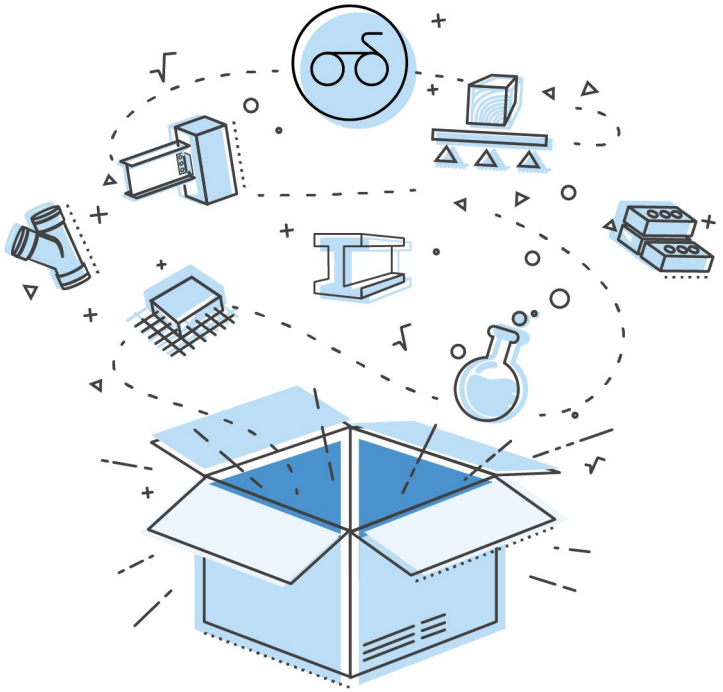
ClearCalcs

Snow Loads

Connor Conzelman
connor.conzelman@clearcalcs.com

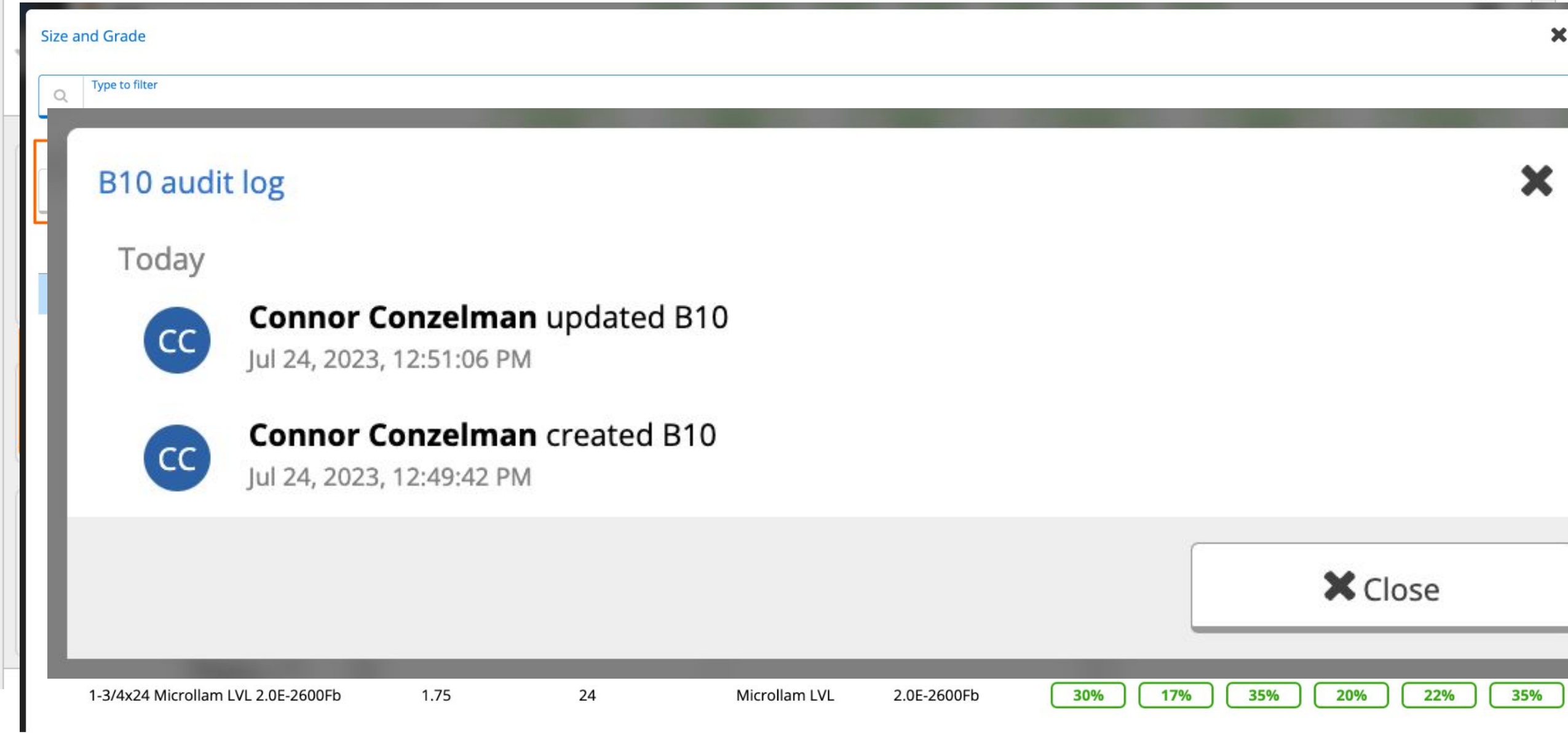
Laurent Gérin
laurent.gerin@clearcalcs.com



