MILLIE'S HOMEMADE ICE CREAM FACILITIES

Cream of the Crop Construction

Team Members

Construction Management

- Nicole Bell
- Nathan Crikelair
- Mike Klena

Structures

- Hannah Schell
- Zach Michak
- Matthew Hanna

Geotechnical

- Jordan Walk

Environmental

- Andrew Ricci

Outline

- **Client: Millie's**
- Conceptual Design
- Identifying Facility Location
- Phase 1: Cold Storage Facilities
  - *Foundation Design*
  - *Parking Lot Design*
  - *Structural Design*
  - *Environmental Design*
  - *Estimate/Schedule*
  - *Health and Safety Plan*
- Phase 2: Manufacturing Facility
- Summary

Client: Millie's

Chad Townsend
Ice Cream Maker & Scientist

Lauren Townsend
Taste Tester & Happiness Curator

Client: Millie's

- Family owned
- Homemade ice cream
- Locally sourced ingredients
- Vegan and gluten free

Problem Statement

Millie's is rapidly expanding and needs a higher storage capacity in order to keep up with their ice cream demand

Owner Preferences

Expand production

Cold Storage facility

- Sizing: 10,000 ft^2
- Budget: $500,000-$750,000

Manufacturing facility

- Sizing: 6,000 ft^2

Location

Scope

Goal:

- Primary: Provide Cold Storage facility
- Secondary: Provide future Manufacturing facility

Designed and constructed:

- Two Phases:
  - Phase 1: Cold Storage
  - Phase 2: Manufacturing
- Constructed on same site

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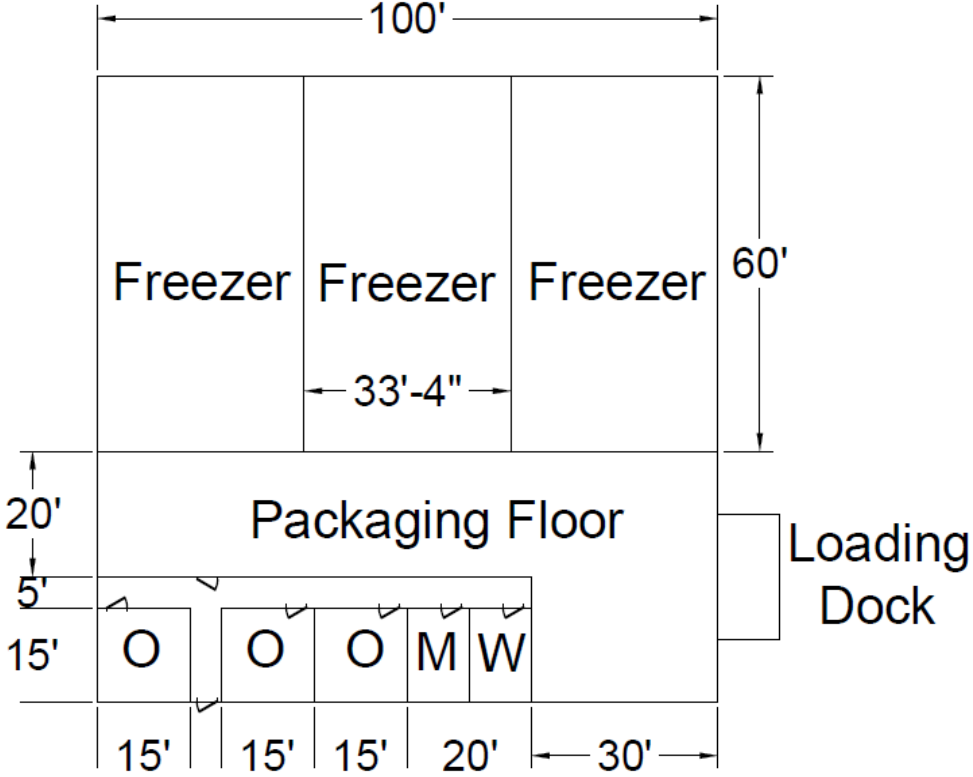
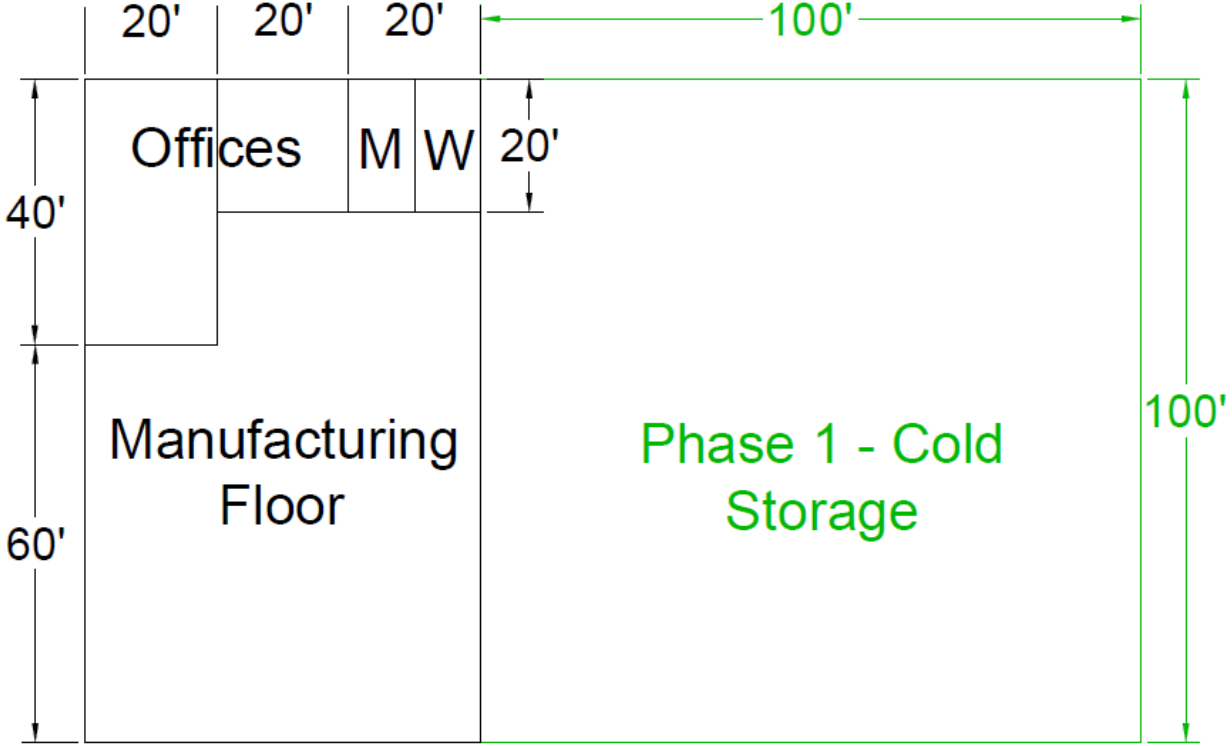
Cold Storage Facility



Manufacturing Facility



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Location Options

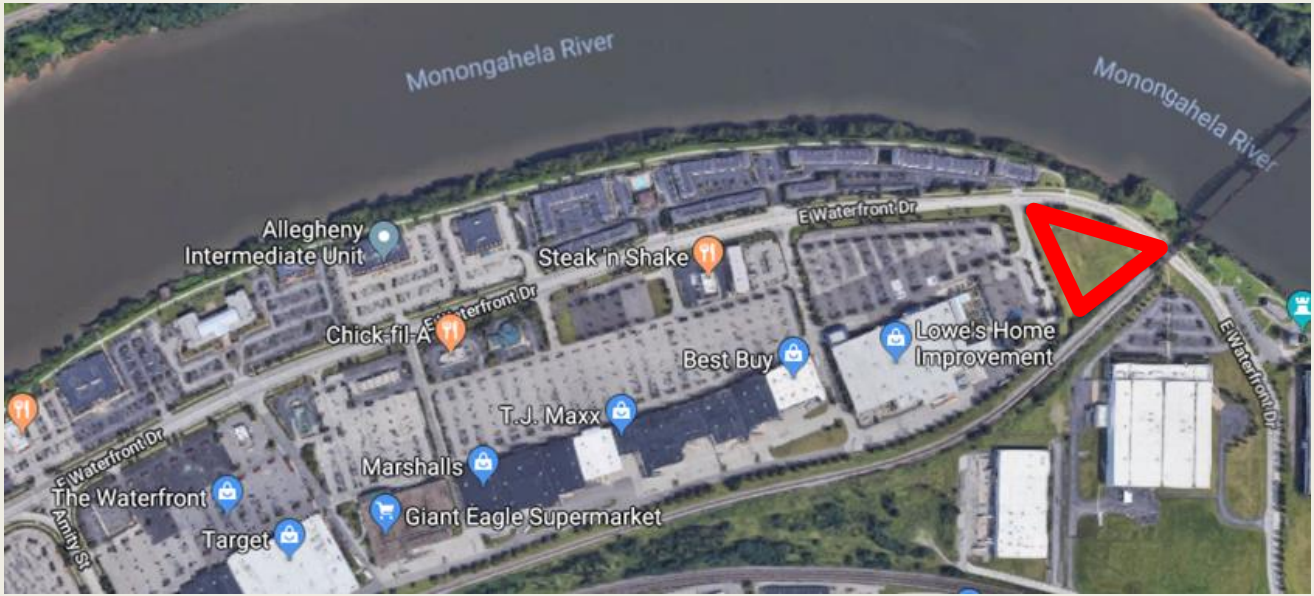
Phase 1: Cold Storage facility

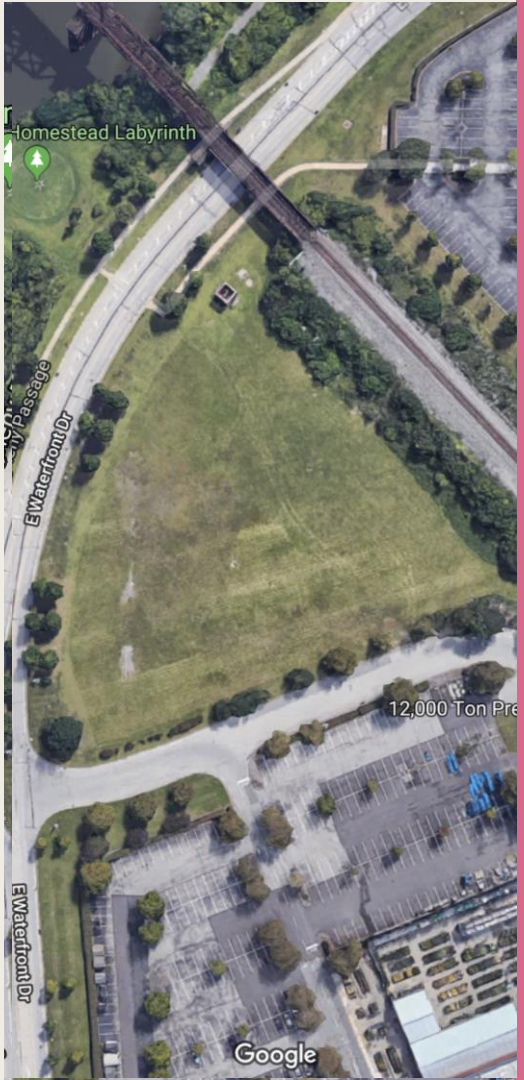
- Alternate options analyzed:
  - Purchase empty lot, construct new facility
  - Purchase existing industrial facility and retrofit
  - Purchase existing building, demo, new construction

Phase 2: Construct Manufacturing facility

- Addition to new Cold Storage facility from options above

Option A: Waterfront
- Empty Lot, New Construction

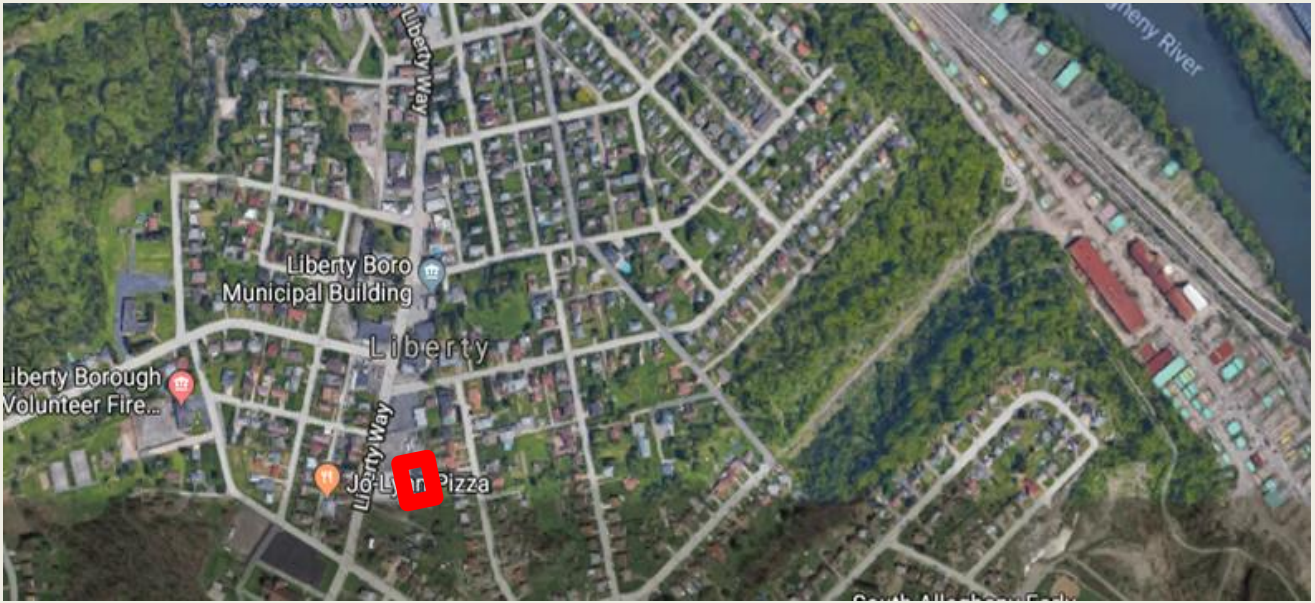




Option A: New Construction

- Location
  - *301 E Waterfront Dr., Homestead, PA*
- Details
  - *Open land*
  - *3 acre lot*
- Price: $1,500,000
- Divided lot details
  - *Assume lot can be divisible*
  - *1.5 acre lot*
  - *$750,000*

