McKEON®

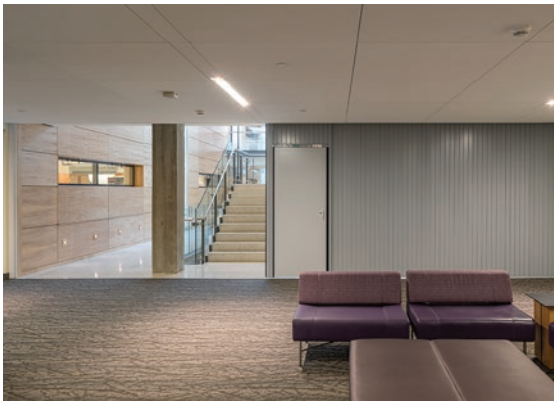
Based on the National Building Code of Canada

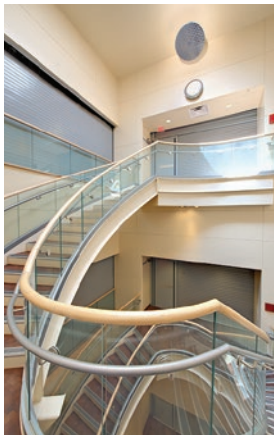
CANADA

Fire Door Systems

A Guide to Code Compliance






McKEON®

Fire Door Systems

A Guide to Code Compliance

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Canada Edition - March 2020

Introduction

THIS EDITION of *Fire Door Systems, A Guide to Code Compliance* is based on the most recent edition of the NBC with excerpts from Provincial amendments. Included in the appendix of this first edition is the NFPA 101 language allowing egress through horizontal sliding accordion or folding fire doors regardless of occupant load. Also featured is the most recent language newly adopted into the International Building Code (IBC) regarding Fire Protective Curtain Assemblies.

THE NATIONAL BUILDING CODE OF CANADA, issued by the National Research Council (NRC), is the model building code recognized throughout the country. Once adopted by the Provinces and their jurisdictions it becomes an enforcible code that regulates construction. The intent of the code is to detail the minimum provisions acceptable to maintain safety, public health, fire protection and accessibility.

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.

All fire- and smoke-rated product solutions shown in this document have been tested and listed to CAN/ULC S104 and ANSI/UL 1784. Size restrictions may apply on all closures as per Article 3.1.8.6. The horizontal oriented technology, Model H200 has been tested and listed to CAN4/S104-M80.

McKEON®

1 Exit Separation

Fundamental Guidelines

Horizontal Exit

Walkways & Tunnels

Fundamental Guidelines

Every building is provided with a minimum number of exits to lead occupants to a separate building or to an exterior open space which has access to a public street. For the purposes of Building Code compliance, the following general categories of exits are described in the Building Code (Article 3.4.1.4.):

1. **Exterior exit door**
2. **Exterior passageways, ramps or stairways**
3. **Horizontal exits**
4. **Interior passageways, ramps, or stairways**

Typically, an exit is required to be enclosed and/or separated from the building by a fire rated separation to provide protection for occupants as they exit the building. This fire separation provision is applicable to both interior and exterior exit facilities, both of which are required to be separated from the remainder of the building. Other special provisions apply to exterior exit passageways which allow the fire separation to be omitted (Article 3.4.3.3.). Additionally, in the case of an exterior exit door, the fire separation is not required as once an occupant passes through the door, the occupant is in an exterior open space.

The fundamental principles which drive the requirements for exits are based on protecting occupants from a fire in the building during the evacuation process. For this reason, certain types of exits are not permitted to be penetrated by openings except those that directly serve the exit.

The case studies in this section illustrate those scenarios where opening protectives in fire separations may be held open until they are required to close in a fire emergency.

Horizontal Exit

Section 3.4., Subsection 3.1.10., Articles 3.2.3.19., 3.2.3.20.

A horizontal exit is a doorway in a firewall, a walkway, a bridge, a balcony, or a vestibule which leads from one building to another. Once an occupant has passed through a horizontal exit, the occupant is considered to have exited the building into a protected space.

Fire and Life Safety Concerns

Fundamentally, a horizontal exit differs from the typical Building Code defined exit. The horizontal exit leads an occupant into a separate building which is separated from the building of origin by a firewall, walkway, or bridge. All other exits are designed to exit occupants out of the building into an exterior open space and away from the building.

Building Code Requirements

Horizontal exits are designed to maintain the continuity of the fire separation required between two adjacent buildings in order to protect occupants on either side of the horizontal exit. Because occupants are not being exited directly to an exterior space where they can move way from the building, the following principles apply:

Principle #1 – Separation: The two buildings on opposite sides of a horizontal exit must be separated from each other by a firewall with a 2-hour or 4-hour fire rating depending on the type occupancy (Article 3.1.10.2.). Alternatively, the two buildings may be separated by exterior space but connected by a walkway (above or below ground). Each building must be separated from the above ground walkway by a wall with a 45 minute fire rating (Article 3.2.3.19.) and the underground walkway by a wall with a 1-hour fire rating (Article 3.2.3.20.).

Principle #2 – Opening Protective: The opening in a horizontal exit must be protected with a fire door which has a self-closing device. The fire rating of the door is dependent on whether the horizontal exit is within a firewall, walkway, or bridge between two buildings. The doors require a 1½-hour and 3-hour rating within 2-hour and 4-hour firewalls, respectively, and a 45-minute fire rating in a walkway.

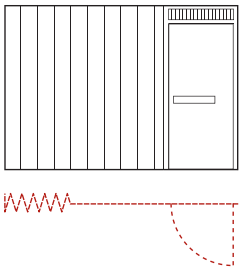
If the door includes a device which holds it open for operational purposes, the device must be designed to release automatically on activation of smoke detectors located near the door or on activation of the building's fire alarm system.

EXIT SEPARATION

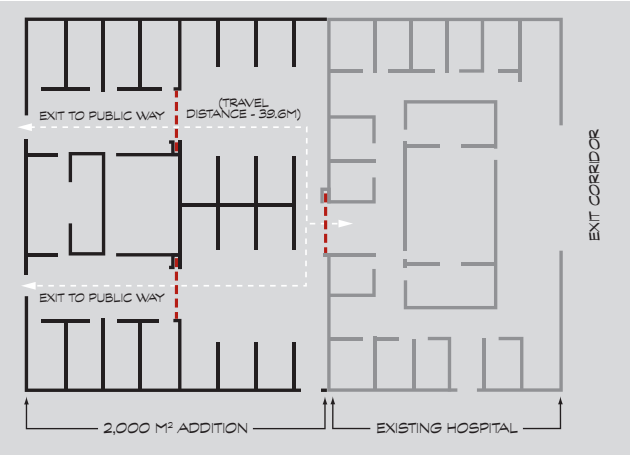
Principle #3 – Number of Horizontal Exits: The Building Code restricts the number of horizontal exits each storey is permitted to have (Article 3.4.1.6.). For hospitals and other facilities classified as Group B-2, horizontal exits which serve sleeping rooms may comprise only up to two thirds of the number of exits required for such areas. For other types of occupancies, the limit is one half. All other exits must lead to an enclosed exit facility or door which discharges directly to an exterior open space.

Design Solutions

CASE 1: Side Acting Accordion with Complying Swing Egress Door



The intent is to add a 1200m² in-patient sleeping ward onto an existing B-2 (hospital). However code requirements come into play that affect the design dramatically:



- First, areas of sleeping rooms cannot exceed 1000m² in a sprinklered structure. In this case a 2000m² ward is being added. *(Sentence 3.3.3.5.(2))*
- Second, there must be two exits from each ward. *(Table 3.4.2.1.-B)*
- Third, the travel distance between any point in an area of sleeping rooms and an exit access exit door shall not exceed 45m with automatic sprinkler protection. *(Clause 3.4.3.5.(1)(C))*

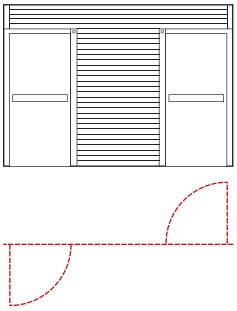
By utilizing the horizontal exit concept, the following will preserve the original design intent and provide code compliance:

- Separate the intended 2000m² addition into two wards, each less than 1000m².
- Provide a 2-hour fire wall separating it from the existing building. *(Sentence 3.1.10.2.(2))*

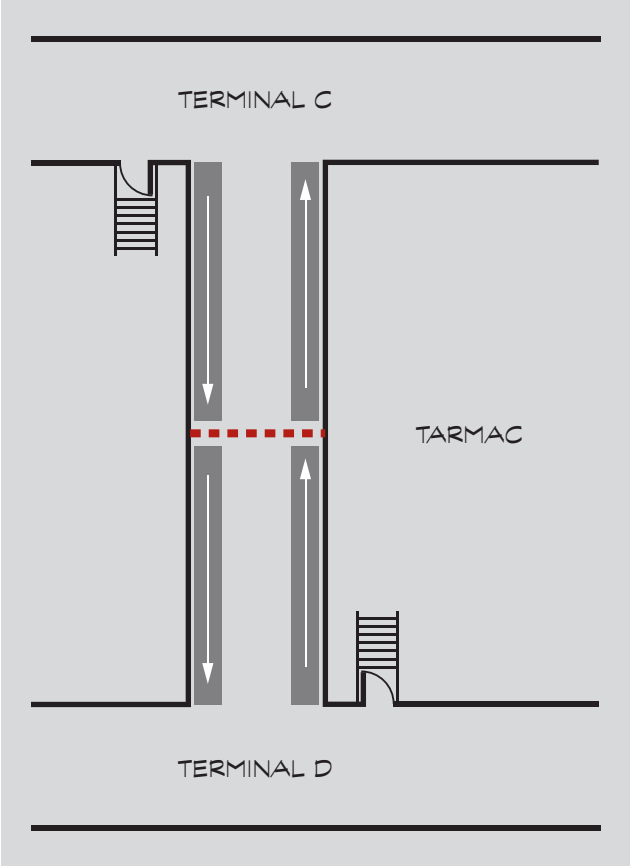
EXIT SEPARATION

- Provide a 1-hour fire separation to divide two compartments. *(Sentence 3.3.3.5.(4))*
- Provide a horizontal exit in the separation as one of two required exits from each space. *(Sentence 3.4.1.6.(2))*
- Provide a 90-minute temperature rise closure at 250° C at the firewall and 45-minute closure at the 1-hour separation. *(Article 3.1.8.4.)*

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 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 closure is provided with no side room and as little as 66cm 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 eliminating the dead end corridor.



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:

Walkways & Tunnels

Articles 3.2.3.19. and 3.2.3.20.

Walkways are designed to provide a connection between buildings. By the Building Code definition, a walkway is a pedestrian thoroughfare used to connect 2 or more buildings. They can be located above or below ground level and serve as a path of travel between buildings.

Fire and Life Safety Concerns

Buildings located across property lines or those on the same property which are designed as separate buildings are required to be sufficiently separated from one another or have fire-rated exterior walls or firewalls to prevent fire and smoke from passing between them. Walkways which connect such separated buildings penetrate the rated exterior walls and may serve as a channel for the propagation of heat and smoke from one building to another.

Building Code Requirements

The Building Code details specific criteria for the design of walkways to limit fire spread between buildings. The design criteria depend on whether the walkway is located below or above ground level. The requirements are based on the following principles:

Principle #1 – Separate Structures: The buildings at each end of a walkway are designed as separate buildings. These buildings are either located far apart enough that the exterior walls facing each other do not require a fire rating, or the exterior walls are fire-rated and include a limited number of window openings.

Principle #2 – Construction: An underground walkway is required to be of noncombustible construction (Article 3.2.3.20.). An above ground walkway is also required to be of noncombustible construction where one or more of the connected buildings is required to be of noncombustible construction, except that heavy timber is permitted in a ground level walkway where 50% of the perimeter walls are open to the outdoors. When heavy timber is used, protection of openings as described in Articles 3.2.3.14. and 3.2.3.15. must be considered.

