



# STRUCTURAL CALCULATIONS FOR

## Mountain Empire HS – Mechanical Unit Replacement

Pine Valley, CA

August 30, 2021  
W+R Job #20-026



## **Structural Scope of Work –**

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Scope of this project is the replacement of a single RTU on an existing one-story wood framed school building roof.

The new unit weight exceeds the existing unit weight so design checks are necessary for the existing roof framing. The new unit is intended to be installed on the existing unit curb as the dimensions of the two units match. New anchorage detail is also provided.

**WISEMAN+ROHY Structural Engineers**  
**== Design Loads ==**  
**Roof Loads**

PROJECT: Mountain Empire HS  
 LOCATION: Pine Valley, CA  
 JOB NO: 20-026 Date: 8/24/2021

**New Roof Loads:**

Material	Joists	Beams	Seismic	Wind Uplift
Built-up Roof w/Cap Sheet	1.0	1.0	1.0	0.5
Re-Roof	0.5	0.5	0.5	-
1/2" Densdeck	2.0	2.0	2.0	2.0
Insulation	1.0	1.0	1.0	1.0
1/2" Sheathing or OSB	1.7	1.7	1.7	1.7
2x10 @ 24" or 18" I-Joists	2.2	2.2	2.2	2.2
Ceilings	2.8	2.8	2.8	1.8
Sprinklers	1.5	1.5	1.5	-
Misc, M&E	1.3	1.3	1.3	0.5
Partitions	-	-	5.0	-
<b>Total</b>	<b>14.0</b>	<b>14.0</b>	<b>19.0</b>	<b>9.7 psf</b>

**Live Loads: (Reducible) 20 psf**

**Existing Flat Roof Loads:**

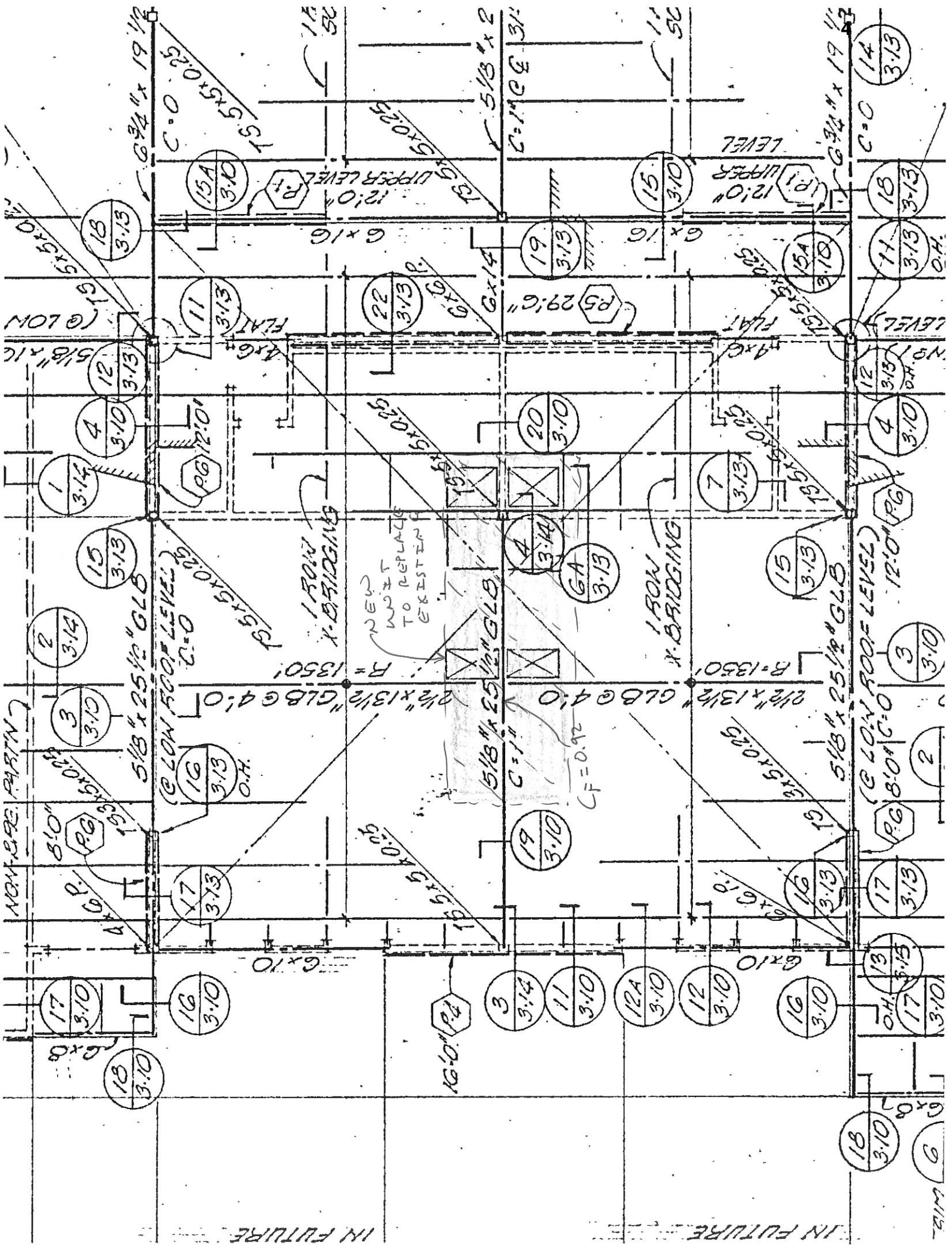
Material	Joists	Beams	Seismic	Wind Uplift
Built-up Roof w/ Gravel	6.0	6.0	6.0	4.0
1/2" Sheathing	1.7	1.7	1.7	1.7
2x Sleepers @ 24"	1.0	1.0	1.0	1.0
3/4" Sheathing	2.3	2.3	2.3	2.3
Insulation	1.0	1.0	1.0	1.0
GLB's @ 48"	3.5	3.5	3.5	3.5
Ceilings	1.8	1.8	1.8	1.8
Misc, M&E	0.7	0.7	0.7	0.7
Partitions	-	-	5.0	-
<b>Total</b>	<b>18.0</b>	<b>18.0</b>	<b>23.0</b>	<b>16.0 psf</b>

