ClearCalcs

Calculating Wind Loads

For residential construction

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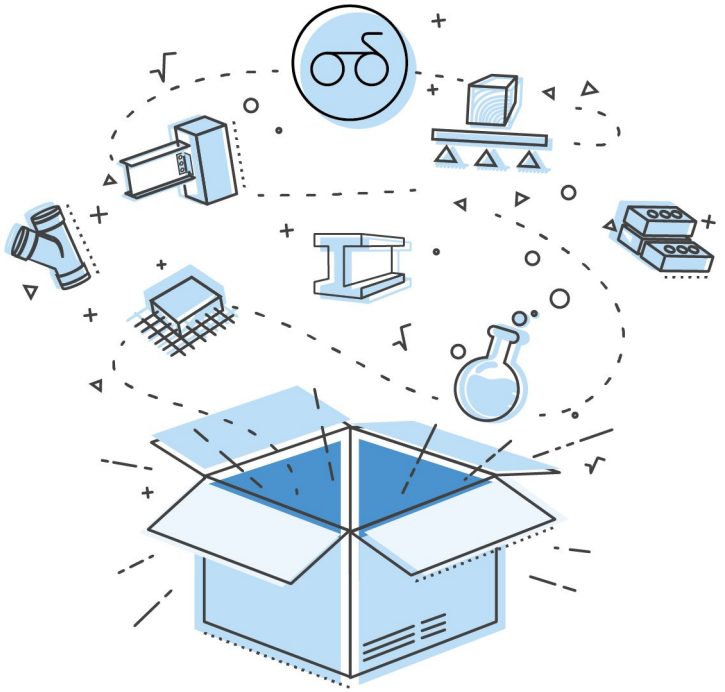
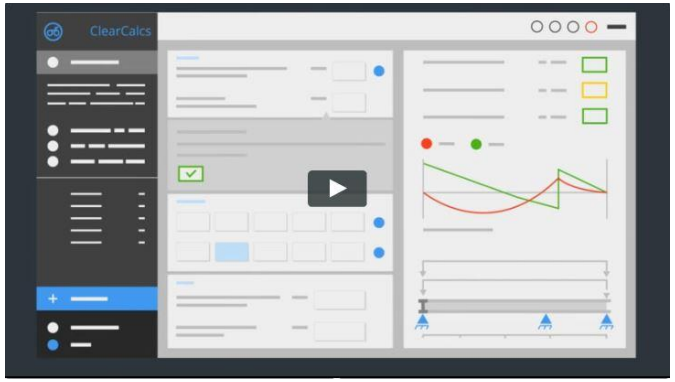


Say hello in the chat box 👋

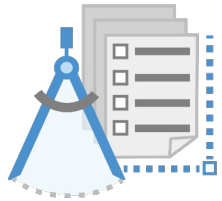
About ClearCalcs.com

ClearCalcs helps engineers design without compromise by bringing together powerful FEA analysis with easy to use design tools for concrete, steel, cold-formed steel and timber.

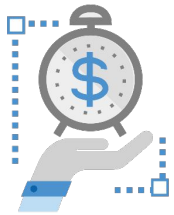
Explore our range at clearcalcs.com



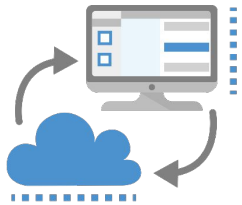
Intro Video Hyperlink



More Accurate
Design more accurately with unrestricted and accessible FEA analysis



Eliminates Wasted Time
Eliminate time wasted using clunky methods or waiting for software licenses to free up



Available Everywhere
Empower engineers to work effectively from office, home, or site