Principle #3 – Fire Separations: Once 2 buildings are connected by a walkway, a fire separation must be provided between each building and the walkway. The fire separation is required to have a 45-minute fire resistance rating for an above ground

walkway and a 1-hour fire resistance rating for an underground walkway.

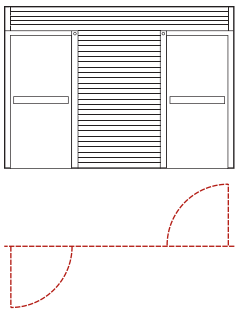
Principle #4 – Maximum Width: The width of a walkway is limited to 9m.

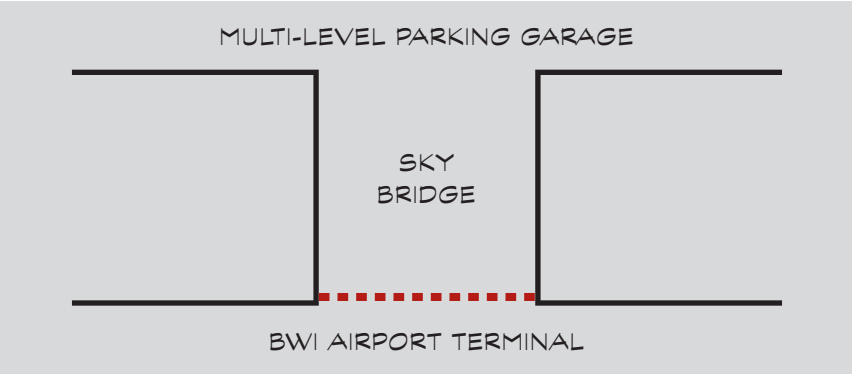
Principle #5 – Use: Typically, a walkway is designed for pedestrian travel between buildings only. If an above ground walkway is designed for other purposes, protection of openings as described in Articles 3.2.3.14. and 3.2.3.15. must be considered. An underground walkway may only be used for other purposes where the purpose is approved by the authority having jurisdiction and sprinklers are provided in occupied areas of the walkway.

Design Solutions

The alternatives to fire barrier separations as listed above are very costly. Complying with the 45 minute separation requirement in Article 3.2.3.19. 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.

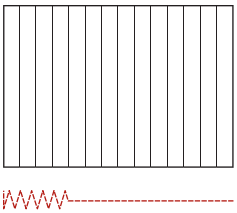
CASE 1: Vertical Coiling with Complying Swing Egress Door(s)

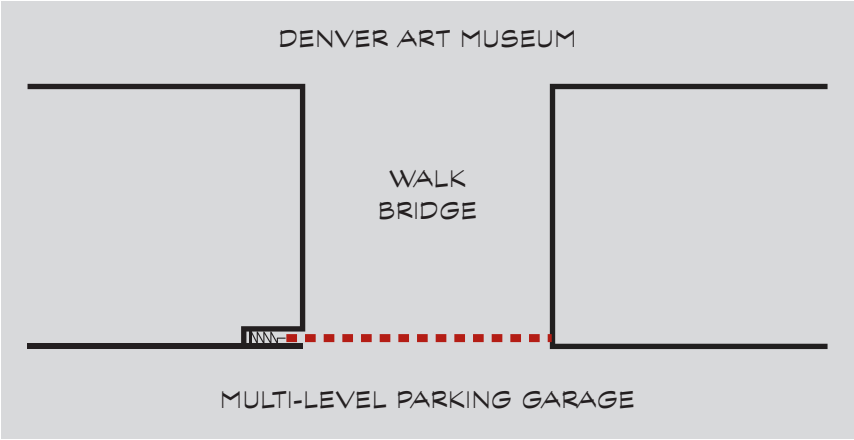




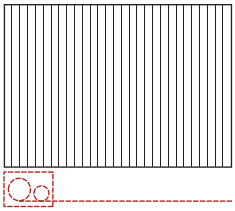
EXIT SEPARATION

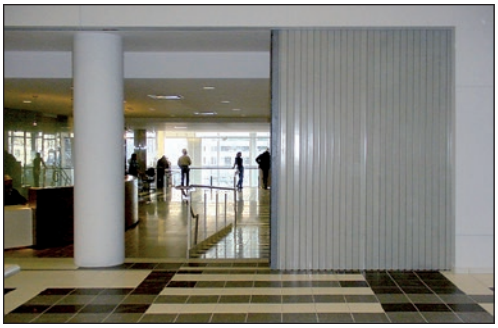
CASE 2: Side Acting Accordion with Power-assisted Egress

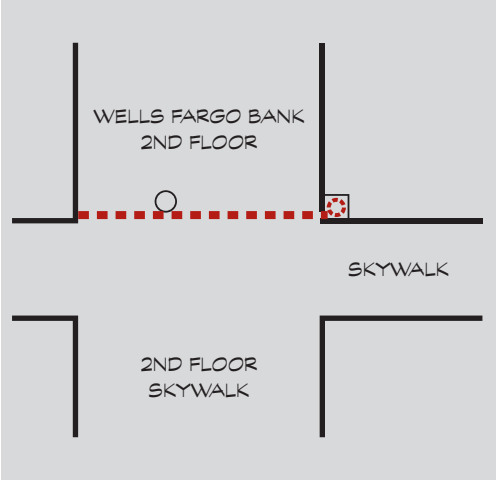




CASE 3: Side Coiling without Egress







EXIT 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. Closure size restrictions may apply as per Article 3.1.8.6.

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 tempered and/or wired glass components?

Notes:

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2 Vertical Openings Separation

Fundamental Guidelines

Interconnected Floor Spaces/ Openings Through Floor Assemblies

Escalators, Moving Walks, and Convenience Stairs

Vertical Compartmentation

Fundamental Guidelines

Vertical openings between floors are commonly designed in multi-storey buildings in many different shapes and heights and for different uses. For the purposes of Building Code compliance, the following general categories are described in the Building Code:

1. **Shaft enclosures**
   - **a. Stairs**
   - **b. Elevators**
   - **c. Service shafts**
2. **Interconnected floor spaces**
3. **Mezzanines**

Anytime two or more floors are open to each other, a vertical opening is created. Two tightly interwoven fundamental principles drive the requirements for the protection of vertical openings. First is the migration of heat, fire, smoke and other toxic gases from floor to floor. Second is the protection of occupants from a fire and its effects as they exit the building.

Interconnected Floor Spaces/Openings Through Floor Assemblies

Subsection 3.2.8.

Interconnected floor spaces are storeys or portions of storeys connected by an opening or a series of openings in a floor assembly required to be designed as a fire separation. By the Building Code definition, interconnected floor spaces are superimposed floor spaces which are connected by floor openings not protected by fire rated shutters or other types of opening protectives. Interconnected floor spaces are typically designed to create communicating spaces between storeys and include typical multi-storey atriums as well as openings created for unenclosed convenience stairs, ramps, or escalators.

Fire and Life Safety Concerns

The default Building Code solution is to require rated floor separations between storeys, with all openings protected by fire rated doors, windows, or shutters. Interconnected floor spaces are only permitted where special provisions are met. These provisions are extremely restrictive as unprotected vertical openings could lead to the rapid spread of fire and smoke which could affect multiple storeys in a short period of time. Subsection 3.2.8. addresses special protection measures for interconnected floor spaces depending on various factors including the size of the vertical openings and the number of interconnected storeys.

Building Code Requirements

Where the provisions of Subsection 3.2.8.[1] are met, the interconnected floor spaces are considered as being protected areas similar to areas with rated floor assemblies between storeys.

Interconnected floor spaces may be categorized under two sections, namely relatively extensive interconnected floor spaces requiring special protection measures listed under Articles 3.2.8.3. to 3.2.8.8.; and interconnected floor spaces of a more limited extent which meet specific criteria listed under Article 3.2.8.2. Listed below

[1] The provisions for interconnected floor spaces in the Ontario Building Code are very different from those in the NBC.

are the specific provisions which allow interconnected floor spaces to be open:

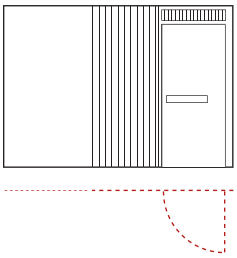
- Interconnected floor spaces are not permitted in floor areas containing sleeping rooms in treatment (Group B-2) or care (Group B-3) occupancies.
- Interconnected floor spaces listed under Article 3.2.8.2. which do not require special protection measures per Articles 3.2.8.3. to 3.2.8.8. are the following:
  - Mezzanines in performance theatres and similar occupancies for the production and viewing of performing arts.
  - Mezzanines in arena buildings not exceeding 2 storeys.
  - Mezzanines with area of 500m^2 or less which meet the criteria in the Building Code to not be counted as a storey, except mezzanines in care or treatment occupancies.
  - Openings in parking garages for vehicular ramps.
  - Openings in manufacturing plants required to facilitate the manufacturing process; for such openings the Building Code requires that precautions such as sprinkler protection be implemented to offset the potential hazard created by the unprotected floor openings.
  - Interconnections between not more than 2 storeys in a detention (Group B-1) occupancy.
  - Openings for escalators and moving walks where the opening size is limited to 10m^2 for each escalator or moving walk, the building is sprinklered, and the interconnected floors contain only assembly, office, or retail occupancies.
  - Interconnections between not more than 2 storeys where the 2 storeys are the 1st storey and the storey directly above or below, the building is sprinklered and the interconnected floors contain only assembly, office, retail, low-hazard, or medium-hazard occupancies.
  - Interconnections between not more than 2 storeys where the 2 storeys are the 1st storey and the storey directly above or below in an unsprinklered building. In this scenario:
    - the opening is limited to stairways, escalators, or moving walks.
    - the building area is limited to not more than one half that permitted by the Building Code.
    - the occupancies are limited to assembly, office, retail, low-hazard, and medium-hazard.
- Other interconnected floor spaces not noted in the foregoing sections are required to be protected in accordance with the measures listed under Articles 3.2.8.3. to 3.2.8.8. summarized as follows:
  - The building must be sprinklered.
  - Pressurized vestibules must be provided for elevator shafts which open both into the interconnected floor space and into storeys above. Pressurized vestibules are also required for all exit stairs which open into the interconnected floor space, and the exit capacity for such exit stairs must be cumulative.
  - Protected floor areas must be provided in front of exit stairs if such space is required to achieve cumulative exiting from the interconnected floor space.
  - Draft stops must be provided at the underside of all floor openings.
  - Mechanical exhaust at 4 air changes per

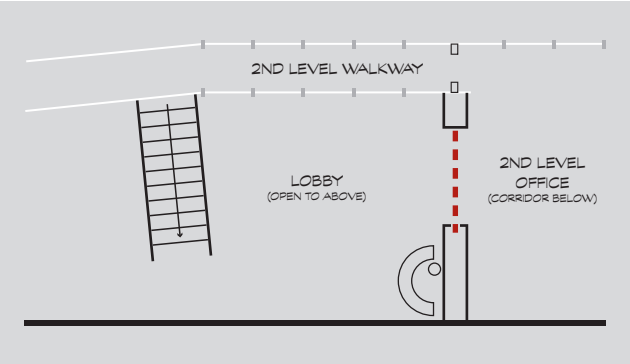
hour must be provided for the interconnected areas.

- The combustible contents in areas where the ceiling height exceeds 8m above the floor must be limited to 16g/m^3.

