

Fire Protection

CANADIAN STEEL CONSTRUCTION COUNCIL

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New (and Better) Limiting Distance Requirements in 1995 NBCC

Introduction

In 1992, the Canadian Steel Construction Council (CSCC) issued Fire Protection Bulletin No. 20, which describes the generic fire-rated insulated sheet steel wall that is now ULC Listed Design No. W605.

Bulletin No. 20 also includes an explanation of the NBCC limiting distance concept (National Building Code of Canada [NBCC] Subsection 3.2.3.), as well as an example of how to calculate the required limiting distance for a specific wall, including the incorporation of any correction factors. These calculations were based on the 1990 NBCC.

The 1995 NBCC has placed significantly increased emphasis on supervised and monitored sprinkler systems as a primary means of fire safety. In doing so, it relaxed the limiting distance requirements for sprinklered buildings, compared with the 1990 NBCC. Those for unsprinklered buildings remain unchanged.

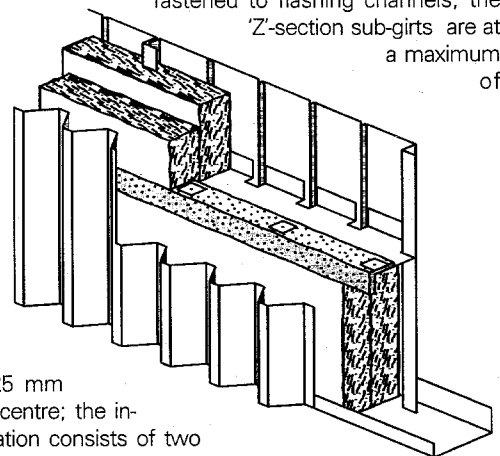
With these changes in mind, this Bulletin both revisits Bulletin No. 20, as well as details the limiting distance changes in the 1995 NBCC. Calculations are included for both sprinklered and non sprinklered buildings, which illustrate just one of the many advantages to be gained in sprinklering buildings.

While this Bulletin revises some aspects of Bulletin No. 20, that Bulletin is still valid, and should be consulted for full details on the construction of the fire-rated sheet steel wall assembly.

Insulated Fire-Rated Sheet Steel Wall Assembly

The following diagram illustrates the fire-rated sheet steel wall assembly (ULC W605). This assembly has a 1 h fire-resistance rating, and can be used where a 2 h rating is required with the incorporation of a correction factor (see Bulletin No. 20). Where a full 2 h rating is required, a similar assembly, but with additional insulation, is listed as ULC W606.

The inner liner of this assembly consists of sheet steel fastened to flashing channels; the 'Z'-section sub-girts are at a maximum of



1525 mm on centre; the insulation consists of two layers of mineral wool batts; a ceramic fibre strip is required between the 'Z'-girts and the exterior cladding; and the exterior cladding may be any corrugated sheet steel profile.

Exposing Building Face

Article 3.2.3.7. of the NBCC specifies the construction of the exposing building face (EBF) according to the limiting distance of the EBF and the amount of unprotected openings. The maximum permitted percentage of unprotected openings is derived from NBCC Tables 3.2.3.1.A. - D. according to the Occupancy of the building and the available limiting distance. This derived maximum percentage of unprotected openings in turn dictates the construction of the EBF. The following tables summarise these requirements:

Occupancy Category 1 - Occupancy Groups A, B, C, D, F3		
Applicable Tables for calculating Limiting Distance and/or % of Unprotected Openings	Table 3.2.3.1.A. - Unsprinklered Buildings (except Group B) Table 3.2.3.1.C. - Sprinklered Buildings	
If Tables 3.2.3.1.A./C. permit EBF to have Unprotected Openings of:	Then EBF shall have:	NBCC Reference
Maximum 10%	- Non-combustible construction - 1 h Fire-resistance rating - Non-combustible cladding	3.2.3.7.(1)
>10% but maximum 25%	- 1 h Fire-resistance rating - Non-combustible cladding	3.2.3.7.(2)
>25% but <100%	- 45 min Fire-resistance rating	3.2.3.7.(3)

Exceptions to above requirements:

- Storage garage with all storeys as open-air storeys - unlimited unprotected openings permitted as long as limiting distance is not less than 3 m (NBCC 3.2.3.9.(1)).
- EBF of street-level storey facing a street - unlimited unprotected openings permitted as long as limiting distance is not less than 9 m (NBCC 3.2.3.9.(2)).
- Combustible cladding permitted if it complies with NBCC 3.1.5.5. (exception for 3.2.3.7.(2) only) (NBCC 3.2.3.7.(9)). Foam plastic insulation in buildings over 3 storeys requires protection (NBCC 3.2.3.7.(7)).
- Low-hazard industrial occupancy conforming to NBCC 3.2.2.82. - EBF may be non-combustible with no fire-resistance rating if not loadbearing and limiting distance is not less than 3 m (NBCC 3.2.3.10.).