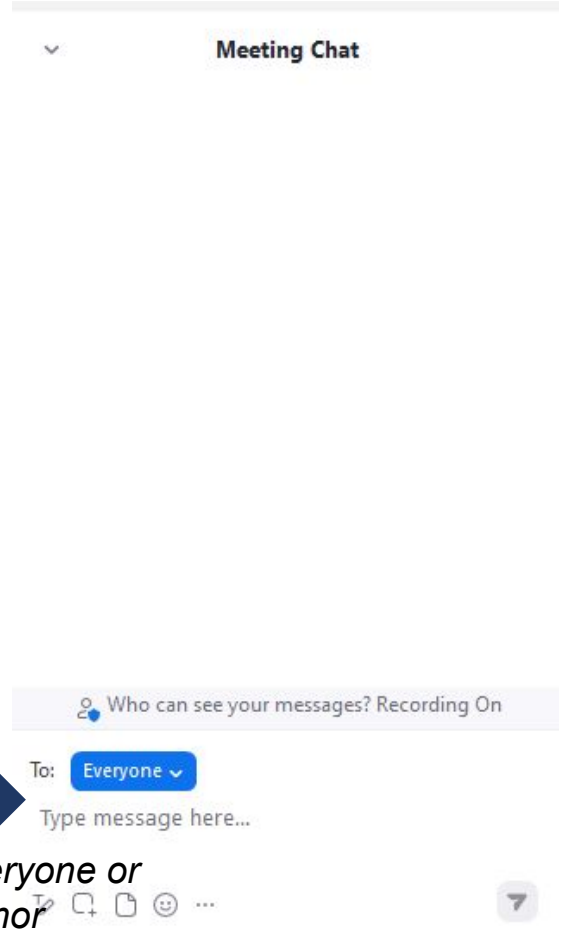
Meet the Presenters

- **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

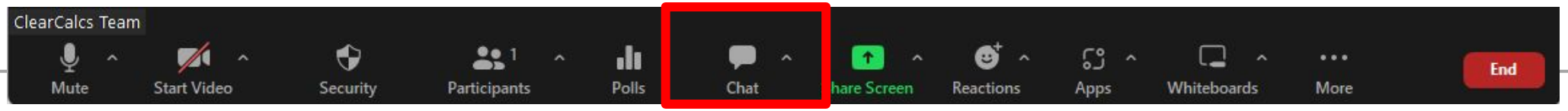
How to Ask Questions

- **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



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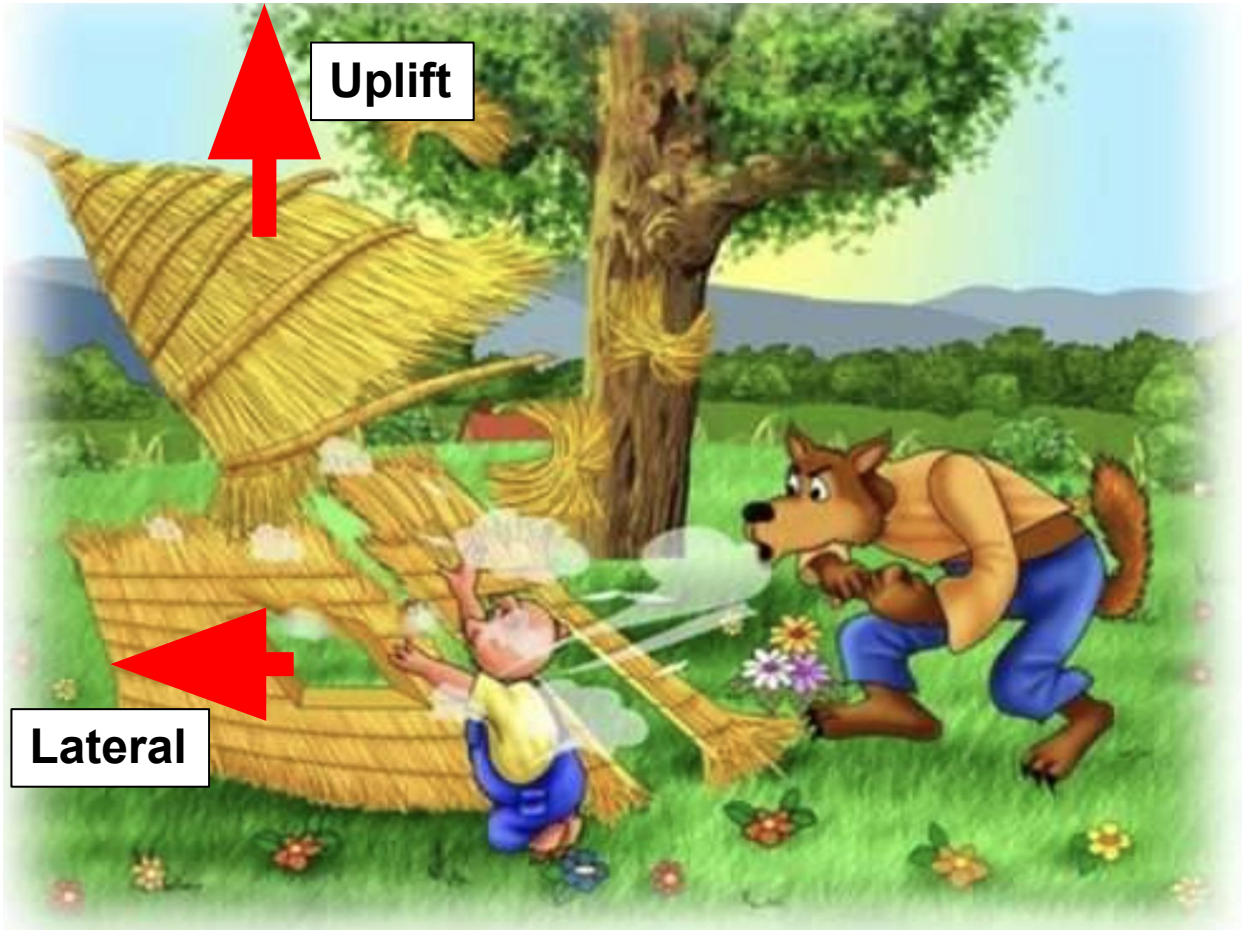
What we'll be discussing today

