

CALCULATING OCCUPANT LOADS IN ASSEMBLY OCCUPANCIES

The method of calculating occupant loads can vary greatly between jurisdictions and even between published Codes. This variance often leads to widely differing occupant load figures being assigned to the same type and size of building or premises in different municipalities.

This Bulletin is intended to clarify the requirements of Alberta Building Code (ABC) and the Alberta Fire Code (AFC) for calculating occupant loads in assembly buildings or floor spaces. By recommending a method of calculation it is the intent of this Bulletin to make the application of both Codes more consistent and uniform throughout the Province. This Bulletin will discuss:

- I. **Purpose** of occupant load calculations
- II. **Determining** occupant loads, and
- III. **Posting** of occupant loads.

I. The Purpose of Occupant Load Calculations

Occupant load calculations are made under both the ABC and AFC for two different purposes.

(1) Occupant Loads During the Design Phase: Alberta Building Code

The ABC defines 'occupant load' as meaning the number of people for which a building or part thereof is designed. When an occupant load is determined for the purposes of design it is referred to in this Bulletin as the *design occupant load*.

The *design occupant load* allows the designer to calculate the approximate number of persons anticipated to use a building or space and to determine Code requirements that may be applicable, such as:

- (a) the minimum number and width of exit and access to exit facilities
- (b) the number of sanitary fixtures required
- (c) if a fire alarm system is required
- (d) if emergency lighting is required
- (e) if exit signs are required
- (f) if additional requirements apply for high buildings
- (g) the type of hardware required on exit and access to exit doors
- (h) the required direction of door swing.

The calculation of a *design occupant load* using Table 3.1.17.1.* of the ABC is not intended to limit the number of people who can safely occupy a room or building based on an area allotment per person only.

*** Note: All Code references are to Division B of the ABC and AFC.**

(2) Occupant Loads for the Operation of a Building: Alberta Fire Code

The AFC has a different definition for occupant load and means the maximum number of persons that may occupy a building or an area of a building at one time. When an occupant load is determined for the purposes of applying the AFC it is referred to in this Bulletin as the *operational occupant load*.

The calculation of an *operational occupant load* for AFC purposes is to determine the maximum permissible occupant load that the fire authority having jurisdiction considers may safely occupy a space. There are three factors that influence how the *operational occupant load* is determined:

- (a) a specified amount of area per person, (this also includes a specific number of people that the building was designed for),
- (b) the capacity of the means of egress, or
- (c) the occupant load as calculated and posted in accordance with the ABC.

The lowest figure (fewest people) calculated by (a), (b) or (c) is used to establish the maximum permissible occupant load (*operational occupant load*).

II. Determining Occupant Loads

Table 3.1.17.1. of the ABC is referred to for calculating both the *design occupant load* under the ABC and the *operational occupant load* under the AFC. However, the purpose of calculating the *design occupant load* differs from the purpose for calculating the *operational occupant load*.

(1) Calculating the Design Occupant Load

In the design stage of a building, Table 3.1.17.1., is used to plan out the area needed to accommodate an expected number of people. A designer wanting to build a restaurant that holds 175 persons would use the coefficient of 1.2 m²/person to estimate approximately the size of floor space that would be needed. In this case, approximately 210 m² would form the base of the design. The Table coefficients are not used to establish the maximum number of persons that will occupy the floor space. In applying Article 3.1.17.1., the designer must consider the use and function of a space or floor area and from there apply the appropriate Table coefficients. The Article also addresses the purpose of a *design occupant load* in that it can either exceed or be less than the values obtained from the Table. This gives the designer latitude in determining what other building features are needed to satisfy other requirements of the Code. It also gives the designer the ability to post the building *design occupant load* to inform any users that there may be special conditions that apply to the overall Code compliance of the facility.

3.1.17.1. Occupant Load Determination

- 1) The occupant load of a floor area or part of a floor area shall be based on
 - a) the number of seats in an assembly occupancy having fixed seats,
 - b) 2 persons per sleeping room in a dwelling unit, or
 - c) the number of persons for which the area is designed, but not less than that determined from Table 3.1.17.1. for occupancies other than those described in Clauses (a) and (b), unless it can be shown that the area will be occupied by fewer persons.

- 2) If a floor area or part thereof has been designed for an occupant load other than that determined from Table 3.1.17.1. a permanent sign indicating that occupant load shall be posted in a conspicuous location.
- 3) For the purposes of this Article, mezzanines, tiers and balconies shall be regarded as part of the floor area.
- 4) If a room or group of rooms is intended for different occupancies at different times, the value to be used from Table 3.1.17.1. shall be the value which gives the greatest number of persons for the occupancies concerned.