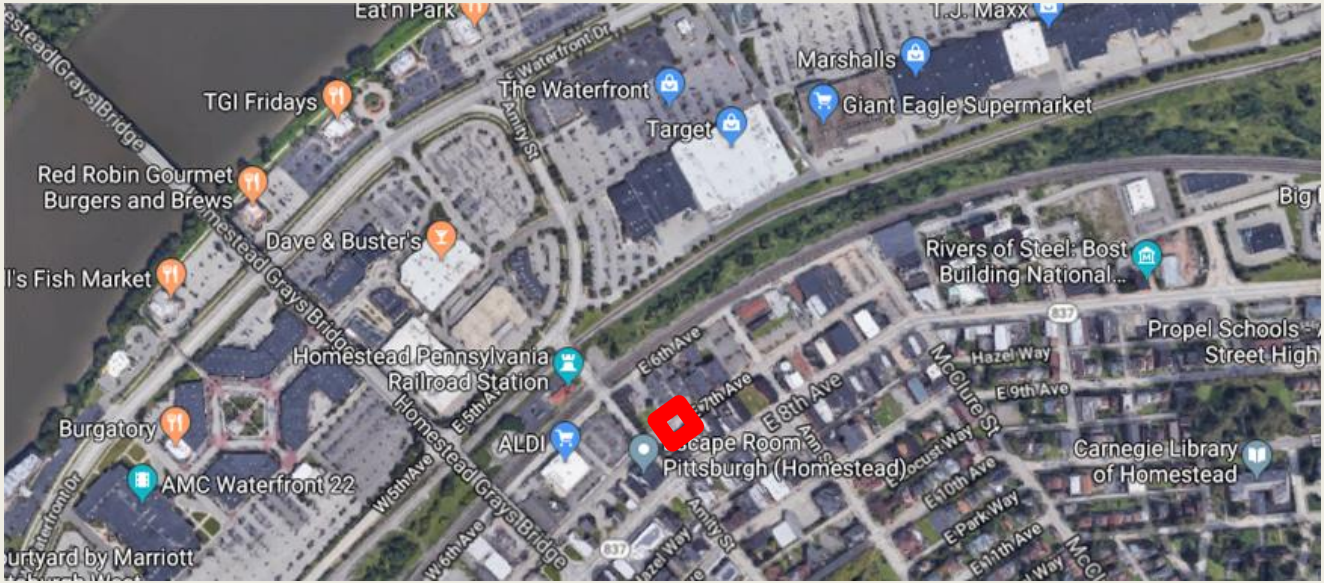
Option B: Liberty - Retrofit Facility



Option B: Retrofit

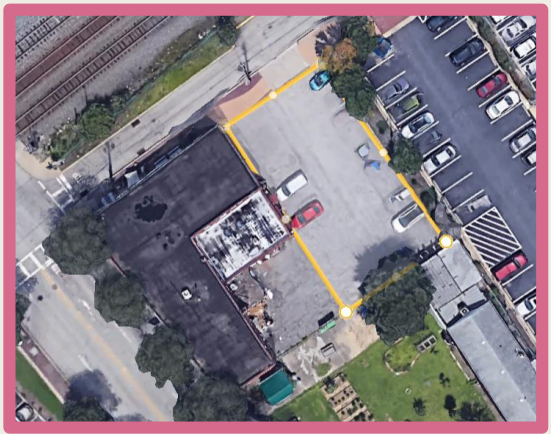
- Details:
  - Existing retail facility and parking lot
  - 1.23 acre lot
  - 7200 ft^2 (may need addition)
- Price : $542,850
- Change layout to meet storage space needs
- Needs expanded laterally and vertically
- Parking lot resurfacing

Option C: Homestead - Demolition/Construction



Option C: Demolition

- Location: 601 Amity St, Homestead PA
- Details:
  - *0.33 acre lot*
  - *6,000 ft² building to demo*
- Price: $550,000



Decision Matrix Ranking

Parameters	A: New Cons	B: Retrofit	C: Demo
Location	2	3	1
Cost	3	1	2
Soil Info	1	3	2
Access	1	2	3
Expansion	1	2	3
Risk	1	3	2
TOTAL	9	14	13

Location Selection

Option A: Empty Lot, New Construction

Reasoning Behind Our Choice

Demolition:

HIGH COSTS

NOT PREFERRED

SCHEDULE

LOCATION

Reasoning Behind Our Choice

Retrofit:

LOCATION

RISK

TOO SMALL

EXPANSION

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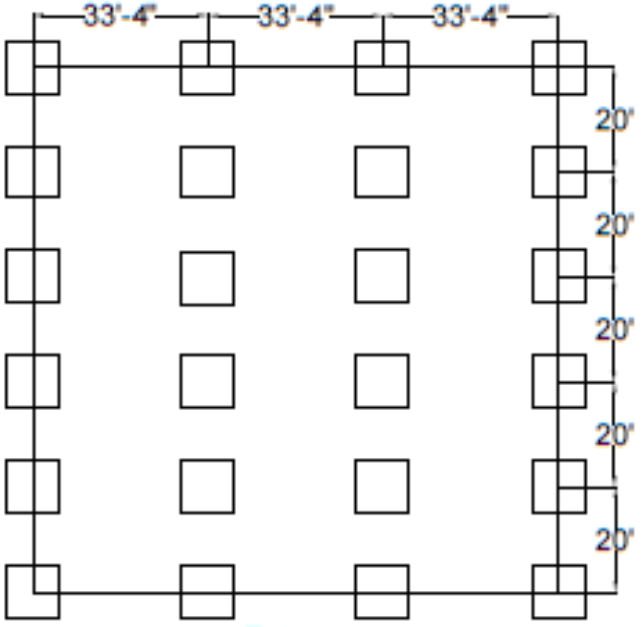
Soil Parameters

- Borings from GAI Consultants

Fill Unit Weight	96 pcf
Fill Angle of Friction	29°
Groundwater Depth	40 ft
Plastic Limit	16
Liquid Limit	25
Plasticity Index	9

Depth (ft)	Soil	Description
1.5		Sand- **FILL**
3		
4.5		
6		
7.5		Slag-**FILL**
9		
10.5		
12		
13.5		Sand- **FILL**
15		
16.5		Clay-**FILL**
18		
19.5		Clay-**Alluvial**
21		
22.5		
24		
25.5		Sand-**Alluvial**
27		
28.5		
30		

Foundation Design-Cold Storage



Cold Storage Facility
Foundation Plan View

- 24 total footings
- 33 ft - 4 in center to center spacing for each column
- 20 ft center to center spacing for each row

Foundation Design-Axial Load

- Axial Load of 175 k.
- Use Terzaghi Square Footing Foundation equation
  - $q=1.2cN_c+\gamma D_f N_q+.4\gamma N_\gamma B$

Factor of Safety	>3
Depth of Embedment	4 ft
Required Width of Footing	7.5 ft
Ultimate Bearing Capacity	10,000 psf
Allowable Bearing Capacity	3,250 psf

Foundation Design-Moment

Strong Moment	
Design Moment	365 k-ft
Required Area of Steel	0.17 in^2/ft
Spacing for #3 Bars	8 in
Required Width	10 ft

Weak Moment	
Design Moment	38 k-ft
Required Area of Steel	0.06 in^2/ft
Spacing for #3 Bars	20 in
Required Width	7.5 ft

Foundation Design-Settlement

- Primary consolidation settlement:

$$S_c = \frac{C_c + H_c}{1 + e_0} log \frac{\sigma_0 + \Delta\sigma_{avg}}{\sigma_0}$$

- Assume normally consolidated
- Newmark diagrams to help determine footing's influence on settlement below
- Resulted in a settlement of **0.86 in**

Foundation Design-Settlement

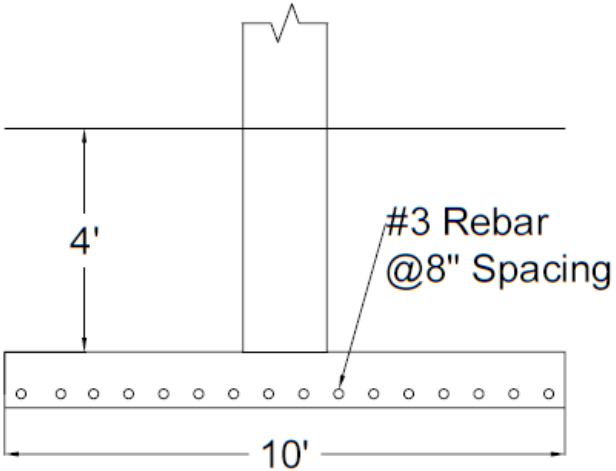
- Elastic settlement for clays

$$S_e = A_1 A_2 \frac{q_0 B}{E_s}$$

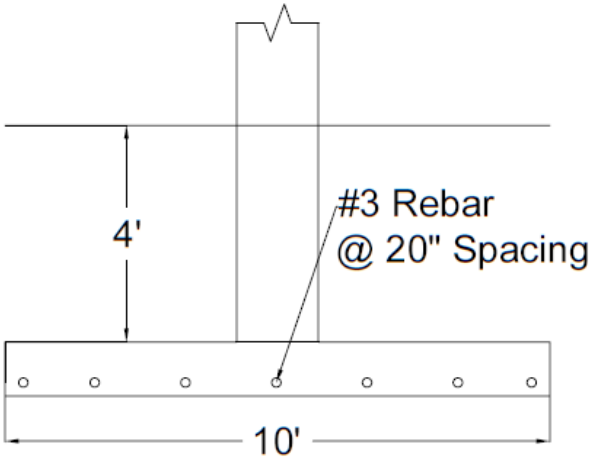
- Janbu (1956)
- Resulted in settlement of **0.25 in**

- Settlement of our building is 0.86 in+0.25 in=**1.11 in**
- Total settlement must be less than **1.75 in.** Based on Skempton and McDonald (1956)
- Add expansion joints to slab to prevent cracking and help reduce effect on slab

Foundation Design-Cross Section



Strong Moment Rebar Layout



Weak Moment Rebar Layout

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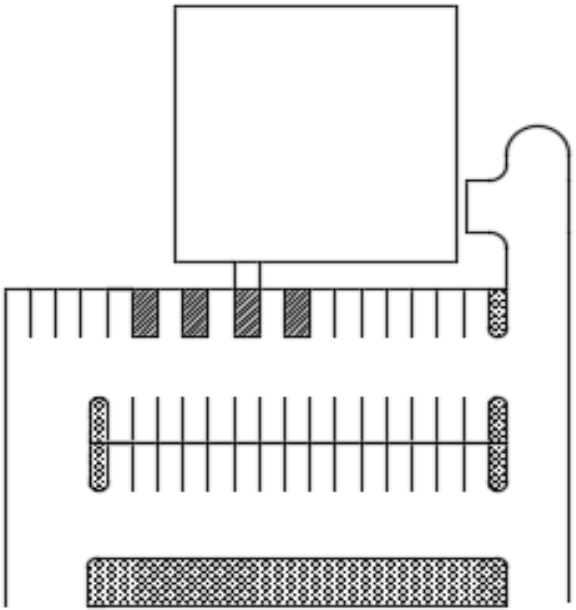
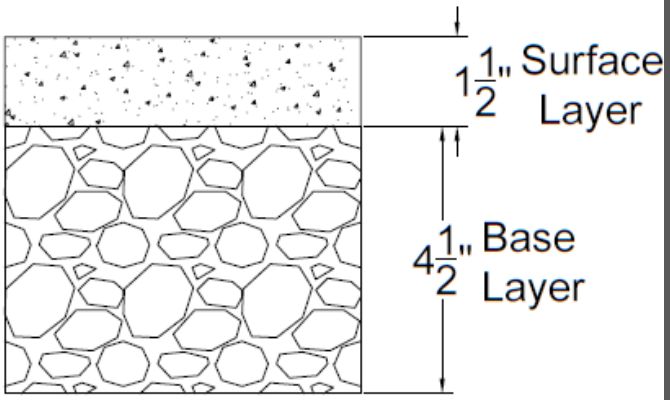
Parking Lot

- 45 Regular parking spaces
  - All 9x18 ft
  - Anticipating 10 CSF employees and 30 future MF employees
- 3 Handicap parking spaces
  - Meets ADA requirements
  - Open spaces on both ends for accessibility
- Space for loading dock
- Turnaround area
- Green space



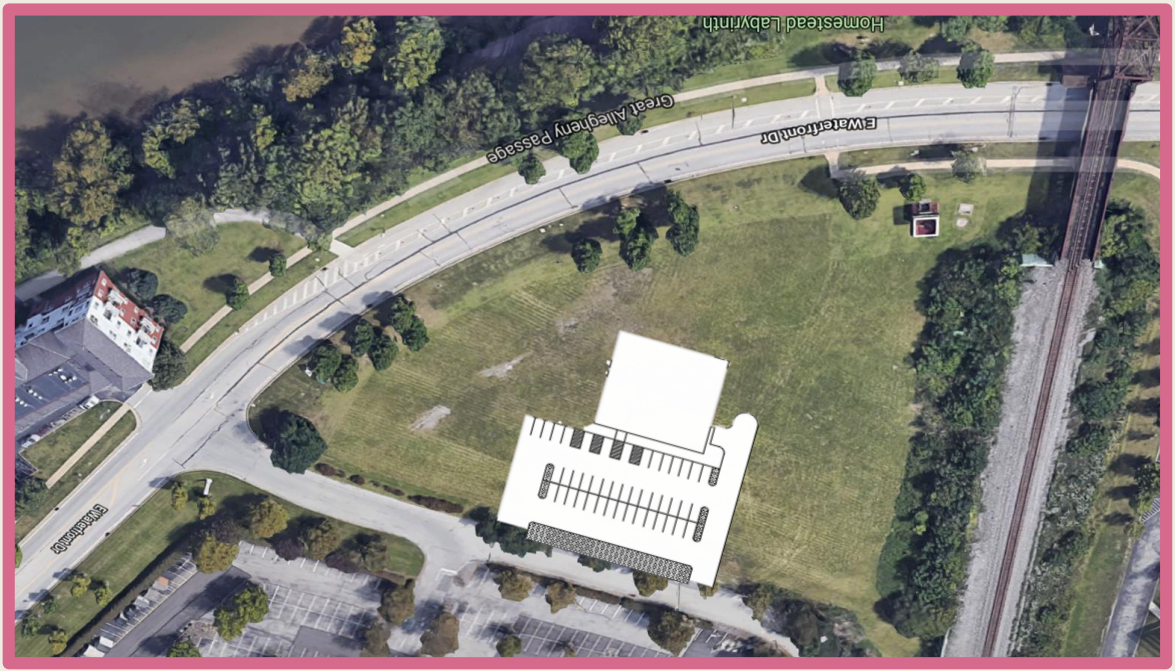
Parking Lot

- Surface area of pavement is 21,000 ft^2
- Pavement distances based on Pennsylvania Asphalt Pavement Association