- The basics of wind loads
- How wind loads apply to buildings
- Two worked examples in ClearCalcs

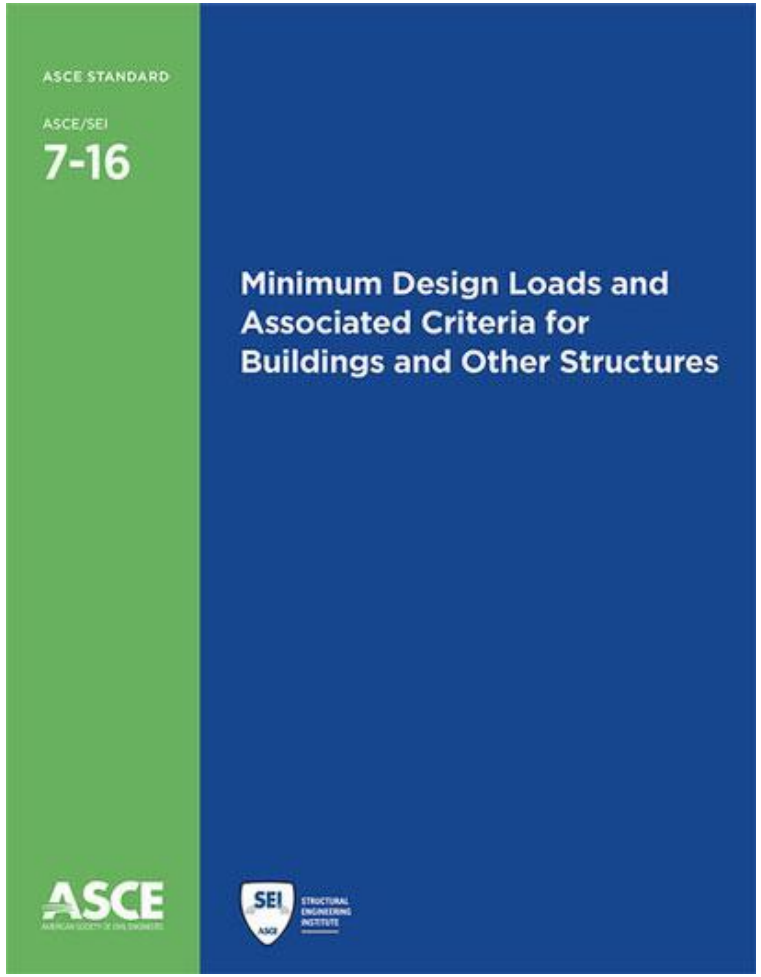
Basics of Wind Loads

- Wind generates air pressure on buildings that turns into loads
- Typically, we consider lateral loads and roof uplift
- The main driver for wind loads is **wind speed** – and a few other parameters we'll be looking at