Design Solutions

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

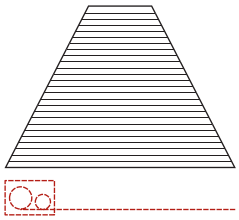




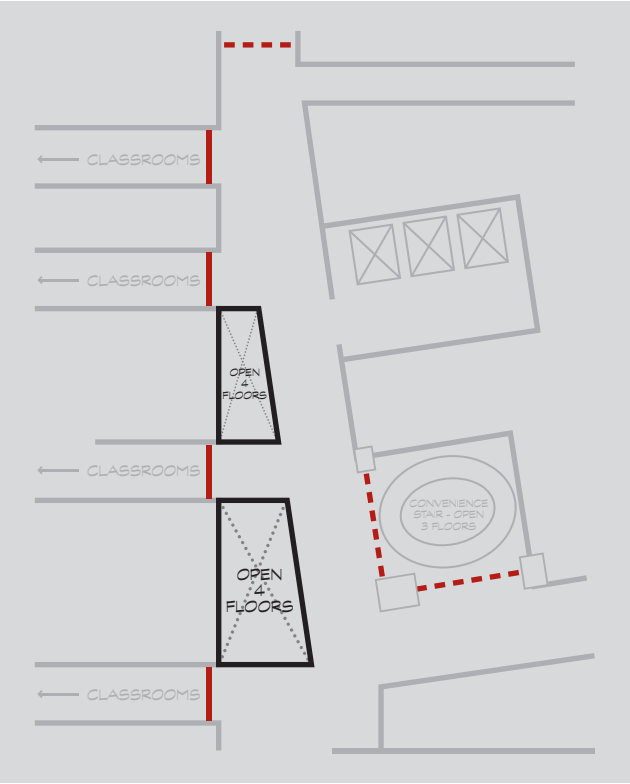
This unique case study features another McKEON product for resolving multiple design/code challenges simultaneously. The lower floor travel path is a required design feature for egress and – combined with the non-rated second floor overlook – is certainly a very creative solution. However, without the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

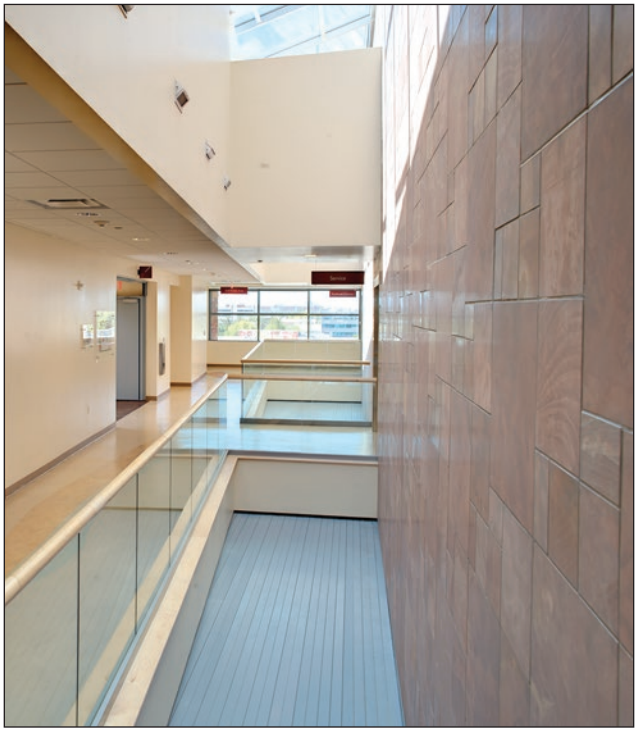
VERTICAL OPENINGS SEPARATION

CASE 2: Horizontal (Floor) Shutter



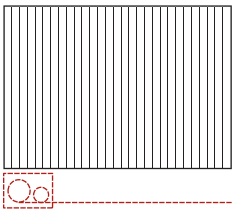
In this case study the atrium space is essentially converted to a 2-storey interconnected floor spaces using the McKEON horizontal shutter. Please refer to the “vertical compartmentation” case studies at the end of this section for more information. Note the absence of a mechanical exhaust system!

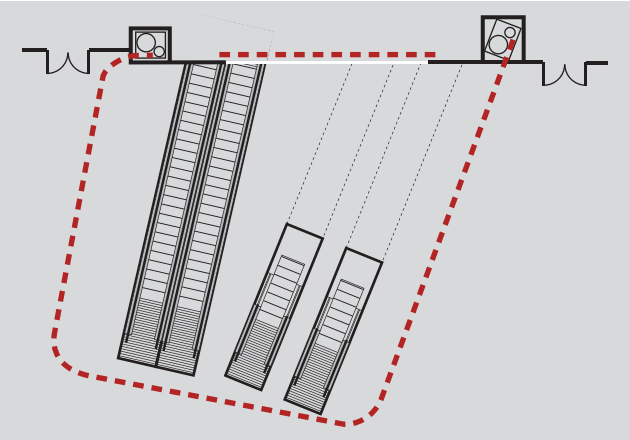




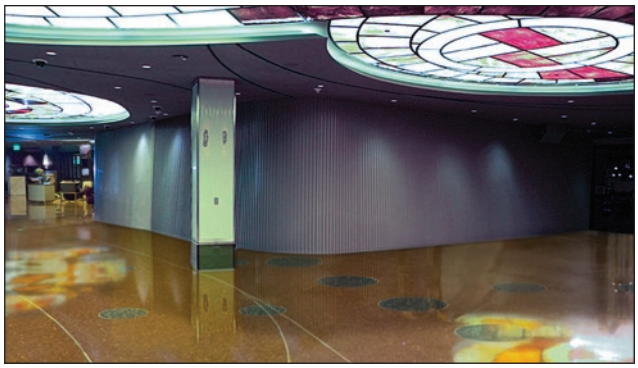
VERTICAL OPENINGS SEPARATION

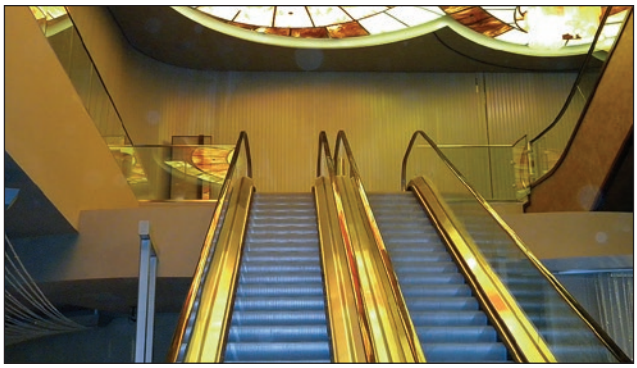
CASE 3: Side Coiling without Egress





Even though this design incorporates an escalator, exception to special protection, Sentence 3.2.8.2.(5) can only be applied if the area of the floor opening between stories does not exceed 100m^2. 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 5.71-cm head-track design, 3-hour fire listing and unlimited width capacity, McKEON easily solved the problem with a triple curve, non-floor track 43-m bi-part opening protective.





Inquiry Discussion & Questions

The following questions may be helpful:

- The size of the mechanical exhaust system is based upon the calculation of total cubic meter air in the space of not only the atrium space but all spaces that open into the atrium space in order to remove air at a rate of 4 changes per hour. 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 interconnecting floor atrium requirements by creating a fully enclosed shaft or horizontal compartmentation in this vertical space?
- Closure size restrictions may apply as per Article 3.1.8.6.

Notes:

Escalators, Moving Walks, and Convenience Stairs

Article 3.2.8.2.

Escalators, moving walks, and convenience stairs provide a convenient path for building occupants to move between communicating floors in a building. However, escalators, moving walks, and convenience stairs are not typically part of the required means of egress from the floor area and create interconnected floor spaces which may require special protection per the Building Code.

Fire and Life Safety Concerns

Openings through floor assemblies allow the spread of fire, smoke and other toxic gases from floor to floor. Enclosing escalators, moving walks, and convenience stairs in a rated shaft is certainly the most efficient way of confining a fire to the floor of origin. The enclosure is intended to limit the effects of the fire on occupants as they exit the building and the building structure itself. The Building Code includes some relaxations for certain limited sizes and types of openings created for convenience stairs, escalators, and moving walks provided the opening meets specific criteria described in the Building Code.

Building Code Requirements

The Building Code allows openings for escalators and inclined moving walks without requiring extra protection measures normally required for relatively more extensive interconnected floor spaces, where the design meets the following requirements *(Sentence 3.2.8.2.(5)):*

- The opening for each escalator or moving walk must be limited to 10m^2,
- The building must be sprinklered throughout, and
- The interconnected floors are allowed to contain only assembly, office, or retail occupancies.

Where the above provisions are met, the moving walks or escalators may span multiple storeys and may include any storeys in the building. These provisions are not applicable to openings for stairs[2].

[2] The Ontario Building Code permits opening for stairs under this provision.

VERTICAL OPENINGS SEPARATION

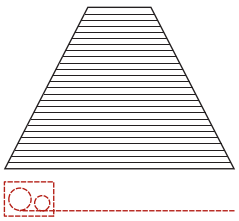
Larger openings for escalators or moving walks and openings created for stairs in assembly, office, retail, low- and medium-hazard occupancies must meet the following requirements or be enclosed in a fire rated shaft *(Sentence 3.2.8.2.(6)):*

- The opening must be limited to 2-storeys consisting of the 1st storey and the storey directly above or directly below only.
- The building must be sprinklered or the building area must be not more than one half that permitted by the Building Code.

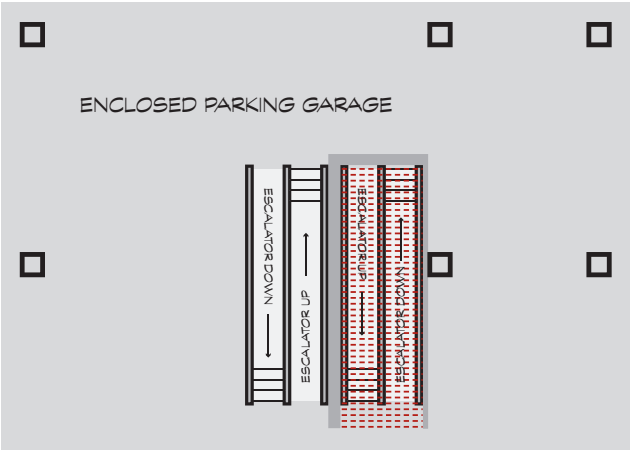
In a detention occupancy, an unenclosed convenience stair would be permitted to connect not more than 2 adjacent storeys *(Sentence 3.2.8.2.(4))*.

Design Solutions

CASE 1: L-Shape Horizontal Shutter

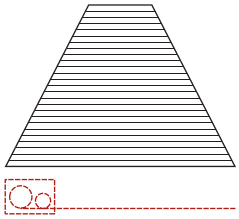


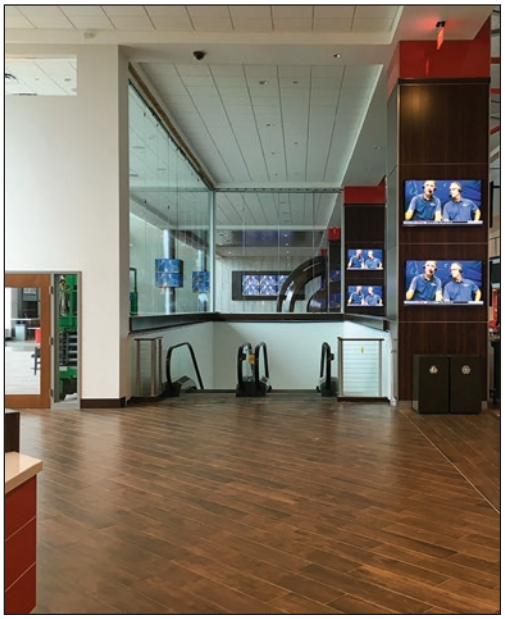
While a parking garage doesn't require an aesthetically pleasing solution, from a life safety perspective the need for fire and smoke protection is the same. A 2-hour rated horizontal shutter satisfies both the basic requirement of opening protection and enclosure of the escalator.