Parking Lot
Pavement Cross Section

Parking Lot


Homestead Labyrinth
Great Allegheny Passage
E Waterfront Dr

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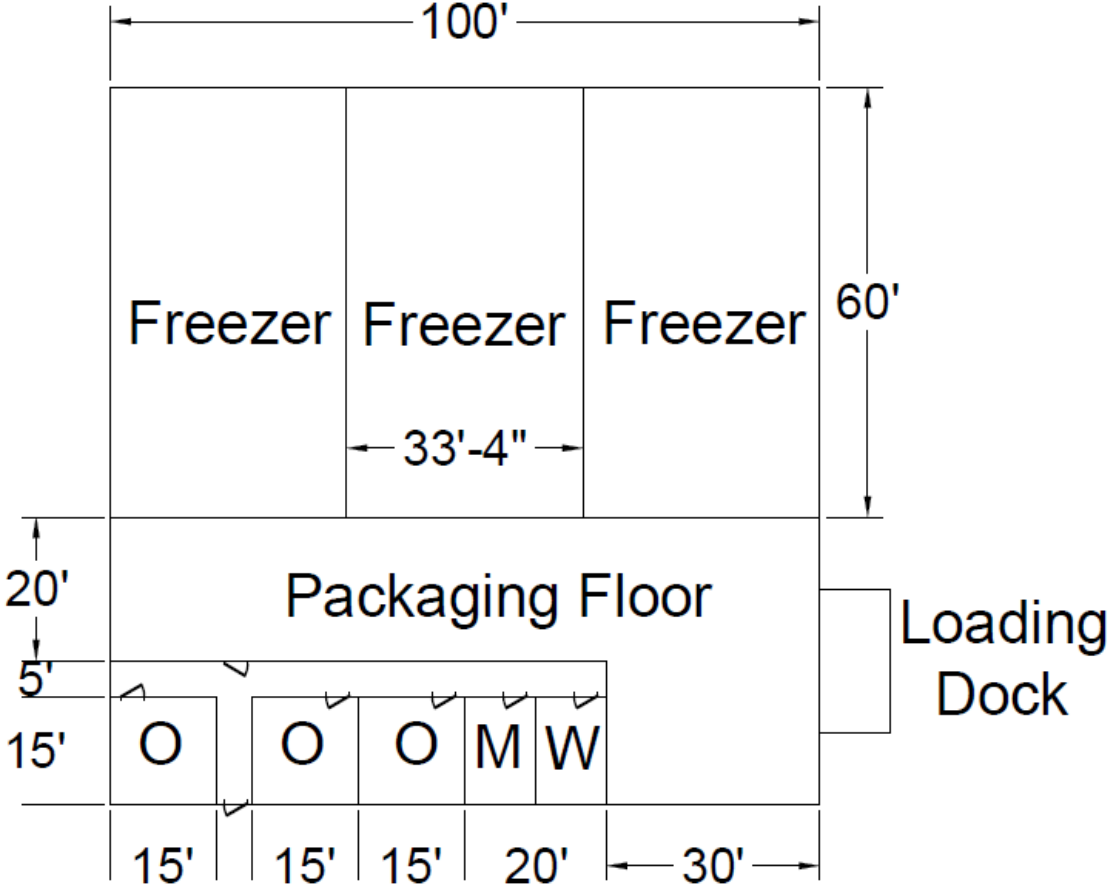

100'
Freezer
Freezer
Freezer
60'
33'-4"
20'
Packaging Floor
Loading
Dock
5'
15'
O
O
O
M
W
15'
15'
15'
20'
30'

Loadings

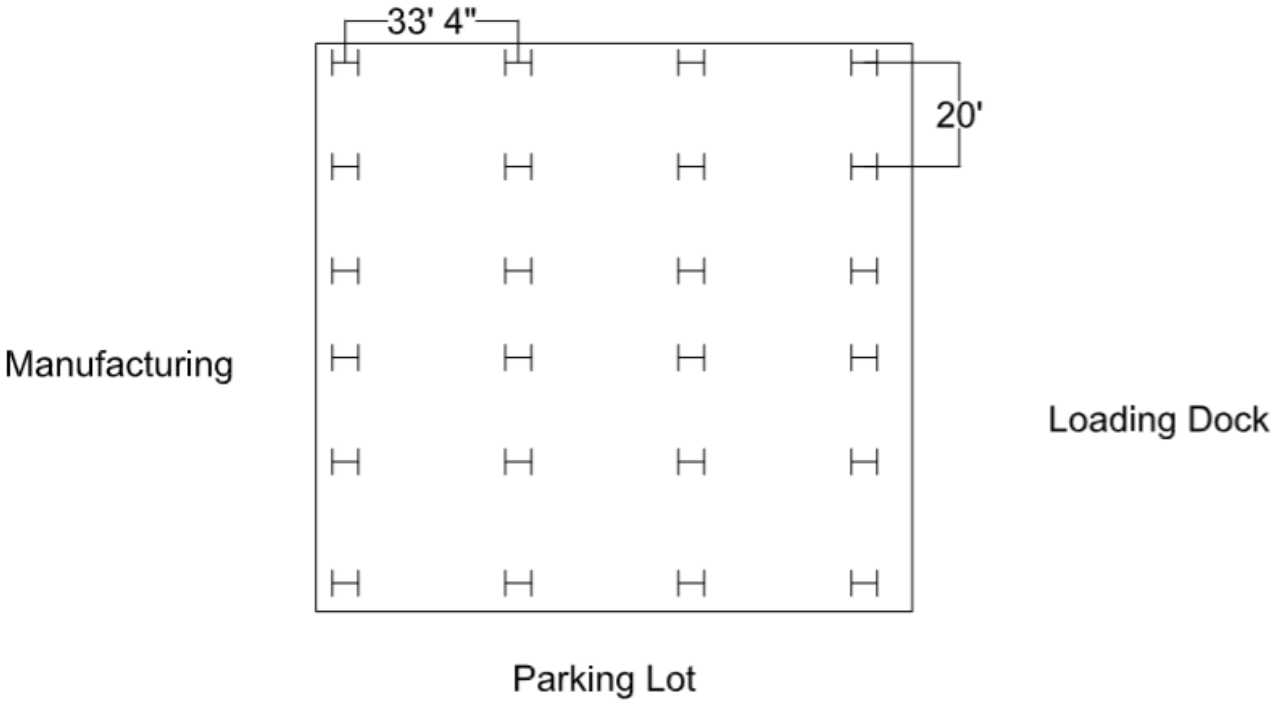
ASCE 7-10 used to determine loadings:

- *Dead load - 125 psf*
- *Snow load - 17.5 psf*
- *Wind load - 27 psf*
- *Seismic load - 1.2 psf*

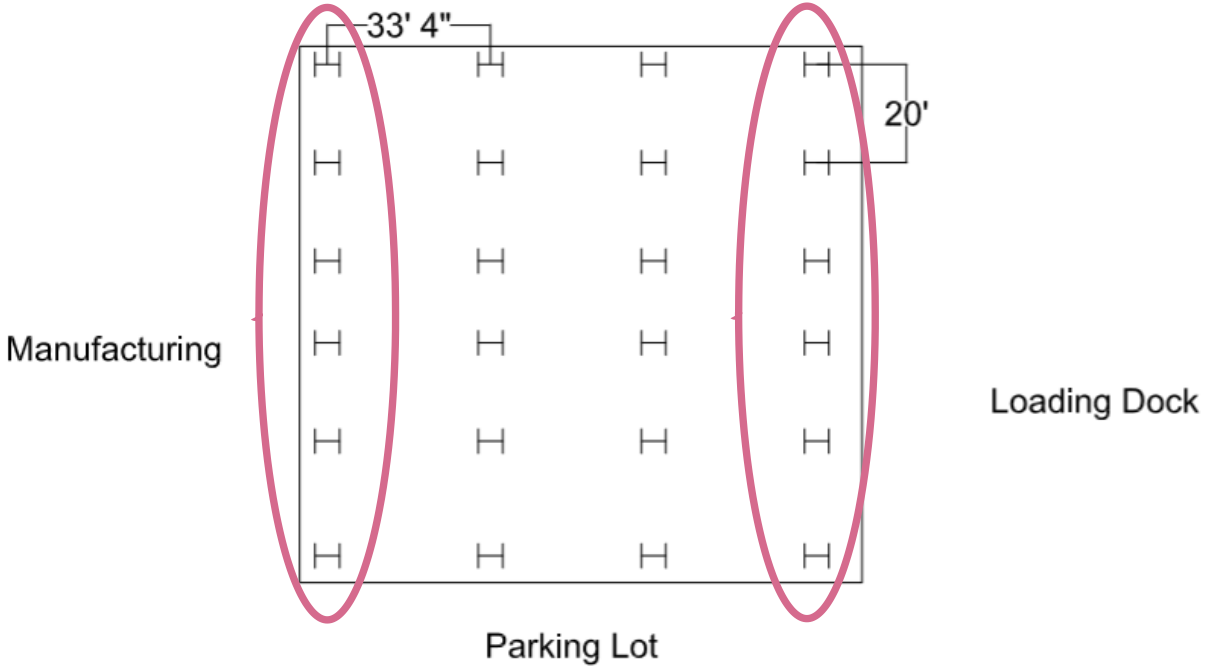
LRFD load cases:

- *1.4D = 175 psf*
- *1.2D + 1.6L + 0.5(L_r or S or R) = 159 psf*
- ***1.2D + 1.6(L_r or S or R) + (L or 0.5W) = 192 psf***
- *1.2D + 1.0W + L + 0.5(L_r or S or R) = 186 psf*
- *1.2D + 1.0E + L + 0.2S = 155 psf*
- *0.9D + 1.0W = 140 psf*
- *0.9D + 1.0E = 114 psf*

Column Layout



Exterior Column Design



Exterior Column Design

Design parameters

- Axial Load: 70 k
- Bending Moment (X): 380 k-ft
- Bending Moment (Y): 13 k-ft
- Unbraced Length: 15 ft

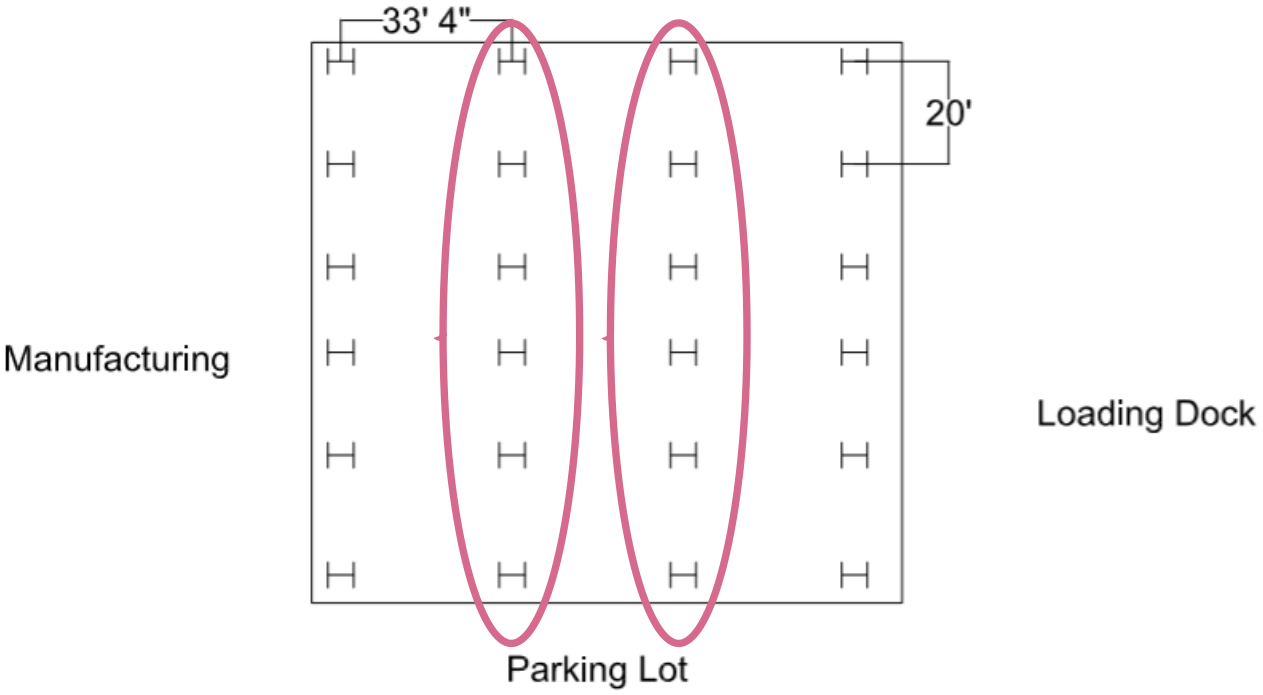
W14x74 member selected per AISC

- Axial Compressive Strength: 809 k
- Bending Strength (X): 422 k-ft
- Bending Strength (Y): 187 k-ft

Flexural and bending capacity check

- =.92<1----OK

Interior Column Design



Interior Column Design

Design parameters

- Axial Load: 140 k
- Bending Moment (X): 0 k-ft
- Bending Moment (Y): 26 k-ft
- Unbraced Length: 15 ft