In using Table 3.1.17.1. the designer can perform the calculation and exempt certain parts of floor areas where occupancy is not expected:

Rooms and Spaces Not to be Included in Design Calculations

- i) Service spaces that are provided to facilitate or conceal the installation of building services, such as chutes, ducts, pipes, vertical service shafts and other shafts.
- ii) Service rooms such as boiler, furnace, incinerator, garbage, elevator machinery, electrical and compressor rooms and storage rooms.
- iii) Exit corridors would not normally be considered in the calculation of the *design occupant load*. However, where a corridor contains an occupancy, that occupancy must be included in the calculation.
- iv) Stairways including landings on stairways.
- v) Kitchens and coat check rooms.

Mezzanines

A mezzanine is treated as part of the main floor area if any of the exiting from the mezzanine directs persons down and through the main floor level. In this case, the occupant load calculated for a mezzanine is included as part of the main floor area. The main floor exit capacity must support both loads. For example, a mezzanine is calculated to hold 50 persons and the main floor level has an exit capacity for 500 persons. The maximum occupant load for the building is 500. By deduction, the main floor can safely only hold 450 persons and must facilitate the 50 persons on the mezzanine as if they were on the main floor level. If the exiting from the main floor will not support the combined loads, then the authority having jurisdiction, in consultation with the owner, will determine where the occupant load will be reduced, either on the mezzanine or the main floor and will post the reduced load.

A mezzanine that has separate exiting from it should be considered as a separate floor area. The exiting must handle the full mezzanine occupant load.

In either case, the main floor and the mezzanine must have a separate maximum permissible occupant load posted on each level.

Multi use Spaces

A building or part of a floor area may have two or more uses. It is necessary to determine the correct *design occupant load* for each use situation. Please note that this is a *design occupant load* calculation for buildings that are intended to have more than one use. Instances where an *operational occupant load* is required for unique or infrequent changes in occupancy use are discussed under calculation of the *operational occupant load*.

Special Circumstances

There are activities and uses that are not covered in Table 3.1.17.1. Combining the good judgement of the owner/designer and the authority having jurisdiction is the best way to determine *design occupant loads* in these types of situations.

(2) Calculating the Operational Occupant Load

The AFC requires us to consider the following when determining the *operational occupant load*.

(a) Operational occupant loads derived from Table 3.1.17.1.

Not all figures in Table 3.1.17.1. are appropriate to calculate an *operational occupant load* for an assembly space.

The categories and numbers from the ABC table are intentionally being used for a different purpose under the AFC. The AFC applies the m² per person factor to situations where rooms and spaces are being occupied and that may contain a variety of furniture and fixtures that can compromise the safety requirements for the overall egress system. Therefore the number of persons that a building is designed for may be substantially different than what the maximum permissible occupant load is calculated for.

Rooms and Spaces Included in Gross Area Calculation

The AFC directs individuals to use Table 3.1.17.1. of the ABC for the calculation of the maximum permissible occupant load of a room and then applies a factor to take into consideration the overall general intended functions for the floor space use.

FIRST: Determine the gross area available for assembly use within the occupancy. This will include: the floor area to be occupied, interior line up areas, seating areas, stand up areas, stage areas, dance floor areas, and areas for service staff behind bar counters.

Rooms and Spaces Not to be Included in Operational Calculations

- i) Service spaces that are provided to facilitate or conceal the installation of building services, such as chutes, ducts, pipes, vertical service shafts and other shafts.
- ii) Service rooms such as boiler, furnace, incinerator, garbage, elevator machinery, electrical and compressor rooms and storage rooms.

- iii) Exit corridors would not normally be considered in the calculation of the *operational occupant load*. However, where a corridor contains an occupancy, that occupancy must be included in the calculation.
- iv) Stairways including landings on stairways.
- v) Kitchens, washrooms, and coat check rooms.

SECOND: Determine the net floor area by deducting all substantial architectural, decor and service items within the occupied space. Deduct pillars and planters, bar counters, free standing coolers and ice machines, pool tables, games tables, VLT's, and video games. The deduction of these or other areas that will not be occupied by a person from the gross area will result in the "net useable floor space."

Once the net useable floor space is determined then a decision as to what factor number from the following Table is to be selected for the typical floor use. For example any licensed premises such as a restaurant, nightclub, lounge, pub or bar would have the floor space factor of 1.2 m² per person applied throughout the entire "net useable floor space area".