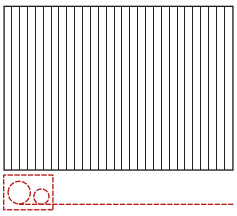
VERTICAL OPENINGS SEPARATION

CASE 2: L-Shape Horizontal Shutter



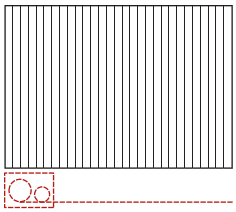


CASE 3: Extreme Height & Width Side Coiling without Egress



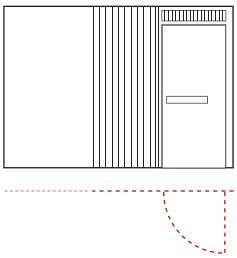
VERTICAL OPENINGS SEPARATION

CASE 4: Side Coiling without Egress

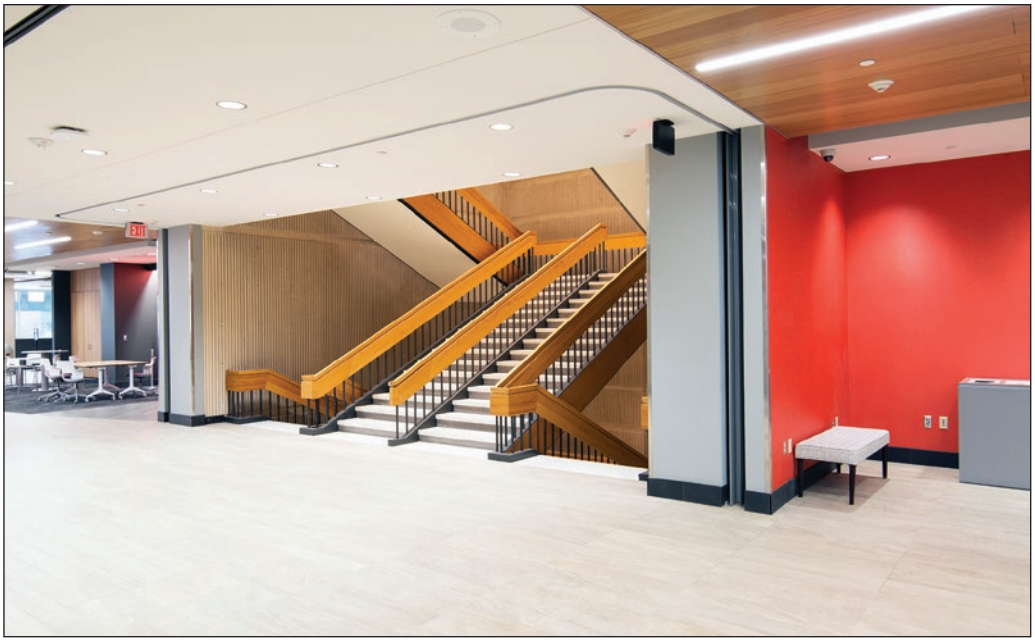


VERTICAL OPENINGS SEPARATION

CASE 5: Side Acting with Complying Egress Door(s)

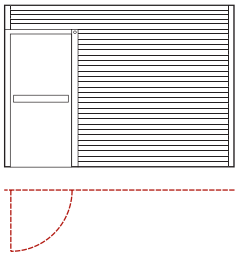


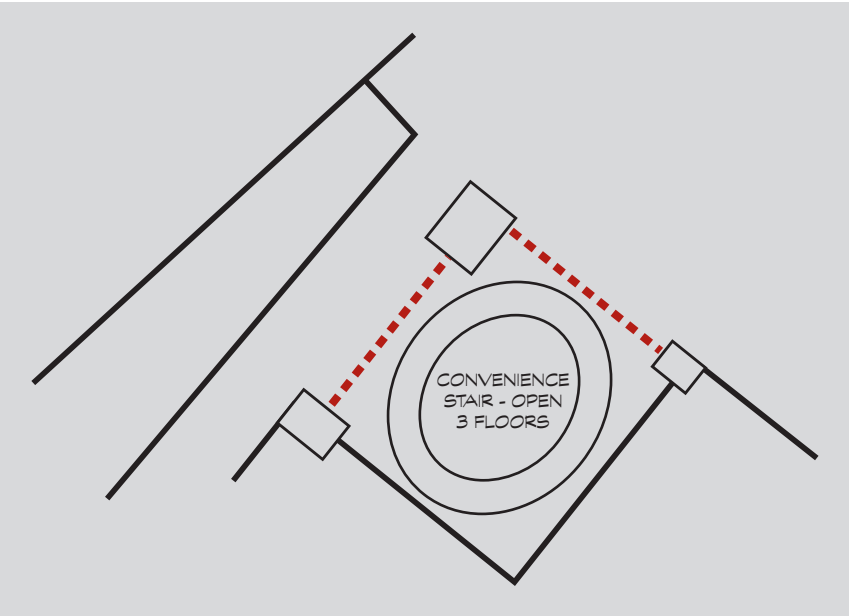
In this case study a convenience stair within a university learning center is open to each floor it connects during normal school operation. When the building goes into alarm two McKEON 3-hour side acting assemblies, each with a conforming egress swing door and conventional fire exit hardware, combine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

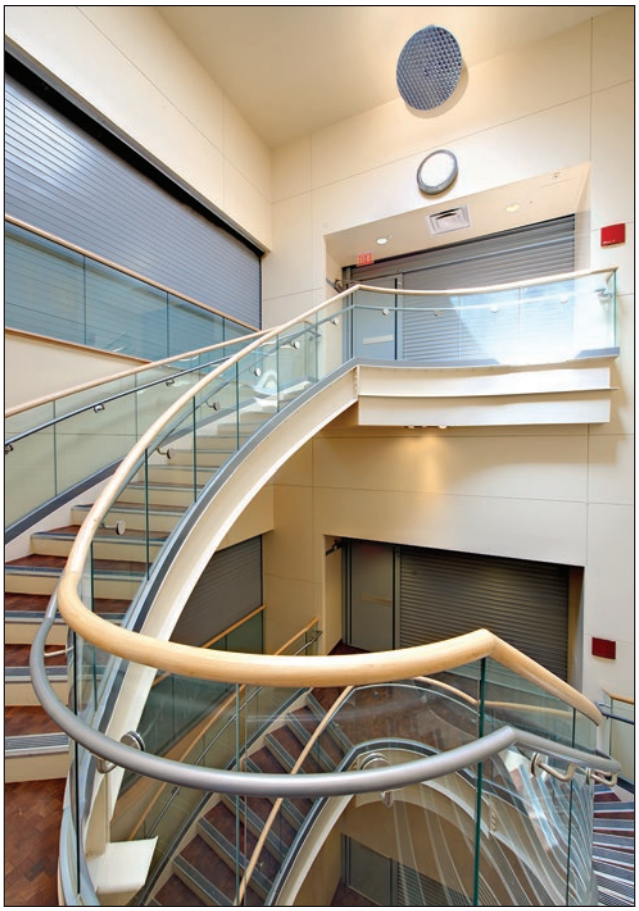


VERTICAL OPENINGS SEPARATION

CASE 6: Vertical Coiling with Complying Swing Egress Door(s)







VERTICAL OPENINGS SEPARATION

Inquiry Discussion & Questions

The applications in this study, at first glance, would seem to fall under the provisions found in tall multi-story interconnected story (atrium) applications because there are at least two floors common to each other. However, as indicated in the code requirements section of this study under specific conditions, we can have open and seemingly unprotected areas at stair locations. Closure size restrictions may apply as per Article 3.1.8.6.

The following questions may be helpful:

- Do you have clients who wish to occupy multiple floors with a vertical common area connecting all floors?
- Have you been concerned, when attempting vertical spaces separation, with avoiding the closed-in shaft appearance?
- Did you know there is a product available that offers wide-span opening protection and separation of vertical spaces that can also serve as the required exit from unenclosed stairways?

Notes:

Vertical Compartmentation

Subsections 3.2.2. and 3.2.8.

The fundamental provisions of the Building Code require each storey to be compartmentalized to limit fire events to at least the storey of origin. However, for functional purposes, floor assemblies are invariably penetrated by vertical openings. Protecting openings that connect multiple floors are currently addressed by the Building Code by way of shaft enclosures, full interconnected floor space design provisions, or requirements relative to limited size openings. In the following case studies, a new technology and product application will be discussed wherein compartments can be created to separate any number of storeys from each other in other to limit the extent of an interconnected floor space or eliminate it completely. This will be accomplished by coordinating the intent of the provisions for interconnected floor spaces and fire separation requirements in one application.

Fire and Life Safety Concerns

As discussed in the interconnected floor space case studies, vertical openings which interconnect more than one storey allow heat, smoke and toxic gases to migrate beyond the storey of origin and affect occupants remote from the fire. As such, the default solution of the Building Code is to require compartmentalized storeys unless specific provisions are met.

Building Code Requirements

The Building Code generally requires each storey to be separated from other storeys by fire rated separations under Subsection 3.2.2. and Subsection 3.2.8. addresses vertical openings. Subsection 3.2.8. includes very specific requirements as to the extent of interconnection permitted and what provisions must be met depending on the location, type, and extent of interconnection. Sentence 3.2.8.1.(1) provides the following acceptable solutions for the protection of vertical openings through floor assemblies:

- Compliance with the full interconnected floor space design provisions noted under Articles 3.2.8.3. to 3.2.8.9. or,
- Compliance with one of the exemptions provided in Article 3.2.8.2.

VERTICAL OPENINGS SEPARATION

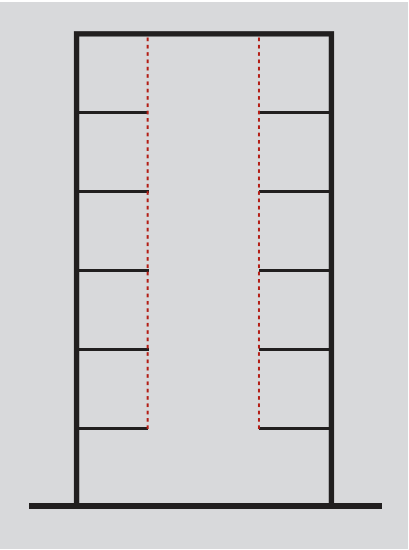


Figure 1

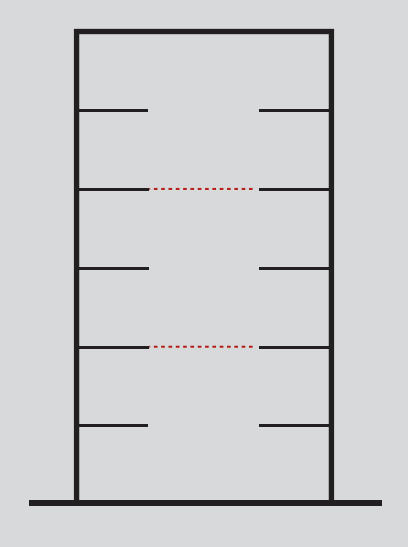


Figure 2

Where the above noted provisions are not met, the opening must be protected by a fire rated shaft or fire separation to eliminate the interconnection and maintain the continuity of the fire separation between storeys. Alternatively, shafts and/or fire rated separations may be used to limit the extent of the interconnection to allow compliance with the exemptions provided in Article 3.2.8.2. which include less onerous requirements for the design of the interconnected floor space.

Figure 1 shows the default solution with the continuity of the floor fire separations maintained at the floor line of each storey.

As shown by the configuration illustrated in **Figure 2**, providing rated vertical fire separations at each storey above the 1st level effectively eliminates the interconnected floor space such that the provisions in Subsection 3.2.8. would not be applicable. Although the 1st level now includes an environment which spans the total height of the building, the multiple height space is simply considered part of the 1st storey.

Similarly, the vertical fire separations could be provided for all storeys above the 2nd level, with the 1st and 2nd levels interconnected. This will enable the application of the exception in Sentence 3.2.8.2.(6) of the Building Code. In this case, the multiple height space will be considered part of the 2nd-level interconnected floor space.

