Loads and Load Paths

- Structural Design
- Design Loads
  - Snow Load
  - Lateral Loads(wind)
- Load Path

Steps in Structural Design

1. Planning – How will the building be supported?
2. Establishing the loads
3. Designing preliminary structural configuration and layout
4. Analyzing structural members
5. Selecting preliminary structural members
6. Evaluating the preliminary design
7. Redesigning (if needed) – Repeat the above steps as necessary to achieve a safe and efficient design
8. Designing and detailing the structural components

Design Loads

- The load that is assumed for the design of a structure
- May include one or more of the following:
  - Dead Load
  - Live Load
  - Snow and Ice Load
  - Rain Load
  - Flood Load
  - Wind Load
  - Earthquake Load
  - Earth Pressure Load

Design Loads

Snow Load

- Force of accumulated snow on a roof
- Specified in building codes (or local building department)
- Depends on
  - Location
  - Exposure to wind
  - Importance of building
  - Roof slope

Design Loads

Design Snow Load Calculation

$$p_s = 0.7 C_s C_e C_t I_s p_g$$

p_s = Design snow load

C_s = Roof slope factor

C_e = Exposure factor

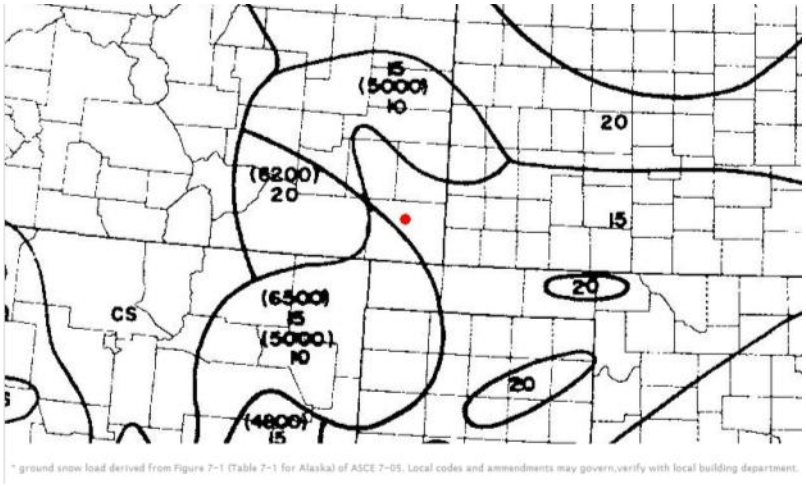
C_t = Thermal factor

I_s = Importance factor

p_g = Ground snow load

Design Snow Load

- Find the ground snow load
- For Springfield, CO (red dot) the snow load is 15 psf



