

# ROOF SNOW OVERLOAD RISK ESTIMATION

## PW&S/GNWT MANAGED FACILITIES/BUILDINGS



### Objectives:

1. Provide a simple 'rule-of-thumb' method for identifying which GNWT structures are potentially at risk of developing snow overloading during any one winter, applicable to every community in the NWT, and applicable to GNWT-operated buildings.
2. Take into account:
  - snow loading potential;
  - construction type; and
  - condition, age and era of construction.

### Factors Incorporated into Roof Risk Assessment Checklist:

#### Climate and Configuration:

- A. Identify roof snow load potential for the particular NWT community – climate factors:
  - a. Community snow loading criteria: ground snow load (historical and recent) for each community (includes rainfall absorption ( $S_r$ ) factor as obtained from 1995 NBCC climate data tables), based on National Building Code of Canada climate data summaries assigns each community a snow risk value ( $V_{SR}$ ) from Table I, "Snow Loading Criteria".
  - b. Identify potential for ice, dammed meltwater, and snowdrift retention or formation on a roof as affected by:
    - i. Drifting/accumulation potential – exposed to wind or sheltered, including roof height above ground and;
    - ii. Building overall size (Part 3 NBCC or Part 9 NBCC);
    - iii. Ice formed from building heat loss – concentrated building heat loss zones, including excessive heat loss near boiler room;
    - iv. Unevenly distributed snow loads.

Cont.

- c. Identify shape factors and material covering factors of roof (snow –shedding or snow accumulation capacity due to shape and surface texture):
  - i. Uniformly flat or low-sloped, or slope greater than 45 degrees
  - ii. Rounded or dome shape (difficult to predict snow distribution)
  - iii. Steps or transitions of shape (high and low portions next to each other)
  - iv. Cup (notch between walls), valley, or similar shapes that trap snow
  - v. Slick and shedding (i.e., metal) or textured and retaining (such as granulated)

### **Construction Type and Condition:**

- B. Construction type and condition:
  - a. Type, construction history, building records:
    - i. Non-combustible construction, mixed or non-combustible construction ;
    - ii. Problem-free or problematic construction – project team experience and competency;
    - iii. Available records, manuals and as-built documents – e.g. shop drawings for wood bending members and wood compression members;
  - b. Water infiltration (leading to rot or rust) or other structural damage:
    - i. History of uncorrected leakage or water damage;
    - ii. Previous superstructure damage from foundation movement, impact, partial collapse;
  - c. Renovations causing structural changes or major repairs resulting from structural damage (like fire):
    - i. Re-commissioning after renovation/repair – clarity and access to building information.

### **Facility/Building Age:**

- C. Age and Era of Construction – older buildings are designed to a different structural standard and deficiencies are more likely to have developed over time during operation of older buildings;
  - a. Design criteria in effect at time of construction:
    - i. Post-1985 structural design criteria (Part 4) NBCC or equivalent design standard;
    - ii. Pre-1985 structural design standards may have used lower equivalent roof snow loads than post-1985 design standards;
    - iii. Pre-1965 NBCC used higher snow loads (100% ground snow load), but used informal roof snow load distribution assignment protocols;
  - b. Administration (project delivery) in effect at time of construction:
    - i. Construction documentation and verification uncertainty – the fewer the records (structural drawings), the less certain the structural condition;
    - ii. Construction interruption: started by one organization but completed by another (i.e., first contractor abandoned the work) and therefore greater potential for errors;
    - iii. Buildings built by non-GNWT organization but taken over by GNWT – assumed to be higher risk because less is known about the project.



**Roof Risk Assessment Risk Rating Checklist:**

Factors	Info Source, or observed at site	Value Range	Facility Risk Rating
<b>Climate and Configuration</b>			
A a - Ground snow load factor	Community List ( $V_{SR}$ )*	0 to 2	
A b i - Drifting potential factor (wind effect on snow retention; building height)	Exposed/high (0) or Sheltered/low (1) (Direct observation)	0 to 1	
A b ii - Size: less than 600 m <sup>2</sup> = 0 (typ. part 9 NBCC), over 600 m <sup>2</sup> = 1 (typ. part 3 NBCC)	Building records	0 to 1	
A b iii - Local ice formed: no = 0; yes = 1	Maintenance records	0 to 1	
A b iv - Uneven snow load: no = 0; yes = 1	Maintenance records	0 to 1	
<b>A c - Roof shape and texture factors</b>			
I - uniform low slope, flat or steep (0)	Direct observation	0 to 2	
ii - Rounded or dome shape (1)			
iii - Stepped low to high (1)			
iv - Cup (notch) or deep valley (2)			
v - Slick surface (0); Rough surface (1)	Direct observation	0 to 1	
Sub-Total (1)			
<b>Construction Type and Condition</b>			
B a i - Non-combustible (0); Mixed or combustible (1)	Source: Building documents	0 to 1	
B a ii - Problem free (0); Problems (1)	Source: Project records	0 to 1	
B a iii - Documents all there (0); Documents lost (1)	Source: Project records	0 to 1	
<b>B b - Water or other structural damage</b>			
B b i - Water damage history			
None (0); Some (1)	Source: Maintenance records	0 to 1	
B b ii - Structural damage history			
None (0); Some (1)	Source: Maintenance records	0 to 1	
<b>B c - Structural renovations or reconstruction history (if renovated only)</b>			
B c i - Re-commissioned/verified (0); Not Re-commissioned/verified (1)	Project and maintenance records	0 to 1	
Sub-Total (2)			
<b>Facility/Building Age</b>			
<b>C a - Design criteria @ time of design</b>			
C a i - Post 1985 NBCC (0)	Design date of record	0 to 2	
C a ii - 1965 to 1985 NBCC (1)			
C a iii - Pre 1965 NBCC (2)			
<b>C b - Construction administration factors</b>			
C b i - Commissioned (0); Not commissioned (1)	Source: Project records	0 to 1	
<b>C b ii - Construction interruption</b>			
No interruption (0); Interrupted (1)	Source: Project records	0 to 1	
C b iii - GNWT project origin (0); Non-GNWT (1)	Source: Asset ownership history	0 to 1	
<b>TOTAL (1+2+3)</b>			