**Live Loads: (Reducible) 20 psf**

**Existing Flat Roof Loads (New Roofing):**

Material	Joists	Beams	Seismic	Wind Uplift
Single Ply Roofing	1.0	1.0	1.0	1.0
Re-Roof	0.5	0.5	0.5	0.5
1/2" Sheathing	1.7	1.7	1.7	1.7
2x Sleepers @ 24"	1.0	1.0	1.0	1.0
3/4" Sheathing	2.3	2.3	2.3	2.3
Insulation	1.0	1.0	1.0	1.0
GLB's @ 48"	3.5	3.5	3.5	3.5
Ceilings	1.8	1.8	1.8	1.8
Misc, M&E	0.7	0.7	0.7	0.7
Partitions	-	-	5.0	-
<b>Total</b>	<b>13.5</b>	<b>13.5</b>	<b>18.5</b>	<b>13.5 psf</b>



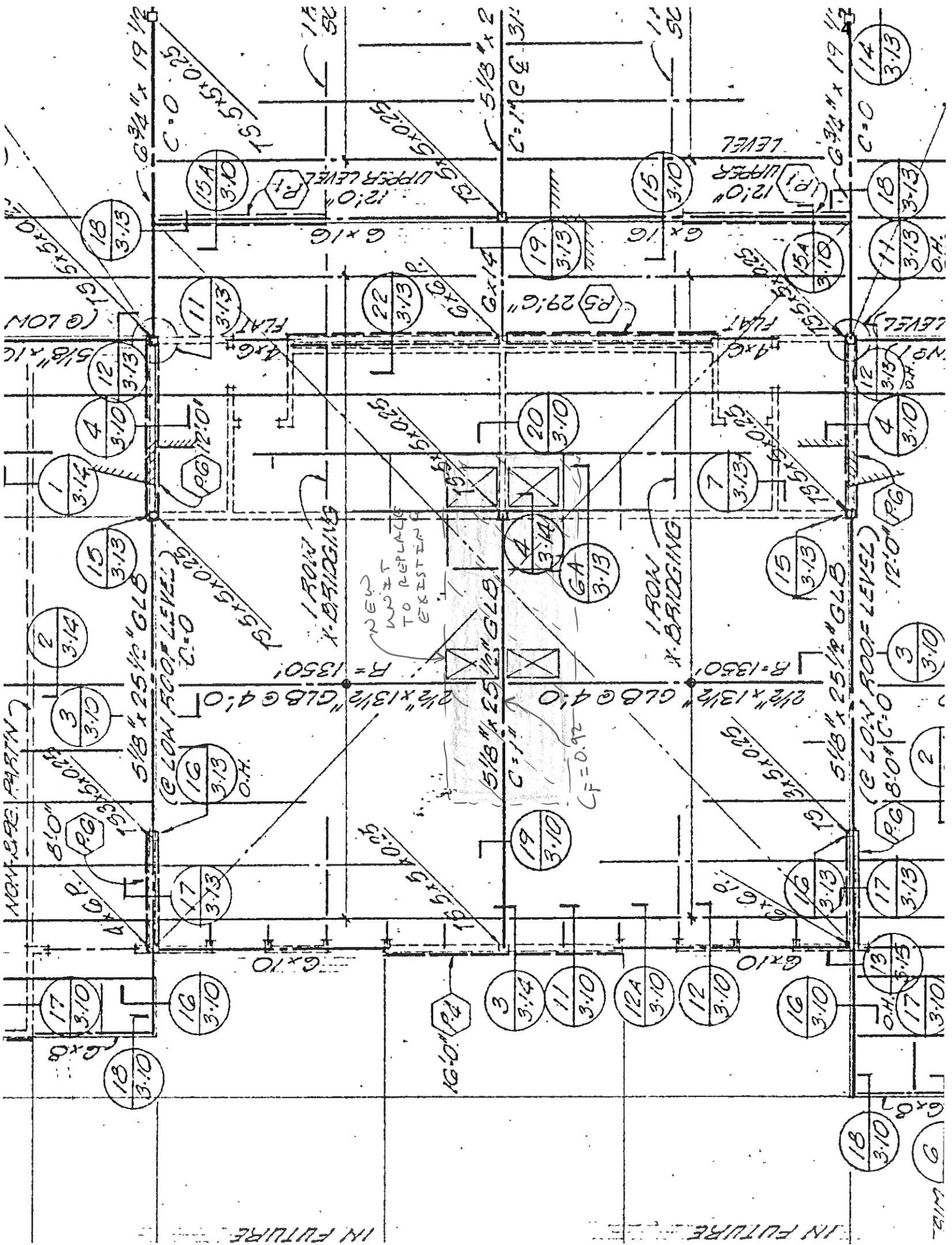


NON-SEE PARTIN

IN FUTURE

IN FUTURE

W/15



NON-SEE PARTIN

IN FUTURE

IN FUTURE

W/15

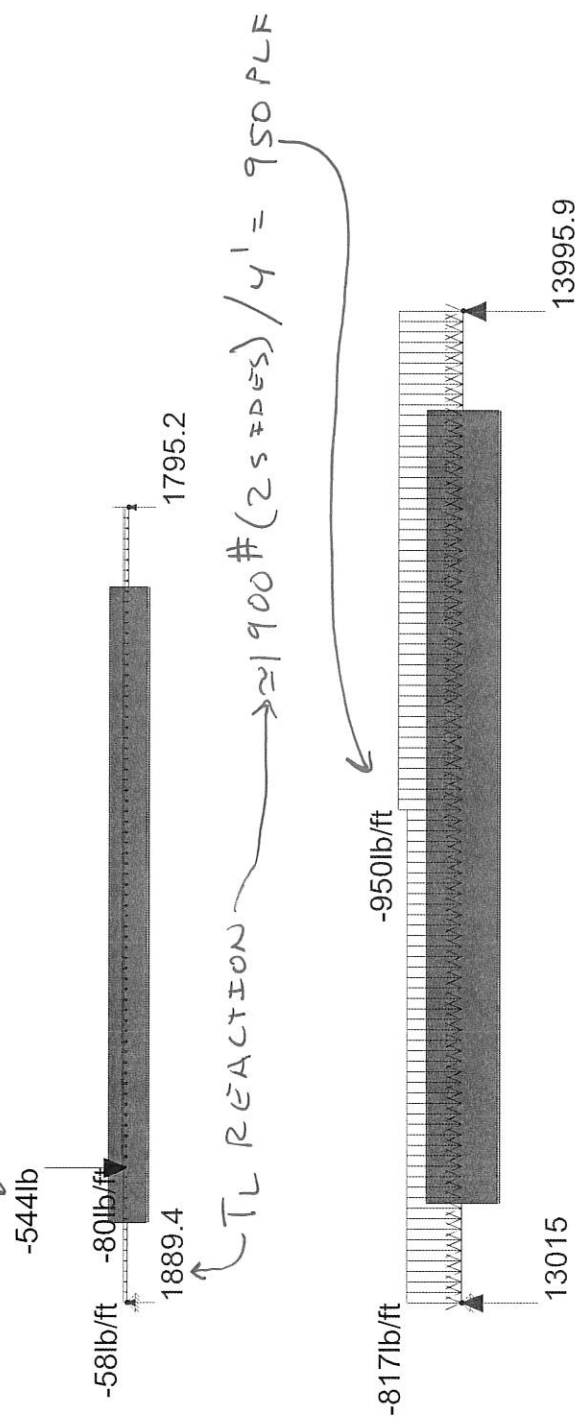
OR JOISTS unless fully detailed on approved plans.  
11. Glued laminated timbers shall be manufactured  
of Coast Region Douglas fir. Timbers 3-1/2" wide  
or narrower shall be comb. 20F. All others shall be  
comb. 22F.

