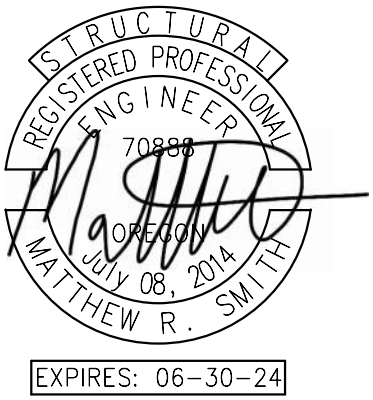
ZCS ENGINEERING ARCHITECTURE

Structural Calculations

Grant Union HS HVAC

911 S. Canyon Blvd.
John Day, Oregon 97845



Prepared for:
Grant County School District
401 N. Canyon City Blvd.
Canyon City, OR 97820

ZCS	**PROJECT:** Grant Union HS HVAC	**PROJECT #:** P-2869-23
	CLIENT: Grant County School District	
	DATE: 3/7/2024 **VERSION:** 3.05	**DESIGNED BY:** BLD

DESIGN CRITERIA

Project	Project Number	P-2869-23
	Project Name	Grant Union HS HVAC
Address	Legal Description of Property	
	Street Address	911 S. Canyon Blvd.
	City, State Zip-Code	John Day, Oregon 97845
Client	Client	Grant County School District
	Address	401 N. Canyon City Blvd.
		Canyon City, OR 97820
Contact	Contact	Mark Witty
	Phone	541-575-1799
	Fax	
	Email	markwitty@grantesd.org
Billing	Bill to	Grant County School District
	Billing Address	401 N. Canyon City Blvd.
		Canyon City, OR 97820

BUILDING DEPARTMENT INTERVIEW

Governing Body & Building Type	Building Department	Grant County
	Governing Codes	Building: 2022 OSSC ASCE: ASCE 7-16
	Occupancy & Risk Category	Educational III
Snow Loading	Ground Snow Load	8.00 *psf*
	Minimum Roof Snow Load?	Yes 20.00 *psf*
	Exposure of Roof	Partially Exposed
	Duration Factor for Wood?	Yes
Wind Loading	Design Wind Speed	108 *mph* LRFD
	Enclosure Classification	Enclosed Buildings
	Exposure Classification	C
	Roof Angle	0.5/12 2.39°
	Mean Height	20.00 ft
	Site Elevation	3,140 ft
	Topographic Factor (K_{zt})	1.000
	Wind Elevation Factor (K_e)	0.893
Seismic Loading	Site Soil Classification	Site Class D – Stiff Soil
	Seismic Design Category	C
	Acceleration Parameters:	**ASCE 7**
	Short-Period	S_S = 0.310 g S_{DS} = 0.321
	One Second	S_1 = 0.123 g S_{D1} = 0.193
	Component Importance Factor	I_p = 1.00
Soil Loading	Geotech Report	No
	Soil Bearing Pressure	1,500
	Frost Depth	24.00 in

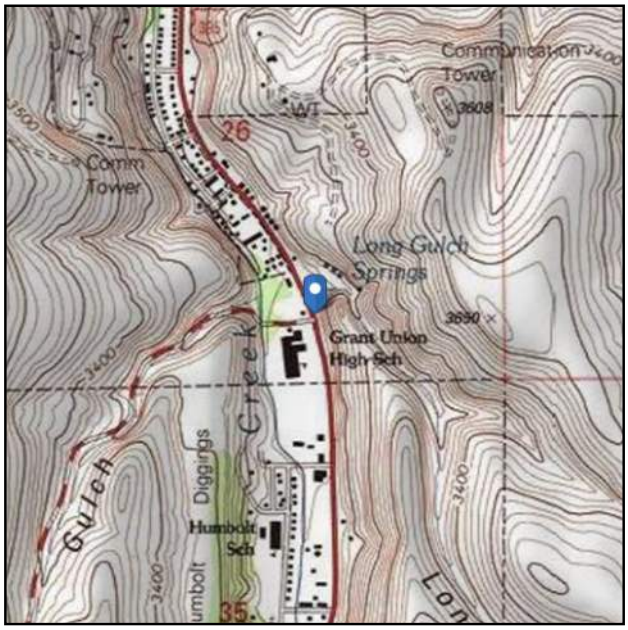
ZCS	**PROJECT:** Grant Union HS HVAC		**PROJECT #:** P-2869-23
	CLIENT: Grant County School District		
	DATE: 3/7/2024	**VERSION:** 3.05	**DESIGNED BY:** BLD

ASCE 7-16 DESIGN WIND SPEED

ASCE 7 Hazards Report

Address:
911 S Canyon Blvd
John Day, Oregon
97845

Standard:	ASCE/SEI 7-16	**Latitude:**	44.405029
Risk Category:	III	**Longitude:**	-118.947804
Soil Class:	D - Default (see Section 11.4.3)	**Elevation:**	3144.1274532695556 ft (NAVD 88)



Wind

Results:

Wind Speed	107 Vmph	← USE 108 MPH PER OSSC
10-year MRI	69 Vmph	
25-year MRI	76 Vmph	
50-year MRI	80 Vmph	
100-year MRI	86 Vmph	

Data Source: ASCE/SEI 7-16, Fig. 26.5-1C and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed: Mon Nov 06 2023

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 3% probability of exceedance in 50 years (annual exceedance probability = 0.000588, MRI = 1,700 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2.

ZCS	**PROJECT:** Grant Union HS HVAC	**PROJECT #:** P-2869-23
	CLIENT: Grant County School District	
	DATE: 3/7/2024 **VERSION:** 3.05	**DESIGNED BY:** BLD

ASCE 7-16 SEISMIC DESIGN CRITERIA

OSHPD

911 S Canyon Blvd, John Day, OR 97845, USA

Latitude, Longitude: 44.4042044, -118.948402

Date	11/6/2023, 8:51:47 AM
Design Code Reference Document	ASCE7-16
Risk Category	III
Site Class	D - Default (See Section 11.4.3)

Type	Value	Description
S_S	0.31	MCE_R ground motion. (for 0.2 second period)
S_1	0.123	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.481	Site-modified spectral acceleration value
S_{M1}	0.289	Site-modified spectral acceleration value
S_{DS}	0.321	Numeric seismic design value at 0.2 second SA
S_{D1}	0.193	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	C	Seismic design category
F_a	1.552	Site amplification factor at 0.2 second
F_v	2.354	Site amplification factor at 1.0 second
PGA	0.139	MCE_G peak ground acceleration
F_{PGA}	1.522	Site amplification factor at PGA
PGA_M	0.212	Site modified peak ground acceleration
T_L	16	Long-period transition period in seconds
SsRT	0.31	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	0.34	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.123	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.137	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)

SNOW LOADS

Site & Building Design Criteria

Ground Snow Load, p_g =	8.00 *psf*	Exposure of Roof =	Partially Exposed
Snow Density, γ =	15.04 *pcf*	Exposure Category =	C
Importance Factor, I_s =	1.10	Exposure Factor, C_e =	1.00

Flat & Sloped Roof Snow Loads

Roof	Roof Slope X:12	Roof Slope θ°	Obstructed	Rain on Snow?	Thermal Factor C_t	Slope Factor C_s	Flat Roof SL p_f (*psf*)	**Design Roof SL p_f (*psf*)**	**Sloped Roof SL p_s (*psf*)**
1	0.5	2.39	Yes	No	1	1.00	6.16	**22.00**	**22.00**
2	2.5	11.77	Yes	No	1	1.00	6.16	**22.00**	**22.00**

SEAO GROUND SNOW LOAD

Oregon Snow Loading

The design ground snow of any location in the state of Oregon may be determined by entering the latitude and longitude of your site into the boxes below. The tool provides the design ground snow load (pg in ASCE7*) for your site. The design ground snow load values can also be viewed on the online map. Users are strongly recommended to review the Map Usage Notes.

Ground snow loads are very sensitive to geographic location, and particularly sensitive to elevation. It is recommended that the latitude and longitude values be entered with a precision of 0.001 (about 105 yards).

* ASCE Standard (ASCE/SEI 7-10) *Minimum Design Loads for Buildings and Other Structures* published by the American Society of Civil Engineers.

Latitude - Longitude Lookup

Results

Latitude:	44.40076460
Longitude:	-118.94889190
Snow Load:	8.0 psf
Modeled Elevation:	3307 ft

Site Elevation versus Modeled Grid Elevation

Site elevation refers to the elevation (above sea level, in feet) of the location for which the snow load is required. The modeled grid elevation is the average elevation of the 4 km (about 2-1/2 miles) grid cell that was used in the snow load modeling. In relatively flat terrain, the two elevations will likely be the same or very similar. In sloped or mountainous terrain, the two elevations may be quite different.

The design ground snow load may be underreported for some locations where the site elevation is higher than the modeled grid elevation. Consult the Map Usage Notes if your site elevation is more than 100 ft. above the modeled grid elevation shown, or if your site is at or near the top of a hill.

Oregon Design Ground Snow Load Look Up Results

It is important that the user of this tool understand the principals and limitations of the modeling used to create it. Ground snow loads can vary dramatically over short distances due to changes in precipitation and elevation. It is critical to use good engineering judgment when interpreting and using the results reported by this tool. The user is recommended to review the online map, to gain a better understanding of the variations and range of magnitudes of the ground snow loads in the vicinity of the site location.

In remote regions at high elevation, reliable snow data was not available during the creation of the map. A site-specific case study is required to determine the design ground snow load in these areas. The ground snow load values on the map are based on extrapolation, and are not recommended for design. See the Map Usage Notes for the regions that require a site-specific case study.

It is recommended that the local building official having jurisdiction at the site be consulted for minimum design ground snow or roof snow loads.

The reported design ground snow loads must be adjusted as required by Chapter 7 of ASCE7* for site exposure, roof slope, roof configuration, etc. Only the properly adjusted loads can be used to design roof structural elements.

Oregon requires a minimum roof snow load of 20 psf (pm in ASCE7*) for all roofs, plus a 5 psf rain-on-snow surcharge for many roof types, resulting in a 25 psf minimum roof design load for most roofs. See the Map Usage Notes or *Snow Load Analysis for Oregon, Part II* for further information.

* ASCE Standard (ASCE/SEI 7-10) Minimum Design Loads for Buildings and Other Structures published by the American Society of Civil Engineers.

PROJECT: Grant Union HS HVAC		**PROJECT #:** P-2869-23
CLIENT: Grant County School District		
DATE: 3/7/2024	**VERSION:** 3.05	**DESIGNED BY:** BLD

GRAVITY LOADS

Upper Roof Dead Load			Load (psf)
Roofing Type:	Comp Roofing (2-Layers)		4.5
Sheathing:	1/2" Plywood Sheathing		1.4
Sheathing:	2x6 T&G Decking		4.3
Roof Framing:	Engr'd Trusses/Rafters	@ 48 OC	1.5
Insulation:	12" Batt Insulation		0.5
Ceiling:	NA		0.0
Misc:	Misc.		2.0
		Total:	14.2 psf

Slope Correction	
3/12	0.98

Use Sloped: **14.5 psf**

Use Flat: **15.0 psf**

Lower Roof Dead Load		Load (psf)
Roofing Type:	TPO	0.7
Roofing Type:	1/2" Gyp	2.2
Sheathing:	5/8" Plywood Sheathing	1.8
Roof Framing:	2x6 T&G Decking	4.3
Insulation:	6" Rigid Insulation	1.5
Ceiling:	NA	0.0
Misc:		2.0
	Total:	12.5 psf

Slope Correction	
1/12	1.00

Use Sloped: **13.0 psf**

Use Flat: **13.0 psf**

Roof Live Load		Load (psf)
Snow	**Use:**	**22.0 psf**
Live	**Use:**	**20.0 psf**

PROJECT: Grant Union HS HVAC		**PROJECT #:** P-2869-23
CLIENT: Grant County School District		
DATE: 3/7/2024	**VERSION:** 3.05	**DESIGNED BY:** BLD

SEISMIC DEMANDS ON NONSTRUCTURAL COMPONENTS

HVAC GROUND UNITS & DUST COLLECTOR

Seismic Design Criteria

Building Occupancy Risk Category		Risk Category =	III	Table 1.5-1
Seismic Importance Factor (I_p)		I_p =	1.00	Table 1.5-2
Site Soil Classification		Site Class =	D	11.4.2
Structure Height (h_n)		h_n =	20.00 ft	12.8.2.1
Attachment Height (z)		z =	0.00 ft	
Short-Period Acceleration Parameter (S_S)		S_S =	0.310 g	11.4.1
One Second Acceleration Parameter (S_1)		S_1 =	0.123 g	
Seismic Design Category (SDC)		SDC =	C	11.6
Long-Period Transition Period (T_L)		T_L =	16 sec	12.8.1.1
Regular Structure Less than 5 Stories, w/ Redundancy Factor =1.0 ?			Yes	12.8.1.3
Site Adjusted Short-Period Acceleration (S_{MS})	$S_{MS} = F_a S_S$	S_{MS} =	0.481 g	11.4.3
Site Adjusted One Second Acceleration (S_{M1})	$S_{M1} = F_v S_1$	S_{M1} =	0.290 g	
Design Short-Period Acceleration (S_{DS})	$S_{DS} = \left(\frac{2}{3}\right) S_{MS}$	S_{DS} =	0.321 g	11.4.4
Design One Second Acceleration (S_{D1})	$S_{D1} = \left(\frac{2}{3}\right) S_{M1}$	S_{D1} =	0.193 g	
Approximate Fundamental Period, conservative (T_a)	$T_a = 0.02 * h_n^{0.75}$	T_a =	0.189 sec	12.8.2.1
(For All Other Structural Systems)				

Seismic Response Coefficient: Nonstructural Component

Include Overstrength Factor? Yes — 13.3.1

Architectural Component	a_P [a]	R_P	Ω_0 [c]	Table 13.5-1
Air-side HVACR, fans, air handlers, air conditioning units, cabinet heaters, air distribution boxes, and other mechanical components constructed of sheet metal framing	2 1/2	6	2	