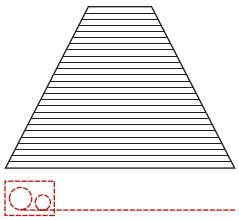
The interconnected floor exemption is only for an interconnected floor space that connects the first storey and the storey next above or below, but not both. *(Sentence 3.2.8.2.(6)*

For Detention occupancies – Group B, Division 1 – **Figure 2** represents an allowable condition. (Sentence 3.2.8.2.(4). Otherwise, one must consult NFPA 101 to justify this configuration as an alternate solution (code deviations) in other occupancies.

VERTICAL OPENINGS SEPARATION

Design Solutions

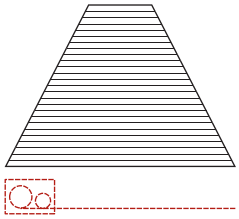
CASE 1: Horizontal (Floor) Shutter



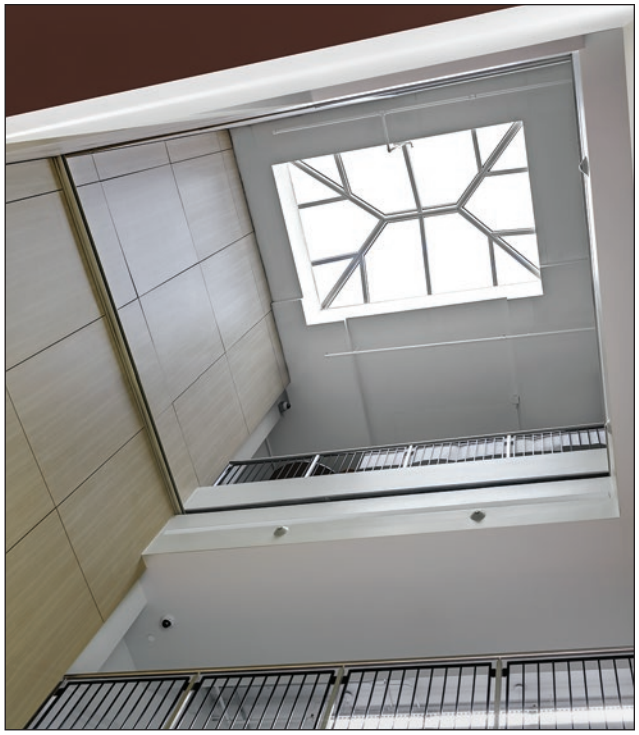
ULC S104, UL 10B 2-hour & UL 1784 "S" labeled, hose stream tested assembly.

VERTICAL OPENINGS SEPARATION

Case 2: Horizontal (Floor) Shutter

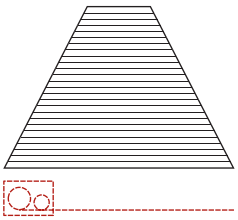


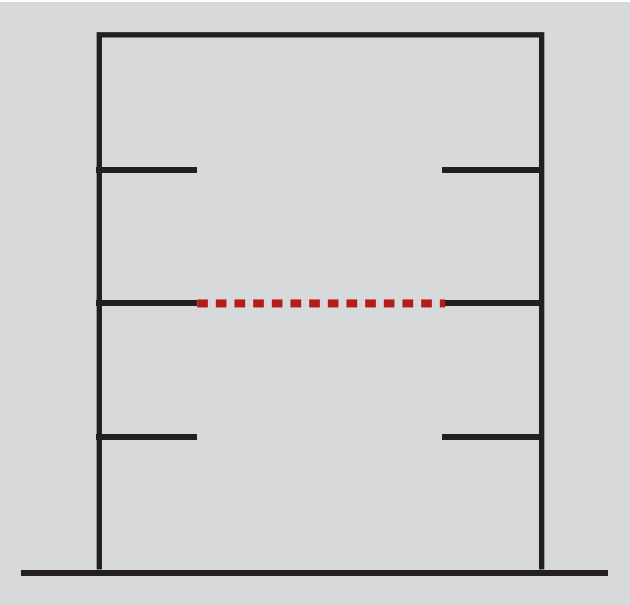
ULC S104, UL 10B 2-hour & UL 1784 "S" labeled, hose stream tested assembly.



VERTICAL OPENINGS SEPARATION

CASE 3: Horizontal (Floor) Shutter

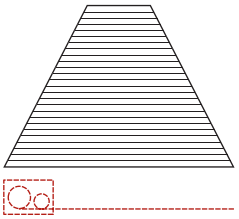




ULC S104, UL 10B 2-hour
& UL 1784 "S" labeled,
hose stream tested
assembly.

VERTICAL OPENINGS SEPARATION

CASE 4: Horizontal (Floor) Shutter



The following case study is based on an actual event. An arsonist entered an office on the 4th floor of a newly constructed building on the Emily Carr University of Art and Design campus in Vancouver, BC. They ignited a significant amount of paper in an attempt to start a fire in an atrium a few feet away. The plan was foiled as the initial ignition in the office area set off the fire alarm system throughout the structure. Within seconds the building fire protection systems deployed – both sprinklers and the closure of the McKEON horizontal floor shutters protecting the open vertical spaces (shutters shown in red on the elevation below).

VERTICAL OPENINGS SEPARATION

Thanks to the McKEON horizontal floor shutters, the fire damage was not as bad as it might have been. When the perpetrator attempted to spread the fire by dropping the burning debris through the atrium opening closest to the fire's origin he was surprised to discover that the once-open atrium spaces were now closed at each floor level with 2,826mm wide x 16,410mm long steel shutters, each fire-rated for 2 hours UL10B and UL1784 for smoke. Thus the fire was blocked from reaching beyond the floor of origin and the arsonist's attempt to simultaneously ignite multiple floors failed. The burning debris was unable to penetrate the steel slats of the floor shutter and merely charred the finish paint, and surrounding drywall and finishes.This fire event demonstrates perfect harmony between two major fire and life safety components – passive shutters and active sprinklers.

While the fire was quickly extinguished, one-third of the building's third and fourth floors suffered water damage. The photo on the left shows the water pooling on the concrete floor surfaces, but an absence of water pooling on the McKEON floor shutter. Flames burned through the surrounding drywall, yet only charred the finish paint of McKEON horizontal fire shutter. The horizontal shutter remained in place regardless of the water load and shielded the floors below from heat, smoke and falling burning debris.

The flame on the diagram below shows the location of the fire.

McKEON®

3 Separation of Uses

Fundamental Guidelines

Separation of Major Occupancies

Separation of Suites

Separation of Rooms and Spaces

SEPARATION OF USES

Fundamental Guidelines

Most buildings and structures are designed for multiple uses that will typically result in more than one occupancy classification. The Building Code addresses the separation between uses under:

1. **Separation of major occupancies – Subsection 3.1.3.**
2. **Separation of suites – Article 3.3.1.1.**
3. **Separation of rooms – Various provision throughout the Building Code**

Article 3.1.2.1. 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. Depending on the level of hazard of a particular occupancy, the Building Code prescribes limits related to a combination of construction type, building height, building area, and use of automatic sprinkler systems. Subsection 3.2.2. outlines construction requirements including fire resistance levels for each occupancy type.

Increased fire resistance of the structural members of the building in combination with the provision of active and passive fire protection systems permits greater height and area allowances. Notwithstanding this, the type and combination of uses and occupancies of the building will become a determining factor regarding the extent of separation and compartmentation required. For example, in a Group B, Division 2 (hospital) and Group B, Division 3 (care facility) occupancies, a minimum of two fire compartments are required for floor areas containing sleeping rooms with each compartment not exceeding 1000m^2. This level of compartmentation is not required for other occupancy types. Hospitals and care facilities also require a greater level of fire separation from most other adjoining occupancies. The difference is the use of the facility. Occupants in a hospital or care facility typically need more protection for a greater amount of time because they may be non-ambulatory and dependent on others for assistance to move to a safe place in an emergency. Therefore, the fire and life safety requirements to help protect building occupants are very different for this type of occupancy.

Separation of Major Occupancies

Subsection 3.1.3.

A major occupancy is the primary use a building or part of a building is intended for. A single building may include multiple major occupancies. Occupancies and uses which are an integral part of the functioning of a particular major occupancy are considered as subsidiary to that major occupancy. For example, a boardroom in an office building would typically be considered part of the office occupancy notwithstanding its size.

Fire and Life Safety Concerns

Buildings are classified based on their occupancy and use. The purposes for classifying structures is to configure optimum safety requirements commensurate to the need as dictated by each individual use. When a building is designed with mixed occupancies, there may be a concern because basic fire and life safety requirements are being mixed within the same structure. The general areas of concern are related to building construction type, interior finishes, means of egress, fire protection systems, and other general building limitations. In buildings with more than one major occupancy, construction requirements for each storey must be based on the most restrictive major occupancy it contains to provide appropriate protection of the occupants who need it most. However, where a major occupancy does not occupy more than 10% of a particular storey, it does not need to be considered in determining the construction requirements of that storey. This is based on the consideration that it will have a limited effect on the rest of the building due to its limited size.

Building Code Requirements

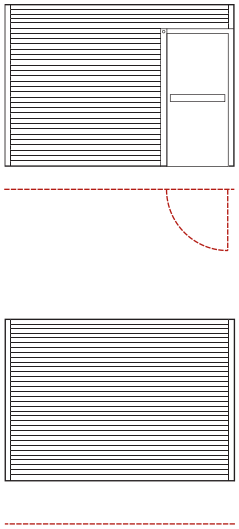
Table 3.1.3.1. in Subsection 3.1.3. provides the requirements for separation of major occupancies from other adjoining major occupancies, notwithstanding which major occupancies were used to determine construction requirements. Each major occupancy may be required to be separated from adjoining major occupancies on the same storey and on storeys above or below by a fire rated separation. The fire separation required is independent of whether or not the building is sprinklered.

SEPARATION OF USES

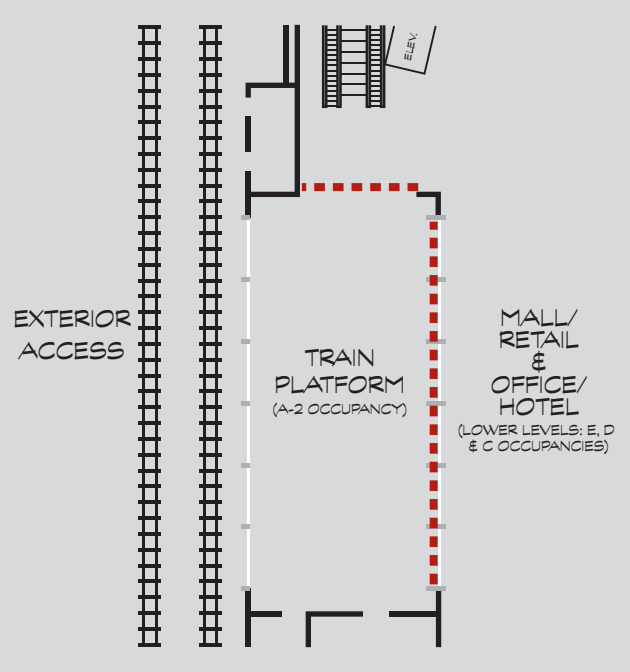
For certain occupancies a 1-hour, 2-hour, or 3-hour fire separation is required, while other occupancy combinations are restricted or completely prohibited. For other major occupancy combinations, the risk of fire spread between the two is deemed an acceptable risk such that no separation is required based solely on the major occupancy.