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EXISTING GUB  
NOTES

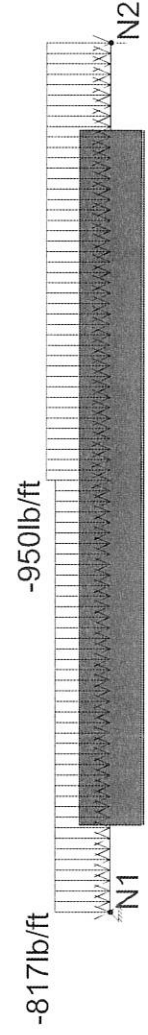
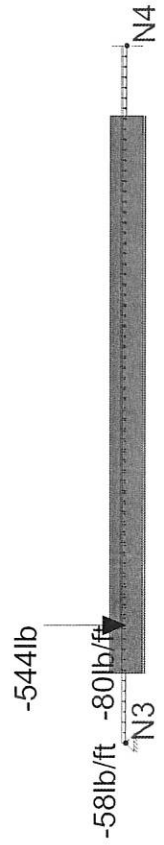


UNIT WT PER ROOF JST =  $6500 \# / (2 \text{ SIDES}) (24' \text{ LONG})$   
 $= 136 \text{ PLF } (4') = 544 \#$



Loads: LC 2, IBC 16-10 (a)  
 Results for LC 2, IBC 16-10 (a)  
 Y-direction Reaction Units are lb and k-ft

Wiseman + Rohy	MEHS - AC Unit Support	SK - 2
DM		Aug 24, 2021 at 1:05 PM
		MEHS Existing Beam Checks.r2d



Loads: LC 2, IBC 16-10 (a)

Wiseman + Rohy

DM

MEHS - AC Unit Support

SK - 1

Aug 24, 2021 at 1:02 PM

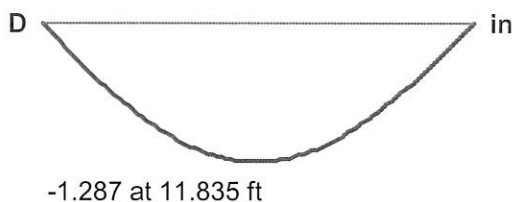
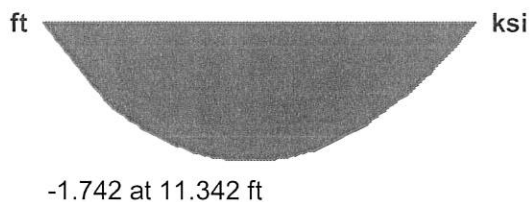
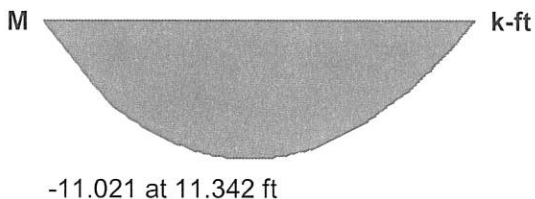
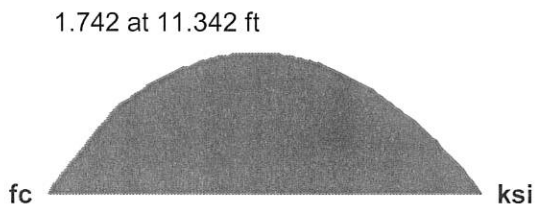
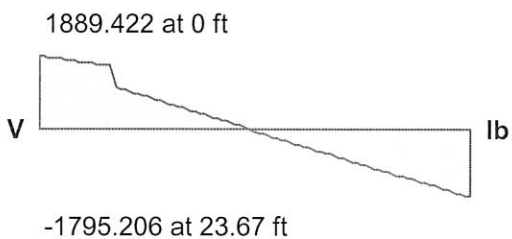
MEHS Existing Beam Checks.r2d



Beam: **M2**  
 Shape: **2.5X13.5FS**  
 Material: **1973 GLB-20F**  
 Length: **23.67 ft**  
 I Joint: **N3**  
 J Joint: **N4**  
 LC 2: IBC 16-10 (a) *(E) BM OKAY*  
 Code Check: **0.697 (bending)**  
 Report Based On 97 Sections

