increases as sun goes further away from the reference point
  - Varies widely depending on
    - Location
    - Time of year
    - Time of day

Mass of the Air



windynation

www.windynation.com

clean | power to the people

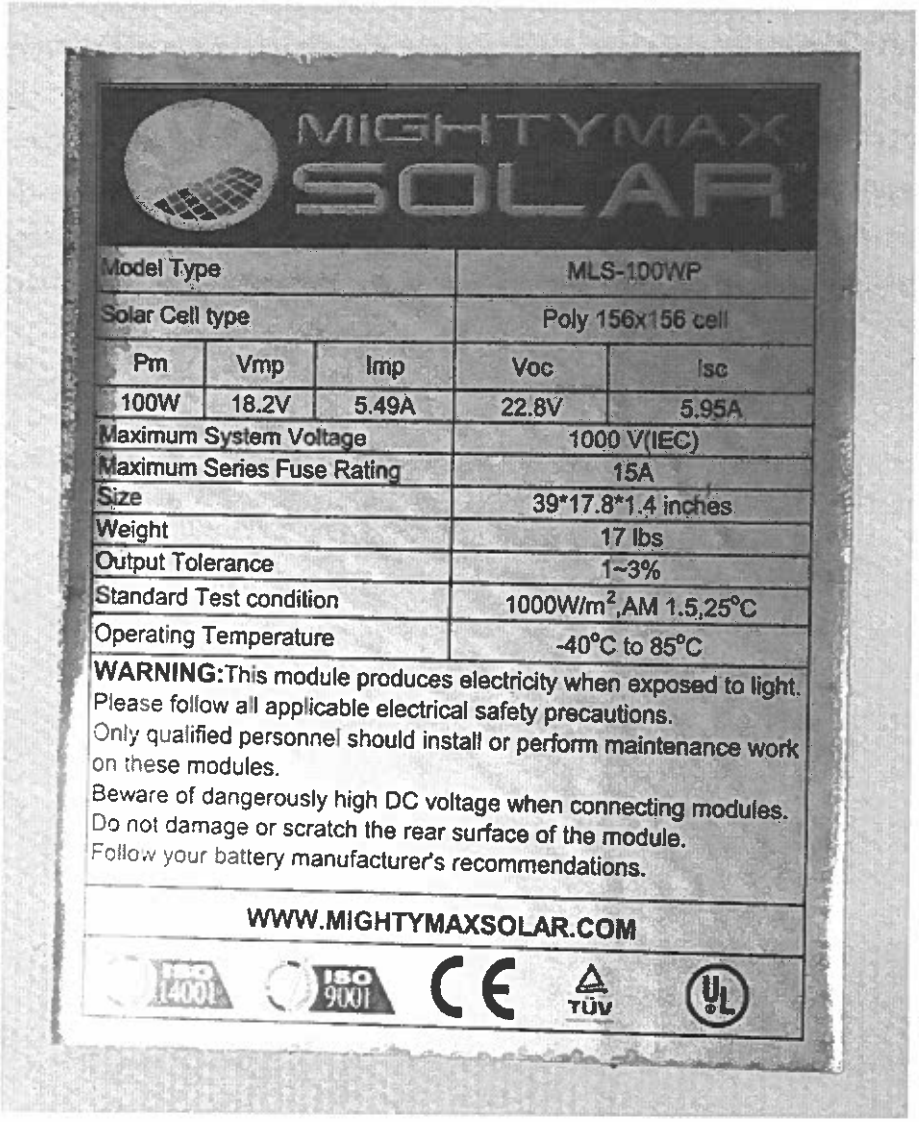
100W Polycrystalline Photovoltaic Solar Panel

Part #: SOL-100P-01

Maximum Power (Pmax): 100 Watts
Open Circuit Voltage (Voc):21.60 Volts
Short Circuit Current (Isc): 6.32 Amps
Max Power Voltage (Vpm): 17.40 Volts
Max Power Current (Imp): 5.75 Amps
Max System Voltage: 1000 VDC (600 VDC UL)

Dimensions: 40.0" x 26.4" x 1.2"
[1015mm x 670mm x 30mm]
Weight: 18.7 lbs [8.5kg]
Max Series Fuse Rating: 8 Amps
Nom Operating Cell Temp: 48 C [+/-2]

C US UL-1703 CE RoHS MADE IN INDONESIA



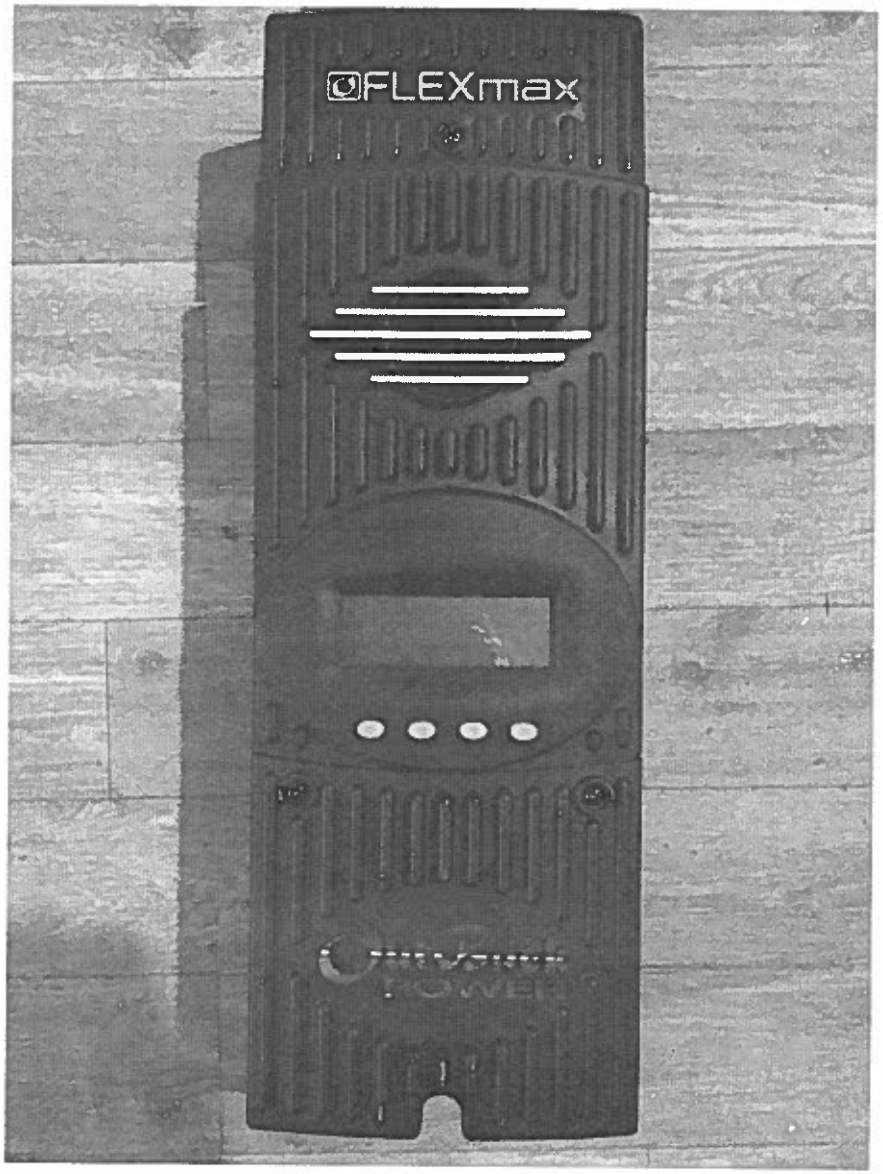
MIGHTYMAX SOLAR

Model Type			MLS-100WP	
Solar Cell type			Poly 156x156 cell	
Pm	Vmp	Imp	Voc	Isc
100W	18.2V	5.49A	22.8V	5.95A
Maximum System Voltage			1000 V(IEC)	
Maximum Series Fuse Rating			15A	
Size			39*17.8*1.4 inches	
Weight			17 lbs	
Output Tolerance			1~3%	
Standard Test condition			1000W/m^2,AM 1.5,25°C	
Operating Temperature			-40°C to 85°C	

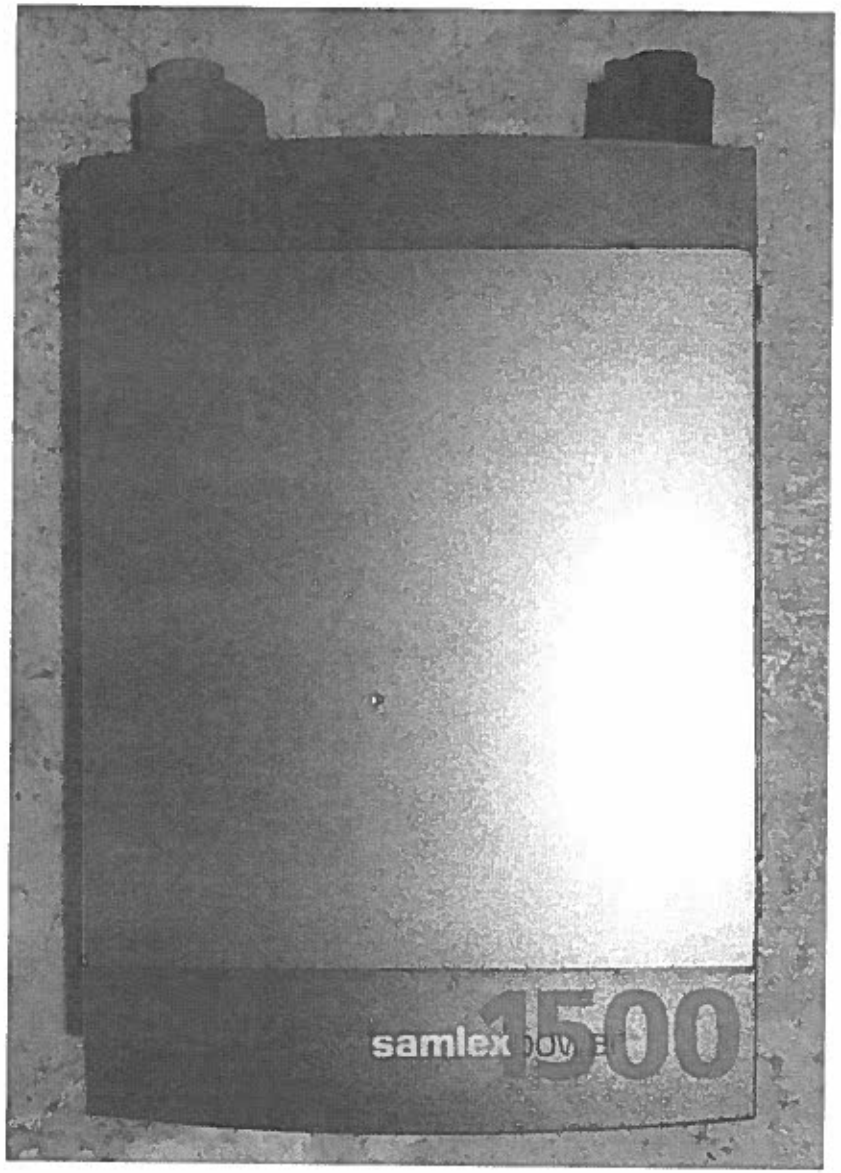
WARNING: This module produces electricity when exposed to light.
Please follow all applicable electrical safety precautions.
Only qualified personnel should install or perform maintenance work on these modules.
Beware of dangerously high DC voltage when connecting modules.
Do not damage or scratch the rear surface of the module.
Follow your battery manufacturer's recommendations.

WWW.MIGHTYMAXSOLAR.COM

ISO 14001 ISO 9001 CE TÜV UL

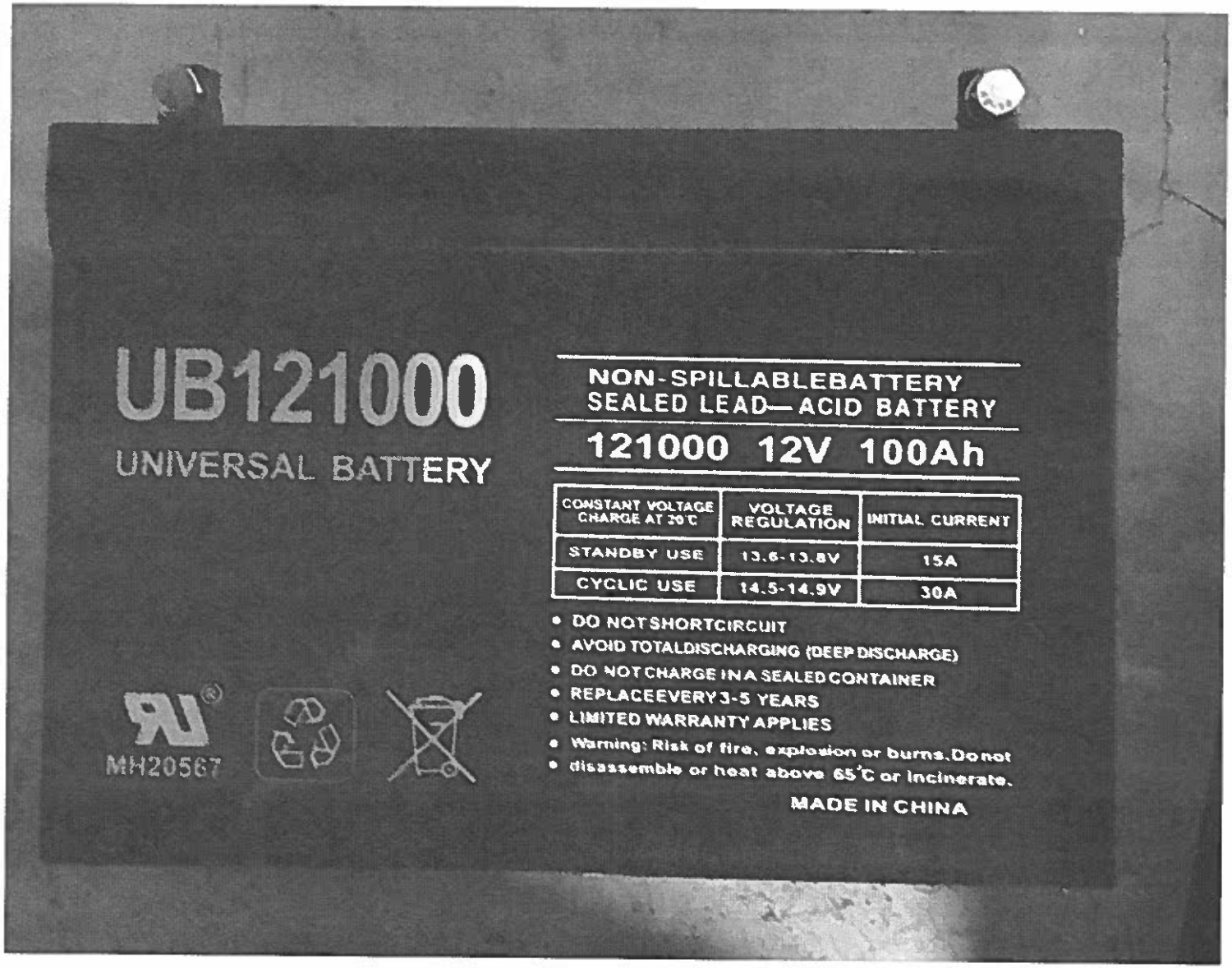

FLEXmax


FLEXmax 80
FM80-150VDC



SAMLEX AMERICA INC.

