Saskatchewan
Corrections and
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Technical Advisory

Title: Calculating Occupant Load

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The National Building Code and National Fire Code of Canada treat the calculation of occupant loads in a much different manner. The building code allows a designer to design a building based on a "known" occupant load or to design for a specific minimum occupant load. For example, in designing an office space the designer would "know" that the office space must be large enough to accommodate the 100 employees that work in the company. The building code design criteria is sufficient to allow the designer to ensure the floor area design is large enough to accommodate 100 persons. Additionally, in looking at a specific floor space the designer would then be able to determine how many offices could be placed within the floor space. The general calculations also allow the designer to first determine and then to ensure, certain safety features are appropriate and provided for, such as fire alarm systems, exits, means of egress, all based on the expected occupant load.

Caution must be exercised in calculating an occupant load based on the building code's generalized criteria from a fire safety standpoint. The use of these calculations may result in unsafe practices and over crowding of a floor area. Fire safety personnel must use the fire code calculation to ensure fire safety in floor areas.

The National Fire Code calculation is not a "design" calculation, but a means to determine the maximum number of people that can safely be accommodated in a floor area. The fire code also addresses certain issues that the designer cannot take into account during the design phase. While the designer may have a specific result in mind for the design, once people move into a building and actually use it, the designer's plan for the use may be entirely forgotten.

Calculation of an Occupant Load

The National Fire Code uses two calculations to determine the maximum permissible occupant load in existing buildings. Net Floor Space available to allow people to move freely to an exit and exit capacity. Whichever calculation gives the lowest number is the maximum permissible occupant load.

Net Floor Space is the floor space that is not taken up by structural features (i.e.: a pillar, walls, etc.), furniture, equipment and other objects that may be in place within the floor area. "Net floor space" (in m^2) is divided by 0.4 m^2 to determine a potential occupant load of the floor area.

Once an occupant load has been calculated, the capacity of exits must also be calculated to ensure there are sufficient exits for the persons in the floor area.

Exit capacity is calculated based on the requirements of the building code. The building code requires that the aggregate **required width of exit** for a floor space is calculated by multiplying the occupant load by:

In A, C, D and E occupancies
- 6.1 mm per person (where gradient is not more than 1:8)
- 9.2 mm per person (where gradient is more than 1:8 and stairs)

In B occupancies
- 18.4 mm per person

In A-4 occupancies
- 1.8 mm per person (aisles, stairs [other than exit stairs], ramps, passageways, and exits
- 2.4 mm per person on exit stairs.

This information only provides the total (aggregate) number of mm's that must be available for exiting and should not be confused as indicating the number of exits or any other criteria for exiting from a floor area. For example a room with an occupant load of 100 persons requires more than just a single door 610 mm wide. Other sections of the code establish specific criteria for the minimum size opening, number, travel distance to, and other criteria for exits that must also be complied with. The minimum mm opening calculation is only a means to ensure sufficient exit opening is available

Example Calculation of Occupant Load

A room with tables and chairs is 12 m by 26 m in size.
Each table is round at 1.75 m and each chair is 0.50 m by 0.50 m in size.
(table = 2.4 m^2, chair = 0.25 m^2)
There are 45 tables with 4 chairs at each table.

- 12 m x 26 m = 312 m^2 (size of room)
- 2.4 m^2 + 1 m^2 (0.25 x 4 chairs) = 3.4 m^2 (tables and chairs, 1 set)
- 3.4 m^2 x 45 tables = 153 m^2 (used by tables and chairs)
- 312 m^2 - 153 m^2 = 159 m^2 (Net Floor Area NFA)
- 159 m^2 NFA/0.4 m^2 per person=397 persons

The room has 3 exit doors. The doors are, a 900 mm door, a 914 mm door and a 810 mm door. What is the exit capacity?

- 900 mm + 914 mm + 810 mm = 2624 mm
- 2624 mm / 6.1 mm = 430 persons

The calculations indicate the maximum permissible occupant load is 397 persons, which is the lesser of the two calculations. It is assumed the occupancy will be 180 persons (45 tables x 4 persons per table), which is well below the calculation of 397 persons. Therefore there is a sufficient amount of floor space and exits to permit the occupancy of 180 persons.

Suppose the number of tables is increased to 70.

- 12 m x 26 m = 312 m^2 (size of room)
- 2.4 m^2 + 1 m^2 (0.25 x 4 chairs) = 3.4 m^2 (tables and chairs, 1 set)
- 3.4 m^2 x 70 tables = 238 m^2 (used by tables and chairs)
- 312 m^2 - 238 m^2 = 74m^2 (Net Floor Area NFA)
- 74 m^2 NFA/0.4 m^2 per person=185 persons

The seating capacity is 280 persons (70 tables x 4 persons per table) but the NFA has been reduced to 74 m^2, which allows for only 185 persons. This indicates that the floor area is overcrowded by tables and chairs. Exits are still adequate at 430 persons, but there is a safety problem in allowing people to move to the exits that must be resolved.

Fire inspectors may then wonder, "How do I determine how many people could be safely placed in the room, or what calculation should be made to indicate the number of people versus the number of tables and chairs that may be in the room?"

This is a design question and the calculation in the building code should then be used to estimate an occupant load.

312 m^2 / 1.2 m^2 = 260 persons

This calculation would allow the owner of the property to place 65 tables with 4 chairs in the floor area. The fire inspector should then determine if this is a "safe" occupant load by doing the calculation identified by the fire code. A quick calculation would indicate a "safe" occupant load is only 227 persons in this situation, and occupant load should be limited to 227 persons.

Fire inspectors may ask the question about why this difference in "design" and "safe" occupant load numbers happens. The thought is that the building code assigns 1.2m^2/person for the floor area and this should be allowed. The problem that occurs is, as in this specific instance, is that the building code does not take into account what the size of the table and chairs are in reality, only in generalized or theoretical manner. A table larger or smaller than that supposed by the building code in the 1.2m^2/person calculation relates to either an unsafe, crowded floor area, or an area that could actually have more occupants than calculated using the arbitrary figure of 1.2m^2/person. It is neither fair to the occupants nor to the owner to unnecessarily restrict or allow too liberal of an occupant load.

The fire inspector must understand that the point of the calculation in the fire code is not to determine an occupant load, but a "safe" occupant load. While it is possible that the fire code calculation may exceed the building code designed occupant load, the intent is not to calculate an occupant load for a floor area, just to determine the maximum occupant load that can safely be accommodated in a floor area.

The number of occupants permitted to enter a room must not exceed the maximum occupant load calculated. In assembly occupancies with occupant loads exceeding 60 persons, the occupant load should be posted in conspicuous locations near the principal entrances to the room or floor area. Signs should have lettering not less than 50 mm high with a 12 mm stroke.