Say hello in the chat box 👋

About ClearCalcs.com

ClearCalcs



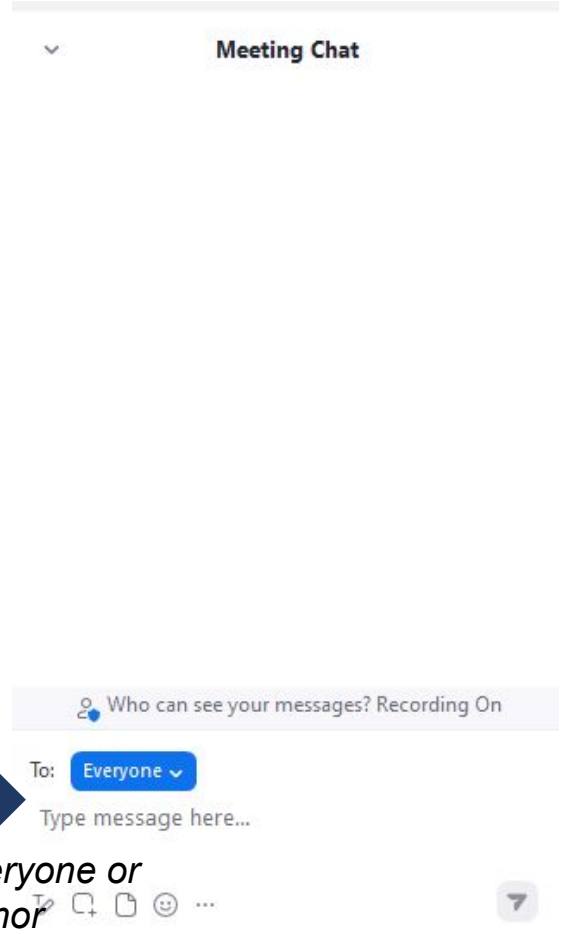
Meet the Presenters

- Connor Conzelman – Dir. of Customer Success
  - Here to make sure you're successful in ClearCalcs!

- Laurent Gérin, P.Eng. – N.A. Engineering Content Lead
  - Leading our calculator work in the US and in Canada

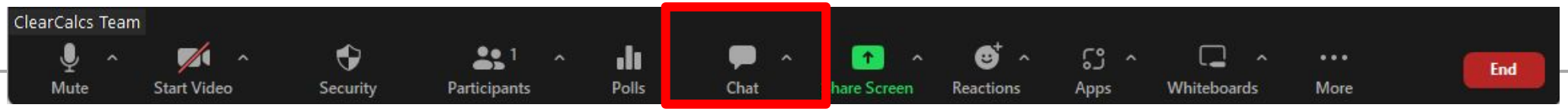
How to Ask Questions

- Type your questions in the Chat tab on your Zoom control panel and click Send
  - You can send your questions to everyone or directly to Connor
  - We will address all questions in the second half of the webinar during the 30-minute Q&A session
  - We might invite you to unmute yourself to ask your question live!



Ask your questions here

You can send to everyone or directly to Connor



What we'll be discussing today

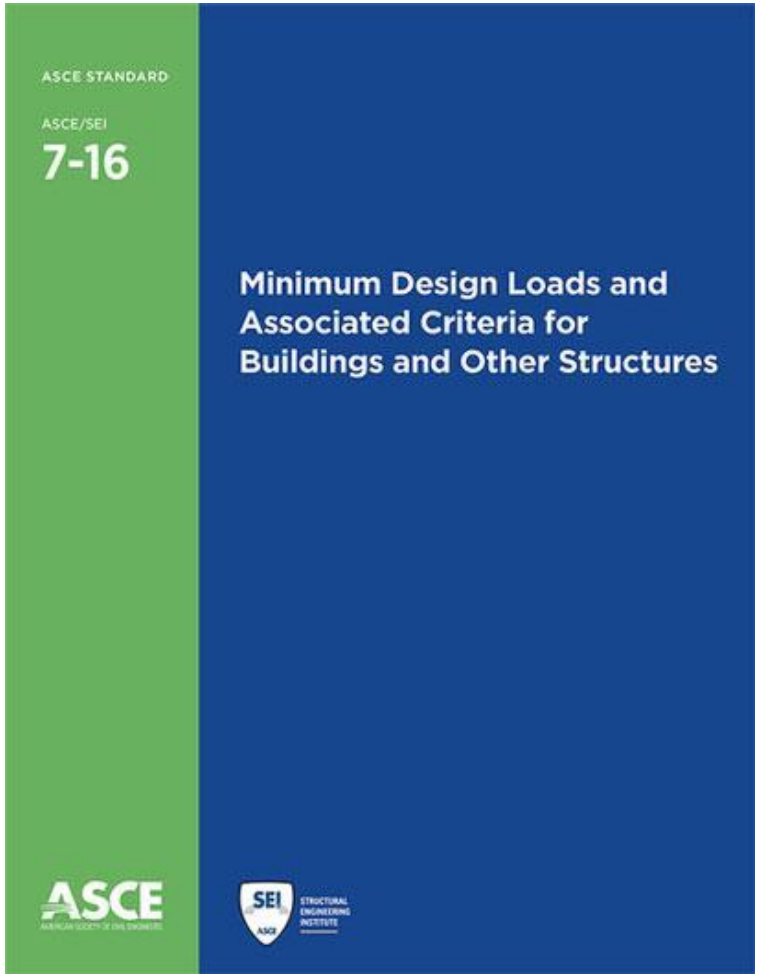
- Who snow loads matter and how they're calculated
- Parameters that affect snow loads
- Other considerations with snow loads
- ASCE 7-16 and ASCE 7-22
- Design example in ClearCalcs

