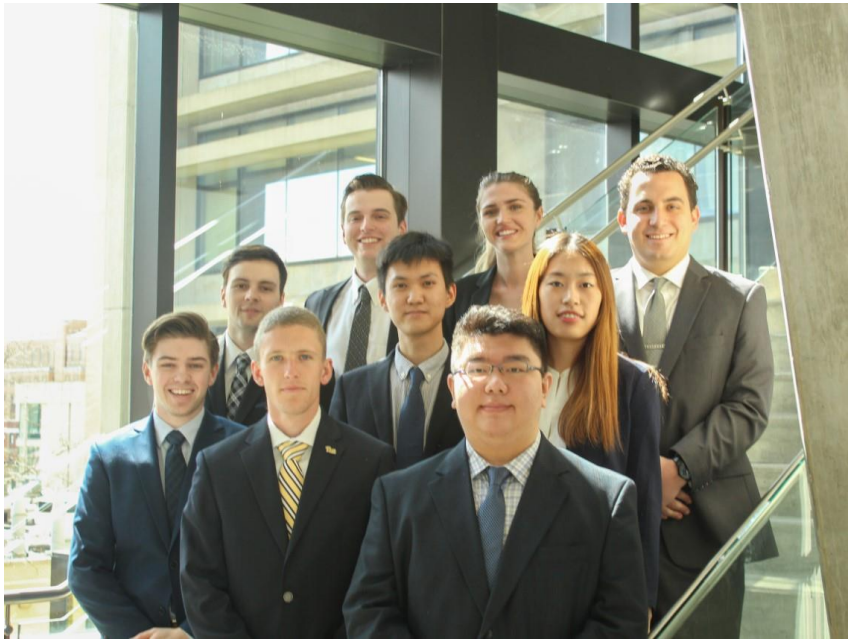
# Schenley Oval Project

# Team Members

- Vincent DiCarolis (Project Leader, Construction Group)
- Jacob Bobak (Construction Group)
- Alex Farris (Structural Group)
- Kaixuan (Kevin) Li (Construction Group)
- Megan McNally (Structural Group)
- Tyler Roman (Construction Group)
- Nathan Sloan (Construction Group)
- Yizhen Yan (Construction Group)
- Jiangnan Zheng (Geotechnical Group)



# Presentation Schedule

- Project Background
- Building Model/Utility Line
- Soil/Foundation Analysis
- Structural Analysis
- Cost Estimate
- Risk Analysis
- Scheduling & Staging
- Future Steps

# Project Background


Oakland
Google Earth

# Schenley Park

- 456 acre municipal park operated by the **Pittsburgh Parks Conservatory** and the **City of Pittsburgh**
- Many of the facilities are provided by the **City of Pittsburgh Department of Parks and Recreation (aka Citiparks)**
- Located between Oakland, Greenfield, and Squirrel Hill

# Schenley Oval

1. Disc Golf Course
2. Ice Skating Rink
3. Playground/Pavilion
4. Restrooms
5. Soccer Field, Track, Tennis Courts
6. Open Field (Used for soccer fields)

# Need Assessment

- **Need:**
  - There is a lack of facilities for use by the public during sporting events at the Schenley Oval
- **Approach:**
  - Add a 1 story building at the sports complex at the Schenley Oval
  - Provide a rest area for the parents while their kids are playing sports
  - Benefits will include:
    - Food Concessions
    - Covered eating and relaxing area
    - View looking out at downtown
    - Storage for sports, kitchen,  and other equipment
    - Restrooms

# Site Location

- Close proximity to playground for easy supervision
- Nice view of the city
- Short walking distance to the soccer field/track

# Public Feedback

- Discussed  the scope with Sportsplex users
  - Enjoyed the Project Scope
  - Appropriate location
  - Gained knowledge on demand
    - March through October
    - Estimated 1,000 people during peak hours

# Building Code/Zoning Laws

- Park District, P
  - No restrictions due to zoning law setbacks
    - 150’ between street and playground
- Allegheny County Health Department
  - Easily cleanable walls, ceiling, and floor
  - 2 separated ADA compliant restrooms
- 2012 IBC used for structural analysis

# Building Operations

The building will

- Be open seasonally, (March - October)
- Hours will fluctuate around events
- Will be maintained with regular park building maintenance.
- Serving food, we will  need an inspection from the Allegheny County Health Department
- The storage can be used for sports equipment, kitchen equipment, etc.

# Building Model/Utility Map

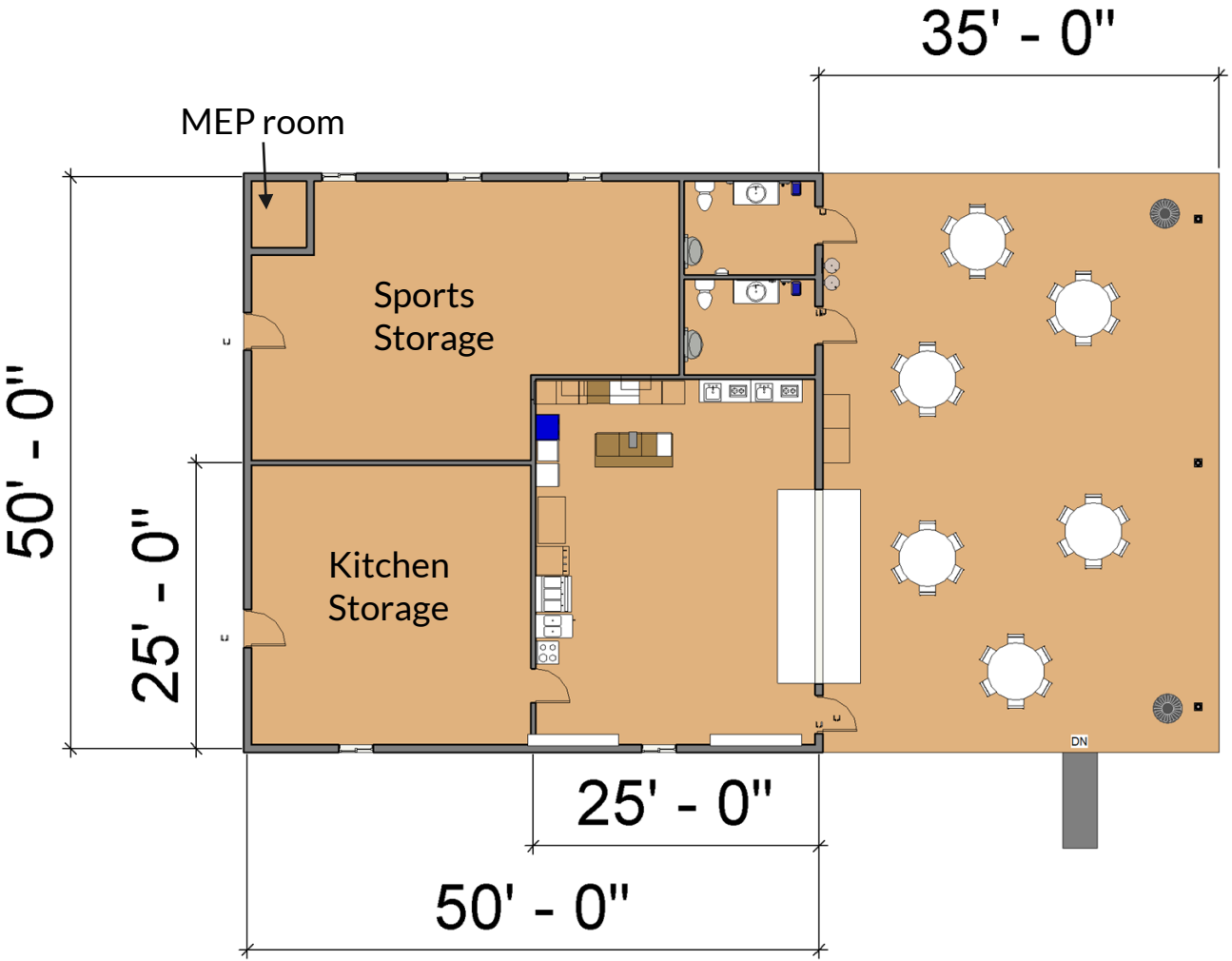
# Building Layout

- Design developed through discussions with team members, suggestions from Dr. Rizzo and responses from the Survey.
- Current design consists of Five sections
  - Indoor Kitchen - 750 $ft^2$
  - Kitchen Storage room - 625 $ft^2$
  - Sports Storage rooms - 925 $ft^2$
  - Outdoor seating area (can be enclosed) - 1750 $ft^2$
  - Restrooms - 250 $ft^2$
- Overall dimensions are 85 ft x 50 ft - **4250 $ft^2$**

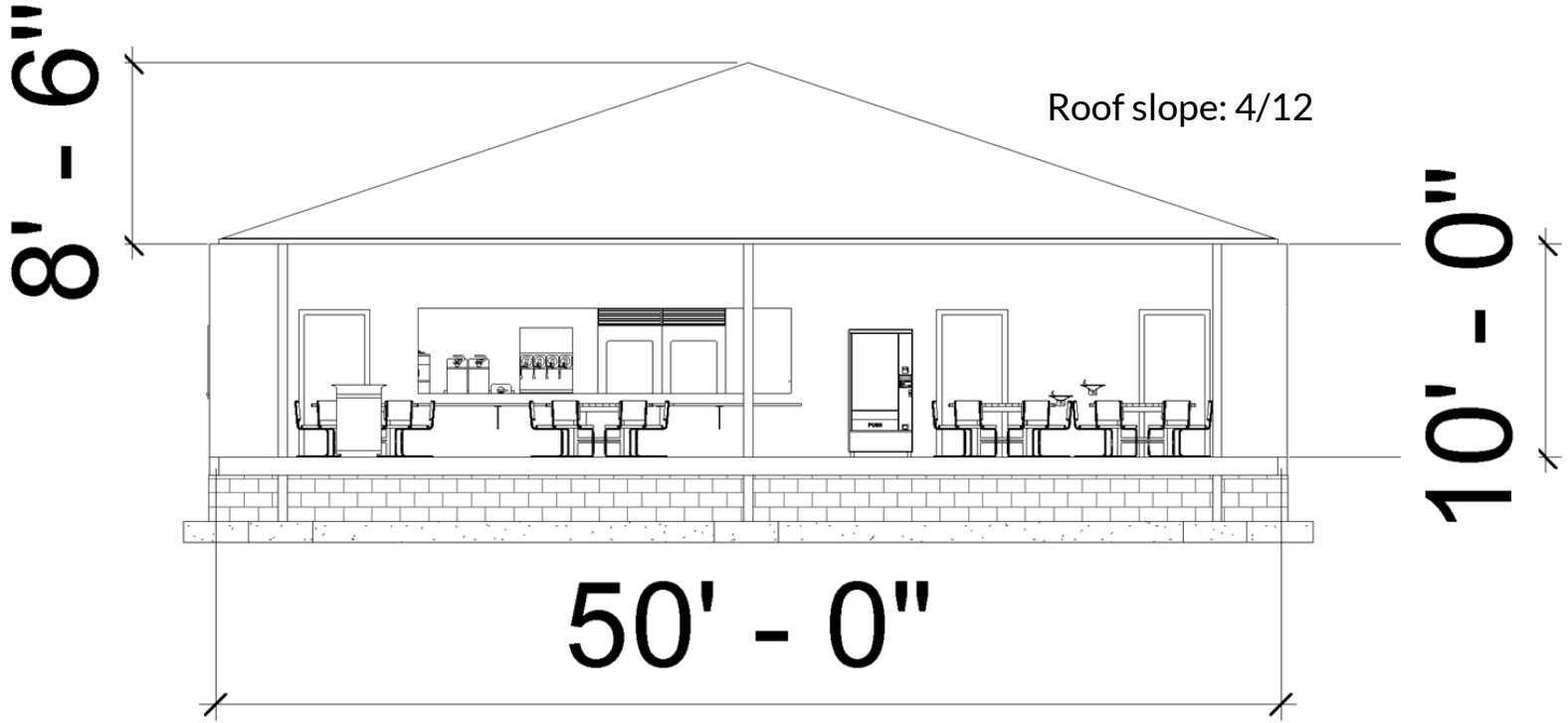
# Building Orientation

- Changed from initial E-W orientation to N-S orientation.
- View for the city Skyline.
- Better view of the playground and soccer field.
- Away from direct wind.