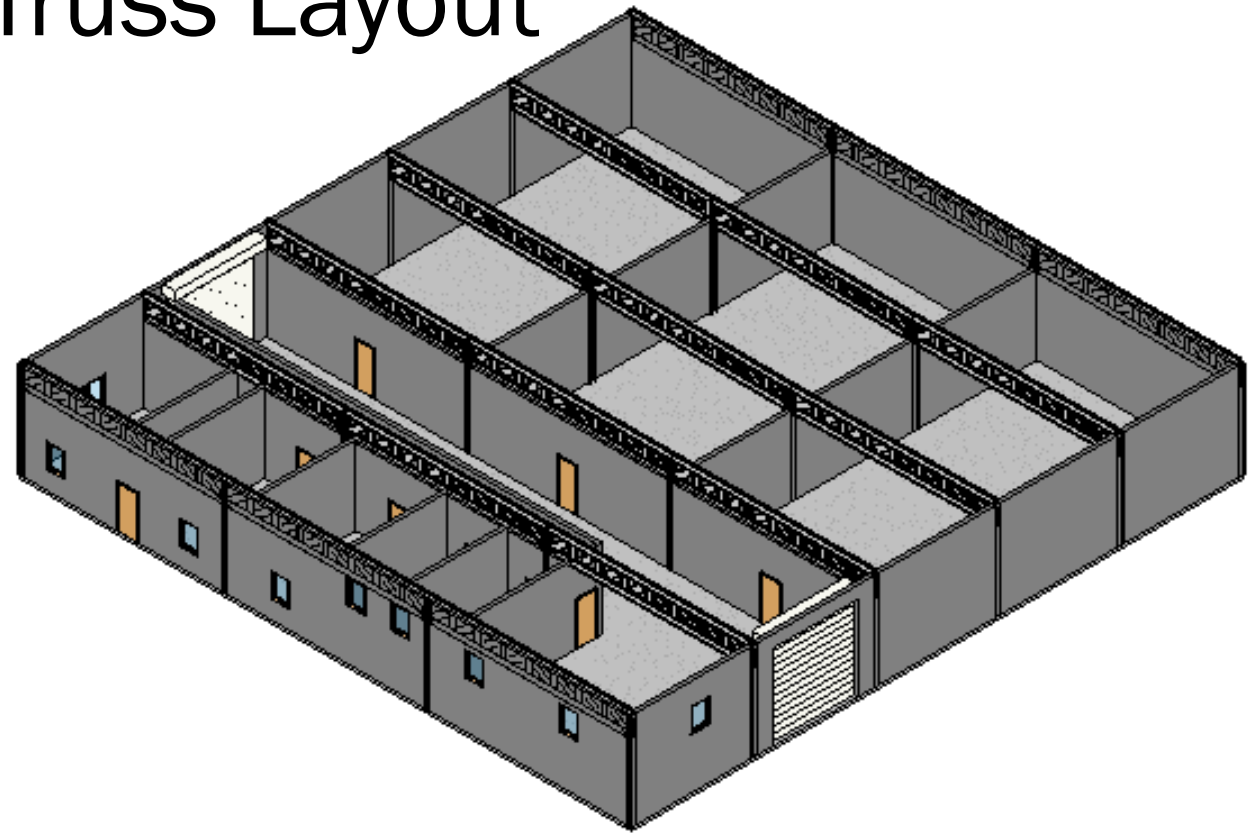
W10x33 member selected per AISC

- Axial Compressive Strength: 295 k
- Bending Strength (X): 119 k-ft
- Bending Strength (Y): 38 k-ft

Flexural and bending capacity check

- =.76<1----OK

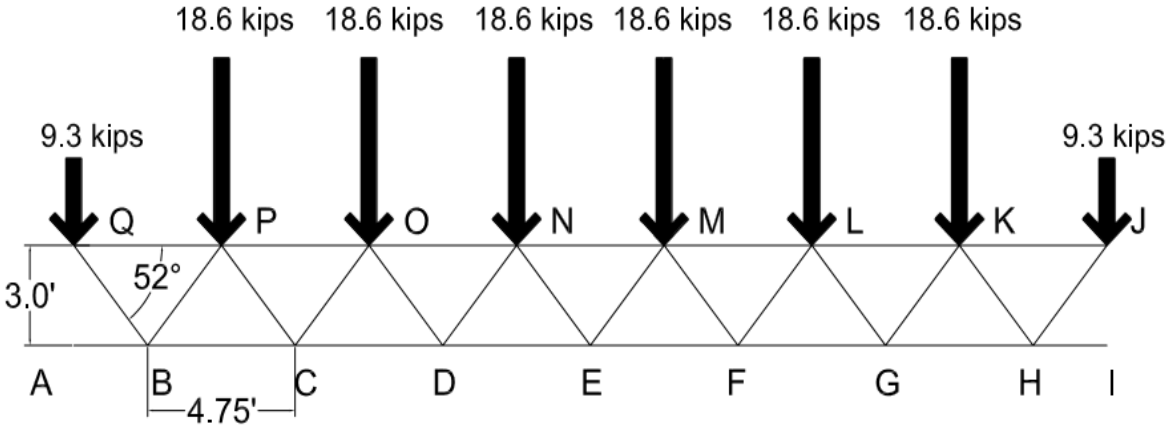
Truss Layout



Truss Design Concept

- Initial considerations:
  - Open web steel joists: Prefabricated truss system
  - 100 ft span trusses personally designed
- Secondary considerations
  - Interior columns
- Final selection
  - Smaller flat Warren truss
  - 33 ft 4 in long
  - 18 total trusses

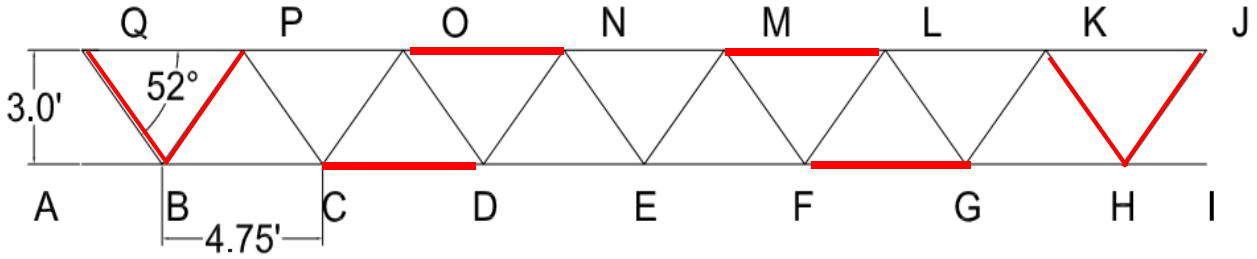
Truss Design



Truss Internal Loadings

Member	Load (k)	T or C
AB	4.1	T
BQ	226	C
QP	144	T
BP	226	T
BC	276	C
PC	202	C
PO	409	T
CO	202	T
CD	527	C
DO	178	C
ON	645	T
DN	178	T

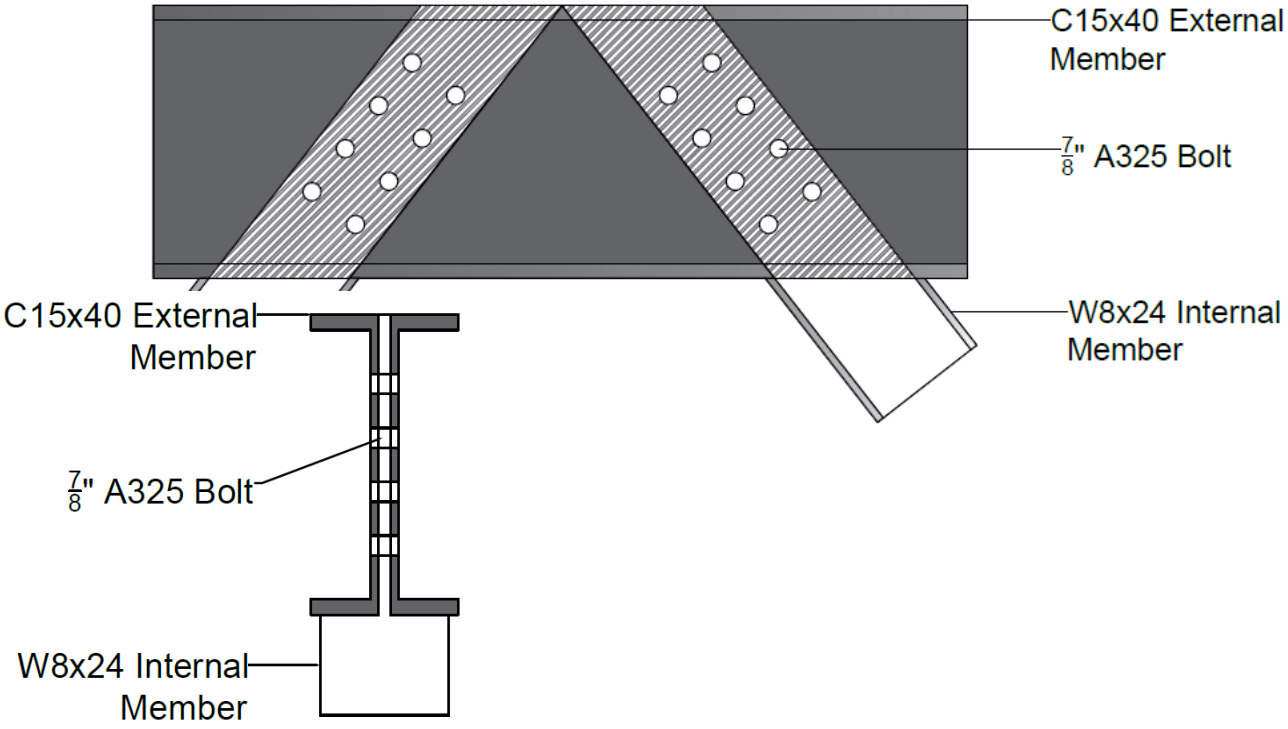
Maximum Loaded Members



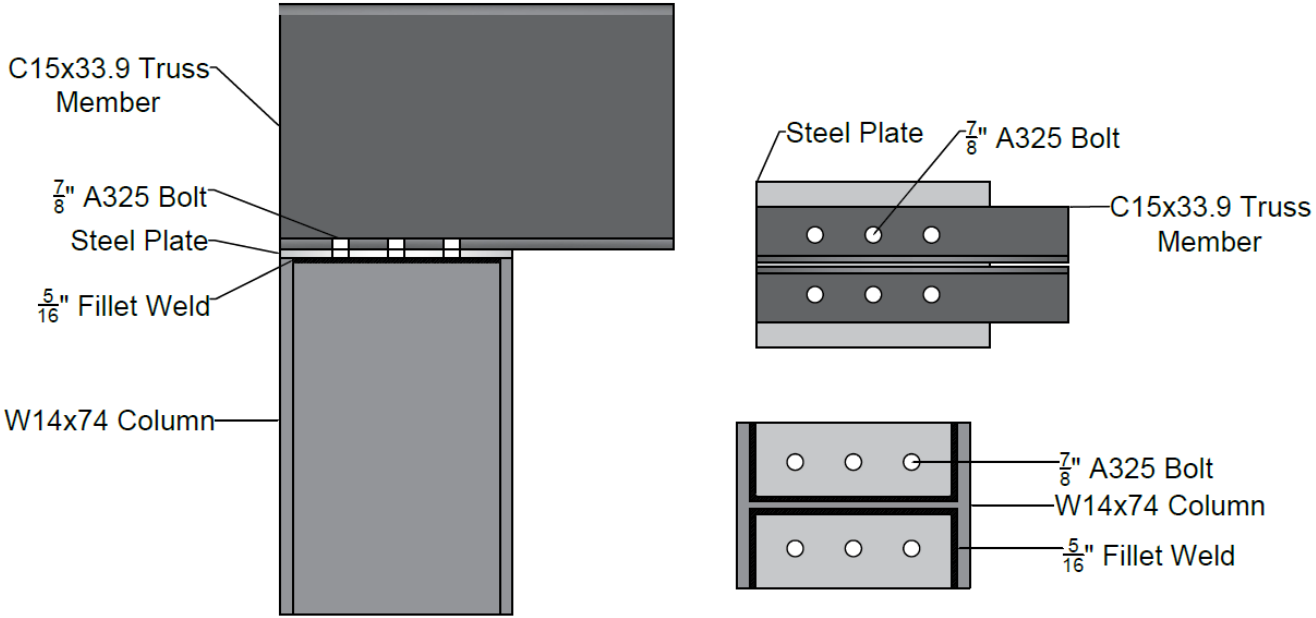
Truss Member Selection

Truss Member	Maximum Force	Member Selection
Horizontal Tension	645 k	2C15x40
Horizontal Compression	527 k	2C15x33.9
Diagonal Tension	226 k	W8x24
Diagonal Compression	226 k	W8x24