Why Snow Loads Matter

- Knickerbocker Theater (1922)
  - One of the deadliest structural collapse in US history, killing 98 people
- Huge amount of roof failures every year due to snow
  - Winter of 2011 in the Northeast: almost 400 collapses
  - Metrodome in Minneapolis: 4 roof collapses due to snow!

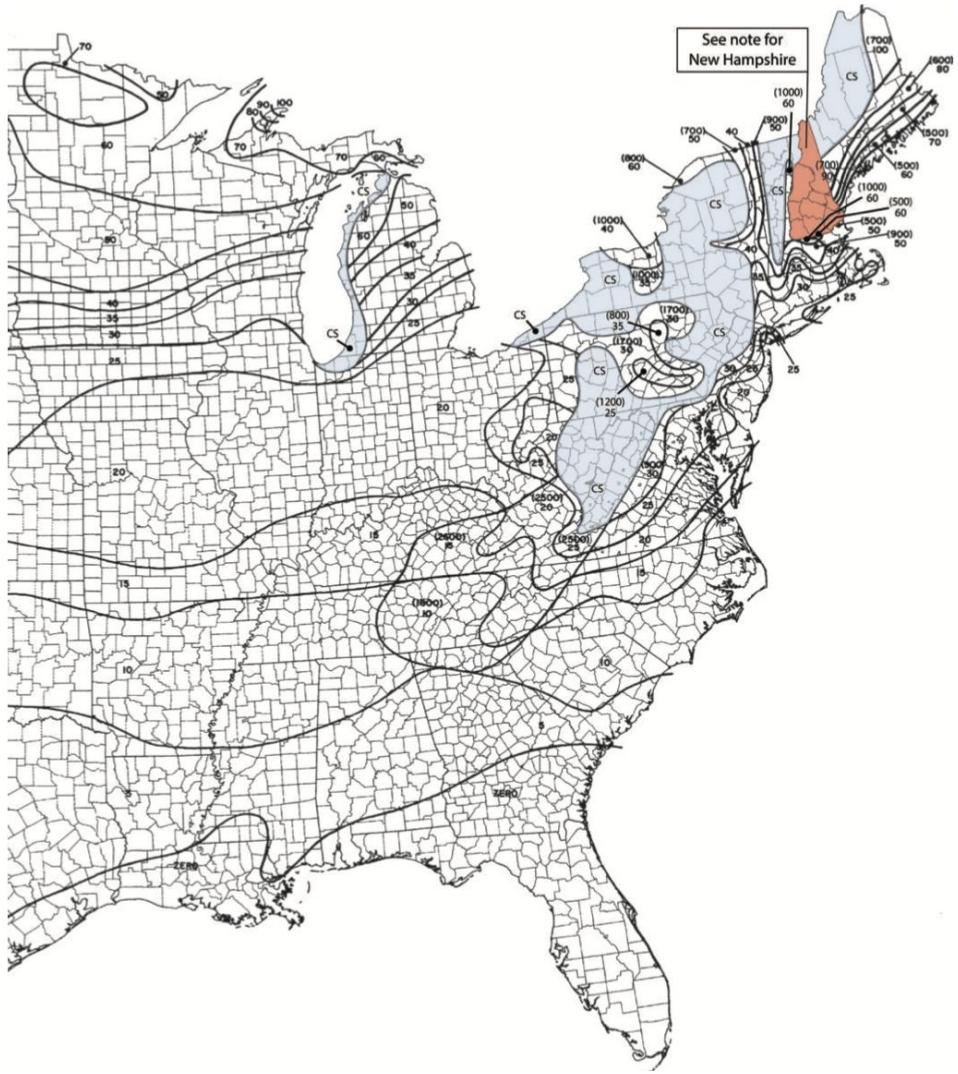