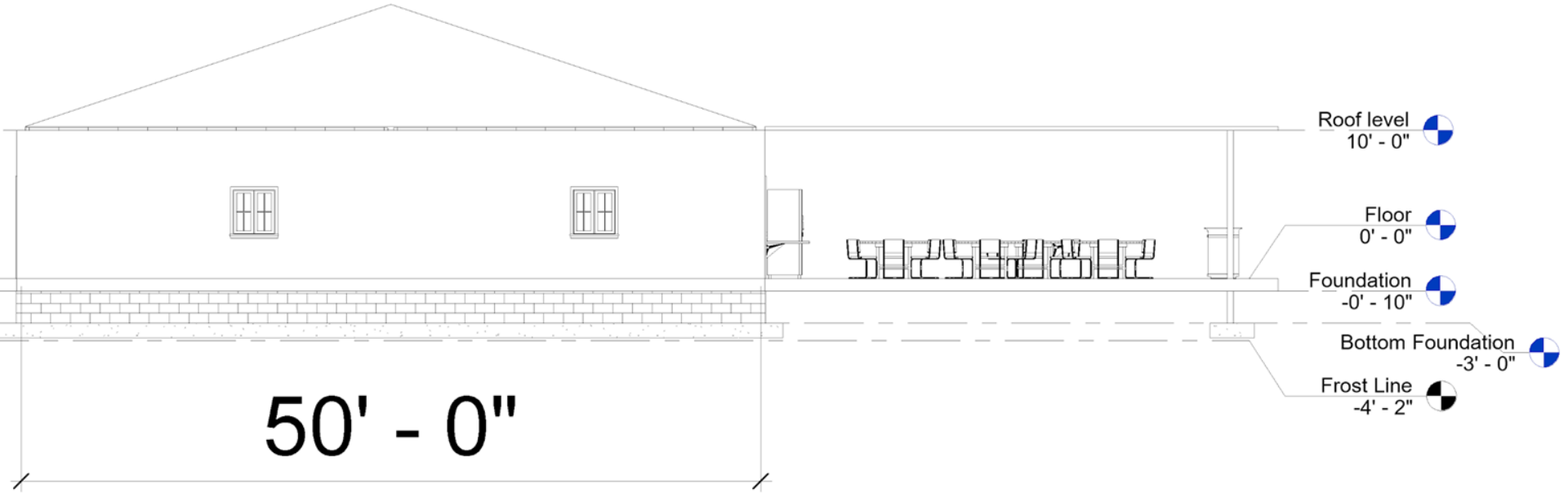
# Plan View


35' - 0"
MEP room
Sports
Storage
Kitchen
Storage
50' - 0"
25' - 0"
DN
25' - 0"
50' - 0"

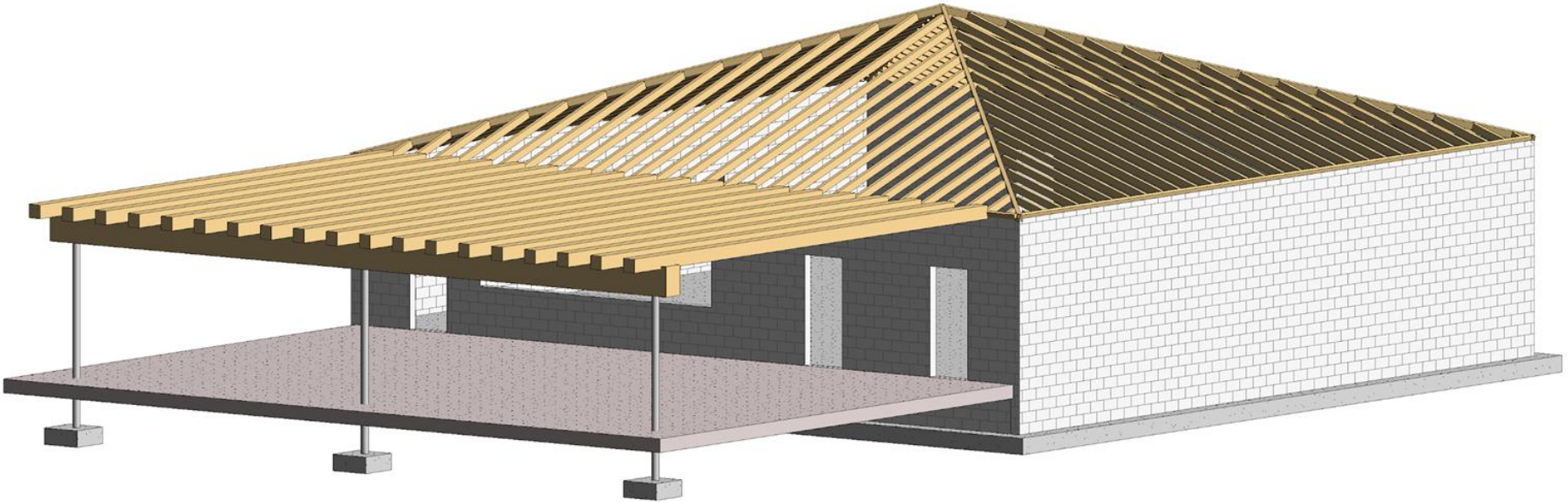
# North Elevation



# East Elevation



# Structural Model



# Architectural Model

# Seating Area

# Exterior Enclosure

- Easy system attachment and roll up
- Wind rated up to 35 mph
- UV inhibitors when sunny
- Safe to use with standing space heaters

# Kitchen

- Refrigerator/Freezer
- Flat Top Grill
- Deep Fryers
- Sinks
- Countertop Space
- Food Machines



# Rendering

# Storage Rooms

- Kitchen Storage
  - Shelving
  - Refrigerators/Freezers

- Equipment Storage
  - Areas divided by chain link fence
  - 7 areas, 8 ft x 10 ft

Representative Cage

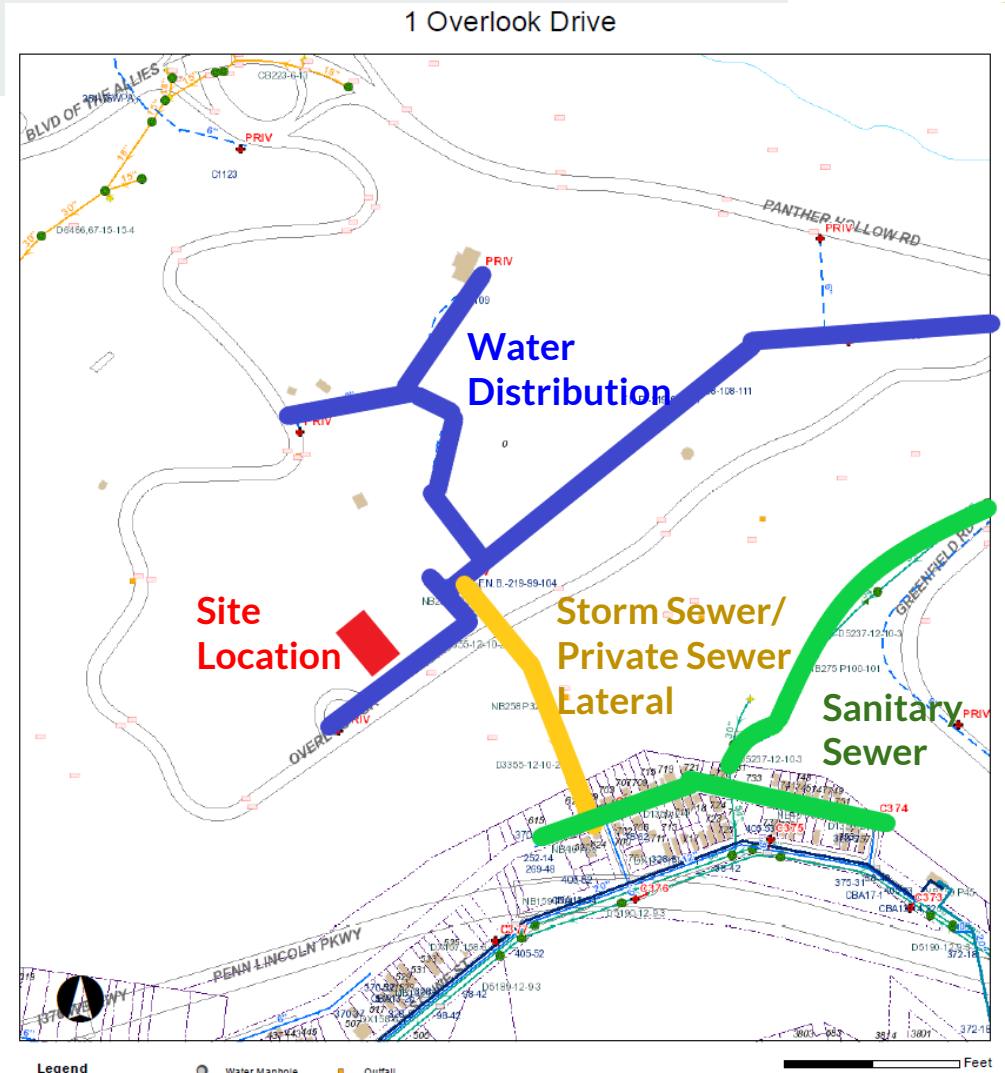
# Restrooms

- 2 ADA compliant restrooms
  - Male and Female
- Single stall
- Sink/Mirror
- Hand dryer
- Baby changing station
- More restrooms located nearby

# Rendered Bathroom Model

# Site Sewage Line

- Red - Site Location
- Yellow line - storm sewer
- Green Line - Sanitary sewer
- Private sewer Lateral not shown on map
- Blue Line - Water Distribution Main