Horizontal Seismic Coefficient Minimum ($C_{c\,min}$)		$C_{c\,min}$ =	0.096	13.3-3
Horizontal Seismic Coefficient (C_c)		C_c =	0.053	
Horizontal Seismic Coefficient Maximum ($C_{c\,max}$)		$C_{c\,max}$ =	0.513	13.3-2
Horizontal Seismic Coefficient (C_c)		**C_c =**	**0.096**	13.3-1
Vertical Seismic Coefficient (C_{cv})	$C_{cv} = 0.2 * S_{DS}$	**C_{cv} =**	**0.064**	13.3.1

$$C_{c\,min} = 0.3 S_{DS} I_p \qquad C_{c\,max} = 1.6 S_{DS} I_p \qquad C_c = \frac{0.4 a_p S_{DS}}{\left(\frac{R_p}{I_p}\right)} \left(1 + 2\frac{Z}{h}\right)$$

PROJECT: Grant Union HS HVAC		**PROJECT #:** P-2869-23
CLIENT: Grant County School District		
DATE: 3/7/2024	**VERSION:** 3.05	**DESIGNED BY:** BLD

SEISMIC DEMANDS ON NONSTRUCTURAL COMPONENTS

GENERATOR

Seismic Design Criteria

Building Occupancy Risk Category		Risk Category =	III	Table 1.5-1
Seismic Importance Factor (I_p)		I_p =	1.00	Table 1.5-2
Site Soil Classification		Site Class =	D	11.4.2
Structure Height (h_n)		h_n =	20.00 ft	12.8.2.1
Attachment Height (z)		z =	0.00 ft	
Short-Period Acceleration Parameter (S_S)		S_S =	0.310 g	11.4.1
One Second Acceleration Parameter (S_1)		S_1 =	0.123 g	
Seismic Design Category (SDC)		SDC =	D	11.6
Long-Period Transition Period (T_L)		T_L =	16 sec	12.8.1.1
Regular Structure Less than 5 Stories, w/ Redundancy Factor =1.0 ?			Yes	12.8.1.3
Site Adjusted Short-Period Acceleration (S_{MS})	$S_{MS} = F_a S_S$	S_{MS} =	0.481 g	11.4.3
Site Adjusted One Second Acceleration (S_{M1})	$S_{M1} = F_v S_1$	S_{M1} =	0.290 g	
Design Short-Period Acceleration (S_{DS})	$S_{DS} = \left(\frac{2}{3}\right) S_{MS}$	S_{DS} =	0.321 g	11.4.4
Design One Second Acceleration (S_{D1})	$S_{D1} = \left(\frac{2}{3}\right) S_{M1}$	S_{D1} =	0.193 g	
Approximate Fundamental Period, conservative (T_a)	$T_a = 0.02 * h_n^{0.75}$	T_a =	0.189 sec	12.8.2.1
(For All Other Structural Systems)				

Seismic Response Coefficient: Nonstructural Component

Include Overstrength Factor? Yes — 13.3.1

Architectural Component	a_p [a]	R_P	Ω_0 [c]	Table 13.5-1
Generators, batteries, inverters, motors, transformers, and other electrical components constructed of high-deformability materials	1	2 1/2	2	

Horizontal Seismic Coefficient Minimum ($C_{c\,min}$)	$C_{c\,min}$ =	0.096	13.3-3
Horizontal Seismic Coefficient (C_c)	C_c =	0.051	
Horizontal Seismic Coefficient Maximum ($C_{c\,max}$)	$C_{c\,max}$ =	0.513	13.3-2
Horizontal Seismic Coefficient (C_c)	**C_c =**	**0.096**	13.3-1
Vertical Seismic Coefficient (C_{cv}) $C_{cv} = 0.2 * S_{DS}$	**C_{cv} =**	**0.064**	13.3.1

$$C_{c\,min} = 0.3 S_{DS} I_p \qquad C_{c\,max} = 1.6 S_{DS} I_p \qquad C_c = \frac{0.4 a_p S_{DS}}{\left(\frac{R_p}{I_p}\right)} \left(1 + 2\frac{Z}{h}\right)$$

ZCS	**PROJECT:** Grant Union HS HVAC	**PROJECT #:** P-2869-23
	CLIENT: Grant County School District	
	DATE: 3/7/2024 **VERSION:** 3.05	**DESIGNED BY:** BLD

GROUND EQUIPMENT SEISMIC DESIGN

HVAC GROUND UNITS

Ground Equipment

Length of Equipment (*L*)	*L* =	7.39	ft
Depth of Equipment (*D*)	*D* =	4.44	ft
Height of Equipment (*H*)	*H* =	3.91	ft
Weight of Equipment (*W*)	*W* =	1239	lbs

Seismic Forces on Equipment

Horizontal Seismic Coefficient (Cc)	Cc =	0.096	
Vertical Seismic Coefficient (Ccv)	Ccv =	0.064	
Horizontal Seismic Force (F_H)	F_H =	119	lbs
Vertical Seismic Force (F_V)	F_V =	79	lbs

Overturning Moment

Center of Force	H_C =	1.96	ft
Overturning Moment	M_O =	233	ft-lbs

Resistive Moment

Center of Force	D_C =	2.22	ft
Resistive Moment	M_R =	2751	ft-lbs

$M_R > M_O$ No Net Overturning

Net Tension per Anchor

Vertical Seismic Force (F_V)	F_V =	79	lbs
Overstrength Factor	Ω =	2	
Vertical Seismic Force (F_V) w/ Overstrength	Ω*F_V =	159	lbs
Number of Anchors	n =	4	
Seismic Vertical Force Per Anchor	F_V =	40	lbs
Dead Load Per Anchor	DL =	310	lbs
Net Tension Force Per Anchor, T = Fv - 0.6*DL	T =	-146	lbs

T < 0 No Net Tension

Net Shear per Anchor

Horizontal Seismic Force (F_H)	F_H =	119	lbs
Overstrength Factor	Ω =	2	
Horizontal Seismic Force (F_H) w/ Overstrength	Ω*F_H =	238	lbs
Number of Anchors	n =	4	
Seismic Shear Per Anchor	V =	60	lbs

ZCS	**PROJECT:** Grant Union HS HVAC	**PROJECT #:** P-2869-23
	CLIENT: Grant County School District	
	DATE: 3/7/2024 **VERSION:** 3.05	**DESIGNED BY:** BLD

GROUND EQUIPMENT SEISMIC DESIGN

DUST COLLECTOR

Ground Equipment

Length of Equipment (*L*)	*L* =	5.00	ft
Depth of Equipment (*D*)	*D* =	3.67	ft
Height of Equipment (*H*)	*H* =	10.50	ft
Weight of Equipment (*W*)	*W* =	400	lbs

Seismic Forces on Equipment

Horizontal Seismic Coefficient (Cc)	Cc =	0.096	
Vertical Seismic Coefficient (Ccv)	Ccv =	0.064	
Horizontal Seismic Force (F_H)	F_H =	38	lbs
Vertical Seismic Force (F_V)	F_V =	26	lbs

Overturning Moment

Center of Force	H_C =	7.46	ft
Overturning Moment	M_O =	287	ft-lbs

Resistive Moment

Center of Force	D_C =	1.83	ft
Resistive Moment	M_R =	733	ft-lbs

$M_R > M_O$ No Net Overturning

Net Tension per Anchor

Vertical Seismic Force (F_V)	F_V =	26	lbs
Overstrength Factor	Ω =	2	
Vertical Seismic Force (F_V) w/ Overstrength	Ω*F_V =	51	lbs
Number of Anchors	n =	4	
Seismic Vertical Force Per Anchor	F_V =	13	lbs
Dead Load Per Anchor	DL =	100	lbs
Net Tension Force Per Anchor, T = Fv - 0.6*DL	T =	-47	lbs

T < 0 No Net Tension

Net Shear per Anchor

Horizontal Seismic Force (F_H)	F_H =	38	lbs
Overstrength Factor	Ω =	2	
Horizontal Seismic Force (F_H) w/ Overstrength	Ω*F_H =	77	lbs
Number of Anchors	n =	4	
Seismic Shear Per Anchor	V =	19	lbs

ZCS	**PROJECT:** Grant Union HS HVAC	**PROJECT #:** P-2869-23
	CLIENT: Grant County School District	
	DATE: 3/7/2024 **VERSION:** 3.05	**DESIGNED BY:** BLD

GROUND EQUIPMENT SEISMIC DESIGN

GENERATOR

Ground Equipment

Length of Equipment (*L*)	*L* =	14.42	ft
Depth of Equipment (*D*)	*D* =	6.08	ft
Height of Equipment (*H*)	*H* =	6.75	ft
Weight of Equipment (*W*)	*W* =	29000	lbs

Seismic Forces on Equipment

Horizontal Seismic Coefficient (Cc)	Cc =	0.096	
Vertical Seismic Coefficient (Ccv)	Ccv =	0.064	
Horizontal Seismic Force (F_H)	F_H =	2790	lbs
Vertical Seismic Force (F_V)	F_V =	1860	lbs

Overturning Moment

Center of Force	H_C =	3.38	ft
Overturning Moment	M_O =	9418	ft-lbs

Resistive Moment

Center of Force	D_C =	3.04	ft
Resistive Moment	M_R =	88208	ft-lbs

$M_R > M_O$ No Net Overturning

Net Tension per Anchor

Vertical Seismic Force (F_V)	F_V =	1860	lbs
Overstrength Factor	Ω =	2	
Vertical Seismic Force (F_V) w/ Overstrength	Ω*F_V =	3721	lbs
Number of Anchors	n =	4	
Seismic Vertical Force Per Anchor	F_V =	930	lbs
Dead Load Per Anchor	DL =	7250	lbs
Net Tension Force Per Anchor, T = Fv - 0.6*DL	T =	-3420	lbs

T < 0 No Net Tension

Net Shear per Anchor

Horizontal Seismic Force (F_H)	F_H =	2790	lbs
Overstrength Factor	Ω =	2	
Horizontal Seismic Force (F_H) w/ Overstrength	Ω*F_H =	5581	lbs
Number of Anchors	n =	4	
Seismic Shear Per Anchor	V =	1395	lbs

Company:	ZCS	Date:	2/17/2023
Engineer:	BLD	Page:	1/5
Project:	P-2869-23 - Grant Union HS HVAC		
Address:			
Phone:			
E-mail:			

1.Project information

Project description:
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-19
Units: Imperial units

Anchor Information:
Anchor type: Concrete screw
Material: Carbon Steel
Diameter (inch): 0.375
Nominal Embedment depth (inch): 2.500
Effective Embedment depth, h_{ef} (inch): 1.770
Code report: ICC-ES ESR-2713
Anchor category: 1
Anchor ductility: No
h_{min} (inch): 4.00
c_{ac} (inch): 2.69
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 4.00
State: Cracked
Compressive strength, f'_c (psi): 2500
$\Psi_{c,V}$: 1.0
Reinforcement condition: Supplementary reinforcement not present
Supplemental edge reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Ignore 6do requirement: Not applicable
Build-up grout pad: No

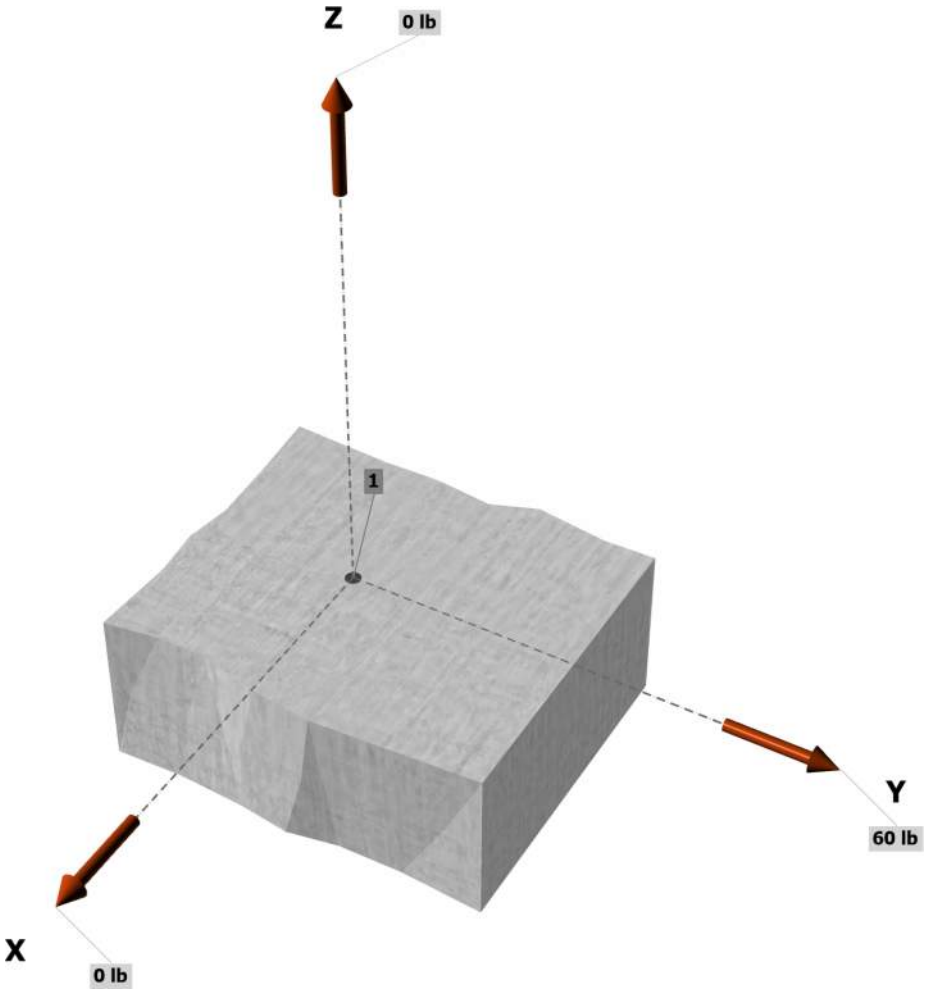
Recommended Anchor
Anchor Name: Titen HD® - 3/8"Ø Titen HD, hnom:2.5" (64mm)
Code Report: ICC-ES ESR-2713

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: Not applicable
Ductility section for tension: 17.10.5.2 not applicable
Ductility section for shear: 17.10.6.2 not applicable
Ω_0 factor: not set
Apply entire shear load at front row: Yes
Anchors only resisting wind and/or seismic loads: Yes