Ground Snow Load in psf

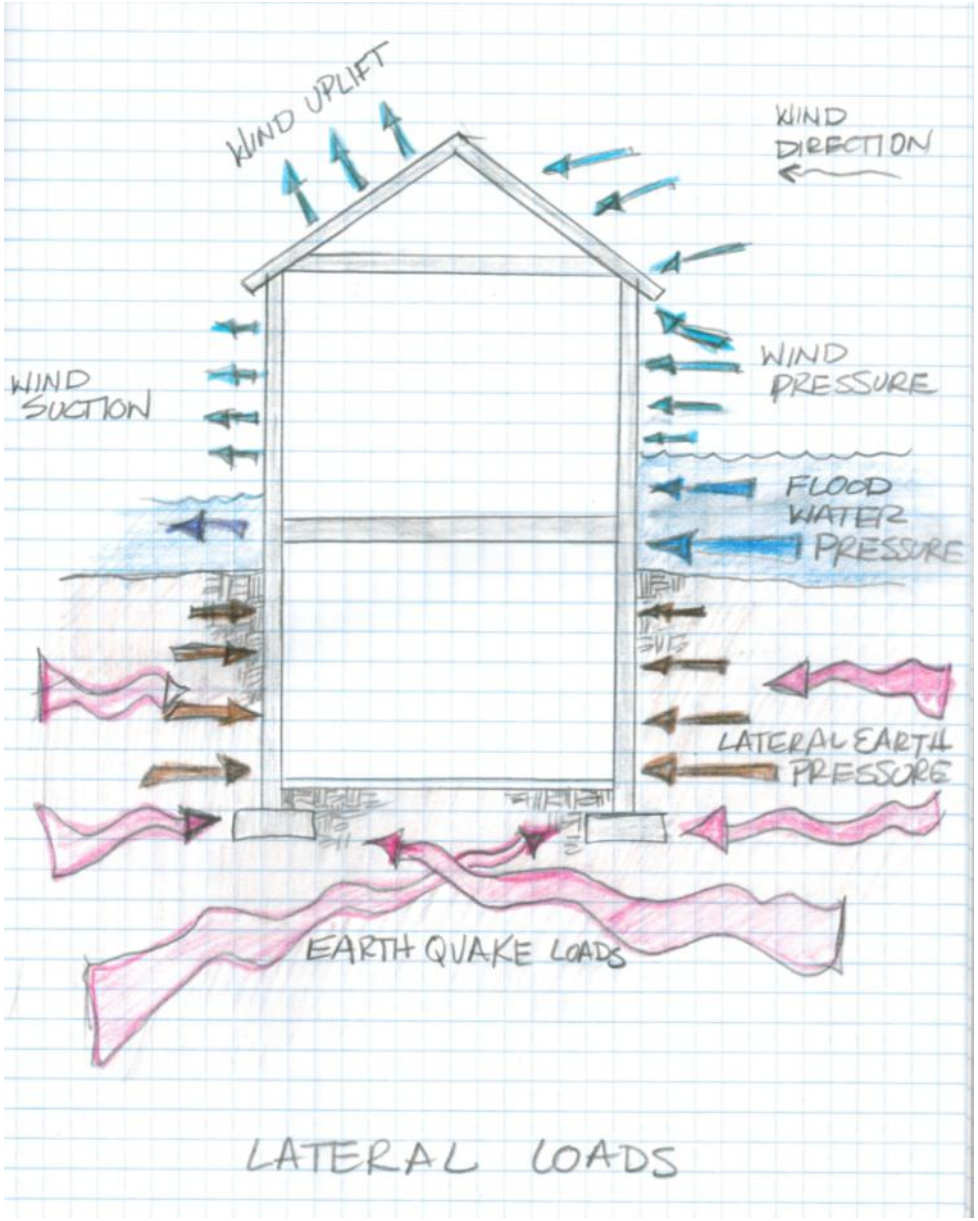
Minimum Snow Load

- If $p_g \leq 20\ psf$, then $p_s \geq I_s p_g$
- If $p_g > 20\ psf$, then $p_s \geq I_s \cdot 20\ psf$