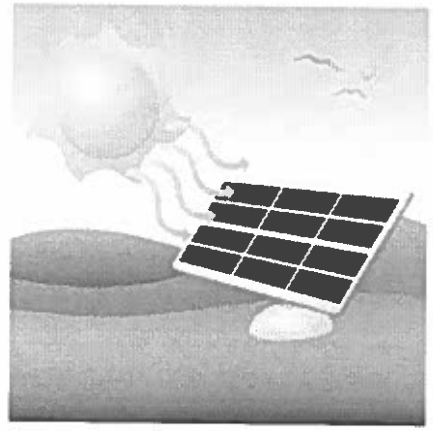
Model / Modèle : SSW-1500-12A
Input / Entrée : 12.5V DC, 150A
Output / Sortie : 115V AC, 60Hz
1500 Watts
Made in China / Fabriqué en Chine


UB121000
UNIVERSAL BATTERY
NON-SPILLABLEBATTERY
SEALED LEAD—ACID BATTERY
121000 12V 100Ah
CONSTANT VOLTAGE CHARGE AT 20°C
VOLTAGE REGULATION
INITIAL CURRENT
STANDBY USE
13.6-13.8V
15A
CYCLIC USE
14.5-14.9V
30A
• DO NOTSHORTCIRCUIT
• AVOID TOTALDISCHARGING (DEEP DISCHARGE)
• DO NOT CHARGE IN A SEALED CONTAINER
• REPLACEEVERY 3-5 YEARS
• LIMITED WARRANTY APPLIES
• Warning: Risk of fire, explosion or burns. Do not
• disassemble or heat above 65°C or incinerate.
MADE IN CHINA
MH20567

Maximum Current

- For PV module
  - Must account for the ability to have more irradiance than STD (1000 w/m^2)
  - Multiply module short circuit current (Isc) x 1.25

- For inverters, microinverters and DC-to-DC converters
  - These devices will limit the maximum current
  - No need to multiply by 1.25
  - Use manufacturer's maximum current number



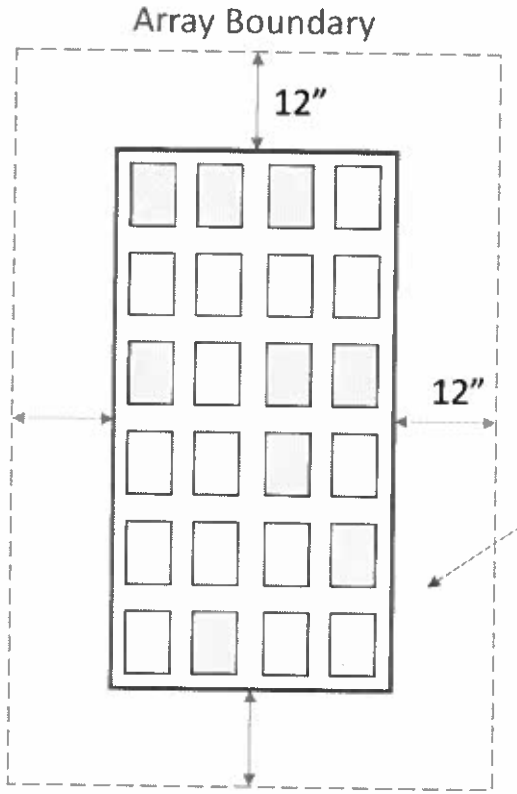
Sizing OCPDs (Circuit Breakers and Fuses)

- For DC side, must be listed for PV use
- Sized to limit current to 80% of OCPD
  - In other words… multiply by 125% (1.25)
- To size PV OCPD for PV modules:
  - Multiply Isc x 1.25 x 1.25
    - First 1.25 is for over-irradiance potential (maximum current)
    - Second 1.25 is to limit current in circuit to 80% of OCPD
      - Exception – unless OCDP is rated for continuous use (100%)

Sizing OCPDs (Circuit Breakers and Fuses)

- To size PV OCPD for inverters:
  - Use manufacturer information: maximum current output
    - Then multiply by 1.25, or
    - Use maximum OCDP as specified by manufacturer.

Rapid Shutdown Requirements



Outside of Array Boundary:
Voltage limited to not more than 30 volts within 30 seconds of rapid shutdown start

Inside of Array Boundary:
Voltage limited to not more than 80 volts within 30 seconds of rapid shutdown start

Rapid Shutdown Requirements

- Initiation Device can be one or more of the following:
  - Service disconnecting means
  - PV system disconnecting means
  - Readily accessible switch that indicate whether it is in the “Off” or “On” position
- Device shall be listed for providing rapid shutdown protection

Disconnects Part III - 690.13

- Accessibility
- Marking
  - PV SYSTEM DISCONNECT
  - Where line and load terminals may be energized in the open position, the device shall be marked:

WARNING
ELECTRIC SHOCK HAZARD
TERMINALS ON THIS LINE AND LOAD
SIDES MAY BE
ENERGIZED IN THE OPEN POSITION

- Must have rating sufficient to handle maximum available fault current

Part IV Wiring Methods and Materials (690.31)

- Note cable ampacity ratings – different than Chapter 3 requirements
  - 105 deg C (221 deg F)
  - 125 deg C (257 deg F)
- Determined by Table 690.31(A)(b)
- Ampacities corrected by Table 690.31 (A)(a)
  - Must be adjusted for anything about 86 deg F (30 deg C)
- PV system DC circuits cannot be run with circuits of non-PV systems
  - Cannot share enclosures, cable or raceways
  - Exception: unless separated by a barrier or partition.
- Circuit conductors shall be identified and grouped
  - See exceptions

Identification of Conductors

- Must be identified at all terminations, connections and splice points
- Methods: color coding, marking tape, tagging etc.
- Marking requirements for non-solidly grounded conductors:
  - For positive conductors: “POSITIVE”, “POS”, or “+”
  - For negative conductors: “NEGATIVE”, “NEG”, “-”
- Cannot use green, white, gray or red
- Grouping for conductors of more than one system:
  - Cable ties or other acceptable methods
  - Not to exceed 6 ft intervals

Conductors

- Cables:
  - Type PV and DG (Distributed Generation)
    - See UL 4703 (PV) and UL 3003 (DG)

- Single conductor cable or wire marked sunlight resistant:
  - PV, Type USE-2 and Type RHW-2
  - Supported at intervals not to exceed 24”
  - Allowed in cable trays with or without the cable tray rating
    - Must be secured at least every 12”

- Multiconductor Jacketed Cables
  - Follow PV system or cable listing instructions. See 690.31 (C)(3)(1) & (2)

- Flexible Cords and Cables (for movable aka tracking arrays)

Table 690.7(A) Voltage Correction Factors for Crystalline and Multicrystalline Silicon Modules (Multiply by the rated open-circuit voltage by the correction factor below)

Ambient Temperature (°C)	Factor	Ambient Temperature (°F)
24 to 20	1.02	76 to 68
19 to 15	1.04	67 to 59
14 to 10	1.06	58 to 50
9 to 5	1.08	49 to 41
4 to 0	1.10	40 to 32
-1 to -5	1.12	31 to 23
-6 to -10	1.14	22 to 14
-11 to -15	1.16	13 to 5
-16 to -20	1.18	4 to -4
-21 to -25	1.20	-5 to -13
-26 to -30	1.21	-14 to -22
-31 to -35	1.23	-23 to -31
-36 to -40	1.25	-32 to -40

Voltage and Current Limitations
On or In Buildings - 690.31(D)

- Where DC voltage exceeds 30 volts or 8 amps…
  - Circuits shall be enclosed in metal raceway or Type MC cable that complies 250.118(10)
    - See exception

- Refer to table 690.31(C) for wire size stranding requirements

Marking and Labeling Requirements- 690.31(D)(2)

- Components shall have the following markings:
  - PHOTOVOLTAIC POWER SOURCE or
  - SOLAR PV DC CIRCUIT
- Required for:
  - Exposed raceways, cable trays, and other wiring methods
  - Covers or enclosures of pull boxes and junction boxes
  - Conduit bodies in which any of the available conduit openings are unused
- Physical requirements:
  - White or red background
  - Spacing between labels shall not exceed 10 ft.

Mating Connector Requirements 690.33

- Shall be polarized
- Shall be constructed to guard against inadvertent contact with live parts
- Shall be the latching type
- Shall be of the same type and brand or listed for interconnectibility

Part V. Grounding and Bonding

Starting at 690.41

- 6 types of grounding configurations
- Systems that exceed 30V or 8 amps shall have DC ground fault protection
  - GF devices shall provide indication of faults
- Exposed conductive surfaces of PV equipment shall be connected to an equipment grounding conductor.
- Equipment used for mounting PV modules and used to bond module frames shall be listed, labeled and identified for bonding PV modules.

Grounding and Bonding

- Equipment Grounding Conductors sized per 250.122
  - Note: no need to increase EGC to account for voltage drop
- Grounding Electrode System
  - Required for a building or structure that supports a PV system
  - Follows rules in Article 250
  - For solidly grounded system, the grounded conductor sized per NEC 250.166
- See Part VIII, starting with section 250.160 for grounding of DC systems
- Note: Most PV systems are functionally grounded rather than solidly grounded

Functionally Grounded

- A system that has an electrical ground reference for operational purposes that is not solidly grounded
  - Note: a functionally grounded system is often connected to ground through an electronic means internal to an inverter or charge controller that provides ground fault protection.
- Grounding Electrode Conductors
  - Size per 250.66
  - Array support structures of building frames can qualify as grounding electrodes if they fit definition of electrodes in 250.52 and 250.68(C)(2)

File Attachments for Item:

EC-8 Solar Photovoltaics and the NEC Part 1 (Matthews Electrical Services)

All Certifications except Plumbing

APPLICATION

FOR

Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.

Board of Building Standards
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER: HENRY PETER MATTHEWS

Course Submitter: HENRY PETER MATTHEWS (Contact Name)

Organization: MATTHEWS ELECTRICAL SERVICES (Organization/Company)

Address: 1203 MCKINLEY PLACE (Include Room Number, Suite, etc.)

City: FOSTORIA State: OHIO Zip: 44830

E-Mail: hpmatthews@matthewselectrical.net

Telephone: 419-575-3488 Fax:

Course Sponsor:

COURSE INFORMATION

Course Title: SOLAR PHOTOVOLTAICS AND THE NEC PART 1 WEBINAR

New Course Submittal: ■ Update Course: ☐ Prior Approval Number:

Purpose and Objective: The objective of this course is to provide some of the basic concepts for a safe installation based on the NEC. Articles 690, 705 and others will be examined in detail to provide an important subject. This is a 4-hour course that will be provided in a webinar format.

Number of Instructional Contact Hours that can be obtained upon completion: 4

If Multi-Session, Number of Instructional Contact Hours Per Session:

Program Applicable for the Following Participants:

Building Official ■	Master Plans Examiner ■	Building Inspector ■	Fire Protection Inspector ■	Mechanical Inspector ■	
	Building Plans Exam. ✔			Plumbing Inspector ☐	
	Plumbing Plans Exam. ☐			Non-Res IU Inspector ■	
	Electrical Plans Exam. ■				
	Mechanical Plans Exam. ■				
	Fire Protect. Plans Exam. ✔				
Res Building Official ■	Res Plans Examiner ■	Res Building Inspector ■	Res Mechanical Inspector ■	Res IU Inspector ■	

Electrical Safety Inspectors X

Location of ESI Course: www.matthewselectrical.net Date(s) of ESI Course(s): August 14, 2021

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**		Check Off
Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	X
	Organization sponsoring or requesting the program (if any)	
Course Title:	Name of course (related to content)	X
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	X
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	X
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	X
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	X
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	X
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	X
Test Materials:	Quizzes and polls will be used throughout the course	X
Completed Application:		X

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

Solar Photovoltaics Part I - 4 Hour Webinar
Course Outline

1. Objective: This introductory course will cover some of the basic concepts of solar photovoltaics and provide guidance on how to use relevant NEC articles for solar PV installations including articles 690 and 691.

2. This webinar will cover the following topics:
    a. A short history of the solar PV industry and its projected growth in the future
    b. Other relevant NEC, NFPA 70E, UL and OSHA codes, standards and regulations
    c. Basic math used for PV installations, primarily DC calculations
    d. PV safety
    e. Key definitions used in the industry and article 690
    f. The different types of PV installations including:
        i. Grid-direct
        ii. Stand-alone, and
        iii. Hybrid systems such as grid-direct with battery backup
    g. Equipment used in PV installations such as:
        i. Modules, inverters, micro-inverters, DC-to-DC converters (DC optimizers), combiner boxes, charge controllers, batteries, disconnects, rapid-shutdown devices, mounting options etc.
    h. Series and parallel connection of PV modules
    i. Series and parallel connection of batteries
    j. How to read and interpret the labels of PV equipment
        i. Modules
        ii. Inverters
        iii. Charge controllers and more
    k. NEC NRTL listing and marking requirements
    l. Conductors used for PV installations
    m. Introduction to concepts covered in Part 2
        i. Sizing conductors
        ii. Conductor installation requirements
        iii. Selecting and sizing overcurrent devices
        iv. Labeling and marketing requirements
        v. Disconnect requirements
        vi. Rapid shutdown requirements
3. Course Agenda
    a. Welcome
    b. Webinar instructions
    c. Survey: determine attendees' exposure, interests and pre-knowledge of PV systems
    d. Webinar content (see above)
        i. note : 5-10 minute breaks will be given every hour
    e. Quizzes will be given periodically during the webinar to test understanding

f. Webinar wrap-up and instructions
g. Questions and feedback
h. Instructions on how certificates will be distributed and how hours will be reported to the OBBS.
i. Conclusion

4. Webinar format:
    a. Attendees will register for the course via: www.matthewselectrical.net
    b. They will then be directed to www.zoom.us for official Zoom webinar registration
    c. After payment via PayPal, the attendees will receive an email with their unique and encrypted webinar login link.
    d. Attendees are encouraged to log in 10 to 15 minutes before the start of the webinar
    e. At the beginning of the webinar, the instructor (Henry Matthews) will verify every attendee with the report generated from Zoom and will confirm their attendance using their web cameras.
    f. Attendees are required to be present the entire time except breaks. After breaks, attendance will be taken again to verify attendance.
    g. At the end of class, attendance will be taken again.

File Attachments for Item:

EC-9 Solar Photovoltaics and the NEC Part 2 (Matthews Electrical Services)

All Certifications except Plumbing (4 hours)

Solar Photovoltaics Part 2 - 4 Hour Webinar
Course Outline

1. Objective: This course will follow up on the basic solar PV topics covered in part 1 and will go into more detail on many of the important topics in articles 690, 250, 705 and others that are important for developing a baseline understanding of what is required for a code-compliant and safe PV installation.

2. This webinar will cover the following topics:
3. Sizing conductors
    a. Conductor installation requirements
        i. Understanding why the 125% rule is applied for irradiance
        ii. Considering voltage drop for conductor sizing
    b. Selecting and sizing overcurrent devices
        i. Understanding when to apply another 125% for continuous operation
        ii. Understanding when OCPD are required and their ratings
    c. Grounding and bonding, including
        i. Equipment grounding requirements
        ii. Functional grounding and what does it mean
    d. Labeling and marketing requirements
    e. Disconnect requirements
    f. Rapid shutdown requirements
    g. PV array boundaries
    h. Battery sizing for battery-based systems
4. Course Agenda
    a. Welcome
    b. Webinar instructions
    c. Survey: determine attendees' exposure, interests and pre-knowledge of PV systems
    d. Webinar content (see above)
        i. note : 5-10 minute breaks will be given every hour
    e. Quizzes will be given periodically during the webinar to test understanding
    f. Webinar wrap-up and instructions
    g. Questions and feedback
    h. Instructions on how certificates will be distributed and how hours will be reported to the OBBS.
    i. Conclusion
5. Webinar format:
    a. Attendees will register for the course via: www.matthewselectrical.net
    b. They will then be directed to www.zoom.us for official Zoom webinar registration
    c. After payment via PayPal, the attendees will receive an email with their unique and encrypted webinar login link.
    d. Attendees are encouraged to log in 10 to 15 minutes before the start of the webinar

e. At the beginning of the webinar, the instructor (Henry Matthews) will verify every attendee with the report generated from Zoom and will confirm their attendance using their web cameras.
f. Attendees are required to be present the entire time except breaks. After breaks, attendance will be taken again to verify attendance.
g. At the end of class, attendance will be taken again.

APPLICATION

FOR

Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.

Board of Building Standards
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER: HENRY PETER MATTHEWS

Course Submitter: HENRY PETER MATTHEWS (Contact Name)

Organization: MATTHEWS ELECTRICAL SERVICES (Organization Company)

Address: 1203 MCKINLEY PLACE (Include Room Number, Suite, etc.)

