

Structural Systems Design of the Lincoln Fire Department Headquarters

Michelle Burback

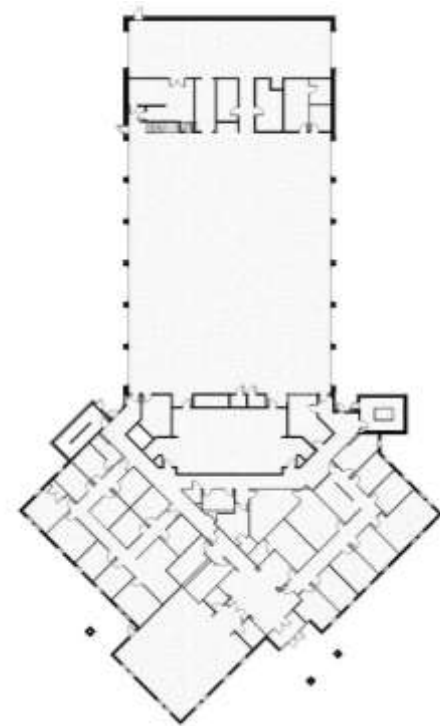
Structural Engineering Capstone
and Senior Honors Project

Objective

- To design both gravity and lateral load systems in accordance with the local codes of Lincoln, Nebraska