Design Solutions

CASE 1: Vertical Coiling with Complying Swing Egress Door(s) & Vertical Coiling without Egress

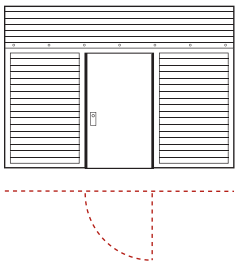


In this case study McKEON offers a solution to a difficult challenge by providing two different products within the same space. A combination of six fire-rated vertical rolling shutters installed on a diagonal path of travel and one vertical coiling assembly with conventional egress for exiting from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

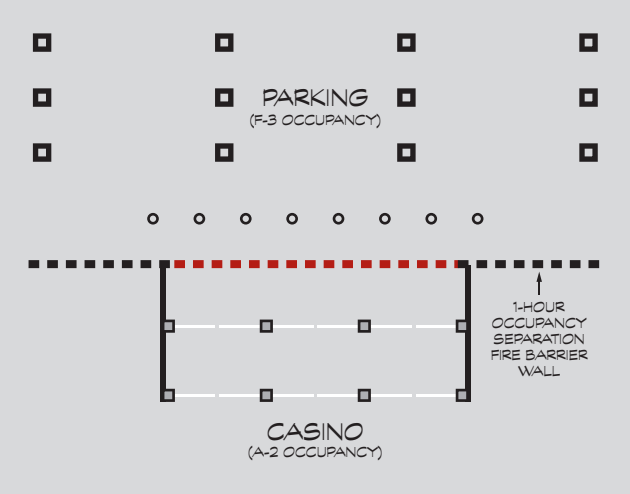


SEPARATION OF USES

CASE 2: 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.



Separation of Suites

Article 3.3.1.1.

A suite is a room or group of rooms which have complementary use and are operated under a single tenancy. A building may include multiple suites even where the building is of a single major occupancy.

Fire and Life Safety Concerns

Generally, each suite must be separated from adjoining suites by a fire rated separation except where special criteria outlined in the Building Code are met. A group of rooms which are operated under a single tenancy invariably include enclosing walls and doors to maintain function, privacy and security. Thus, occupants may not be aware of operations or a fire in an adjoining suite for a period of time and thus, may not be able to evacuate the building in a timely manner relative to the growth of a fire. For this reason, the Building Code may require minimum fire separations between suites to protect occupants in one suite from a fire in an adjoining suite.

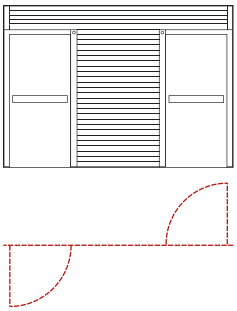
Building Code Requirements

The Building Code addresses minimum fire separation requirements between suites under Article 3.3.1.1. Suites are required to be separated from adjoining suites by a 1-hour fire separation except:

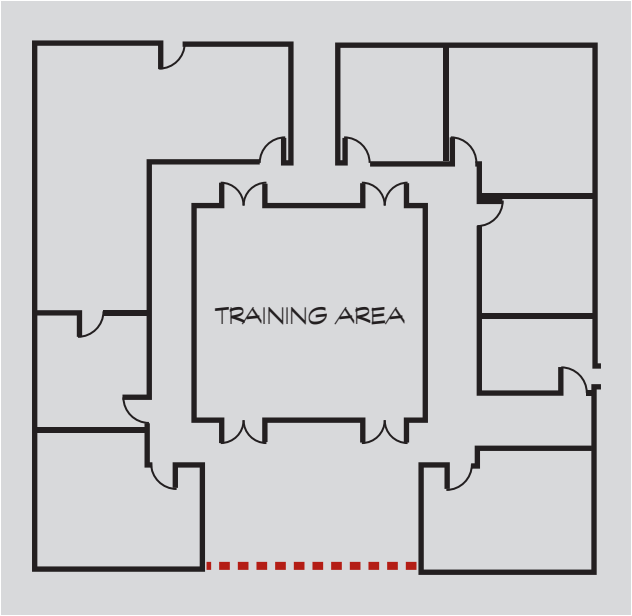
- Between office occupancy suites – no fire separation is required.
- The 1-hour fire separation is permitted to be reduced to 45 minutes where the Building Code permits the fire rating of the floor assembly directly above the suite to be 45 minutes under the construction requirements outlined in Subsection 3.2.2.
- In a sprinklered mall with wide and high public corridors, the suite fire separation may be waived for suites containing any combination of retail, office, or fast food vending uses provided the fast food vending does not include seating area.

Design Solution

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 the training area, an A-2 occupancy, is centered within a D occupancy, non-sprinklered. However, the number of persons in the training area exceeds 30.



Separation of Rooms and Spaces

Section 3.3.

A building is typically divided into multiple rooms and spaces for functional purposes, to separate various uses. Such divisions may be provided even where the building contains a single major occupancy or suite.

Fire and Life Safety Concerns

Rooms within suites or major occupancies may be required to be separated from other spaces in the building by fire separations based on the fire hazards they contain. Rooms such as service rooms contain equipment which could lead to a large fire with rapid production of potentially toxic smoke and fire gases which could quickly affect occupants in another part of the building. For this reason, the Building Code includes specific fire separation requirements for specific room depending its use an equipment contain therein. At other times, the fire separations are to provide protection for occupants in a particular room from other hazards in the remainder of the building or to provide protection for occupants as they travel within the floor plate to an exit.

Building Code Requirements

The Building Code prescribes various fire separations for different rooms and spaces depending on the intended use. The rating of fire separations may depend on whether the room or building is sprinklered.

Using a 3-storey sprinklered school as an example, the building will contain classrooms, laboratories, offices, a gymnasium, a theatre, an auto shop, and an atrium which extends through all 3 storeys. The building is classified as a Group A Division 2 major occupancy based on its use as a school. The laboratories, offices, gymnasium, and theatre will be used as part of the normal operation of the school and as such are considered subsidiary to the Group A Division 2 major occupancy. This would mean that major occupancy fire separations (Table 3.1.3.1.) would not apply. Additionally, as the building does not contain multiple suites (rooms or group of

rooms operated under a difference tenancy than the remainder of the building), suite fire separations per Article 3.3.1.1. would not apply. For this study the theatre is designed as a proscenium theatre with seating for more than 200 and has fly tower, wings, and back stage areas for storing sets and props as well as dressing rooms.

Other fire separations will apply around different rooms and uses as follows:

- The theatre is classified as a Group A, Division 1 occupancy. Although it is not considered a separate major occupancy, the seating area must be separated from adjacent occupancies by a 1h fire rated separation where the occupant load exceeds 200. *(Article 3.3.2.2.)*

Additionally, a 1-hour fire rated separation must be provided between the stage and ancillary spaces such as the dressing rooms, workshops, and storage areas. A 1-hour fire separation may also be required between the stage and ancillary areas and the seating areas unless other provisions outlined under Article 3.3.2.13. are met.

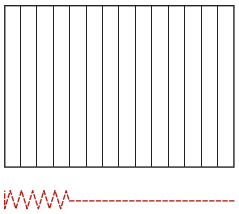
These provisions would not apply at a school theatre designed as a multi-purpose room with an elevated platform (similar to a stage in a gymnasium).

- A 2-hour fire separation is required between the auto shop and remainder of the school. *(Article 3.3.5.5.)*
- Fire separations may be required around laboratories depending on the chemicals and gases stored therein. *(Subsection 3.3.6.)*
- No fire separations would be required around classrooms, offices, and the gymnasium provided travel distance from the most remote location in the floor area to at least one exit does not exceed 45m.
- The 45m travel distance is permitted to be measured from the door of each room (or suite of rooms) along a corridor, to an exit, provided the corridor is separated from the remainder of the building by an unrated fire separation and each room or suite of rooms is separated from the reminder of the building by an unrated fire separation. *(Articles 3.3.1.4. and 3.4.2.4.)*
- Other rooms such as janitor rooms and service rooms must be separated from the remainder of the building by a fire rated separation. *(Article 3.3.1.21. and Subsection 3.6.2.)*

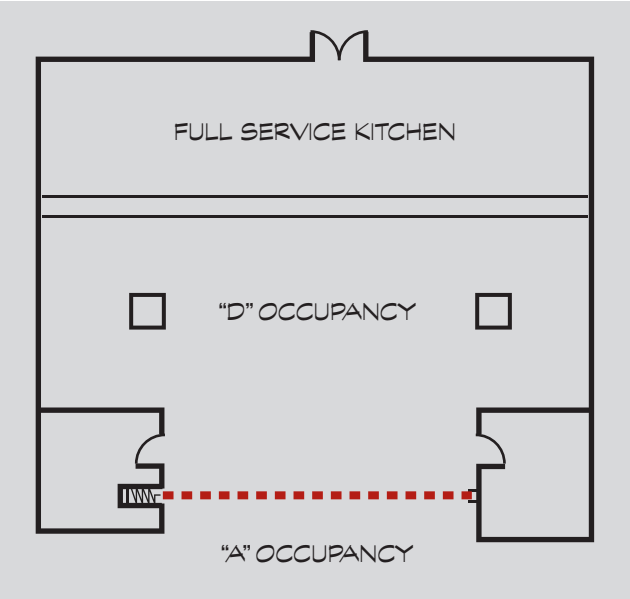
Assuming that the theatre was run as an entity separate from the school with the public attending shows which were not part of the normal functions of the school, then the entire theatre, including all ancillary areas will need to be separated from the school by a 1-hour fire rated separation as this area would be considered to function as a separate suite. Additionally, independent exits must be provided for the theatre or a fire separated public corridor with exits at either end of the corridor must be provided.

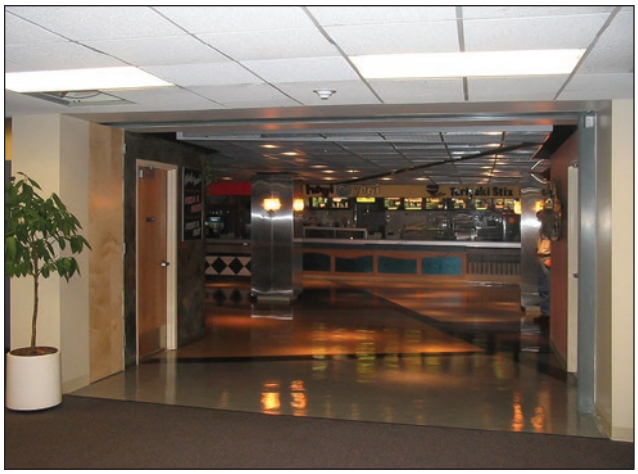
Design Solution

CASE 1: Side Acting Accordion with Power-assisted Egress



This 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 a power-assisted egress feature.





SEPARATION OF USES

Inquiry Discussion and Questions

Fully sprinklered buildings sharing multiple occupancy spaces are often exempt from the requirements of Table 3.1.3.1. However, there are circumstances where separation must be applied with either 1- or 2-hour walls.

The following questions may be helpful:

- In a mixed use structure that includes a theater, have you attempted to design theater space smaller than desired in order to avoid the need for separation?
- In occupancies where laboratories require separation would you like to consider the use of wide-span opening protectives to allow for openness during normal use?
- Where travel distance exceeds 45 meters and requires separation around classrooms, offices and a gymnasium, have you considered wide-span opening protectives within the require separation in order to provide openness?

Notes:

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4 Area Separation

Allowable Building Area

Opening Size Limitations

Allowable Building Area

Subsections 3.1.10. and 3.2.2.

The allowable area of a building is determined largely by four basic factors:

1. **combustibility of the building's structural materials,**
2. **height of the building in terms of number of storeys,**
3. **occupancies contained within the building, and**
4. **whether the building is sprinklered.**

When a building design exceeds the established set of parameters, the intent of the Code is to create another separate building structure to accommodate the increase. Since this is not always desirable and could disrupt the functionality of a building, the code allows interior firewalls to serve as separations such that the building structure on either side of the firewall can be considered a separate building with respect to applying of the established set of parameters which determine building area. In essence, what appears to be a single structure may be comprised of multiple compliant buildings.