City: FOSTORIA State: OHIO Zip: 44830

E-Mail: hpmatthews@matthewselectrical.net

Telephone: 419-575-3488 Fax:

Course Sponsor:

COURSE INFORMATION

Course Title: SOLAR PHOTOVOLTAICS AND THE NEC PART 2 WEBINAR

New Course Submittal: ■ Update Course: ☐ Prior Approval Number:

Purpose and Objective: This is a follow up to the Solar PV and the NEC part 2 webinar presented by M
This 4-hour webinar will further examine the requirements in articles 690, 691, 705 and others to
the requirements for a safe and code-compliant solar PV installation.

Number of Instructional Contact Hours that can be obtained upon completion: 4

If Multi-Session, Number of Instructional Contact Hours Per Session:

Program Applicable for the Following Participants:

Building Official	■	Master Plans Examiner	■	Building Inspector	■	Fire Protection Inspector	■
		Building Plans Exam.	✔				
		Plumbing Plans Exam.	☐				
		Electrical Plans Exam.	■				
		Mechanical Plans Exam.	■				
		Fire Protect. Plans Exam.	✔				

Mechanical Inspector	■	Plumbing Inspector	☐	Non-Res IU Inspector	■				
Res Building Official	■	Res Plans Examiner	■	Res Building Inspector	■	Res Mechanical Inspector	■	Res IU Inspector	■

Electrical Safety Inspectors [X]

Location of ESI Course: www.matthewselectrical.net Date(s) of ESI Course(s): September 11, 2021

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**		Check Off
Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	x
	Organization sponsoring or requesting the program (if any)	
Course Title:	Name of course (related to content)	x
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	x
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	x
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	x
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	x
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	x
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	x
Test Materials:	Quizzes and polls will be used throughout the course	x
Completed Application:		x

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

File Attachments for Item:

EC-10 Codes and Egress (Allegion - OBOA/ODPCA Conference)

BO, MPE, BPE, PPE, EPE, MechPE, FPPE, ESI, BI, FPI, MI, PI, NRIUI (1 hour)

CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

Instructors: Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications for which the BBS has approved the class, and fees in promotion materials and advertising. ***The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising***. Advertising shall not disclose improper approval information to the public.

Course sponsors/co-sponsors: provide participants a certificate of completion containing the following information: name of participant, title of approved courses, BBS approval #, BBS approved certifications, date of the continuing education program, number of approved credit hours awarded and signature of authorized sponsor or instructor.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

Participants: Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

Board approval: Remains in effect through the calendar year of approval. The course may be renewed administratively by sponsor application in subsequent years so long as it references current codes and standards Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

Facility/training area: Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

APPLICATION

FOR

Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.

Board of Building Standards
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Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax: (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: Michael Fox
(Contact Name)
Organization: Allegion, PLC
(Organization/Company)
Address: 11819 North Pennsylvania Street
(Include Room Number, Suite, etc.)
City: Carmel State: Indiana Zip: 46032
E-Mail: Mike.Fox@allegion.com
Telephone: 614-493-8404 (Cell) Fax: _____
Course Sponsor: Ohio Design Professionals & Code Analysts

COURSE INFORMATION:

Course Title: Codes & Egress

New Course Submittal: ■ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective: Discuss code requirements applicable to openings along the path of egress.
Understand building codes (IBC/OBC) that affect hardware choices for egress doors
Describe the difference between panic an fire hardware and list needs to consider when specifying these products.
Describe the difference between panic and fire hardware and list needs to consider when specifying these products.
Identify access control products fro egress doors that meet code requirements.

Number of Instructional Contact Hours that can be obtained upon completion: (1) hour

If Multi-Session, Number of Instructional Contact Hours Per Session: _____

Program Applicable for the Following Participants:

Building Official	■	Master Plans Examiner	■	Building Inspector	■	Fire Protection Inspector	■
		Building Plans Exam.	✔				
		Plumbing Plans Exam.	■				
		Electrical Plans Exam.	■				
		Mechanical Plans Exam.	■				
		Fire Protect. Plans Exam.	✔				

Mechanical Inspector	■	Plumbing Inspector	■	Non-Res IU Inspector	☐				

Res Building Official	☐	Res Plans Examiner	☐	Res Building Inspector	☐	Res Mechanical Inspector	☐	Res IU Inspector	☐

Electrical Safety Inspectors ☒
Location of ESI Course: _____ Date(s) of ESI Course(s): _____

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**:		Check Off
Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	
	Organization sponsoring or requesting the program (if any)	
Course Title:	Name of course (related to content)	
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	
Test Materials:		
Completed Application:		

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

Allegion Architectural Services Consultant
RSO Midwest

Mike Fox

Architectural Services Consultant, DHT

Door and Hardware Technician (DHT) Door and Hardware Technician (DHT) Specialist in the door hardware industry since 2006

Contact

Office: 877.238.2022

Mobile: 614.493.8404

Email: mike.fox@allegion.com

https://www.linkedin.com/in/mike-fox-90685513/

https://twitter.com/AllegionUS

www.idighardware.com

Bio

Mike Fox, is currently an Architectural Consultant with Allegion, a leading manufacturer of doors and hardware. Prior to this current role Mike was an End User Sales Consultant for Allegion for 13 years in Central Ohio. As an architectural consultant, Mike's main role is to assist architects with development of a specification that meets the building owners needs. And to work as a consultant to the architect concerning hardware applications related to fire, egress and ADA codes. Mike has been in the commercial door and hardware industry for 20 years and got his start in the business as a solutions engineer & installation technician.

Key projects worked on

The Ohio State University NRDT – Columbus, Ohio; The Ohio State University Advance Materials Corridor, Columbus, Ohio; South-Western City Schools – Elementary School Replacement(11 new elementary schools & 2 Renovations), Grove City, Ohio; Mt. Carmel Grove City New Hospital, Grove City, Ohio; Mt. Carmel East New Tower & Renovation, Columbus, Ohio; Franklin County Corrections Center, Columbus, Ohio; Franklin County Forensic Science Center, Columbus, Ohio; Nationwide Children's Hospital Livingston Ambulatory Center, Columbus, Ohio; Nationwide Children's Hospital Behavioral Health Pavilion, Columbus, Ohio

Personal Achievements

Eagle Scout – Boy Scouts of America – May 1999

Bachelor of Science in General Business from The Ohio State University – 2004

Ingersoll Rand Security Technologies President's Club – 2008

ASIS Member – January 2009 – Present Ingersoll Rand Security Technologies Playmaker Award – 2013

Location

3405 York Road
Pataskala, OH 43062

Course Outline from one of the course initial slides:

1. Discuss OBC code requirements applicable to openings along the path of egress,
2. Understand building codes OBC/IBC that affect hardware choices for egress doors,
3. Describe the difference between panic and fire hardware and list needs to consider when specifying these products,
4. Identify electronic/mechanical access control products for egress doors that meet code requirements.

Copyright Materials

“Allegion” is a Registered Provider with The American Institute of Architects Continuing Education Systems (AIA/CES). Credit(s) earned on completion of this program will be reported Allegion to AIA/CES for AIA members.

Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Program Title: Codes & Egress

Program Number: CDI20020

Provider Name: Allegion

AIA Provider #: J247

Learning Units: 1 HSW

Course Description:
This course focuses on code requirements that would affect a specifier's choice of hardware as it applies to egress openings.

Upon successful completion of this course participants will be able to:

- Discuss code requirements applicable to openings along the path of egress.
- Understand building codes that affect hardware choices for egress doors.
- Describe the difference between panic and fire hardware and list needs to consider when specifying these products.
- Identify access control products for egress doors that meet code requirements.

State of _____ Applicable Codes

Building Code

- _____ State (county/city) Building Code - __ Edition – Year in use

Fire/Life Safety Code

- International Building Code - __ Edition – Year in use
- or
- NFPA101 - Life Safety Code – Year in use
- International Fire Code - __ Edition – Year in use

Standard for Fire Doors

- NFPA80 - Standard for Fire Doors & Fire Windows – Year in use

Accessibility Standard

- ICC/ANSI A117.1- Accessible and Usable Buildings and Facilities – Year in use
- 2010 ADA Standards for Accessible Design

Authority Having Jurisdiction (AHJ)

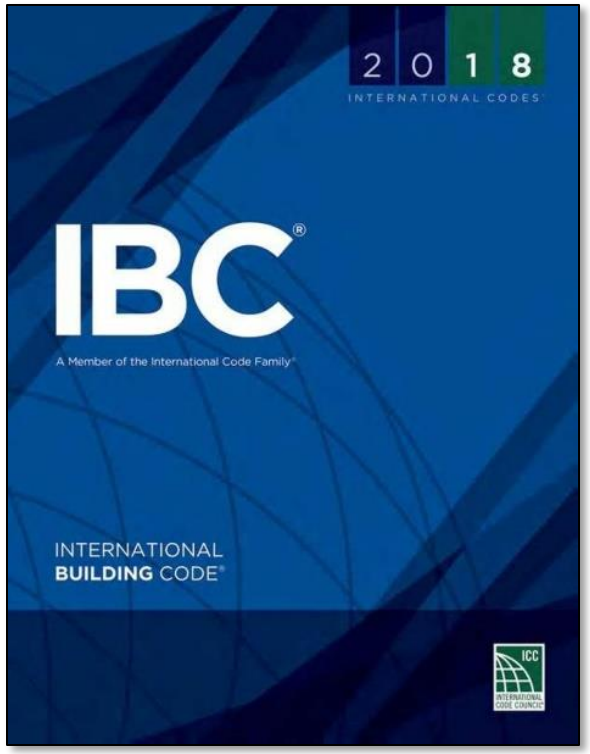
Building Inspector

Fire Marshal

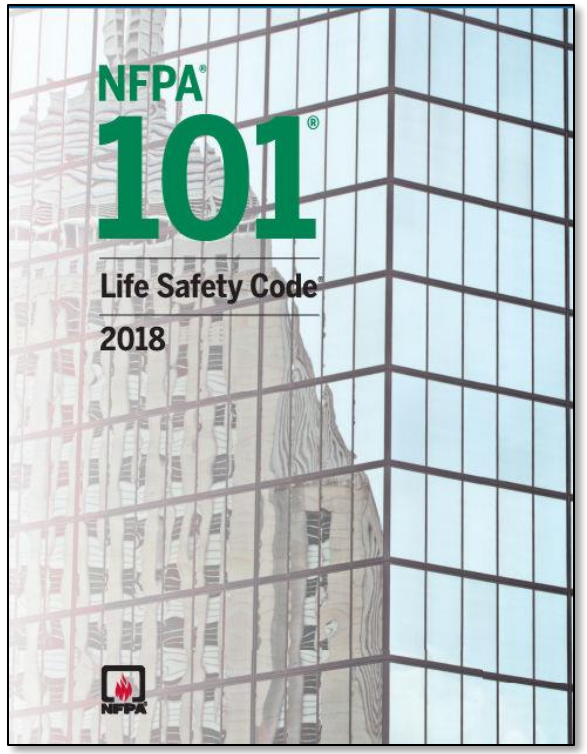
JCAHO

Others

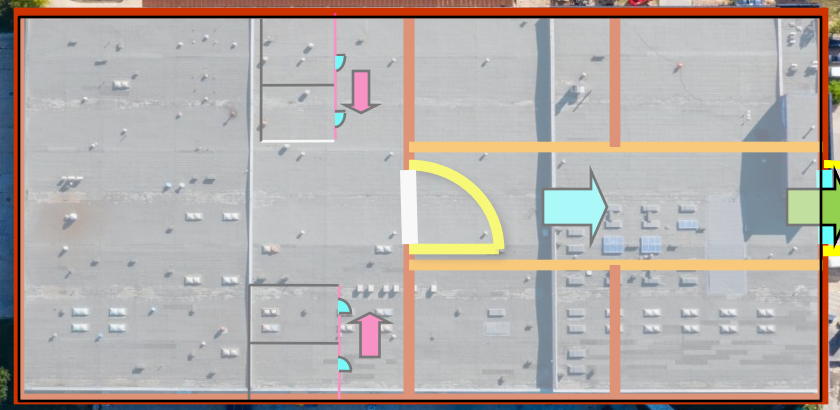
Who is yours?


2018
INTERNATIONAL CODES
IBC
A Member of the International Code Family
INTERNATIONAL
BUILDING CODE
ICC

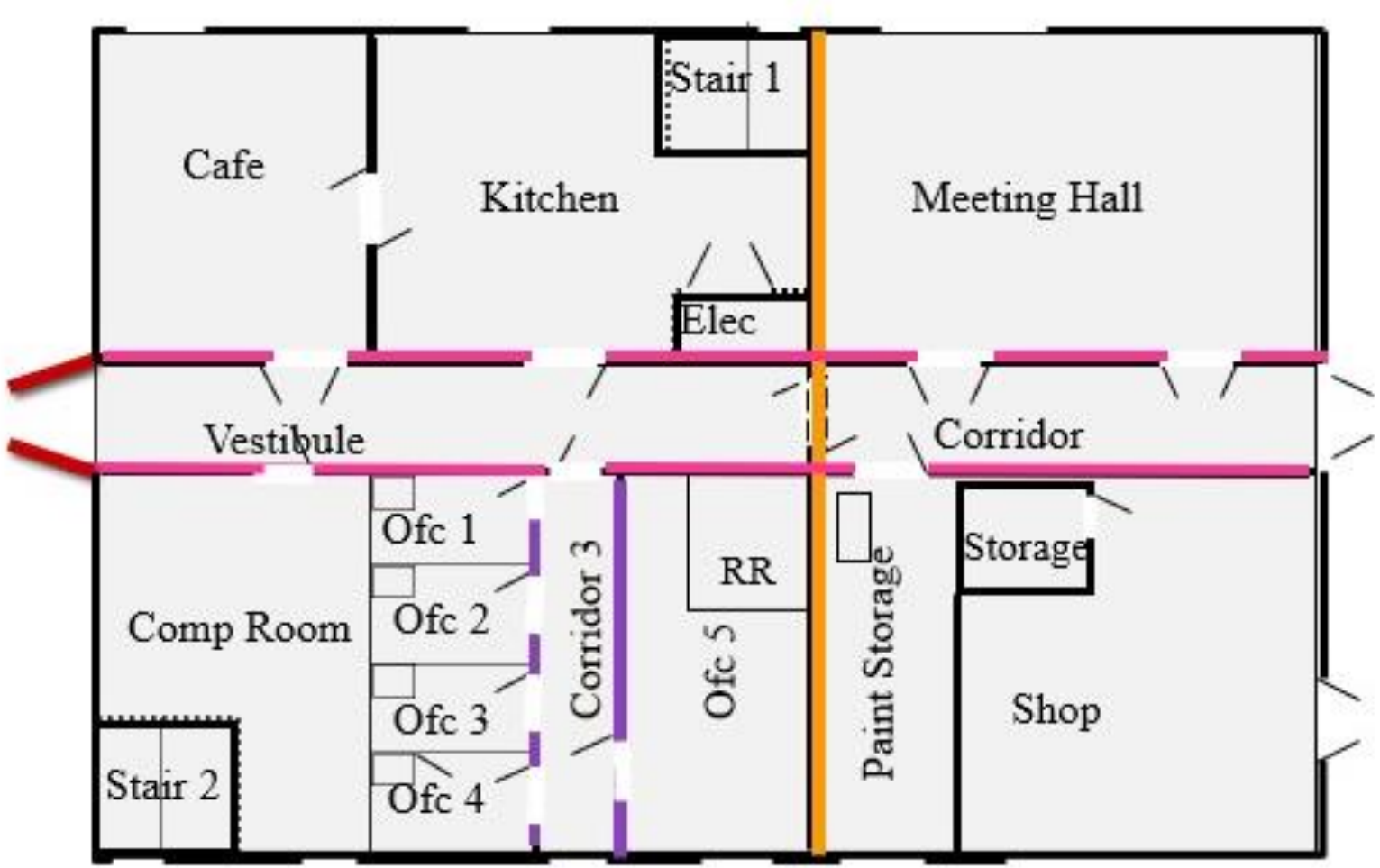

2018
INTERNATIONAL CODES
IFC
A Member of the International Code Family
INTERNATIONAL
FIRE CODE
ICC


NFPA
101
Life Safety Code
2018
NFPA

What's a means of egress?