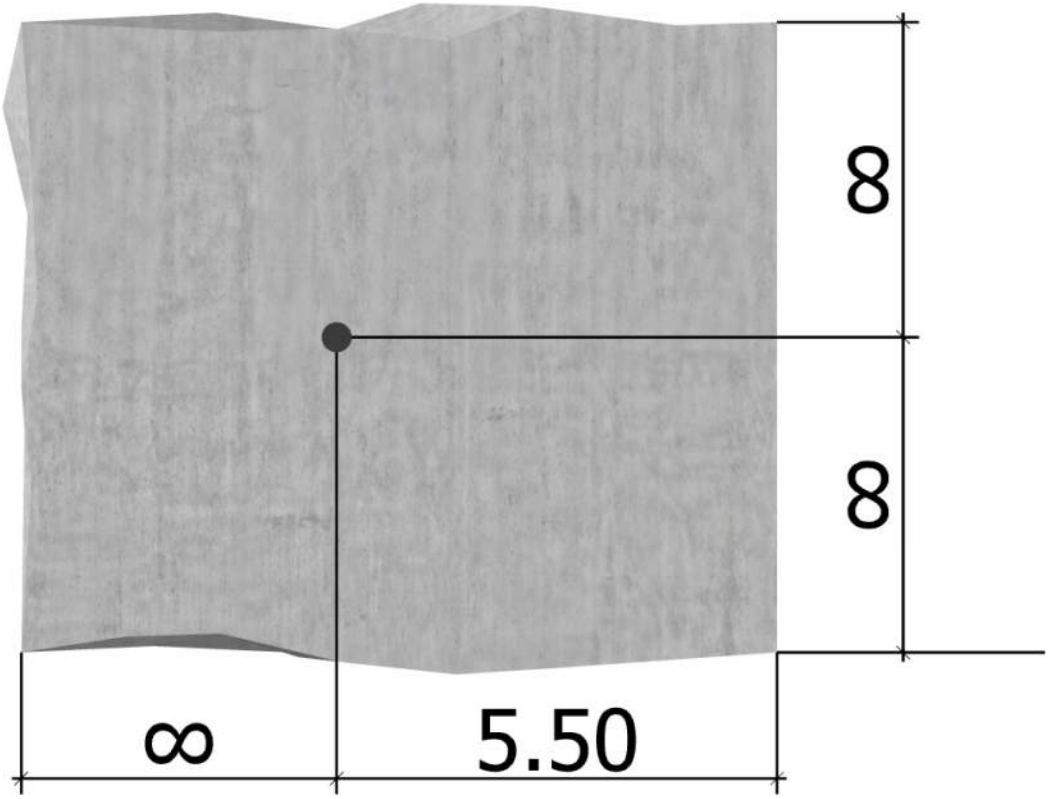
Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 0
V_{uay} [lb]: 60

<Figure 1>



<Figure 2>



3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	0.0	60.0	60.0
Sum	0.0	0.0	60.0	60.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

8. Steel Strength of Anchor in Shear (Sec. 17.7.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
2855	1.0	0.60	1713

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.7.2)

Shear perpendicular to edge in y-direction:

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.7.2.2.1a & Eq. 17.7.2.2.1b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
1.77	0.375	1.00	2500	5.50	3771

$\phi V_{cby} = \phi\,(A_{Vc} / A_{Vco})\,\Psi_{ed,V}\,\Psi_{c,V}\,\Psi_{h,V}\,V_{by}$ (Sec. 17.5.1.2 & Eq. 17.7.2.1a)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cby} (lb)
66.00	136.13	1.000	1.000	1.436	3771	0.70	1838

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.7.3)

$\phi V_{cp} = \phi k_{cp} N_{cb} = \phi k_{cp}(A_{Nc} / A_{Nco})\,\Psi_{ed,N}\,\Psi_{c,N}\,\Psi_{cp,N} N_b$ (Sec. 17.5.1.2 & Eq. 17.7.3.1a)

k_{cp}	A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕV_{cp} (lb)
1.0	28.20	28.20	1.000	1.000	1.000	2002	0.70	1401

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.8)

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status

Steel	60	1713	0.04	Pass
T Concrete breakout y+	60	1838	0.03	Pass
Pryout	**60**	**1401**	**0.04**	**Pass (Governs)**

3/8"Ø Titen HD, hnom:2.5" (64mm) meets the selected design criteria.

12. Warnings

- Minimum spacing and edge distance requirement of 6da per ACI 318 Table 17.9.2(a) for torqued cast-in-place anchor is waived per designer option.\n
- Per designer input, the tensile component of the strength-level earthquake force applied to anchors does not exceed 20 percent of the total factored anchor tensile force associated with the same load combination. Therefore the ductility requirements of ACI 318 17.10.5.2 for tension need not be satisfied – designer to verify.

- Per designer input, the shear component of the strength-level earthquake force applied to anchors does not exceed 20 percent of the total factored anchor shear force associated with the same load combination. Therefore the ductility requirements of ACI 318 17.10.6.2 for shear need not be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

ZCS	**PROJECT:** Grant Union HS HVAC	**PROJECT #:** P-2869-23
	CLIENT: Grant County School District	
	DATE: 3/7/2024 **VERSION:** 3.05	**DESIGNED BY:** BLD

SEISMIC DEMANDS ON NONSTRUCTURAL COMPONENTS

HVAC HUNG UNITS

Seismic Design Criteria

Building Occupancy Risk Category		Risk Category =	III	Table 1.5-1
Seismic Importance Factor (I_p)		I_p =	1.00	Table 1.5-2
Site Soil Classification		Site Class =	D	11.4.2
Structure Height (h_n)		h_n =	20.00 ft	12.8.2.1
Attachment Height (z)		z =	30.00 ft	
Short-Period Acceleration Parameter (S_S)		S_S =	0.310 g	11.4.1
One Second Acceleration Parameter (S_1)		S_1 =	0.123 g	
Seismic Design Category (SDC)		SDC =	C	11.6
Long-Period Transition Period (T_L)		T_L =	16 sec	12.8.1.1
Regular Structure Less than 5 Stories, w/ Redundancy Factor =1.0 ?			Yes	12.8.1.3
Site Adjusted Short-Period Acceleration (S_{MS})	$S_{MS} = F_a S_S$	S_{MS} =	0.481 g	11.4.3
Site Adjusted One Second Acceleration (S_{M1})	$S_{M1} = F_v S_1$	S_{M1} =	0.290 g	
Design Short-Period Acceleration (S_{DS})	$S_{DS} = \left(\frac{2}{3}\right) S_{MS}$	S_{DS} =	0.321 g	11.4.4
Design One Second Acceleration (S_{D1})	$S_{D1} = \left(\frac{2}{3}\right) S_{M1}$	S_{D1} =	0.193 g	
Approximate Fundamental Period, conservative (T_a)	$T_a = 0.02 * h_n^{0.75}$	T_a =	0.189 sec	12.8.2.1
(For All Other Structural Systems)				

Seismic Response Coefficient: Nonstructural Component

Include Overstrength Factor? No — 13.3.1

Architectural Component	a_p[a]	R_P	Ω_0[c]	Table 13.5-1
Air-side HVACR, fans, air handlers, air conditioning units, cabinet heaters, air distribution boxes, and other mechanical components constructed of sheet metal framing	2 1/2	6	2	

Horizontal Seismic Coefficient Minimum ($C_{c\,min}$)		$C_{c\,min}$ = 0.096	13.3-3
Horizontal Seismic Coefficient (C_c)		C_c = 0.214	
Horizontal Seismic Coefficient Maximum ($C_{c\,max}$)		$C_{c\,max}$ = 0.513	13.3-2
Horizontal Seismic Coefficient (C_c)		**C_c = 0.214**	13.3-1
Vertical Seismic Coefficient (C_{cv})	$C_{cv} = 0.2 * S_{DS}$	**C_{cv} = 0.064**	13.3.1

$$C_{c\,min} = 0.3 S_{DS} I_p \qquad C_{c\,max} = 1.6 S_{DS} I_p \qquad C_c = \frac{0.4 a_p S_{DS}}{\left(\frac{R_p}{I_p}\right)} \left(1 + 2\frac{Z}{h}\right)$$

Equipment Weight (W)	W =	500.00 lbs
Horizontal Seismic Forece (F_h)	**F_h =**	**106.92 lbs**
Vertical Seismic Force (F_v)	**F_v =**	**32.07 lbs**

ZCS	**PROJECT:** Grant Union HS HVAC	**PROJECT #:** P-2869-23
	CLIENT: Grant County School District	
	DATE: 3/7/2024 **VERSION:** 3.05	**DESIGNED BY:** BLD

HUNG EQUIPMENT SEISMIC DESIGN

HVAC HUNG UNITS

Hung Equipment

Weight of Equipment (*W*)	*W* =	500 lbs

Seismic Forces on Equipment

Horizontal Seismic Coefficient (Cc)	Cc =	0.214
Vertical Seismic Coefficient (Ccv)	Ccv =	0.064
Horizontal Seismic Force (F_H)	F_H =	107 lbs
Vertical Seismic Force (F_V)	F_V =	32 lbs

Force on Cable Brace

Horizontal Seismic Force (F_H)	F_H =	107 lbs
Number of Braces in Each Direction	n =	2
Cable Angle		45 deg
Tension Force Per Cable	T =	102 lbs

ZCS	**PROJECT:** Grant Union HS HVAC	**PROJECT #:** P-2869-23
	CLIENT: Grant County School District	
	DATE: 3/7/2024 **VERSION:** 3.05	**DESIGNED BY:** BLD

SEISMIC DEMANDS ON NONSTRUCTURAL COMPONENTS

ROOFTOP UNITS

Seismic Design Criteria

Building Occupancy Risk Category		Risk Category =	III		Table 1.5-1
Seismic Importance Factor (I_p)		I_p =	1.00		Table 1.5-2
Site Soil Classification		Site Class =	D		11.4.2
Structure Height (h_n)		h_n =	20.00	ft	12.8.2.1
Attachment Height (z)		z =	30.00	ft	
Short-Period Acceleration Parameter (S_S)		S_S =	0.310	g	11.4.1
One Second Acceleration Parameter (S_1)		S_1 =	0.123	g	
Seismic Design Category (SDC)		SDC =	C		11.6
Long-Period Transition Period (T_L)		T_L =	16	sec	12.8.1.1
Regular Structure Less than 5 Stories, w/ Redundancy Factor =1.0 ?			Yes		12.8.1.3
Site Adjusted Short-Period Acceleration (S_{MS})	$S_{MS} = F_a S_S$	S_{MS} =	0.481	g	11.4.3
Site Adjusted One Second Acceleration (S_{M1})	$S_{M1} = F_v S_1$	S_{M1} =	0.290	g	
Design Short-Period Acceleration (S_{DS})	$S_{DS} = \left(\frac{2}{3}\right) S_{MS}$	S_{DS} =	0.321	g	11.4.4
Design One Second Acceleration (S_{D1})	$S_{D1} = \left(\frac{2}{3}\right) S_{M1}$	S_{D1} =	0.193	g	
Approximate Fundamental Period, conservative (T_a) (For All Other Structural Systems)	$T_a = 0.02 * h_n^{0.75}$	T_a =	0.189	sec	12.8.2.1

Seismic Response Coefficient: Nonstructural Component

Include Overstrength Factor? No — 13.3.1

Architectural Component	a_p[a]	R_P	Ω_0[c]	Table 13.5-1
Roof-mounted stacks, cooling and electrical towers laterally braced below their center of mass	2 1/2	3	2	

Horizontal Seismic Coefficient Minimum ($C_{c\,min}$)		$C_{c\,min}$ =	0.096	13.3-3
Horizontal Seismic Coefficient (C_c)		C_c =	0.428	
Horizontal Seismic Coefficient Maximum ($C_{c\,max}$)		$C_{c\,max}$ =	0.513	13.3-2
Horizontal Seismic Coefficient (C_c)		**C_c =**	**0.428**	13.3-1
Vertical Seismic Coefficient (C_{cv})	$C_{cv} = 0.2 * S_{DS}$	**C_{cv} =**	**0.064**	13.3.1

$$C_{c\,min} = 0.3 S_{DS} I_p \qquad C_{c\,max} = 1.6 S_{DS} I_p \qquad C_c = \frac{0.4 a_p S_{DS}}{\left(\frac{R_p}{I_p}\right)} \left(1 + 2\frac{Z}{h}\right)$$

Equipment Weight (W)	W =	278.00	lbs
Horizontal Seismic Forece (F_h)	**F_h =**	**118.89**	**lbs**
Vertical Seismic Force (F_v)	**F_v =**	**17.83**	**lbs**

WIND CONTROLS

ZCS	**PROJECT:** Grant Union HS HVAC	**PROJECT #:** P-2869-23
	CLIENT: Grant County School District	
	DATE: 3/7/2024 **VERSION:** 3.05	**DESIGNED BY:** BLD

WIND LOADS ON ROOFTOP EQUIPMENT

TRANSVERS LOADING

Building Data

Structure Type:	Rooftop Equipment		Table 26.6-1
Exposure Category:	C		
Mean Roof Height:	20.00	ft	
Elevation	3,140	ft	

Velocity Pressure

Velocity Pressure Exposure Coefficient (K_z)	K_z =	0.90		Table 26.10-1
Topographic Factor (K_{zt})	K_{zt} =	1.00		Figure 26.8-1
Wind Directionality Factor (K_d)	K_d =	0.85		Table 26.6-1
Ground Elevation Factor (K_e)	K_e =	0.89		Table 26.9-1
Basic Wind Speed (V)	V =	108	mph	26.5.1
Velocity Pressure (q_z)	q_z =	20.39	psf	26.10-1

Roof Top Equipment

Length of Equipment (B)	B =	3.50	ft
Height of Equipment (L)	L =	4.42	ft
Depth of Equipment (D)	D =	1.08	ft
Height from Groung to Top of Equipment (h)	h =	27.00	ft
Vertical Projected Area (A_f)	A_f =	15.46	ft^2
Horizontal Projected Area (A_r)	A_r =	3.79	ft^2

Horizontal Force on Equipment			Vertical Force on Equipment			29.4.1
		$(GC_r)_h$			$(GC_r)_v$	
$0.1*B*h$ =	9.45	1.90	$0.1*B*L$ =	1.55	1.50	
$B*h$ =	94.50	1.00	$B*L$ =	15.46	1.00	
A_f =	15.46	**1.84**	A_r =	3.79	**1.42**	

