STRUCTURAL ANALYSIS OF
PROPOSED RESIDENTIAL HOME

14AUG2024

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1 DESIGN CRITERIA:

1.1 DESIGN CODES & REFERENCES

- Phoenix building codes (IBC 2018 with amendments and additions)
- 2018 Edition of the International Building Code with
- The Residential Code for One- and Two-Family Dwellings (IRC 2018 with amendments and additions)
- 2018 Edition of the International Residential Code
- ASCE 7-16
- Steel design: AISC 360-16: LRFD Specification for Structural Steel Buildings
- Cold-formed steel: AISI S100-16w
- Seismic AISC 341-16 Seismic Provisions for Structural Steel Buildings
- Concrete: Reinforced Concrete Design Handbook (ACI)
- Ultimate Strength Design Handbook (ACI)

The calculation performed by SCIA Engineer 20.0

1.2 CODE CRITERIA

2018 IBC

Seismic Design Category:	**B**
Wind Speed:	**115** MPH
Wind Exposure:	**C**
Snow Load (Roof):	**0** psf

1.3 MATERIALS

Hot Rolled Steel Grade

- HOLLOW STRUCTURAL SECTIONS - ASTM A500 Gr.B

Cold-Formed Steel Grade

- ASTM A653 GRADE 33, TYPE H 27-33 mil GALV. STEEL
- ASTM A 913 GRADE 50, TYPE H 43-97 mil GALV. STEEL

1.4 STRUCTURAL LOADS

LIVE LOAD

Floor Live Load	**40.00 psf**
Roof Live Load	**20.00 psf**

DEAD LOAD

Roof Dead Loads

Standing Seam Metal	3 psf
60 mil waterproofing membrane	0.4 psf
1/2” OSB Plywood Sheathing	2 psf
Roof Framing /Roof Rafters	3.4 psf
R-38 Batt Insulation	1.25 psf
5/8" Gypsum Board	2.8 psf
Misc.	5 psf
Total roof Dead Load	**17.85 psf**
Solar panels	5 psf
Total roof Dead Load with Solar panels	**22.85 psf** at solar panel locations (present or future)

Interior LGS Wall Dead Loads

5/8" Gypsum Board	2.8 psf
Framing	2 psf
Acoustical batt insulation R-19	0.54 psf
5/8" Gypsum Board	2.8 psf
Misc.	5 psf
Total wall Dead Load	**13.14 psf**

Exterior LGS Wall Dead Loads

7/8” Stucco Finish	10 psf
1/2” OSB Plywood Sheathing	2 psf
Framing	2 psf
Insulation R-19	0.54 psf
5/8" Gypsum Board	2.8 psf
Misc.	5 psf
Total wall Dead Load	**22.34 psf**

LOAD SUMMARY

	Dead load (DL), psf	Live Load (LL), psf
Roof	17.85 / 22.85	20
Wall	22.34 / 13.14	

Load Combinations for strength design (per 2.3.1 ASCE 7-16)

1.4D

1.2D + 1.6L + 0.5(Lr or S or R)

1.2D + 1.6(Lr or S or R) + (L or 0.5W)

1.2D + 1.0W + L + 0.5(Lr or S or R)

0.9D + 1.0W

1.2D+1E+0.5LL

0.9D+1W

0.9D+1E

Per 2.2 ASCE 7-16

D =dead load:

L =live load

Lr =roof live load

S =snow load

R =rain load

W =wind load

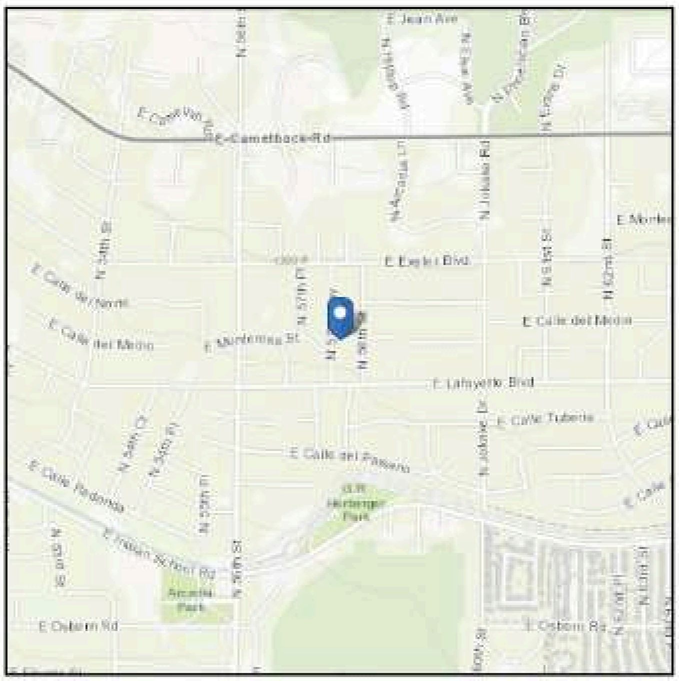
E =earthquake load

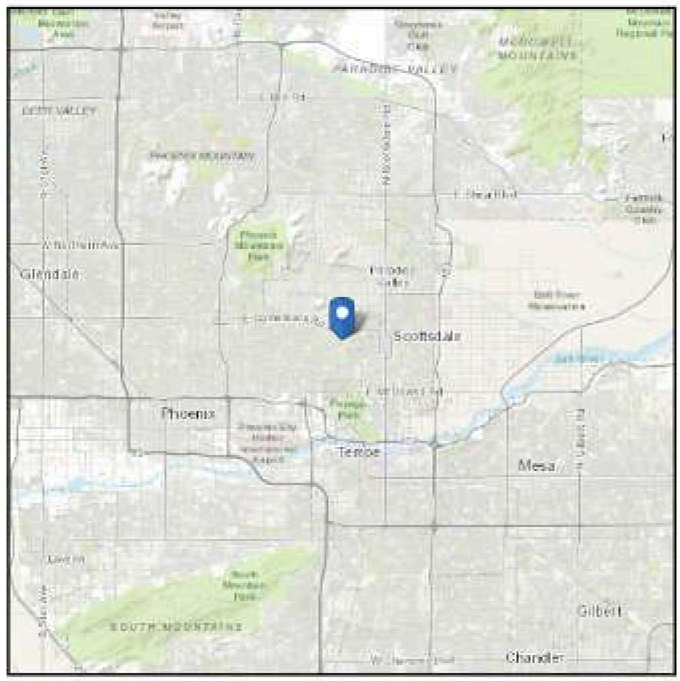
WIND LOADS

ASCE Hazards Report

Address:
4135 North 57th Way
Phoenix, Arizona
85018

Standard:	ASCE/SEI 7-22	**Latitude:**	33.495885
Risk Category:	II	**Longitude:**	-111.95718
Soil Class:	C - Very Dense Soil and Soft Rock	**Elevation:**	1287.6989621512473 ft (NAVD 88)





Wind

Results:

Wind Speed	102 Vmph
10-year MRI	71 Vmph
25-year MRI	77 Vmph
50-year MRI	82 Vmph
100-year MRI	87 Vmph
300-year MRI	95 Vmph
700-year MRI	102 Vmph

1,700-year MRI	108 Vmph
3,000-year MRI	113 Vmph
10,000-year MRI	122 Vmph
100,000-year MRI	139 Vmph
1,000,000-year MRI	157 Vmph

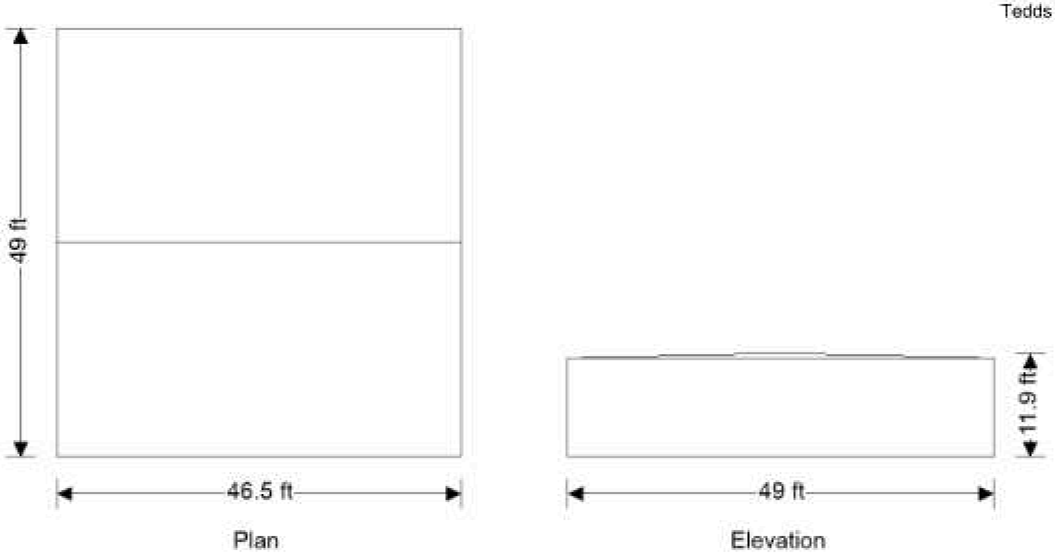
Data Source:	ASCE/SEI 7-22, Fig. 26.5-1B and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed:	Fri May 17 2024

ROOF SLOPE 0.25:12

In accordance with ASCE7-16

Using the directional design method

Tedds calculation version 2.1.03



Building data

Type of roof	Gable	Length of building	b = **46.50** ft
Width of building	d = **49.00** ft	Height to eaves	H = **11.35** ft
Pitch of roof	α_0 = **1.2** deg		
Mean height	h = **11.35** ft		