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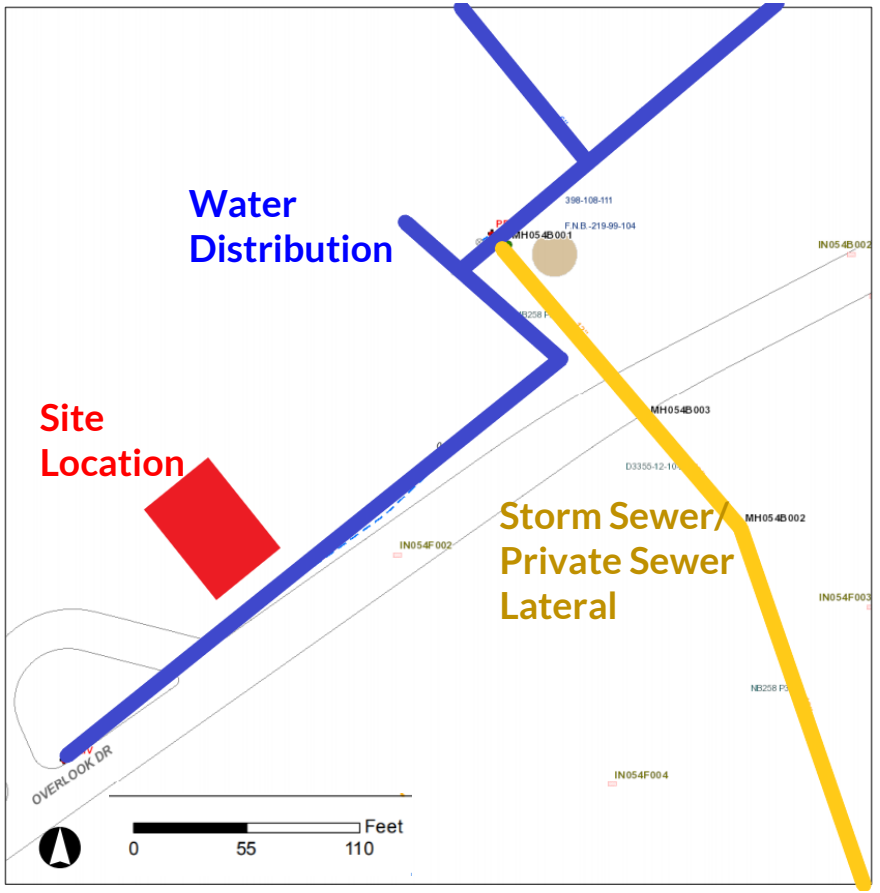
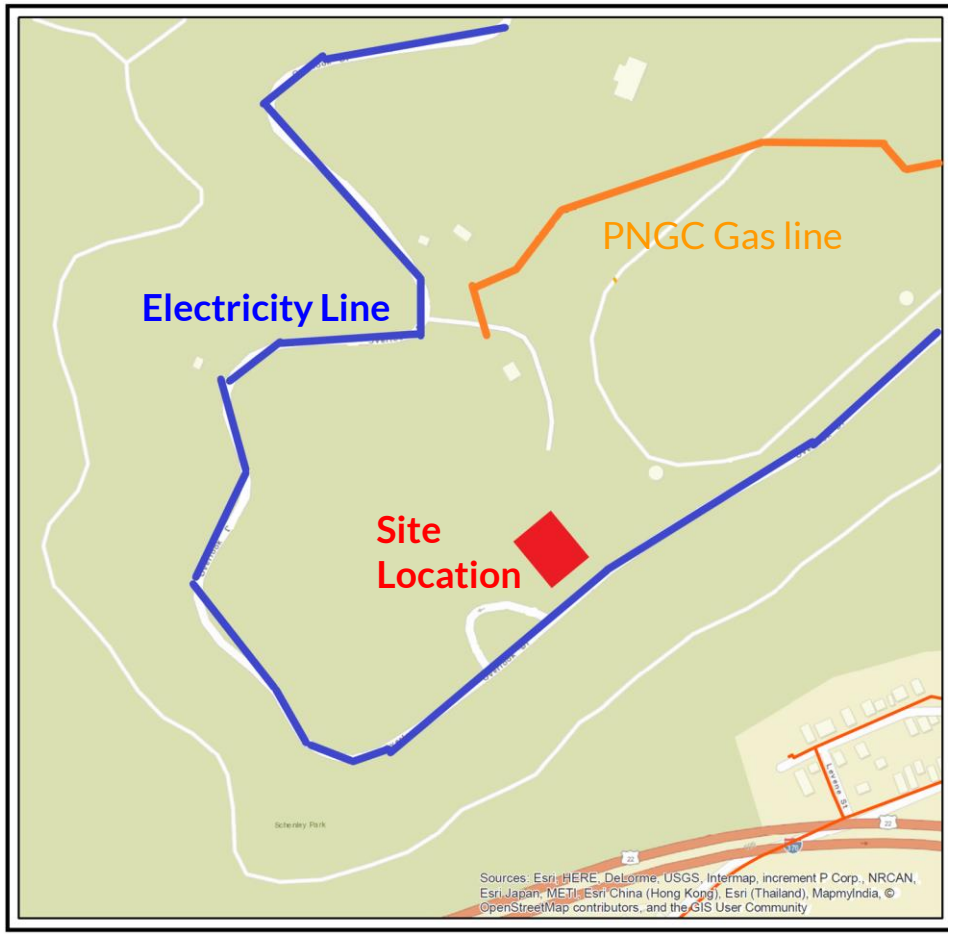


# Gas/Electricity Line

- PNGC Gas Line
- Duquesne Light Electricity Line



# Utility tie-in

- All within close range of the building
  - Water distribution line <50 ft
  - Electricity line <50 ft
  - Sewer line ~150 ft
  - Gas line ~250 ft
- Excavation is required but no significant Geotechnical Challenges

# Soil/Foundation Analysis

# Soil Analysis

- U.S. Department of Agriculture (USDA) Soil Map
  - Gilpin silt loam => Poor subgrade
- Result of laboratory test
  - Direct shear test
    - Supporting soil cohesion: 10 kPa
    - Angle of internal friction: 25°
  - Unit weight test
    - $\gamma = 125.5\ lb/ft^3$

**Allegheny County, Pennsylvania (PA003)**

Allegheny County, Pennsylvania (PA003)

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| GlB | Gilpin silt loam, 3 to 8 percent slopes | 0.6 | 100.0% |

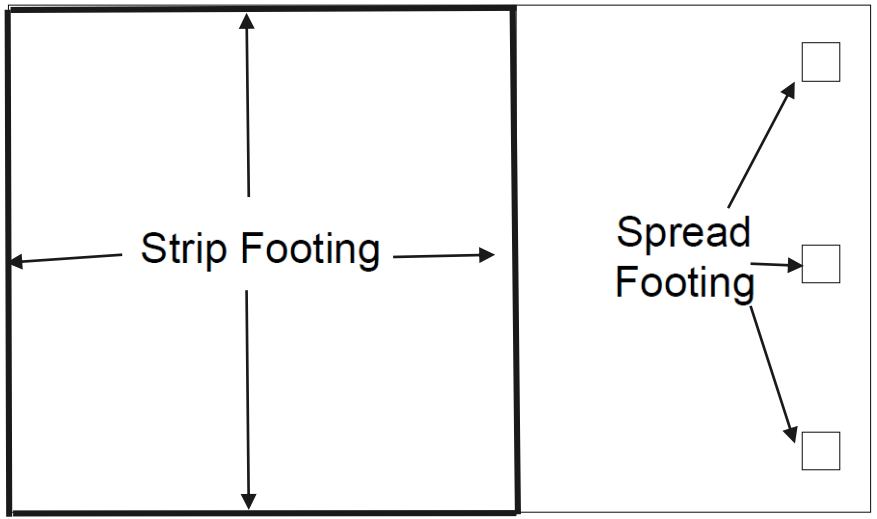
# Shallow Foundation

- Advantage:
  - Cost (affordable)
  - Construction Procedure (simple)
  - Material (mostly concrete)
  - Labour (does not need expertise)




# Summary of Foundation Work

- Foundation consists of
  - Spread footings
  - Strip footings
- Size of footing based on settlement calculation from loadings



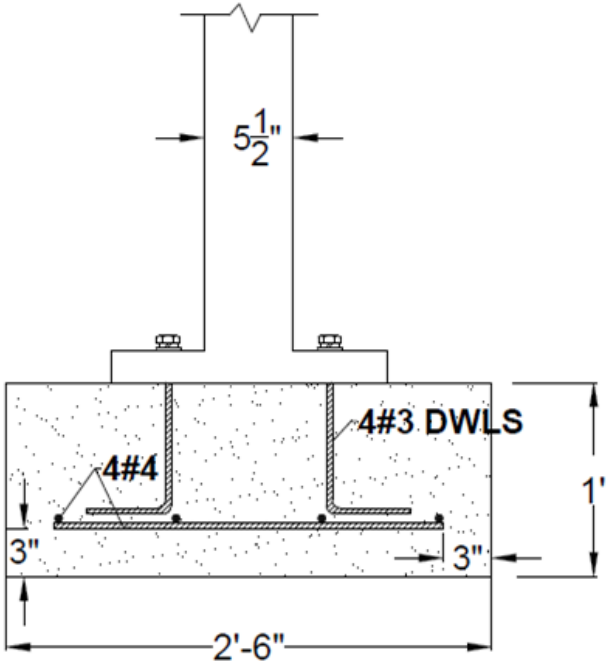
# Spread Footing Final Design

- Designed using ACI 318-14
- Shear ultimate < factored shear capacity
- One way shear
  - Shear ultimate: 2.38 kip
  - Factored shear capacity: 21.35 kip
  - Assumed effective depth checks: 7.5"
- Two way shear
  - Shear ultimate: 7.73 kip
  - Factored shear capacity: 47.5 kip

| | | |
|---|---|---|
| Load combination | 1.9 | ksf |
| fy | 60,000 | psi |
| f'c | 4,000 | psi |
| Clear cover | 3 | inches |
| Assumed depth | 3 | Feet |
| φ | 0.75 | - |

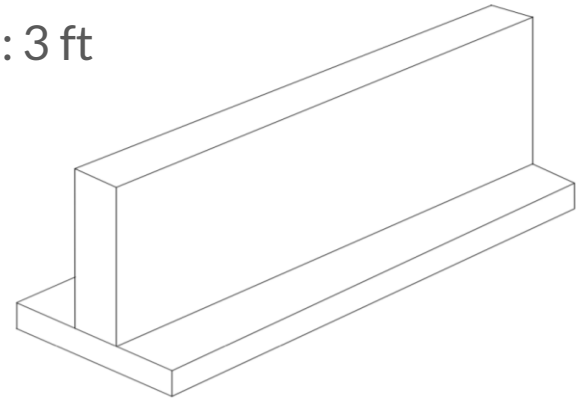
# Spread Footing Calculations

- Flexure
  - Mu: 2.58 kip-ft
  - Solve for area of horizontal rebar by using ultimate flexural
  - Area of rebar: 0.65in$^2$
  - Requires # rebar: 4#4 bars
- Assumed Tension was controlling factor
  - $\varepsilon_t$=0.037 > 0.005
- Transfer of column forces to the base
  - Dowel reinforcement: 4#3 bars



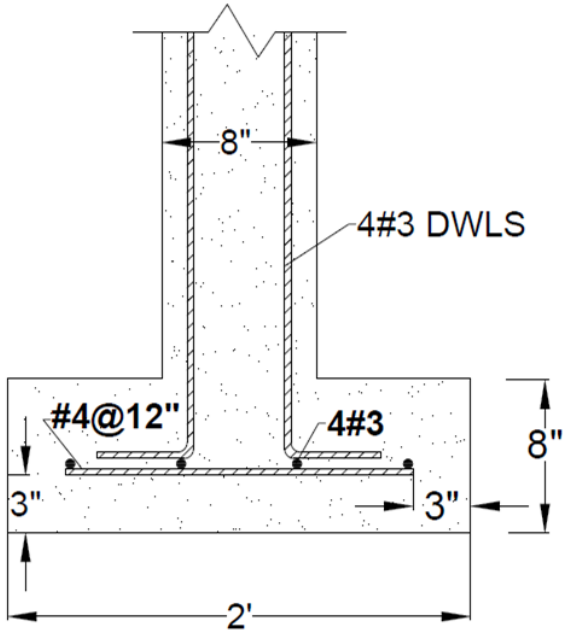
# Strip Footing Final Design

- Strip footing were design using the same process as spread footings.
  - Designed using ACI 318-14
- Generally controlled by minimum rebar requirements.
- Distance from the ground level to the footing base: 3 ft
- Ultimate bearing capacity: 9,600 $lb/ft^2$
- Allowable soil pressure: 3,200 $lb/ft^2$