ASCE 7 – Your Friendly Wind Code

- Essentially all building codes in the US refer to ASCE 7 for calculating wind 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

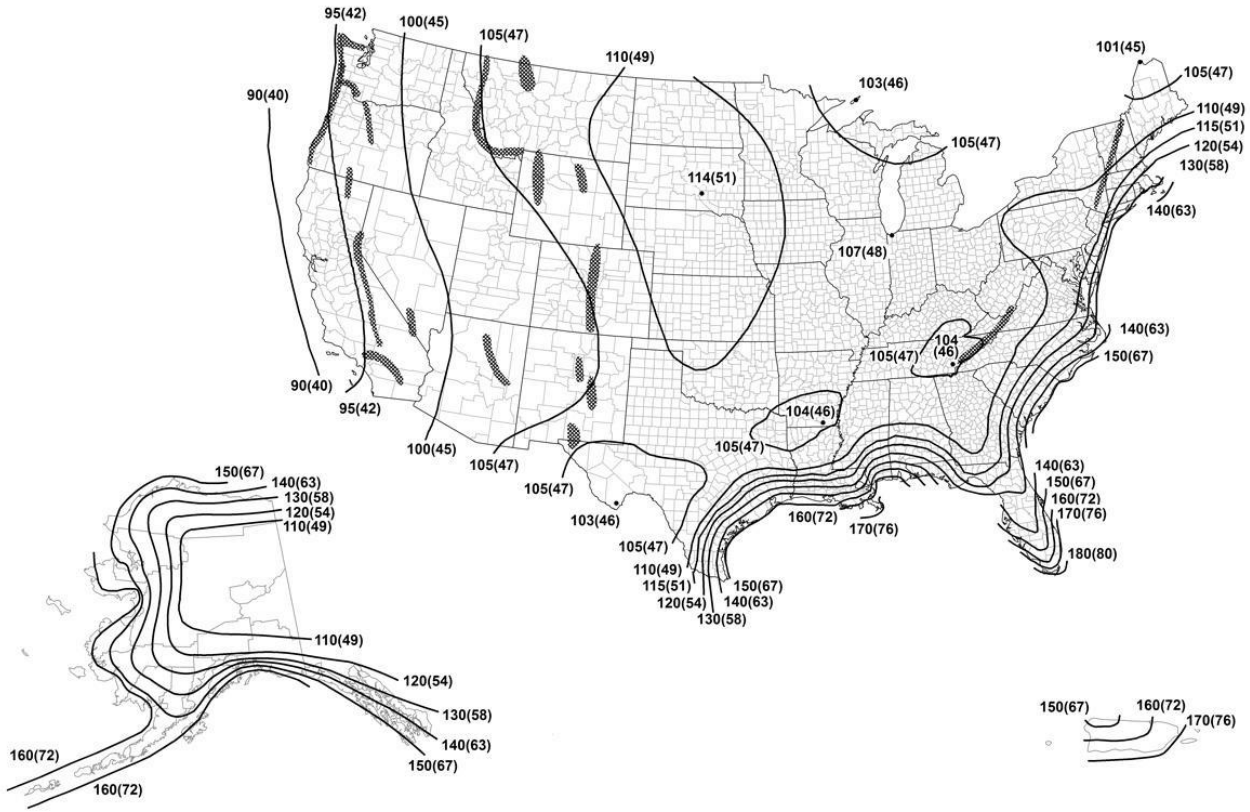


Design Wind Speed

- Design wind speed is based on geographic historical records
- The reference here is ASCE 7
- Wind pressure scales with the **square** of speed

Going from 100mph to 140 mph wind…

Double the wind load!