General wind load requirements

Basic wind speed	V = **115.0** mph	Risk category	II
Exponent coef (Table 26.6-1)	K_d = **0.85**	Elevation above sea level	z_{gl} = **0** ft
Ground elevation factor	K_e = **1.00**	Exposure category (cl 26.7.3)	C
Enclosure class (cl.26.12)	Enclosed buildings	Int pres coef +ve	GC_{pi_p} = **0.18**
Int pres coef –ve	GC_{pi_n} = **-0.18**		
Gust effect factor	G_f = **0.85**		
Minimum design wind loading	p_{min_r} = **8** lb/ft^2		

Topography

Topo factor not significant $K_{zt} = 1.0$

Velocity pressure equation $q = 0.00256 \times K_z \times K_{zt} \times K_d \times V^2 \times$ 1psf/mph^2

Velocity pressures table

z (ft)	K_z (Table 26.10-1)	q_z (psf)
11.35	0.85	24.46
11.86	0.85	24.46

Peak velocity pressure for internal pressure

Peak velocity pressure – int q_i = **24.46** psf

Pressures and forces

Net pressure $p = q \times G_f \times C_{pe} - q_i \times GC_{pi}$

Net force $F_w = p \times A_{ref}$

Roof load case 1 - Wind 0, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (-ve)	11.35	-0.90	24.46	-23.12	263.95	-6.10
B (-ve)	11.35	-0.90	24.46	-23.12	263.95	-6.10
C (-ve)	11.35	-0.50	24.46	-14.80	527.89	-7.81
D (-ve)	11.35	-0.30	24.46	-10.64	83.72	-0.89
E (-ve)	11.35	-0.30	24.46	-10.64	1139.50	-12.12

Total vertical net force $F_{w,v}$ = **-33.02** kips Total horizontal net force $F_{w,h}$ = **-0.18** kips

Walls load case 1 - Wind 0, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft²)	Net force F_w (kips)
A	11.35	0.80	24.46	12.23	527.78	6.45
B	11.35	-0.49	24.46	-14.58	527.78	-7.69
C	11.35	-0.70	24.46	-18.96	568.72	-10.78
D	11.35	-0.70	24.46	-18.96	568.72	-10.78

Overall loading

Proj vertical plan area of wall $A_{vert\_w\_0}$ = **527.78** ft²

Projected vertical area of roof $A_{vert\_r\_0}$ = **23.86** ft²

Min overall horizontal loading $F_{w,total\_min}$ = **8.64** kips

Leeward net force F_l = **-7.7** kips

Windward net force F_w = **6.5** kips

Overall horizontal loading $F_{w,total}$ = **14.0** kips

Roof load case 2 - Wind 0, GC_{pi} -0.18, $-0c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft²)	Net force F_w (kips)
A (+ve)	11.35	-0.18	24.46	0.66	263.95	0.17
B (+ve)	11.35	-0.18	24.46	0.66	263.95	0.17
C (+ve)	11.35	-0.18	24.46	0.66	527.89	0.35
D (+ve)	11.35	-0.18	24.46	0.66	83.72	0.06
E (+ve)	11.35	-0.18	24.46	0.66	1139.50	0.75

Total vertical net force $F_{w,v}$ = **1.50** kips

Total horizontal net force $F_{w,h}$ = **0.00** kips

Walls load case 2 - Wind 0, GC_{pi} -0.18, $-0c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft²)	Net force F_w (kips)
A	11.35	0.80	24.46	21.04	527.78	11.10
B	11.35	-0.49	24.46	-5.77	527.78	-3.04
C	11.35	-0.70	24.46	-10.15	568.72	-5.77
D	11.35	-0.70	24.46	-10.15	568.72	-5.77

Overall loading

Proj vertical plan area of wall $A_{vert\_w\_0}$ = **527.78** ft²

Projected vertical area of roof $A_{vert\_r\_0}$ = **23.86** ft²

Min overall horizontal loading $F_{w,total\_min}$ = **8.64** kips

Leeward net force F_l = **-3.0** kips

Windward net force F_w = **11.1** kips

Overall horizontal loading $F_{w,total}$ = **14.1** kips

Roof load case 3 - Wind 90, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (-ve)	11.35	-0.90	24.46	-23.12	278.14	-6.43
B (-ve)	11.35	-0.90	24.46	-23.12	278.14	-6.43
C (-ve)	11.35	-0.50	24.46	-14.80	556.27	-8.23
D (-ve)	11.35	-0.30	24.46	-10.64	1166.46	-12.41

Total vertical net force $F_{w,v}$ = **-33.50** kips Total horizontal net force $F_{w,h}$ = **0.00** kips

Walls load case 3 - Wind 90, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A	11.86	0.80	24.46	12.23	568.72	6.96
B	11.35	-0.50	24.46	-14.80	568.72	-8.42
C	11.35	-0.70	24.46	-18.96	527.78	-10.01
D	11.35	-0.70	24.46	-18.96	527.78	-10.01

Overall loading

Proj vertical plan area of wall $A_{vert\_w\_90}$ = **568.72** ft^2

Projected vertical area of roof $A_{vert\_r\_90}$ = **0.00** ft^2 Min overall horizontal loading $F_{w,total\_min}$ = **9.10** kips

Leeward net force F_l = **-8.4** kips Windward net force F_w = **7.0** kips

Overall horizontal loading $F_{w,total}$ = **15.4** kips

Roof load case 4 - Wind 90, GC_{pi} -0.18, $+c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (+ve)	11.35	-0.18	24.46	0.66	278.14	0.18
B (+ve)	11.35	-0.18	24.46	0.66	278.14	0.18
C (+ve)	11.35	-0.18	24.46	0.66	556.27	0.37
D (+ve)	11.35	-0.18	24.46	0.66	1166.46	0.77

Total vertical net force $F_{w,v}$ = **1.50** kips Total horizontal net force $F_{w,h}$ = **0.00** kips

Walls load case 4 - Wind 90, GC_{pi} -0.18, $+c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A	11.86	0.80	24.46	21.04	568.72	11.96
B	11.35	-0.50	24.46	-5.99	568.72	-3.41
C	11.35	-0.70	24.46	-10.15	527.78	-5.36
D	11.35	-0.70	24.46	-10.15	527.78	-5.36

Overall loading

Proj vertical plan area of wall $A_{vert\_w\_90}$ = **568.72** ft^2

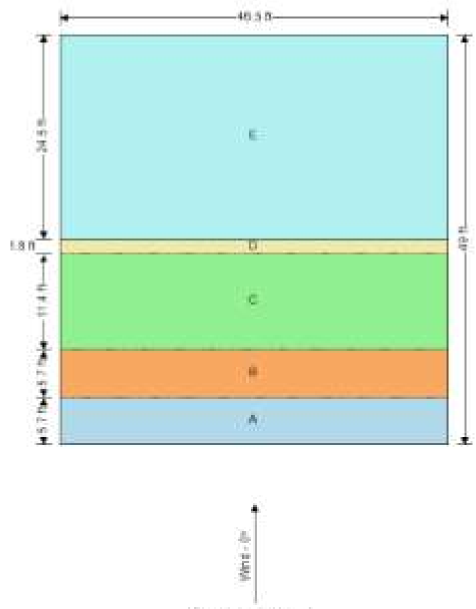
Projected vertical area of roof $A_{vert\_r\_90}$ = **0.00** ft^2

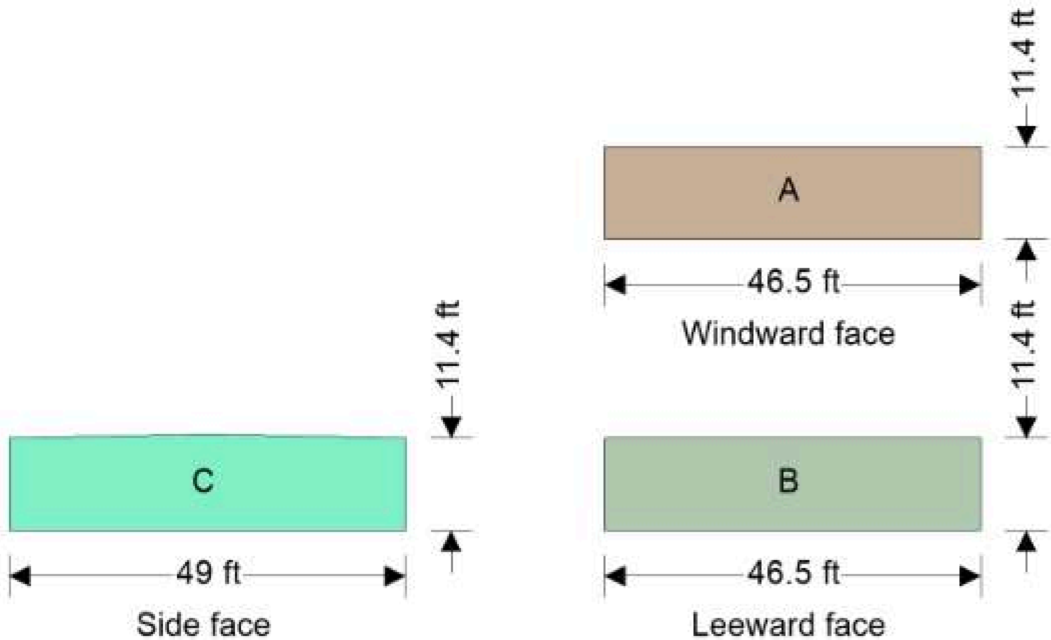
Min overall horizontal loading $F_{w,total\_min}$ = **9.10** kips