Horizontal Wind Pressure (p_h)		p_h =	37.44	psf	
Vertical Wind Pressure (p_v)		p_v =	28.94	psf	
Horizontal Wind Force (F_h)	$F_h = q_h(GC_r)_h A_f$	F_h =	**579**	**lbs**	29.4-2
Vertical Wind Force (F_v)	$F_v = q_h(GC_r)_v A_v$	F_v =	**110**	**lbs**	29.4-3

ZCS	**PROJECT:** Grant Union HS HVAC	**PROJECT #:** P-2869-23
	CLIENT: Grant County School District	
	DATE: 3/7/2024 **VERSION:** 3.05	**DESIGNED BY:** BLD

WIND LOADS ON ROOFTOP EQUIPMENT

LONGITUDINAL LOADING

Building Data

Structure Type:	Rooftop Equipment		Table 26.6-1
Exposure Category:	C		
Mean Roof Height:	20.00	ft	
Elevation	3,140	ft	

Velocity Pressure

Velocity Pressure Exposure Coefficient (K_z)	K_z =	0.90		Table 26.10-1
Topographic Factor (K_{zt})	K_{zt} =	1.00		Figure 26.8-1
Wind Directionality Factor (K_d)	K_d =	0.85		Table 26.6-1
Ground Elevation Factor (K_e)	K_e =	0.89		Table 26.9-1
Basic Wind Speed (V)	V =	108	mph	26.5.1
Velocity Pressure (q_z)	q_z =	20.39	psf	26.10-1

Roof Top Equipment

Length of Equipment (B)	B =	1.08	ft
Height of Equipment (L)	L =	4.42	ft
Depth of Equipment (D)	D =	3.50	ft
Height from Groung to Top of Equipment (h)	h =	27.00	ft
Vertical Projected Area (A_f)	A_f =	4.78	ft^2
Horizontal Projected Area (A_r)	A_r =	3.79	ft^2

Horizontal Force on Equipment			Vertical Force on Equipment			29.4.1
		$(GC_r)_h$			$(GC_r)_v$	
$0.1*B*h$ =	2.93	1.90	$0.1*B*L$ =	0.48	1.50	
$B*h$ =	29.25	1.00	$B*L$ =	4.78	1.00	
A_f =	4.78	**1.84**	A_r =	3.79	**1.12**	

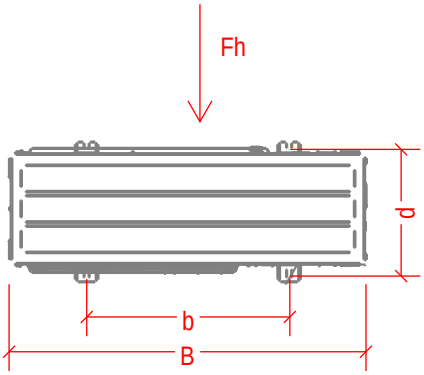
Horizontal Wind Pressure (p_h)		p_h =	37.44 psf	
Vertical Wind Pressure (p_v)		p_v =	22.74 psf	
Horizontal Wind Force (F_h)	$F_h = q_h(GC_r)_h A_f$	F_h =	**179 lbs**	29.4-2
Vertical Wind Force (F_v)	$F_v = q_h(GC_r)_v A_v$	F_v =	**86 lbs**	29.4-3

PROJECT: Grant Union HS HVAC **PROJECT #:** P-2869-23

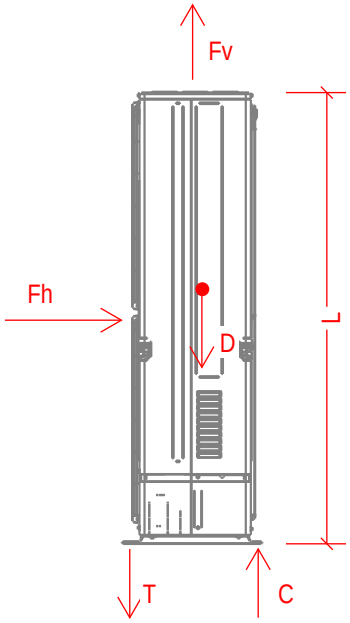
CLIENT: Grant County School District

DATE: 11/06/2023 **DESIGNED BY:** BLD

RTU ROOFTOP RACK DESIGN



PLAN VIEW



ELEVATION VIEW

DIMENSIONS
B = 42"
L = 53"
d = 14.5"
b = 23.5"

LOADS
D = 278 LBS
Fh = 579 LBS
Fv = 110 LBS

WIND LOAD REACTIONS
Twind = (L/2*Fh + d/2*Fv) / d
Twind = ((53"/2)*(579 LBS) + (14.5"/2)*(110 LBS)) / (14.5")
Twind = 1113.17 LBS
Twind = 556.58 LBS PER ANCHOR

Cwind = Twind - Fv
Cwind = (1113.17 LBS) - (110 LBS)
Cwind = 1003.17 LBS
Cwind = 501.58 LBS PER ANCHOR

DEAD LOAD REACTIONS
Tdead = -((d/2)*D) / d
Tdead = -((14.5"/2)*(278 LBS)) / (14.5")
Tdead = -139 LBS
Tdead = -69.5 LBS PER ANCHOR

Cdead = Tdead + D
Cdead = (-139 LBS) + (278 LBS)
Cdead = 139 LBS
Cdead = 69.5 LBS PER ANCHOR

ASD FACTORED VERTICAL REACTIONS
0.6D+0.6W:
T = 0.6*Tdead + 0.6*Twind
T = 0.6*(-139 LBS) + 0.6*(1113.17 LBS)
T = 584.50 LBS
T = 292.25 LBS PER ANCHOR

1.0D+0.6W:
C = 1.0*Cdead + 0.6*Cwind
C = 1.0*(139 LBS) + 0.6*(1003.17 LBS)
C = 740.90 LBS
C = 370.45 LBS PER ANCHOR

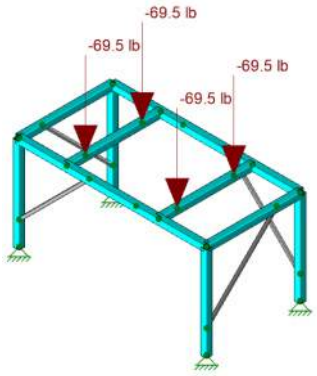
ASD FACTORED SHEAR REACTIONS
1.0D+0.6W:
V = 0.6*Fh
V = 0.6*(579 LBS)
V = 347.4 LBS
V = 86.85 LBS PER ANCHOR

RISA ROOFTOP RACK VERTICAL REACTIONS:
DL = 154.4 LBS
SL = 24.0 LBS
WL+Z = 653.7 LBS
WL-Z =-715.1 LBS

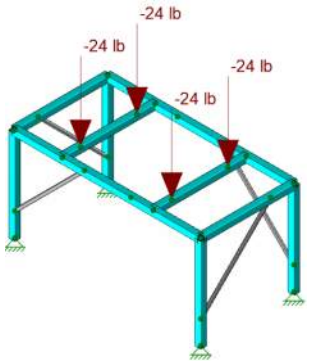
ZCS	**PROJECT:** Grant Union HS HVAC	**PROJECT #:** P-2869-23
	CLIENT: Grant County School District	
	DATE: 11/06/2023	**DESIGNED BY:** BLD

RISA ROOFTOP RACK DESIGN

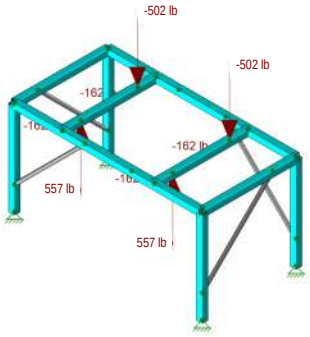
LOADING



DEAD LOAD

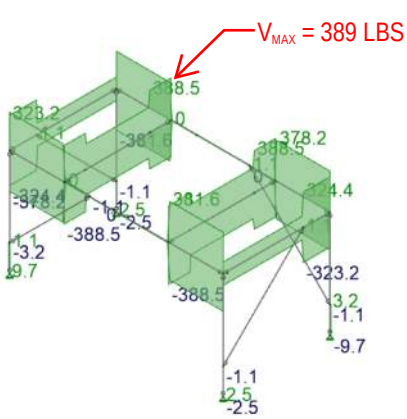


SNOW LOAD

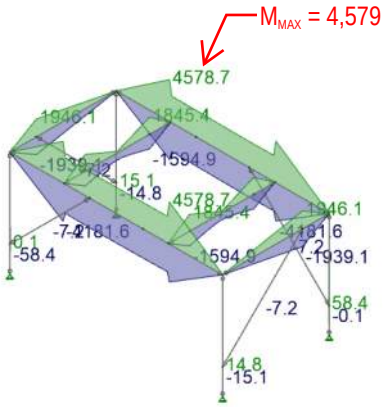


WIND LOAD

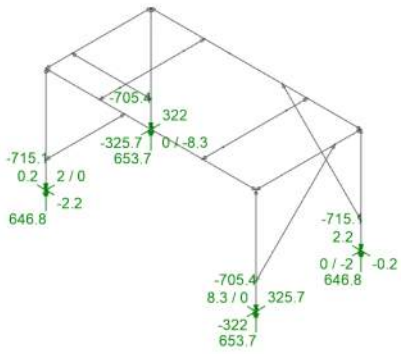
FORCES AND REACTIONS



ENVELOPE DESIGN SHEARS (LBS)

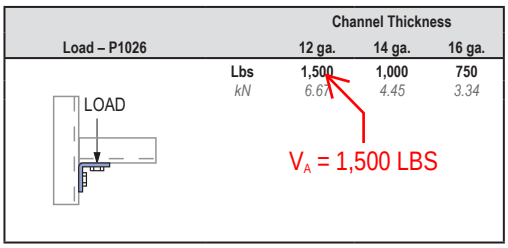


ENVELOPE DESIGN MOMENTS (LB-IN)

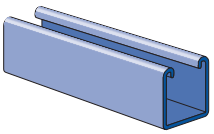


ENVELOPE DESIGN REACTIONS (LBS)

DESIGN CHECKS



UNISTRUT FITTING P1026



M_A = 5,070 LB-IN

Wt/100 Ft:189 Lbs (281 kg/100 m)
Allowable Moment 5,070 In-Lbs (570 N•m)
12 Gauge Nominal Thickness .105" (2.7mm)

UNISTRUT P1000

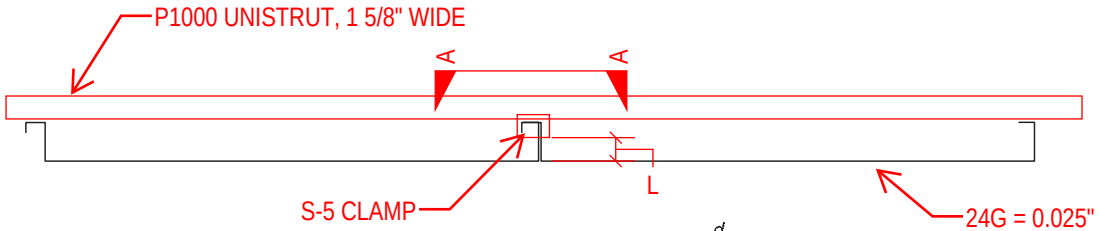
V_{MAX} / V_A = (389 LBS) / (1,500 LBS)
= 0.26 < 1.00 --> OK

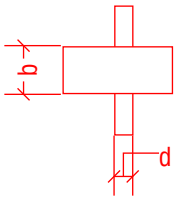
M_{MAX} / M_A = (4,579 LB-IN) / (5,070 LB-IN)
= 0.90 < 1.00 --> OK

ZCS	**PROJECT:** Grant Union HS HVAC	**PROJECT #:** P-2869-23
	CLIENT: Grant County School District	
	DATE: 11/06/2023	**DESIGNED BY:** BLD

S-5 BEARING DESIGN

CHECK METAL ROOF SEAM BUCKING CAPACITY





SECTION A-A

d = 2*0.025" = 0.050"
b = 1.625"
L = 1.25"
Ag = 0.08125IN2
K = 2

Fy =47KSI
E = 29,000KSI

$r = \frac{d}{\sqrt{12}}$ = 0.0144IN

$\frac{KL}{r}$ = 173.61

$4.71\sqrt{\frac{E}{F_y}}$ = 117

$F_e = \frac{\pi^2 E}{\left(\frac{KL}{r}\right)^2}$ = 9.496KSI (E3-4)

When $\frac{KL}{r} > 4.71\sqrt{\frac{E}{F_y}}$ $F_{cr} = 0.877F_e$ = 8.328KSI (E3-3)

$P_n = F_{cr} A_g$ = 0.676K (E3-1)

Ω = 1.67 $P_a = P_n/\Omega$ =0.405K

USE Pa = 400 LBS PER CLAMP

ROOFTOP RACK TRANSVERSE LOADING

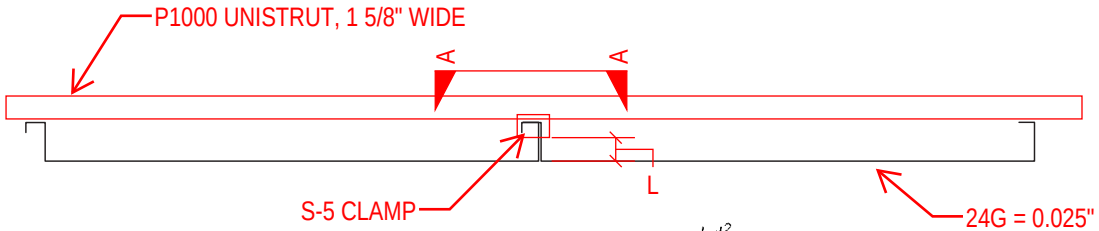
RISA ROOFTOP RACK VERTICAL REACTIONS:
DL = 154.4 LBS
SL = 24.0 LBS
WL+Z = 653.7 LBS
WL-Z =-715.1 LBS

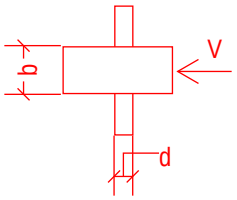
RACK REACTION AT EACH LEG:
# OF CLAMPS = 1.5
P = (DL+0.6WL) / (# OF CLAMPS)
P = (154.4 LBS+0.6*653.7 LBS) / 1.5

P = 364 LBS < Pa

S-5 BEARING DESIGN CONT.