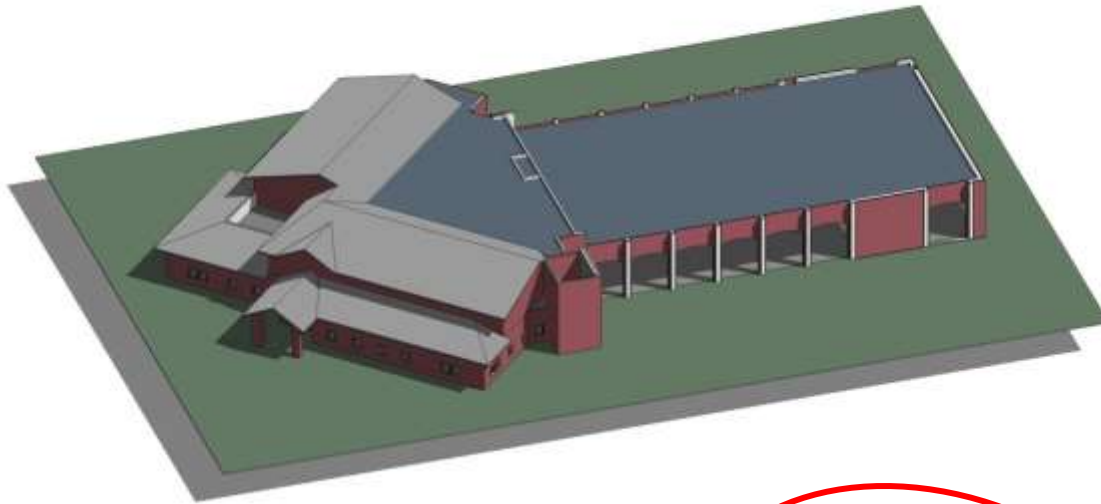


Building Site in Lincoln, Nebraska

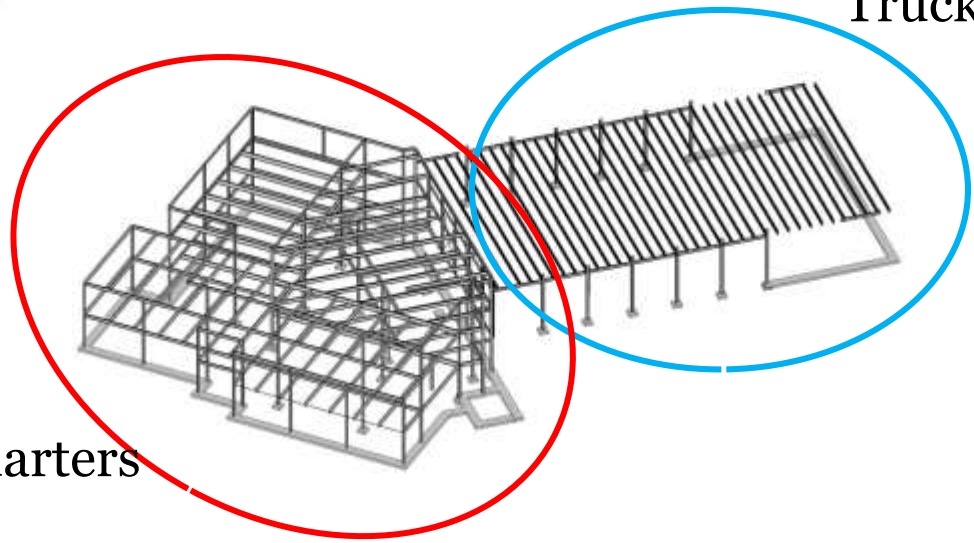


Architectural Floor Plans

Building Layout



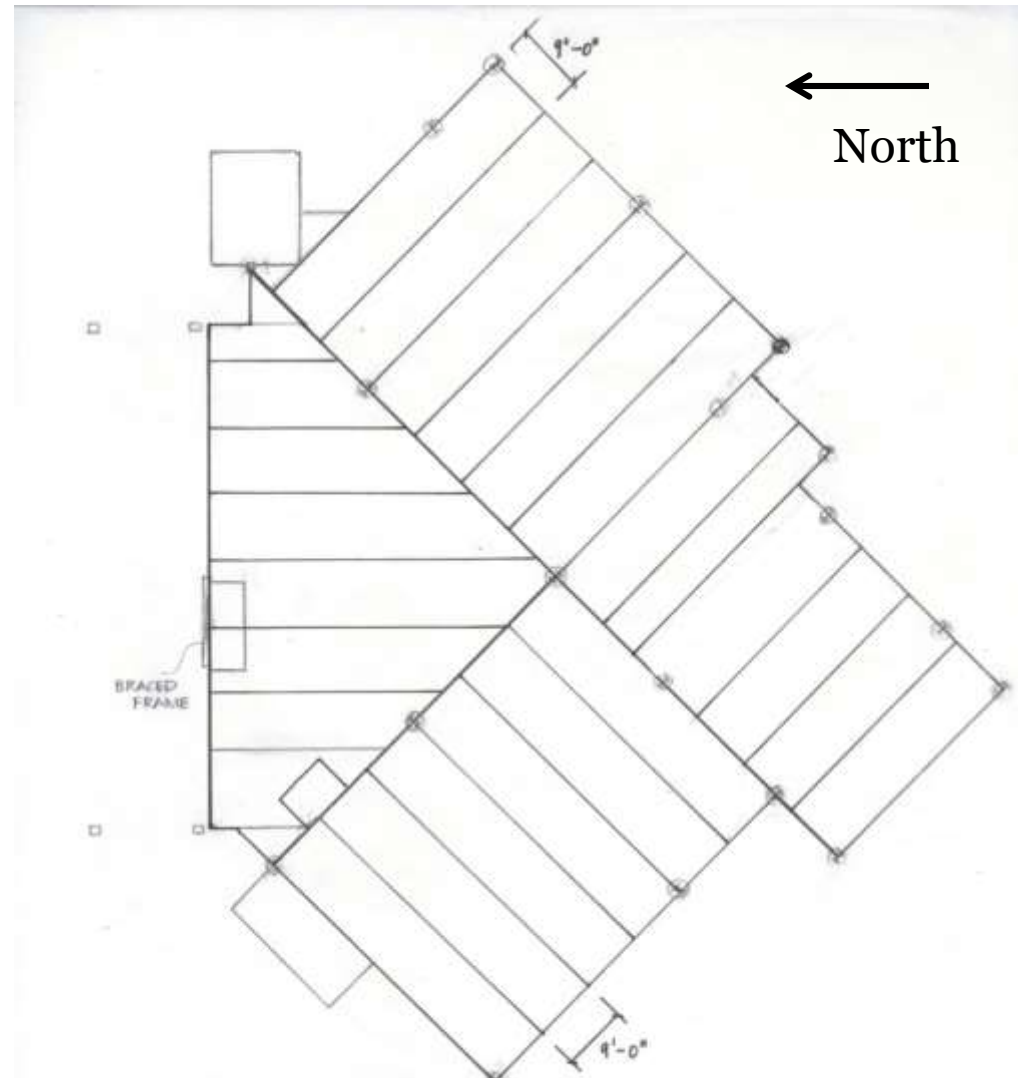