Fire Safety Concerns

Building area and height are calculated to accommodate three fundamental principles to provide fire and life safety; namely structural integrity, compartmentation, and fire control. Firstly, the structural elements, whether rated or unrated, are intended to maintain structural integrity during fire to allow occupants to egress and emergency responders to perform their duties without the building collapsing. This means the larger the area and height of a building, the greater the protection required for structural elements. Secondly, additional height and area are allowed when sprinkler systems are used. Such systems are considered active fire suppressions systems and are intended to provide fire control during the initial stages of a fire while evacuation and rescue activities take place. Finally, passive redundant elements are used to compartmentalize the building and provide protection for evacuations and rescue activities. Fire rated structural elements provide structural integrity, sprinklers protect the building contents and provide fire control, and rated construction protect occupants and emergency responders removing them from harm's way. All three principles overlap and work together to provide occupants with sufficient time to safely exit the structure. The reduction or absence of any of these elements from that

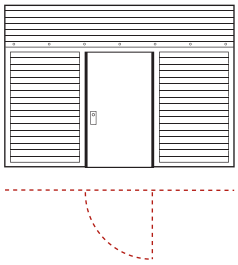
required by the code, can compromise the safety of building occupants and cause property damage.

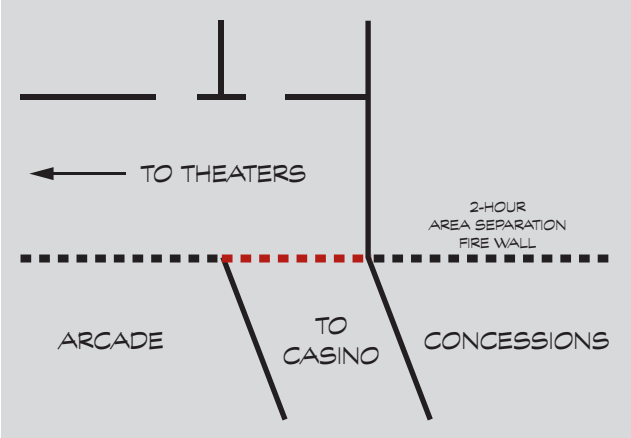
Code Requirements

- The Code at Subsection 3.2.2. outlines the area allowances for specific building types depending on the characteristics of the building which include number of storeys, occupancy, construction type and presence of sprinklers.
- Each portion of a building separated by one or more firewalls can be considered a separation building. *(Subsection 3.1.10.)*

Design Solutions

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

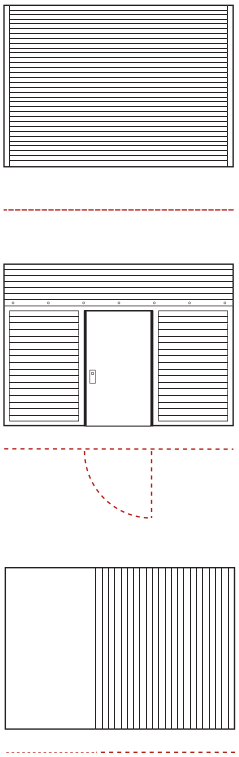


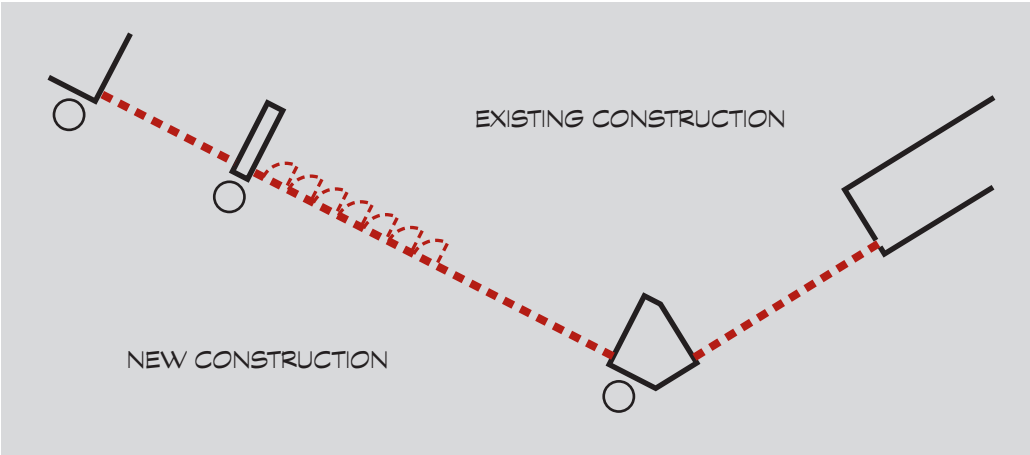


In this application McKEON resolved two significant design code compliance problems without sacrificing wide span open appearance. First, nearly the entire opening was necessary to meet the exit width requirements located in the primary means of egress system in an "A" occupancy. Using the McKEON accordion 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





AREA SEPARATION

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:

Opening Size Limitations

Subsections 3.1.8. and 3.1.10.

Compartmentation in a building is achieved through the use of passive redundant systems - fire rated walls and ceiling/floor assemblies. The rating required for each enclosing passive system is dependent on the use of the subject room or space. Where a rating is required, the wall must pass CAN/ULC S101, *"Standard Methods of Fire Endurance Tests of Building Construction and Materials."* For functional purposes, to move occupants, goods, and services through the building, openings must be created. In order to maintain compartmentation required, the opening protectives used at openings have to maintain the continuity of the fire rated separation.

Less onerous tests and a lesser degree of fire protection is required for opening protectives based in part on the practical difficulty of meeting the requirements for fire separations in a door and in part on the lower likelihood of storage of combustible materials immediately adjacent an opening protective which is typically installed to allow access or for circulation.

Fire and Life Safety Concerns

Because doors and opening protectives in general are permitted to meet less onerous fire tests and requirements than rated passive systems, the size of openings allowed in the rated passive systems is restricted. In particular, this is more so the case with firewalls between buildings as these fire separations are crucial to building area limitations. Opening size limitations are imposed to maintain the integrity of fire separations and compartmentation during fire conditions. The structural integrity of the wall must be maintained regardless of the wall opening size or its protective. It is crucial to remember that the opening protective is not required to conform to the structural integrity provisions required for a wall, ceiling, or floor assembly. The opening protective is protecting the opening – NOT the wall.

Code Requirements

- The test standard opening protectives are required to meet is noted under Article 3.1.8.4. of the Code and varies depending on the type of opening protective.
- The maximum size of an opening in an interior fire rated separation is limited by Article 3.1.8.6. to:

- 11m^2 with no dimension more than 3.7m in an unsprinklered building and
- 22m^2 with no dimension more than 6.0m in a fully sprinklered building.

• In addition to the above noted size limitations, in a firewall the aggregate width of all openings on any one storey is limited to 25% of the entire length of the firewall (Article 3.1.10.5.). Also, Closure size restrictions may apply as per Article 3.1.8.6.

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5 Corridor Separation

Corridor Separation

Corridor Separation

Articles 3.3.1.4., 3.3.1.9., 3.3.2.6. and 3.3.3.3.

A building typically includes several rooms or spaces connected by a common corridor which is part of the means of egress from the building. The Building Code includes fire and life safety provisions for corridors to provide for the safety of occupants during evacuation. The Building Code requirements are applied to both public corridors and corridors used by the public. Public corridors serve multiple suites, typically providing access to at least 2 exits at opposing ends of the corridor. Corridors serving the public occur in a building under the care and control of one group (i.e. school, hospital, convention centre) but also serve multiple rooms and groups of rooms.

Fire and Life Safety Concerns

The corridor system in a building is considered protected space in many instances because multiple rooms and spaces may need to use the corridor to access the building's exits. Depending on the use of the building and the proximity of exits within the floor area, it may need to be separated from the remainder of the building by a fire rated separation. If not fire separated as required, a fire from a single room could contaminate the entire corridor and hinder the evacuation of the occupants from other rooms. The Building Code also limits the length of deadend portions of corridors depending in their location. This is intended to limit the probability that occupants will travel too far down a deadend corridor before realizing that is does not lead to an exit. Such long deadend corridors could potentially increase the total travel distance occupants end up traversing to an exit.

Code Requirements

The following are the Building Code requirements for fire separations at public corridors:

- The basic requirement for a public corridor is that it be separated from the remainder of the storey by a 45-minute fire resistance rated fire separation. The rating of the fire separation may be waived depending on the occupancy classification, presence of sprinkler systems, and use of the corridor for travel distance purposes. Additionally, the fire separation of the public corridor may be waived depending on travel distance.

CORRIDOR SEPARATION

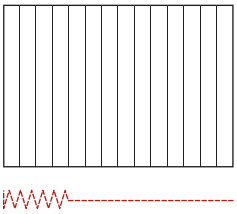
- Openings in the fire separation are to be protected by closures which are positive latching and self-closing with a fire protection rating relative to the rating of the public corridor. The rating of closures in a 45-minute fire resistance rated fire separation may be limited to 20 minutes depending on building height and occupancy.

The following are the Building Code requirements for fire separations at corridors serving the public:

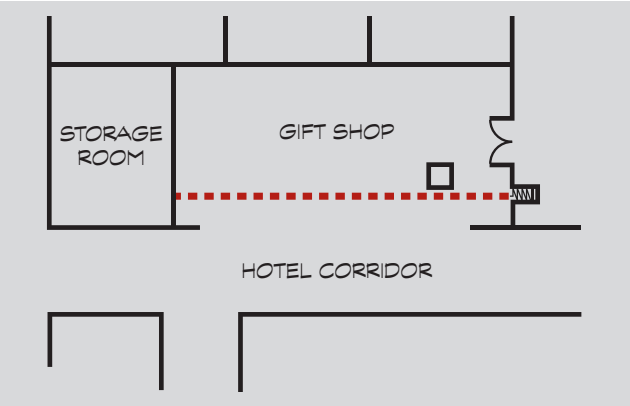
- Generally, corridors serving the public do not require a fire resistance rating with the exception of those used to increase exit travel distance as described in Article 3.4.2.4.
- When Article 3.4.2.4. is applied to a corridor serving the public it must be fire separated from the remainder of the floor area using the same criteria as a public corridor.
- Openings in corridors serving the public fire separations are to be protected by closures which are positive latching and self-closing with a fire protection rating relative to the rating of the corridor. Depending on occupancy and building height, the need for self-closing devices and positive latching may be waived.

Design Solution

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

Inquiry Discussion & Questions

In structures that are considered housing or small buildings, Part 9, Article 9.10.9.15. addresses Separation of Public Corridors. Article 9.10.9.15. (1 through 3) exempts public corridors from being rated in fully sprinklered buildings unless they fall under Residential occupancies. Therefore, in structures such as hotels, college dorms, etc., corridors must be a minimum of 45-minute rated.

The following questions may be helpful in understanding pertinent challenges:

- Do you desire to have a gift shop open to a corridor?
- In other residential occupancies it is often advantageous to have areas open to the corridor but only protected in case of fire. What challenges do you face with your current design?
- May I show you how McKEON can help you eliminate a closed-in appearance at the corridor bordering large display areas, small recreation rooms, etc.?

Notes:

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6 Smoke Compartmentation

Fundamental Guidelines

Sleeping Room Zones

Areas of Refuge

Fundamental Guidelines

A fire typically produces heat, smoke and other toxic gases. The smoke and toxic gases are able to migrate more quickly to different parts of the building than heat and the fire itself. Because of the harmful effects of smoke, even on occupants in a location in the building remote from the fire, designers have to consider not only fire spread but smoke migration as well in their building design.

The Building Code requires fire separations to be continuous and relatively smoke tight around fire separated rooms and spaces. While fire separations may not be completely smoke tight because of leakages around doors and at joints, there is an expectation that a fire separation will retard the passage of smoke to a large extent. For rooms and spaces where it is anticipated that occupants will remain for a period of time during a fire in another part of the building, the Building Code prescribes very strict requirements for limiting the infiltration of smoke across fire separations.

Sleeping Room Zones

Articles 3.3.3.5. and 3.1.8.5.

The compartmentation requirements in these case studies are limited to care and treatment occupancies. The strict requirements for limiting smoke migration is driven by the need to protect non-ambulatory occupants who may need to remain in the building during a fire emergency.