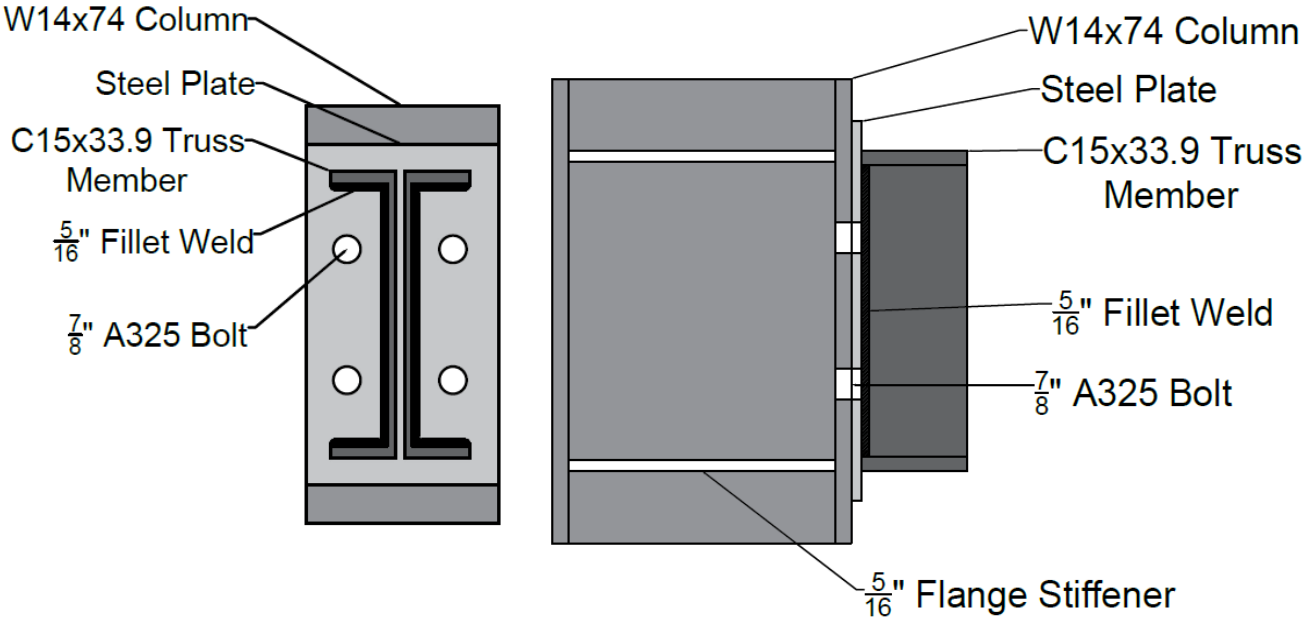
Internal Truss Connection



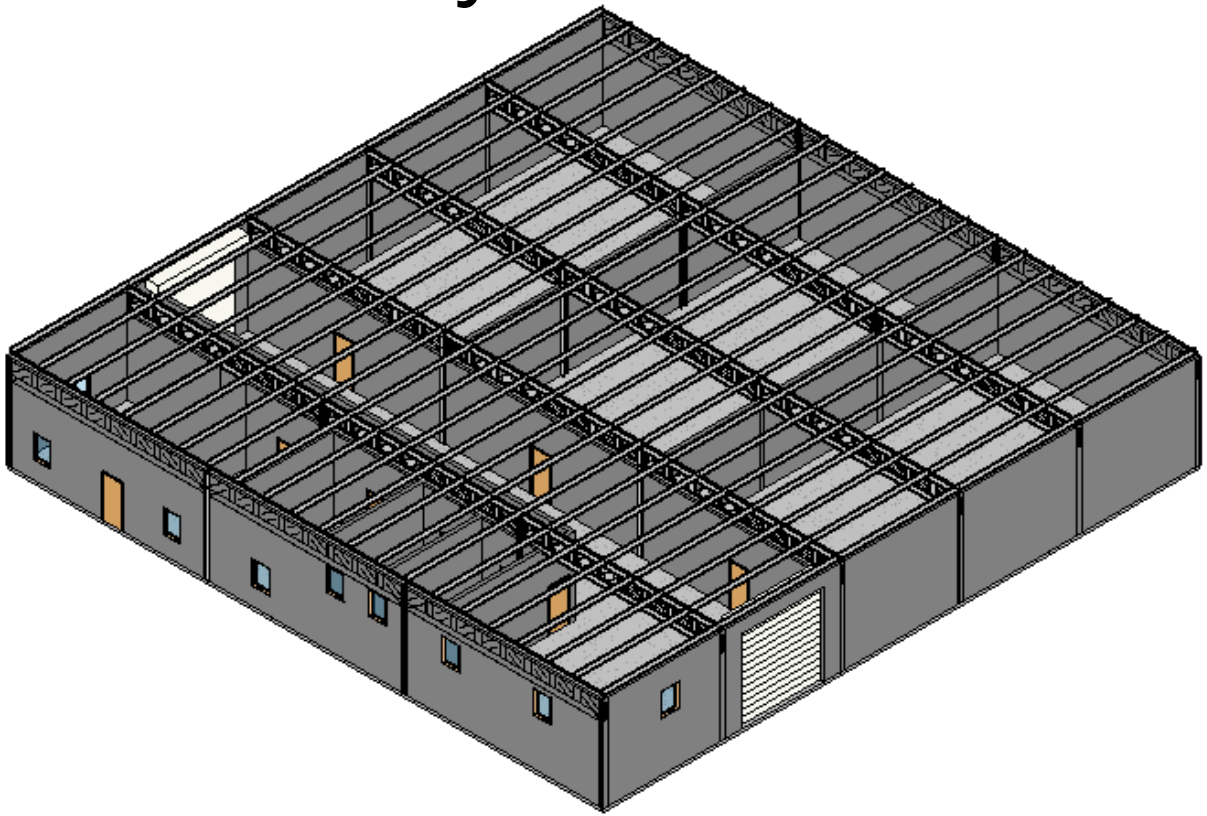
External Truss Connection



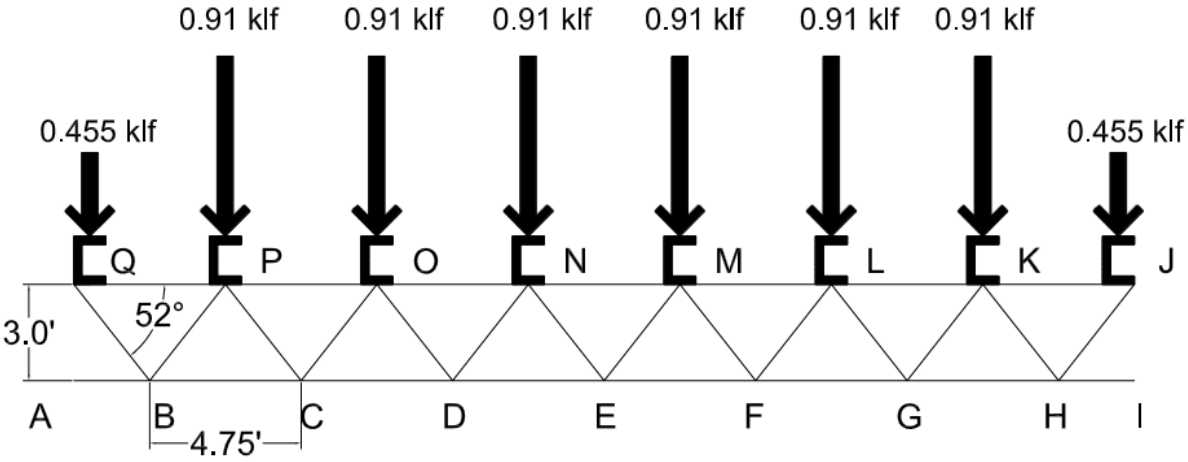
External Truss Connection



Channel Layout



Channel Design



Channel Design

Design parameters

- Span Length: 20 ft
- Channel Spacing: 4.75 ft
- Unbraced Length: 0 ft
- Design Moment: 48 k-ft
- Design Shear: 9.9 k

C12x20.7 member selected per AISC

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Water Tank Considerations

- Sizing off monthly demand
  - Yields a smaller tank but more variation
  - Less total weight for building
- Sizing off yearly demand
  - Large tank
  - Less risk involved as tank can store more
  - Increases total weight of building significantly

Water Tank Parameters

- Water use per capita is 40 gallons a day
  - *Industrial use*
    - Designed for 5 people
- Average water use is 200 gallons per day
  - *A safety factor of 1.25 is used*
- 10,000 gallon storage tank is chosen
  - *With a usage of 7,750 gallons a month*
- Minimum monthly rainfall is 2.3 in
  - *Found on www.weather.gov*
- Evapotranspiration rate of 1,600 gallons a month
  - *0.26 in/day for sedum*

Distribution of Water within the Facility

Storm water will be stored on site for gray water purposes

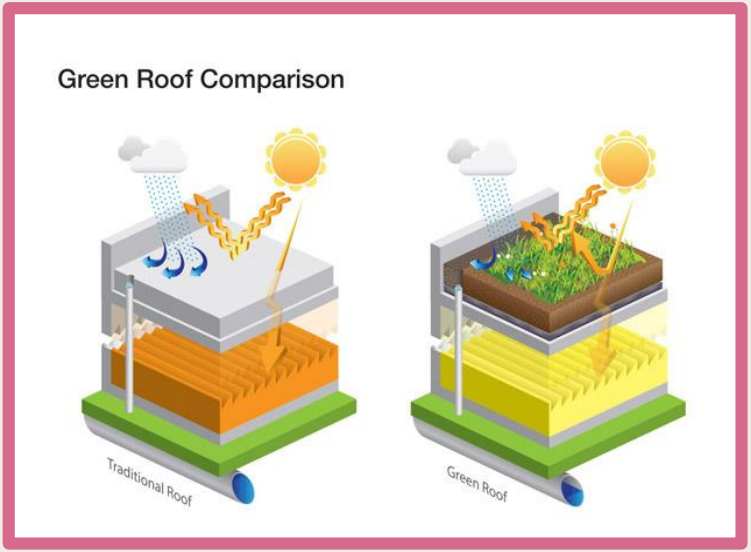
- The green roof will act as a natural filtration system
- From the filtration, no excess treatment will be required
- Stored water can also be used for additional irrigation

Drinking water

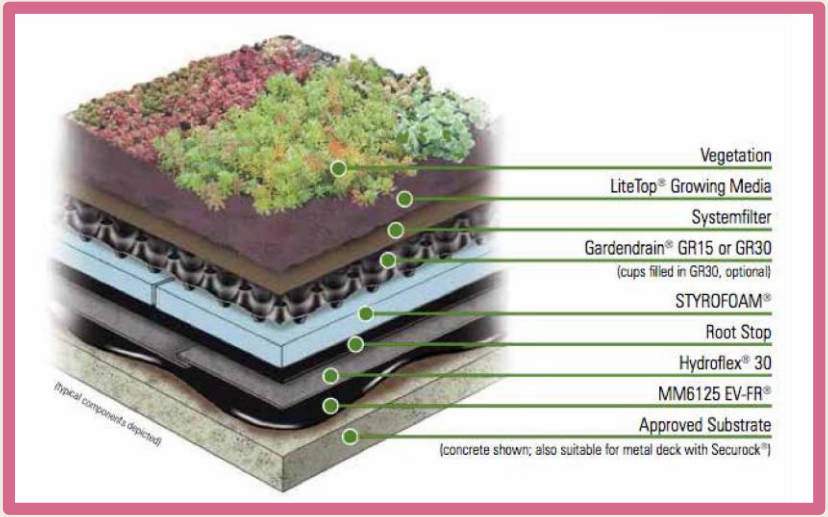
- The domestic use of water will be supplied by PWSA
- Black water will be discharged to PWSA

Green Roof Benefits

- Controls storm water runoff
- Improves water runoff quality
- Mitigates urban heat-island effects
- Reduce HVAC costs



Green Roof Design



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Phase 1: Cost Estimate

- Used the *RSMeans Building Construction Cost Data*

ITEM	COST
COST/SF	$128/SF
STORAGE FREEZERS	$270,000
GREEN ROOF (w/TANK)	$100,000
TOTAL	**$1,276,000**

Phase 1: Cost Estimate

ITEM	COST
PARKING LOT	$72,000
FOUNDATIONS & SLAB	$109,000
STRUCTURAL STEEL	$27,000
GREEN ROOF (w/ TANK)	$100,000
UTILITIES/TIE INS	$66,000
FINISHES	$413,000
GENERAL CONDITIONS & OVERHEAD	$450,000
RISK CONTINGENCY	$43,500

TOTAL COST: $1,276,000

- Assuming Guaranteed Maximum Price (GMP) contract

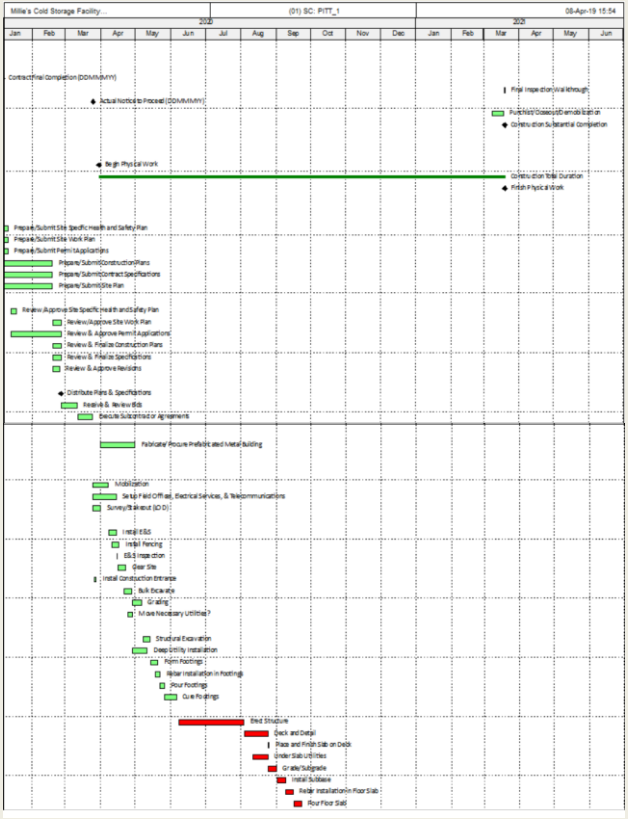
Risk Contingency Plan

Risk #	What can go wrong	Probability	Estimated Cost	Contingency	Can we prevent it?	Plan
1	Inclement Weather	40%	$5,000.00	$2,000.00	No	Work overtime or crash schedule. Schedule any concrete pours or temperature dependent activities through warm months
2	Delay due to Equipment Malfuncti	30%	$6,000.00	$1,800.00	No	Have mechanic on call. Try and schedule alternate activities if delayed on specific activity.
3	Shipping & Supply delays	20%	$2,000.00	$400.00	Yes	Make sure all material orders are placed in advance and all calculations are triple checked. Prepare storage area in advance to accommodate any critical pieces

- Total risk contingency = **$43,500**
  - Total risk contingency = 3.4% of project value

Project Schedule

- Notice to proceed: March 25th, 2020
- Completed: March 19th, 2021
- Construction duration: 12 months
- Possible delays:
  - Inclement weather conditions
  - Subcontractor delays
  - Unforeseen utility delays
  - Long lead times for materials



MILESTONES AND KEY TASKS

Milestone/Key Task	Date
Submit and Approve GMP	Jan 6, 2020
Mobilization and Ground Breaking	Mar 25, 2020
Pour Footings	May 22, 2020
Erect Structure	July 8 – Aug 3, 2020
Pour Slab on Grade	Sept 16 – Sept 22, 2020
Exterior Enclosure	Sept 23 - Oct 28, 2020
Rough-in and Finishes	Oct 9 – Jan 29, 2021
Punchlist	Mar 8, 2021
Turnover	Mar 19, 2021