Codes Affecting Egress



Codes Affecting Egress

- IBC – 2018
  - General Requirements - Chapter 10
  - Requirements for Shopping Malls– Chapter 4
- NFPA 101 – 2018
  - General Requirements – Chapter 7
  - Requirements based on Occupancy Type – Chapters 12 - 42

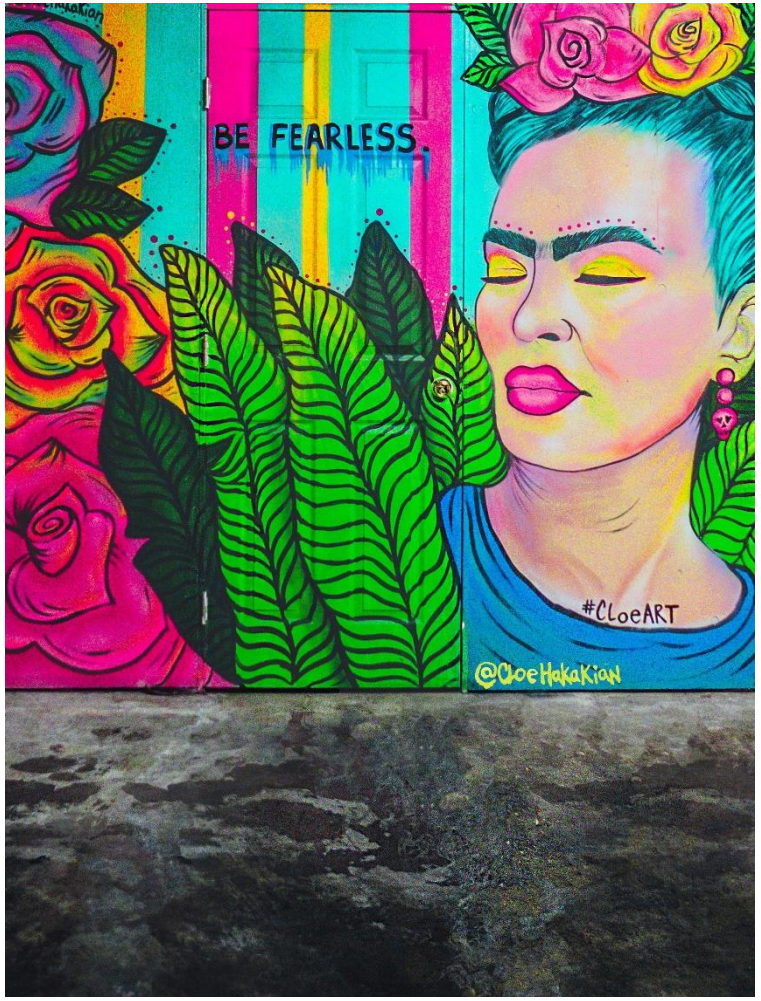
EXIT ACCESS TRAVEL DISTANCE[a]

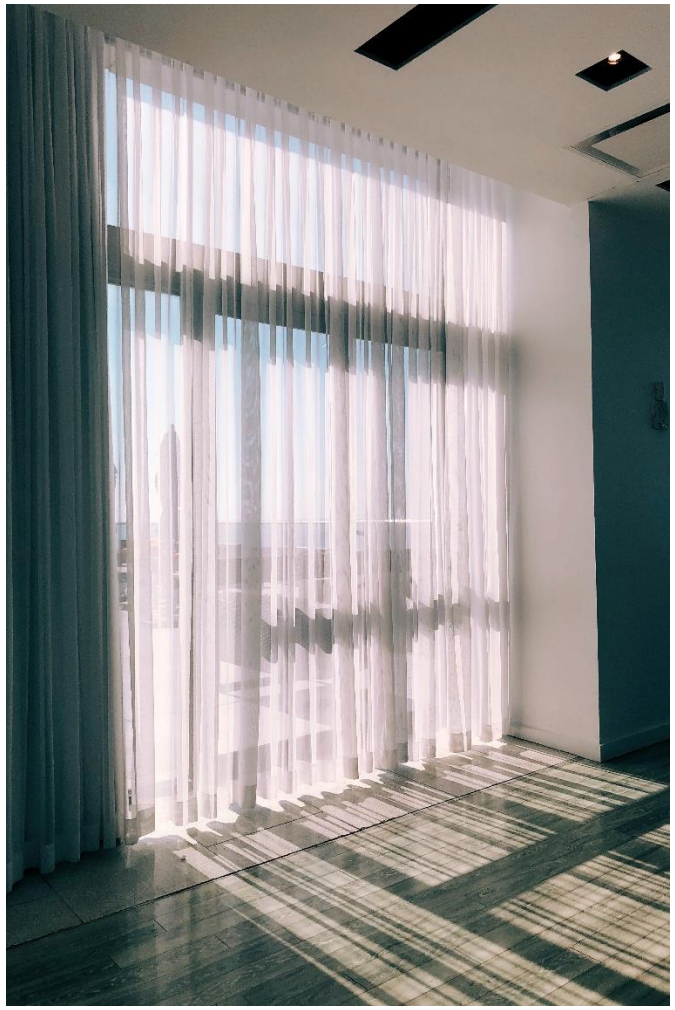
OCCUPANCY	WITHOUT SPRINKLER SYSTEM (feet)	WITH SPRINKLER SYSTEM (feet)
A, E, F-1, M, R, S-1	200	250[b]
I-1	Not Permitted	250[c]
B	200	300[c]
F-2, S-2, U	300	400[c]
H-1	Not Permitted	75[c]
H-2	Not Permitted	100[c]
H-3	Not Permitted	150[c]
H-4	Not Permitted	175[c]
H-5	Not Permitted	200[c]
I-2, I-3, I-4	Not Permitted	200[c]

Failures of Public Safety

- Iroquois Theater
- Coconut Grove Nightclub
- Triangle Shirtwaist Factory

When Is A Door Not A Door?





Fire Door Ratings

Class A – 3 HR
Openings in fire walls & walls that divide a single building into fire areas

Class B – 1.5 HR
Openings in enclosures of vertical communications through buildings & in 2-hour rated partitions providing horizontal fire separations

Class C – 0.75 HR
Openings in walls or partitions between rooms & corridors having a fire resistance rating of 1 hour or less

Class D – 1.5 HR
Openings in exterior walls subject to severe fire exposure from outside the building

Class E
Openings in exterior walls subject to moderate or light fire exposure from outside the building

20 Min
not typically associated with a letter designation even though they are usually installed as a Class C opening protective in a corridor wall.

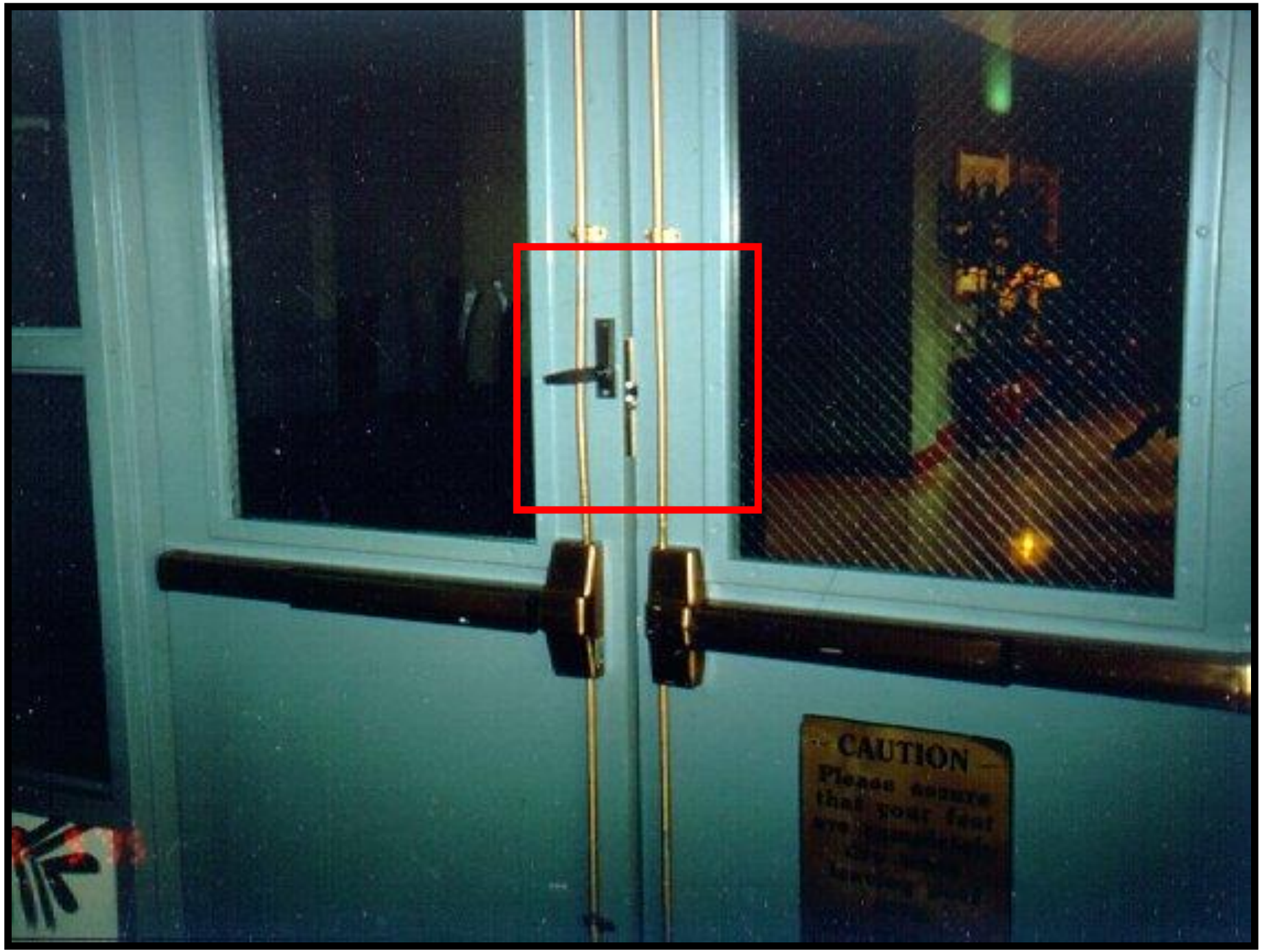
http://schlagesupport.allegion.com/Products/doors_frames/service_support/Pages/default.aspx

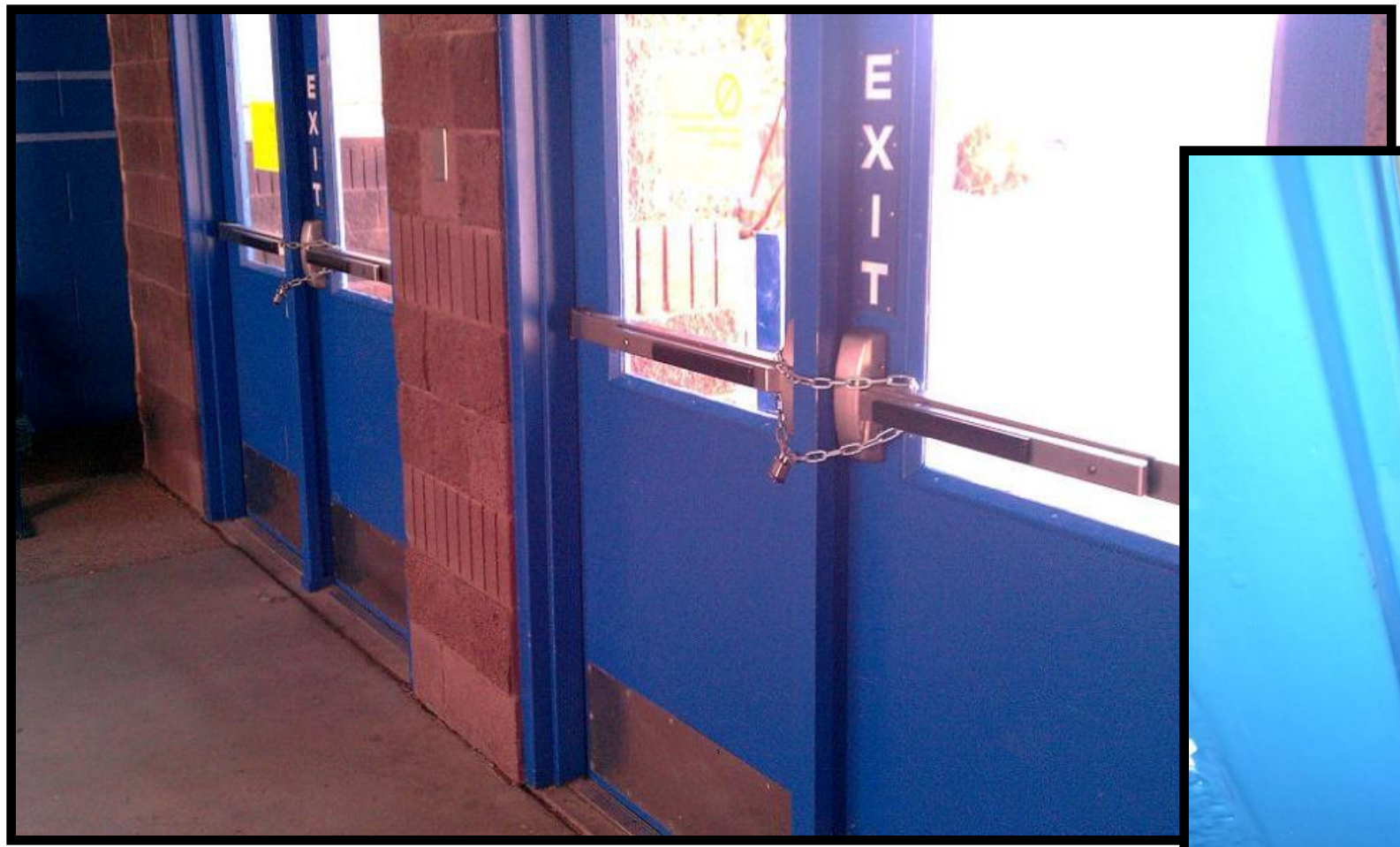
Egress Doors

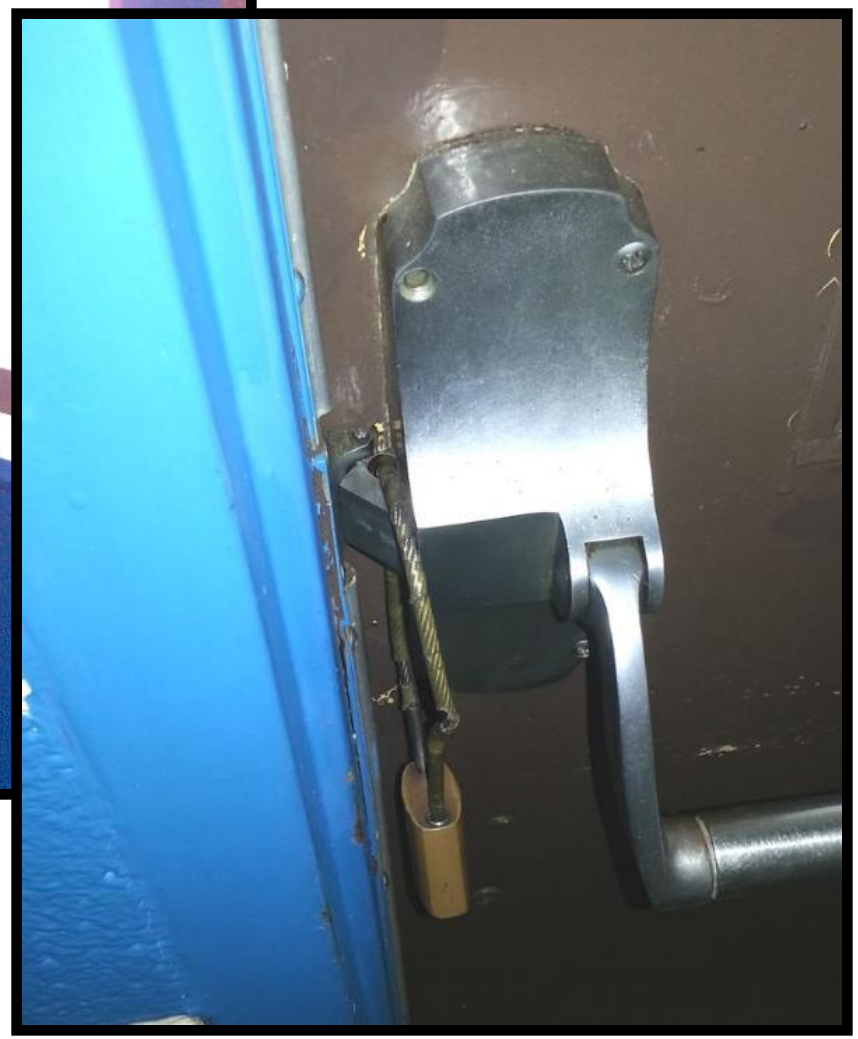
0 No prior knowledge or tools shall be required to exit