Truck Bay



Living Quarters

Gravity Loads

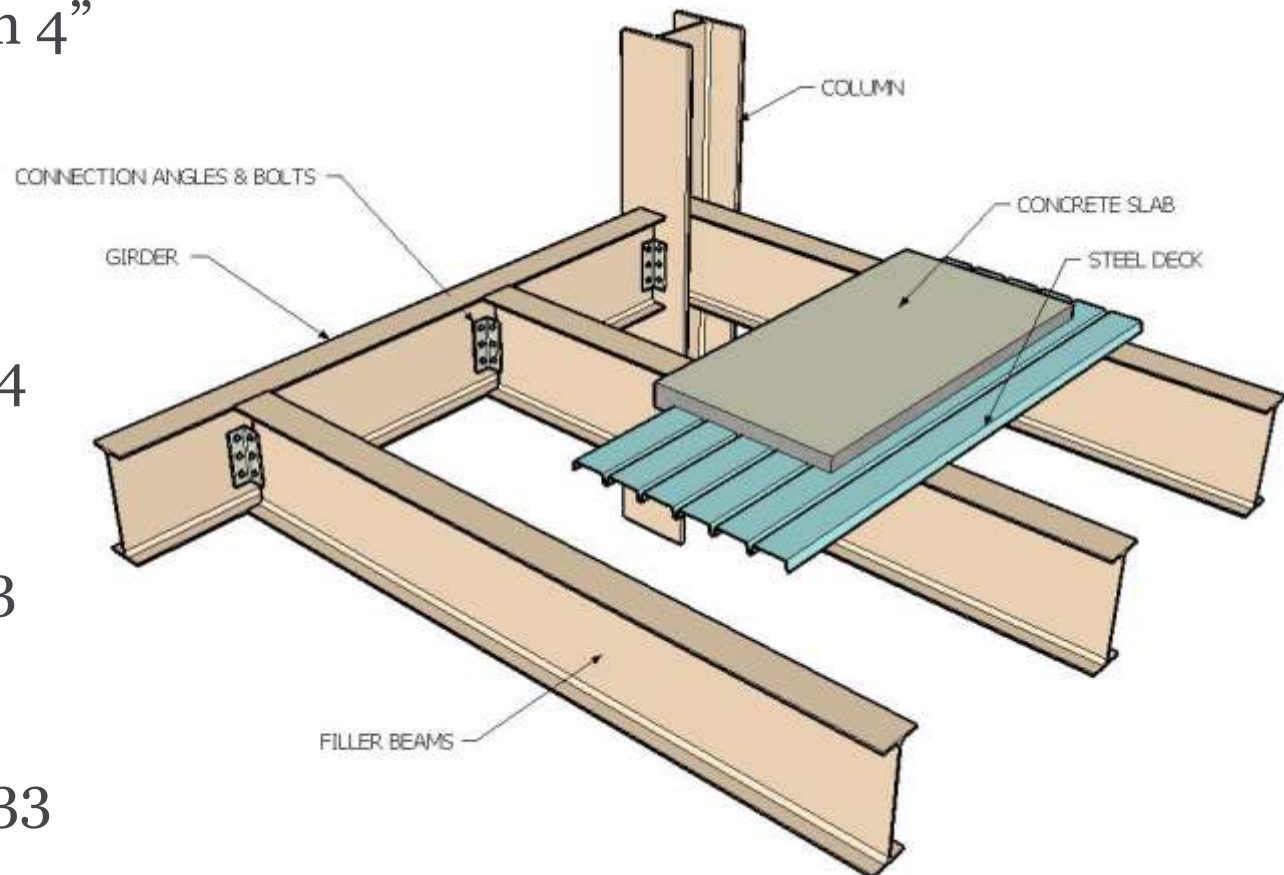
- Design Loads:
 - Flat roof snow load: 25 psf
 - Floor live load: 100 psf
 - Floor dead load: 45 psf