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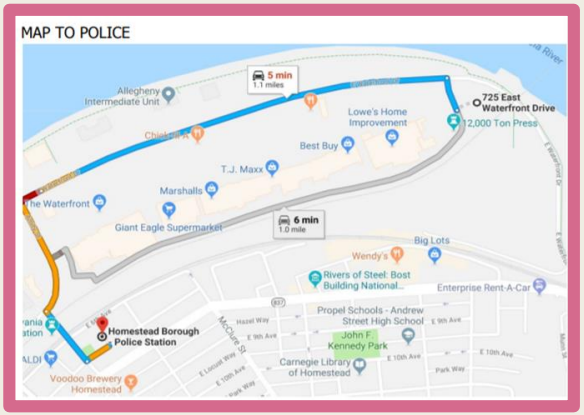
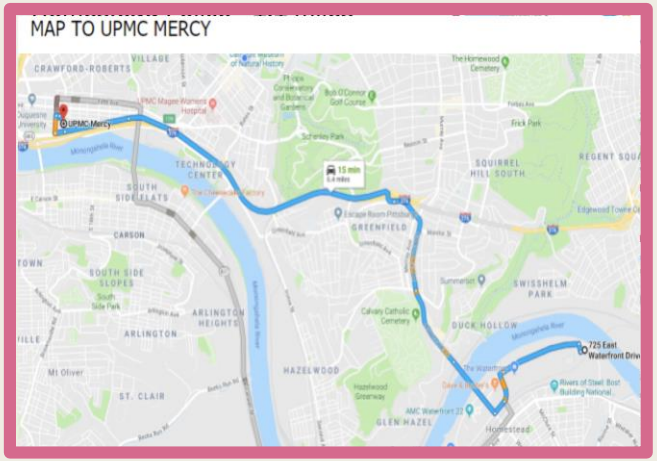
  - *Environmental Design*
  - *Estimate/Schedule*
  - ***Health and Safety Plan***
- Phase 2: Manufacturing Facility
- Summary

Health and Safety Plan

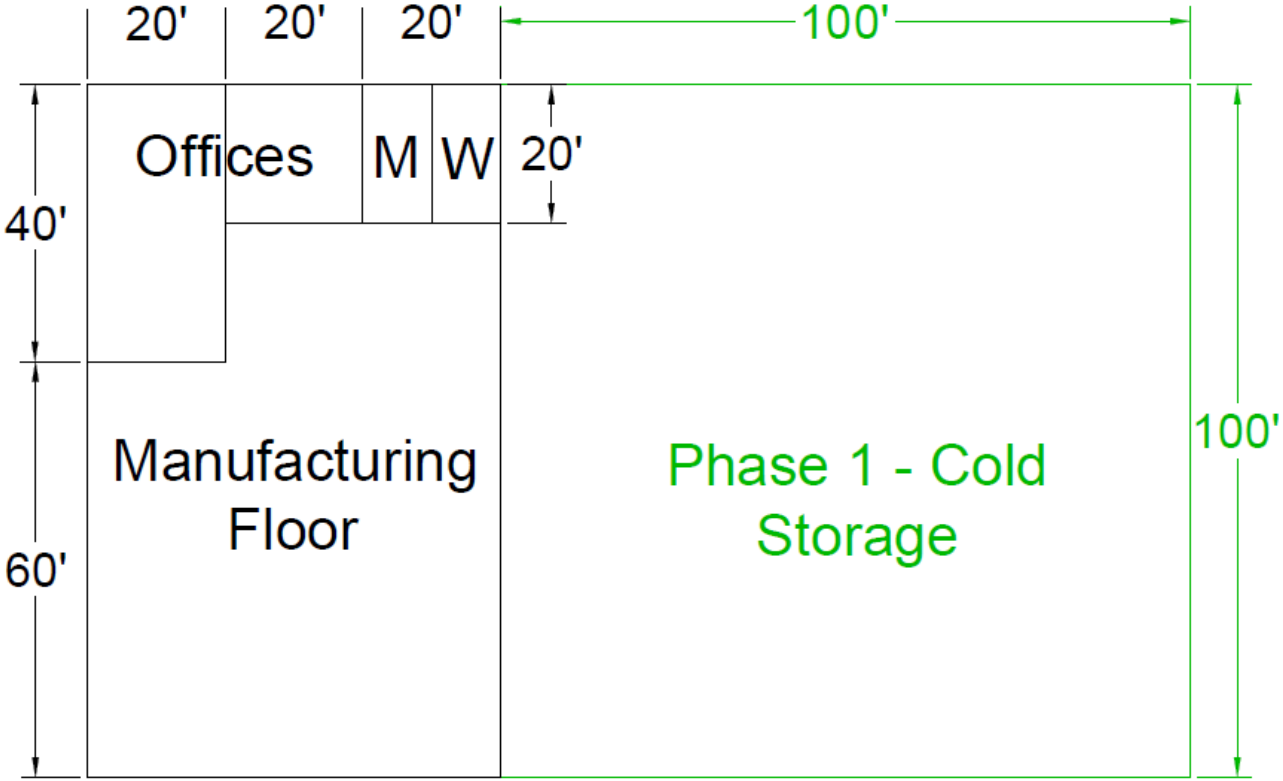
- Homestead Police - 1.1 miles
- Fire Department - 1.3 miles
- UPMC Mercy Hospital - 6.4 miles





Outline

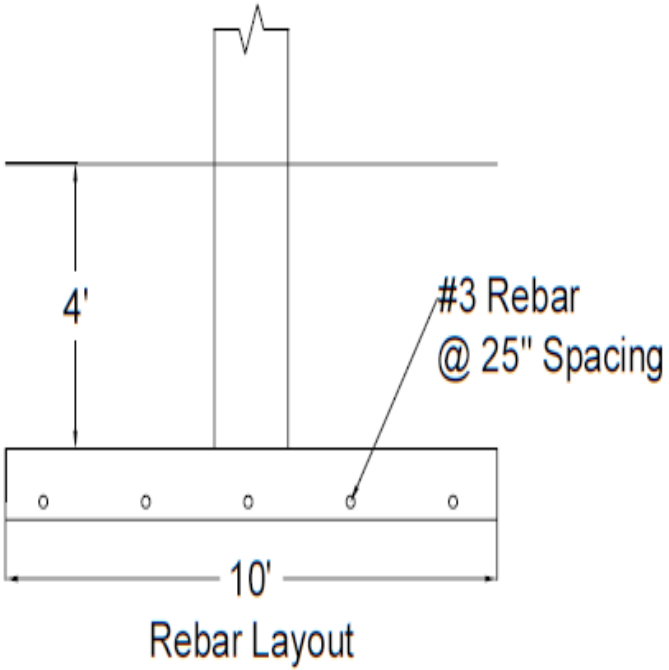
- Client: Millie's
- Conceptual Design
- Identifying Facility Location
- Phase 1: Cold Storage Facilities
  - *Foundation Design*
  - *Parking Lot Design*
  - *Structural Design*
  - *Environmental Design*
  - *Estimate/Schedule*
  - *Health and Safety Plan*
- **Phase 2: Manufacturing Facility**
- Summary


20'
20'
20'
100'
Offices
M
W
20'
40'
Manufacturing Floor
60'
Phase 1 - Cold Storage
100'

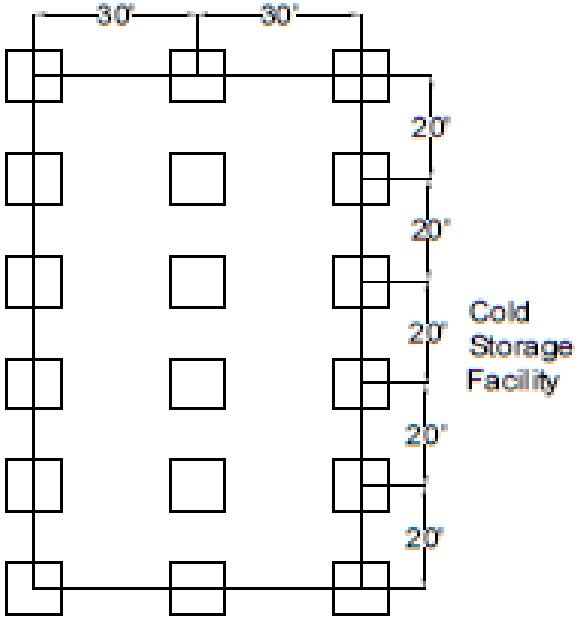
Foundation Design

Manufacturing Foundation Summary	
Axial Load	90 k
Strong Moment	190 k-ft
Weak Moment	38 k-ft
Reinforcement	#3 @25 in spacing
Primary Consolidation	0.88 in
Elastic	0.01 in
Total Settlement	0.89 in
Width	10 ft

Foundation Design



Rebar Layout



Manufacturing Facility
Foundation Plan View

Loadings

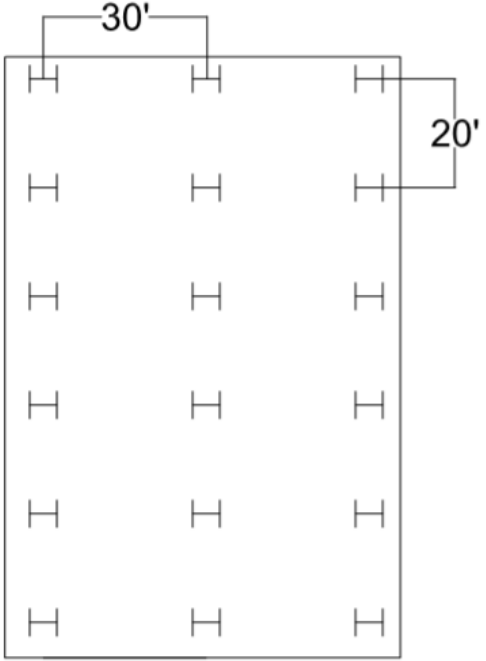
ASCE 7-10 used to determine loadings:

- *Dead load - 71 psf*
- *Snow load - 17.5 psf*
- *Wind load - 27 psf*
- *Seismic load - 1.2 psf*

LRFD load cases:

- *1.4D = 100 psf*
- *1.2D + 1.6L + 0.5(L_r or S or R) = 94 psf*
- ***1.2D + 1.6(L_r or S or R) + (L or 0.5W) = 127 psf***
- *1.2D + 1.0W + L + 0.5(L_r or S or R) = 121 psf*
- *1.2D + 1.0E + L + 0.2S = 90 psf*
- *0.9D + 1.0W = 91 psf*
- *0.9D + 1.0E = 65 psf*

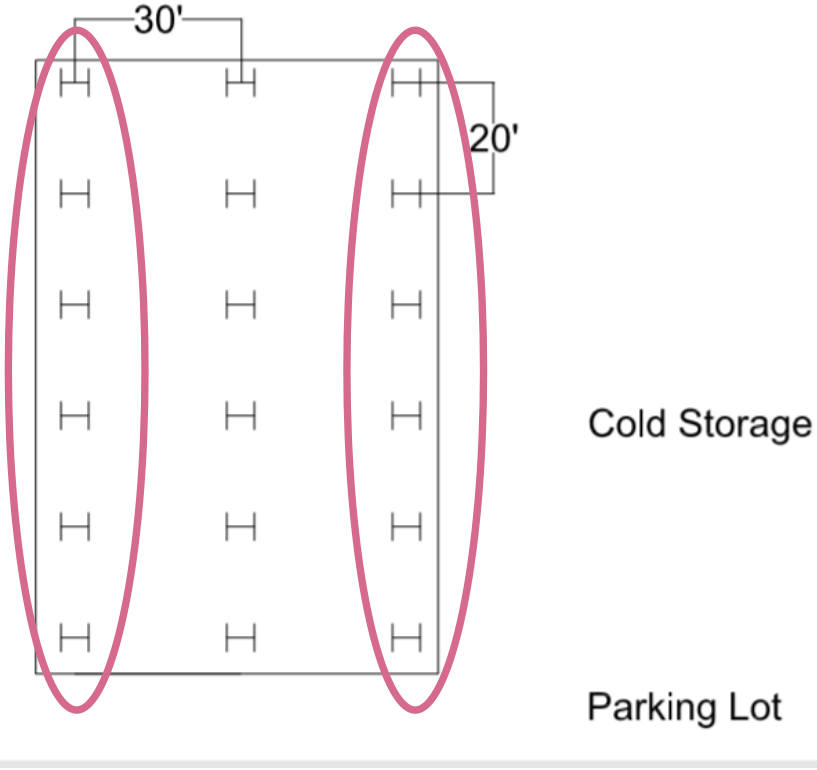
Column Layout



Cold Storage

Parking Lot

Exterior Columns



Exterior Column Design

Design parameters

- Axial Load: 43 k
- Bending Moment (X): 200 k-ft
- Bending Moment (Y): 11.4 k-ft
- Unbraced Length: 15 ft

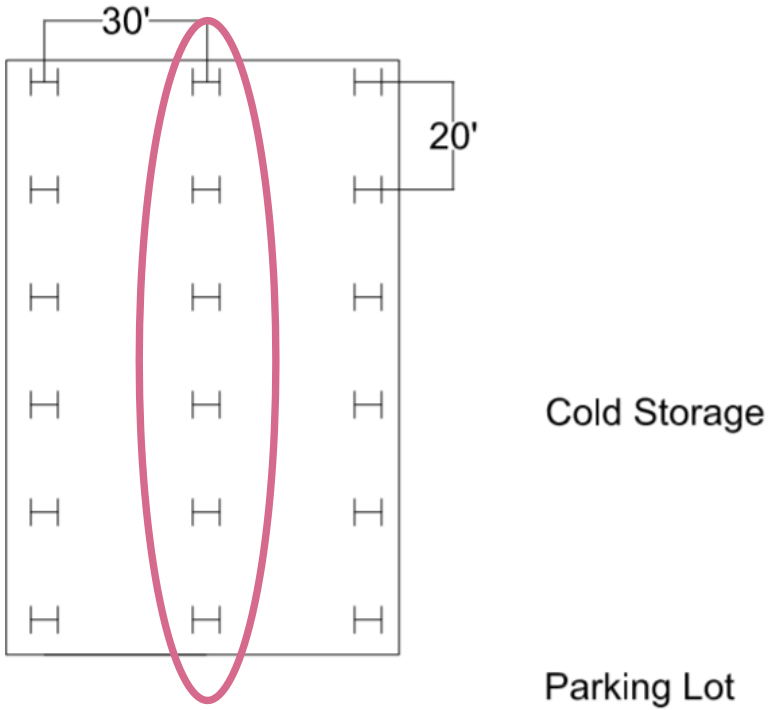
W14x53 member selected per AISC

- Axial Compressive Strength: 369 k
- Bending Strength (X): 261 k-ft
- Bending Strength (Y): 58.5 k-ft

Flexural and bending capacity check

- =.91<1----OK

Interior Columns



Interior Column Design

Design parameters

- Axial Load: 90 k
- Bending Moment (X): 0 k-ft
- Bending Moment (Y): 23 k-ft
- Unbraced Length: 15 ft