Near the coast… wind speeds can drastically increase within a few miles

Exposure Categories

Exposure B

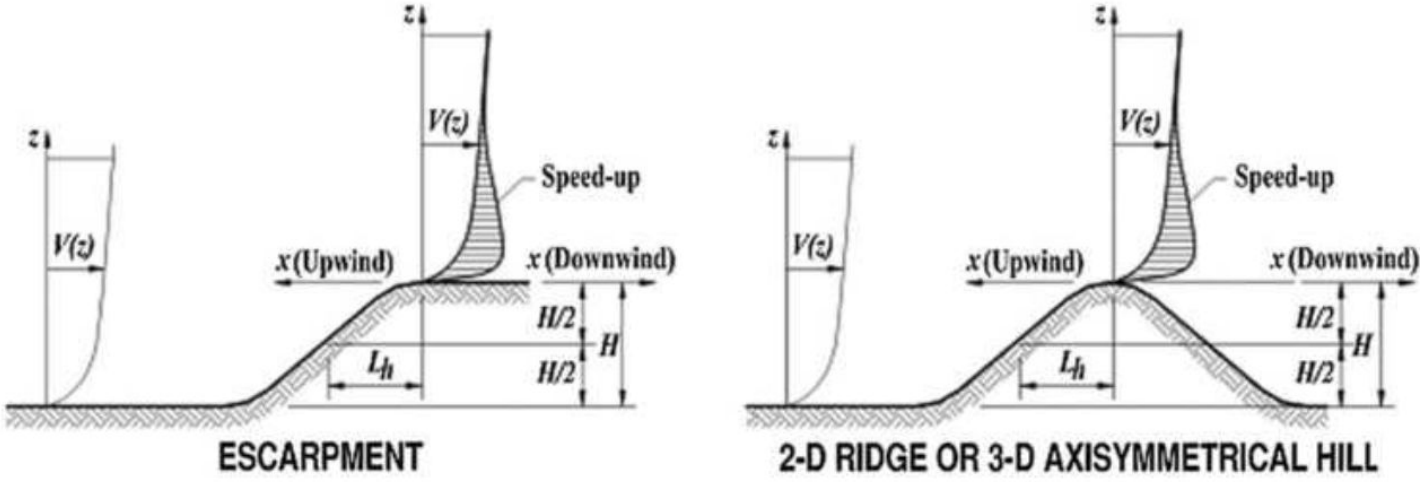
Exposure C

Exposure D

Generally… pick the worst-case exposure for your site

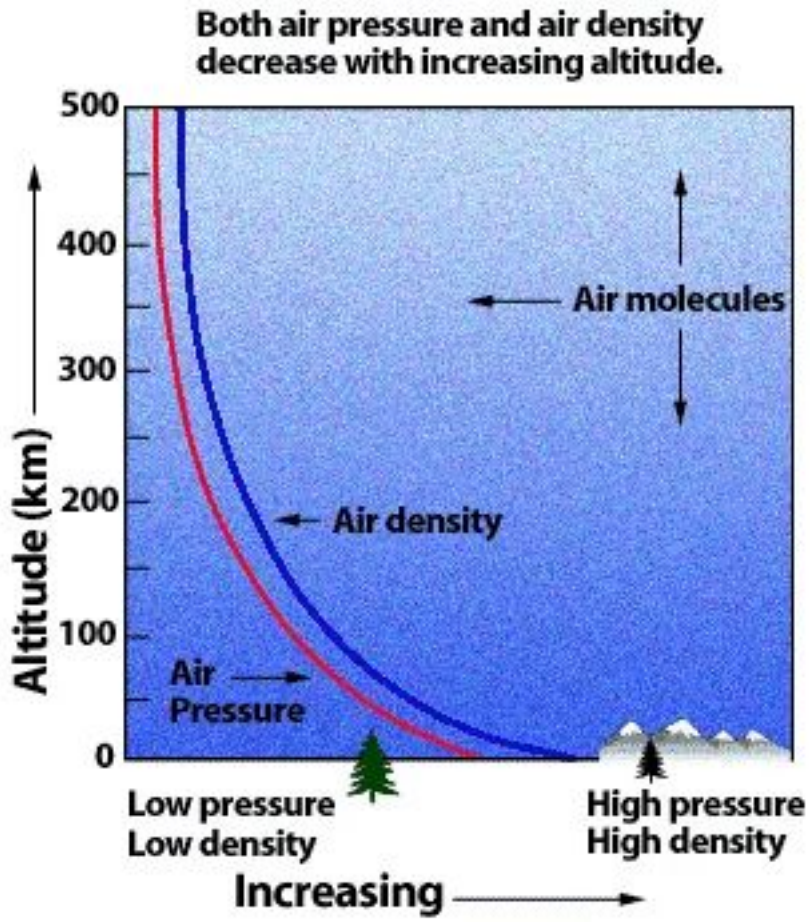
Topography

- Local topography can significantly increase wind speeds (sometimes more than double)
- If you're building near the top of a hill or ridge, you must consider this!
- Can apply to hills as low as 15 ft!



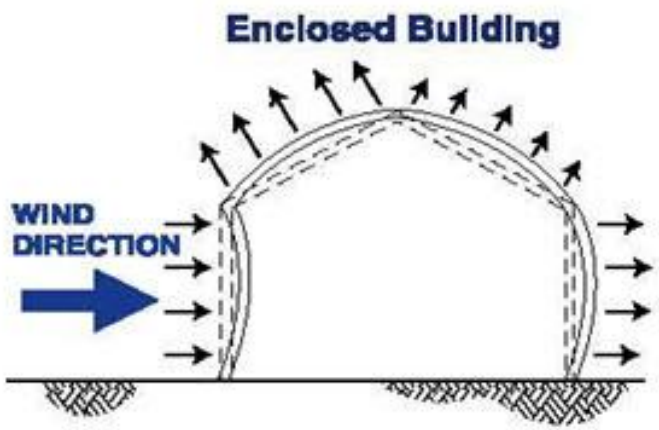
Elevation

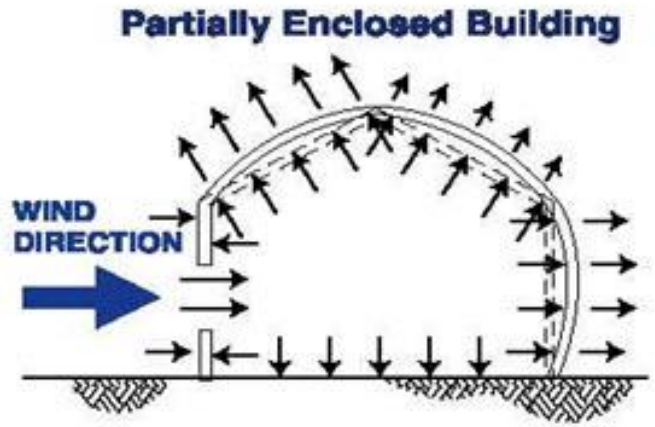
- Air gets thinner as elevation increases – this translates to lighter wind loads