Framing plan for the living quarters

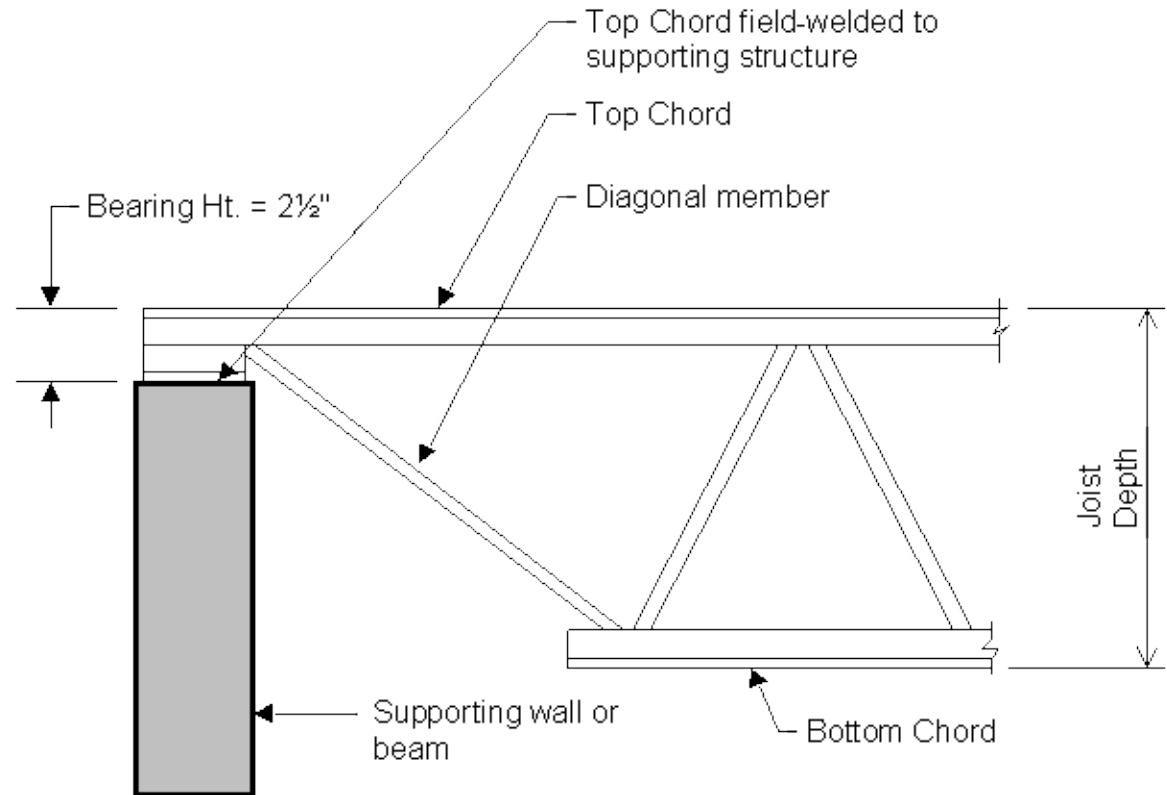
Firehouse Gravity System

- Composite deck:
2VLI19 deck with 4”
concrete slab
- Steel beams:
W16x40,
W18x40, W21x44
- Girders:
W14x34, W21x73
- Columns:
W12x106, W10x33