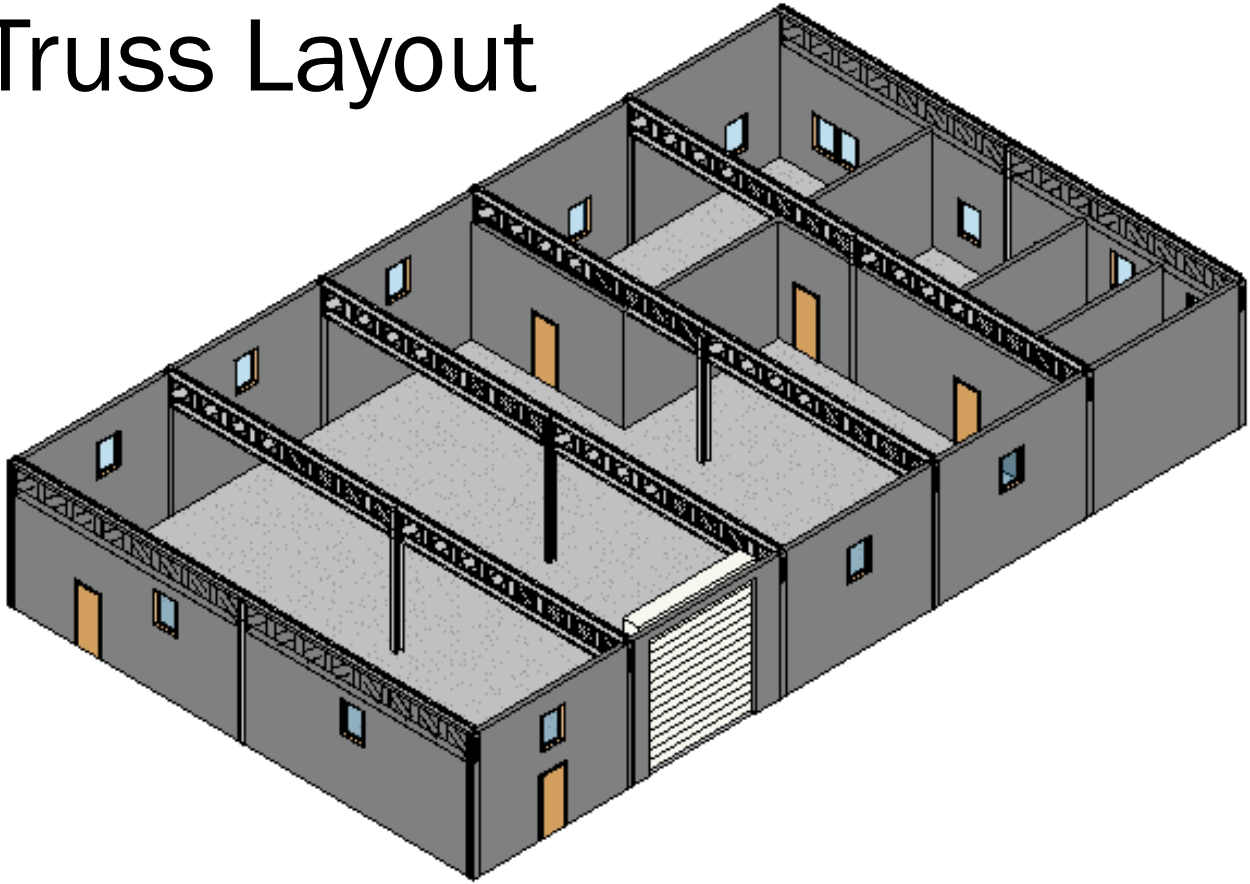
W10x33 member selected per AISC

- Axial Compressive Strength: 295 k
- Bending Strength (X): 119 k-ft
- Bending Strength (Y): 38 k-ft

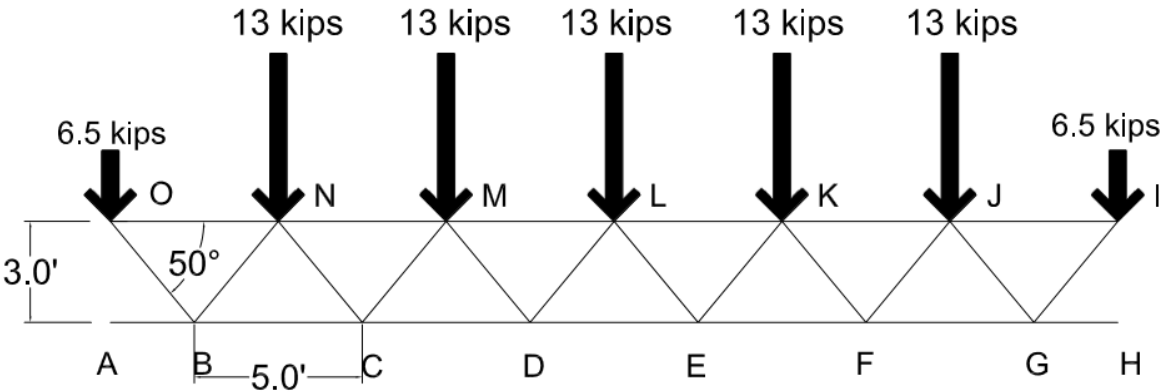
Flexural and bending capacity check

- =0.54<1----OK

Truss Layout



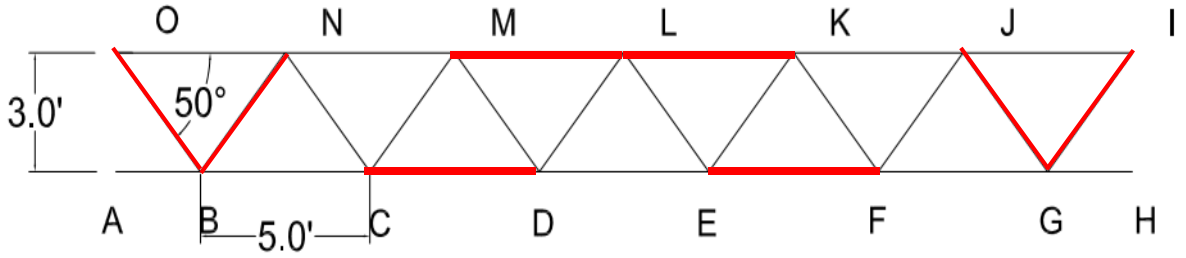
Truss Design



Truss Internal Loadings

Member	Load (k)	T or C
AB	4.1	T
BO	161	C
ON	107	T
BN	161	T
BC	202	C
NC	144	C
NM	302	T
CM	144	T
CD	386	C
MD	127	C
ML	475	T
DL	127	T

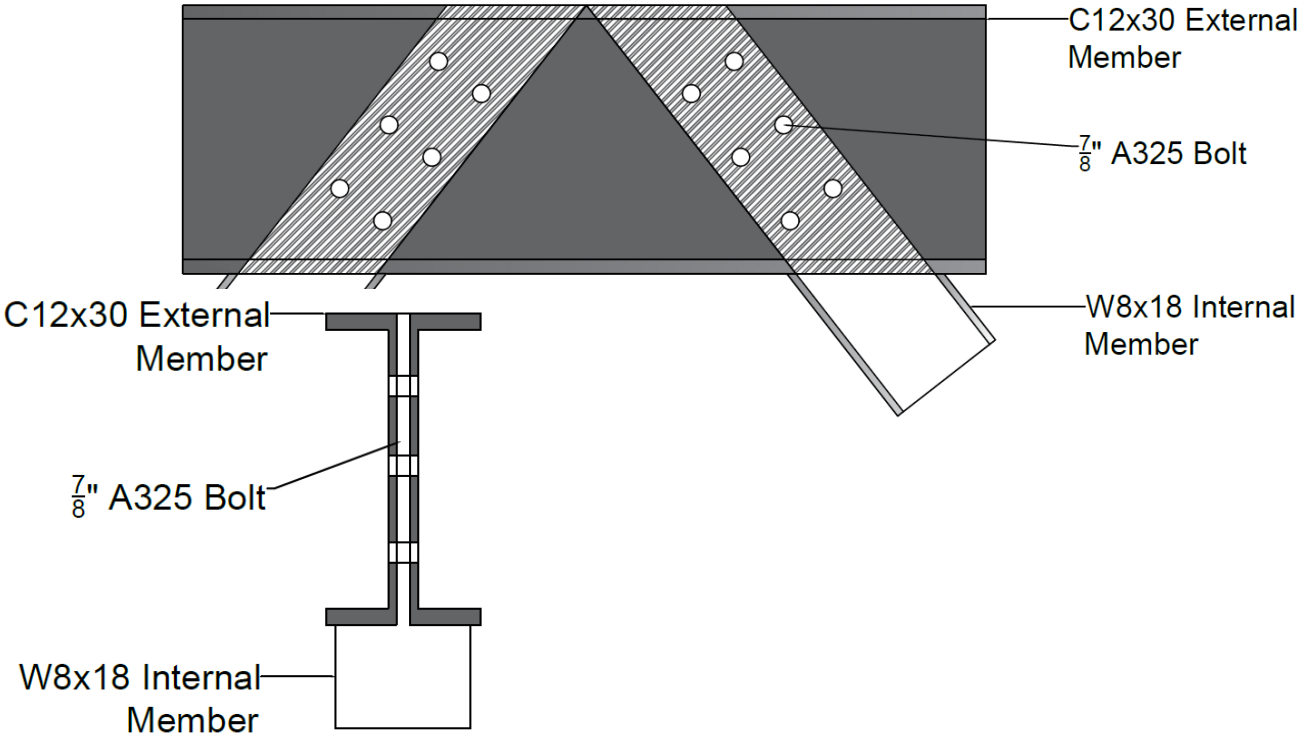
Maximum Load Members



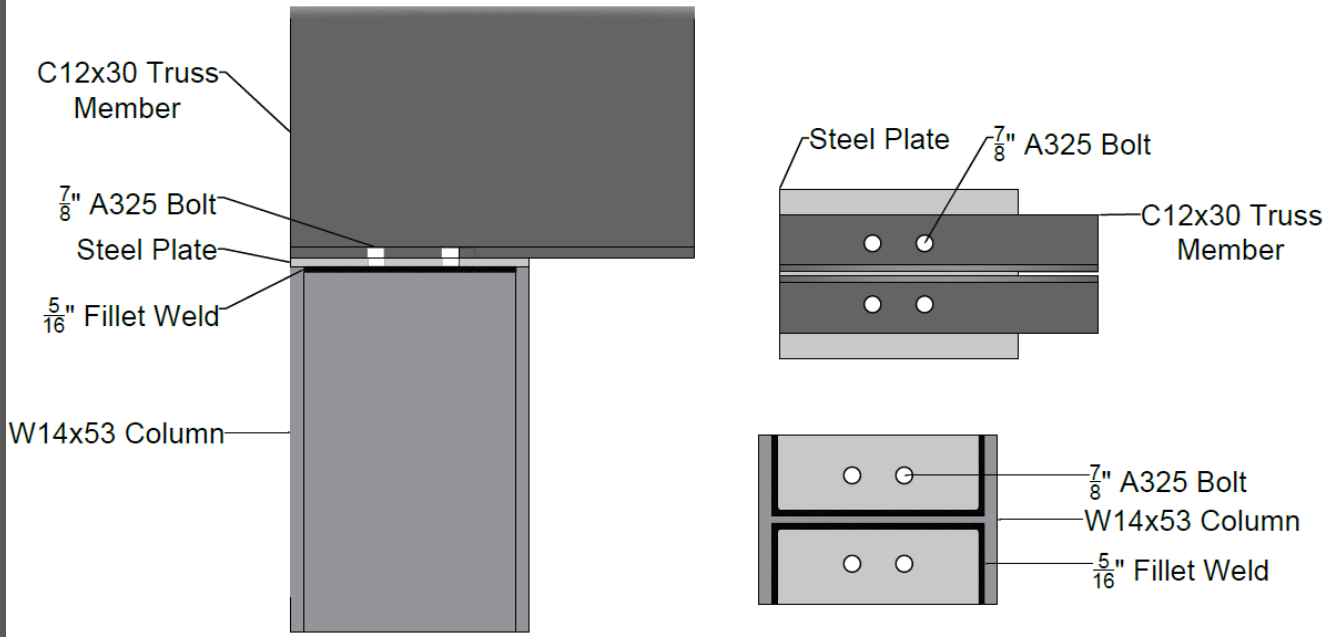
Member Selection

Truss Member	Maximum Force	Member Selection
Horizontal Tension	476 k	2C12x30
Horizontal Compression	386 k	2C12x30
Diagonal Tension	161 k	W8x18
Diagonal Compression	161 k	W8x18