Occupancy Category 2 - Occupancy Groups E, F1, F2		
Applicable Tables for calculating Limiting Distance and/or % of Unprotected Openings	Table 3.2.3.1.B. - Unsprinklered Buildings Table 3.2.3.1.D. - Sprinklered Buildings	
If Tables 3.2.3.1.B./D. permit EBF to have Unprotected Openings of:	Then EBF shall have:	NBCC Reference
Maximum 10%	- Non-combustible construction - 2 h Fire-resistance rating - Non-combustible cladding	3.2.3.7.(4)
>10% but maximum 25%	- 2 h Fire-resistance rating - Non-combustible cladding	3.2.3.7.(5)
>25% but <100%	- 1 h Fire-resistance rating	3.2.3.7.(6)

Exceptions to above requirements:

- EBF of street-level storey facing a street - unlimited unprotected openings permitted as long as limiting distance is not less than 9 m (NBCC 3.2.3.9.(2)).
- Combustible cladding permitted if it complies with NBCC 3.1.5.5. (exception for 3.2.3.7.(5) only) (NBCC 3.2.3.7.(9)). Foam plastic insulation in buildings over 3 storeys requires protection (NBCC 3.2.3.7.(7)).

Subsection 3.2.3. of the NBCC contains additional requirements or relaxations for either the exposing building face, or for any building elements affected by the exposing building face (NBCC 3.2.3.8. to 3.2.3.20.). These requirements may modify an exposing building face designed in accordance with NBCC 3.2.3.7.

Calculating Exposing Building Face Parameters:

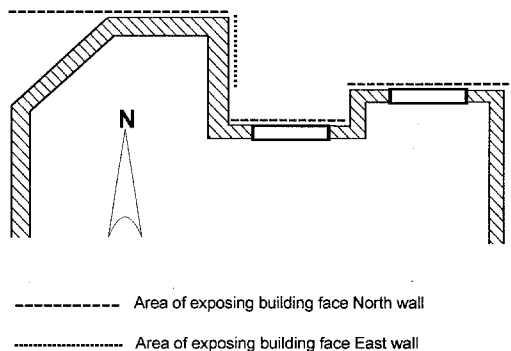
The two most important parameters that have to be calculated for an exposing building face are its area and the amount of unprotected openings.

Area of Exposing Building Face:

NBCC Article 3.2.3.2. defines how the area of an exposing building face shall be calculated. This is shown in this diagram.

The exposing building face area is its length x its vertical height, measured from the finished ground to the uppermost ceiling (NBCC 3.2.3.2.(1)).

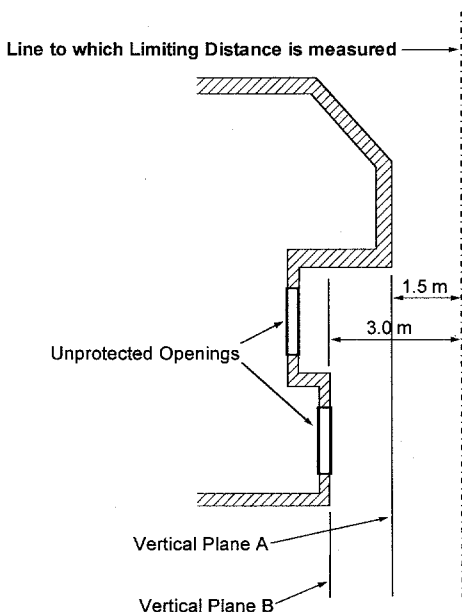
Any angled walls are measured as a projection on to a vertical plane parallel to the general plane of the wall. This angled wall projection must be calculated for adjacent exposing building faces (North and West faces in the diagram). Sloping walls are also measured as a projection on to this vertical plane.



Permitted Area of Unprotected Openings:

The second parameter is to calculate the permitted percentage of unprotected openings. This is done by reference to one of NBCC Tables 3.2.3.1.A., 3.2.3.1.B., 3.2.3.1.C., or 3.2.3.1.D., and is based upon the area of the exposing building face and the available limiting distance.

For example, consider a fully sprinklered single fire compartment Group D (Office) building, which would be governed by Table 3.2.3.1.C. The diagram below represents the configuration of one exposing building face of this building that is, at its closest point, 1.5 m from the limiting distance line. The area of this exposing building face is 100 m².