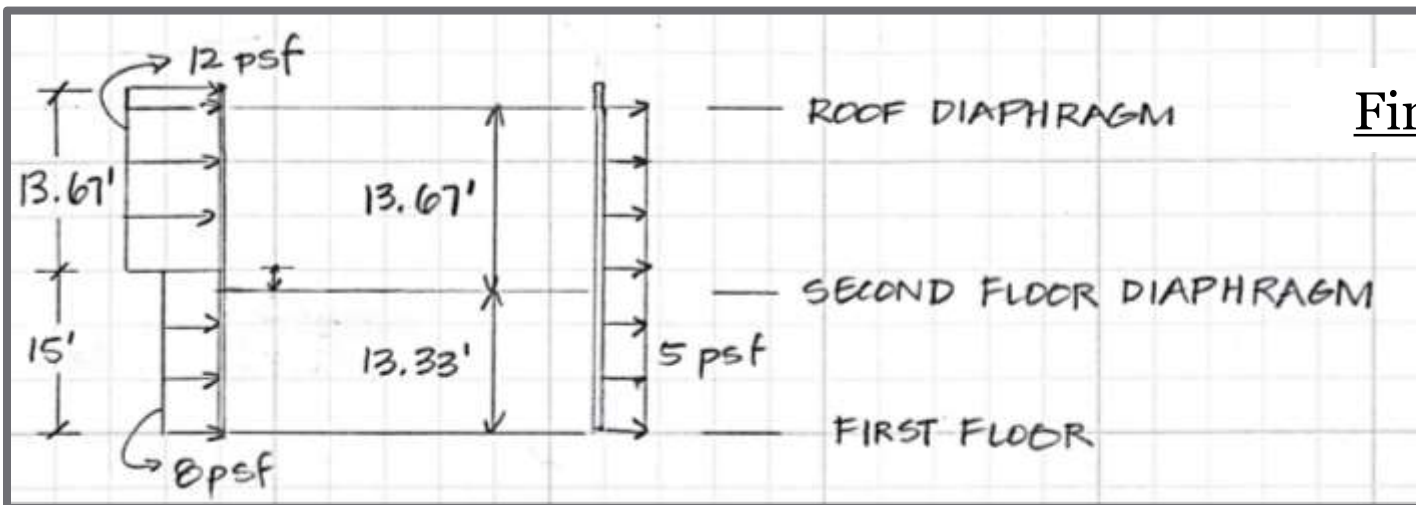
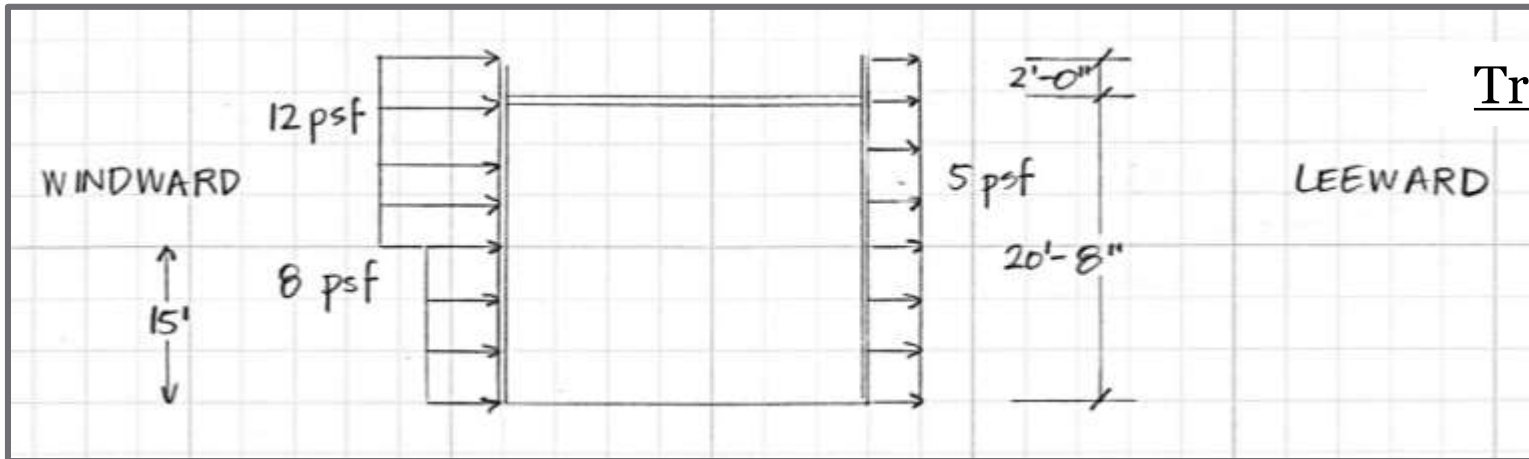
Truck Bay Gravity System

- Steel deck (non-composite):
NR22
- Open-web joists: 40LH09
- Girders:
W10x26
- Columns:
W10x33