Fire and Life Safety Concerns

In a care or treatment occupancy, staff are directly responsible for the safety of patients and residents in the event of a fire. The expectation during a fire event is that occupants may be moved from a compartment of fire origin to an adjacent fire compartment. Evacuation typically only occurs when adjacent fire compartments are compromised, or the building becomes unsafe. To provide for occupant safety, areas of the building containing sleeping accommodations are required to be divided into smoke tight fire compartments with short travel distances to adjacent compartments and access to protected exits.

Code Requirements

The following are the Building Code requirements for fire separations of compartments in areas containing sleeping accommodations in care and treatment occupancies. These requirements apply to areas containing a series of rooms which share a corridor and common facilities:

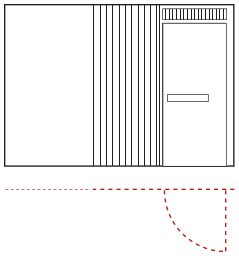
- Floor areas containing sleeping rooms must be divided into a minimum of 2 fire compartments, each not exceeding 1000m^2.
- The travel distance from the most remote point in one fire compartment to a door in an adjoining fire compartment is limited to 45m.
- The floor space in each fire compartment must be able to accommodate its own occupants and all occupants in the largest adjacent compartment at 2.5m^2 per person.
- The compartments must be separated from one another by a 1h fire rated separation. The fire rating is permitted to be reduced to 45 minutes where the floor

assembly is permitted to have a 45-minute fire rating.

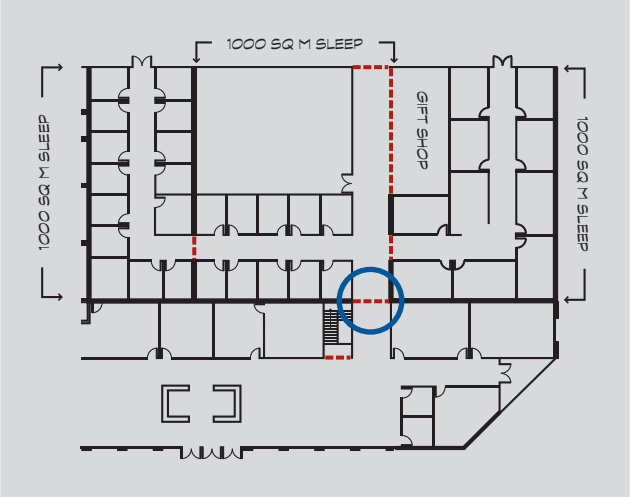
- The fire separation at a horizontal exit is permitted to be the division between the required fire compartments.
- Openings in a sleeping room compartment fire separation must be protected by closures which demonstrate a leakage rate per ANSI/UL-1784, “Air Leakage Tests of Door Assemblies and Other Opening Protectives.”

Design Solution

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 fire separation walls. With the wide-span capabilities of the McKEON door assembly there is no compromise between building functionality and code compliance.



Areas of Refuge

Articles 3.2.8.5., 3.3.1.7., 3.3.3.6. and 3.8.4.8.

For certain types of buildings, fire compartments with enclosing walls which retard the passage of smoke may need to be created to protect occupants who are unable to evacuate the building immediately. Such smoke separated spaces serve as a defend-in-place mechanism and areas of refuge for occupants who may not be able to use the protected exits.

Fire and Life Safety Concern

Areas of refuge may be required in hospitals in areas containing facilities where patients cannot be moved easily during a fire emergency due to their dependence on life saving equipment or where movement of patients is impractical due procedures they may be undergoing. For these types of spaces, a defend-in-plan mechanism is critical to the proper functioning of the facility. Such areas may include operating rooms, recovery rooms, delivery rooms, and intensive care units which must be protected from both fire and smoke. Other types of spaces where areas of refuge may be required include protected floor spaces which are fire separated from the remainder of the floor area and used as a means of egress from interconnected floor spaces, as well as separations created to address protection of occupants with disabilities on floor areas with barrier-free paths of travel.

Code Requirements

The Building Code requirements which relate to the protection of areas of refuge are as follows:

- For interconnected floor spaces, protected floor spaces may need to be created to satisfy the requirements for cumulative exiting (Article 3.2.8.5.). Such protected floor spaces must be separated from the interconnected floor space by a fire separation with the same rating as required for the floor assembly of the space.

Openings between this space and the interconnected floor space must be protected by vestibules designed to retard the passage of smoke.

- To provide protection for occupants who may not be able to evacuate a building via protected exits due to mobility limitations (Articles 3.3.1.7. and 3.8.4.8.), floor areas below or above the accessible storey in an unsprinklered building must be provided with one of the following:

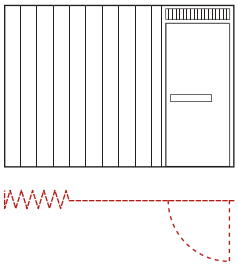
SMOKE COMPARTMENTATION

- Served by an elevator in a hoistway designed to limit the infiltration of smoke.
- Divided into a minimum of 2 zones by rated fire separations with openings protected by closures which demonstrate a leakage rate per ANSI/UL-1784, “Air Leakage Tests of Door Assemblies and Other Opening Protectives.”
- Provided with direct access to balconies, an exterior exit at ground level, or a ramp leading to ground level.

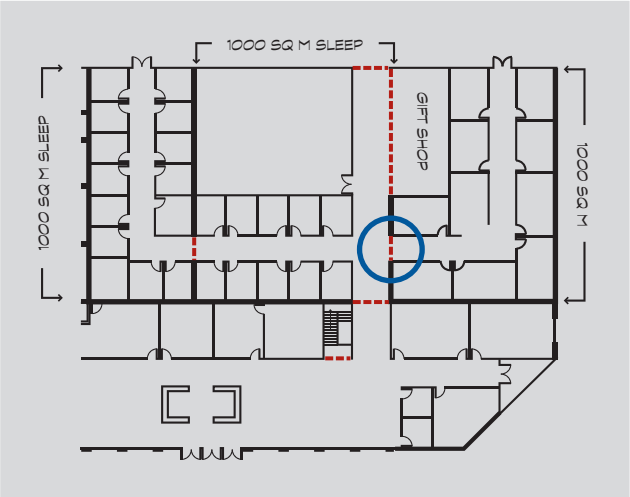
• Compartments which contain rooms such as operating rooms, recovery rooms, delivery rooms, and intensive care units where it is impractical to move patients must be separated by adjacent spaces by 1-hour rated fire separations and designed to limit the infiltration of smoke by mechanical means.

Design Solution

CASE 1: 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.



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Appendix

Definitions

Resources

Firewalls – Subsection 3.1.10.

Definition

Firewall means a type of fire separation of noncombustible construction that subdivides a building or separates adjoining buildings to resist the spread of fire and that has a fire-resistance rating as prescribed in this Code and the structural stability to remain intact under fire conditions for the required fire-rated time. *(Article 1.4.1.2.)*

Fire Ratings: *(Article 3.1.10.2.)*

2-hour

4-hour

Opening Protection: *(Articles 3.1.10.5. and 3.1.8.6.)*

Openings in a firewall shall conform to the size limits described in Article 3.1.8.6. and the aggregate width of openings shall be not more than 25% of the entire length of the firewall. *(Article 3.1.10.5.)*

Maximum Openings

1. The size of an opening in an interior fire separation required to be protected with a closure shall be not more than 11m^2, with no dimension more than 3.7m, if a fire compartment on either side of the fire separation is not sprinklered.
2. The size of an opening in an interior fire separation required to be protected with a closure shall be not more than 22m^2, with no dimension more than 6m, provided the fire compartments on both sides of the fire separation are sprinklered. *(Article 3.1.8.6.)*

Design Notes

A Firewall can be constructed as a single wall component or a double-wall system. Article 3.1.10.1. addresses these two conditions.

Article 3.1.10.1. Prevention of Firewall Collapse

1. Except as permitted by Sentence (2), the connections and supports for structural framing members that are connected to or supported on a firewall and have a fire-resistance rating less than that required for the firewall, shall be designed so that the failure of the framing systems during a fire will not affect the integrity of the firewall during the fire.
2. Sentence (1) does not apply to a firewall consisting of two separate wall assemblies each tied to its respective building frame but not to each other, provided each wall assembly is,

   (a) a fire separation having one-half of the fire-resistance rating required for the firewall by Sentences 3.1.10.2.(1) and (2), and

   (b) designed so that the collapse of one wall assembly will not cause the collapse of the other.
3. A firewall is permitted to be supported on the structural frame of a building of noncombustible construction provided the supporting frame has a fire-resistance rating not less than that required for the firewall.
4. Piping, ducts and totally enclosed noncombustible raceways shall be installed so that their collapse will not cause the collapse of the firewall.

Fire Separation – Subsection 3.1.8.

Definition

Fire separation means a construction assembly that acts as a barrier against the spread of fire. *(Article 1.4.1.2.)*

Fire Ratings: *(Table 3.1.8.4.)*

30-minute

45-minute

1-hour

1.5-hour

2-hour

3-hour

4-hour

Opening Protection: *(Article 3.1.8.6.)*

Maximum Openings

1. The size of an opening in an interior fire separation required to be protected with a closure shall be not more than 11m^2, with no dimension more than 3.7m, if a fire compartment on either side of the fire separation is not sprinklered.
2. The size of an opening in an interior fire separation required to be protected with a closure shall be not more than 22m^2, with no dimension more than 6m, provided the fire compartments on both sides of the fire separation are sprinklered. *(Article 3.1.8.6.)*

Design Notes

It is generally understood that the term "fire" refers to all products of combustion, including heat and smoke. Although a fire separation is not always required to have a fire-resistance rating, it should act as a barrier to the spread of smoke and fire until some type of response is initiated. If the fire-resistance rating of a fire separation is permitted to be waived on the basis of the presence of an automatic sprinkler system, it is nonetheless the intent of the Code that the fire separation be constructed so that it will remain in place and act as a barrier against the spread of smoke until the sprinklers have actuated.

Fire-Resistance Rating

Fire-resistance rating means the time in minutes or hours that a material or assembly of materials will withstand the passage of flame and transmission of heat when exposed to fire under conditions of test and performance criteria, or as determined by extension or interpretation of information derived from that test and performance as prescribed in this Code.

CAN/ULC-S101, "Fire Endurance Tests of Building Construction and Materials"

Fire-Protection Rating

Fire-protection rating means the time in minutes or hours that a closure will withstand the passage of flame when exposed to fire under specified conditions to test and performance criteria, or as otherwise prescribed in this Code.

CAN/ULC-S104, "Fire Tests of Door Assemblies"

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)

Intertek and UL will test fabrics to UL 10D only.

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 Curtain Systems Egress Feature

All SmokeFire® and FireFighter® models that incorporate the egress feature are intended for conditional use in low occupant load applications. The smoke or smoke and fire rated swinging curtain door complies with all exit door requirements in IBC, Chapter 10, Means of Egress, with the exception of the 32/80 rule. In simple terms, a required exit door must open a minimum of 32 inches in width and 80 inches high. Consult the following page for details regarding opening widths and heights.

Code Requirements

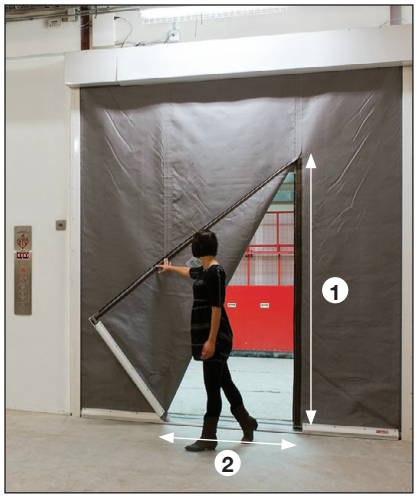
Section 1010.1.2 Door Swing. Egress doors shall be of the pivoted or side-hinged swinging type.

The egress door of both SmokeFighter and FireFighter 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 egress 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 egress feature of both SmokeFighter and FireFighter 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.

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