- If you're in Colorado Springs, with all other factors the same, you get a 20% reduction on wind loads compared to sea level
- ClearCalcs will automatically calculate this elevation for you!



Building Enclosure

- Relates to the area of openings in the structure
  - **Enclosed**: Air generally doesn't come in – wind pressure outside
  - **Partially Enclosed:** Air flows into the building, but can't escape
  - **Partially Open:** Air flows into the building, and can escape
  - **Open**: Air flows through the building





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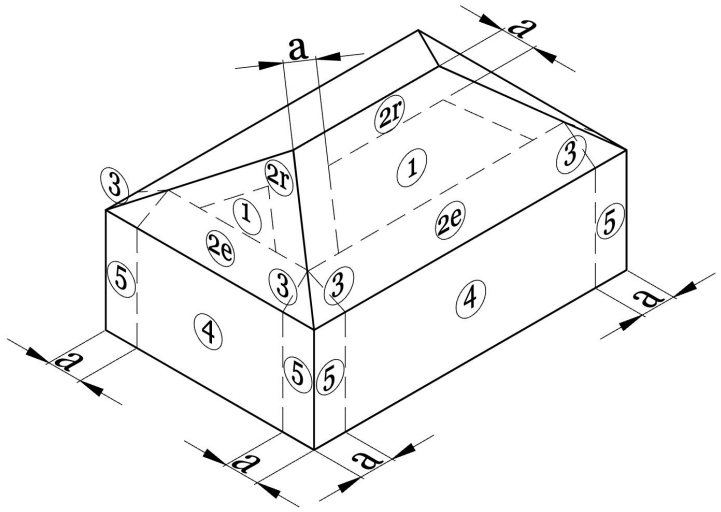
Wind Effects on Buildings