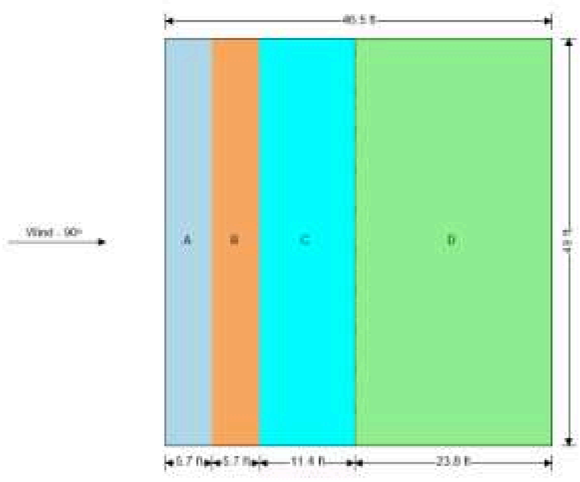
Leeward net force F_l = **-3.4** kips

Windward net force F_w = **12.0** kips

Overall horizontal loading $F_{w,total}$ = **15.4** kips







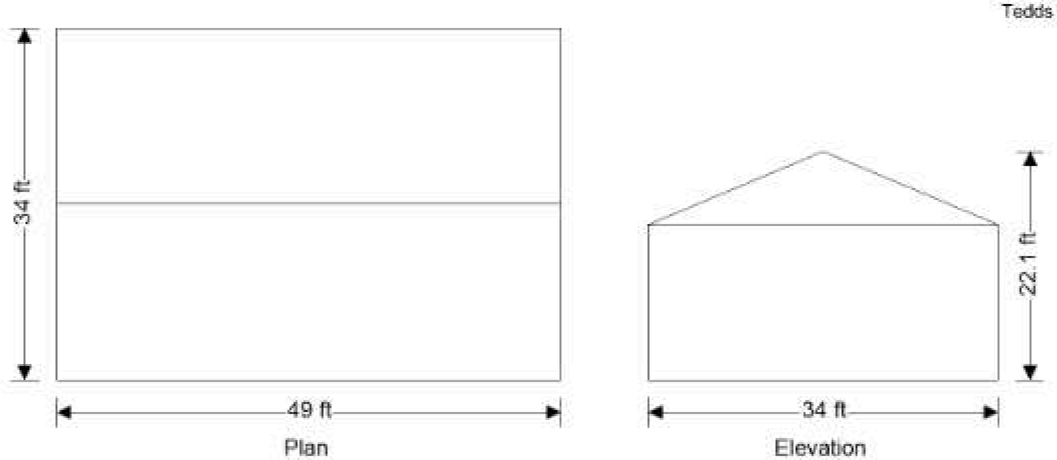
Plan view - Gable roof

ROOF SLOPE 5:12

In accordance with ASCE7-16

Using the directional design method

Tedds calculation version 2.1.03



Building data

Type of roof	Gable	Length of building	b = **49.00** ft
Width of building	d = **34.00** ft	Height to eaves	H = **15.00** ft
Pitch of roof	α_0 = **22.6** deg		
Mean height	h = **18.54** ft		

General wind load requirements

Basic wind speed	V = **115.0** mph	Risk category	II
Exponent coef (Table 26.6-1)	K_d = **0.85**	Elevation above sea level	z_{gl} = **0** ft
Ground elevation factor	K_e = **1.00**	Exposure category (cl 26.7.3)	C
Enclosure class (cl.26.12)	Enclosed buildings	Int pres coef +ve	GC_{pi_p} = **0.18**
Int pres coef –ve	GC_{pi_n} = **-0.18**		
Gust effect factor	G_f = **0.85**		
Minimum design wind loading	p_{min_r} = **8** lb/ft^2		

Topography

Topo factor not significant K_{zt} = 1.0

Velocity pressure equation $q = 0.00256 \times K_z \times K_{zt} \times K_d \times V^2 \times 1\text{psf/mph}^2$

Velocity pressures table

z (ft)	**K_z (Table 26.10-1)**	**q_z (psf)**
15.00	0.85	24.46
15.00	0.85	24.46
18.54	0.89	25.48
22.08	0.92	26.38

Peak velocity pressure for internal pressure

Peak velocity pressure – int q_i = **25.48** psf

Pressures and forces

Net pressure $p = q \times G_f \times C_{pe} - q_i \times GC_{pi}$

Net force $F_w = p \times A_{ref}$

Roof load case 1 - Wind 0, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (-ve)	18.54	-0.37	25.48	-12.60	902.42	-11.37
B (-ve)	18.54	-0.60	25.48	-17.58	902.42	-15.87

Total vertical net force $F_{w,v}$ = **-25.14** kips   Total horizontal net force $F_{w,h}$ = **1.73** kips

Walls load case 1 - Wind 0, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A	15.00	0.80	24.46	12.05	735.00	8.85
B	18.54	-0.50	25.48	-15.42	735.00	-11.33
C	18.54	-0.70	25.48	-19.75	630.42	-12.45
D	18.54	-0.70	25.48	-19.75	630.42	-12.45

Overall loading

Proj vertical plan area of wall $A_{vert\_w\_0}$ = **735.00** ft^2

Projected vertical area of roof $A_{vert\_r\_0}$ = **347.09** ft^2 Min overall horizontal loading $F_{w,total\_min}$ = **14.54** kips

Leeward net force F_l = **-11.3** kips   Windward net force F_w = **8.9** kips

Overall horizontal loading $F_{w,total}$ = **21.9** kips

Roof load case 2 - Wind 0, GC_{pi} -0.18, $-0c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (+ve)	18.54	0.09	25.48	6.48	902.42	5.85
B (+ve)	18.54	-0.60	25.48	-8.41	902.42	-7.59

Total vertical net force $F_{w,v}$ = **-1.60** kips   Total horizontal net force $F_{w,h}$ = **5.17** kips

Walls load case 2 - Wind 0, GC_{pi} -0.18, $-0c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A	15.00	0.80	24.46	21.22	735.00	15.60
B	18.54	-0.50	25.48	-6.24	735.00	-4.59
C	18.54	-0.70	25.48	-10.57	630.42	-6.67
D	18.54	-0.70	25.48	-10.57	630.42	-6.67

Overall loading

Proj vertical plan area of wall $A_{vert\_w\_0}$ = **735.00** ft^2

Projected vertical area of roof $A_{vert\_r\_0}$ = **347.09** ft^2

Min overall horizontal loading $F_{w,total\_min}$ = **14.54** kips

Leeward net force F_l = **-4.6** kips

Windward net force F_w = **15.6** kips

Overall horizontal loading $F_{w,total}$ = **25.4** kips

Roof load case 3 - Wind 90, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (-ve)	18.54	-0.90	25.48	-24.08	341.48	-8.22
B (-ve)	18.54	-0.90	25.48	-24.08	341.48	-8.22
C (-ve)	18.54	-0.50	25.48	-15.42	682.95	-10.53
D (-ve)	18.54	-0.30	25.48	-11.08	438.93	-4.87

Total vertical net force $F_{w,v}$ = **-29.39** kips

Total horizontal net force $F_{w,h}$ = **0.00** kips

Walls load case 3 - Wind 90, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A_1	15.00	0.80	24.46	12.05	510.00	6.14
A_2	15.00	0.80	24.46	12.05	0.00	0.00
A_3	22.08	0.80	26.38	13.35	120.42	1.61
B	18.54	-0.41	25.48	-13.50	630.42	-8.51
C	18.54	-0.70	25.48	-19.75	735.00	-14.51
D	18.54	-0.70	25.48	-19.75	735.00	-14.51

Overall loading

Proj vertical plan area of wall $A_{vert\_w\_90}$ = **630.42** ft^2

Projected vertical area of roof $A_{vert\_r\_90}$ = **0.00** ft^2

Min overall horizontal loading $F_{w,total\_min}$ = **10.09** kips

Leeward net force F_l = **-8.5** kips

Windward net force F_w = **7.8** kips

Overall horizontal loading $F_{w,total}$ = **16.3** kips

Roof load case 4 - Wind 90, GC$_{pi}$ -0.18, +c$_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (+ve)	18.54	-0.18	25.48	0.69	341.48	0.23
B (+ve)	18.54	-0.18	25.48	0.69	341.48	0.23
C (+ve)	18.54	-0.18	25.48	0.69	682.95	0.47
D (+ve)	18.54	-0.18	25.48	0.69	438.93	0.30

Total vertical net force $F_{w,v}$ = **1.15** kips

Total horizontal net force $F_{w,h}$ = **0.00** kips

Walls load case 4 - Wind 90, GC$_{pi}$ -0.18, +c$_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A_1	15.00	0.80	24.46	21.22	510.00	10.82
A_2	15.00	0.80	24.46	21.22	0.00	0.00
A_3	22.08	0.80	26.38	22.52	120.42	2.71
B	18.54	-0.41	25.48	-4.33	630.42	-2.73
C	18.54	-0.70	25.48	-10.57	735.00	-7.77
D	18.54	-0.70	25.48	-10.57	735.00	-7.77

Overall loading

Proj vertical plan area of wall $A_{vert\_w\_90}$ = **630.42** ft^2

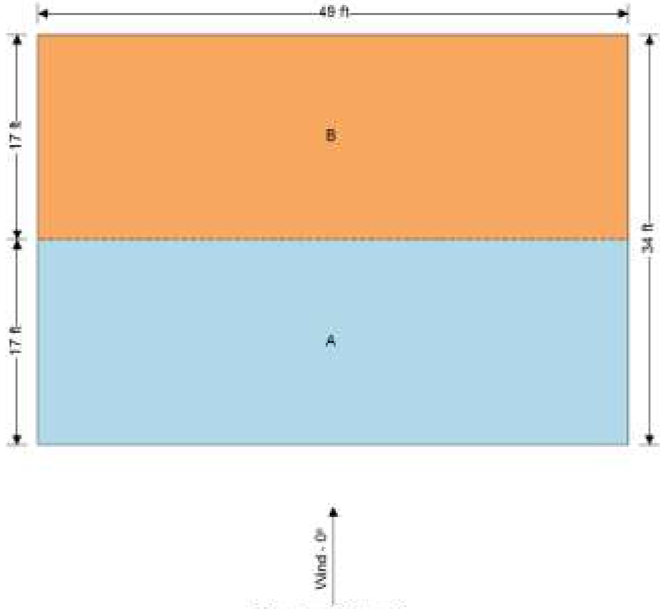
Projected vertical area of roof $A_{vert\_r\_90}$ = **0.00** ft^2