CHECK METAL ROOF SEAM BENDING CAPACITY





SECTION A-A

d = 2*0.025" = 0.050"
b = 1.625"
L = 1.25"

Fy =47KSI

$Z = \frac{bd^2}{4}$ = 0.0010156IN^3

$M_n = M_p = F_y Z$ = 0.0477K-IN (F11-1)

$\Omega_b = 1.67$ $M_a = M_n/\Omega_b$ = 28.58LB-IN

Va = Ma / L = 22.87 LBS

USE Va = 22 LBS PER CLAMP

ROOFTOP RACK LONGITUDINAL LOADING

ROOFTOP RACK SHEAR REACTIONS:
W = 200 LBS
W = 50 LBS PER LEG

RACK REACTION AT EACH LEG:
# OF CLAMPS = 1.5
V = 0.6*W / (# OF CLAMPS)
V = 20 LBS

V = 20 LBS < Va

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 2 MAR 2024, 10:19PM

Wood Beam

Project File: p-2869-23 - grant union hs hvac.ec6

DESCRIPTION: (E) 2x6 RAFTER w/ HALF RTU WL+Z

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : ASCE 7-16

Wood Species : Douglas Fir - Larch
Wood Grade : No.2

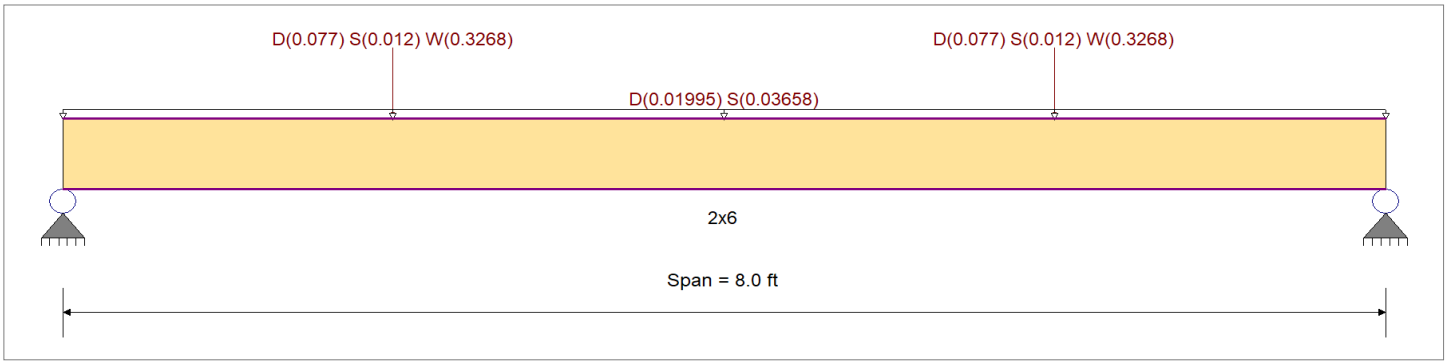
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	900.0 psi
Fb -	900.0 psi
Fc - Prll	1,350.0 psi
Fc - Perp	625.0 psi
Fv	180.0 psi
Ft	575.0 psi

E : Modulus of Elasticity

Ebend- xx	1,600.0 ksi
Eminbend - xx	580.0 ksi
Density	31.210 pcf

Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loading
Loads on all spans...
Uniform Load on ALL spans : D = 0.0150, S = 0.02750 ksf, Tributary Width = 1.330 ft
Point Load : D = 0.0770, S = 0.0120, W = 0.3268 k @ 2.0 ft, (HALF RTU WL+Z)
Point Load : D = 0.0770, S = 0.0120, W = 0.3268 k @ 6.0 ft, (HALF RTU WL+Z)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.661 : 1	Maximum Shear Stress Ratio	=	0.261 : 1
Section used for this span		2x6	Section used for this span		2x6
fb: Actual	=	1,022.68 psi	fv: Actual	=	53.95 psi
F'b	=	1,547.33 psi	F'v	=	207.00 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	4.000 ft	Location of maximum on span	=	7.562 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.250 in	Ratio =	383 >=240	Span: 1 : W Only
Max Upward Transient Deflection	0 in	Ratio =	0 <240	n/a
Max Downward Total Deflection	0.316 in	Ratio =	304 >=180	Span: 1 : +D+0.750S+0.450W
Max Upward Total Deflection	0 in	Ratio =	0 <180	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 8.0 ft	1	0.430	0.173	0.90	1.00	1.00	1.00	1.300	1.00	1.00	1.15	0.33	520.3	1,211.0	0.15	28.1	162.0
+D+S					1.00	1.00	1.00	1.300	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 8.0 ft	1	0.661	0.261	1.15	1.00	1.00	1.00	1.300	1.00	1.00	1.15	0.64	1,022.7	1,547.3	0.30	53.9	207.0
+D+0.750S					1.00	1.00	1.00	1.300	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 8.0 ft	1	0.580	0.229	1.15	1.00	1.00	1.00	1.300	1.00	1.00	1.15	0.57	897.1	1,547.3	0.26	47.5	207.0
+D+0.60W					1.00	1.00	1.00	1.300	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 8.0 ft	1	0.531	0.221	1.60	1.00	1.00	1.00	1.300	1.00	1.00	1.15	0.72	1,142.6	2,152.8	0.35	63.7	288.0

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 2 MAR 2024, 10:19PM

Wood Beam

Project File: p-2869-23 - grant union hs hvac.ec6

DESCRIPTION: (E) 2x6 RAFTER w/ HALF RTU WL+Z

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
+D+0.450W					1.00	1.00	1.00	1.300	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 8.0 ft	1	0.458	0.190	1.60	1.00	1.00	1.00	1.300	1.00	1.00	1.15	0.62	987.0	2,152.8	0.30	54.8	288.0
+D+0.750S+0.450W					1.00	1.00	1.00	1.300	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 8.0 ft	1	0.633	0.258	1.60	1.00	1.00	1.00	1.300	1.00	1.00	1.15	0.86	1,363.8	2,152.8	0.41	74.2	288.0
+0.60D+0.60W					1.00	1.00	1.00	1.300	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 8.0 ft	1	0.434	0.182	1.60	1.00	1.00	1.00	1.300	1.00	1.00	1.15	0.59	934.5	2,152.8	0.29	52.5	288.0
+0.60D					1.00	1.00	1.00	1.300	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 8.0 ft	1	0.145	0.058	1.60	1.00	1.00	1.00	1.300	1.00	1.00	1.15	0.20	312.2	2,152.8	0.09	16.8	288.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750S+0.450W	1	0.3155	4.029		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.430	0.430
Max Upward from Load Combinations	0.430	0.430
Max Upward from Load Cases	0.327	0.327
D Only	0.164	0.164
+D+S	0.322	0.322
+D+0.750S	0.283	0.283
+D+0.60W	0.360	0.360
+D+0.450W	0.311	0.311
+D+0.750S+0.450W	0.430	0.430
+0.60D+0.60W	0.294	0.294
+0.60D	0.098	0.098
S Only	0.158	0.158
W Only	0.327	0.327

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 21 NOV 2023, 2:56PM

Wood Beam

Project File: P-2869-23 - Grant Union HS HVAC.ec6

LIC# : KW-06014690, Build:20.23.08.30 ZCS, INC. (c) ENERCALC INC 1983-2023

DESCRIPTION: (E) 2x8 RAFTER w/ HALF RTU WL+Z

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : ASCE 7-16

Wood Species : Douglas Fir - Larch
Wood Grade : No.2

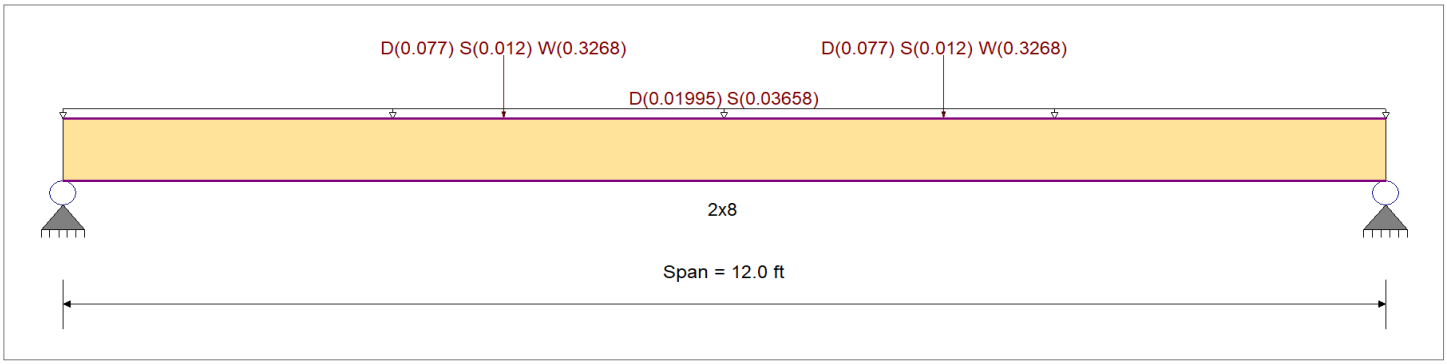
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	900.0 psi
Fb -	900.0 psi
Fc - Prll	1,350.0 psi
Fc - Perp	625.0 psi
Fv	180.0 psi
Ft	575.0 psi

E : Modulus of Elasticity

Ebend- xx	1,600.0 ksi
Eminbend - xx	580.0 ksi
Density	31.210 pcf

Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loading
Loads on all spans...
Uniform Load on ALL spans : D = 0.0150, S = 0.02750 ksf, Tributary Width = 1.330 ft
Point Load : D = 0.0770, S = 0.0120, W = 0.3268 k @ 4.0 ft, (HALF RTU WL+Z)
Point Load : D = 0.0770, S = 0.0120, W = 0.3268 k @ 8.0 ft, (HALF RTU WL+Z)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.905 : 1	Maximum Shear Stress Ratio	=	0.272 : 1
Section used for this span		2x8	Section used for this span		2x8
fb: Actual	=	1,292.98 psi	fv: Actual	=	56.38 psi
F'b	=	1,428.30 psi	F'v	=	207.00 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	6.000 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.457 in	Ratio =	315	>=240	Span: 1 : W Only
Max Upward Transient Deflection	0 in	Ratio =	0	<240	n/a
Max Downward Total Deflection	0.632 in	Ratio =	227	>=180	Span: 1 : +D+0.750S+0.450W
Max Upward Total Deflection	0 in	Ratio =	0	<180	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios										Moment Values			Shear Values		
Segment Length	Span #	M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	M	fb	F'b	V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.580	0.169	0.90	1.00	1.00	1.00	1.200	1.00	1.00	1.15	0.71	647.9	1,117.8	0.20	27.3	162.0
+D+S					1.00	1.00	1.00	1.200	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.905	0.272	1.15	1.00	1.00	1.00	1.200	1.00	1.00	1.15	1.42	1,293.0	1,428.3	0.41	56.4	207.0
+D+0.750S					1.00	1.00	1.00	1.200	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.792	0.237	1.15	1.00	1.00	1.00	1.200	1.00	1.00	1.15	1.24	1,131.7	1,428.3	0.36	49.1	207.0
+D+0.60W					1.00	1.00	1.00	1.200	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.686	0.189	1.60	1.00	1.00	1.00	1.200	1.00	1.00	1.15	1.49	1,364.2	1,987.2	0.39	54.4	288.0

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 21 NOV 2023, 2:56PM

Wood Beam

Project File: P-2869-23 - Grant Union HS HVAC.ec6

DESCRIPTION: (E) 2x8 RAFTER w/ HALF RTU WL+Z

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
+D+0.450W					1.00	1.00	1.00	1.200	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.596	0.165	1.60	1.00	1.00	1.00	1.200	1.00	1.00	1.15	1.30	1,185.1	1,987.2	0.35	47.6	288.0
+D+0.750S+0.450W					1.00	1.00	1.00	1.200	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.840	0.241	1.60	1.00	1.00	1.00	1.200	1.00	1.00	1.15	1.83	1,668.9	1,987.2	0.50	69.4	288.0
+0.60D+0.60W					1.00	1.00	1.00	1.200	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.556	0.151	1.60	1.00	1.00	1.00	1.200	1.00	1.00	1.15	1.21	1,105.0	1,987.2	0.31	43.4	288.0
+0.60D					1.00	1.00	1.00	1.200	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.196	0.057	1.60	1.00	1.00	1.00	1.200	1.00	1.00	1.15	0.43	388.8	1,987.2	0.12	16.4	288.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750S+0.450W	1	0.6322	6.044		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.531	0.531
Max Upward from Load Combinations	0.531	0.531
Max Upward from Load Cases	0.327	0.327
D Only	0.211	0.211
+D+S	0.442	0.442
+D+0.750S	0.384	0.384
+D+0.60W	0.407	0.407
+D+0.450W	0.358	0.358
+D+0.750S+0.450W	0.531	0.531
+0.60D+0.60W	0.323	0.323
+0.60D	0.127	0.127
S Only	0.231	0.231
W Only	0.327	0.327

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 2 MAR 2024, 10:26PM

Wood Beam

Project File: p-2869-23 - grant union hs hvac.ec6

DESCRIPTION: (E) 2x10 RAFTER w/ HALF RTU WL+Z

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : ASCE 7-16

Wood Species : Douglas Fir - Larch
Wood Grade : No.2

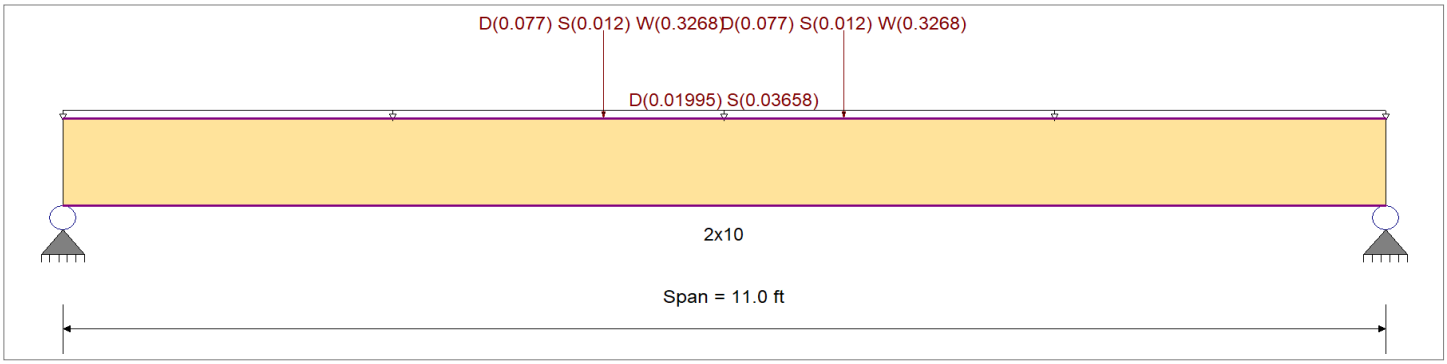
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	900.0 psi
Fb -	900.0 psi
Fc - Prll	1,350.0 psi
Fc - Perp	625.0 psi
Fv	180.0 psi
Ft	575.0 psi

