Fire Inspector

CHAPTER TWO
BUILDING CONSTRUCTION

Part 3

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Welcome to Chapter 2, part 3 Building Construction
In this Part we will discuss:

- Doors and Windows
- Exterior finish
- Construction Assemblies
- Fire Resistive Rating
- Compartmentation
- Fire separation
- Laundry and refuse chutes
- And
- Interstitial spaces

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Where a fire separation, which is a construction assembly built to act as a barrier against the spread of fire, is penetrated by openings, such as for doors and windows, those openings must be protected by assemblies, that meet certain fire-resistive requirements, so that the ability of the fire separation to act as a fire barrier is not compromised. The building code defines these assemblies as closures.

A closure, as defined by the Building Code, is a device or assembly for closing an opening through a fire separation or an exterior wall, such as a door, a shutter, a damper, wired glass or glass block, and includes all components such as hardware, closing devices, frames and anchors.

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Closures typically require a fire-protection rating, that is based on the fire-resistance rating of the fire separation in which it is located. The fire protection rating of a closure is typically permitted to be lower than the fire-resistance rating of the fire separation in which it is located. And whereas a fire-resistance-rated fire separation is required to resist both the passage of flame AND heat for a rated time, a fire-protection-rated closure is only required to withstand the passage of flame. This reduction is based, in part, on the expectation that the storage of combustibles is less likely against a door or window, and therefore, there is less likelihood of combustibles becoming ignited on the opposite side of the closure.

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Every building is equipped with doors and most have windows. Doors provide entry and exit where windows provide light and ventilation. In an emergency both can be used to exit the building where appropriate.

There are many different types of door and windows and the hardware used to operate them.

Doors can be made of wood, metal, or glass.

Doors have four parts. They are the leaves, the hardware, door frame and locking device.

A door leaf is a single, independently moving panel of a door. The single-leaf door is the most common variety of door. It features a single panel that fills an entire doorway space.

Solid core doors are made of solid wood blocks while hollow core doors are lightweight and have a honeycomb interior which is covered with a thin veneer facing.

Solid core doors will withstand fire much better the hollow core which will burn through quickly and allow for greater fire spread.

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A fire door is a door with a fire protection rating designed to meet the fire separation required by the enclosure. The rating of the door assembly which is made up of the leaf, frame, and hardware should be displayed on a tag on the door like the one shown in this photo. In this case the door frame is rated for one and one half hours. A similar label should be displayed on the door itself.

Fire doors are often the weakest part of the fire separation in a building because they are subject to damage from constant use, building settling, and abuse from occupants. In many cases, fire doors are propped open for convenience, which results in voiding the fire separation and in the event of a fire, heat, smoke, and flames can spread unimpeded.

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Doors can be classified by how they open. The five most common ways doors open are inward, outward, sliding, revolving, and overhead.

On inward and outward swinging doors you can easily tell the direction of swing. If you can see the hinges the door swings toward you. If you can't see the hinges the door swings away from you. Outward swinging doors often have exposed hinges which are normally sealed so the hinges can not be removed. This helps prevent unwanted entry.

Most exit doors are required to swing outward.

Sliding doors are common in residential and commercial buildings. In the event of a power failure or emergency, automatic sliding doors that are used as exit doors must also swing on their vertical axis. The must swing in the direction of travel to the exit when pressure is applied, and must be identified as a swinging door by means of a label or sign affixed to it.

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Revolving doors are usually made of glass panels that will collapse when a certain amount of pressure is applied. Revolving doors must have swing type door located adjacent to them and can only be used from the ground floor level.

Overhead doors come in many different sizes and designs from residential to commercial and industrial use. Residential doors can be made of wood or metal and usually have a hollow core filled with insulation or foam.

Industrial or commercial doors are usually made of metal and are heavier to provide for security needs.

NBC Reference 3.4.6.15

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The building code says that fire doors and fire dampers, window assemblies and glass blocks, used in a required fire separation are required to have a fire-protection rating, shall be installed in conformance with the applicable requirements of NFPA 80, “Fire Doors and Other Opening Protectives.”

All fire doors must be kept in the closed position or have an approved device that releases and closes the door automatically in the event of a fire or power failure.

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There are many different types of windows based on their function and design. Common types of windows are:

Double hung windows which have two movable sashes that move up and down.

Single hung windows are similar to double hung except that the upper sash is fixed in place and only the lower sash moves.

A Jalouse window is made of adjustable sections of tempered glass that overlap each other when closed. It is opened by a small hand-wheel or crank located in the corner of the window.