# Strip Footing Calculation

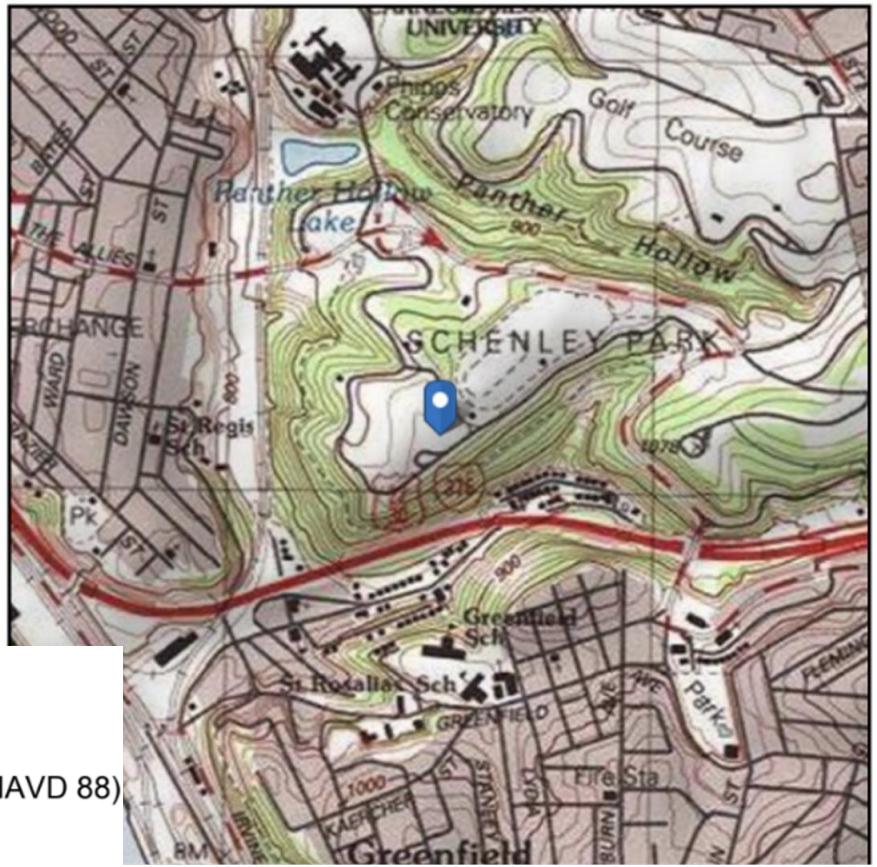
- Preliminary Member sizing
  - Assuming the footing thickness is equal to the thickness of wall
- Shear Capacity Check
  - $V_u < \varphi V_c$ o.k.
- Flexural Reinforcement design
  - Provide #4 bars at 12in
- Shrinkage and Temperature Reinforcement
  - Provide 4#3 bars
- Dowel reinforcement
  - Provide 4#3 bars



# Structural Analysis

# ASCE Design Hazard Tool

- Ultimate Wind Speed : 115 mph
- Risk Category: II
- Elevation: 1046.3’ (NAVD 88)
- Seismic Design Category: B
  - Sds: 0.117
- Ice Thickness: 0.75”
- Pg: 25 psf (~20” settled snow)
- Precipitation Intensity: 2.55 in./h




## ASCE 7 Hazards Report

| | | | |
|---|---|---|---|
| **Standard:** | ASCE/SEI 7-10 | **Elevation:** | 1046.25 ft (NAVD 88) |
| **Risk Category:** | II | **Latitude:** | 40.430921 |
| **Soil Class:** | D - Stiff Soil | **Longitude:** | -79.944914 |

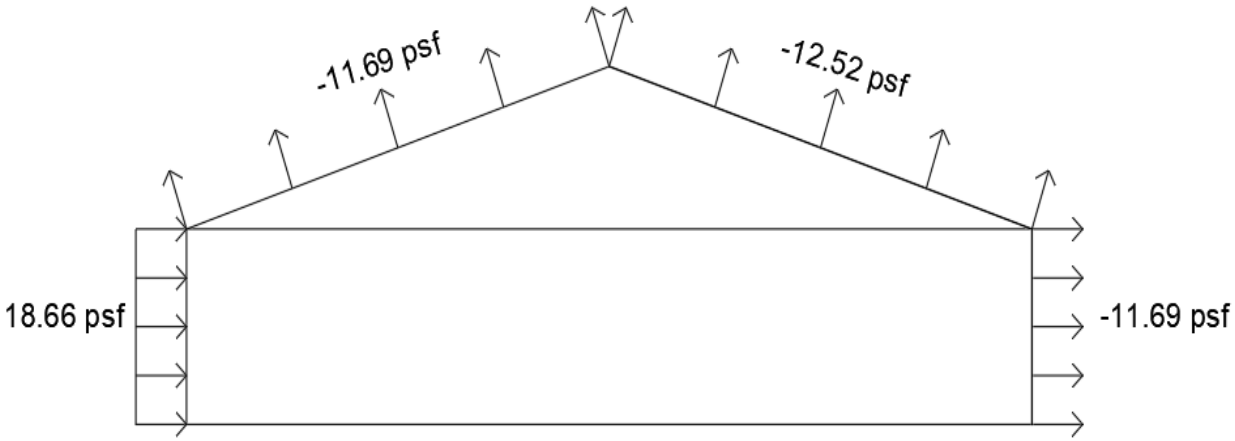
# Dead Loads and Roof Live Loads for Design

- Roofing
  - Metal Deck : 2.5 (psf)
  - Insulation: 1.5 (psf)
  - Waterproofing: 0.7 (psf)
  - Wood rafters: 8 (psf)
- Live Load (Roof Maintenance)

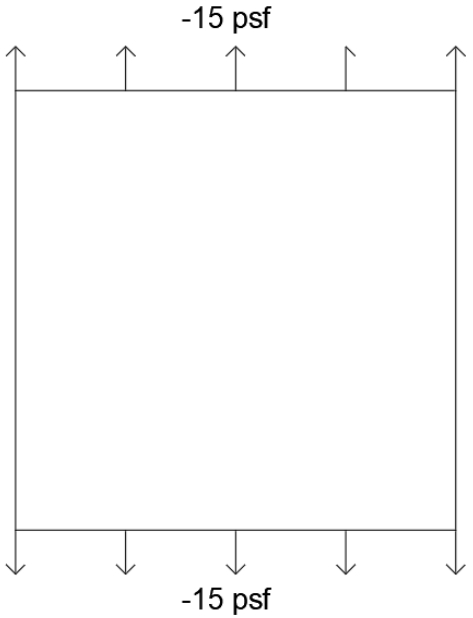
- Minimum Reduced Load = 12 (psf)

- Ceiling
  - Acoustic Fiber Board: 1 (psf)
  - Gypsum Board: 2.75 (psf)
  - Mechanical Duct Allowance: 4 (psf)

# Wind Loads

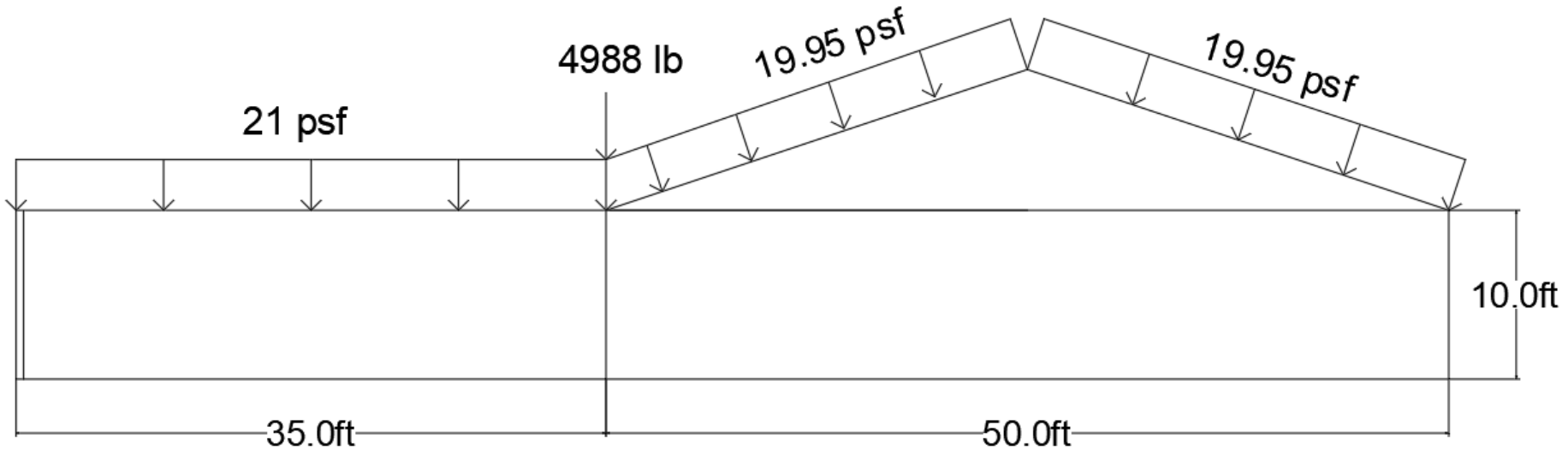



Elevation View



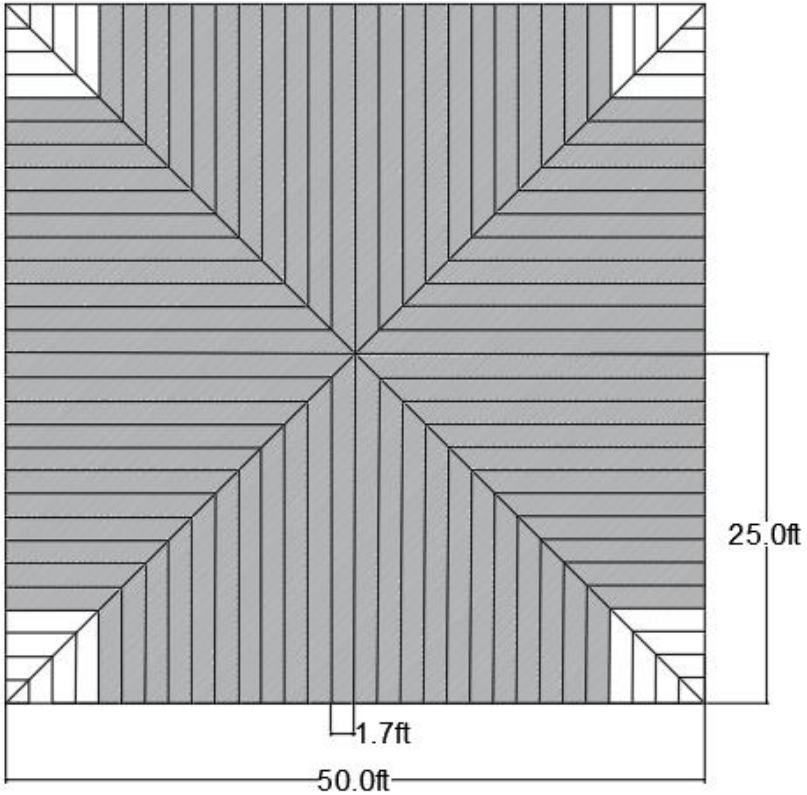

Plan View

# Snow Loads



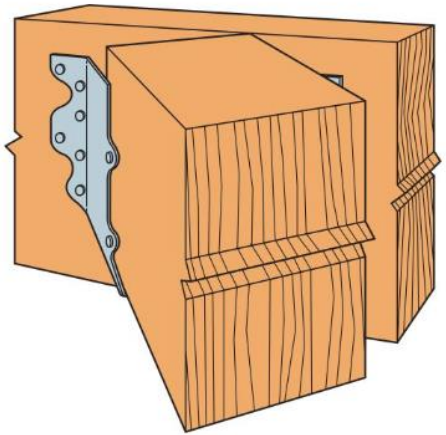
# Main Roof Layout

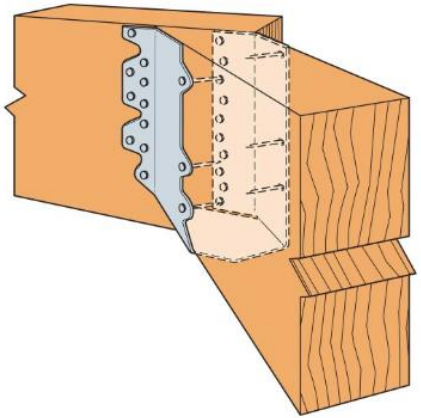
- Girders: 12” x 24” Douglas Fir-Larch
- Beams: 4” x 16” Redwood
- Shaded Area: ⅜ in. plywood sheathing
- Connections:
  -Simpson Strong Ties
  -Angled Steel Plates
  -Rotafix Structural Adhesive