Design Loads

Lateral Loads

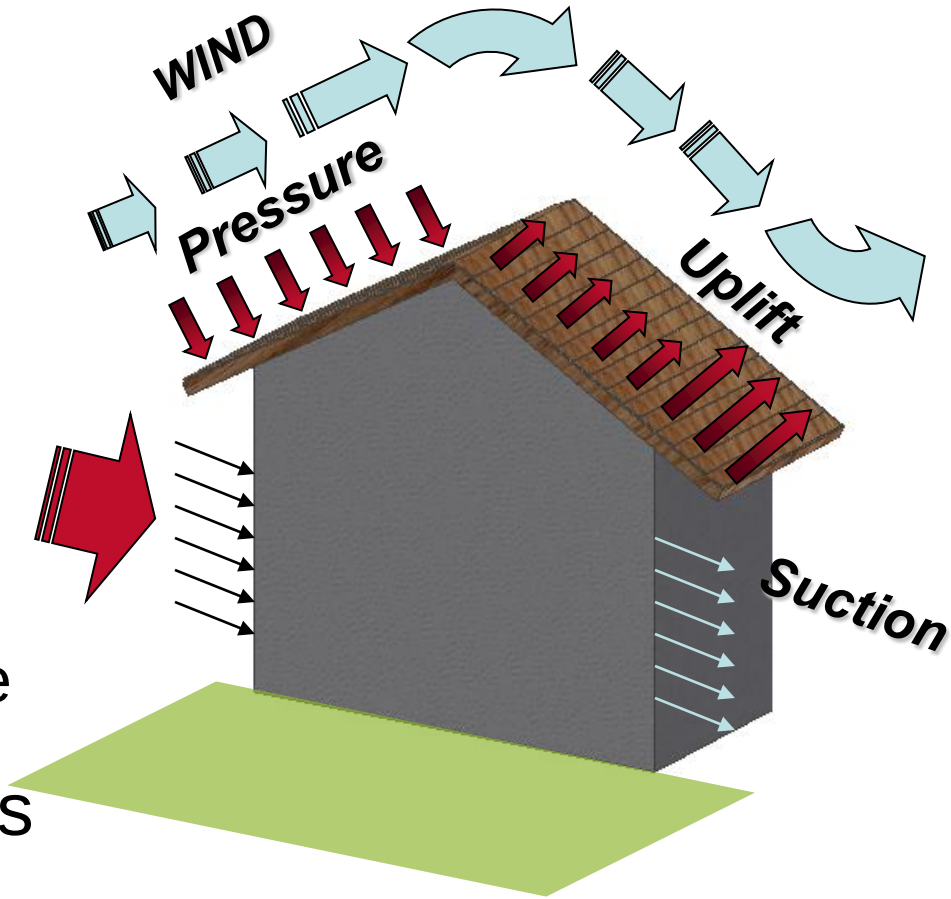
- Wind Loads
- Earthquake Loads
- Flood Loads
- Earth Pressure Loads



Design Loads

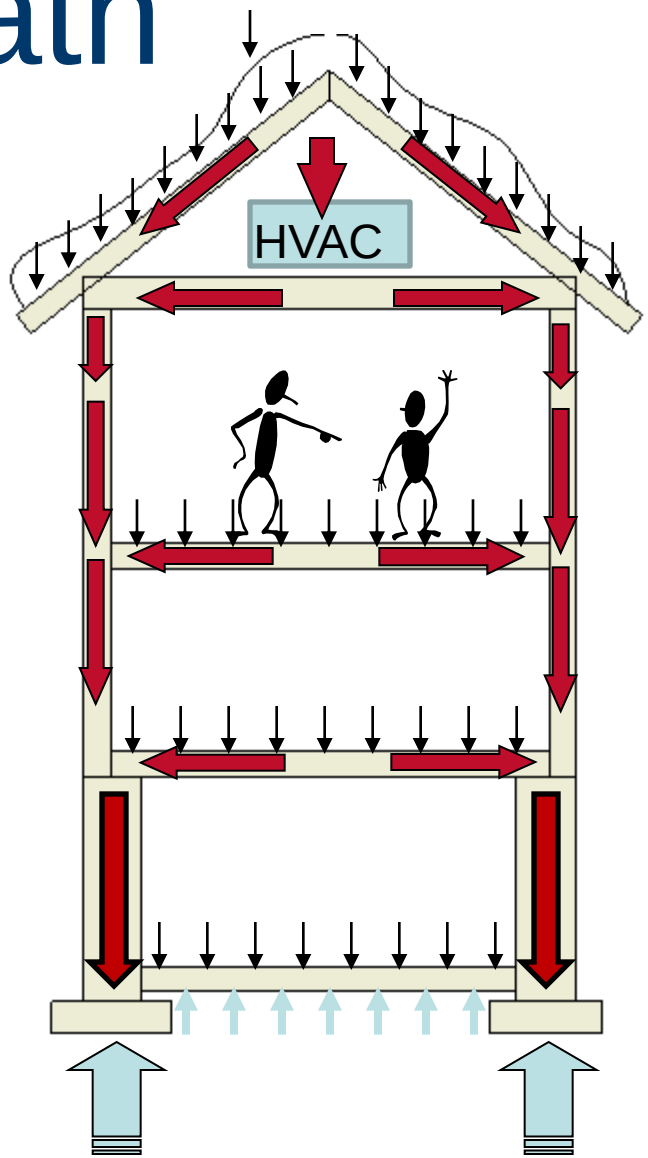
Wind Load (WL)