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Horizontal windows are similar to sliding doors with sliding part of the window being able to slide open or closed.
Casement windows have a steel or wood frame and open away using a crank mechanism. Although similar to Jalouse windows, casement windows have a side hinge rather than a top hinge.
Awning windows are also similar to a Jalouse window except that they usually have one large or two medium panes of glass instead of many.
Projected windows, also called factory windows, are usually found in older commercial building. They can project inward or outward on an upper hinge.

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The flammability of building materials, including interior finishes, can greatly affect the speed at which a fire grows.

Any material that forms part of the building interior that is directly exposed is considered interior finish. This includes flooring, walls, ceilings and doors, paint, wallpaper etc. These surfaces contribute to the overall flame spread performance of the interior of the structure.

Carpets that are glued or nailed to an unfinished floor are also considered part of the interior finish while loose rugs are considered building contents.

Foam plastic materials should not be permitted as an interior finish unless they are covered with a protective material such as gypsum wallboard or other acceptable thermal barrier with an acceptable flame spread rating.

There are standards referenced in the building code that apply to flame spread and smoke development ratings for interior finish materials. For example, CAN/CGSB-4.129 applies to most

indoor commercial carpets but does not apply to carpets with attached foam backing. There is no current experience to validate attached foams for commercial use.

References:
NBC D-3.1.1. Interior Finish Materials
CAN/CGSB-4.129-93
Canadian Wood Council Fire Safety Design in Buildings
https://cwc.ca/wp-content/uploads/publications-FireSafetyDesign-s.pdf

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Construction assemblies are an assortment of devices or products, that are linked together to have a specific purpose. An assembly in construction terms can be things like window assembly, a door assembly or basically any combination of materials that, when assembled together will have a specific purpose and function. The term can also be used to show a wall, ceiling, or floor assembly that may consist of various products.

All construction assemblies have some inherent fire resistance. Fire-rated assemblies, however, are components designed to resist and confine a fire, that have been tested under specific procedures established for hourly fire ratings.

Reference
BCBC 1.4.1.2 Division A Defined terms
https://www.builder-questions.com/construction-glossary/assembly/

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In Canadian building codes “fire-resistance rating” is defined in part as: *“the time in minutes or hours that a material or assembly of materials will withstand the passage of flame and the transmission of heat when exposed to fire under specified conditions of test and performance criteria…”*

The test and acceptance criteria referred to in the building code are contained in a standard fire test method, CAN/ULC-S101, published by Underwriters Laboratories of Canada (ULC) .
ULC Standards is an independent, not-for-profit standards development organization that publishes and maintains close to 300 Canadian safety standards and other related documents.

This photo shows a Time/Temperature Curve used for testing the fire resistance rating of passive fire protection systems in North America.

Reference
BCBC 1.4.1.2 Division A Defined terms
https://www.builder-questions.com/construction-glossary/assembly/
ULC https://canada.ul.com/aboutus/

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Partitions or interior walls required to have a fire-resistance rating must be rated equally from each side, since a fire could develop on either side of the fire separation. The fire-resistance rating of the assembly is determined based on testing from the weakest side. Most wood-stud wall assemblies are tested and listed as loadbearing which allows them to be used in both loadbearing and non-loadbearing applications.

Floors, ceilings, and roofs are tested for fire exposure from the underside only, because a fire in the compartment below presents the most severe threat. For this reason, the fire-resistance rating is required from the underside of the assembly only.

Exterior walls only require rating for fire exposure from within a building. This is because fire exposure from the exterior of a building is not likely to be as severe as that from a fire in an interior room or compartment.

Part 9 of the building code lists hundreds of different wall and floor assemblies with assigned fire-resistance ratings and sound transmission ratings.

Reference:
BCBC Part 9 Table 9.10.3.1.A Fire and sound resistance of walls
Canadian Wood Council (CWC) https://cwc.ca/why-build-with-wood/safe/fire-safety/flame-spread/

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When required by the building code, properly designed and constructed buildings will have fire compartments which contain a fire and restrict its spread.

Vertical fire separations between suites or compartments contain a fire from spreading between units horizontally.

Horizontal fire separations, without breaches, restrict the spread of smoke, heat, and flames from spreading vertically.

Fire separations need to be inspected to see if they will be effective in restricting fire development as intended.

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Fire Partitions or Fire Separations as they are more commonly called in Canada are interior walls, floors or ceilings that divide the floor area into fire compartments.

Fire separations along with early fire detection and adequate exiting are the three most important aspects of a fire safe building. Fire separations are structural elements made in accordance to building code requirements that prevent the spread of fire for a given period of time. Fire separations are provided in buildings to limit the spread of fire and the premature collapse of the building under fire conditions.

Rooms, areas and suites in buildings are usually separated into fire compartments. These compartments contain the fire and reduce fire spread allowing people to escape. They also contain the fire until the fire department arrives and extinguishes the fire.