(b) Table 3.1.17.1., of the ABC

The following have been extracted from the Table in the ABC and expanded to provide clarification and examples to enable a more uniform method of determining *operational occupant loads*.

| Type of use of Floor Area or Part Thereof | Area per person m ² |
|---|---|
| ASSEMBLY USES | |
| <p>space with fixed seats Fixed seating includes any seating which is permanently secured to the floor and is not intended for rearrangement. This category would be used when calculating an <i>operational occupant load</i> for buildings such as movie houses, live entertainment theatres, sports arenas (when used for viewing sporting events), auction houses, lecture theatres, etc.</p> | <p>See Clause 3.1.17.1.(1)(a) of the ABC</p> |
| <p>space with non-fixed seats Non-fixed seating refers to those seats which are not permanently attached to the floor and are intended to be re-arranged, and the use of other furniture is limited. Examples of functions where non-fixed seating is generally used include, school concerts, public information meetings, etc. This category is not to be used for licensed premises.</p> | <p>0.75 See Article 2.7.1.5. of the AFC for seating and aisle arrangements</p> |

| | |
|---|--|
| <p>space with non-fixed seats and tables This category is intended to include those areas used for assembly purposes where the function includes the use of seats and tables but neither are secured to the floor and are intended to be re-arranged from time to time. Examples of buildings where the figure for this type of category would be appropriate include bingo halls and meeting rooms. These occupancies may include incidental service of food and beverages. This category is not to be used for licensed premises.</p> | <p style="text-align: center;">0.95</p> <p style="text-align: center;">See Sentence 2.7.1.5.(4) of the AFC for seating, table, and aisle arrangements</p> |
| <p>dining, beverage and cafeteria space</p> <p>Licensed Premises When the <i>operational occupant load</i> of licensed premises is being calculated all spaces are to be included except service areas such as washrooms, mechanical rooms, kitchens, coat checks, separated storage rooms, exit stairways or exit corridors. All other areas, including interior line up areas, seating areas, stand up areas, stage areas, dance floor areas, and areas for service staff behind bar counters, are to be included in the calculation.</p> <p>After the above area has been determined, the area of all substantial architectural, decor and service items within the occupancy will be deducted. These will include pillars and planters, bar counters, free standing coolers and ice machines, pool tables, games tables, VLT's, and video games. The deduction of these or other areas that will not be occupied by a person from the above area will result in the "net useable floor space" figure.</p> <p>When an <i>operational occupant load</i> is being determined for a licensed premises and the premises is intended to allow for more than one function such as dance floors, stand-up bars, seating areas, games areas, etc., the ratio of 1.20 m² per person throughout the "net usable floor space" is considered appropriate.</p> <p>The required aisles and exits may be affected by the style and size of tables, chairs or furnishings within assembly occupancies. This may in turn dictate the need for adjustments to the calculated occupant load. The AHJ may require a scaled drawing of the room or area and its furnishings and may adjust the maximum occupant load to meet life safety requirements.</p> | <p style="text-align: center;">1.20</p> |

(3) Calculation of Exit and Access to Exit Capacity

(a) The AFC also uses the exits and access to exits to determine the allowable occupant load.

(b) Means of egress is defined by the AFC and the ABC as being a continuous path of travel provided for the escape of persons from any point in a building or contained open space to a separate building, an open public thoroughfare, or an exterior open space protected from fire exposure from the building and having access to an open public thoroughfare. Means of egress includes exits and access to exits.

(c) The AFC refers to the ABC method of calculating the capacity of access to exits and exits. The ABC assigns a ratio expressed in mm per person to determine the capacity of an exit or an access to exit. This ratio varies in accordance with the type of exit facility and with the type of building it is located in.

The capacity of an exit or an access to exit in a Group A occupancy may be calculated by dividing the width of:

- (i) Ramps with a gradient of not more than 1 in 8, doorways, corridors, or passageways by 6.1 mm per person, or
- (ii) 8 mm per person for a stair consisting of steps whose rise is not more than 180 mm and whose run is not less than 280 mm, and
- (ii) For ramps with a gradient of 1 in 8 or more, and for stairs by 9.2 mm per person.

(d) In a Group A Division 4 by dividing aisles, stairs other than exit stairs, ramps, and passageways in vomitories by 1.8 mm per person and by 2.4 mm per person in exit stairs.

(e) There are minimum widths that must be considered as well. The minimum widths are:

- (i) 1100 mm for
 - (A) corridors and passageways, and
 - (B) stairs and ramps that serve more than 3 storeys above grade or more than 1 storey below grade,
- (ii) 900 mm for stairs and ramps that serve not more than 3 storeys above grade or more than 1 storey below grade,

III. Posting of Occupant Loads

(1) Alberta Building Code

Sentence 3.1.17.1.(2) of the ABC states that where the occupant load of a room or floor area is designed for an occupant load other than that determined from Table 3.1.17.1. then the room or floor area must be posted with a permanent sign indicating the occupant load for which the room or floor area was designed. The sign with the *design occupant load* must be posted at or near the principle entrance to the room or floor area.

(2) Alberta Fire Code

Article 2.7.1.4. of the AFC requires that those areas in a building that are classified as assembly occupancies and have a maximum occupant load exceeding 60 people are to show the maximum occupant load on an acceptable sign in a conspicuous location near the principle entrance.