E : Modulus of Elasticity

Ebend- xx	1,600.0 ksi
Eminbend - xx	580.0 ksi
Density	31.210 pcf

Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loading
Loads on all spans...
Uniform Load on ALL spans : D = 0.0150, S = 0.02750 ksf, Tributary Width = 1.330 ft
Point Load : D = 0.0770, S = 0.0120, W = 0.3268 k @ 4.50 ft, (HALF RTU WL+Z)
Point Load : D = 0.0770, S = 0.0120, W = 0.3268 k @ 6.50 ft, (HALF RTU WL+Z)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.558 : 1	Maximum Shear Stress Ratio	=	0.194 : 1
Section used for this span		2x10	Section used for this span		2x10
fb: Actual	=	1,015.90 psi	fv: Actual	=	40.11 psi
F'b	=	1,821.60 psi	F'v	=	207.00 psi
Load Combination		+D+0.750S+0.450W	Load Combination		+D+S
Location of maximum on span	=	5.500 ft	Location of maximum on span	=	10.237 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.190 in	Ratio =	695	>=240	Span: 1 : W Only
Max Upward Transient Deflection	0 in	Ratio =	0	<240	n/a
Max Downward Total Deflection	0.241 in	Ratio =	548	>=180	Span: 1 : +D+0.750S+0.450W
Max Upward Total Deflection	0 in	Ratio =	0	<180	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios										Moment Values			Shear Values		
Segment Length	Span #	M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	M	fb	F'b	V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 11.0 ft	1	0.380	0.124	0.90	1.00	1.00	1.00	1.100	1.00	1.00	1.15	0.69	389.2	1,024.7	0.19	20.1	162.0
+D+S					1.00	1.00	1.00	1.100	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 11.0 ft	1	0.557	0.194	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.15	1.30	729.8	1,309.3	0.37	40.1	207.0
+D+0.750S					1.00	1.00	1.00	1.100	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 11.0 ft	1	0.492	0.170	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.15	1.15	644.7	1,309.3	0.32	35.1	207.0
+D+0.60W					1.00	1.00	1.00	1.100	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 11.0 ft	1	0.485	0.143	1.60	1.00	1.00	1.00	1.100	1.00	1.00	1.15	1.58	884.2	1,821.6	0.38	41.3	288.0

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 2 MAR 2024, 10:26PM

Wood Beam

Project File: p-2869-23 - grant union hs hvac.ec6

DESCRIPTION: (E) 2x10 RAFTER w/ HALF RTU WL+Z

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
+D+0.450W					1.00	1.00	1.00	1.100	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 11.0 ft	1	0.417	0.125	1.60	1.00	1.00	1.00	1.100	1.00	1.00	1.15	1.36	760.4	1,821.6	0.33	36.0	288.0
+D+0.750S+0.450W					1.00	1.00	1.00	1.100	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 11.0 ft	1	0.558	0.177	1.60	1.00	1.00	1.00	1.100	1.00	1.00	1.15	1.81	1,015.9	1,821.6	0.47	51.0	288.0
+0.60D+0.60W					1.00	1.00	1.00	1.100	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 11.0 ft	1	0.400	0.115	1.60	1.00	1.00	1.00	1.100	1.00	1.00	1.15	1.30	728.5	1,821.6	0.31	33.2	288.0
+0.60D					1.00	1.00	1.00	1.100	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 11.0 ft	1	0.128	0.042	1.60	1.00	1.00	1.00	1.100	1.00	1.00	1.15	0.42	233.5	1,821.6	0.11	12.0	288.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750S+0.450W	1	0.2407	5.540		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.510	0.510
Max Upward from Load Combinations	0.510	0.510
Max Upward from Load Cases	0.327	0.327
D Only	0.203	0.203
+D+S	0.416	0.416
+D+0.750S	0.363	0.363
+D+0.60W	0.399	0.399
+D+0.450W	0.350	0.350
+D+0.750S+0.450W	0.510	0.510
+0.60D+0.60W	0.318	0.318
+0.60D	0.122	0.122
S Only	0.213	0.213
W Only	0.327	0.327

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 2 MAR 2024, 10:37PM

Wood Beam

Project File: p-2869-23 - grant union hs hvac.ec6

DESCRIPTION: (E) 7-1/2x16 GLB w/ RTU WL+Z-Z

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : ASCE 7-16

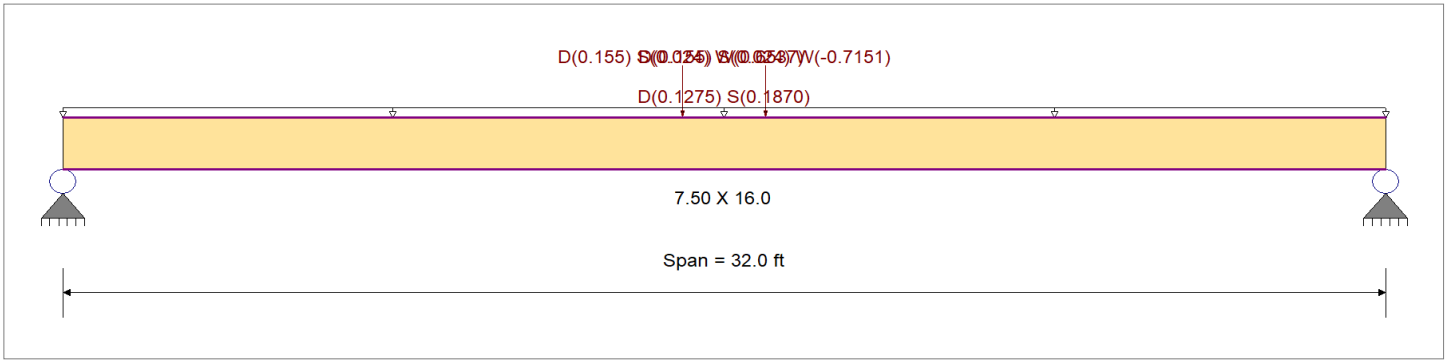
Wood Species : DF/DF
Wood Grade : 24F - V4

Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	1,800.0 psi
Fb -	1,850.0 psi
Fc - Prll	1,650.0 psi
Fc - Perp	650.0 psi
Fv	265.0 psi
Ft	1,100.0 psi

E : Modulus of Elasticity

Ebend- xx	1,800.0 ksi
Eminbend - xx	930.0 ksi
Ebend- yy	1,600.0 ksi
Eminbend - yy	830.0 ksi
Density	31.210 pcf



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loading
Loads on all spans...
Uniform Load on ALL spans : D = 0.0150, S = 0.0220 ksf, Tributary Width = 8.50 ft
Point Load : D = 0.1550, S = 0.0240, W = 0.6537 k @ 15.0 ft, (RTU WL+Z)
Point Load : D = 0.1550, S = 0.0240, W = -0.7151 k @ 17.0 ft, (RTU WL-Z)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.838 : 1	Maximum Shear Stress Ratio	=	0.213 : 1
Section used for this span		7.50 X 16.0	Section used for this span		7.50 X 16.0
fb: Actual	=	1,735.13 psi	fv: Actual	=	64.87 psi
F'b	=	2,070.00 psi	F'v	=	304.75 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	16.000 ft	Location of maximum on span	=	30.715 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.975 in	Ratio =	393 >=240	Span: 1 : S Only
Max Upward Transient Deflection	-0.018 in	Ratio =	21398 >=240	Span: 1 : W Only
Max Downward Total Deflection	1.845 in	Ratio =	208 >=180	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <180	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 32.0 ft	1	0.509	0.127	0.90	1.00	1.00	1.00	1.000	1.00	1.00	1.00	21.97	824.0	1,620.0	2.41	30.2	238.5
+D+S					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 32.0 ft	1	0.838	0.213	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.00	46.27	1,735.1	2,070.0	5.19	64.9	304.8
+D+0.750S					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 32.0 ft	1	0.728	0.184	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.00	40.20	1,507.4	2,070.0	4.50	56.2	304.8
+D+0.60W					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 32.0 ft	1	0.286	0.071	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	21.99	824.6	2,880.0	2.42	30.3	424.0

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 2 MAR 2024, 10:37PM

Wood Beam

Project File: p-2869-23 - grant union hs hvac.ec6

DESCRIPTION: (E) 7-1/2x16 GLB w/ RTU WL+Z-Z

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
+D+0.450W					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 32.0 ft	1	0.286	0.071	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	21.97	823.9	2,880.0	2.42	30.2	424.0
+D+0.750S+0.450W					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 32.0 ft	1	0.523	0.133	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	40.13	1,504.9	2,880.0	4.50	56.3	424.0
+0.60D+0.60W					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 32.0 ft	1	0.172	0.043	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	13.24	496.4	2,880.0	1.46	18.2	424.0
+0.60D					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 32.0 ft	1	0.172	0.043	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	13.18	494.4	2,880.0	1.45	18.1	424.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	1.8452	16.117		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	5.627	5.627
Max Upward from Load Combinations	5.627	5.627
Max Upward from Load Cases	3.016	3.016
Max Downward from all Load Conditio		-0.073
Max Downward from Load Cases (Resis		-0.073
D Only	2.611	2.611
+D+S	5.627	5.627
+D+0.750S	4.873	4.873
+D+0.60W	2.618	2.567
+D+0.450W	2.617	2.578
+D+0.750S+0.450W	4.879	4.840
+0.60D+0.60W	1.574	1.523
+0.60D	1.567	1.567
S Only	3.016	3.016
W Only	0.012	-0.073

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 2 MAR 2024, 10:38PM

Wood Beam

Project File: p-2869-23 - grant union hs hvac.ec6

DESCRIPTION: (E) 5-1/4x35-3/8 GLB w/ RTU WL+Z-Z

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : ASCE 7-16

Wood Species : DF/DF
Wood Grade : 24F - V4

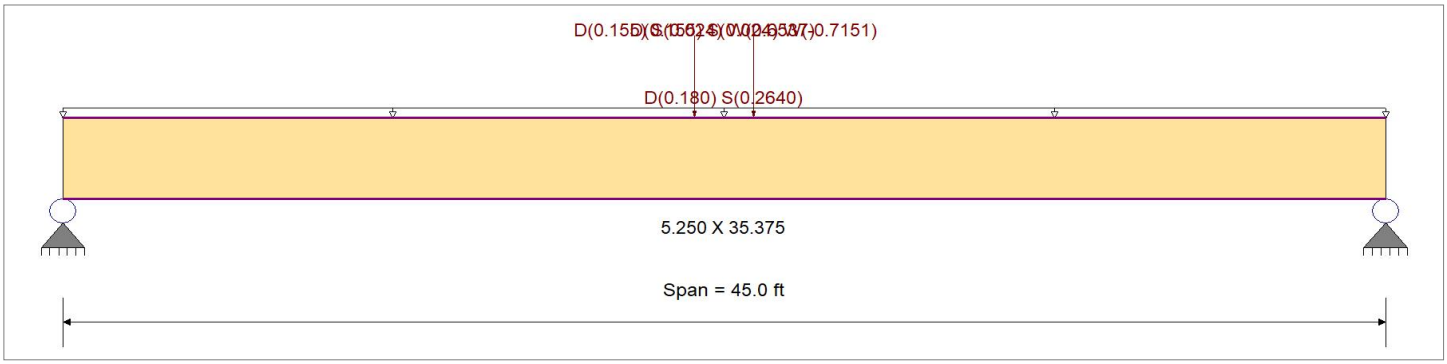
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	1,800.0 psi
Fb -	1,850.0 psi
Fc - Prll	1,650.0 psi
Fc - Perp	650.0 psi
Fv	265.0 psi
Ft	1,100.0 psi

E : Modulus of Elasticity

Ebend- xx	1,800.0 ksi
Eminbend - xx	930.0 ksi
Ebend- yy	1,600.0 ksi
Eminbend - yy	830.0 ksi
Density	31.210 pcf

Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loading
Loads on all spans...
Uniform Load on ALL spans : D = 0.0150, S = 0.0220 ksf, Tributary Width = 12.0 ft
Point Load : D = 0.1550, S = 0.0240, W = 0.6537 k @ 21.50 ft, (RTU WL+Z)
Point Load : D = 0.1550, S = 0.0240, W = -0.7151 k @ 23.50 ft, (RTU WL-Z)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.669 : 1	Maximum Shear Stress Ratio	=	0.258 : 1
Section used for this span		5.250 X 35.375	Section used for this span		5.250 X 35.375
fb: Actual	=	1,385.52 psi	fv: Actual	=	78.53 psi
F'b	=	2,070.00 psi	F'v	=	304.75 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	22.500 ft	Location of maximum on span	=	42.208 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.707 in	Ratio =	763 >=240	Span: 1 : S Only
Max Upward Transient Deflection	-0.006 in	Ratio =	85913 >=240	Span: 1 : W Only
Max Downward Total Deflection	1.323 in	Ratio =	408 >=180	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <180	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios										Moment Values			Shear Values		
Segment Length	Span #	M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	M	fb	F'b	V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 45.0 ft	1	0.400	0.152	0.90	1.00	1.00	1.00	1.000	1.00	1.00	1.00	59.08	647.5	1,620.0	4.50	36.3	238.5
+D+S					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 45.0 ft	1	0.669	0.258	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.00	126.42	1,385.5	2,070.0	9.72	78.5	304.8
+D+0.750S					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 45.0 ft	1	0.580	0.223	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.00	109.59	1,201.0	2,070.0	8.42	68.0	304.8
+D+0.60W					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 45.0 ft	1	0.224	0.086	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	58.97	646.2	2,880.0	4.50	36.3	424.0