1 Operable with one hand / single effort

34-48 Releasing mechanism must be located between 34 and 48 inches AFF

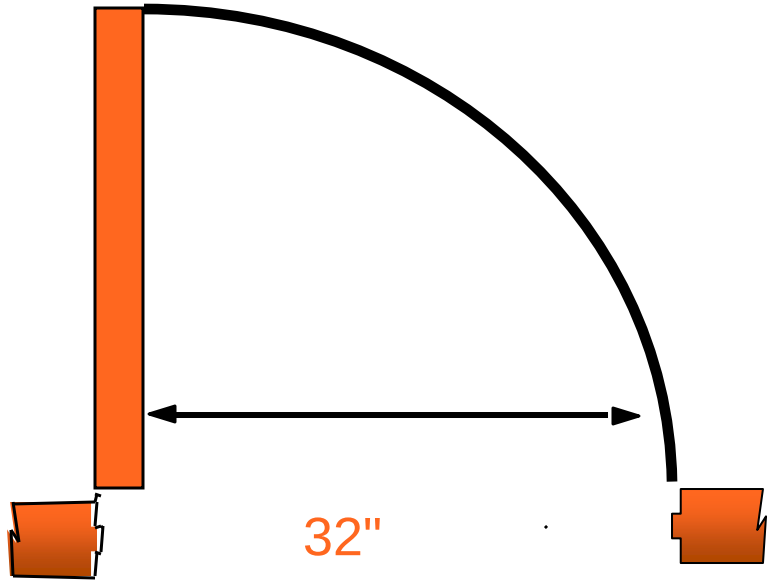

CAUTION


EXIT
EXIT

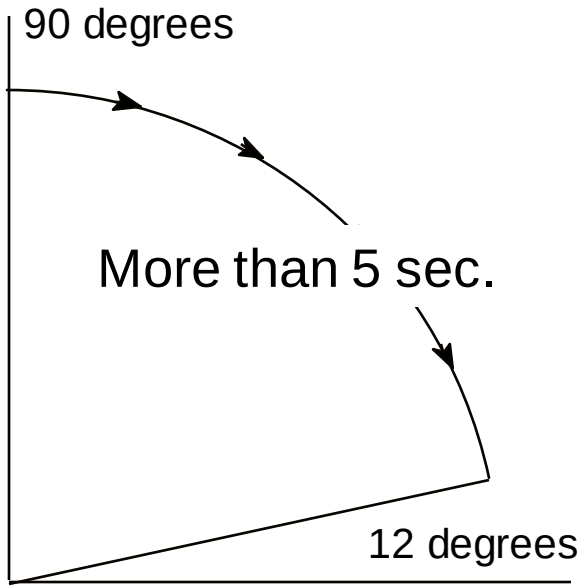


Size of Doors
Egress & Accessibility

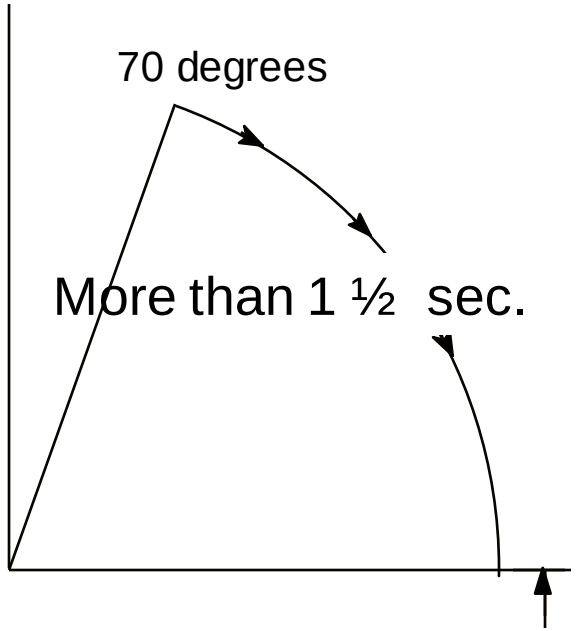
- 32” - Min Width
- 80” - Min Height



Accessibility
Door Closing Speed



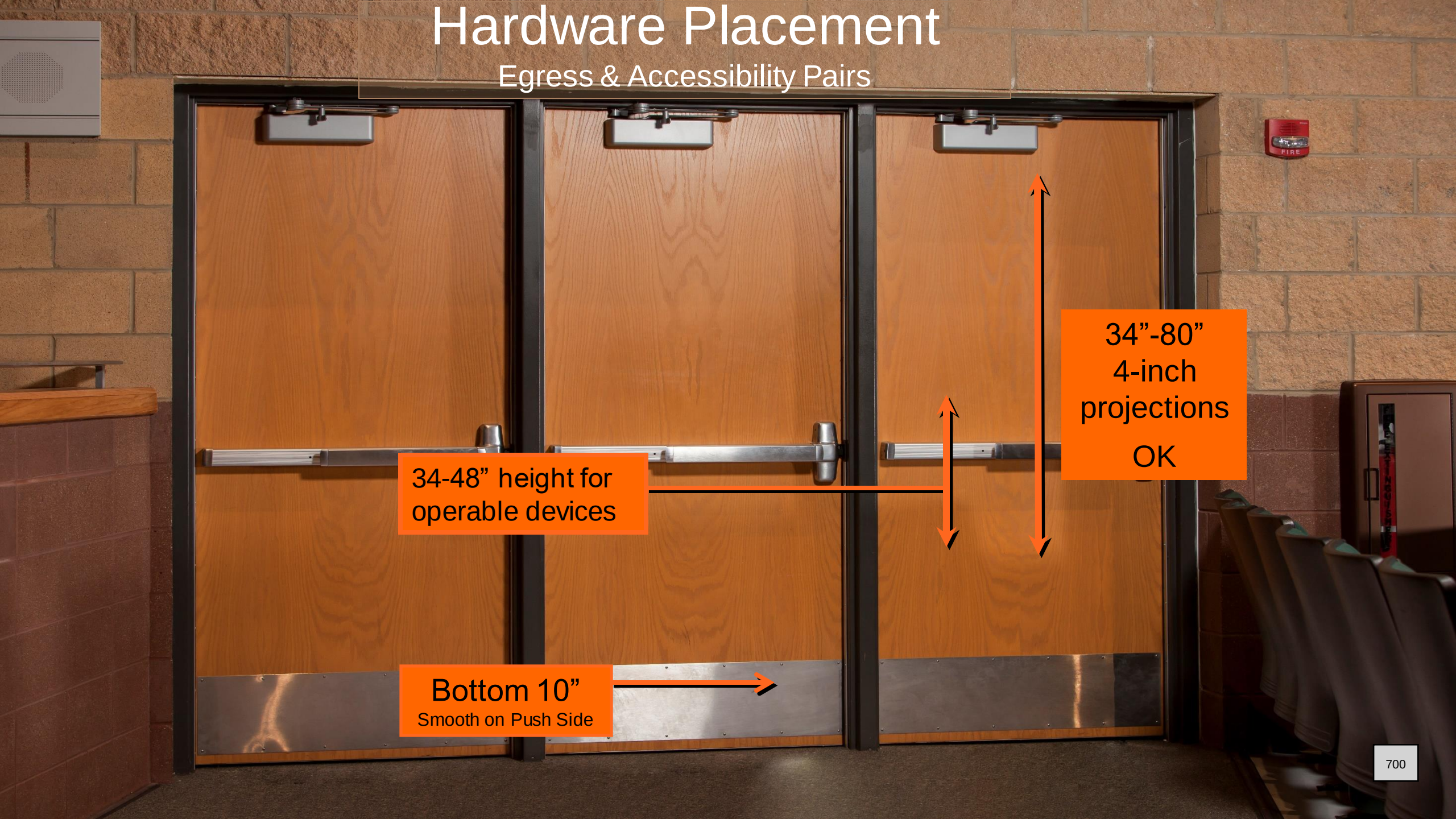
ANSI 117.1 2017



Spring Hinges

Hardware Placement

Egress & Accessibility Pairs



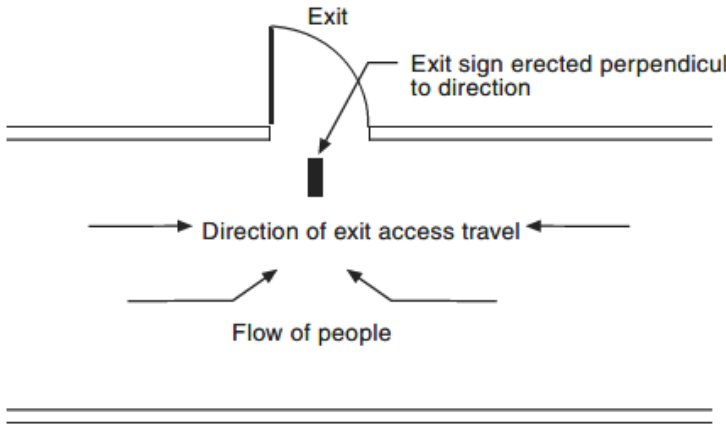
Signage and Lighting Along Egress Route

Signage:

- Direct occupants toward exits
- Visible from any direction of egress travel
- Contrast between word EXIT and background

Lighting:

- Continuous along egress path
- Emergency electrical system
- Floor illumination

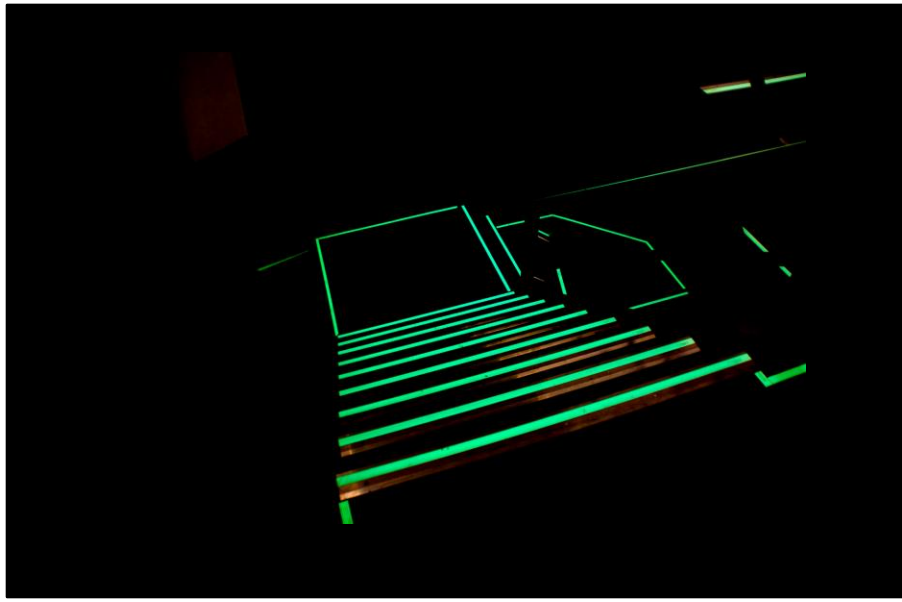


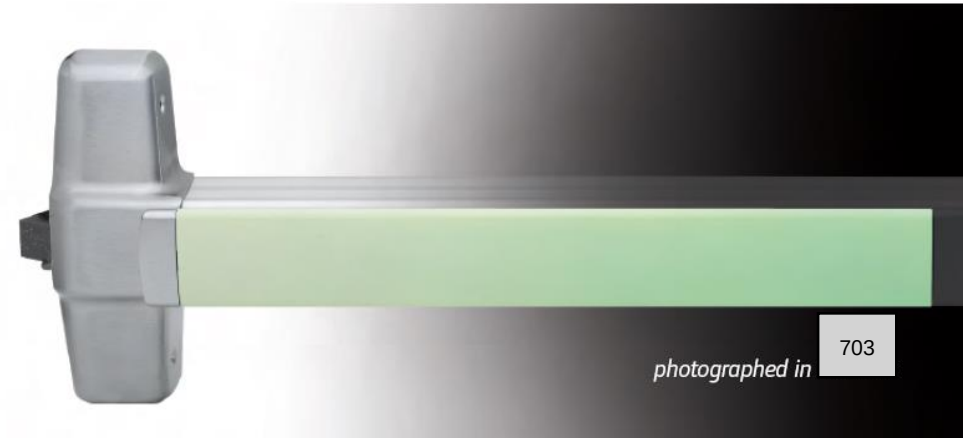
Signage and Lighting Along Egress Route

- Located 5 feet above floor landing, readily visible
- Sign size 18 inches by 12 inches minimum
- Letter size not less than 1 ½ inches in height
- Number to designate floor
- Other lettering and numbering not less than 1 inch
- Non-glare finish for characters and background; contrast

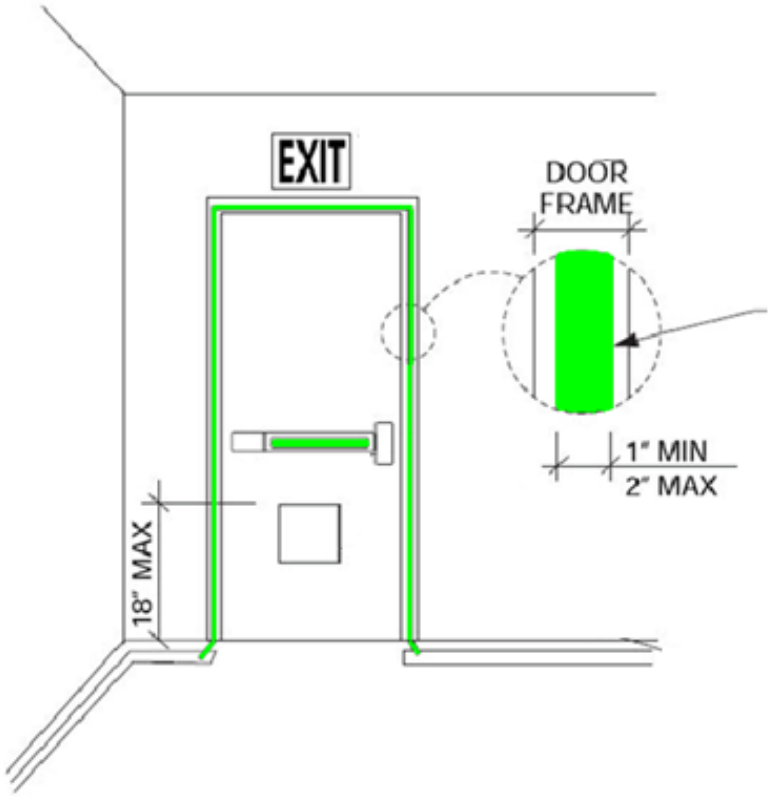
Luminous Egress Path Markings

- May be self-luminous or photoluminescent
- 1” horizontal width marking stripe panic hardware
- Marking stripe full length of actuating bar or touch pad
- Not interfere with hardware instructions
- Marking on or behind hardware





Luminous Egress Path Markings



- "Exit" in bottom 18" of door
- 1" stripe around frame
- Additional marking on stairs, walls, etc.
- Typically required on exit and exit discharge doors – not on doors leading to the exit
- Required by IBC in high-rise buildings in Group A – Assembly, B – Business, E – Educational, I – Institutional, M – Mercantile, and R-1 – Residential
- Not currently required by NFPA 101 occupancy chapters