Think of a fire compartment like a box. Most multi-tenant buildings have many fire compartments (boxes), which are situated side by side and on top of each other. Generally, each fire compartment has walls, a floor and a ceiling. The walls are fire separations that limit the spread of fire horizontally from one fire compartment to an adjoining fire compartment. The top and bottom of each fire compartment are floor ceiling assemblies that separate one storey from another. The floor and ceiling assemblies limit the spread of fire vertically from one fire compartment or from

one floor in the building to another.

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Fire separations are intended to contain the fire in the room where it started. If they work effectively, they will extend the time people have to safely evacuate the building. When fire separations contain the fire, they reduce the amount of fire loss to the structure making it easier to repair and put back in use. Fire separations also make it safer for firefighters as they act as a barrier to fire travel.

Fire separations are designed and installed in the construction phase to divide a building into compartments that will inhibit the spread of fire. They are part of the building design and construction but must be maintained after the building is occupied to work effectively.

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This photo shows a building with commercial businesses on the ground floor and residential suites on the second and third floors. Each floor must be fire separated from the other floors to inhibit the spread of fire. This is accomplished by enclosed stairways and all openings are protected with approved closures. Each suite must also be fire separated from the other suites so that a fire starting in one suite is contained within the suite of origin to allow time for the fire to be detected and the alarm to activate.

A suite is any room or group of rooms operated by a single tenant. It is not necessarily a distinct real estate entity. “Suite” is a general classification that can be a single dwelling unit in an apartment or condominium building, a store in a plaza or an office in a multi- use building operated by a single tenant.

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In residential occupancies like an apartment building each individual suite must be fire separated from other suites and the exit corridor. This is usually accomplished by continuous layers of drywall and suite doors that automatically close and positively latch after each use. In the event of a fire in a residential suite the occupant may be alerted by a smoke alarm in the suite, but that device is a local alarm only and does not activate the building’s fire alarm system. In the haste to get out occupants often forget to close the suite door so smoke, hot gases and flames can enter the exit corridor. When other occupants are alerted to the fire by the fire alarm system the exit corridor may already be untenable. If the suite door is equipped with a self-closing device the smoke and hot gases are confined to the room of origin.

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Suites in commercial buildings must also be fire separated from other suites. This is usually accomplished by a continuous layer of drywall and suite doors that automatically close and positively latch after each use. In most cases even suites used for the same purpose must be fire separated from each other. For example, if there are two small retail shops operating independently in the building, each shop must be fire separated from the other. An exception to this is that most building and fire codes do not require Business and Personal Service occupancies such as a doctor’s office and a lawyer’s office to be fire separated from each other.

In cases where the building is fully sprinklered the fire separation may not be required but to confirm this the fire inspector should consult the approved drawings, research the building code, or consult a building inspector or design professional.

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Fire separation is also required between suites and convenience corridors. In this case the convenience corridor is not accessible to the public and not part of the required exits from the building but is there for the convenience of the tenants. There should be no storage allowed in the convenience corridor and the fire separation must be maintained.

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The growth and spread of fire can be controlled by the amount of air available for combustion. In this video you will see the firefighter controls the growth of the fire by simply closing the door. Fire separation doors are critical in controlling fire development and providing safe exit routes.

Just imagine how effective this is in a building fire if the fire separation doors remain closed and latched. The fire will be contained and relatively easy for the fire department to extinguish as long as it does not enter concealed spaces. Watch how quickly the fire grows when the door is open and how it reduces when the door is closed over.

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Convenience openings are allowed in fire separations for the movement of people and things, but they must be protected by closures.

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A fire damper is a closure installed in an air distribution system, wall, or floor assembly that is normally held in the open position. They are designed to close automatically in the event of a fire to maintain the integrity of the fire separation. Fire dampers are equipped with a fusible link that melts at a given temperature which automatically closes the damper.

This photo is a grill that has been installed in a fire separation. The problem is that it is not a fire damper and does have a fusible link or close in the event of a fire.

The operation of a proper fire damper can be seen in the following video courtesy of Kimpton Energy Solutions.

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Video

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Many residential and institutional buildings are equipped with refuse or laundry chutes for the convenience of the occupants.

There are four basic parts to such chutes: The outlet is where the chute empties into a laundry or garbage room, the doors where occupants access the chute at each floor level, the roof termination where a sprinkler head must be located, and the walls of the chute which must be fire rated to contain a fire.

The building code strictly regulates the use of laundry chutes.

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The bottom of the chute is normally equipped with a discharge door protected by a fusible link that will melt in case of a fire in the discharge room. Once the link melts the door must automatically close to seal off the chute. This is a simple mechanism but vital to the safety of the building. Normally, the discharge door is kept in the open position so trash will not accumulate in the shaft causing a fire hazard.