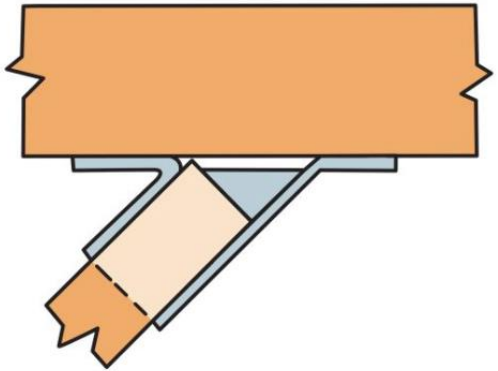


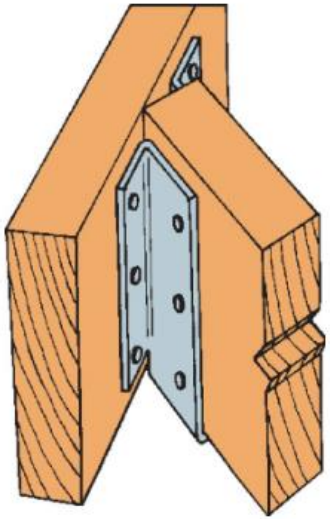
# Truss Framing Connections

- 45-degree Skewed Face-Mount Hangers
- Fasteners: Structural Connector Screws









# Structural Checks - Main Roof Frame

**Girders:**

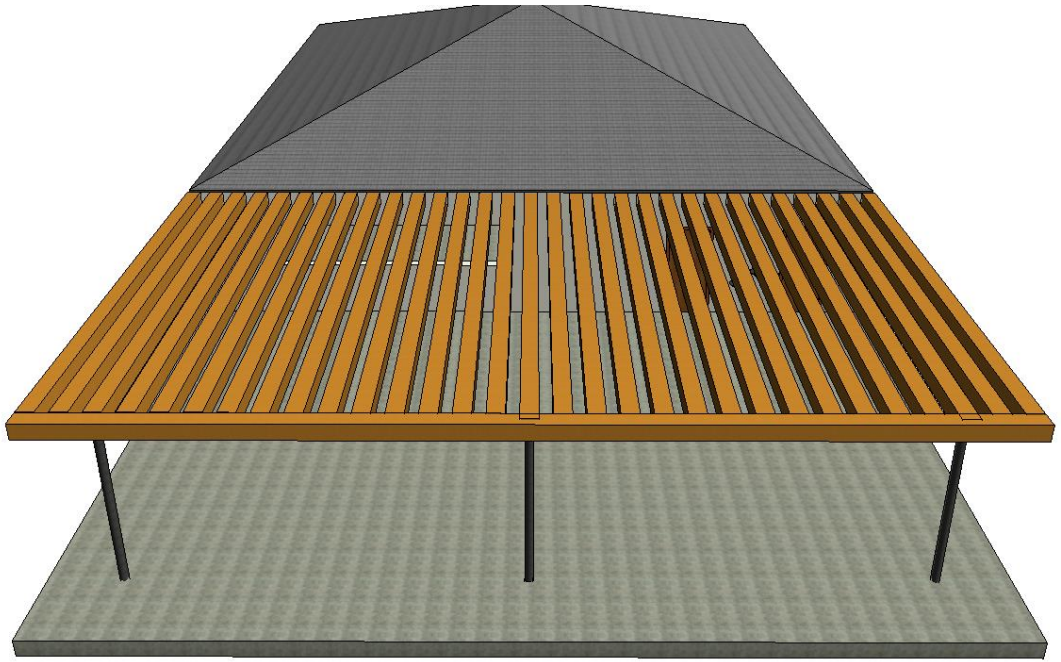
- **Flexure (capacity = 3773 psi)**
  - 2394 psi < 3773 psi
- **Shear (capacity = 338 psi)**
  - 318 psi < 338 psi
- **Compression (capacity = 1300 psi)**
  - 680 psi < 1300 psi

**Beams:**

- **Flexure (capacity = 3997 psi)**
  - 3636 psi < 3997 psi
- **Shear (capacity = 318 psi)**
  - 46 psi < 318 psi
- **Compression (capacity = 1850 psi)**
  - 205 psi < 1850 psi

# Outside Roof Layout

- All Members are Douglas Fir-Larch
- Girder: 16” x 22”
- Outer Beams: 10” x 10”
- Inner Beams: 12” x 12”



# Structural Checks - Outside Roof Frame

**Girder:**

- **Flexure (capacity = 3510 psi)**
  - 3419 psi < 3510 psi
- **Shear (capacity = 338 psi)**
  - 123 psi < 338 psi

**Outer Beams:**

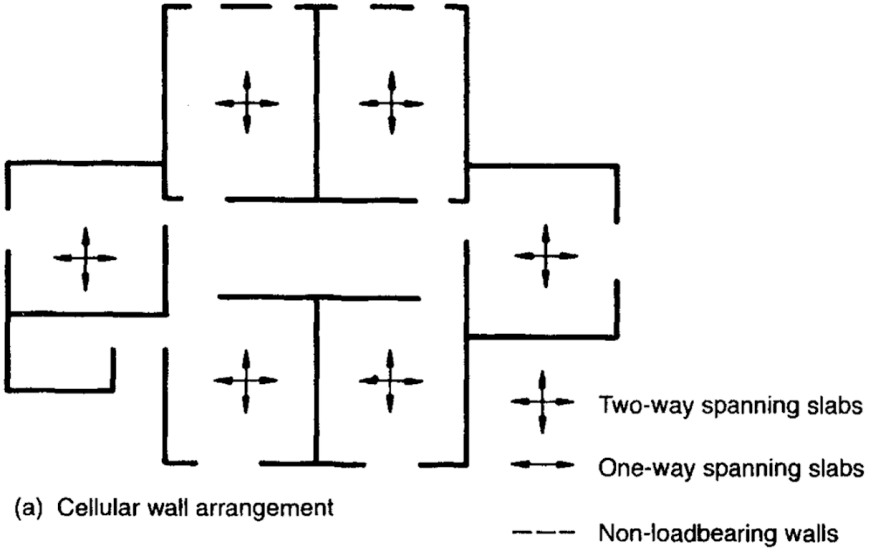
- **Flexure (capacity = 3773 psi)**
  - xx axis: 3596 psi < 3773 psi
  - yy axis: 800 psi < 3773 psi
- **Shear (capacity = 338 psi)**
  - 41 psi < 338 psi

**Inner Beams:**

- **Flexure (capacity = 3773 psi)**
  - 3714 psi < 3773 psi
- **Shear (capacity = 338 psi)**
  - 51 psi < 338 psi

# Wall Arrangements in Masonry Buildings

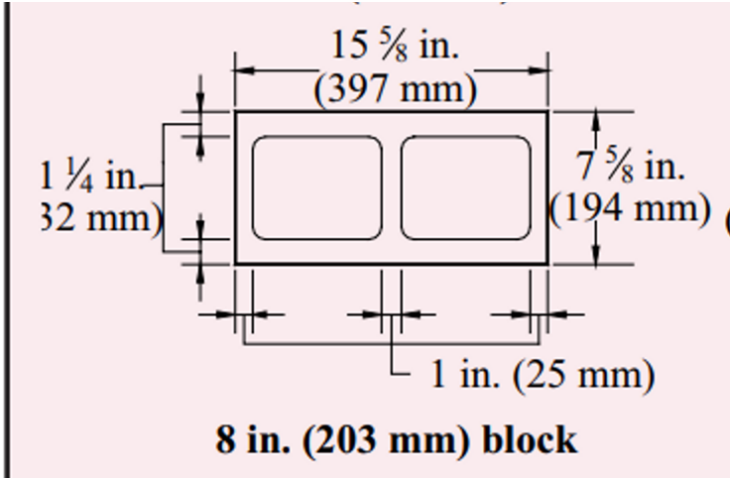
- Based on building model, a cellular wall arrangement will be the most appropriate option for our project.
- Other design considerations:
  - Robustness of the building
  - Serviceability
  - Frost resistance of the blocks
  - Dimensional changes
  - Fire Resistance
  - Mortar
  - Reinforcement



(a) Cellular wall arrangement

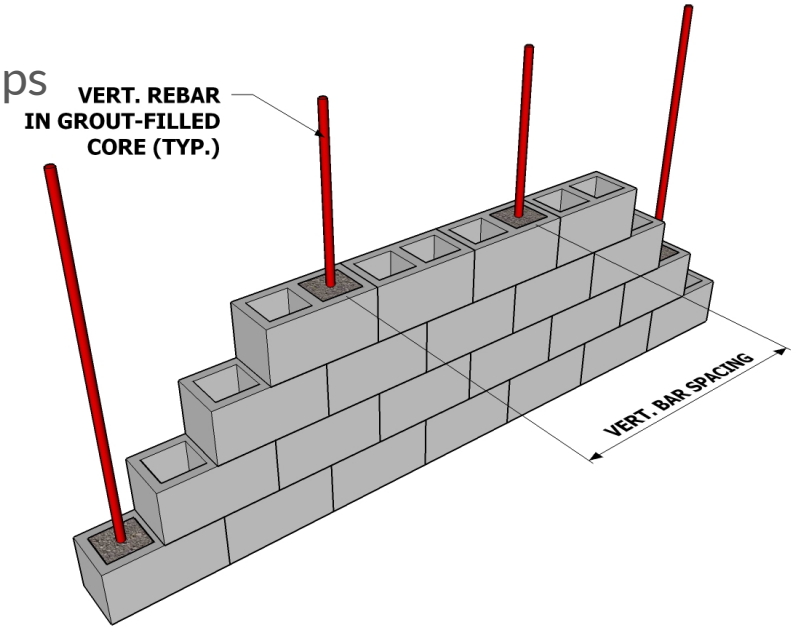
# Structural Design- Concrete Masonry Walls

- Used Unit Strength Method
  - 8 inch medium weight hollow CMU
  - Type S Mortar
- Check Compressive Strength
- Determine Quantity and Size of Rebar



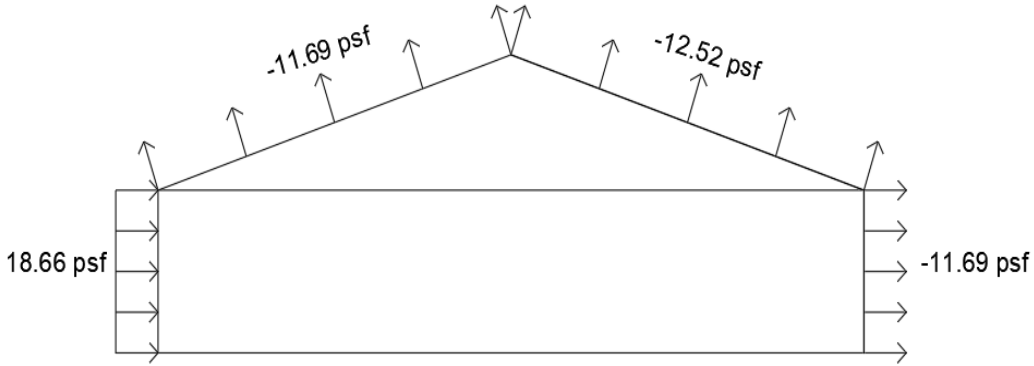
# CMU Wall Compression Check

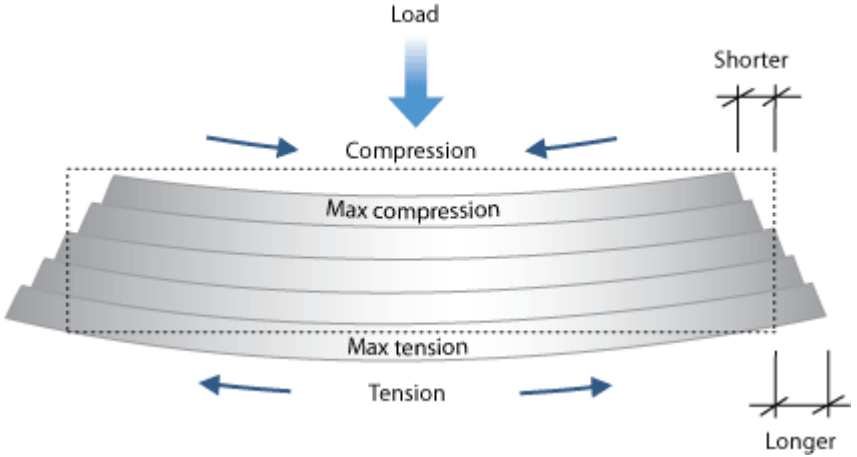
- Axial Force/ Wall = 56 Kips
  - Includes Weight of Sliding Snow ~ 5 Kips
- Compressive Strength = 65 kips
  - Includes Safety Factors
- 65 > 56 Kips, Compression Check Passes