\*See Table 1 on page 4 – Community Snow Load Risk Factor

**Table 1: Snow Loading Criteria – Roof Risk Determination**

Snow Loading Criteria – Roof Risk Determination		Ss = Snow Precipitation Load				
Ground Snow Load History – kPa – 1985 to Present		VSR = Community Snow Load Risk Factor				
Community	1985	Sr = Rain Precipitation Contribution (wetted snow)				VSR
		1990		1995		
		Ss only	Ss	Sr	Ss	
Aklavik	2.2	2.1	0.1	2.1	0.1	1
Buffalo River	2.6	2.2	0.1	2.2	0.1	1
Camsell Bend	3.3	2.5	0.1	2.5	0.1	2
Colville Lake	3.3	2.5	0.1	2.5	0.1	2
Déline (Fort Franklin)	3.3	2.5	0.1	2.5	0.1	2
Dettah	2.0	2.0	0.1	2.0	0.1	1
Dory Point	2.5	2.2	0.1	2.2	0.1	1
Enterprise	2.6	2.2	0.1	2.2	0.1	1
Fort Liard	3.3	2.5	0.1	2.5	0.1	2
Fort McPherson	2.2	2.1	0.1	2.1	0.1	1
Fort Providence	2.5	2.2	0.1	2.2	0.1	1
Fort Resolution	2.3	2.1	0.1	2.1	0.1	1
Fort Simpson	2.5	2.1	0.1	2.1	0.1	1
Fort Smith	2.0	2.1	0.2	2.1	0.2	1
Hay River	2.6	2.2	0.1	2.2	0.1	1
Holman	1.4	1.9	0.1	1.9	0.1	0
Inuvik	2.2	2.1	0.1	2.1	0.1	1
Jean Marie River	2.5	2.1	0.1	2.1	0.1	1
Kasho Gotine (Fort Good Hope)	2.8	2.7	0.1	2.7	0.1	2
Kahtlodeeche (Hay River Reserve)	2.6	2.2	0.1	2.2	0.1	1
Kakisa Lake	2.5	2.2	0.1	2.2	0.1	1
Lutsel Ke (Snowdrift)	2.3	2.1	0.1	2.1	0.1	1
Nahanni Butte	3.3	2.5	0.1	2.5	0.1	2
Norman Wells	3.3	2.5	0.1	2.5	0.1	2
Paradise Gardens	2.6	2.2	0.1	2.2	0.1	1
Paulatuk	1.4	1.9	0.1	1.9	0.1	0
Rae Edzo	2.4	2.1	0.1	2.1	0.1	1
Rae Lakes	2.4	2.1	0.1	2.1	0.1	1
Redknife Camp	2.0	2.1	0.2	2.1	0.2	1
Sachs Harbour	1.4	1.9	0.1	1.9	0.1	0
Trout Lake	3.3	2.5	0.1	2.5	0.1	2
Tsiigehtchic (Arctic Red River)	2.2	2.1	0.1	2.1	0.1	1
Tuktoyaktuk	1.4	1.9	0.1	1.9	0.1	0
Tulita (Fort Norman)	3.3	2.5	0.1	2.5	0.1	2
Wekweti (Snare Lake)	2.4	2.1	0.1	2.1	0.1	1
Wha Ti (Lac La Martre)	2.4	2.1	0.1	2.1	0.1	1
Wrigley	3.3	2.5	0.1	2.5	0.1	2
Yellowknife	2.0	2.0	0.1	2.0	0.1	1

VSR Range:    0=0≤S1995≤1.49    1=1.49≤S1995≤2.49    2=S1995≥2.49  
 0=Low            1=Moderate            2=Highest Ground Snow Load Ranges

**Building Name:** \_\_\_\_\_

**Asset #:** \_\_\_\_\_

**Community:** \_\_\_\_\_

**Completed By:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**For further information, please contact**

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