A \_\_\_\_\_ lb

fa \_\_\_\_\_ ksi



**AWC NDS-18: ASD Code Check**

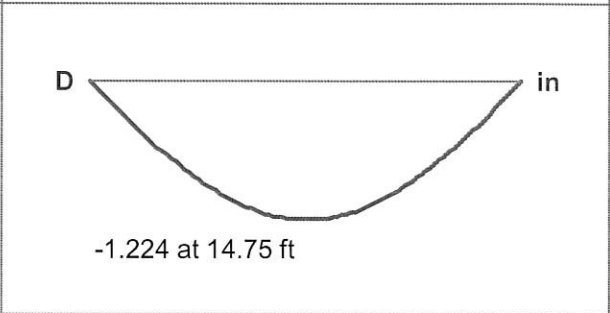
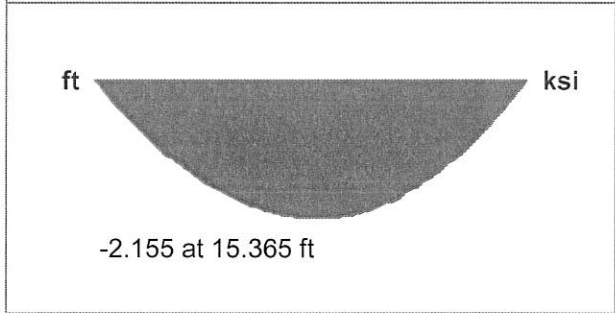
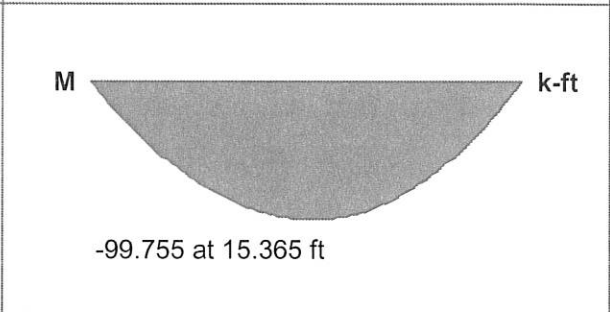
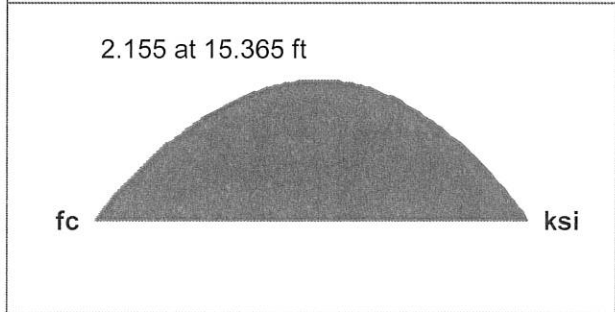
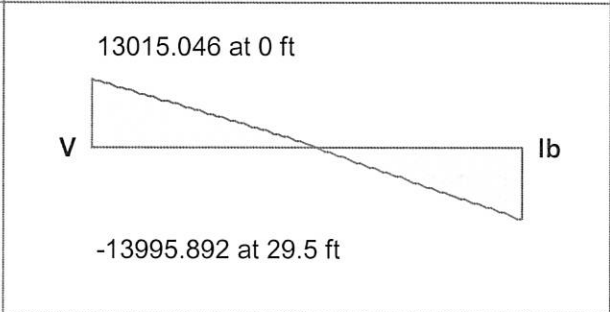
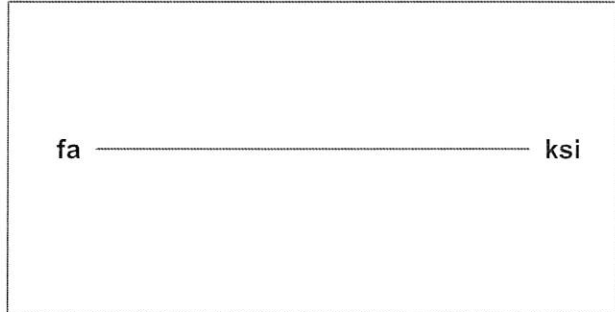
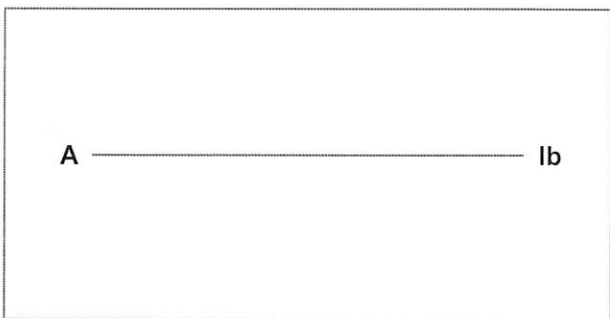
Max Bending Check **0.697** Max Shear Check **0.407** Max Defl Ratio **L/220**  
 Location **11.342 ft** Location **0 ft** Location **11.835 ft**  
 Equation **3.9-3** Span **1**

CD **1.25** RB **0** CL **1** CV **1**  
 Cr **1** Cfu **1.19** CP **0.713**

	(ksi)	Cm	Ct	CF
Fc'	1.337	1	1	1
Ft'	2	1	1	1
Fb'	2.5	1	1	1
Fv'	0.206	1	1	
E'	1700	1	1	

Lb **0 ft** In **23.67 ft**  
 le/d **0** **21.04**  
 Sway **No** **No**  
 Le-Bending Top **0 ft**  
 Le-Bending Bot **23.67 ft**

Beam: **M1**  
 Shape: **5.125X25.5FS**  
 Material: **1973 GLB-22F**  
 Length: **29.5 ft**  
 I Joint: **N1**  
 J Joint: **N2**  
 LC 2: IBC 16-10 (a) *(E) BM OKAY*  
 Code Check: **0.874 (bending)**  
 Report Based On 97 Sections