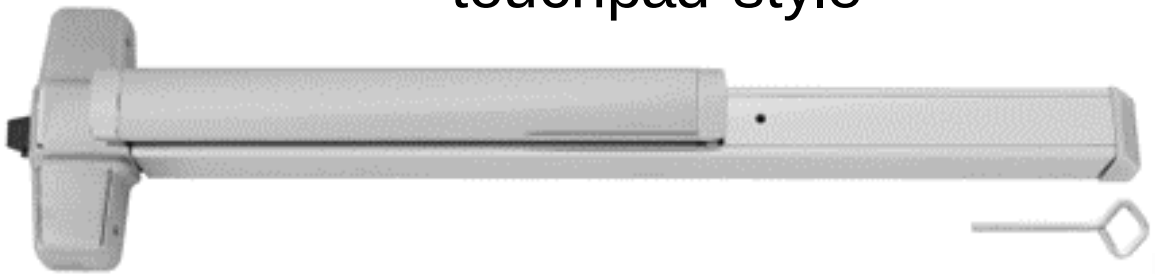
Panic Hardware
vs.
Fire Exit Hardware

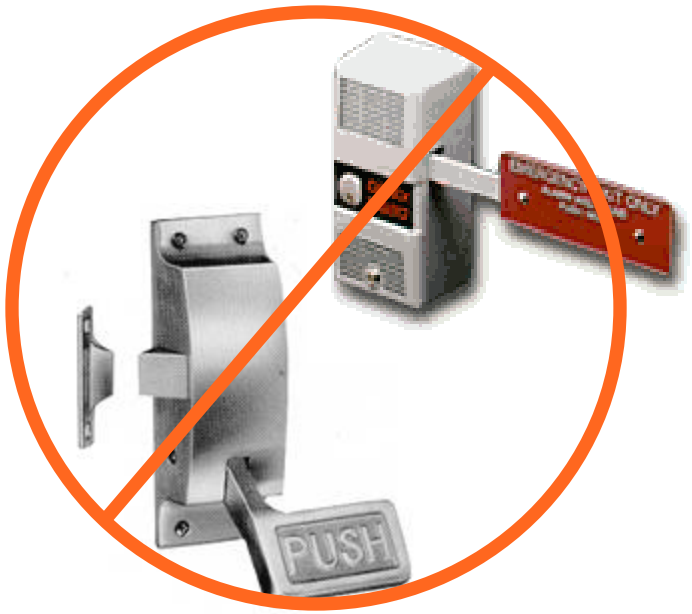
- Provides free egress
- Dogging permitted
- UL Panic Hardware label

- Panic Exit Hardware for use on a fire door
- Must be self-latching
- No mechanical dogging permitted
- UL Fire Exit Device Label

Panic and Fire Hardware

touchpad style





crossbar style

Specifying the Right Exit Device

Style

- Architectural finish selection
- Lever designs to match the balance of the project
- Low profile designs

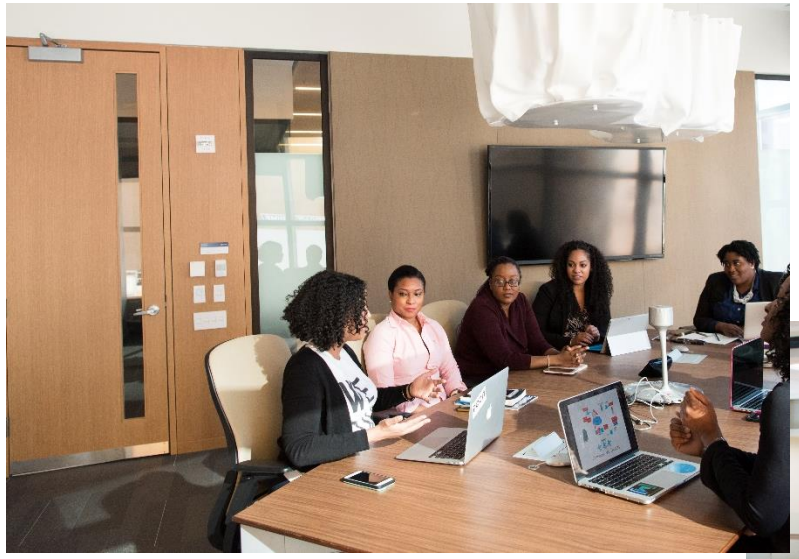
Spaces Important to Egress Safety

Public Buildings – people are not familiar with the layout, so exiting must be obvious

Hospitals, Theaters, Stadiums, Office Buildings, Schools

- Interior doors from rooms – small numbers vs large numbers of occupants
- Vertical exits
- Horizontal exits
- Exterior exits

Interior Exit Access



- Swing in direction of egress
- Meet occupancy load requirements

- Pivoted or side-hinged swinging
- Meet opening force requirements

Stairways

- Minimum 44 inch width
- Doors openable from both sides
- No special knowledge or effort to open doors

Elevator Lobby Egress

IBC:
shall have at least one means of egress complying with Chapter 10 and other provisions within this code

NFPA101:

- *Fail safe lock–unlocks on fire alarm & power failure (battery backup not allowed)*
- *Must be allowed by occupancy chapter*
- *Lock listed per UL 294 Access Control Sys. Units*
- *Two-way communication system in elevator lobby*
- *Some state codes also have modifications for elevator lobby doors*

Horizontal Exits

An exit component consisting of fire-resistance rated construction and opening protectives intended to compartmentalize portions of a building thereby creating refuge areas that afford safety from the fire and smoke from the area of fire origin.

IBC

Exit Passageways

- A horizontal exit; used when stairway does not end at an exit discharge
- Fire-resistant rated
- Minimum 44 inch clearance width

Exit Discharge Exterior Doors

- Must meet requirements for visibility, width, closing, latching, locking
- Unobstructed path to public way
- Openable from egress side at all times

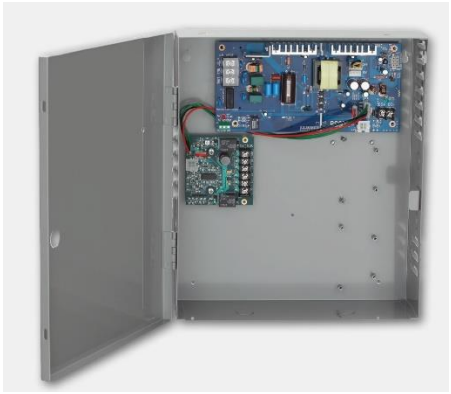
How Does Electronics Affect Egress?

IBC 2018

- 1010.1.9.7 – Controlled Egress
- 1010.1.9.8 – Delayed Egress
- 1010.1.9.9 – Sensor Release
- 1010.1.9.10 – Door Hardware Release
- 1010.1.9.11 – Correctional Facilities

Controlled Egress - 1010.1.9.7

- Allows certain units to have locked doors in means of egress
- Common to memory care unit housing, pediatrics, maternity ward
- Occupancy Types I-1 and I-2



Controlled Egress

Requirements

- Unlock upon actuation of automatic sprinkler system / automatic fire detection system
- Unlock upon loss of power; fail safe
- Be capable of being unlocked by a switch from approved location
- An occupant can’t have to pass through more than one door equipped with a controlled egress locking system before entering an exit
- Requires an emergency plan with procedures for unlocking
- Emergency lighting

Delayed Egress – 1010.1.9.8

- Allows certain areas to have locked doors in means of egress
- Common to airports, museums, retail back entrance, employee doors
- Occupancy Types B, F, I, M, R, S, and U

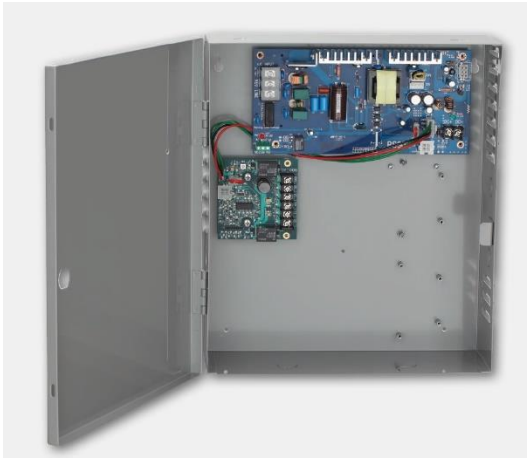
Delayed Egress

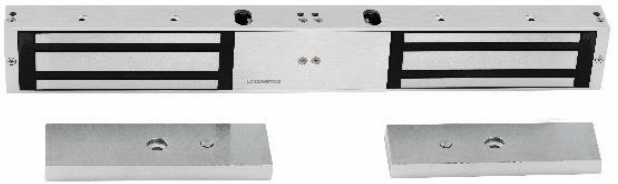
Requirements

- Permitted with sprinklered/smoke-heat detection
- Fail safe locking
- 15 lbs. max. force applied for up to 3 seconds to release device within 15 sec.
- Signage
- Emergency Lighting

Sensor Release – 1010.1.9.9

used to be “Access Controlled Egress Door”





Sensor Release on Egress Doors

Requirements

- Sensor on egress side
- Fail safe locking
- Height and distance requirements
- Signage
- Free egress at all times
- Prohibited on entrance doors in Groups A, B, E, or M while open to the public

Door Hardware Release – 1010.1.10

Door Hardware Release

Requirements

- Door hardware affixed to the door leaf has an obvious method of operation that is readily operated under all lighting conditions
- Capable of being operated with one hand and shall comply with Section 1010.1.9.6
- Operation of the door hardware directly interrupts the power to the electric lock and unlocks the door immediately
- Loss of power to electric locking system automatically unlocks door
- Where panic or fire exit hardware is required by Section 1010.1.10, operation of the panic or fire exit hardware also releases the electric lock

Correctional Facilities – 1010.1.11

Doors in means of egress shall be permitted to be locked if equipped with egress control devices that unlock manually by at least one of these methods:

- Activation of automatic sprinkler system
- Activation of approved manual file alarm box
- Signal from a constantly attended location

Remember...

- The AHJ has the final say.
- The codes are constantly changing.
- The most stringent code applies.
- Check local codes!
- This is our interpretation of the codes.
- This is the tip of the iceberg.

Questions?

Thank You!

This concludes the American Institute of Architects Continuing Education Systems Program


ALLEGION™

File Attachments for Item:

EC-11 Hardware for Healthcare Openings (Allegion - OBOA/ODPCA Conference)

All Commercial Certifications (1 hour)

Allegion Architectural Services Consultant
RSO Midwest

Mike Fox

Architectural Services Consultant, DHT

Door and Hardware Technician (DHT) Door and Hardware Technician (DHT) Specialist in the door hardware industry since 2006

https://www.linkedin.com/in/mike-fox-90685513/

https://twitter.com/AllegionUS

www.idighardware.com

Contact

Office: 877.238.2022

Mobile: 614.493.8404

Email: mike.fox@allegion.com

Bio

Mike Fox, is currently an Architectural Consultant with Allegion, a leading manufacturer of doors and hardware. Prior to this current role Mike was an End User Sales Consultant for Allegion for 13 years in Central Ohio. As an architectural consultant, Mike's main role is to assist architects with development of a specification that meets the building owners needs. And to work as a consultant to the architect concerning hardware applications related to fire, egress and ADA codes. Mike has been in the commercial door and hardware industry for 20 years and got his start in the business as a solutions engineer & installation technician.

Key projects worked on

The Ohio State University NRDT – Columbus, Ohio; The Ohio State University Advance Materials Corridor, Columbus, Ohio; South-Western City Schools – Elementary School Replacement(11 new elementary schools & 2 Renovations), Grove City, Ohio; Mt. Carmel Grove City New Hospital, Grove City, Ohio; Mt. Carmel East New Tower & Renovation, Columbus, Ohio; Franklin County Corrections Center, Columbus, Ohio; Franklin County Forensic Science Center, Columbus, Ohio; Nationwide Children's Hospital Livingston Ambulatory Center, Columbus, Ohio; Nationwide Children's Hospital Behavioral Health Pavilion, Columbus, Ohio

Personal Achievements

Eagle Scout – Boy Scouts of America – May 1999

Bachelor of Science in General Business from The Ohio State University – 2004

Ingersoll Rand Security Technologies President's Club – 2008

ASIS Member – January 2009 – Present Ingersoll Rand Security Technologies Playmaker Award – 2013

Location

3405 York Road
Pataskala, OH 43062

Course Outline:
List 2018 IBC codes & standards that affect doors found in healthcare facilities
Choose hardware that will protect the door, withstand the abuses of hospital environment and still meet the hospital's opening needs,
Provide electrified hardware solutions that will eliminate common healthcare opening issues,
Specify opening hardware solutions for fire rated openings that will meet the needs of of the hospital staff and IBC code requirements.

Electronic hardware is very complicated, hospital hardware adds a complexity to the allowable hardware allowed by the 2017 OBC/2018 IBC.

“Allegion” is a Registered Provider with The American Institute of Architects Continuing Education Systems (AIA/CES). Credit(s) earned on completion of this program will be reported to AIA/CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This program is registered with AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Copyright Materials

ALLEGION™

Program Name: **Hardware for Healthcare Openings**

Program Number: VMG903

Learning Units: One CEU HSW

Provider Number: J247

Provider Name: Allegion

Course Description

This course is delivered in an interactive game format.

Healthcare facilities are often open 24/7, can have a large volume of foot traffic, and the openings can take a lot of abuse. If specifying opening hardware is confusing, and you aren't sure what products would work best for all the opening types found in healthcare, join us for this interactive course to learn more about healthcare opening solutions and the codes that affect your hardware choices.

Objectives:

Upon successful completion of this course participants should be able to:

- List codes & standards that affect doors found in healthcare facilities
- Choose hardware that will protect the door, withstand the abuses of the hospital environment and still meet the hospital's opening needs
- Provide electrified hardware solutions that will eliminate common healthcare opening issues
- Specify opening hardware solutions for fire rated openings that will meet the needs of the hospital staff and code requirements

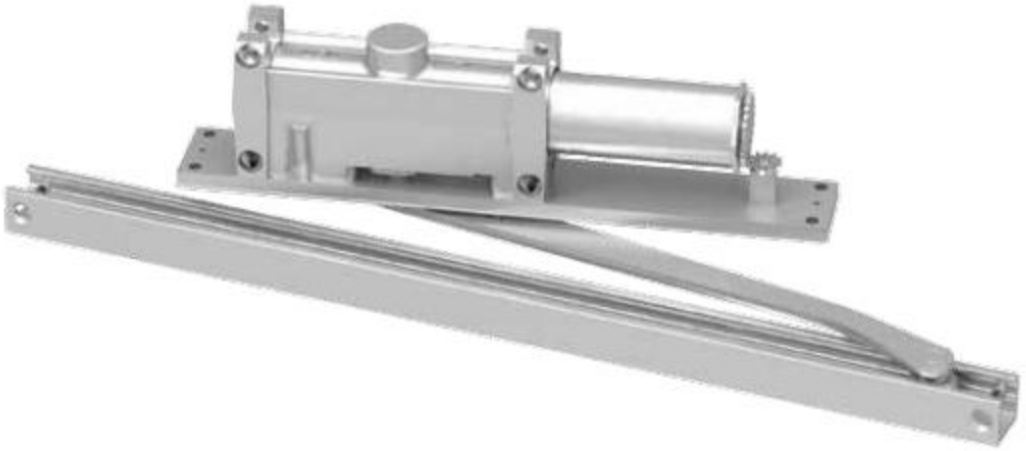
It's an Emergency	Care for Me	Vital Stats	Visitors
100	100	100	100
200	200	200	200
300	300	300	300
400	400	400	400
500	500	500	500

Healthcare facilities, must be sensitive to protection of people and property.

Question: What is the best solution to allow only authorized personnel access to the treatment areas and keep staff and patients protected?

A. Specify a mechanical push button lock with only staff knowing the code.
B. Specify a lock cylinder with restricted keys, available only from the head of maintenance.
C. Specify a networked system that can provide approved only access and immediate lockdown.
D. Specify biometric handreaders to provide approved only access and alarmed hardware for all other ER entrances.

C. Specify a networked system that can provide approved only access and immediate lockdown.



Fire-rated openings require a closing device to ensure the door is kept closed.