ASCE 7 – Your Friendly Snow Code

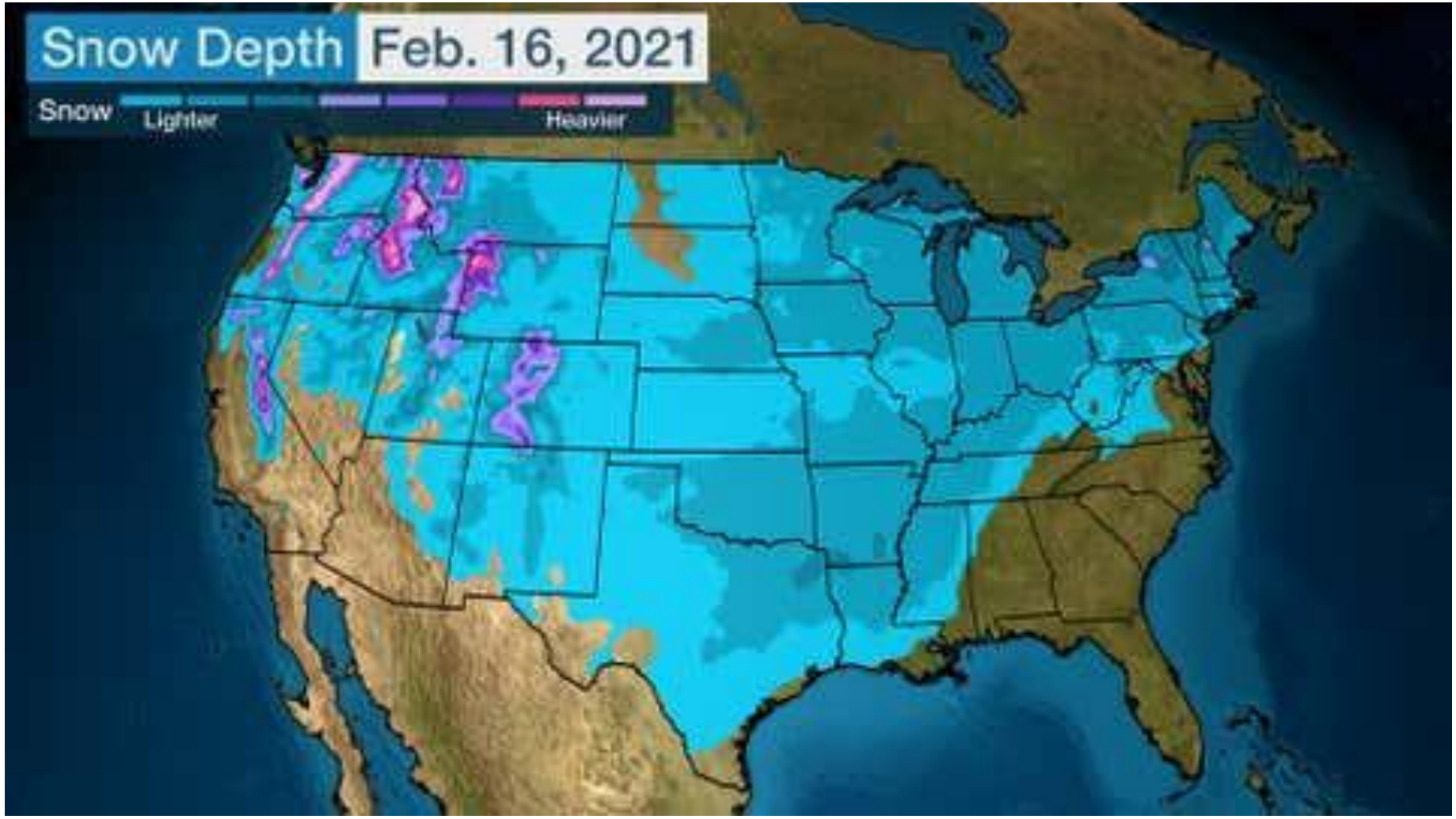
- Essentially all building codes in the US refer to ASCE 7 for calculating snow loads
- You'll find formulae and design values here
  - Local jurisdiction might still override this!
- Most states have adopted ASCE 7-16 per IBC 2018 and 2021
  - IBC 2024 will adopt ASCE 7-22