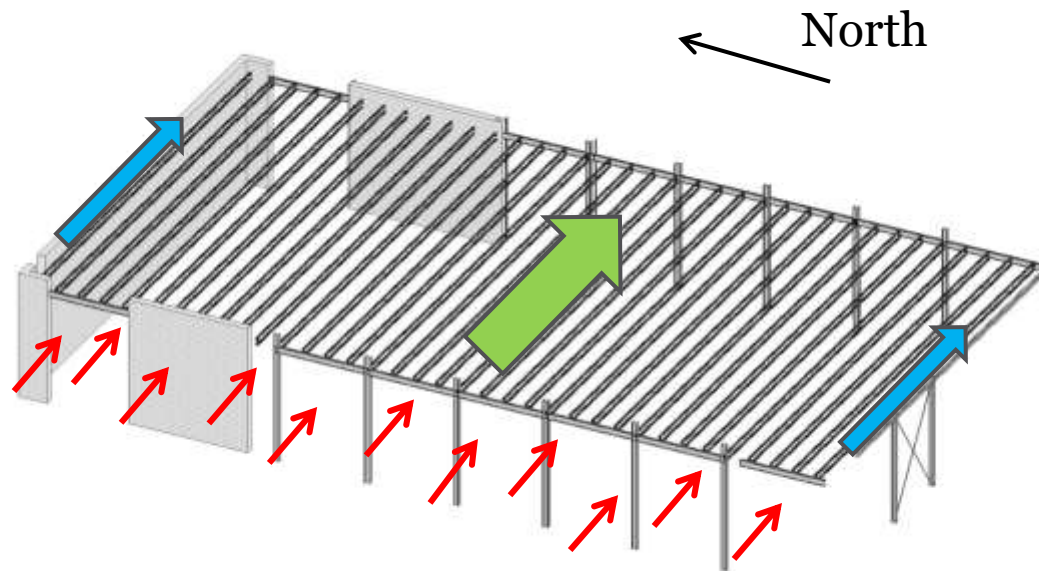


Typical Steel Joist Detail

Lateral Loads



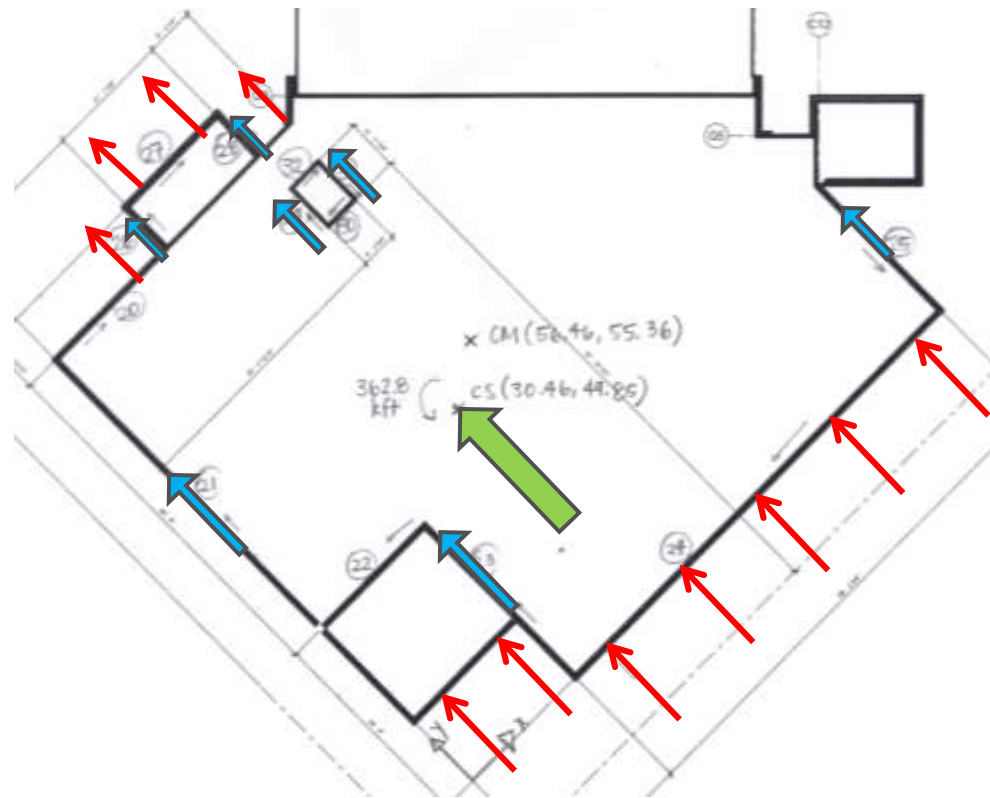
Truck Bay Lateral System



- Flexible roof diaphragm
- Masonry shear walls at north end
- Braced frame at south end