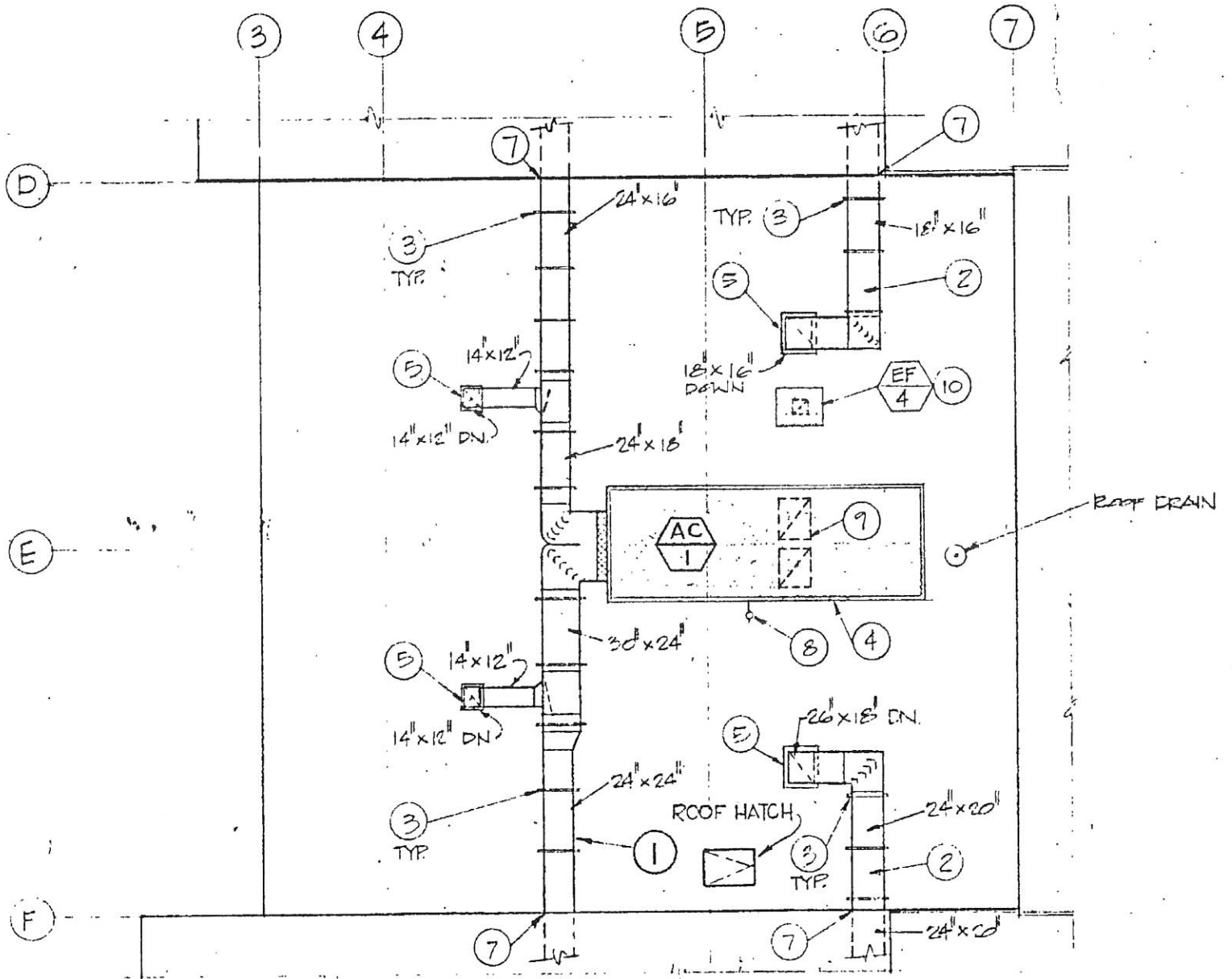
**AWC NDS-18: ASD Code Check**

Max Bending Check **0.874**    Max Shear Check **0.779**    Max Defl Ratio **L/289**  
 Location **15.365 ft**    Location **29.5 ft**    Location **14.75 ft**  
 Equation **3.9-3**    Span **1**

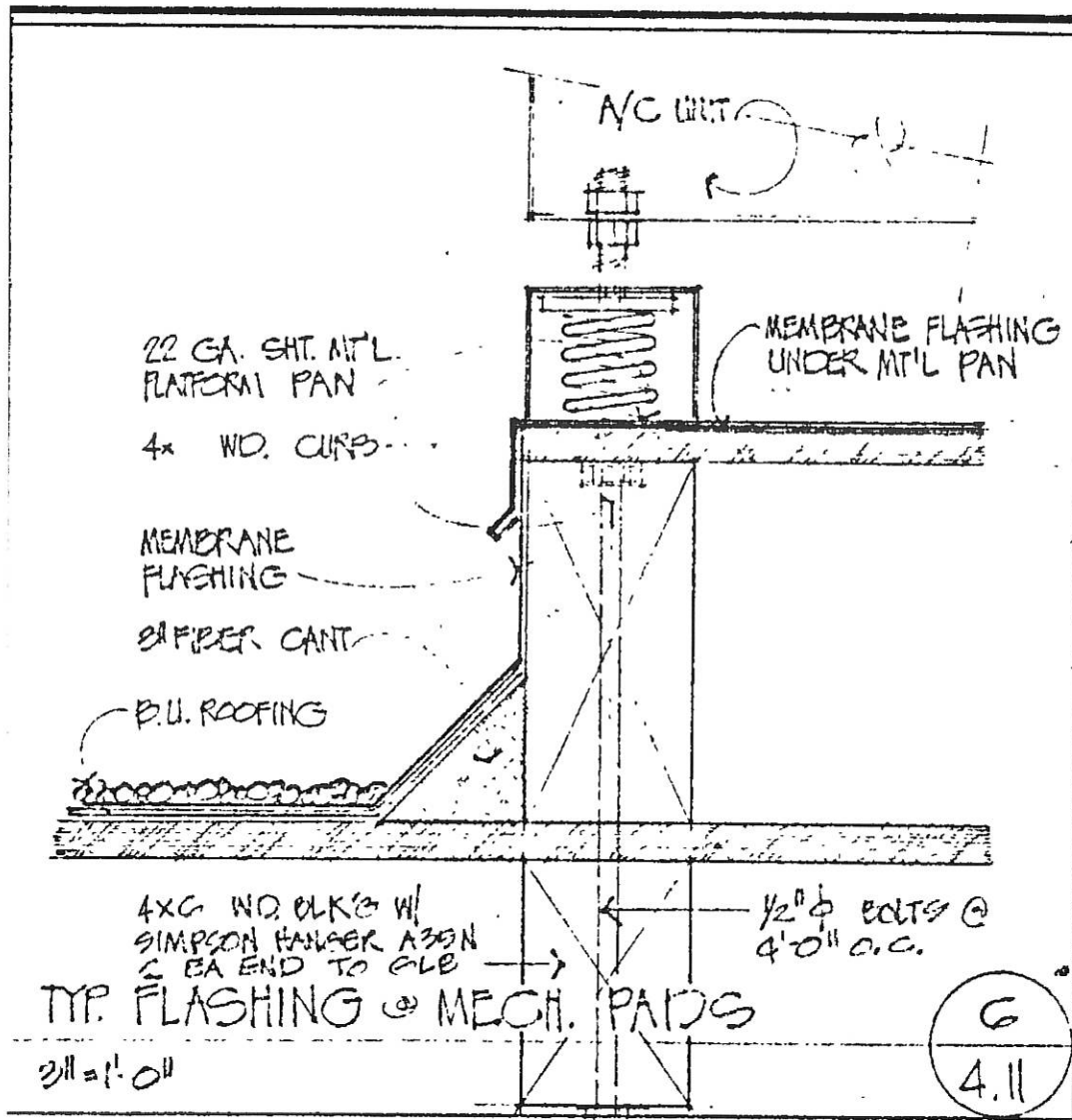
CD **1.25**    RB **6.826**    CL **0.994**    CV **0.896**  
 Cr **1**    Cfu **1.1**    CP **0.93**

	(ksi)	Cm	Ct	CF
Fc'	<b>1.744</b>	<b>1</b>	<b>1</b>	<b>1</b>
Ft'	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>
Fb'	<b>2.465</b>	<b>1</b>	<b>1</b>	<b>1</b>
Fv'	<b>0.206</b>	<b>1</b>	<b>1</b>	
E'	<b>1800</b>	<b>1</b>	<b>1</b>	

Out    In  
 Lb    **4 ft**    **29.5 ft**  
 le/d    **9.366**    **13.882**  
 Sway    **No**    **No**  
 Le-Bending Top    **4 ft**  
 Le-Bending Bot    **29.5 ft**