# Rebar Size and Quantity - Tensile Check

- Wind Pressure on CMU Wall Creates Tensile Stress
- Rebar Needed to Resist Tensile Force
- Max Moment from Wind = 2790 lb-in
    - Area of Steel Needed = 1.67 in²/ft



# Rebar Selection

- Chosen Rebar Parameters:
- Rebar Spacing = 16 in.
  - Area Needed= 2.23 $in.^2$
- Choose #14 Rebar
  - Area= 2.25 $in.^2$

| Imperial Bar Size | "Soft" Metric Size | Weight per unit length (lb/ft) | Mass per unit length (kg/m) | Nominal Diameter (in) | Nominal Diameter (mm) | Nominal Area($in^2$) | Nominal Area ($mm^2$) |
|---|---|---|---|---|---|---|---|
| #10 | #32 | 4.303 | 6.418 | 1.27 | 32.26 | 1.27 | 819 |
| #11 | #36 | 5.313 | 7.924 | 1.41 | 35.81 | 1.56 | 1006 |
| #14 | #43 | 7.65 | 11.41 | 1.693 | 43 | 2.25 | 1452 |
| #18 | #57 | 13.6 | 20.284 | 2.257 | 57.33 | 4 | 2581 |

# Steel Column Design- Porch

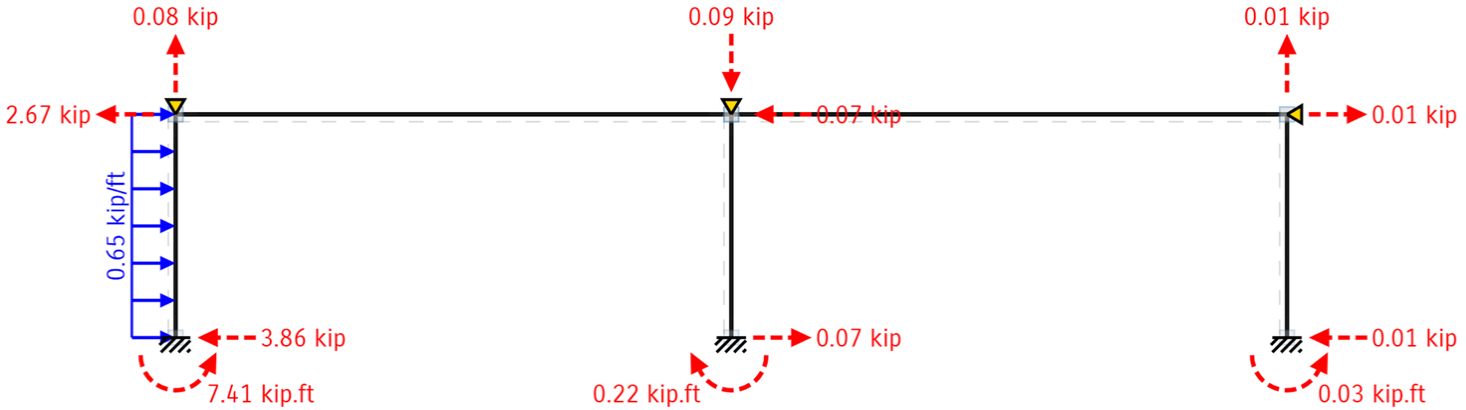
- Porch columns need to be designed to resist flexure.
- Sources of Flexure:
  - Wind when partition is closed- lateral force
  - Moment from Axial Loads
- Columns designed as Beam- Columns
  - Must resist Axial Loads, Moment, and Second-Order Effects.

# Beam-Column Design - Axial Loads

- Factored Load = 57.565 psf
  - From ASCE 7-10 Load Combinations
- Tributary Area of Middle Column = 437.5 $ft^2$
  - Columns were designed to be the same to maximize constructability
- Weight of Girder = 4.05 Kips
- Controlling Axial Load (Pnt) = 27.2 Kips

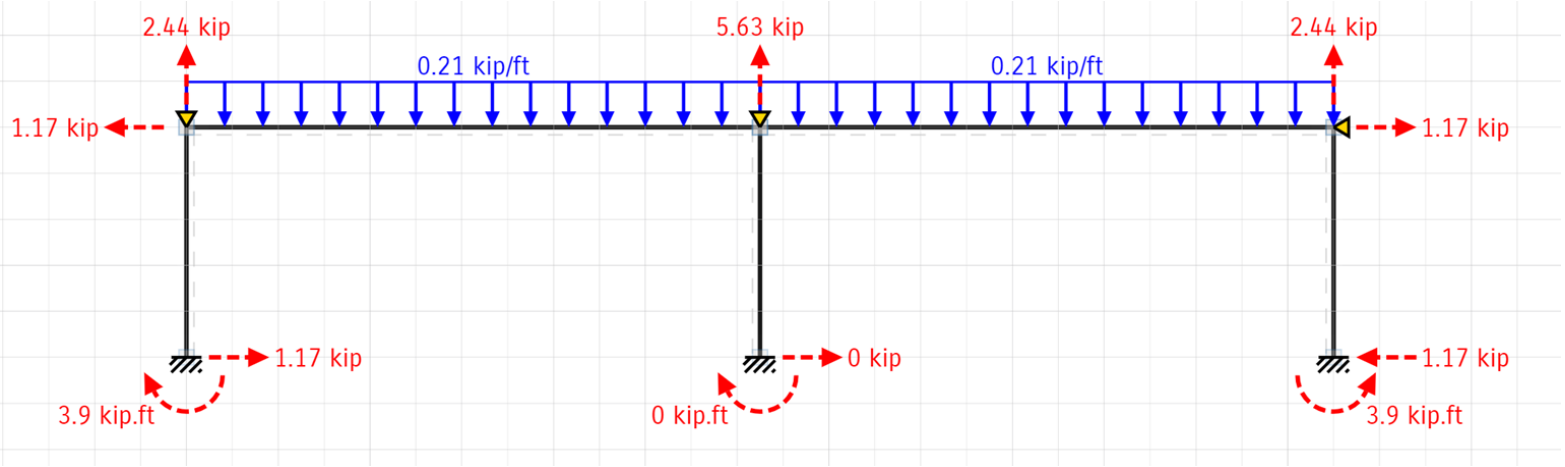
# Beam-Column Design - Flexure

- Max moment from lateral forces must be calculated
  - Distributed Lateral Wind Load (Plt) = 0.65 Kips/Ft
  - Max Moment from Lateral Forces (Mlt) = 7.41 Kip*Ft



# Beam-Column Design - Flexure

- Factored moment from Axial Loading must be calculated
  - Using ASCE 7-10 Load Combinations
  - Factored Moment (Mnt) = 19.5 Kip-Ft
- Example below showed for moment caused by Roof Live Load



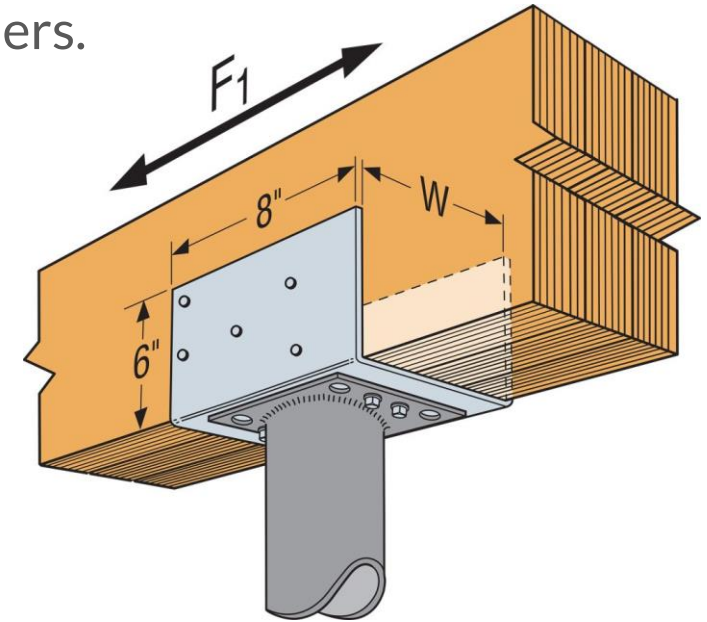
| | Seating area Moments (Kipft): | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Dead Load: | Live Load (L): | Roof Live Load (Lr): | Rain Load (R): | Snow Load (S): | Wind Load (W): | Earthquake load (E): | |
| | 4.15 | 0 | 3.9 | | 6.78 | 7.41 | 1.52 | |
| Combo 1 Factors | 1.4 | | | | | | | 5.81 |
| Combo 2 Factors | 1.2 | 1.6 | 0.5 | 0.5 | 0.5 | | | 8.37 |
| Combo 3 Factors | 1.2 | 0.5 | 1.6 | 1.6 | 1.6 | 0.5 | | 19.533 |
| Combo 4 Factors | 1.2 | 0.5 | 0.5 | 0.5 | 0.5 | 1 | | 15.78 |
| Combo 5 Factors | 1.2 | 0.5 | | | 0.2 | | 1 | 7.856 |
| Combo 6 Factors | 0.9 | | | | | 1 | | 11.145 |
| Combo 7 Factors | 0.9 | | | | | | 1 | 5.255 |

# Beam-Column Design - Member Selection

- Columns are fixed at base and pinned at girder:
  - K = 0.8; KL = 8’
- To account for second- order effects, Mr and Pr are calculated using amplification factors.
  - Mr = 27.0 Kip -Ft
  - Pr = 33.8 Kips
- Select HSS 5.5X0.375 (weight = 20.55 lb/ft)
  - Mn = 32 Kip-Ft
  - Pn = 194 Kips

# Connection

- HSS member was used to fit a special connection designed to connect steel columns to wooden girders.
- Simpson Strong Tie Steel Column Cap
- Girder Dimensions:
  - W= 16”



# Connection

- Axial Loads:
  - Corner Column: 13.6 Kips
  - Middle Column: 27.2 kips

| Model No. | W (in.) | Girder | Nails[7] | Lally Column Outside Diameter (in.) | Allowable Loads | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Download [1,2,3,4] | | Uplift | $F_1$[5] |
| | | | | | DF/SP/SPF | LVL/PSL/LSL | (160) | (160) |
| LCC5.25-3.5 | 5⅜ | 5.25 LVL/PSL/LSL | (8) 16d | 3½ | — | 15,820 | — | 1,615 |
| LCC5.25-4 | 5⅜ | 5.25 LVL/PSL/LSL | (8) 16d | 4 | — | 20,670 | — | 1,615 |
| CCOS5.50 | 5½ | 5.25 LVL/PSL/LSL | (10) 10d | — | — | 22,100 | 1,020 | 2,200 |