Min overall horizontal loading $F_{w,total\_min}$ = **10.09** kips

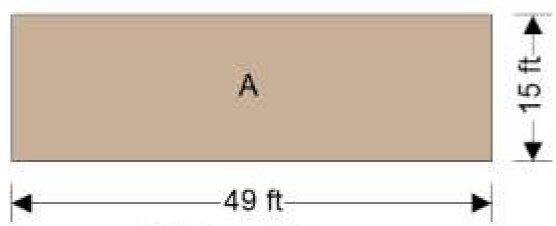
Leeward net force F_l = **-2.7** kips

Windward net force F_w = **13.5** kips

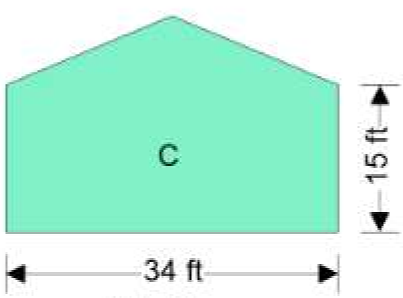
Overall horizontal loading $F_{w,total}$ = **16.3** kips



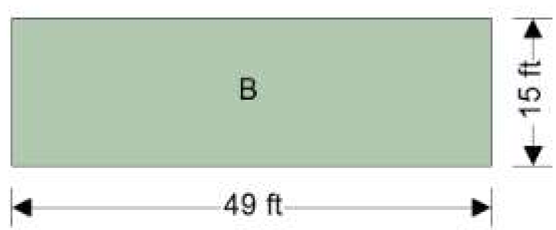
Plan view - Gable roof



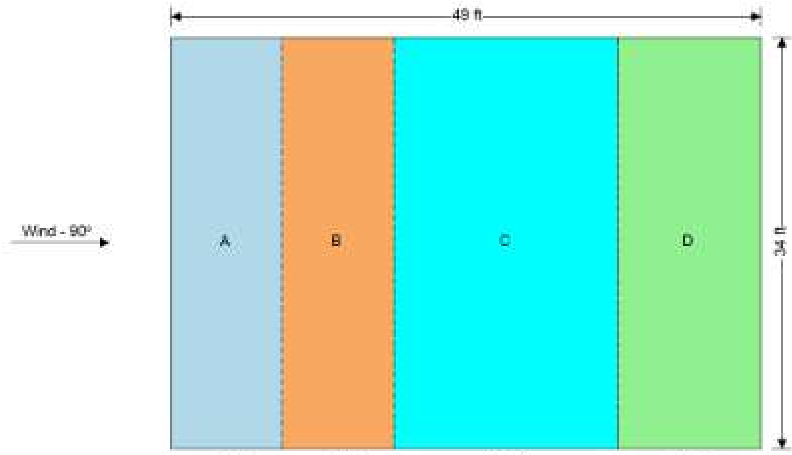
Windward face



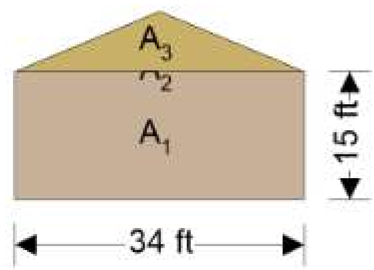
Side face



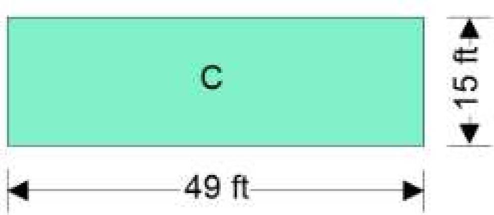
Leeward face



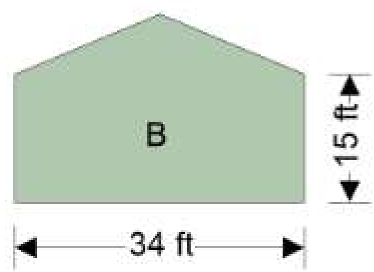
Plan view - Gable roof



Windward face



Side face



Leeward face

SEISMIC LOADS

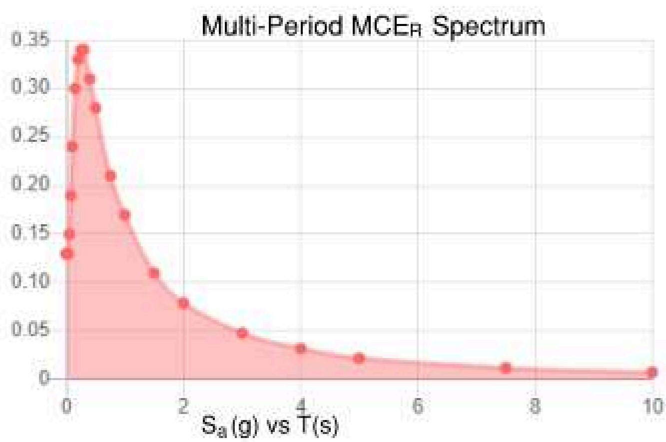
Seismic

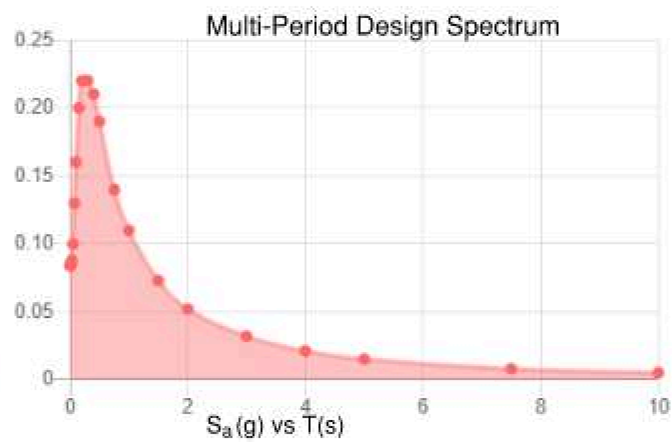
Site Soil Class: D - Stiff Soil

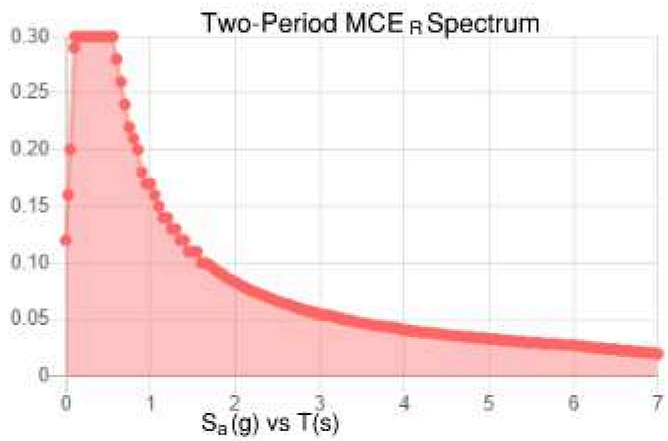
Results:

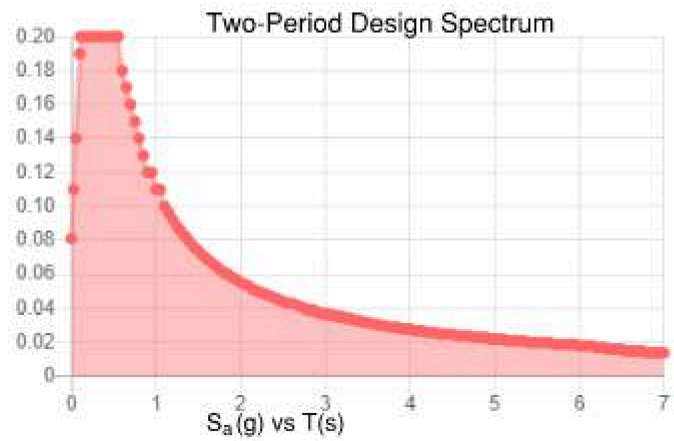
PGA_M :	0.12	T_L :	6
S_{MS} :	0.3	S_S :	0.19
S_{M1} :	0.17	S_1 :	0.059
S_{DS} :	0.192	V_{S30} :	260
S_{D1} :	0.094		

Seismic Design Category: B









MCE$_R$ Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Design Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Data Accessed: **Fri May 17 2024**

Date Source:

USGS Seismic Design Maps based on ASCE/SEI 7-22 and ASCE/SEI 7-22 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-22 Ch. 21 are available from USGS.

2. STRUCTURAL ANALYSIS

2.1 BUILDING DESCRIPTION

The one-storey building is complexly shaped in plan, the building is 138'-1.5" long and 66'-3" wide. Roof rafters, roof trusses, walls and are designed of LGS structural framing. In the middle of the building in the transverse direction runs a concrete wall on which the roof structures are supported by steel columns. Structural rigidity in the longitudinal and transverse directions is achieved due to the shear walls.
The foundation is a slab-on-grade and pad foundation.

The design of the structure is based on the requirements of the Phoenix building codes (IBC 2018 with amendments and additions).