Ground Snow Load

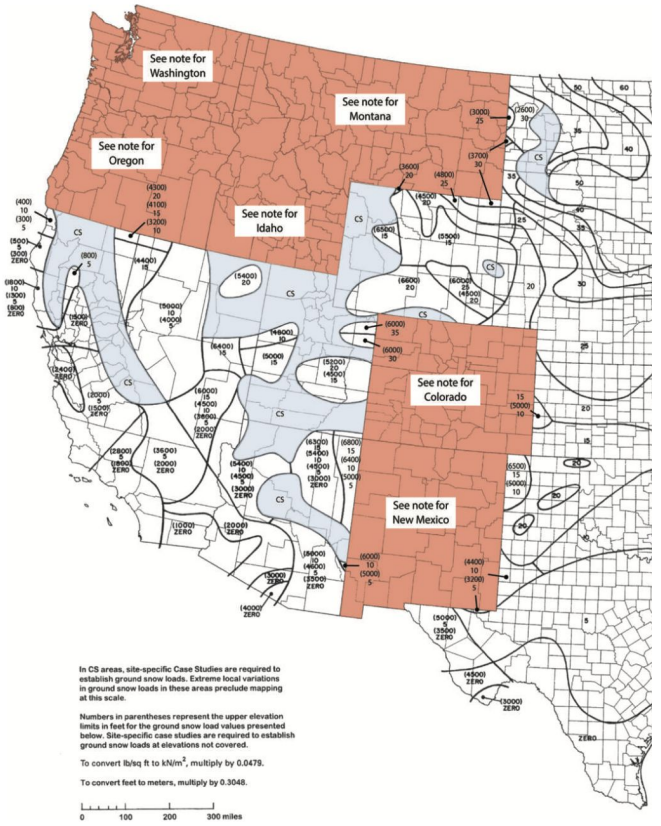
- Main parameter for snow loads
- Snow depth is measured at almost 10,000 locations in the US
- Snow depth AND load is measured directly at 204 locations
  - This is then correlated to snow depth with the 10,000 locations
- From this, a map is created with snow loads through most of the US




Snow Depth
Feb. 16, 2021
Snow
Lighter
Heavier

Site-Specific Ground Snow Load

- Some areas require site-specific studies
  - Great Lakes
  - Mountainous / high elevation areas
- A few western states also have their own snow load values
- Generally, check with your local authorities



15.24.040 - Snow loads/snow design—California Building Code.

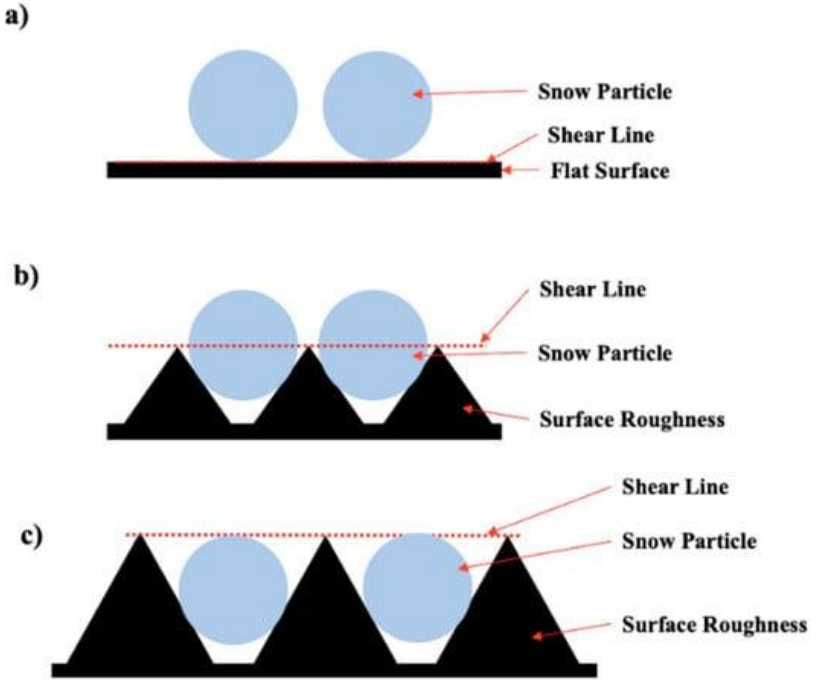
A. The town shall be considered a snow area. All structures within the town shall be designed to withstand snow loads and any additional effects created by snow.

B. Basic ground snow load (Pg) is established as follows:

1. One hundred pounds per square foot for Mammoth Lakes Airport;
2. Two hundred thirty pounds for elevations eight thousand five hundred feet or less;
3. Three hundred pounds for elevations greater than eight thousand five hundred feet.