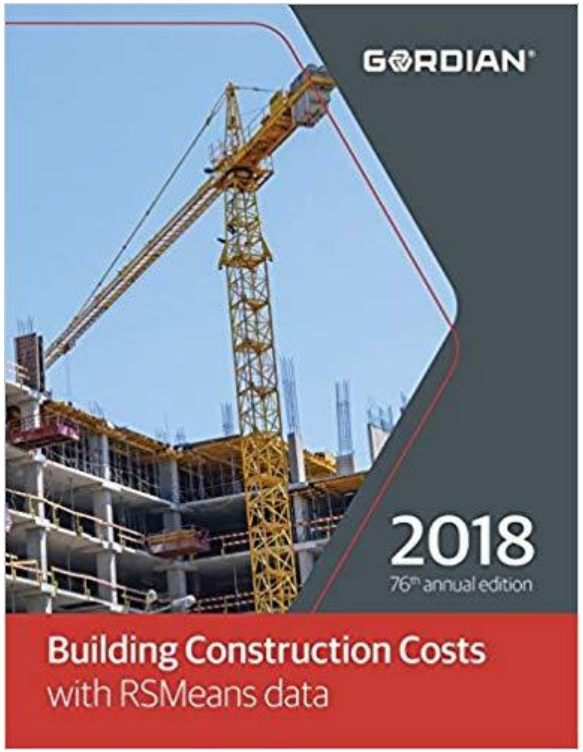
# Connection Details

- Steel column will be attached to connection with 4 Quik Drive self-tapping screws
- Middle column will be a spliced condition, but exceeds axial loading for spliced condition
    - Additional bracing will be installed to transfer axial loads to the column

# Cost Estimate

# Estimating Method

- Unit price estimating
- Quantity takeoffs
- Unit price includes **material** and **labor** cost
- Quantity x Unit Price = Cost
- Unit prices obtained from “2018 Building Construction Costs”



# Supervision Estimate

Key Items

- Project Manager = $33,800
- Project Engineer = $16,900
- Superintendent = $19,500
- Operator = $11,400
- Survey Crew = $1,680

**Supervision Total = $84,900**

# Activity Estimate

Key Items

- Interior Roofing System = $54,600
- Exterior Roofing System = $23,500
- CIP Concrete = $21,300
- CMU Block Construction = $19,900
- Backfilling = $10,900

**Total Activity Cost = $191,500**

# Permitting Estimate

- Building = $2,075
- Electrical = $497
- HVAC = $165
- Fire Alarm/Sprinkler = $95
- Signs = $106
- Land Operations = $880

**Total = $3,800**

*Data taken from the City of Pittsburgh 2018 Fee Schedule

# Equipment Estimate

Key Items

- Excavator = $22,620
- Rough Terrain Crane = $10,800
- Skid Steer = $6,370
- Concrete Pump Truck = $2,150
- Dump Truck = $2,205
- Electric Generator = $1,365

**Equipment Total = $48,500**

# Miscellaneous Items


Field Office

- Furnished Field Trailer= $2,900

Temporary Support Facilities

- Electricity, Fuel Bill
- Drinking Water
- Temporary Toilet
- Total= $14,100

**Misc Total = $68,900**

General Support Items

- Safety - Drug Test/PPE
- Dumpsters
- Total = $7,500

Kitchen

- Equipment = $21,900

Risk

- Contingency = $22,500

# Estimating Summary

- Project Estimate
  - Supervision = $84,900
  - Activity = $191,500
  - Permitting = $3,800
  - Equipment = $48,500
  - Miscellaneous = $68,900

**Total = $397,600**

# Risk Analysis

# Risk Assessment

| What can go wrong? | Probability (%) | Estimated Cost | Contingency | Can we prevent it? | Plan |
|---|---|---|---|---|---|
| Inclement weather | 90% | $4,000.00 | $3,600.00 | No | Use float days |
| Equipment not available to buy | 40% | $4,500.00 | $1,800.00 | Yes | Lease as an alternative |
| Delayed deliveries | 30% | $5,000.00 | $1,500.00 | No | Reassign workers to other tasks. |
| Design errors | 30% | $6,000.00 | $1,800.00 | Yes | Submit RFI to designer |
| Poor subsurface conditions | 30% | $4,000.00 | $1,200.00 | No | Inspect soil and do necessary work to make it usable |
| Flooding | 25% | $4,000.00 | $1,000.00 | No | Halt construction and use pumps to pump water out of site |
| Equipment breaks | 25% | $4,000.00 | $1,000.00 | No | Rent equipment so supplier can send out backup equipment. accept the waiting period |
| Material shortage | 25% | $3,000.00 | $750.00 | Yes | Find alternative material or find a new supplier |
| Theft of equipment | 20% | $5,000.00 | $1,000.00 | Yes | Have work area fenced in and locked at the end of each day |
| Vandalism | 20% | $3,000.00 | $600.00 | No | Put up fences around construction area and lock at the end of each day. |
| Water shortage/electricity blackout | 20% | $2,000.00 | $400.00 | No | Shut down temporarly, if outage continues accept lost time |
| Material arrives broken/ not to standards | 20% | $4,000.00 | $800.00 | No | Return material. Find new supplier if problem not quickly fixed |
| Cost escalation | 20% | $8,000.00 | $1,600.00 | No | Have a conservative const estimate so if it does escalate, it wont be a problem |

# Risk Assessment

| What can go wrong? | Probability (%) | Estimated Cost | Contingency | Can we prevent it? | Plan |
|---|---|---|---|---|---|
| Project manager ill/absent | 20% | $5,000.00 | $1,000.00 | No | Next higest ranking personel in charge |
| Damage existing utilites | 10% | $10,000.00 | $1,000.00 | Yes | Call utility company. ASAP |
| Failed final inspection | 10% | $5,000.00 | $500.00 | Yes | Do bi-weekly inspections so that there would be no problems |
| Fire | 10% | $5,000.00 | $500.00 | Yes | Call 911. Brief workers on Emergency response Plan |
| Incomplete set of drawings provided | 10% | $5,000.00 | $500.00 | Yes | Make sure proper drawings are obtanied prior to work being performed. |
| Owner is late with payments | 10% | $7,500.00 | $750.00 | No | Continue construction unless issue continues to persist |
| Strikes | 10% | $5,000.00 | $500.00 | No | Delay costs until theres a settlement |
| Fire | 10% | $5,000.00 | $500.00 | Yes | Call 911. Brief workers on Emergency response Plan |
| Incomplete set of drawings provided | 10% | $5,000.00 | $500.00 | Yes | Make sure proper drawings are obtanied prior to work being performed. |
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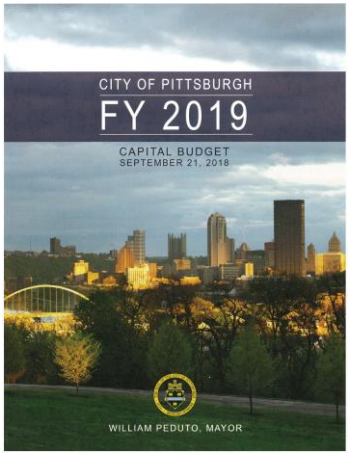
| Strikes | 10% | $5,000.00 | $500.00 | No | Delay costs until theres a settlement |
| Job-site injury | 5% | $15,000.00 | $750.00 | No | Call 911 if serious. Report injury to OSHA. Hold weekly saftey meetings. |
| Job-site injury | 5% | $15,000.00 | $750.00 | No | Call 911 if serious. Report injury to OSHA. Hold weekly saftey meetings. |

# Risk Assessment Final Cost

- Our total estimated risk cost = $22,500
- This is roughly 6% of our final cost.

# Funding

- Pittsburgh has a seven year capital budget that ranges from (2018-2024).
- After contacting the city, they informed us that we wouldn't be able to start this project until the spring of 2025
- One of the cities main goals in the current budget is to restore parks such as:
  - Homewood Park
  - South Side Park
  - Arsenal Park
- Confident that our project will be accepted and incorporated into the new capital budget starting in 2025



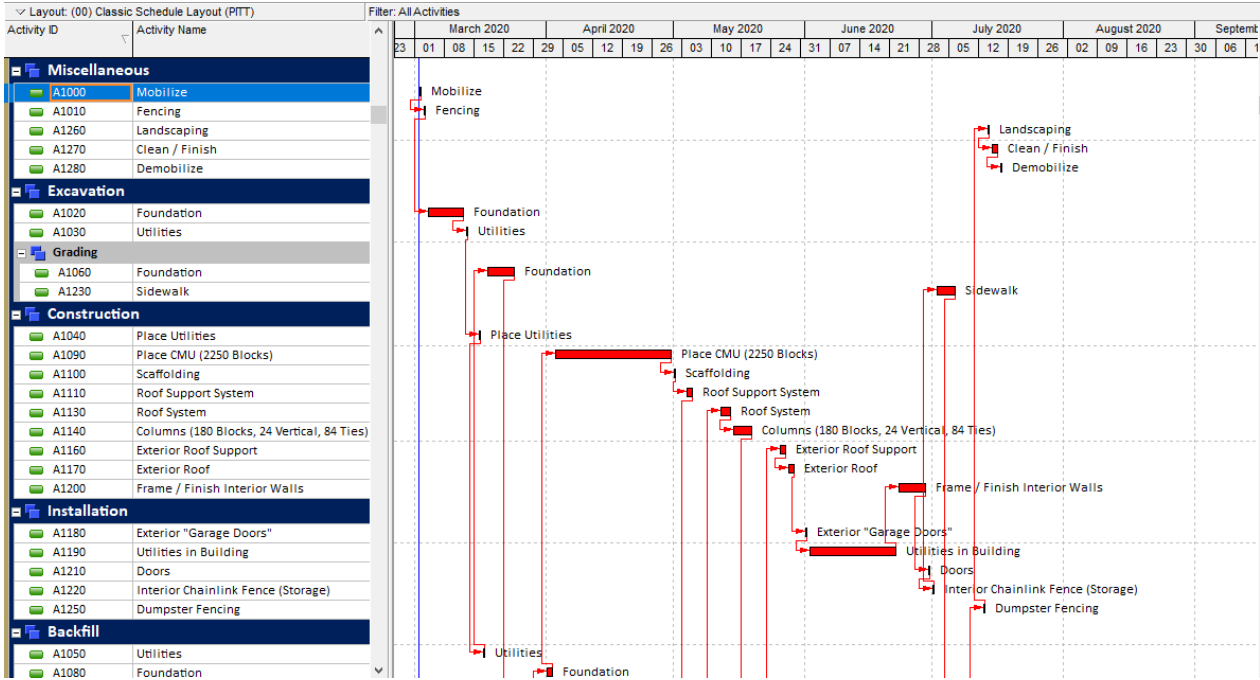
# Schedule & Staging

# Schedule

- The Pre-construction Phase
  - Completed
    - Meeting with shareholders/financial leaders/public
    - Site Surveying
  - Future
    - Environmental Site Assessments
    - Construction plans and other document reviews
- The Construction Phase
  - Site Work
  - Foundation Construction
  - Building Construction
  - Utilities Installation
  - Punchlist/Final Cleaning
- The construction should be completed in 13 weeks