Question: YES / NO / Maybe
Can a concealed closer be used on a fire door?

Maybe

Fire doors are a vital part of a building's passive fire protection system. When properly installed and maintained, they will help to compartmentalize a building to protect occupants and property from the spread of smoke, flames, and toxic gases, and aid in providing a safe means of egress during a fire.

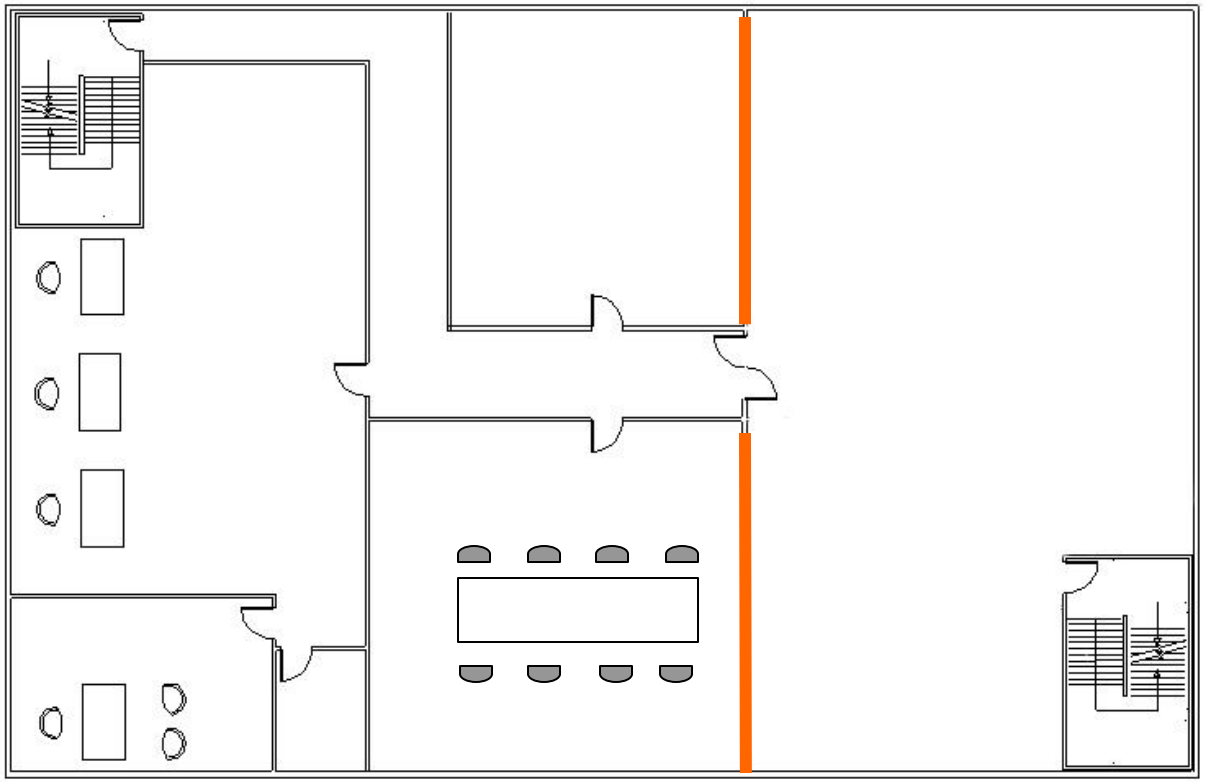
Question:

Which application(s) require doors to be self-closing?

A. Fire doors
B. Doors in smoke barriers
C. Doors for incidental accessory occupancies which require a fire extinguishing system.
D. All of the above
E. None of the above

D. All of the above.

A horizontal exit is a passage from one section of a building into another section of the same building occupied by the same tenant, through a separation wall having a specified fire-resistance rating; usually sets of double egress doors. These are typically an impediment to traffic and communication.



It's an Emergency $400

Question: Can horizontal exit fire doors be held open?

A. Yes with an electromagnetic hold open closer
B. Yes with a battery operated detectored holder with a closer
C. Yes, but only on Class D & E Fire doors that have electromagnetic hold open closers
D. NO! Code prohibits fire doors from being held open
E. A & B are correct
F. A & C are correct

E. A & B are correct

Some fire doors must be tested for the air leakage rate of the door assembly.
Gasketing is required to limit air infiltration to meet the maximum requirement of the standard.

Question: What test standard requires this testing and gasketing?

A. UL10C
B. UL305
C. UL1784
D. NFPA 258

C. UL1784

Keeping patients in a memory care facility from “wandering” away from the building or into unsafe, or otherwise restricted parts of a building, is a challenge faced by staff in these facilities.

Question: What can be done to keep patients from wandering:

A. Lock the doors from the egress side, provided staff is on site 24/7 to unlock doors in an emergency.
B. Monitor patients with cameras and have staff intercept wanderers.
C. Install delayed egress exit devices to keep wanderers in safe areas of the building.

C. Install delayed egress exit devices to keep wanderers in safe areas of the building.

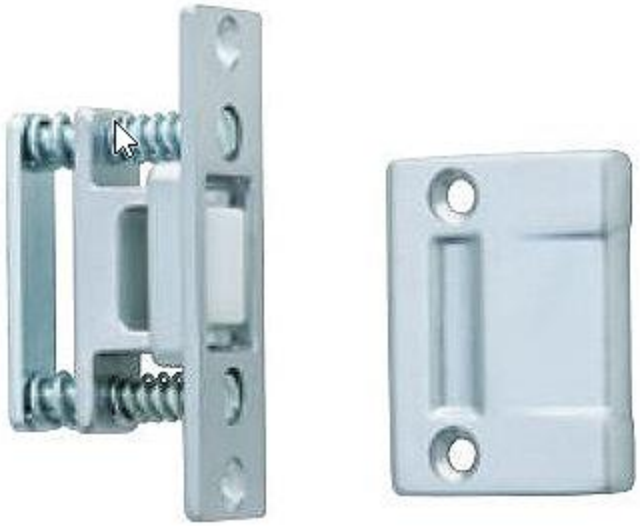
Although NFPA 101 – The Life Safety Code states that most corridor doors in a healthcare facility, including patient room doors, are not required to comply with NFPA 80 – Standard for Fire Doors and Other Opening Protectives, the code does however include some requirements designed to help keep patients safe.

Question: Which of the following is NOT required for patient room doors:

A. Doors must be constructed to resist the passage of smoke.
B. Clearance between the bottom of the door and the floor covering must be no more than 1 inch.
C. Doors must be equipped with closers for smoke/fire containment.
D. Existing facilities, must have either 1 ¾-inch solid bonded-core wood doors, or materials that resist fire for at least 20 minutes.

C. Doors must be equipped with closers for smoke/fire containment

Roller latches are friction bolts designed to hold the door in the closed position.



Question:
True / False / Sometimes?

NFPA 101 requires roller latches for patient room doors to ensure doors are held closed in fire life safety emergency situations.

False

IBC allows for controlled locking in the means of egress in certain occupancies.

Question: According to IBC 2018 1010.1.9.7, “Controlled egress doors in Groups I-1 and I-2”, which types of hospital units may be allowed to lock their egress doors under certain conditions?

A. Dementia & Alzheimer's
B. Maternity & Pediatrics
C. Both A & B
D. None of the above.

C. Both A & B

Fire codes tell us that fire doors must be self-closing and self-latching. Pairs of cross corridor doors in healthcare can cycle more than 1,000,000 times per year, resulting in excess noise and lots of wear and tear.

Question: Your healthcare facility requires the fire door pair near the nursery to be closed. What can you do to reduce the noise that's made when it's opened so it won't disturb the babies.

A. Mechanically hold back ("dog") the latches to prevent noisy latching.
B. Install push/pull hardware on the doors.
C. Electrically hold back ("dog") the latches to prevent noisy latching.
D. Use products with low friction bearings.

C. Electrically hold back ("dog") the latches to prevent noisy latching.

Healthcare applications have many sensitive areas, including pharmacies, testing labs, & record storage areas that must comply with HIPAA etc. A variety of locking & monitoring solutions are available.

Question: Which solution will allow only authorized personnel access to the pharmacy and provide an audit trail of entry?

A. A mechanical push button lock giving the code to those you wish to have access.
B. An electronic lock with a card reader allowing only authorized personnel to carry cards.
C. A biometric hand reader registering only those you wish to have access.

C. Install a biometric hand reader and only register those you wish to have access.

Many healthcare facilities use access cards to help with limited entrance needs.
When specifying electrified hardware for an access control system, there's often confusion about which code requirements to follow and what system components are needed.

True, False or Depends
Question: Electrified hardware used with an access control system must comply with the Access-Controlled Egress Doors section that is found in both the International Building Code (IBC) and NFPA 101 – The Life Safety Code.

Depends on the category in which the hardware falls.

Securing an opening is pointless if you don't' monitor it. Electrified door hardware can be used to monitor an opening's status.

Question: Name two aspects of the opening that electrified door hardware can monitor.

Door position
Latchbolt's position

Access cards are not all the same. Magnetic stripe cards, proximity cards, and smart cards offer varying amounts of security.

Question: Which card offers the least amount of security?

A. Proximity cards
B. Magnetic stripe cards
C. Smart cards

B. Magnetic stripe cards

You are adding onto & remodeling an office for a small local family physician. She would like a way to secure the drug and supply storage rooms, but the budget is tight and she doesn't want to rekey the building.

Question: What would be the best solution?

A. Add a deadbolt to the existing door for which only she has the key.
B. Add an offline lock and give PINS to those that need access.
C. Add an access control system and register only those who need entrance.

B. Add an offline lock and give PINS to those that need access.

The loading dock area in a healthcare facility is having trouble with inventory and supplies “disappearing” out of a remote entrance.

Question: Which IBC compliant product would help?

A. An alarmed exit device.
B. A panic device with electrified lever trim.
C. A delayed egress lock.
D. An electric latch retraction panic device.

A. An alarmed exit device

Americans with Disabilities Act Accessibility Guidelines (ADAAG), specifies requirements for exterior doors.

Question: According to ADAAG, which exterior doors require an auto operator?

A. One exterior door of a public building must have an auto operator.
B. Exterior doors that require more than 15 lbs of force to open must have an auto operator.
C. One exterior door must have an auto operator if the occupant load exceeds 100.
D. No doors are required to have auto operators.

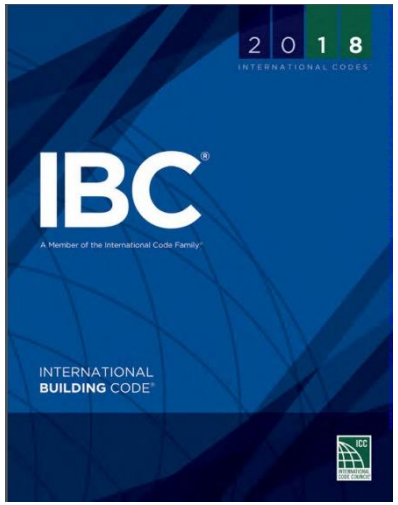
D. No doors are required to have auto operators.

Visitors $200

The International Building Code (IBC) has requirements for exit devices.

Question: According to IBC 2018, where are exit devices required?

A. Any door serving more than 100 people.
B. Any door serving more than 50 people.
C. Any door serving certain occupancy types with more than 100 people.
D. Any door serving certain occupancy types with more than 50 people.



D. Doors serving certain occupancy types with more than 50 people.

Visitors $300

Installing access control in existing buildings could be disruptive to the business of a facility.

Question: The wing of the hospital you're renovating has masonry walls. Because the area houses the maternity ward they need to have access control, but they can't shut down to install an electrical access control system.
What is the best solution for their issue?

A. Recommend rekeying the locks with a restricted key system.
B. Recommend a stand-alone battery operated electronic lock.
C. Recommend a wireless electronic locking system

C. Recommend a wireless electronic locking system

Although stairwells in a hospital are not often used for visitor traffic, staff may use them frequently. In such instances stair doors may be locked from the stair side of the opening, and staff must present a valid credential to pass from the stair tower onto the tenant floor.

Question: Which hardware will allow stairwell re-entry in a fire situation?

A. Fail safe electric strike
B. Fail secure electric strike
C. Fail safe electric lock or exit device trim.
D. Fail secure electric lock or exit device trim.
E. None of the above

C. Fail safe electric lock or exit device trim.

What's the Score?

Questions?

Thank You!

This concludes the American Institute of Architects Continuing Education Systems Program

ALLEGION™

CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

Instructors: Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications for which the BBS has approved the class, and fees in promotion materials and advertising. ***The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising***. Advertising shall not disclose improper approval information to the public.

Course sponsors/co-sponsors: provide participants a certificate of completion containing the following information: name of participant, title of approved courses, BBS approval #, BBS approved certifications, date of the continuing education program, number of approved credit hours awarded and signature of authorized sponsor or instructor.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

Participants: Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

Board approval: Remains in effect through the calendar year of approval. The course may be renewed administratively by sponsor application in subsequent years so long as it references current codes and standards Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

Facility/training area: Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

APPLICATION

FOR

Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.

Board of Building Standards
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax: (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: Michael Fox
(Contact Name)
Organization: Allegion, PLC
(Organization/Company)
Address: 11819 North Pennsylvania Street
(Include Room Number, Suite, etc.)
City: Carmel State: Indiana Zip: 46032
E-Mail: Mike.Fox@allegion.com
Telephone: 614-493-8404 (Cell) Fax: _____
Course Sponsor: Ohio Design Professionals & Code Analysts

COURSE INFORMATION:

Course Title: Hardware for Healthcare Openings

New Course Submittal: ■ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective: Provide Data information on healthcare facilities and the special requirements for healthcare
List codes & standards that affect doors found in healthcare facilities
Choose hardware that will protect the door, withstand abuses of the hospital and still meet the hospitals opening needs
Provide electrified hardware solutions that will eliminate common healthcare code issues
Specify opening hardware solutions for fire rated openings that will meet hospital and staff requirements

Number of Instructional Contact Hours that can be obtained upon completion: (1) hour

If Multi-Session, Number of Instructional Contact Hours Per Session: _____

Program Applicable for the Following Participants:

Building Official	■	Master Plans Examiner	■	Building Inspector	■	Fire Protection Inspector	■
		Building Plans Exam.	✔				
		Plumbing Plans Exam.	■				
		Electrical Plans Exam.	■				
		Mechanical Plans Exam.	■				
		Fire Protect. Plans Exam.	✔				

Mechanical Inspector	■	Plumbing Inspector	■	Non-Res IU Inspector	☐				

Res Building Official	☐	Res Plans Examiner	☐	Res Building Inspector	☐	Res Mechanical Inspector	☐	Res IU Inspector	☐

Electrical Safety Inspectors [X]
Location of ESI Course: _____ Date(s) of ESI Course(s): _____

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**:		Check Off
Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	
	Organization sponsoring or requesting the program (if any)	
Course Title:	Name of course (related to content)	
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	
Test Materials:		
Completed Application:		

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

File Attachments for Item:

EC-12 NEC 2020 Electric Vehicles Charging Systems (Electrical League of Ohio)

ESI, BO, MPE, BPE, EPE, BI, RBO, RPE (4 hours)

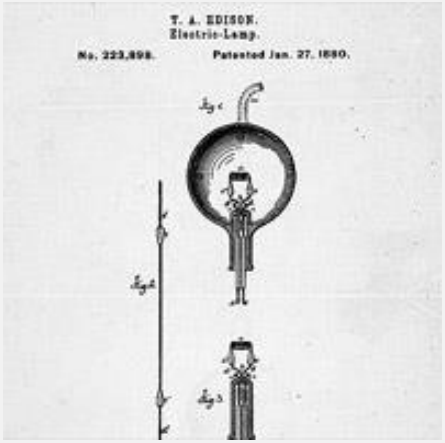
Electrical League of Ohio
June 2021

Electric Vehicle Charging Systems

Presented by: Timothy Pool, P.E., RCDD, ESI

History of the Code and Currently Enforced Edition

History of the Code



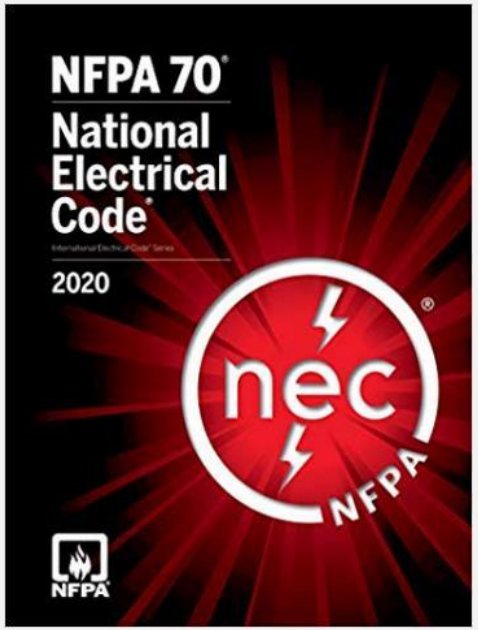
Edison invented the light bulb in 1879.