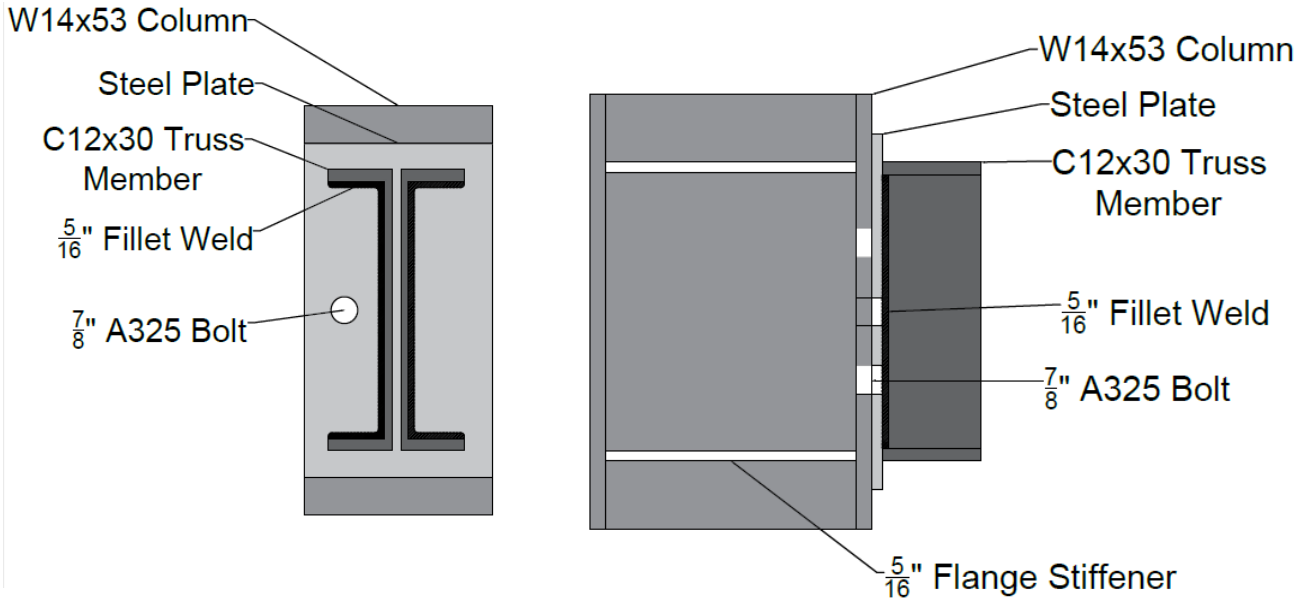
Internal Truss Connection



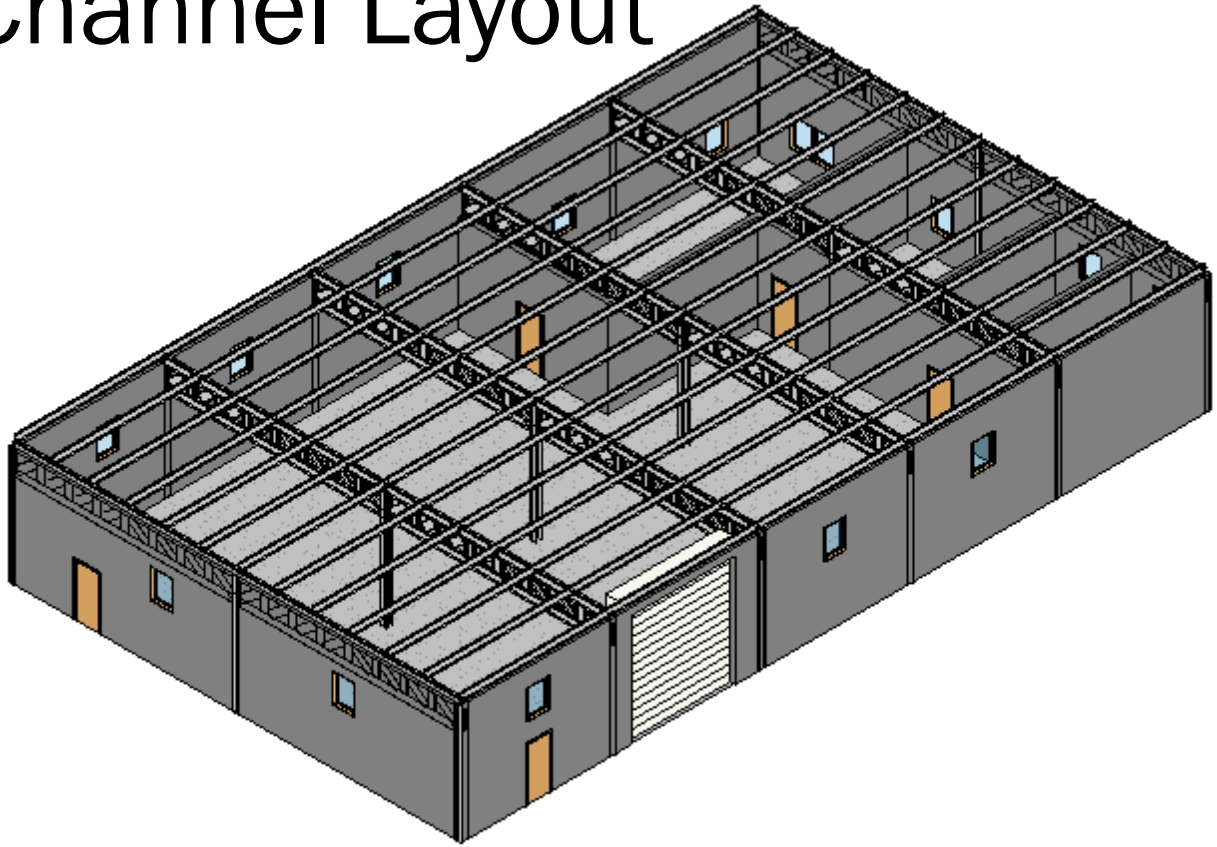
External Truss Connection



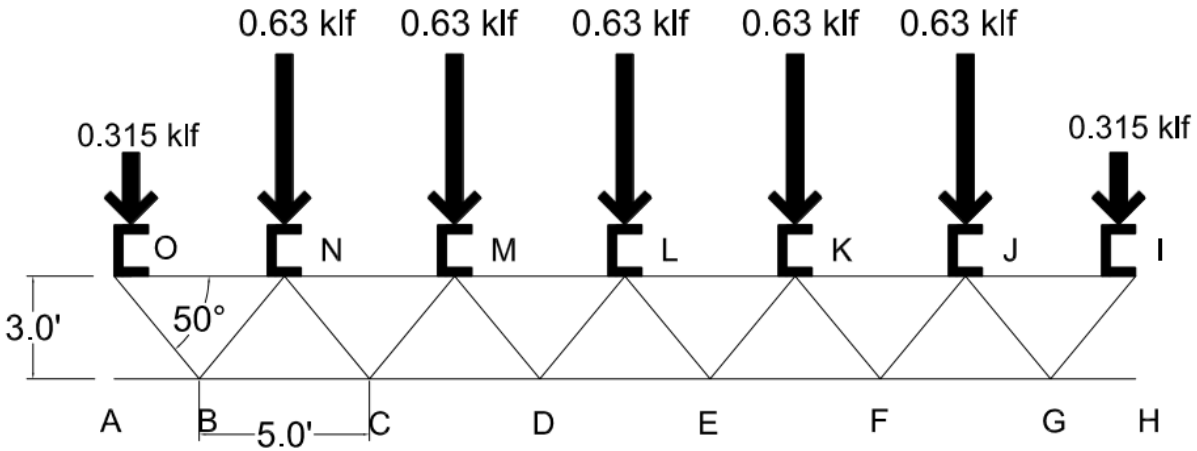
External Truss Connection



Channel Layout



Channel Design



Channel Design

Design parameters

- Span Length: 20 ft
- Channel Spacing: 5 ft
- Unbraced Length: 0 ft
- Design Moment: 33 k-ft
- Design Shear: 6.6 k

C10x15.3 member selected per AISC

Green Roof Design

- Will contain the same layers as the green roof on storage facility
  - Despite no water being stored, filtration layer is still required
- 6,000 ft^2 of coverage
- Continuation of existing parapet from storage facility
  - Roof access is still provided from storage facility

Storage Calculations

- Water use per capita is 40 gallons a day for industrial uses
  - Designed for 30 employees
- Average water use is 1,200 gallons per day
  - A safety factor of 1.25 is used
- Total monthly usage of 37,200 gallons a month
- Surface area of manufacturing facility is 6000 ft^2
  - The current size of the manufacturing facility will not provide adequate water for storage

Phase 2: Cost Estimate

- Used the *RSMeans Building Construction Cost Data*

ITEM	COST
COST/SF	$105/SF
STORAGE FREEZERS	$0
GREEN ROOF	$55,000
TOTAL	**$632,000**

Phase 2: Cost Estimate

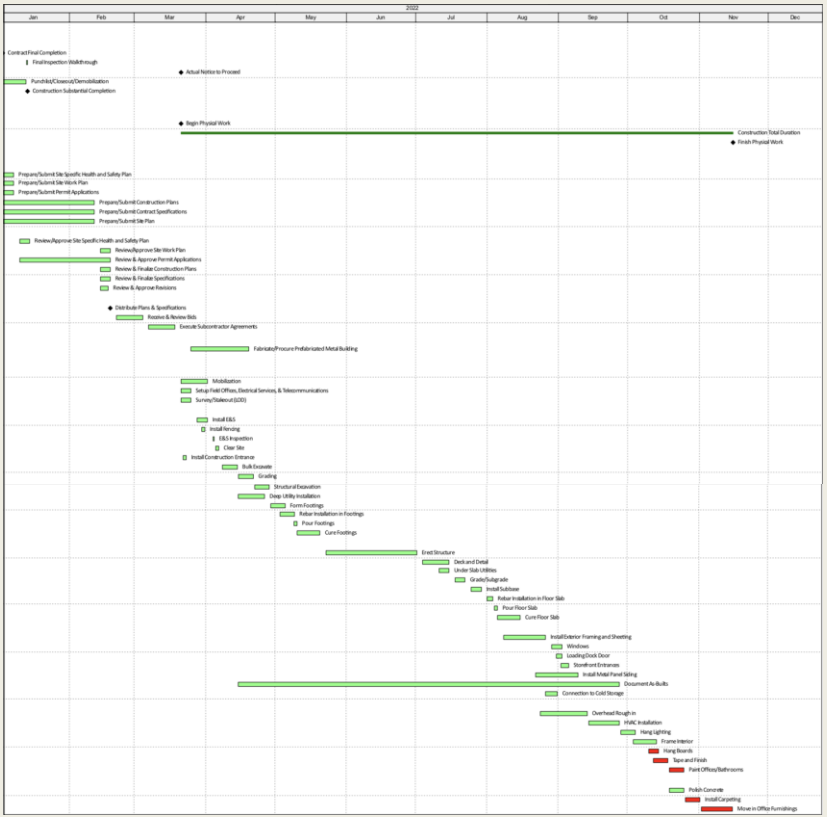
ITEM	COST
FOUNDATIONS & SLAB	$59,000
STRUCTURAL STEEL	$13,000
FINISHES	$95,000
UTILITIES/TIE INS	$45,000
GREEN ROOF	$55,000
OVERHEAD & GENERAL CONDITIONS	$339,000
RISK CONTINGENCY	$24,000

TOTAL COST: $632,000

- Assuming Guaranteed Maximum Price (GMP) contract

Phase 2: Schedule

- Notice to proceed: March 21, 2022
- Completed: December 5, 2022
- Total construction duration: ~8 mo.



MILESTONES AND KEY TASKS

Milestone/Key Task	Date
Submit and Approve GMP	Jan 3, 2022
Mobilization and Ground Breaking	Mar 21, 2022
Pour Footings	May 9, 2022
Erect Structure	May 23 – July 1, 2022
Pour Slab on Grade	Aug 4 - 5, 2022
Exterior Enclosure	Aug 8 - 26, 2022
Rough-in and Finishes	Aug 24 – Oct 25, 2022
Punchlist	Dec 2, 2022
Turnover	Dec 5, 2022

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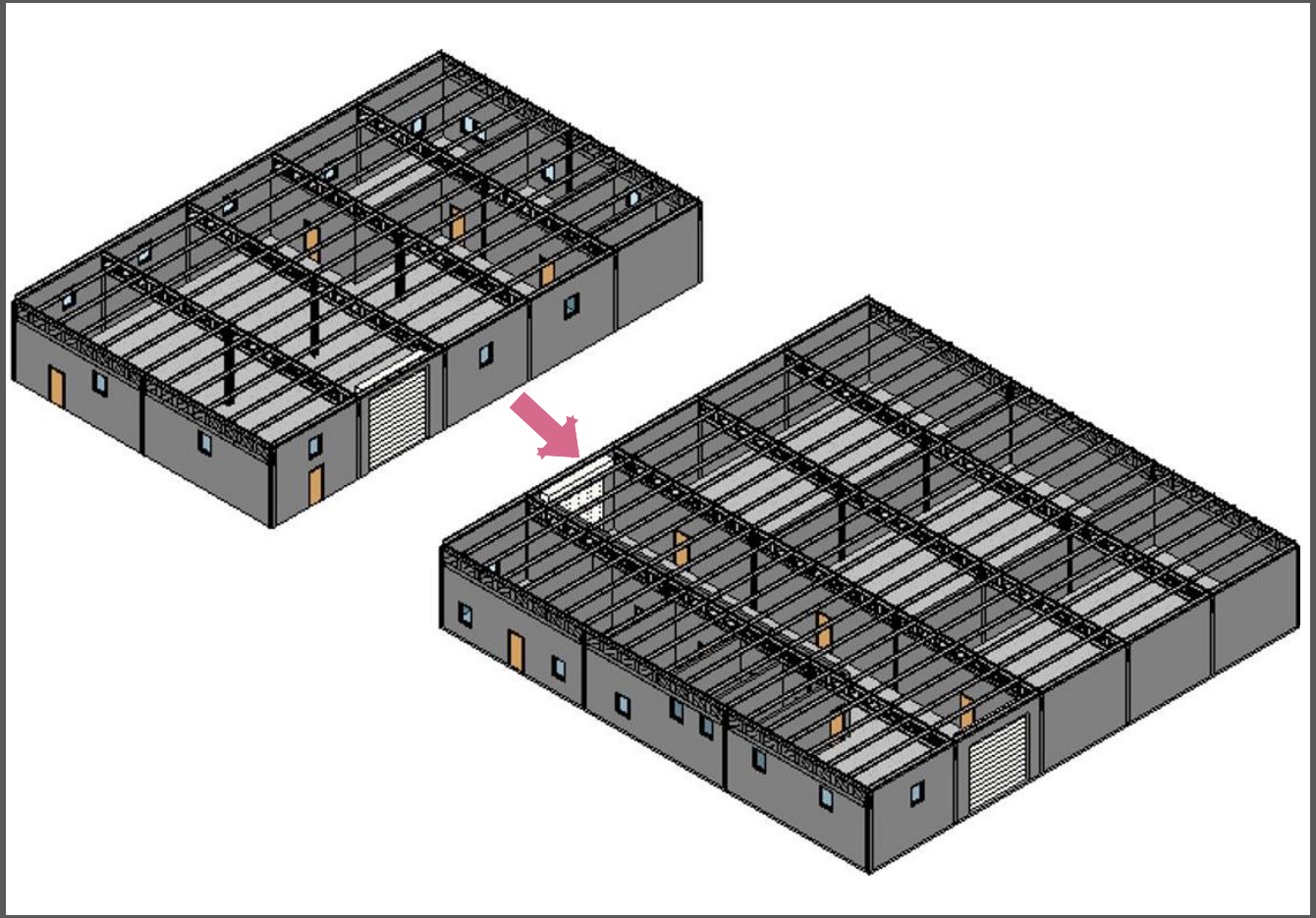

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Nate Martin, Mascaro
Bill Charles, Mascaro


THANK YOU

Questions?