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 2 MAR 2024, 10:38PM

Wood Beam

Project File: p-2869-23 - grant union hs hvac.ec6

DESCRIPTION: (E) 5-1/4x35-3/8 GLB w/ RTU WL+Z-Z

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
+D+0.450W					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 45.0 ft	1	0.224	0.086	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	58.97	646.3	2,880.0	4.50	36.3	424.0
+D+0.750S+0.450W					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 45.0 ft	1	0.416	0.160	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	109.40	1,198.9	2,880.0	8.42	68.0	424.0
+0.60D+0.60W					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 45.0 ft	1	0.135	0.051	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	35.38	387.7	2,880.0	2.70	21.8	424.0
+0.60D					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 45.0 ft	1	0.135	0.051	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	35.45	388.5	2,880.0	2.70	21.8	424.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	1.3229	22.664		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	11.075	11.075
Max Upward from Load Combinations	11.075	11.075
Max Upward from Load Cases	5.964	5.964
Max Downward from all Load Conditio	-0.000	-0.061
Max Downward from Load Cases (Resis	-0.000	-0.061
D Only	5.111	5.111
+D+S	11.075	11.075
+D+0.750S	9.584	9.584
+D+0.60W	5.110	5.074
+D+0.450W	5.111	5.083
+D+0.750S+0.450W	9.584	9.556
+0.60D+0.60W	3.066	3.030
+0.60D	3.066	3.066
S Only	5.964	5.964
W Only	-0.000	-0.061

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 2 MAR 2024, 10:36PM

Wood Beam

Project File: p-2869-23 - grant union hs hvac.ec6

DESCRIPTION: (E) 5-1/8x21 GLB w/ RTU WL+Z-Z

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : ASCE 7-16

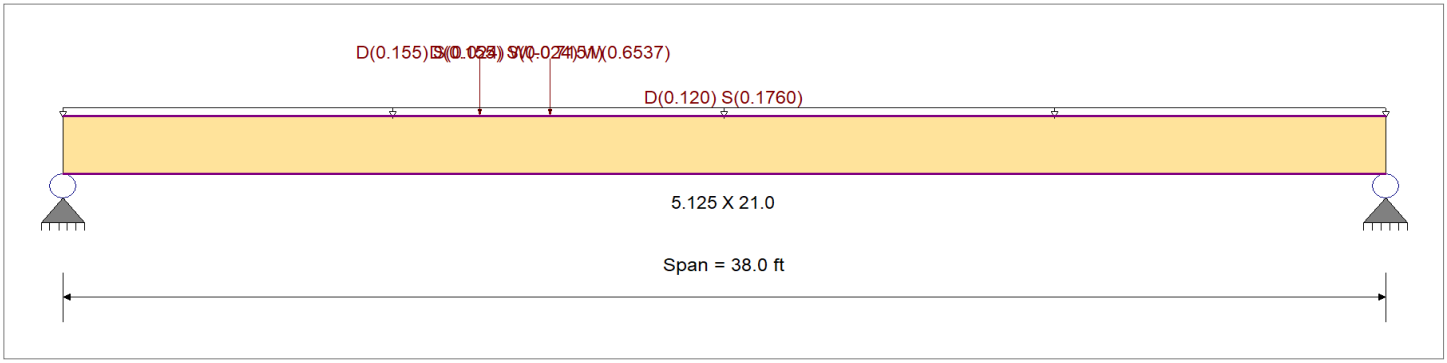
Wood Species : DF/DF
Wood Grade : 24F - V4

Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	1,800.0 psi
Fb -	1,850.0 psi
Fc - Prll	1,650.0 psi
Fc - Perp	650.0 psi
Fv	265.0 psi
Ft	1,100.0 psi

E : Modulus of Elasticity

Ebend- xx	1,800.0 ksi
Eminbend - xx	930.0 ksi
Ebend- yy	1,600.0 ksi
Eminbend - yy	830.0 ksi
Density	31.210 pcf



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loading
Loads on all spans...
Uniform Load on ALL spans : D = 0.0150, S = 0.0220 ksf, Tributary Width = 8.0 ft
Point Load : D = 0.1550, S = 0.0240, W = 0.6537 k @ 14.0 ft, (RTU WL+Z)
Point Load : D = 0.1550, S = 0.0240, W = -0.7151 k @ 12.0 ft, (RTU WL-Z)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.923 : 1	Maximum Shear Stress Ratio	=	0.264 : 1
Section used for this span		5.125 X 21.0	Section used for this span		5.125 X 21.0
fb: Actual	=	1,911.04 psi	fv: Actual	=	80.44 psi
F'b	=	2,070.00 psi	F'v	=	304.75 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	18.584 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	1.178 in	Ratio =	387 >=240	Span: 1 : S Only
Max Upward Transient Deflection	-0.004 in	Ratio =	110216 >=240	Span: 1 : W Only
Max Downward Total Deflection	2.203 in	Ratio =	206 >=180	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <180	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 38.0 ft	1	0.549	0.157	0.90	1.00	1.00	1.00	1.000	1.00	1.00	1.00	27.92	889.6	1,620.0	2.69	37.5	238.5
+D+S					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 38.0 ft	1	0.923	0.264	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.00	59.99	1,911.0	2,070.0	5.77	80.4	304.8
+D+0.750S					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 38.0 ft	1	0.800	0.229	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.00	51.97	1,655.6	2,070.0	5.00	69.7	304.8
+D+0.60W					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 38.0 ft	1	0.311	0.087	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	28.10	895.3	2,880.0	2.64	36.8	424.0

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 2 MAR 2024, 10:36PM

Wood Beam

Project File: p-2869-23 - grant union hs hvac.ec6

DESCRIPTION: (E) 5-1/8x21 GLB w/ RTU WL+Z-Z

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
+D+0.450W					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 38.0 ft	1	0.310	0.087	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	28.06	893.8	2,880.0	2.65	37.0	424.0
+D+0.750S+0.450W					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 38.0 ft	1	0.576	0.163	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	52.10	1,659.8	2,880.0	4.97	69.2	424.0
+0.60D+0.60W					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 38.0 ft	1	0.187	0.052	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	16.93	539.4	2,880.0	1.57	21.8	424.0
+0.60D					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 38.0 ft	1	0.185	0.053	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	16.75	533.7	2,880.0	1.61	22.5	424.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	2.2030	19.000		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	6.303	6.190
Max Upward from Load Combinations	6.303	6.190
Max Upward from Load Cases	3.376	3.360
Max Downward from all Load Conditio	-0.076	
Max Downward from Load Cases (Resis	-0.076	
D Only	2.927	2.829
+D+S	6.303	6.190
+D+0.750S	5.459	5.350
+D+0.60W	2.881	2.838
+D+0.450W	2.893	2.836
+D+0.750S+0.450W	5.424	5.356
+0.60D+0.60W	1.710	1.707
+0.60D	1.756	1.698
S Only	3.376	3.360
W Only	-0.076	0.015

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 2 MAR 2024, 10:31PM

Wood Beam

Project File: p-2869-23 - grant union hs hvac.ec6

DESCRIPTION: (N) 6x6 RAFTER w/ RTU WL+Z-Z - PERP

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : ASCE 7-16

Wood Species : Douglas Fir - Larch
Wood Grade : No.2

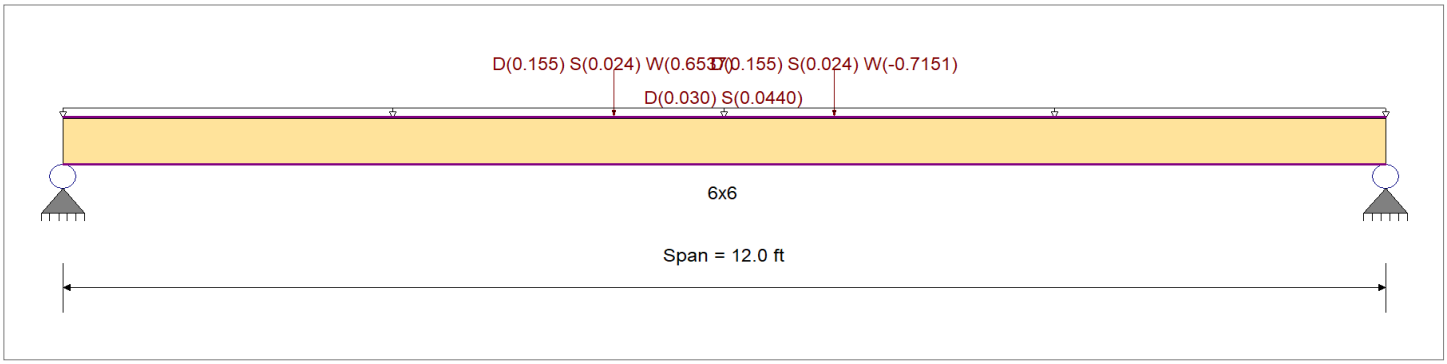
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	900.0 psi
Fb -	900.0 psi
Fc - Prll	1,350.0 psi
Fc - Perp	625.0 psi
Fv	180.0 psi
Ft	575.0 psi

E : Modulus of Elasticity

Ebend- xx	1,600.0 ksi
Eminbend - xx	580.0 ksi
Density	31.210 pcf

Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loading
Loads on all spans...
Uniform Load on ALL spans : D = 0.0150, S = 0.0220 ksf, Tributary Width = 2.0 ft
Point Load : D = 0.1550, S = 0.0240, W = 0.6537 k @ 5.0 ft, (RTU WL+Z)
Point Load : D = 0.1550, S = 0.0240, W = -0.7151 k @ 7.0 ft, (RTU WL-Z)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.853 : 1	Maximum Shear Stress Ratio	=	0.150 : 1
Section used for this span		6x6	Section used for this span		6x6
fb: Actual	=	1,014.82 psi	fv: Actual	=	31.09 psi
F'b	=	1,190.25 psi	F'v	=	207.00 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	6.000 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.193 in	Ratio =	746 >=240	Span: 1 : S Only
Max Upward Transient Deflection	-0.046 in	Ratio =	3113 >=240	Span: 1 : W Only
Max Downward Total Deflection	0.486 in	Ratio =	296 >=180	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <180	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios										Moment Values			Shear Values		
Segment Length	Span #	M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	M	fb	F'b	V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.666	0.110	0.90	1.00	1.00	1.00	1.000	1.00	1.00	1.15	1.43	620.1	931.5	0.36	17.8	162.0
+D+S					1.00	1.00	1.00	1.000	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.853	0.150	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.15	2.35	1,014.8	1,190.3	0.63	31.1	207.0
+D+0.750S					1.00	1.00	1.00	1.000	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.770	0.134	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.15	2.12	916.2	1,190.3	0.56	27.8	207.0
+D+0.60W					1.00	1.00	1.00	1.000	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.435	0.070	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.15	1.66	719.7	1,656.0	0.41	20.2	288.0

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 2 MAR 2024, 10:31PM

Wood Beam

Project File: p-2869-23 - grant union hs hvac.ec6

DESCRIPTION: (N) 6x6 RAFTER w/ RTU WL+Z-Z - PERP

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
+D+0.450W					1.00	1.00	1.00	1.000	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.418	0.068	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.15	1.60	692.7	1,656.0	0.40	19.6	288.0
+D+0.750S+0.450W					1.00	1.00	1.00	1.000	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.593	0.103	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.15	2.27	981.4	1,656.0	0.60	29.6	288.0
+0.60D+0.60W					1.00	1.00	1.00	1.000	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.287	0.063	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.15	1.10	475.1	1,656.0	0.36	18.0	288.0
+0.60D					1.00	1.00	1.00	1.000	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.225	0.037	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.15	0.86	372.1	1,656.0	0.21	10.7	288.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.4862	6.044		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.662	0.662
Max Upward from Load Combinations	0.662	0.662
Max Upward from Load Cases	0.374	0.374
Max Downward from all Load Conditio		-0.145
Max Downward from Load Cases (Resis		-0.145
D Only	0.374	0.374
+D+S	0.662	0.662
+D+0.750S	0.590	0.590
+D+0.60W	0.424	0.287
+D+0.450W	0.412	0.309
+D+0.750S+0.450W	0.628	0.525
+0.60D+0.60W	0.275	0.138
+0.60D	0.225	0.225
S Only	0.288	0.288
W Only	0.083	-0.145

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 2 MAR 2024, 10:32PM

Wood Beam

Project File: p-2869-23 - grant union hs hvac.ec6

DESCRIPTION: (N) 6x6 RAFTER w/ RTU WL+Z - PARA

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : ASCE 7-16

Wood Species : Douglas Fir - Larch
Wood Grade : No.2

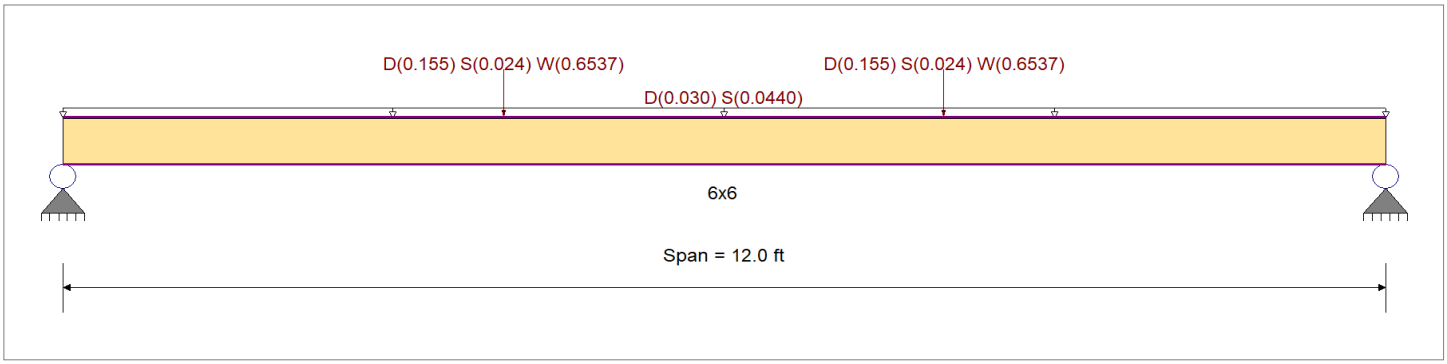
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	900.0 psi
Fb -	900.0 psi
Fc - Prll	1,350.0 psi
Fc - Perp	625.0 psi
Fv	180.0 psi
Ft	575.0 psi