# Schedule P6

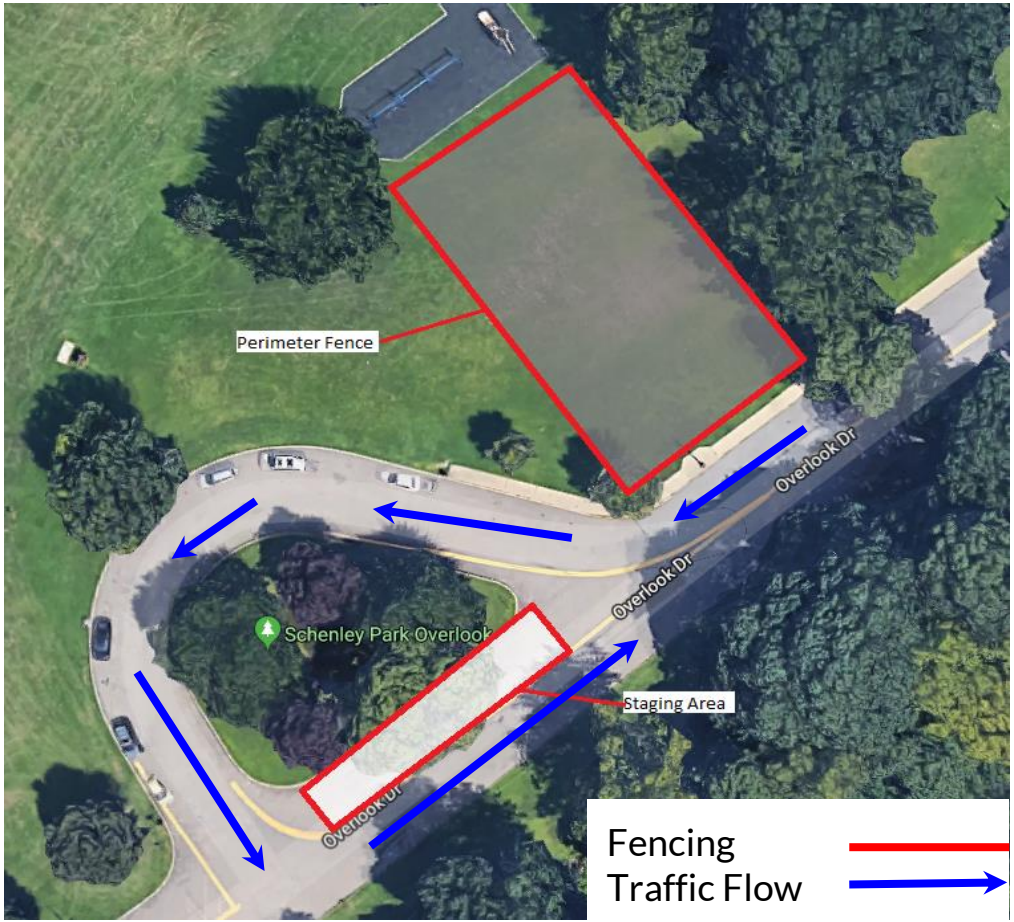
- Schedule broken down into dozens of activities
- Activities separated into various WBS
- Activities connected together with FS & SS logic ties
- Each activity is resource loaded



# Site Logistics

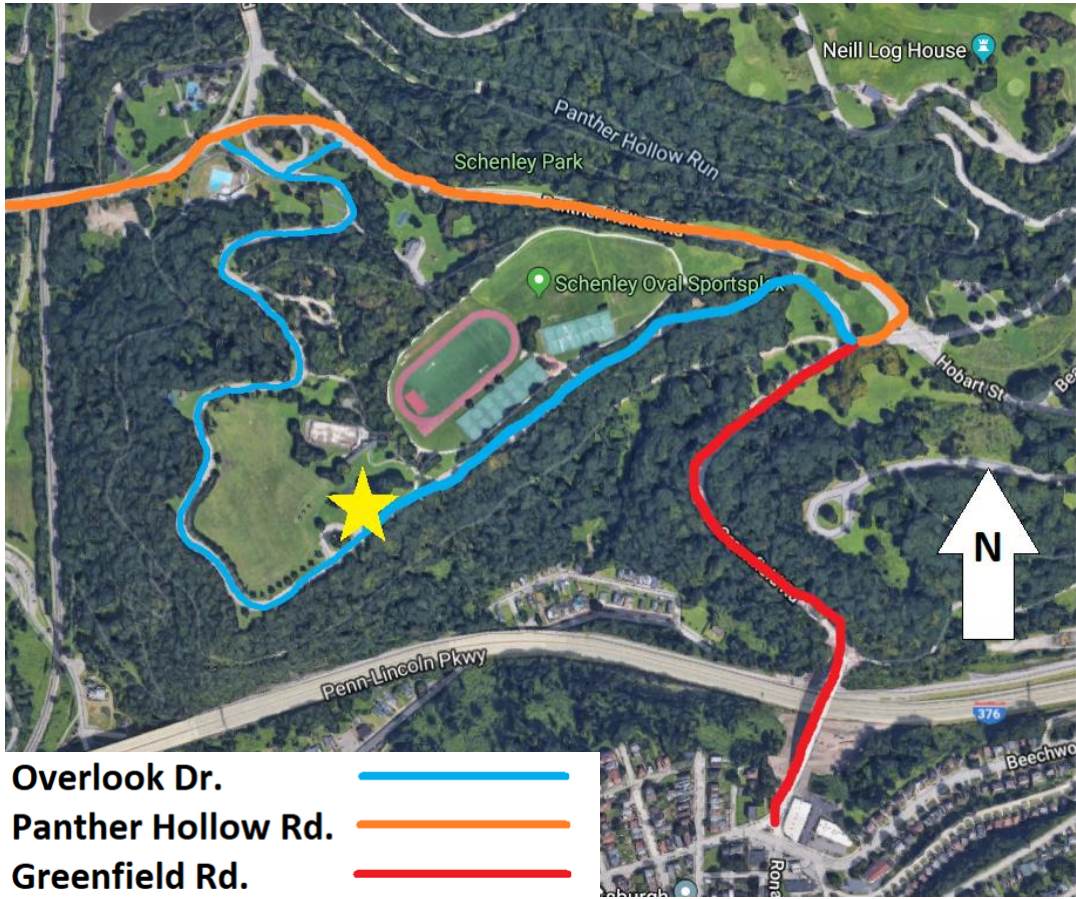
# Equipment Staging

- Material & equipment will be stored on site
- Excess material stored in staging area
- Fencing set up around staging area and on site for loss prevention
- Security cameras already in place on light poles



# Traffic

- Construction will have low impact on traffic
- Traffic will remain open
  - Flagging used when necessary
- Access road is Overlook Drive, the Northern Entrance
  - (~38 ft width including parking)
- Larger vehicles will access using East entrance



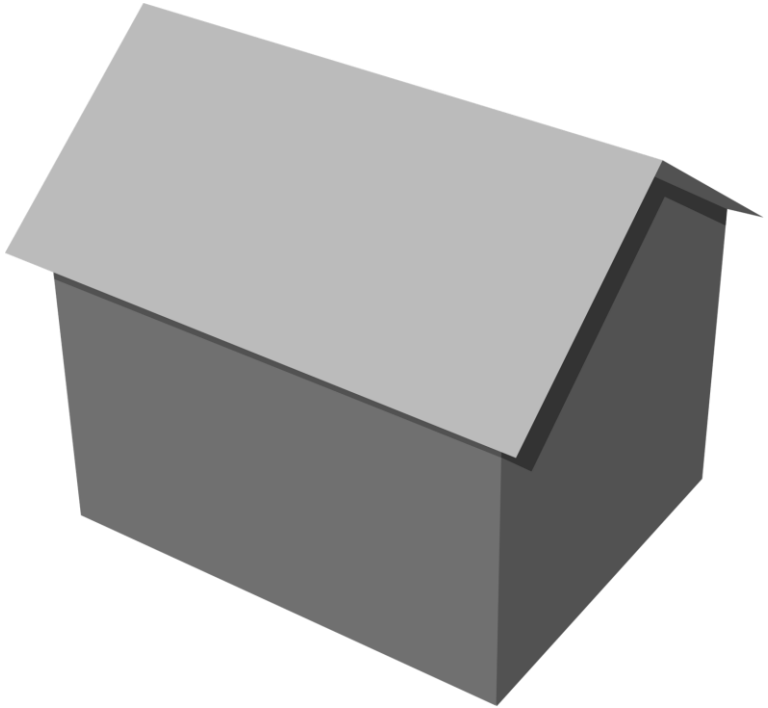
# Future Steps

# Solar Power

- Panel Requirement
  - 2,000 kWh during active months
  - 400 W per panel
  - 35 Panels required
- Cost
  - $2.50 per Watt
  - $35,000
- Savings
  - $170 per month
  - $2,000 per year
  - Pennsylvania Net Metering

# Spatial Requirement for Solar Panels

- Space for maintenance
- 35 Panels
  - 750 SF
- Current roof design
  - 650 SF per side
- 2 Sided (Gable) roof design
  - 1200 SF per side
- Mono-pitched
  - 2300 SF



# Final Thoughts

# Additional Steps

- Funding
  - Alternative sources of funding
    - Community Support
    - Sports Organizations
- Leasing food services
  - Reduce costs to the city

# Summary

# Resources and Thank You

- Dr. Rizzo
- Professor Sebastian
- Dr.  Bunger
- Dr. Oyler
- Dr. Stephens
- Dr. Sachs
- Engineering Library
- Cindy (Soccer Organizer)
- Sue (Citiparks)
- Julie Asciolla (PWSA)
- David Hommrich (President of Sunrise Energy)

# Thank You

# Roof Live Load Table

| Flat roof section: | |
|---|---|
| F= | <4 |
| At= | 1750 |
| R1= | 0.6 |
| R2= | 1 |
| Lr =20R1R2 | 12 |

| Sloped roof section: | |
|---|---|
| F= | 4 |
| At= | 1750 |
| R1= | 0.6 |
| R2=1.2 -.05 F | 1 |
| Lr =20R1R2 | 12 |

# Snow Load:

| Flat Roof | |
|---|---|
| Ce = | 1 |
| Ct = | 1.2 |
| Pg(psf) = | 25 |
| Is | 1 |
| Pf(psf) = 0.7*Ce*Ct*Pg*Is: | 21 |

| Sloped Roof: | |
|---|---|
| Cs = | 0.95 |
| Pf (psf) = | 21 |
| Ps(psf)= Cs*Pf: | 19.95 |

| Side Wall, Closed Case: | | |
|---|---|---|
| Ext. Pres. Coefficient, Cp: | -0.7 | Fig. 27.4-1 |
| Wind Pressure, P=qh*G*Cp-qh(GCpi) | -14.98065581 | Eq. 27.4-1 |
| **Windward Roof, Closed Pitched Case (Negative):** | | |
| Ext. Pres. Coefficient, Cp: | -0.5 | Fig. 27.4-1 |
| Wind Pressure, P=qh*G*Cp-qh(GCpi) | -11.69457647 | Eq. 27.4-1 |

| Windward Wall, Closed Case: | | |
|---|---|---|
| Ext. Pres. Coefficient, Cp: | 0.8 | Fig. 27.4-1 |
| Wind Pressure, P=qz*G*Cp-qh(GCpi) | 18.65841953 | Eq. 27.4-1 |

| Roof, Open Flat Case (case A): D<h | | |
|---|---|---|
| Ext. Pres. Coefficient, Cn: | -0.8 | Fig. 27.4-5 |
| Wind Pressure, P=qh*G*Cn | -13.14431736 | Eq. 27.4-3 |

| Leeward Roof, Closed Pitched Case: | | |
|---|---|---|
| Ext. Pres. Coefficient, Cp: | -0.55 | Fig. 27.4-1 |
| Wind Pressure, P=qh*G*Cp-qh(GCpi) | -12.51609631 | Eq. 27.4-1 |

# Solar

- 2000 kWh/month or
  - 16,000 kWh over 8 months
  - 17,000 kWh per year
- 1240 kWh/kW/year
  - 14 kW / year
- 400 W / panel
  - 35 Panels Required

- 35 Panels
  - 1,100 SF
- Current roof design (4 sides)
  - 500 SF per side
- 2 Sided roof design
  - 1,200 SF
  - Limited by panel dimensions
- 1 Slope roof design
  - 2,300 SF
  - No Configuration Restrictions

# What Would Need to Happen

- Roof Redesign (Single Slope)
  - Use Standing Seam Roof
    - S-5 Seam Clamp at $5 per clamp
    - $300 Total