- We typically consider two distinct wind loads on buildings
  - **Components & Cladding (C&C)**
  - **Main Wind Force Resisting System (MWFRS)**
- Two main actions – lateral loads and uplift
  - In some cases –we need to consider torsion! But not in small residential

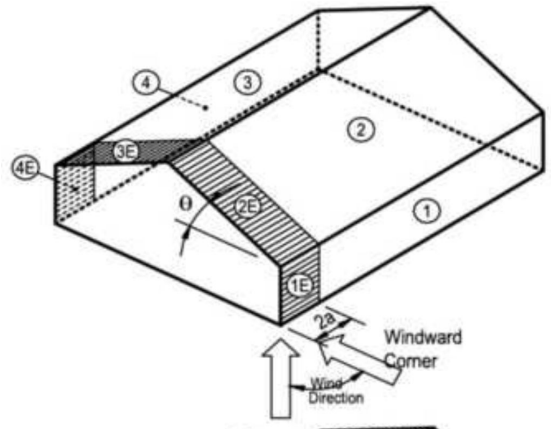
Components & Cladding

- This is governed by turbulence and local geometry (eg corners)
- Wind loads decrease as tributary area increases
- For small buildings such as houses, this is made straightforward with tabulated values
- Where you'd often to use this:
  - Cladding connections
  - Studs in tall walls
  - Rafters



MWFRS Loads

- These loads are applied over the entire area of the building
- This gets complicated for tall buildings for vibration considerations
  - Low and rigid buildings are much simpler
- ASCE 7 offers two methods to calculate these
  - Directional procedure (most universal method)
  - Envelope procedure (low-rise buildings only, but often lower loads)
- Where you'd normally use these loads:
  - Diaphragms & Shear walls
  - Foundations



ASD and LRFD Wind Loads

- Wind loads in ASCE 7 are at the **LRFD** level! To convert to ASD, multiply by 0.6
- Wind loads in ClearCalcs **are entered at the LRFD level** – the 0.6 factor is already included in load combinations

2.4 LOAD COMBINATIONS FOR ALLOWABLE STRESS DESIGN

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

Design Example 1 – Tall Wall

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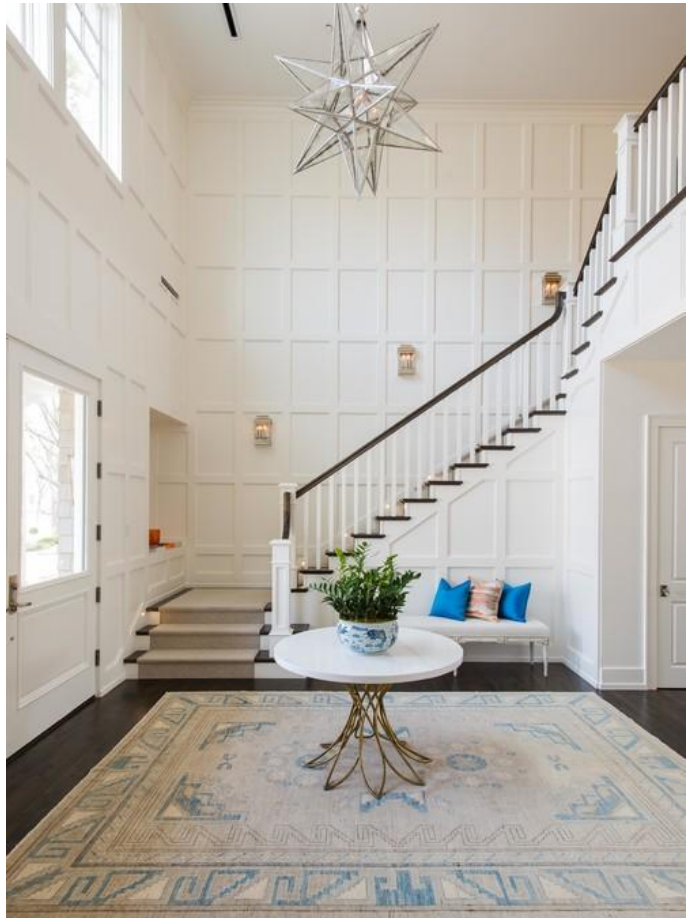
- Design a stud wall spanning two floors
- Design parameters:
  - Near City Hall (920 O St) in Lincoln NE
  - 2-story single-family bungalow
  - Gable roof
  - Plan dimensions are 40’ x 30’
  - Ridge height is 25’, top plate height 20’
  - Ridge runs along long dimension
  - Dead load on stud wall is 100 plf
  - Snow load is 200 plf