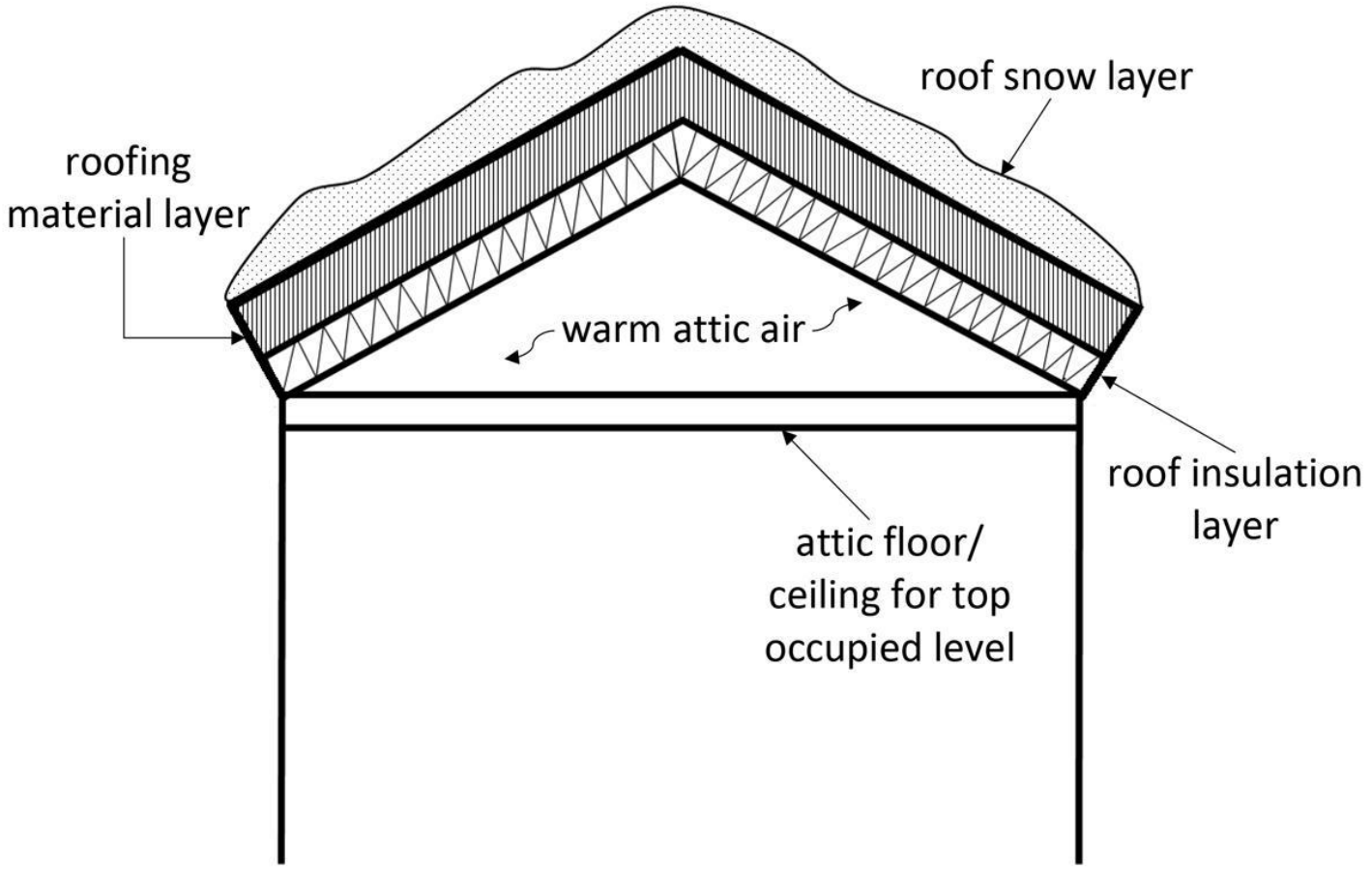
Other Environmental Parameters

- Surface roughness
  - Based on the same parameters as for wind loads – accounts for shielding provided by the area around the building
- Roof exposure
  - Accounts for the exposure of the roof in its immediate surrounding
  - Eg: is the roof higher than the trees surrounding it?
- These two parameters get combined into the exposure factor C_e



Building Thermal Condition

- Thermal condition
  - If a roof is warmer than freezing, it'll melt snow and reduce the snow load
  - For very cold roofs, snow might melt slower than on the ground
  - This is accounted for by factor C_t – varies from 0.85 for warm greenhouses to 1.3 for freezer buildings