EXISTING UNIT  
LOCATION



EXISTING MECH'L PLATFORM

**EQUIPMENT ANCHORAGE PER ASCE 7-16 13.3.1**

$a_p = 2.5$	Equipment Weight = 6162 lb	Length (long side) (@ anchors) = 289 in
$R_p = 6.0$	Curb Weight = 0 lb	Width (short side) (@ anchors) = 93 in
$\Omega_0 = 1.0$	<b>Total Weight = 6162 lb (<math>W_p</math>)</b>	
$S_{DS} = 0.728$		# Anchors on long side (10 max) = 2 (289 in oc)
$I_p = 1.0$	Top of Curb to COG = 43.5 in	# Anchors on short side (8 max) = 2 (31 in oc)
$z = 12$ ft (equip ht)	Curb Height = 12 in	(not counting corners at short sides)
$h = 12$ ft (roof ht)	<b>Total Ht to COG = 55.5 in (HT)</b>	
		Total Anchor Points = 8

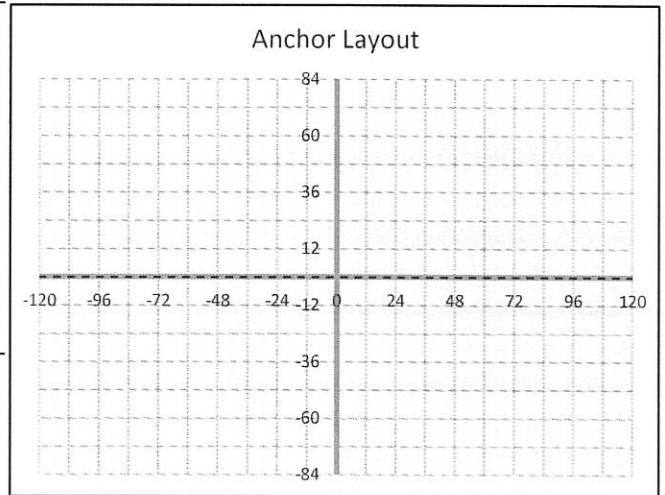
**Horizontal Component (LRFD)**

$$F_{px} = 0.4 \left( \frac{a_p}{R_p} \right) (I_p) (S_{DS}) (W_p) \left( 1 + 2 \frac{z}{h} \right) = 0.364 W_p$$

$$F_{px \text{ MIN}} = 0.3 (S_{DS}) (I_p) (W_p) = 0.218 W_p$$

$$F_{px \text{ MAX}} = 1.6 (S_{DS}) (I_p) (W_p) = 1.165 W_p$$

**$F_{px} = 0.364 W_p$**



**Vertical Component (LRFD)**

$$F_{pz} = \pm 0.2 (S_{DS}) (W_p) = 0.1456 W_p$$

**Anchorage Calculations:**

**Strength Level Forces:**

$F_{px} = 0.364 W_p = 2243.0$  lb  
 $F_{pz} = 0.146 W_p = 897.2$  lb

Critical Angle = 0 degrees

$M_{OT} = F_{px} * HT = 124485$  lb-in

$M_R = (0.9 - F_{pz}) * W_p * L_x = 216160$  lb-in (at critical angle)

$M_{NET} = (M_{OT} - M_R) = 0$  lb-in (at critical angle)

$T_u = 0$  lb Tension / Anchor (worst case anchor)  
 $V_u = 280$  lb Shear / Anchor (all equal)

**ASD Level Forces:**

$F_{px} = 0.255 W_p = 1570.1$  lb  
 $F_{pz} = 0.102 W_p = 628.0$  lb

Critical Angle = 0 degrees

$M_{OT} = F_{px} * HT = 87139$  lb-in

$M_R = (0.6 - F_{pz}) * W_p * L_x = 142716$  lb-in (at critical angle)

$M_{NET} = (M_{OT} - M_R) = 0$  lb-in (at critical angle)

$T_{ASD} = 0$  lb Tension / Anchor (worst case anchor)  
 $V_{ASD} = 196$  lb Shear / Anchor (all equal)

*3/8" φ LAG w/ 2 1/4" EMBED:  $Z_{11} = 280 \# (0.75)(1.6) = 336 \#$  / SCREW  $> 196 \#$*

**NOTES:**

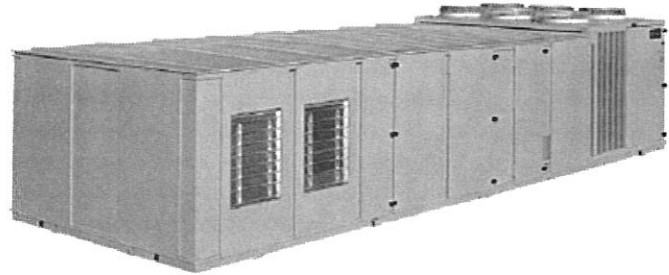
- This spreadsheet checks all angles (0 deg - 90 deg) for each bolt arrangement. Forces given are for the worst-case angle.
- Angles are measured up from the horizontal line in the diagram above through the center of the unit (0 deg = right, 90 deg = up).
- Attachment to concrete or masonry shall use Omega unless governed by a ductile shear or tensile failure.
- If equipment is mounted on vibration isolators with the clearance from equipment to frame  $> 0.25$  inch use 2Fp (double Sds).
- Lx is the distance to the farthest anchor measured perpendicularly from the angled line of rotation.

**Unit Overview**

Unit Function	Tonnage	EER @ AHRI	IEER @ AHRI	System Power	Elevation
Natural Gas Heat	25 ton Air cooled	10.8 EER	14.5 EER	31.44 kW	0.00 ft
<b>Installed Weight</b>					
6161.8 lb					

**Unit Features**

Capacity/Efficiency Option	High efficiency unit
Filters	High-Efficiency Throwaway Filters
Agency Approval	cULus

**Unit Electrical**

Voltage/Phase/Frequency	460/60/3
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Condenser Fans FLA	5.40 A
Supply Fan FLA	12.60 A
Supply Fan Motor Count	1
Exhaust/Return Fan FLA	4.20 A
Other FLA	2.00 A

Compressor 1 RLA	22.20 A
Compressor 1 Count	1.00 Each
Compressor 2 RLA	19.10 A
Compressor 2 Count	1.00 Each