Interior Design Info

Design Example 2 – Finding MWFRS Loads

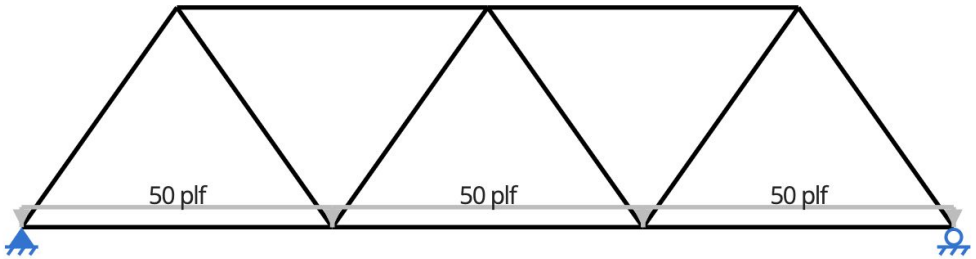
- Design parameters:
  - Same building as in Example 1
- Find the MWFRS loads in psf using the envelope procedure

Conclusion

- Wind loads are a critical design load to consider in most designs
- Most important is the design wind speed, but there are also significant factors to consider
- We consider two type of wind loads
  - Components and Cladding
  - Main Wind Force Resisting System (MWFRS)
- ClearCalcs can help you perform these calculations smoothly

What's new at ClearCalcs

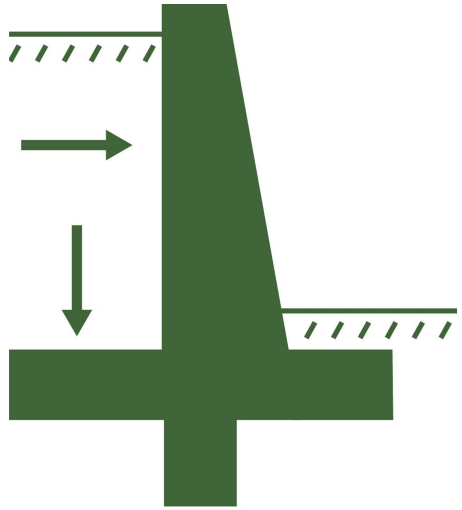
- Custom wood properties
- Wood and steel truss design
- Shear keys in retaining walls



▸ Custom Species Parameters

Custom Parameters =

Species Name	Bending F_b (psi)	Shear Parallel to Grain F_v (psi)	Compression Parallel $F_{c\perp}$ (psi)	Modulus of Elasticity for Deflections E (psi)	Modulus of Elasticity For Stability E_{min} (psi)
Custom Species	1000	175	565	1 600 000	580 000



Webinars coming up!

- Shuriken Connectors for Steel Tubes
  - with inventor Ted Goldstein at Atlas Tubes
  - **June 7**
- Steel Base Plate Design to American Standards
  - **June 28 at 1 PM (ET)**
- Starting your engineering practice with David Hourdequin
  - **Date TBD**
- Sign up at https://clearcalcs.com/webinars !

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Questions?

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.
- If you have further questions, send an email to help@clearcalcs.com or use the Help button in ClearCalcs