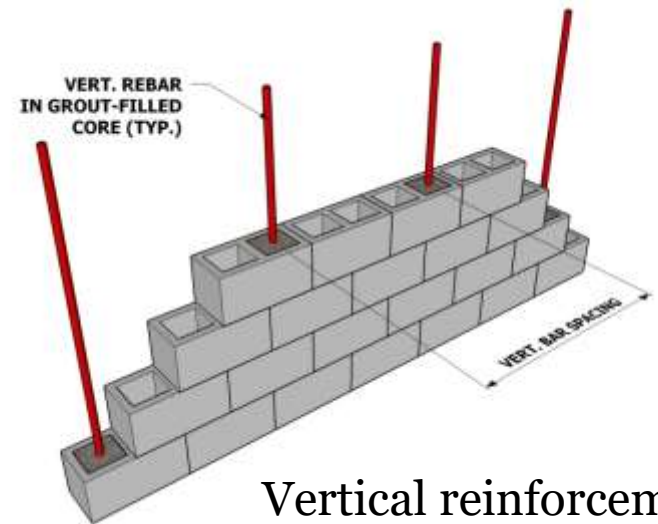
Firehouse Lateral System

- Wind pushes on exterior walls
- Exterior walls transfer load to floor or roof diaphragm
- Floor/roof act as rigid diaphragms
- Diaphragms transfer load to masonry shear walls

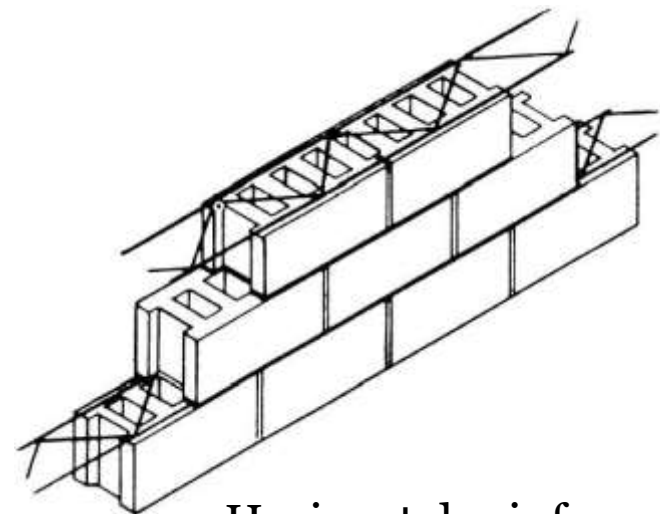


Shear Wall Design

- 8" CMU walls
- $f'_m = 1500$ psi
- Fully grouted
- Designed as unreinforced detailed masonry
 - Vertical: 1 No. 4 bar every 10 feet, around openings, movement joints, and corners
 - Horizontal: two longitudinal wires every two CMU courses, and at bottom and top of walls



Vertical reinforcement



Horizontal reinforcement

Summary

- Gravity and lateral systems were designed to:
 - Withstand the given loads
 - Meet the needs of the architect and mechanical engineers
 - Maximize ease of construction
 - Minimize construction cost

Any questions?

A decorative horizontal line consisting of a thick green bar on top, followed by a thin white bar, and then three thin white lines below it, all extending across the width of the slide.

References:

- “Steel Frame Construction.” Delhi State University: 2011. Image.
<http://faculty.delhi.edu/hultendc/A220-Week3-Lecture-Web.html>.
- “Concrete Masonry Unit (CMU) Construction.” Delhi State University: 2008. Image.
<http://faculty.delhi.edu/hultendc/A220-Week2-Lecture-Web.html>.