Structural analysis is done in SCIA Engineer 20 software. This software allows automatic determination of the load combination that causes the highest forces in structural members for further analysis and cross-section selection. Governing load cases are shown in the sections "CHECKING STEEL ELEMENTS". The seismic force-resisting system is A16: Light-frame (cold-formed steel) walls sheathed with wood structural panels rated for shear resistance or steel sheets.

To determine the design forces from dynamic loads (earthquake), two types of calculations are used: Modal Mode, Equivalent Lateral Forces, or Response Spectrum Method

Modal Mode:
This approach allows the modal analysis of the structure, setting the first n values and eigenvectors of the structure.
The available analysis methods: subspace iteration, Lanczos method and the basis reduction method.
Iterations will be completed if the following condition is met: where:

$$\frac{\left|\omega_i^k - \omega_i^{k-1}\right|}{\left|\omega_i^k\right|} < tolerance$$

i = 1,2,...,n vibration modes, k - number of iterations.
Upper limit is the period value (pulsation, frequency), which describes that in the range, (0, upper limit) the following values and eigenvectors will be set. Sturm check, which allows finding the skipped pulsations, is possible.

Response Spectrum Method:
Seismic analysis is based on the response spectrum method. All data is defined the same way as in modal analysis. Additionally, parameters required by a specific national code to establish the response spectrum shape must be specified. Calculations and results are the same as those for spectral analysis.
In addition to results obtained from modal analysis, for each eigenform the seismic analysis provides the following values:

- Seismic excitation multiplier (value of the accelerating excitation spectrum).
- Seismic participation factors calculated as those for the modal analysis. However, vector D describing excitation direction is user defined. Coefficients are specified for each dynamic degree of freedom according to the method selected in Job Preferences. (Maximum or Distinct).
- Seismic mode coefficients as a product of the seismic excitation factor and the respective seismic participation factor for each dynamic degree of freedom.
- Displacements, internal forces and reactions for each form of vibration or quadratic combination calculated with the SRSS or CQC method.
- Pseudostatic forces, which are the external loads generated according to the seismic analysis assumptions.

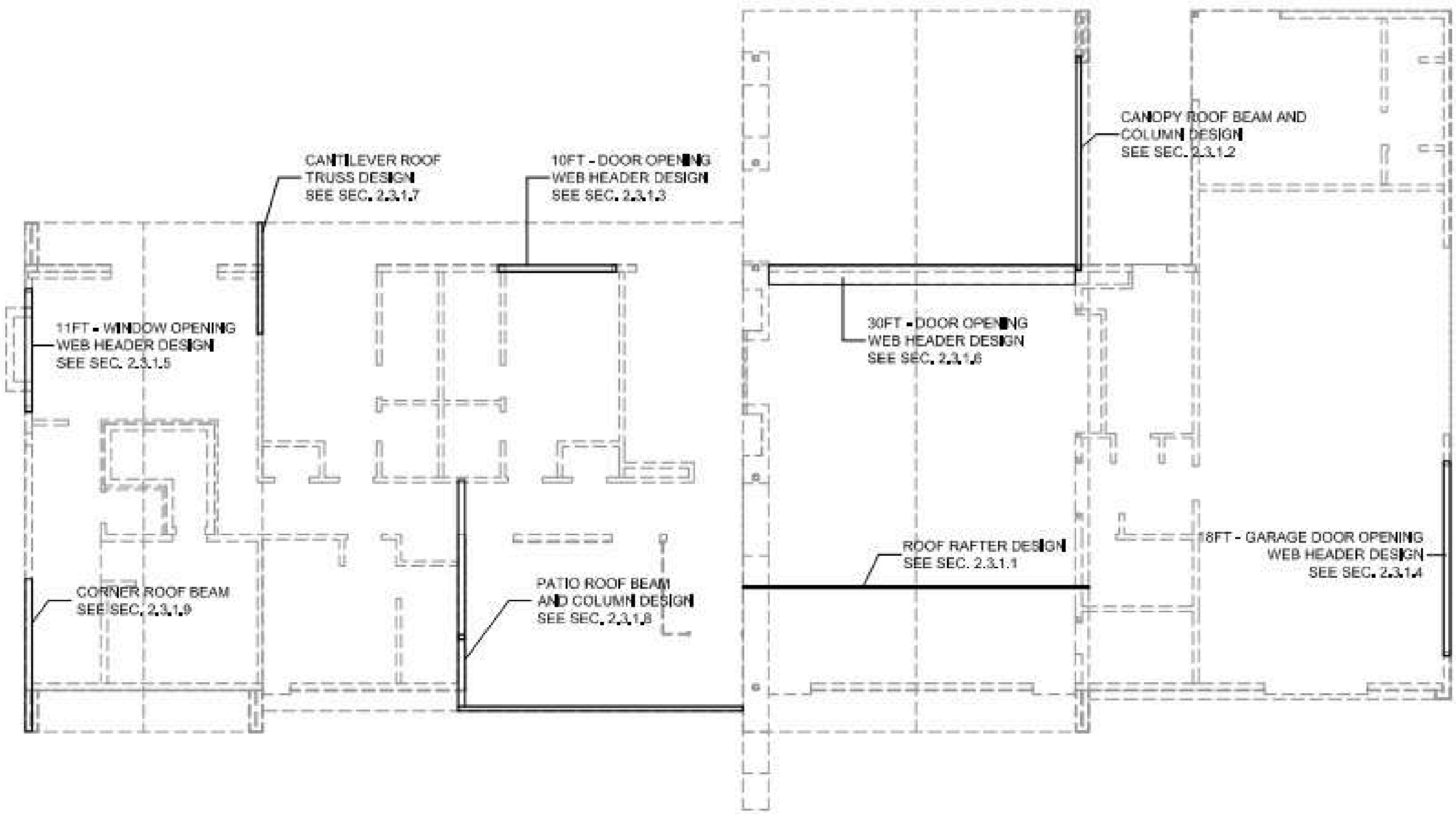
For seismic analysis, the same quadratic combination methods as those for spectral analysis are available.

2.2 APPLIED LOADS

Load cases

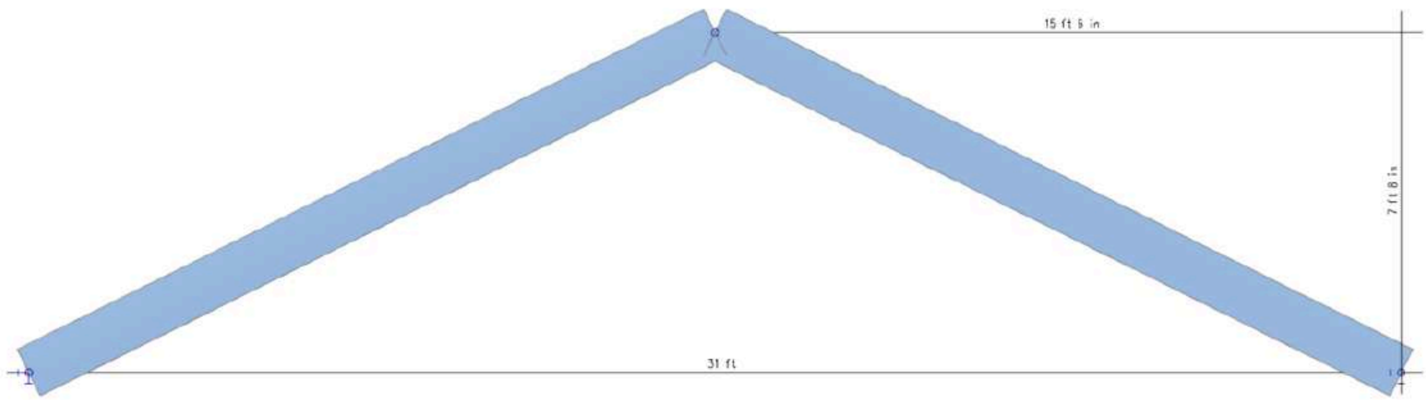
Name	Description Spec	Action type / Load type	Load Group	Direction
DL1	Self-weight	Permanent / Self-weight	DL	-Z
DL2	Floor dead load	Permanent / Standard	DL	
DL3	Wall dead load	Permanent / Standard	DL	
DL4	Roof dead load	Permanent / Standard	DL	
Lr	Roof Live Load	Variable / Static	Lr	
Wx+(+0.18)	Wind Load	Variable / Static	W	
Wx+(-0.18)	Wind Load	Variable / Static	W	
Wx-(+0.18)	Wind Load	Variable / Static	W	
Wx-(-0.18)	Wind Load	Variable / Static	W	
Wy+(+0.18)	Wind Load	Variable / Static	W	
Wy+(-0.18)	Wind Load	Variable / Static	W	
Wy-(+0.18)	Wind Load	Variable / Static	W	
Wy-(-0.18)	Wind Load	Variable / Static	W	