**Circuit 1**

MCA	MOP	DSS	RDE
71.05 A	90.00 A	75.00 A	80.00 A

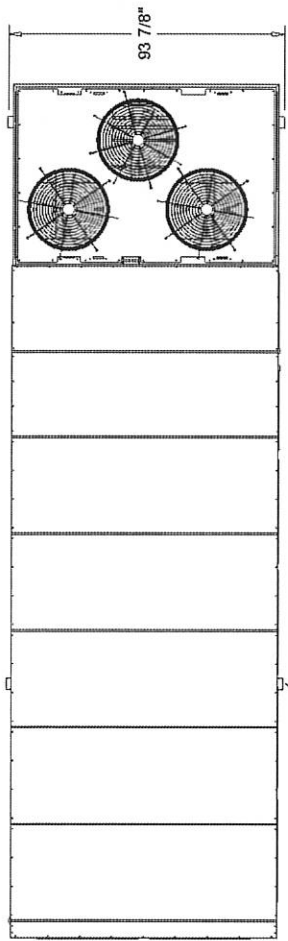
**Condensing Section**

Capacity/Efficiency Option	High efficiency unit	Ambient Control	Standard ambient control
Refrigerant Type	R-410A refrigerant	Design Ambient Dry Bulb	95.00 F
Refrigerant Charge Circuit 1	31.5 lb	Outdoor Fan Type	Prop
		Outdoor Fan Drive	Direct

**Heating Section**

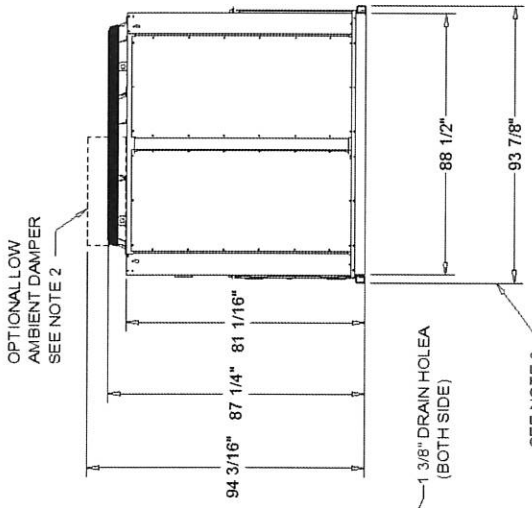
Function	Natural Gas Heat	Heating EAT	70.00 F
Heat Capacity	2 Stage Low Gas Heat	Heating LAT	87.33 F
Input Heating Capacity	235.00 MBh	Heating DeltaT	17.33 F
Output Heating Capacity	188.00 MBh		
Output Heating Capacity w/ Fan	188.00 MBh		

- NOTES:
1. VERIFY WEIGHT, CONNECTION, AND ALL DIMENSION WITH INSTALLER DOCUMENTS BEFORE INSTALLATION.
  2. LOW AMBIENT DAMPER ONLY COMES WITH SELECTED UNIT.
  3. OVERALL UNIT WIDTH INCREASES 3/8" BEYOND LIFTING LUG WITH ULTRA LOW LEAK POWER EXHAUST DAMPERS.
  4. RETURN AIR OPENING CONFIGURATION FOR USES WITH NO AIR OPTION, BAROMETRIC RELIEF, AND EXHAUST FAN.
  5. IF FIELD CONVERTING SUPPLY & RETURN OPENING(S) TO HORIZONTAL OR VERTICAL AIRFLOW, FACTORY OPENING(S) TO IF UNIT OPTIONS WILL ALLOW IT. FACTORY INSTALLATION IS ALWAYS RECOMMENDED.