E : Modulus of Elasticity

Ebend- xx	1,600.0 ksi
Eminbend - xx	580.0 ksi
Density	31.210 pcf

Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loading
Loads on all spans...
Uniform Load on ALL spans : D = 0.0150, S = 0.0220 ksf, Tributary Width = 2.0 ft
Point Load : D = 0.1550, S = 0.0240, W = 0.6537 k @ 4.0 ft, (RTU WL+Z)
Point Load : D = 0.1550, S = 0.0240, W = 0.6537 k @ 8.0 ft, (RTU WL+Z)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.816 : 1	Maximum Shear Stress Ratio	=	0.150 : 1
Section used for this span		6x6	Section used for this span		6x6
fb: Actual	=	1,350.49 psi	fv: Actual	=	31.09 psi
F'b	=	1,656.00 psi	F'v	=	207.00 psi
Load Combination		+D+0.750S+0.450W	Load Combination		+D+S
Location of maximum on span	=	6.000 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.571 in	Ratio =	252 >=240	Span: 1 : W Only
Max Upward Transient Deflection	0 in	Ratio =	0 <240	n/a
Max Downward Total Deflection	0.676 in	Ratio =	213 >=180	Span: 1 : +D+0.750S+0.450W
Max Upward Total Deflection	0 in	Ratio =	0 <180	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.594	0.110	0.90	1.00	1.00	1.00	1.000	1.00	1.00	1.15	1.28	553.1	931.5	0.36	17.8	162.0
+D+S					1.00	1.00	1.00	1.000	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.788	0.150	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.15	2.17	937.4	1,190.3	0.63	31.1	207.0
+D+0.750S					1.00	1.00	1.00	1.000	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.707	0.134	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.15	1.94	841.3	1,190.3	0.56	27.8	207.0
+D+0.60W					1.00	1.00	1.00	1.000	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.744	0.129	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.15	2.85	1,232.0	1,656.0	0.75	37.2	288.0

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 2 MAR 2024, 10:32PM

Wood Beam

Project File: p-2869-23 - grant union hs hvac.ec6

DESCRIPTION: (N) 6x6 RAFTER w/ RTU WL+Z - PARA

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
+D+0.450W					1.00	1.00	1.00	1.000	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.641	0.112	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.15	2.45	1,062.3	1,656.0	0.65	32.4	288.0
+D+0.750S+0.450W					1.00	1.00	1.00	1.000	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.816	0.147	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.15	3.12	1,350.5	1,656.0	0.85	42.3	288.0
+0.60D+0.60W					1.00	1.00	1.00	1.000	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.610	0.105	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.15	2.34	1,010.8	1,656.0	0.61	30.1	288.0
+0.60D					1.00	1.00	1.00	1.000	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.200	0.037	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.15	0.77	331.8	1,656.0	0.21	10.7	288.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750S+0.450W	1	0.6757	6.044		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.885	0.885
Max Upward from Load Combinations	0.885	0.885
Max Upward from Load Cases	0.654	0.654
D Only	0.374	0.374
+D+S	0.662	0.662
+D+0.750S	0.590	0.590
+D+0.60W	0.767	0.767
+D+0.450W	0.669	0.669
+D+0.750S+0.450W	0.885	0.885
+0.60D+0.60W	0.617	0.617
+0.60D	0.225	0.225
S Only	0.288	0.288
W Only	0.654	0.654

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 17 AUG 2023, 10:22AM

Wood Beam

Project File: P-2869-23 - Grant Union HS HVAC.ec6

DESCRIPTION: (N) 4x8 HDR

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : ASCE 7-16

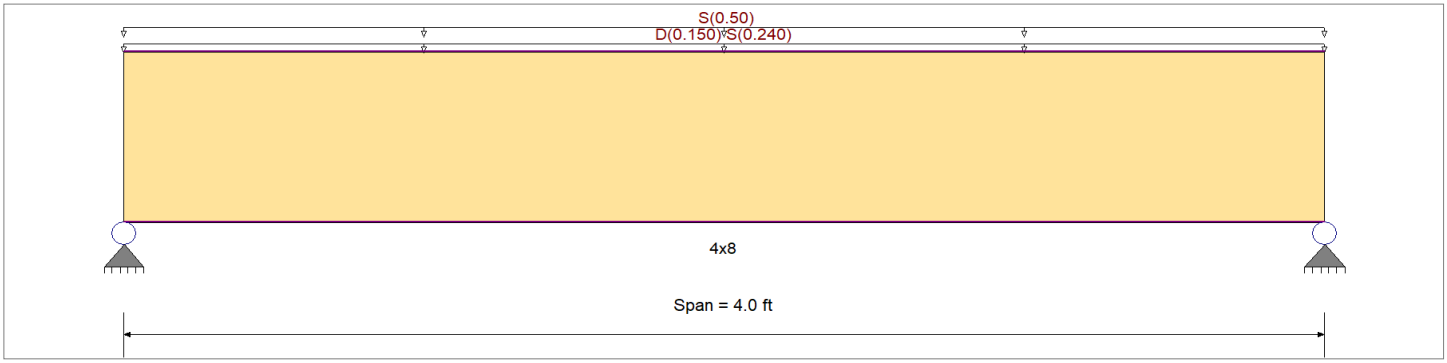
Wood Species : Douglas Fir - Larch
Wood Grade : No.2

Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	900 psi
Fb -	900 psi
Fc - Prll	1350 psi
Fc - Perp	625 psi
Fv	180 psi
Ft	575 psi

E : Modulus of Elasticity

Ebend- xx	1600 ksi
Eminbend - xx	580 ksi
Density	31.21 pcf



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Loads on all spans...
Uniform Load on ALL spans : D = 0.0150, S = 0.0240 ksf, Tributary Width = 10.0 ft
Uniform Load on ALL spans : S = 0.050 ksf, Tributary Width = 10.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.518 : 1	Maximum Shear Stress Ratio	=	0.356 : 1
Section used for this span		4x8	Section used for this span		4x8
fb: Actual	=	696.64 psi	fv: Actual	=	73.73 psi
F'b	=	1,345.50 psi	F'v	=	207.00 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	2.000 ft	Location of maximum on span	=	3.401 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.024 in	Ratio =	1991 >=240	Span: 1 : S Only
Max Upward Transient Deflection	0 in	Ratio =	0 <240	n/a
Max Downward Total Deflection	0.029 in	Ratio =	1655 >=180	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <180	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 4.0 ft	1	0.112	0.077	0.90	1.00	1.00	1.00	1.300	1.00	1.00	1.00	0.30	117.4	1,053.0	0.21	12.4	162.0
+D+S					1.00	1.00	1.00	1.300	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 4.0 ft	1	0.518	0.356	1.15	1.00	1.00	1.00	1.300	1.00	1.00	1.00	1.78	696.6	1,345.5	1.25	73.7	207.0
+D+0.750S					1.00	1.00	1.00	1.300	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 4.0 ft	1	0.410	0.282	1.15	1.00	1.00	1.00	1.300	1.00	1.00	1.00	1.41	551.8	1,345.5	0.99	58.4	207.0
+0.60D					1.00	1.00	1.00	1.300	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 4.0 ft	1	0.038	0.026	1.60	1.00	1.00	1.00	1.300	1.00	1.00	1.00	0.18	70.4	1,872.0	0.13	7.5	288.0

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 17 AUG 2023, 10:22AM

Wood Beam

Project File: P-2869-23 - Grant Union HS HVAC.ec6

DESCRIPTION: (N) 4x8 HDR

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.0290	2.015		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	1.780	1.780
Max Upward from Load Combinations	1.780	1.780
Max Upward from Load Cases	1.480	1.480
D Only	0.300	0.300
+D+S	1.780	1.780
+D+0.750S	1.410	1.410
+0.60D	0.180	0.180
S Only	1.480	1.480

ZCS	**PROJECT:** Grant Union HS HVAC	**PROJECT #:** P-2869-23
	CLIENT: Grant County School District	
	DATE: 3/7/2024 **VERSION:** 3.05	**DESIGNED BY:** BLD

WIND LOADS C&C

Building Data

Structure Type:	Buildings: Main Wind Force Resisting System	
Enclosure Classification:	Enclosed Buildings	
Exposure Category:	C	
Mean Roof Height:	20.00	ft
Design Roof Angle	2.39	°
Site Elevation	3,140	ft

Velocity Pressure & Internal Pressure Coefficient

Velocity Pressure Exposure Coefficient (K_z)	K_z =	0.900		Table 26.10-1
Topographic Factor (K_{zt})	K_{zt} =	1.000		Figure 26.8-1
Wind Directionality Factor (K_d)	K_d =	0.850		Table 26.6-1
Wind Elevation Factor (K_e)	K_e =	0.893		Table 26.9-1
Basic Wind Speed (V)	V =	108	mph	26.5.1
Velocity Pressure (q_z)	q_z =	20.39	psf	26.10.2
Internal Pressure Coefficients (GC_{pi})	GC_{pi} =	0.18		Table 26.13-1

External Pressure Coefficients & Wall Pressures

Area (ft^2)	Wall (GC_p)				Wall Pressure (psf)				Max Pressure (psf)
	4		5		4		5		
	+	-	+	-	+	-	+	-	
30.00	0.82	-0.91	0.82	-1.11	20.47	-22.31	20.47	26.27	**26.27**

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 4 MAR 2024, 3:25PM

Wood Column

Project File: p-2869-23 - grant union hs hvac.ec6

DESCRIPTION: (2) 2x6 King Stud

Code References

Calculations per NDS 2018, IBC 2021, ASCE 7-16
Load Combinations Used : ASCE 7-16

General Information

Analysis Method	Allowable Stress Design		
End Fixities	Top & Bottom Pinned		
Overall Column Height	20 ft		
(Used for non-slender calculations)			
Wood Species	Douglas Fir-Larch		
Wood Grade	No.2		
Fb +	900.0 psi	Fv	180.0 psi
Fb -	900.0 psi	Ft	575.0 psi
Fc - Prll	1,350.0 psi	Density	31.210 pcf
Fc - Perp	625.0 psi		

Wood Section Name	**2-2x6**	
Wood Grading/Manuf.	Graded Lumber	
Wood Member Type	Sawn	
Exact Width	**3.0** in	Allow Stress Modification Factors
Exact Depth	**5.50** in	
Area	16.50 in^2	Cf or Cv for Bending 1.30
Ix	41.594 in^4	Cf or Cv for Compressio 1.10
Iy	12.375 in^4	Cf or Cv for Tension 1.30
		Cm : Wet Use Factor 1.0
		Ct : Temperature Fact 1.0
		Cfu : Flat Use Factor 1.0
		Kf : Built-up columns 1.0
		Use Cr : Repetitive ? No

E : Modulus of Elasticity . . .

	x-x Bending	y-y Bending	Axial
Basic	1,600.0	1,600.0	1,600.0 ksi
Minimum	580.0	580.0	

Column Buckling Condition:
ABOUT X-X Axis: Lux = 20 ft, Kx = 1.0
Fully braced against buckling ABOUT Y-Y Axis

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Column self weight included : 71.523 lbs * Dead Load Factor
BENDING LOADS . . .
WIND: Lat. Uniform Load creating Mx-x, W = 0.04290 k/ft

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio = **0.5664 : 1**

Load Combination	+D+0.60W
Governing NDS Forumla	Comp + Mxx, NDS Eq. 3.9-3
Location of max.above base	10.067 ft
At maximum location values are .	
Applied Axial	0.07152 k
Applied Mx	1.287 k-ft
Applied My	0.0 k-ft
Fc : Allowable	244.760 psi

PASS Maximum Shear Stress Ratio = **0.08125 : 1**

Load Combination	+D+0.60W
Location of max.above base	20.0 ft
Applied Design Shear	35.10 psi
Allowable Shear	288.0 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.4290 k	Bottom along Y-Y	0.4290 k
Top along X-X	0.0 k	Bottom along X-X	0.0 k

Maximum SERVICE Load Lateral Deflections . . .

Along Y-Y 2.346 in at 10.067 ft above base
for load combination : W Only

Along X-X 0.0 in at 0.0 ft above base
for load combination : n/a

Other Factors used to calculate allowable stresses . . .

	Bending	Compression	Tension

Load Combination Results

Load Combination	C_D	C_P	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
D Only	0.900	0.179	0.01807	PASS	0.0 ft	0.0	PASS	20.0 ft
+D+0.60W	1.600	0.103	0.5664	PASS	10.067 ft	0.08125	PASS	20.0 ft
+D+0.450W	1.600	0.103	0.4249	PASS	9.933 ft	0.06094	PASS	20.0 ft
+0.60D+0.60W	1.600	0.103	0.5622	PASS	10.067 ft	0.08125	PASS	20.0 ft
+0.60D	1.600	0.103	0.01063	PASS	0.0 ft	0.0	PASS	20.0 ft

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction k @ Base	@ Top	Y-Y Axis Reaction @ Base	@ Top	Axial Reaction @ Base	My - End Moments k-ft @ Base	@ Top	Mx - End Moments @ Base	@ Top
D Only					0.072				
+D+0.60W			0.257	0.257	0.072				

Project Title: Grant Union HS HVAC
Engineer:
Project ID: P-2869-23
Project Descr:

Printed: 4 MAR 2024, 3:25PM

Wood Column

Project File: p-2869-23 - grant union hs hvac.ec6

DESCRIPTION: (2) 2x6 King Stud

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction @ Base	@ Top	k	Y-Y Axis Reaction @ Base	@ Top	Axial Reaction @ Base	My - End Moments @ Base	@ Top	k-ft	Mx - End Moments @ Base	@ Top
+D+0.450W				0.193	0.193	0.072					
+0.60D+0.60W				0.257	0.257	0.043					
+0.60D						0.043					
W Only				0.429	0.429						

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
D Only	0.0000 in	0.000ft	0.000 in	0.000 ft
+D+0.60W	0.0000 in	0.000ft	1.407 in	10.067 ft
+D+0.450W	0.0000 in	0.000ft	1.056 in	10.067 ft
+0.60D+0.60W	0.0000 in	0.000ft	1.407 in	10.067 ft
+0.60D	0.0000 in	0.000ft	0.000 in	0.000 ft
W Only	0.0000 in	0.000ft	2.346 in	10.067 ft

Sketches