2.3 STEEL STRUCTURE CHECK
2.3.1 WEB HEADER & ROOF MEMBER DESIGN

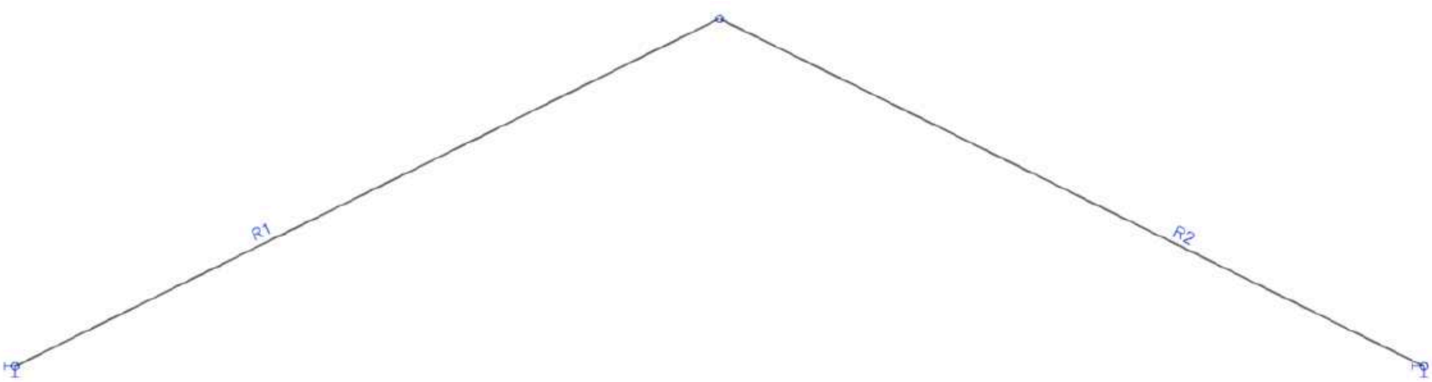


2.3.1.1 ROOF RAFTER DESIGN

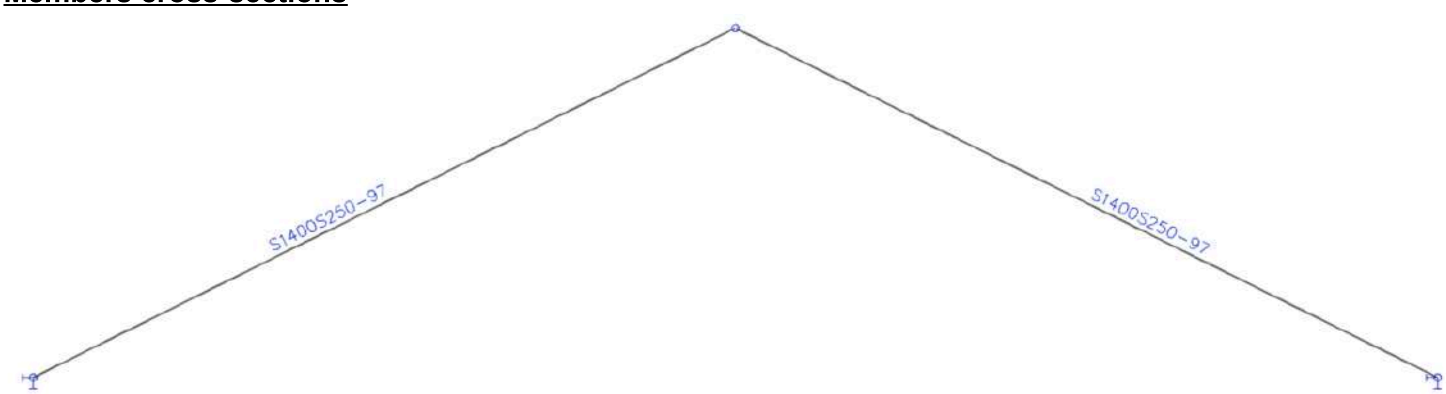
General scheme



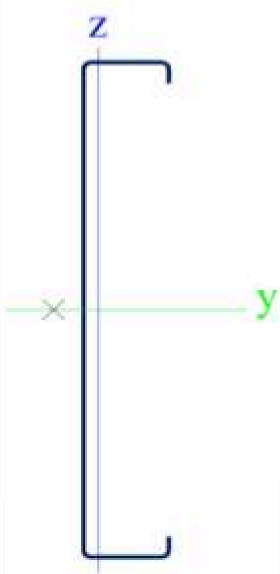
Members number



Members cross-sections



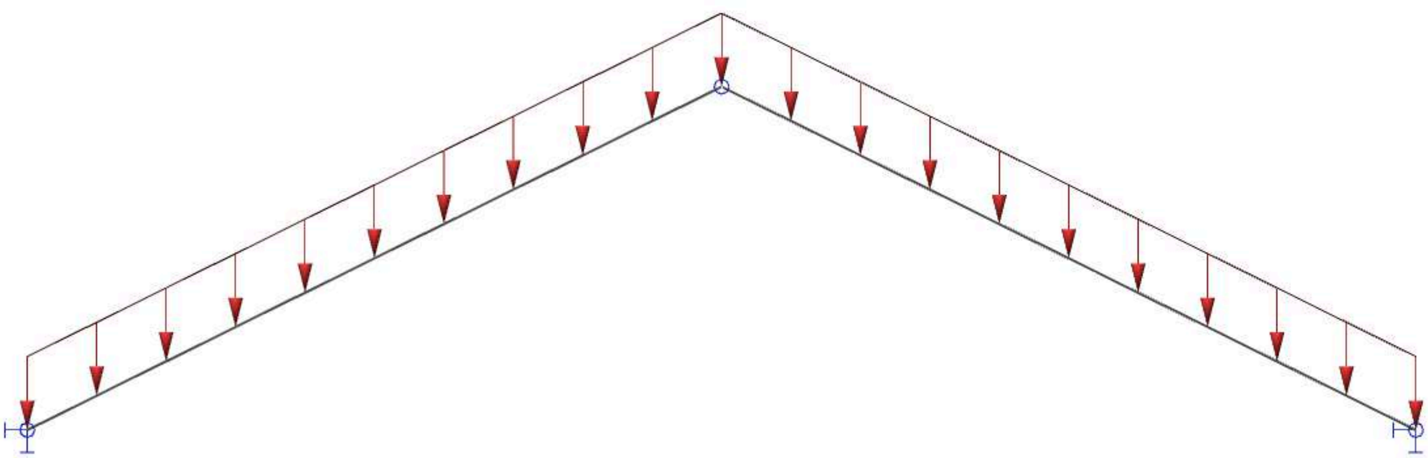
Cross-sections properties 1400S250-97

CS3		
Type	S1400S250-97	
Formcode	114 - Cold formed C section	
Shape type	Thin-walled	
Item material	A913 grade 50	
Fabrication	cold formed	
Colour	■	
A [inch^2]	1.991	
A_y [inch^2], A_z [inch^2]	0.506	1.396
A_L [inch^2/inch], A_D [inch^2/inch]	3.92e+01	3.92e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	0.465	7.000
α [deg]	0.00	
I_y [inch^4], I_z [inch^4]	50.215	1.162
i_y [inch], i_z [inch]	5.022	0.764
$W_{el.y}$ [inch^3], $W_{el.z}$ [inch^3]	7.105	0.571
$W_{pl.y}$ [inch^3], $W_{pl.z}$ [inch^3]	8.827	0.851
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	4.41e+02	4.41e+02
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	4.25e+01	4.25e+01
d_y [inch], d_z [inch]	-1.239	0.000
I_t [inch^4], I_w [inch^6]	0.007	46.520
β_y [inch], β_z [inch]	0.000	19.187
Picture		

APPLIED LOADS

LOAD ON ROOF RAFTERS				
Rafters spasing, (ft)	2			
Load	**Distr. Load, psf**	**R1 Liner Load, plf**	**Distr. Load, psf**	**R2 Liner Load, plf**
DL1 Self - weight		Automatically		Automatically
DL2 Roof dead load	17.85	35.70	17.85	35.70
Lr Roof live load	20.00	40.00	20.00	40.00
Wx+ (+0.18)	-13.30	-26.60	-17.50	-35.00
Wx+ (-0.18)	8.00	16.00	-8.50	-17.00
Wx- (+0.18)	-17.5	-35.00	-13.3	-26.60
Wx- (-0.18)	-8.5	-17.00	8	16.00
Wy+ (+0.18)	-24	-48.00	-24	-48.00
Wy+ (-0.18)	8	16.00	8	16.00
Wy- (+0.18)	-24	-48.00	-24	-48.00
Wy- (-0.18)	8	16.00	8	16.00

Wind loads are applied perpendicular to the rafters. Liner load with “-” - uplift.



MAXIMUM FORCES

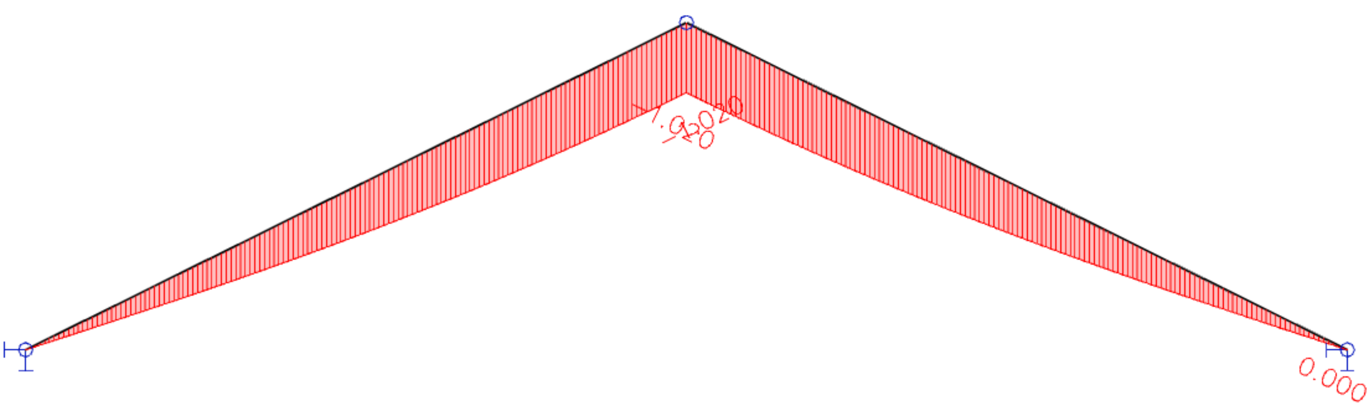
Selection: R2, R1

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
R1	0.000"	LRFD-Ult (auto)/1	**-1106.4**	-0.1	1951.5	-0.7	0.0	-0.4
R2	17' 3.509"	LRFD-Ult (auto)/2	**329.9**	-0.1	-163.2	-0.8	-4832.1	-1.6
R2	0.000"	LRFD-Ult (auto)/3	-1071.1	-0.1	**-2165.5**	0.7	0.0	-0.4
R1	0.000"	LRFD-Ult (auto)/3	-1071.1	-0.1	**2165.5**	-0.7	0.0	-0.4
R1	16' 0.000"+	LRFD-Ult (auto)/4	-45.5	**-0.1**	92.1	**0.9**	10659.1	-1.7
R2	17' 0.407"	LRFD-Ult (auto)/3	-70.1	-0.1	-5.5	-0.8	**-18493.2**	-1.6
R1	17' 0.407"	LRFD-Ult (auto)/3	-70.1	-0.1	5.5	0.8	**18493.2**	-1.6
R2	17' 3.509"	LRFD-Ult (auto)/4	0.0	-0.1	0.0	**-0.9**	-10718.7	**-1.9**
R2	0.000"	LRFD-Ult (auto)/5	-64.2	**-0.1**	-129.9	0.6	0.0	**-0.3**