By the late 1800's electricity and light was showing up in mainly higher-class households.

Five independent committees (insurance, electrical and architectural) convene in New York City in 1896.

The first code edition was published in 1897 by these committees.

History of the Code



The NFPA took control of publishing the NEC and has been sponsoring the updates since 1911.

The 2020 edition marks the 55th edition of the *National Electrical Code*.

The NEC is published on a three-year cycle. The next code is the 2023. Requests for changes are open for comment on the NFPA web site.

Closing date for comments on the 2023 NEC was September 10, 2020.

The projected 2023 NEC First Draft posting is April 2021.

THE MAKING OF THE 2017 NATIONAL ELECTRICAL CODE®

Hundreds of participants give their time and expertise to each update. Each panel member represents one of the following interest categories:

THE NEC® EQUATION

The 520 panel members serve on 19 code-making panels. Each panel can have no more than one third of its representation from the same interest category. This principle of balance prevents any single interest category from dominating the process and ensures all voices have the opportunity to be heard. The 520 panel members reviewed and debated more than 5,500 public inputs during 35,000 person-hours.

19 CODE-MAKING PANELS

520 PANEL MEMBERS

5,500+ PUBLIC INPUTS THROUGH TWO ROUNDS OF PUBLIC REVIEW

35,000 PERSON-HOURS

33% MAXIMUM REPRESENTATION ON ANY PANEL OF ANY INTEREST CATEGORY

NEC® in Effect 1/1/2021

2020 NEC® - 9
2017 NEC® - 27
2014 NEC® - 8
2008 NEC® - 2
County/Municipality NEC® regulation only - 4

Source: dlymaps.net (c)

NEC® Update Process In Progress
1/1/2021

2020 NEC® Update Process Underway - 14
2017 NEC® Update Process Underway - 7
Current Update Process Completed - 25
(See NEC® in Effect Map for Updated Edition)
County/Municipality NEC® regulation only - 4

Source: dipsupp.net (c)

National Electrical Manufacturers Association (NEMA), the Ohio Board of Building Standards (OBBS) recently received Petition 20-01 from the Ohio Electrical Coalition

EC&M

LOG IN REGISTER SEARCH

RECENT

State of Washington Adopts 2020 National Electrical Code
JUN 03, 2020
2020 National Electrical Code Changes

Dropping Your Only Insulated Screwdriver from 200 Feet Up
JUN 03, 2020
Safety

How Do You Deal with an Unsafe Operator?
JUN 03, 2020
Safety

NATIONAL ELECTRICAL CODE

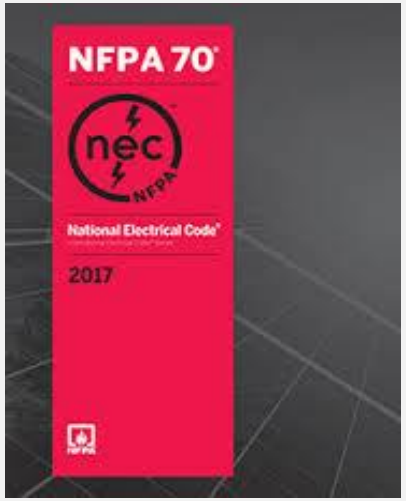
Ohio Looks to Adopt 2020 NEC

Stakeholder meeting to be held March 9, 2020

FEB 20, 2020

According to a recent update in *Code Alerts* from the National Electrical Manufacturers Association

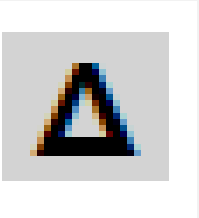
Introduction



Ohio	2017 Commercial (11/1/2017) 2014 One-, two- and three-family dwellings (1/1/2016)	One-, two- and three-family dwellings (7/1/2019)
Oklahoma	2014 Commercial (11/1/2015) Residential 2015 IRC Electrical Chapters (11/1/2016)	Update process underway (effective date not established)
Oregon	2017 with Oregon amendments (10/1/2017)	
Pennsylvania	2014	
Rhode Island	2017 (8/1/2019)	
South Carolina	2014 (7/1/2016)	Update process underway (1/1/2020 projected)
South Dakota	2017 (7/1/2017)	

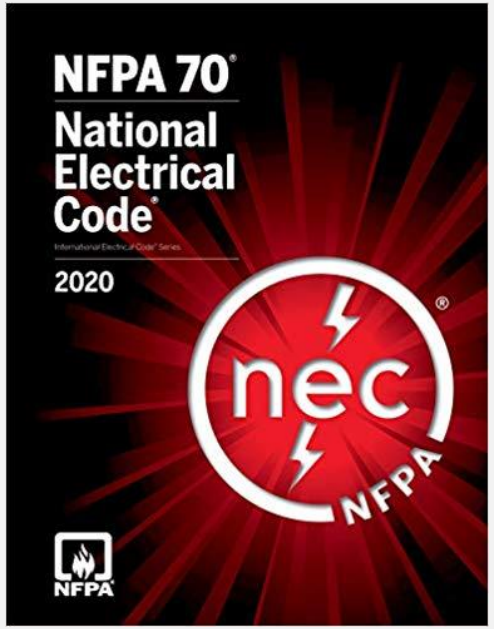
New Revision Marker ‘Δ’

Text revisions are shaded. A **Δ** before a section number indicates that words within that section were deleted and a **Δ** to the left of a table or figure number indicates a revision to an existing table or figure. When a chapter was heavily revised, the entire chapter is marked throughout with the **Δ** symbol. Where one or more sections were deleted, a • is placed between the remaining sections. Chapters, annexes, sections, figures, and tables that are new are indicated with an ***N***.



“delta” symbol added to identify changes

Intro to 2020 NEC Updates



Article 242 Overvoltage Protection – All dwelling unit service must have a type 1 or type 2 surge protection device. Consolidated Articles 280 and 285.

Article 311 Medium Voltage Conductors and Cable – type MV consolidated from articles 310 and 328

Article 337 Type "P" Cable (Hazardous locations and Harsh Environments like offshore oil drilling rigs)

Article 800 - 805 General Requirements for Communications Systems – Major re-write and split of old Article 800 into two Articles 800 and 805

Article 625
Electric Vehicle Charging Systems

ARTICLE 625
Electric Vehicle Charging System

625.1 Scope. This article covers the electrical conductors and equipment connecting an electric vehicle to premises wiring for the purposes of charging, power export, or bidirectional current flow.

Article 625.2
Electric Vehicle Charging Systems

New Technologies:

- Wireless Power Transfer (WPT)Wireless Power Transfer Equipment (WPTE)

Part IV added in NEC 2017 for wireless power transfer equipment.

ARTICLE 625
Electric Vehicle Charging System

625.17 Cords and Cables. (Con't)

(B) Output Cable to the Electric Vehicle. The output cable to the electric vehicle shall be Type EV, EVJ, EVE, EVJE, EVT, or EVJT flexible cable as specified in Table 400.4.

ARTICLE 625
Electric Vehicle Charging System

625.22 Personnel Protection System.

The equipment shall have a listed system of protection against electric shock of personnel. Where cord-and-plug-connected equipment is used, the interrupting device of a listed personnel protection system shall be provided according to 625.17(A). (in the cord or cable) A personnel protection system shall not be required for supplies less than 60 volts dc.

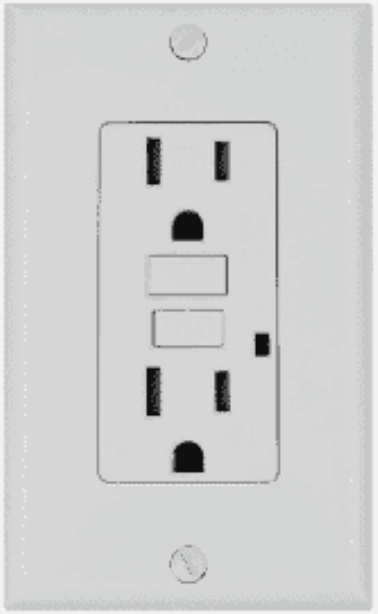
ARTICLE 625
Electric Vehicle Charging System

625.40 Electric Vehicle Branch Circuit.
Each outlet installed for the purpose of charging electric vehicles shall be supplied by an individual branch circuit. Each circuit shall have no other outlets.

ARTICLE 625
Electric Vehicle Charging System

625.43 Disconnecting Means. For electric vehicle supply equipment rated more than 60 amperes or more than 150 volts to ground, the disconnecting means shall be provided and installed in a readily accessible location. The disconnecting means shall be lockable open in accordance with 110.25.

ARTICLE 625
Electric Vehicle Charging System



625.54 Ground-Fault Circuit-Interrupter Protection for Personnel.

In addition to the requirements in 210.8, all receptacles installed for the connection of electric vehicle charging shall have ground-fault circuit-interrupter protection for personnel.

ARTICLE 625
Electric Vehicle Charging System

625.56 Receptacle Enclosures.

All receptacles installed in a wet location for electric vehicle charging shall have an enclosure that is weatherproof with the attachment plug cap inserted or removed. An outlet box hood installed for this purpose shall be listed and shall be identified as extra duty. Other listed products, enclosures, or assemblies providing weatherproof protection that do not utilize an outlet box hood shall not be required to be marked extra duty.

ARTICLE 625
Electric Vehicle Charging System

625.60 AC Receptacle Outlets Used for EVPE.

AC receptacles installed in electric vehicles and intended to allow for connection of off-board utilization equipment shall comply with 625.60(A) through (D).

625.60(A) Type.

The receptacle outlet shall be listed.

625.60(B) Rating.

The receptacle outlet shall be rated 250 volts maximum, single phase 50 amperes maximum.

ARTICLE 625
Electric Vehicle Charging System

625.60 AC Receptacle Outlets Used for EVPE.

625.60(C) Overcurrent Protection.

Electric vehicles provided with receptacle outlets for power export shall be provided with overcurrent protection integral to the power export system. The overcurrent protection shall have a nominal rating sufficient for the receptacle it protects. The overcurrent protection shall also be sufficiently rated for the maximum available fault current at the receptacle and shall be included in the interactive equipment evaluation. See 625.48.

ARTICLE 625
Electric Vehicle Charging System

625.60 AC Receptacle Outlets Used for EVPE.

625.60(D) GFCI Protection for Personnel.

Ground-fault circuit-interrupter protection for personnel shall be provided for all receptacles. The ground-fault circuit-interrupter indication and reset shall be installed in a readily accessible location.

Informational Note: There are various methods available to achieve ground-fault circuit-interrupter protection.

End of Class

APPLICATION

FOR

Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.

Board of Building Standards
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax: (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER: Electrical League of Ohio

Course Submitter: Terri Hanna Wiehn
(Contact Name)

Organization: Electrical League of Ohio
(Organization/Company)

Address: 20575 Center Ridge Road Suite 117
(Include Room Number, Suite, etc.)

City: Rocky River State: Ohio Zip: 44116

E-Mail: terrihanna-wiehn@sbcglobal.net

Telephone: 440-333-5040 Fax: _____

Course Sponsor: Electrical League of Ohio

COURSE INFORMATION:

Course Title: NEC 2020 Electric Vehichles Charging Systems

New Course Submittal: ☒ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective: Electric Vehichles have become more affordable for the general consumer. Now there is major legislation to provide federal and state funding for charging infrastructure and to standardize the charging methods used for electric vehichles. With all of this infrastructure on the horizon, it is important to know the know the code requirements for electric vehicle chargning equipment and to follow the requirements for safe code compliant installation. Course will cover electric vehicle charging, bi-directional charging requirements and discuss some of the proposed legislature.

Number of Instructional Contact Hours that can be obtained upon completion: 4 hours

If Multi-Session, Number of Instructional Contact Hours Per Session: NA

Program Applicable for the Following Participants:

Building Official	☒	Master Plans Examiner	☒	Building Inspector	☒	Fire Protection Inspector	☐
		Building Plans Exam.	☑				
		Plumbing Plans Exam.	☐				
		Electrical Plans Exam.	☒				
		Mechanical Plans Exam.	☐				
		Fire Protect. Plans Exam.	☐				

Mechanical Inspector	☐								
Plumbing Inspector	☐								
Non-Res IU Inspector	☐								

Res Building Official	☒	Res Plans Examiner	☒	Res Building Inspector	☐	Res Mechanical Inspector	☐	Res IU Inspector	☐

Electrical Safety Inspectors ☐

Location of ESI Course: 20575 Corporate Drive ZOOM Date(s) of ESI Course(s): June 16, 2021

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**:		Check Off
Course Submitter:	Name of contact person and their certification numbers, organization, address, fax, phone	x
	Organization sponsoring or requesting the program (if any)	x
Course Title:	Name of course (related to content)	x
Purpose/Objective:	Describe purpose and how course will improve competency of certification(s) listed	x
Contact Hours:	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	x
Participants:	Check off each certification for which credit is requested (for which course relates to certification)	x
Content of Program:	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	x
Course Materials:	Collated workbooks, handouts, hard copy or electronic versions of program is available	x
Instructor(s) Info.:	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	x
Test Materials:		
Completed Application:		x

NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.

Electrical League of Ohio
National Electrical Code Education Class
4-hour Course Outline

NEC 2020 Class
"Electric Vehicle Charging Systems"

Presented By: Timothy G. Pool, PE, RCDD, ESI 7011

Executive Summary of course: Electric vehicles have become more affordable for the general consumer. Now there is major legislation to provide federal and state funding for charging infrastructure and to standardize the charging methods used for electric vehicles. With all of this infrastructure on the horizon, it is important to know the code requirements for electric vehicle charging equipment and to follow the requirements for a safe, code compliant installation. This class course will cover the basics of Electric Vehicle charging, bi-directional charging requirements and discuss some of the proposed legislature.

Article 625 – Electric Vehicle Charging Systems	**Class Time**
• Article 625.1 Definitions and Scope	30 min
• Article 625.2 New charging technologies	30 min
• Article 625.17 Cords and cables	30 min
• Article 625.40 Branch Circuit Sizing	30 min
• Article 625.43 Disconnecting Means	30 min
• Article 625.56 Ground Fault Circuit Interrupter Requirements	30 min
• Article 625.60 AC Receptacle Requirements	30 min
• Article 625.60 Bi-Directional Current	30 min
Total	4 hours

Tim Pool, PE, RCDD
Tec Inc. Engineering & Design

Executive Vice President, Engineering

With over 30 years of experience in consulting engineering Tim manages the engineering design of building systems and infrastructure of healthcare, industrial, data center and laboratory facilities with a keen sense of electrical code compliance and industrial safety. Throughout his career his work has included projects at several public institutions and fortune 500 companies throughout the country.

His accredidations contributing to his expertise include professional engineering licensure in 20 states, BICSI Registered Communication Distribution Designer (RCDD), Licensed Electrical Safety Inspector, and Professional Trainer. Considered an industry subject matter expert in codes and standards, Tim has been an instructor for the Electric League of Ohio, IBEW, NASA, Lubrizol, Lincoln Electric, Avery Dennison, among others. Tim has also published several professional and technical journal articles on the importance of electrical safety and code complaint electrical design.

In his role as Tec's Executive Vice President, Tim devotes time to mentoring the firm's electrical team members, providing the quality control, leadership and communication needed to perform and generate successful projects. A proud Case Western Reserve University Alumni, Tim is a lifelong resident of Northeast, Ohio with his wife and two daughters. Go Browns!