On each floor level there are access points with doors that are required to be self-closing and positive latching. The doors should be approved by a recognized testing agency and display a listing agency label. If these doors are working properly, they will prevent the spread of fire and smoke into the floor area. The access doors should only open 65 degrees so that a small child would not be able to crawl into and fall down the chute. The opening should only allow for a 'normal' bag of household garbage to fit through the door.

The top of the chute is the section that actually exits the building through the roof. Some codes require that the chute is fitted with a vent cap and that the cap be at least 48 inches above the roof. This allows air to pass across the top of the vent. Without this, fumes and gases can build up in the chute. A sprinkler head is required at the top of the chute.

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Refuse and laundry chutes must be properly fire separated or they may create a chimney that can aid in the rapid spread of fire vertically throughout the building.

The chute walls should be constructed as a fire separation to slow the spread of fire and allow the building to be safely evacuated.

Chute access doors must be in a room that is fire separated from the rest of the floor area. The door to that room should be equipped with a self-closing device and cannot open directly into an exit.

Chute access doors should not be available directly from the corridor.

Building and fire codes require the discharge room to be fire separated from the remainder of the building. They also require automatic sprinklers to be installed in each linen or refuse chute at the top, at alternate floor levels, and in the room or bin into which the chute discharges.

References:
NFC 2.4.1.2 Storage Rooms for Combustible Waste Materials
NBC 3.6.3.3 Linen and Refuse Chutes

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An interstitial space is an intermediate space located between regular-use floors, commonly located in hospitals and laboratory-type buildings to allow space for the mechanical systems of the building. By providing this space, rooms may be easily rearranged throughout their lifecycles and therefore reduce alteration cost.

Interstitial and concealed spaces can provide a mechanism for fire spread.

Generally, interstitial spaces lack fire stops, which may allow for fire spread.

Modern building codes sometimes allow concealed spaces if they are constructed with non-combustible material. These “rated” concealed spaces are not designed for occupancy and may become a code-enforcement problem and fire-spread problem if they are used for the general storage of combustible items.

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This drawing is an example of how fire separations that were installed correctly will prevent the spread of fire. In this example, a vertical fire separation is installed through the suspended or T-Bar ceiling and concealed space to connect with the horizontal fire separation above.

By contrast, this drawing shows an unacceptable installation of a vertical fire separation which does not extend through the T-bar ceiling. Because the vertical fire separation does not connect to the horizontal fire separation above, a fire would be free to spread through the concealed space above the T-Bar uninhibited.

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In this part we discussed:

- many different types of door and windows and the hardware used to operate them
- four parts of door assemblies including leaves, hardware, door frame and locking device.
- that solid core doors will withstand fire much better the hollow core
- the five most common ways doors open are inward, outward, sliding, revolving, and overhead.
- that revolving doors must have swing type door located adjacent to them
- that all fire doors must be kept in the closed position or have an approved device that releases and closes the door automatically in the event of a fire or power failure.
- Common types of windows are double hung, single hung, Jalouse, casement, awning, and projected
- And
- interior finish includes flooring, walls, ceilings and doors, paint, wallpaper etc.

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We also talked about:

- Construction assemblies being an assortment of devices or products, that are linked together to have a specific purpose.
- Fire-rated construction assemblies are components designed to resist and confine a fire, that have been tested under specific procedures established for hourly fire ratings.
- The standard fire test method conforms to a ULC standard.
- Partitions or interior walls required to have a fire-resistance rating must be rated equally from each side
- Floors, ceilings, ad roofs only require a fire-resistance rating from the underside.
- Exterior walls only require rating for fire exposure from within a building.

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- Vertical fire separations between suites or compartments contain a fire from spreading between units horizontally.
- Horizontal fire separations restrict the spread of smoke, heat, and flames from spreading vertically.
- Fire Separations are interior walls, floors, or ceilings that divide the floor area into fire

compartments.
- Fire separations, early detection, and adequate exiting are the three most import aspects of a fire safe building.
- Suites in residential and commercial buildings must be fire separated from other suites and exits.
- Closure means a device or assembly for closing an opening through a fire separation
- A fire damper is a closure installed in an air distribution system, wall or floor assembly

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We also talked about
- The four basic parts to refuse and laundry chutes being: 1.the outlet, 2. doors where occupants access the chute, 3. the roof termination where a sprinkler head must be located, and 4. the walls of the chute which must be fire rated to contain a fire.
- Chute access doors must be in a room that is fire separated from the rest of the floor area.
- Each floor level access door is required to listed, self-closing, and positive latching.
- Discharge room must be fire separated from the remainder of the building
- Fusible links on the chute discharge door

And we finished part 3 discussing concealed and interstitial spaces that provide a mechanism for fire spread.