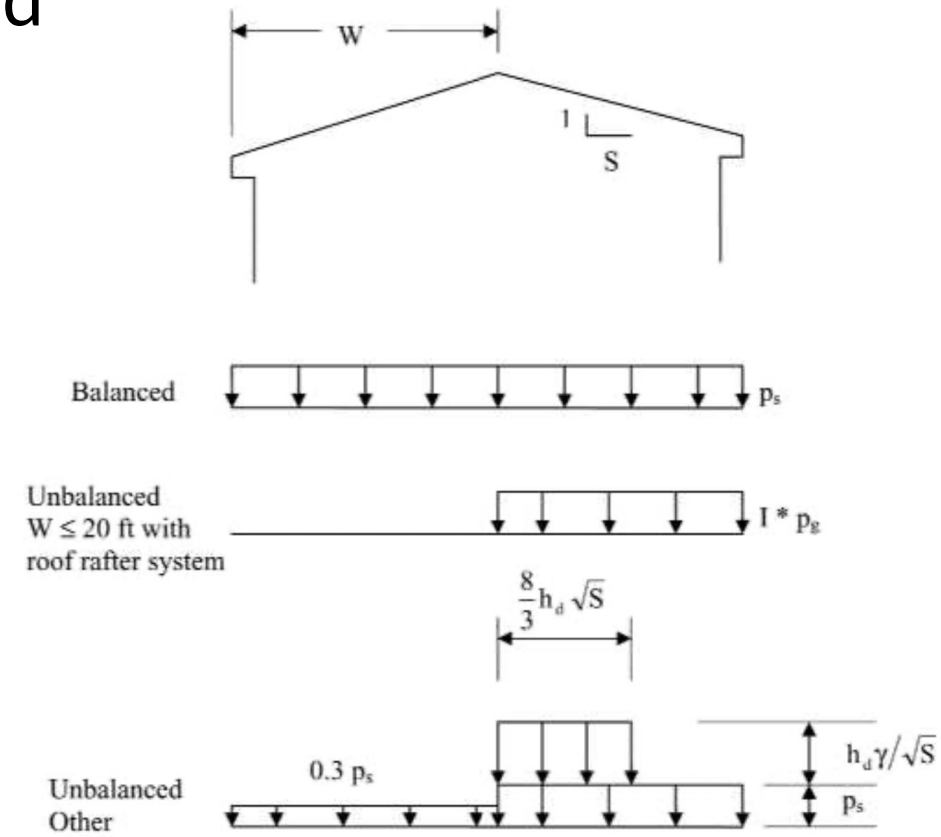


Roof Slope & Slipperiness

- Steep roofs shed off snow due to gravity
- What pitch is required to achieve shedding depends on:
  - Thermal conditions
  - “Slipperiness”
  - Obstructions
- Slippery roofs include metal roofs, glass.
  - Asphalt shingles are NOT slippery
- Roofs need to be steep for this to matter
  - Starts at ~10:12 for asphalt shingles over a ventilated attic

Unbalanced Loads

- Account for snow drifts at the roof ridge, and the sun shining on one side at a time
- Not required for slopes less than ½:12 or greater than 7:12
- For gable roofs, two possibilities
  - Rafter system with span < 20’ is simpler
  - General method otherwise requires calculating drift height



Snow Drifts

- Snow accumulates against obstructionsby wind (steps in the roof, paparets, rooftop units, etc)
- Can dramatically increase loads on just a few members
- 75% of snow roof failures involve some snow drifts (StructureMag)

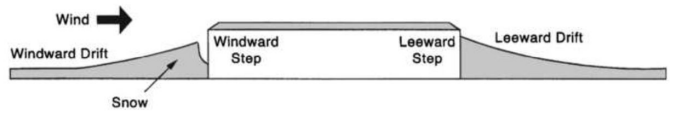


FIGURE 7.7-1 Drifts Formed at Windward and Leeward Steps

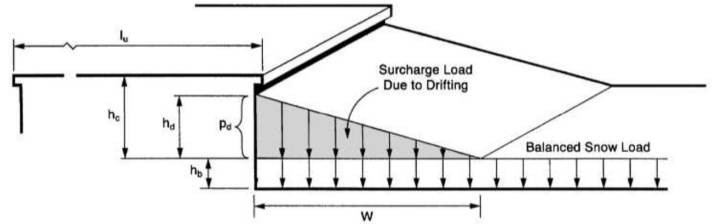


FIGURE 7.7-2 Configuration of Snowdrifts on Lower Roofs

$$\frac{h_d}{\sqrt{l_s}} = \left(0.43\sqrt[3]{l_u}\sqrt[4]{p_g + 10}\right) - 1.5$$

https://mapescanopies.com/snow-drifts/

Upcoming Changes in ASCE 7-22

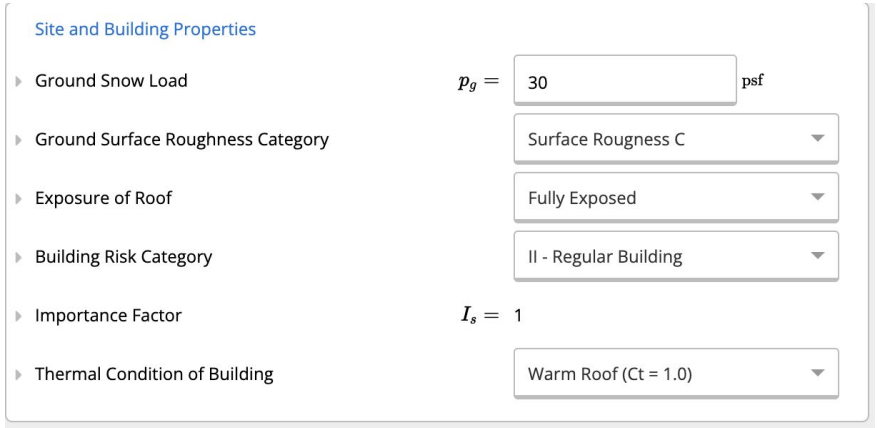
- New ground snow load map
  - Essentially no areas require Site Specific Case Studies
  - Loads now directly based on reliability targets, similar to wind & seismic
    (LRFD factor = 1.0, ASD factor = 0.7)
  - Average increase of 12% in snow loads
  - TBD: Will local jurisdictions adopt ASCE 7-22 values or continue specifying local values