Name	Combination key
LRFD-Ult (auto)/1	1.20*DL1 + 1.60*Lr + 1.20*DL2 + 0.50*Wx-(-0.18)
LRFD-Ult (auto)/2	1.20*DL1 + 1.20*DL2 + Wy+(+0.18)
LRFD-Ult (auto)/3	1.20*DL1 + 1.60*Lr + 1.20*DL2 + 0.50*Wy+(-0.18)
LRFD-Ult (auto)/4	1.40*DL1 + 1.40*DL2
LRFD-Ult (auto)/5	0.90*DL1 + 0.90*DL2 + Wy+(+0.18)

Displacement

Load case D + Lr, inch:



The maximum deflection for a web header is 0.005".

According to TABLE 1604.3 the code IBC 2018, maximum member deflection should not exceed - L/360.
L=31'=372", 372"/360=1.033". 1.020"< 1.033". <u>Deflection is OK!</u>

STEEL MEMBER R1 CHECK

AISI S100-16 LRFD Check

Member R1	S1400S250-97	A913 grade 50	LRFD-Ult (auto)	0.93

Material data		
Yield stress Fy	50.00	ksi
Tensile stress Fu	65.00	ksi
fabrication	cold formed	

The critical check is on position 16.00 ft

Axis definition :
- local x- axis in this code check is referring to the local y axis in Scia Engineer
- local y- axis in this code check is referring to the local z axis in Scia Engineer

Internal forces		
Pu	-131.07	lbf
Vux	-0.12	lbf
Vuy	137.00	lbf
Mut	0.61	lbfft
Mux	18419.89	lbfft
Muy	-1.58	lbfft

...::Flexural Strength about X-axis::...
Nominal Flexural Strength
According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.371	-38.5 -40.9	-	-	-	-	-	- -	- -	-	- -	-
3	1.992	-42.3 -42.3	-	-	-	-	-	- -	- -	-	- -	-
5	13.492	48.6 -40.9	0.84	20.170	30.0	1.272	0.650	- 8.770	2.283 2.480	-	- -	-
7	1.992	50.0 50.0	1.00	2.513	171.8	0.540	1.000	1.992 -	0.348 1.644	30.83	0.001 0.000	0.129
9	0.371	48.6 46.2	0.95	0.448	884.1	0.235	1.000	0.129 -	- -	-	- -	-

Table of values		
Sxe	5.983	inch ^{3}
Mnxo	24929.9	lbfft
Resistance factor	0.90	
Unity check	0.82	-

Lateral-Torsional Buckling Strength
According to article F2.1 and formula (F2.1-1),(F2.1.1-1).

Table of values		
Lltb	2' 0.000"	ft
Sigma,ey	289.9	ksi
Kt	1.00	
Lt	2' 0.000"	ft
Sigma,t	426.2	ksi
Cb	1.01	
Sfx	7.174	$inch^3$
Fcre	514.9	ksi

Note: Lateral-Torsional buckling is not governing since Fe is greater than or equal to 2.78 Fy.

Distortional Buckling Strength
According to article F4 and formula F4.1-2.

Table of values		
Sfy	7.174	$inch^3$
My	29889.9	lbfft
L	1' 6.134"	ft
Beta	1.03	
k,phi,fe	895.1	lbf
k,phi,we	999.3	lbf
k,phi	0.0	lbf
k,phi,fg	0.024	$inch^2$
k,phi,wg	0.021	$inch^2$
Fd	43.4	ksi
Sf	7.174	$inch^3$

Table of values		
Mcrd	25969.8	lbfft
Lambda,d	1.07	
Mn	22147.7	lbfft
Resistance factor	0.90	
Unity check	0.92	-

Data		
Lm	2' 0.000"	ft
Lcr	1' 6.134"	ft
h0	14.000	inch
Ixf	0.006	$inch^4$
Iyf	0.138	$inch^4$
Ixyf	-0.015	$inch^4$
Cwf	0.000	$inch^6$
Jf	0.001	$inch^4$
x0f	0.870	inch
hxf	-1.499	inch
Af	0.273	$inch^2$
y0f	0.051	inch
Ksi,web	2.00	

Number of compressed flanges: 1
Critical flange contains Initial shape parts: 8, 7, 9

...::Flexural Strength about Y-axis::...
Lateral-Torsional Buckling Strength
According to article F2.1 and formula (F2.1-1),(F2.1.2-1).

Table of values		
Sigma,ex	41.8	ksi
Kt	1.00	
Lt	2' 0.000"	ft
Sigma,t	426.2	ksi
Cs	1.00	
CTF	0.94	
Sfy	2.496	$inch^3$
j	10.287	inch
Fcre	1060.6	ksi

Note: Lateral-Torsional buckling is not governing since Fe is greater than or equal to 2.78 Fy.

...::Shear Strength::...
Shear Strength
According to article G2.1 and formula (G2.1.1)
Shear force Vy

Element ID	Aw [$inch^2$]	Vn [lbf]
3	0.000	0.0
5	1.372	10917.4
7	0.000	0.0

Table of values		
Vn,y	10917.4	lbf
Resistance factor	0.95	
Unity check	0.01	-

Combined Bending and Shear
According to article H2 and formula (H2-1)

Table of values		
Mnxo	24929.9	lbfft
Vny	10917.4	lbf
Resistance factor shear	0.95	
Resistance factor bending x	0.90	

Unity check (Mx, Vy) = sqrt(0.67+0.00) = 0.82

Buckling check
According to article E2 and formula (E2-1)
Flexural Buckling Strength
According to article E2.1 and formula (E2.1-1)

Buckling parameters	xx	yy	
Sway type	sway	non-sway	
Unbraced Length L	17 3/8	2	ft
Effective Length factor K	2.00	0.93	
Effective Length	34 3/4	1 7/8	ft
Slenderness	82.75	29.11	
Flexural Buckling stress Fcre	41.8	337.8	ksi

Torsional (-Flexural) Buckling Strength
According to article E2.2, E2.3, E2.4

Table of values		
Sigma,ex	41.8	ksi
Sigma,ey	337.8	ksi
Kt	1.00	
Lt	2	ft
Sigma,t	426.2	ksi
Sigma,TF	41.6	ksi
Torsional (-Flexural) buckling stress Fcre	41.6	ksi

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch^4]	ds [inch]
1	0.371	30.2 30.2	1.00	0.430	848.0	0.189	1.000	0.371 -	- -	-	- -	-
3	1.992	30.2 30.2	1.00	3.681	251.6	0.347	1.000	1.992 -	0.996 0.996	39.66	0.000 0.000	0.371
5	13.492	30.2 30.2	1.00	4.000	6.0	2.252	0.401	5.406 -	- -	-	- -	-
7	1.992	30.2 30.2	1.00	3.681	251.6	0.347	1.000	1.992 -	0.996 0.996	39.66	0.000 0.000	0.371
9	0.371	30.2 30.2	1.00	0.430	848.0	0.189	1.000	0.371 -	- -	-	- -	-

Table of values		
Fe	41.6	ksi
lambda, c	1.10	
Fn	30.2	ksi
Ae	1.160	inch^2
Pn	35056.4	lbf
Resistance factor	0.85	
Unity check	0.00	-

Distortional Buckling Strength
According to article E4 and formula (E4.1-2).