Where an owner has been required to provide a sign under Sentence 3.1.17.1.(2) of the ABC the occupant load number on the fire authority's sign should be the same. There may be extenuating reasons for having different numbers and each case must be evaluated on its own merits. An example for having the same number posted applies to assembly buildings that may contain a very large number of persons but the design number restricts the maximum occupant load to 300 because the building does not have a fire alarm system. It would not be appropriate for the fire authority to use a higher number because of the missing life safety system.

The fire authority can accept an owner's commitment to an occupant load that is less than what is provided for in Table 3.1.17.1. In both cases an infraction would occur should the posted occupant load be exceeded.

AISLES SPACES

The Fire Code requires that an aisle space leading to an egress doorway be provided in every open floor area:

AFC 2.7.1.2.(1) Aisle in conformance with Sentences (2) to (4) shall be provided in every floor area that

- (a) is not subdivided into rooms or suites served by corridors giving access to exits, and
- (b) is required by the Building Code to have more than one egress doorway.

AFC 2.7.1.2.(2) Every required egress doorway shall be served by an aisle that

- (a) has a clear width of not less than 1 100 mm,
- (b) has access to at least one additional egress doorway, and
- (c) at every point on the aisle, provides a choice of 2 opposite directions by which to reach an egress doorway.

Every open floor area in an assembly occupancy must include within the occupant load calculation, the area required for a clear aisle space leading to the required means of egress.

This calculation is required whether the assembly floor area contains standing room, tables and chairs, non-fixed chairs or for a dining and beverage use.

Aisle spacing in assembly occupancies such as bars, taverns, beer gardens etc., is difficult to maintain due to patron movement. This is the reason why AFC Sentence 2.7.1.3.(3) and NFPA 101[®] Life Safety Code^{®1} promotes the use of specific site drawings for each and every layout or event that can take place in the building or floor area.

Establishing adequate aisle space is a critical component in determining the maximum permissible occupant load of a floor space. Aisle space is determined on site after all of the furniture and fixtures are in place. Aisle space must manage the capacity of persons entering the aisle to access the exit and needs to be determined in any situation where fixed seating, non-fixed seating and tables and chairs are part of the floor area use.

SPECIAL CONDITIONS:

PATIOS – DECKS – ROOFTOPS & BEER GARDENS

The occupant load of a building may be affected when licensed establishments incorporate exterior facilities such as a patio, deck, rooftop or beer garden for patron use. Exterior facilities usually have fences or similar barriers placed around the perimeter to restrict patron access and egress. Some establishments can more than double the capacity of the original building on either a permanent or temporary basis.

¹ (1) NFPA 101[®] and Life Safety Code[®] are registered trademarks of the National Fire Protection Association, Inc., Quincy, MA 02169-7471

The issue now becomes how do exterior facilities get approved?

An exterior facility is not specifically addressed in the ABC. Therefore, it becomes a “use” issue and is regulated by the fire authority. In these cases, the patio, deck or rooftop can have an impact on the means of egress and life safety of occupants in the main building. In no case should the required exits from the main building empty into an enclosed patio or contained exterior space.

In inclement weather, occupants from the outside would move into the building. Is there adequate exit capacity for the combined occupant load?

If the answer is yes, then the exterior occupant load has no impact on exit capacity requirements. If the answer is no, then the owner must decide whether to limit the number of patrons on the exterior, or provide additional exits to achieve the required exit capacity. Exterior facilities with separate gates or exits may also pose the same exit capacity concerns.

Therefore:

1. Where exterior facilities are enclosed requiring exiting through the building the egress system and exit capacity must provide for the additional persons using the exterior enclosures.
2. Where exterior facilities are not enclosed and the building and the exterior facility are separate the capacity of the exterior facility should be determined by using the *operational occupant load* calculation.
3. Where exterior facilities have a fenced enclosure with access gates:
 - a. The capacity of the exterior facility is determined by the *operational occupant load* calculation, and
 - b. The exit capacity of the gate openings.

SPECIAL EVENT OR TEMPORARY OCCUPANT LOADS

Alberta Gaming and Liquor Commission process requests for liquor permits at various venues. The terms “temporary” or “special event” are interchangeable for the authority having jurisdiction in that the intent is to establish an occupant load use of a space for a duration other than a permanent licensed beverage establishment. Examples of temporary or special event functions are beer gardens at rodeos, exhibitions, air shows, concerts in arenas, etc. The authority having jurisdiction can use any term necessary to address these special conditions. The common factor is the event has a limited start and end date.

AUTHORITY HAVING JURISDICTION

There can be numerous circumstances that would require the authority having jurisdiction to consider adjusting a calculated maximum permissible occupant load. Each case should be reviewed independently through a formal process where the owner requests a variance from the authority having jurisdiction.