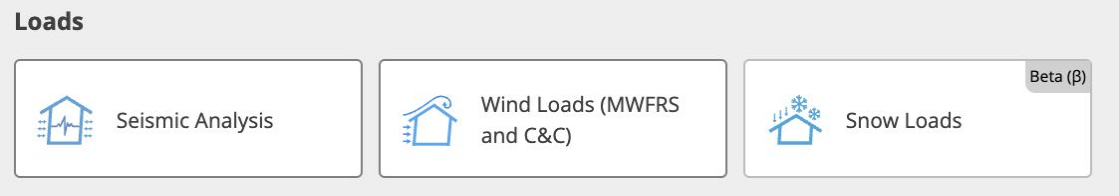
1a. D
2a. $D + L$
3a. $D + (L_r \text{ or } 0.7S \text{ or } R)$
4a. $D + 0.75L + 0.75(L_r \text{ or } 0.7S \text{ or } R)$
5a. $D + 0.6(W \text{ or } W_T)$
6a. $D + 0.75L + 0.75(0.6(W \text{ or } W_T)) + 0.75(L_r \text{ or } 0.7S \text{ or } R)$
7a. $0.6D + 0.6(W \text{ or } W_T)$

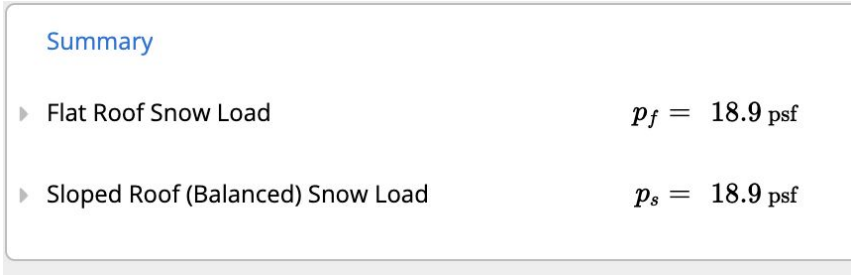
- New Winter Winds (W2) parameter
  - Adjusts snow drift loads for typical local winds in the winter
  - In the Midwest & Northeast: **increased loads (~ 25%)**
  - West of the Rockies and in the Southeast : **decreased loads (~ 40%)**

Snow Loads in ClearCalcs

- ClearCalcs has a snow load calculator based on ASCE 7-16
- We take care of the calculations – you just provide the inputs!
- Still in Beta: we want your feedback!







Worked Example 1

- House in Mammoth Lakes CA
- Ground snow load:
  - From local data
- Building parameters
  - Ventilated attic
  - Asphalt shingle roof
  - Rafter system – 15 ft span
- Steps:
  - Find the roof snow load
  - Design rafter for the snow load

ClearCalcs

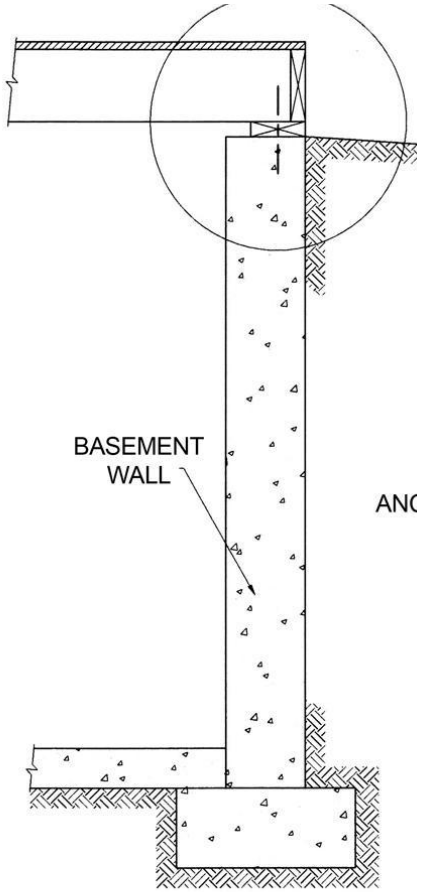
Conclusion

- Snow loads are critical for structural designs in most of the US, and are the source of many collapses
- There are a variety of parameters for snow loads that require some engineering judgement
- ClearCalcs can help you accelerate your design process with our snow load calculator - and we want your feedback how we can make it better!

What's new in ClearCalcs

- Restrained (basement) retaining walls

- Multi-story shear walls



ClearCalcs

Webinars coming up

- Diaphragm Analysis and Lateral Load Linking for Shear Wall Design
  - September 27 at 1 PM (ET)
- Introduction to the Girder-Slab® System and Design Tool V3.4
  - October 11 at 1 PM (ET)
- Open Web Steel Joists Analysis and Design
  - October 25 at 1 PM (ET)
- Sign up at https://clearcalcs.com/webinars !

THANK YOU!

- We will send you a recording of the webinar by email.
- There will be a survey at the end of this webinar, we would appreciate your feedback on how we can improve.
- Filling out the survey is also how we know to send you a PDH certificate!
- If you have further questions, send an email to help@clearcalcs.com or use the Help button in ClearCalcs

ClearCalcs

Questions?