The limiting distance for this wall is measured at its closest point to the limiting distance line, as designated by Vertical Plane A in the diagram at left - in this case 1.5 m (NBCC 3.2.3.1.(3)). Referring to Table 3.2.3.1.C., the maximum permitted amount of unprotected openings in an exposing building face of 100 m² and with a limiting distance of 1.5 m is 16%. The construction of the wall must therefore be in accordance with NBCC 3.2.3.7.(2) - i.e. a 1 h fire-resistance rating, with non-combustible cladding (see Table on Page 2 for Occupancy Category 1).

However, note that, in this example, there is no unprotected opening closer than 3.0 m to the limiting distance line (Vertical Plane B). NBCC 3.2.3.1.(4) permits the total amount of unprotected openings to be calculated on the basis of the limiting distance of the closest unprotected opening - in this case 3.0 m, permitting a total of 26% of unprotected openings in the exposing building face (NBCC Table 3.2.3.1.C.).

The construction of the wall is still governed by the 16% of permitted unprotected openings based on the 1.5 m limiting distance (NBCC A-3.2.3.1.(4)). The only way to relax the construction of the wall based on the 26% permitted unprotected opening value is to divide the building into two or more fire compartments (NBCC 3.2.3.2.(2) and 3.2.3.2.(4)).

Calculating Limiting Distance:

Fire Protection Bulletin No. 20 includes an example that illustrated the calculation of the required limiting distance for the exposing building face of a Group E (Mercantile) Occupancy building, based on the 1990 NBCC. The requirements in the 1995 NBCC for this building, when unsprinklered, have not changed (NBCC Table 3.2.3.1.B.).

To illustrate the gains to be made by sprinklering buildings governed by NBCC Part 3, that example will be repeated here, together with the equivalent calculations for a sprinklered building (NBCC Table 3.2.3.1.D.). Note that these calculations include the incorporation of a correction factor required when using a 1 h fire-rated wall (in this case ULC Listed Design W605 described on Page 1) where a 2 h fire-resistance rating is required. Bulletin No. 20 explains the full details of why the correction factor is needed in this situation, and how it is calculated[†] for this 1 h insulated sheet steel wall assembly. This correction factor would not be required if ULC W606, which has a full 2 h rating, was used.

The following Tables illustrate the three steps involved.

1. Establish Exposing Building Face Design Parameters:

Length:		88.0 m	Total Gross Area:	88.0 x 8.0 m =	704 m ²
Height:		8.0 m	Actual Area of Unprotected Openings*:	4 x 6.0 x 2.0 m =	48 m ²
Length/Height Ratio:	88.0 ÷ 8.0 m =	11 : 1	NET Area of 1 h Wall (excluding openings)	704 m ² – 48 m ² =	656 m ²

* 4 Entrances each 6 m x 2 m

2. Calculate Total Area of Unprotected Openings:

Equivalent Area of unprotected openings, using EOF** of 2.0% (NBCC 3.1.7.2.):	656 m ² x 2.0% =	13 m ²
Total area of unprotected openings (actual + equivalent) (NBCC 3.2.3.1.(6)):	48 m ² + 13 m ² =	61 m ²
Area of unprotected openings, expressed as % of exposing building face:	61 m ² ÷ 704 m ² =	8.7%

** Equivalent Opening Factor

3. Calculate Required Limiting Distance:

Unsprinklered Building (NBCC Table 3.2.3.1.B.), with EBF that has:		Sprinklered Building (NBCC Table 3.2.3.1.D.), with EBF that has:	
◆ Maximum Area =	1 000 m ²	◆ Maximum Area =	> 200 m ²
◆ L/H Ratio:	> 10 : 1	◆ Area unprotected openings:	8.7%
◆ Area unprotected openings:	8.7%	◆ Required Limiting Distance =	3.0 m
◆ Required Limiting Distance =	7.0 m		

NBCC Tables 3.2.3.1.C. and 3.2.3.1.D. for sprinklered buildings ignore the Length/Height ratio of an exposing building face. Note that, in the example above, if the total area of unprotected openings (actual + equivalent) was reduced from 8.7% to 8.0%, the required limiting distances in the above examples would reduce to 6.0 m (unsprinklered - NBCC Table 3.2.3.1.B.) and 1.2 m (sprinklered - NBCC Table 3.2.3.1.D.) respectively.

The 1.2 m limiting distance is the minimum permitted when a wall contains any unprotected openings (actual, equivalent, or both). Only walls containing no unprotected openings at all (and meeting the requirements of NBCC 3.2.3.7. Sentences (1) to (9) as appropriate) can be positioned closer than 1.2 m to the limiting distance line. ULC W606 meets all the requirements of NBCC 3.2.3.7., and is therefore not restricted as to limiting distance.

[†] Fire Protection Bulletin No. 20 used an equivalent opening factor of 1.6% in the example calculations, which was the value derived from the actual test data used to promulgate W605. The published listing for ULC W605 uses a rounded figure of 2.0%, and this value has been used in the calculations shown above.