- Resulting loads yield:
  - Lateral load on walls
  - Downward and upward pressure on roofs
  - Overturning of the structure
- Specified in building codes



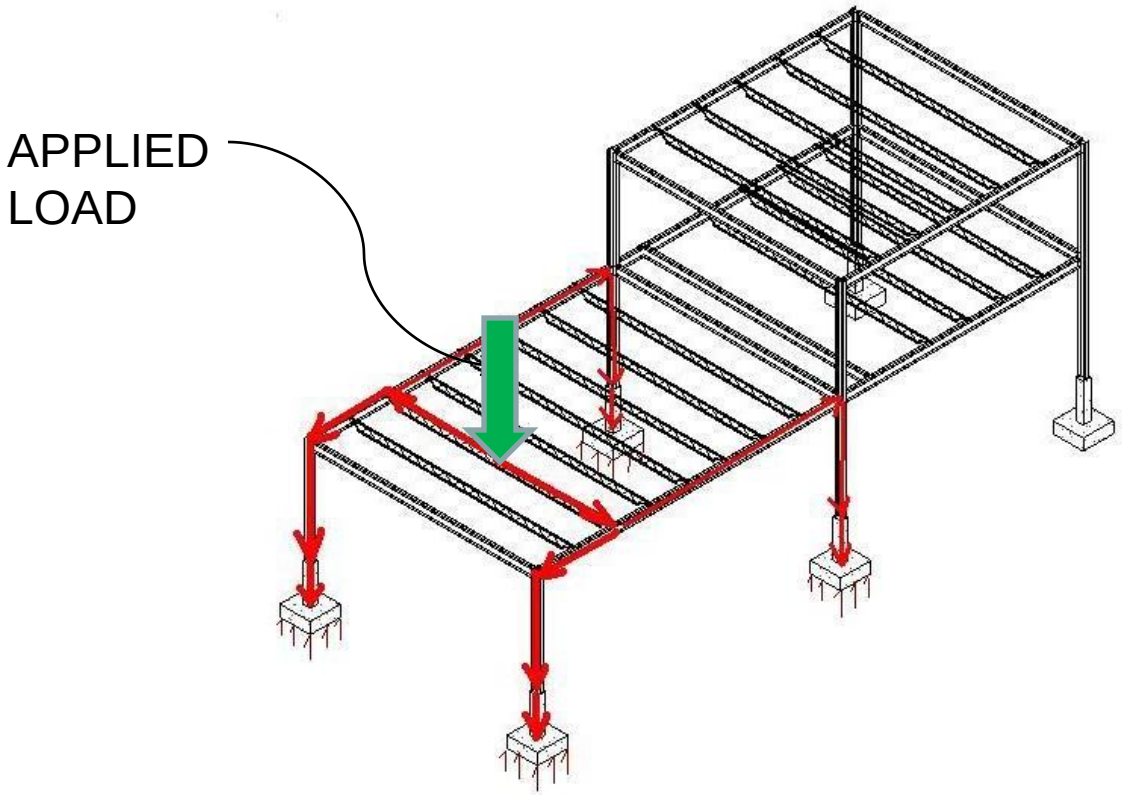
Load Path

- The path that a load travels through the structural system
- “Tracing” or “chasing” the loads
- Each structural element must be designed for all loads that pass through it



Load Path

Every load applied to the building will travel through the structural system until it is transferred to the supporting soil.



Structural Elements

- Within the structural systems, individual structural elements must work together to carry and transfer the applied loads to the ground.
- Examples of structural elements include:
  - Roof Decking
  - Elevated Slabs
  - Load Bearing Walls
  - Connections
  - Beams
  - Girders
  - Columns
  - Footing

“Load Chasing” for Structural Design

The structural design is performed by “chasing the loads” of the dead and live load from slabs to beams to girders, then on to the columns or walls. The loads are then carried down to the footing or foundation walls and finally to the earth below.