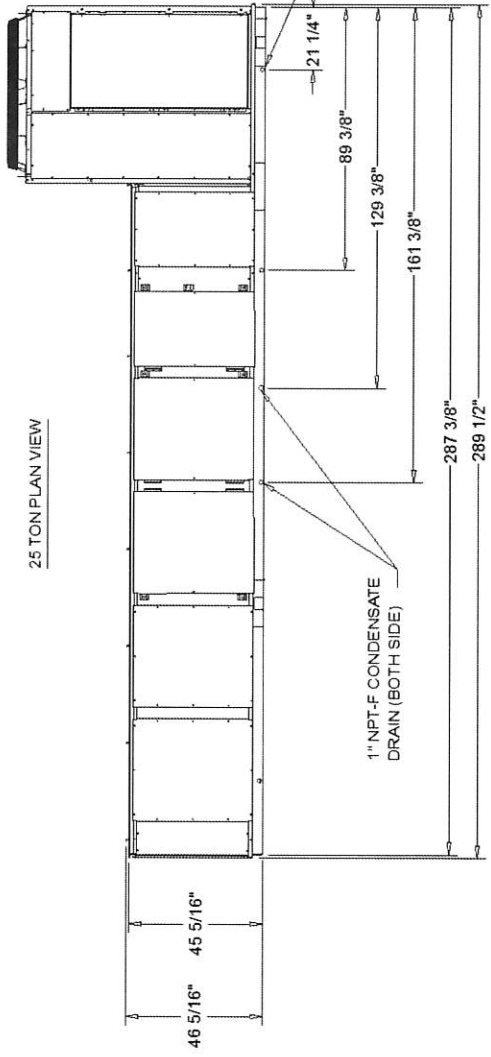


LIFTING POINTS X4

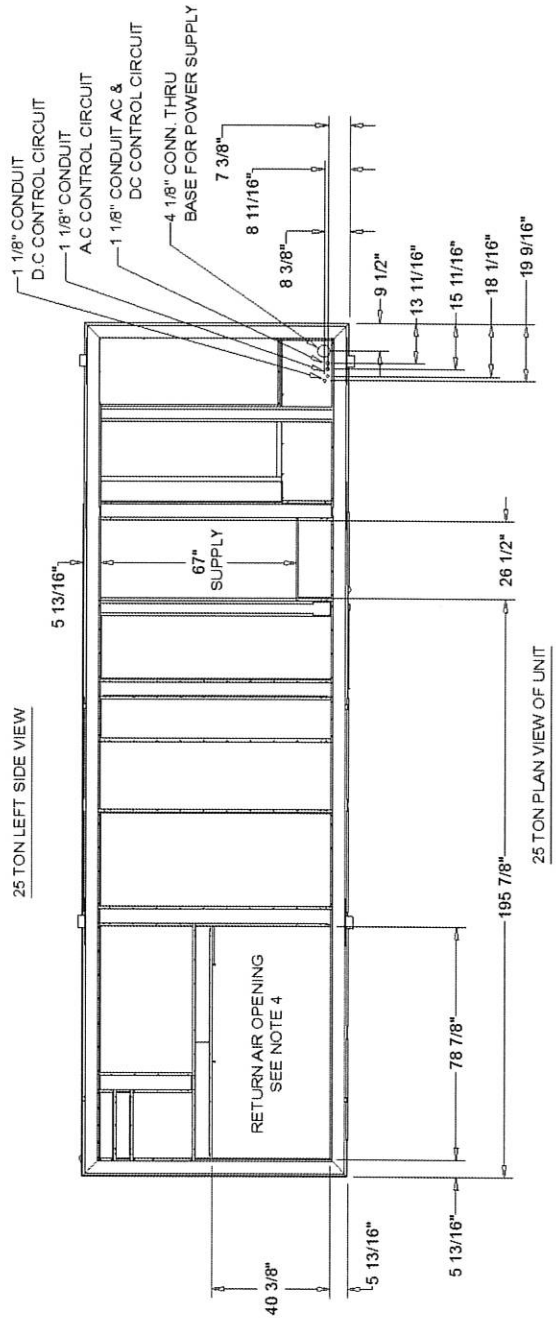
25 TON PLAN VIEW



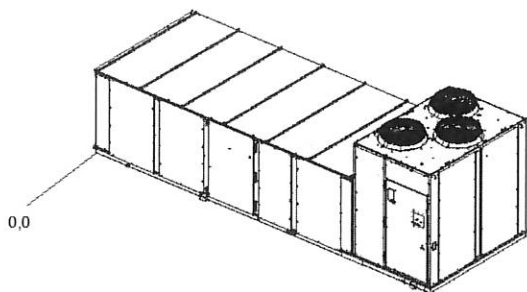
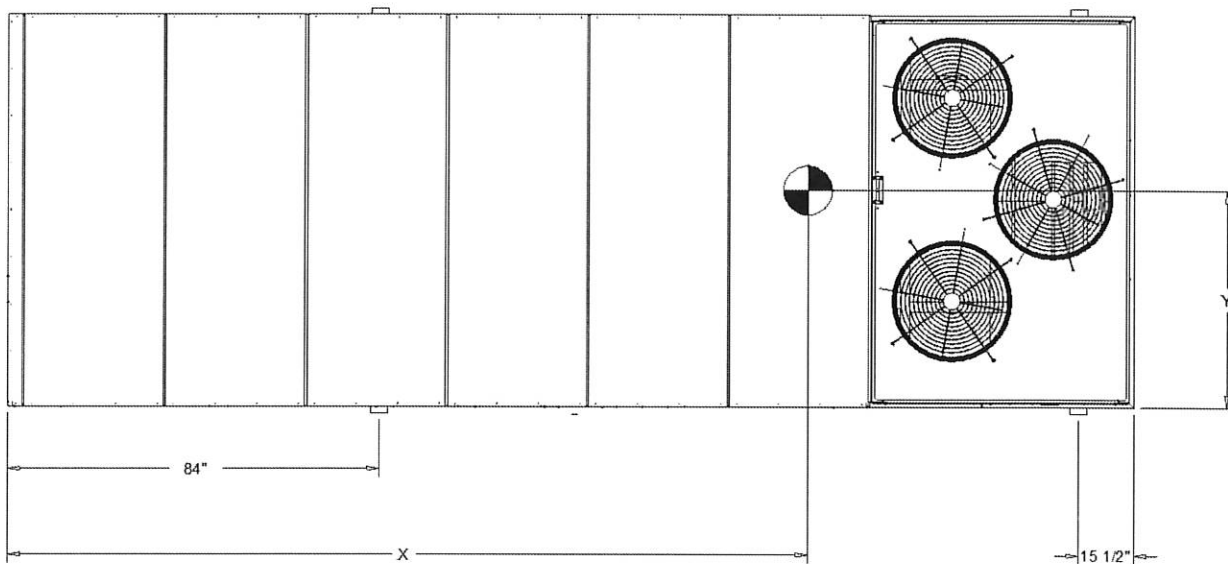
25 TON FRONT VIEW



25 TON LEFT SIDE VIEW

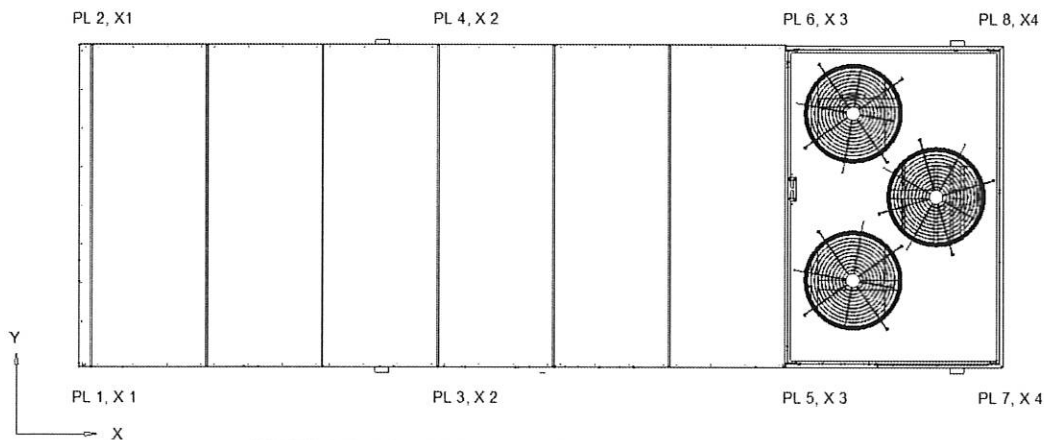


25 TON PLAN VIEW OF UNIT



Center of Gravity X:	14.10 ft	Point load X location 1:	4.000 in
Center of Gravity Y:	3.80 ft	Point load X location 2:	124.000 in
Point Load 1:	605.6 lb	Point load X location 3:	226.000 in
Point Load 2:	607.8 lb	Point load X location 4:	265.000 in
Point Load 3:	735.8 lb	Point load X location 5:	N/A
Point Load 4:	737.9 lb	Point load X location 6:	N/A
Point Load 5:	846.4 lb	Point load X location 7:	N/A
Point Load 6:	848.6 lb	Point load X location 8:	N/A
Point Load 7:	888.8 lb	Point load Y location 1:	4.000 in
Point Load 8:	890.9 lb	Point load Y location 2:	87.000 in
Total Weight:	6,161.8 lb		

- Notes:
1. The actual weight is stamped on the unit nameplate.
  2. The weight shown represents the typical unit operating weight for the configuration selected. Estimated at +/- 10% of the nameplate weight.
  3. Design Special weights are not displayed. Any weight added through COD (Custom Order Design) will not be accounted in the +/- 10% estimate
  4. When 2 or more units are to be placed side by side, the distance between the units should be increased to 150% of the recommended single unit clearance. The units should also be staggered to reduce span deflection & assure proper diffusion of exhaust air.



CENTER OF GRAVITY AND INSTALL WEIGHT X-Y POINTS  
AIR COOLED DRAWING