Table of values		
Py	99569.1	lbf
L	1' 7.823"	ft
k,phi,fe	671.2	lbf
k,phi,we	399.2	lbf
k,phi	0.0	lbf
k,phi,fg	0.020	inch^2
k,phi,wg	0.117	inch^2
Fd	7.8	ksi
Pcrd	15618.0	lbf
Lambda,d	2.52	
Pn	30070.4	lbf
Resistance factor	0.85	
Unity check	0.01	-

Data		
Lm	2' 0.000"	ft
Lcr	1' 7.823"	ft
h0	14.000	inch
Ixf	0.006	$inch^4$
Iyf	0.138	$inch^4$
Ixyf	-0.015	$inch^4$
Cwf	0.000	$inch^6$
Jf	0.001	$inch^4$
x0f	0.870	inch
hxf	-1.499	inch
Af	0.273	$inch^2$
y0f	0.051	inch

Number of compressed flanges: 2
Critical flange contains Initial shape parts: 8, 7, 9

Combined Compressive Axial Load and Bending
According to article H1.2 and formulas (C5.2.1-3)

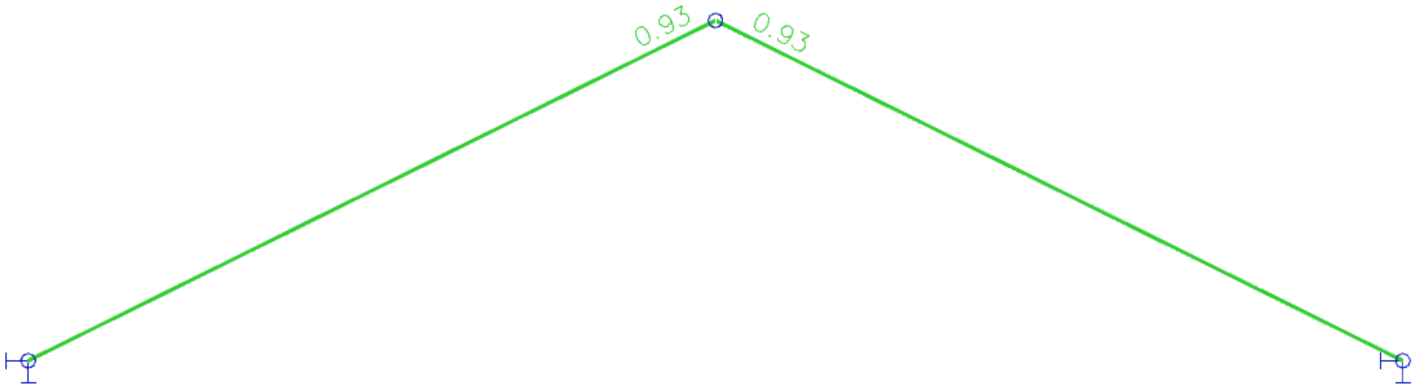
Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [$inch^4$]	ds [inch]
1	0.371	0.1 0.1	1.00	0.430	848.0	0.009	1.000	0.371 -	- -	-	- -	-
3	1.992	0.1 0.1	1.00	4.000	273.5	0.016	1.000	1.992 -	0.996 0.996	849.73	- 0.000	0.371
5	13.492	0.1 0.1	1.00	4.000	6.0	0.105	1.000	13.492 -	- -	-	- -	-
7	1.992	0.1 0.1	1.00	4.000	273.5	0.016	1.000	1.992 -	0.996 0.996	849.73	- 0.000	0.371
9	0.371	0.1 0.1	1.00	0.430	848.0	0.009	1.000	0.371 -	- -	-	- -	-

Table of values		
Mnx	22147.7	lbfft
Mny	2255.8	lbfft
Pn	30070.4	lbf
Resistance factor compression	0.85	
Resistance factor bending x	0.90	
Resistance factor bending y	0.90	

Unity check = 0.01+0.92+0.00 = 0.93 - (C5.2.1-3)

The member satisfies the check !

Unity check



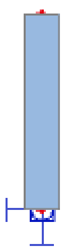
Check of steel

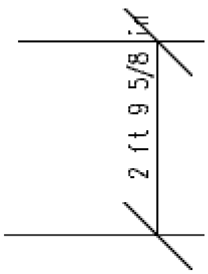
Linear calculation, Extreme : Member
Selection : R2, R1
Combinations : LRFD-Ult (auto)

Case	Member	css	mat	dx [ft]	un.check [-]
LRFD-Ult (auto)/1	R2	CS3 - S(SSMA)1400S250-97	A913 grade 50	15' 12.000"	0.93
LRFD-Ult (auto)/1	R1	CS3 - S(SSMA)1400S250-97	A913 grade 50	15' 12.000"	0.93

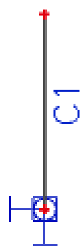
2.3.1.1.1 ROOF RAFTER COLUMN DESIGN
Column spacing - 120 in, Roof rafter spacing - 24 in.

General scheme

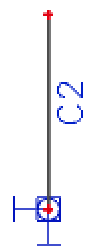




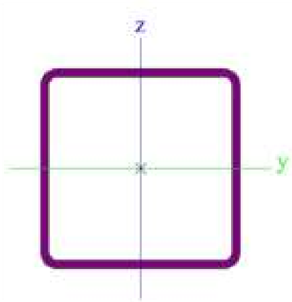
Members number



Members cross-sections



Cross-sections properties C2

C2		
Type	HSS6X6X1/4	
Formcode	2 - Rectangular hollow section	
Shape type	Thin-walled	
Item material	A500 grade C	
Fabrication	rolled	
Colour		
A [inch^2]	5.590	
A_y [inch^2], A_z [inch^2]	2.729	2.925
A_L [inch^2/inch], A_D [inch^2/inch]	2.31e+01	4.47e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	3.000	3.000
α [deg]	0.00	
I_y [inch^4], I_z [inch^4]	30.300	30.300
i_y [inch], i_z [inch]	2.328	2.328
$W_{el.y}$ [inch^3], $W_{el.z}$ [inch^3]	10.100	10.100
$W_{pl.y}$ [inch^3], $W_{pl.z}$ [inch^3]	11.900	11.900
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	5.48e+02	5.48e+02
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	5.48e+02	5.48e+02
d_y [inch], d_z [inch]	0.000	0.000
I_t [inch^4], I_w [inch^6]	46.969	0.157
$β_y$ [inch], $β_z$ [inch]	0.000	0.000
Picture		

APPLIED LOADS

Load type	Description	Rz, lbf	Rx, lbf
DL	Roof dead load	-4940	750
Lr	Roof Live load	-3450	750
W (up)	Roof wind load (up)	1830	730
W (down)	Roof wind load (down)	-200	1160

Point load with "-" - directed downwards.

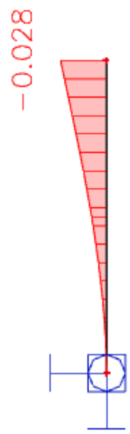
MAXIMUM FORCES

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
C1	2' 9.500"	LRFD-Ult (auto)/1	**-2616.00**	**0.00**	-1405.00	**0.00**	**0.00**	**0.00**
C1	0.000"	LRFD-Ult (auto)/2	-4493.82	0.00	**-675.00**	0.00	1884.37	0.00
C1	0.000"	LRFD-Ult (auto)/3	**-11611.76**	0.00	**-2680.00**	0.00	**7481.67**	**0.00**

Name	Combination key
LRFD-Ult (auto)/1	0.90*DL1 + 0.90*DL2 + W (up)
LRFD-Ult (auto)/2	0.90*DL1 + 0.90*DL2
LRFD-Ult (auto)/3	1.20*DL1 + 1.60*Lr + 1.20*DL2 + 0.50*W (down)

Displacement

Load case D + 0.75xLr + 0.45xW (down), inch:



The maximum deflection for a web header is 0.028".

According to TABLE 1604.3 the code IBC 2018, maximum member deflection should not exceed - L/360.

L= 2'-9" * 2 =66", 66"/360=0.183". 0.028"< 0.183". <u>Deflection is OK!</u>

<u>STEEL MEMBER C1 CHECK</u>

AISC 360-16 LRFD Check

Member C1	HSS6X6X1/4	A500 grade C	LRFD-Ult (auto)	0.21

Material data		
Yield stress Fy	46.00	ksi
Tensile stress Fu	61.50	ksi
fabrication	rolled	

The critical check is on position 0.00 ft

Classification for Axial Compression

according to article B4 and Table B4.1a

Compression N	ratio	Lambda,r (Non-slender)
Webs	20.00	35.16
Internal flanges	20.00	35.16

Section is classified as non-slender section.

Classification for Flexure

according to article B4 and Table B4.1b

Bending Mx	ratio	Lambda,p (Compact)	Lambda,r (Non-compact)
Webs	20.00	60.77	143.14
Internal flanges	20.00	28.13	35.16

Section is classified as compact section.

Axis definition :
- local x- axis in this code check is referring to the local y axis in Scia Engineer
- local y- axis in this code check is referring to the local z axis in Scia Engineer

Internal forces		
Pu	-11611.76	lbf
Vux	0.00	lbf
Vuy	-2680.00	lbf
Mut	0.00	lbfft
Mux	7481.67	lbfft
Muy	0.00	lbfft

Buckling parameters	xx	yy	
type	sway	sway	
Slenderness	28.78	28.78	
Reduced slenderness	0.36	0.36	
Length	2.79	2.79	ft
Effective length factor, K	2.00	2.00	
Effective length, Lc	5.58	5.58	ft

Buckling check
according to article E3 and formula (E3-1)

Table of values		
Pn	243209.92	lbf
Pu	11611.76	lbf
Fcr	43.51	ksi
Resistance factor	0.90	
unity check	0.05	

Torsional buckling check
according to article E4 and formula (E4-1)

Table of values		
Pn	256567.87	lbf
Pu	11611.76	lbf
Fe	8647.93	ksi
Fez	8647.93	ksi
Resistance factor	0.90	
unity check	0.05	

LTB data		
Lb	2.79	ft
Cb	1.67	

Strong axis bending check
according to article F2 and formula (F2-1)

Table of values		
Mn	45616.66	lbfft
Mu	7481.67	lbfft
Resistance factor	0.90	
unity check	0.18	

Shear stress check
according to article G5 and formula (G2-1)
in buckling field 1

Table of values		
a	2.79	ft
h	0.38	ft
tw	0.25	inch
kv	5.34	
Vn	62100.01	lbf
Vu	-2680.00	lbf
Resistance factor	0.90	
unity check	0.05	

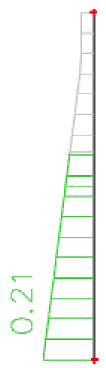
Combined stresses check
according to article H1.1 and formula (H1-1b)

Table of values		
Pr	11611.76	lbf
Mrx	7481.67	lbfft
Mry	-0.00	lbfft
Pc	218888.93	lbf
Mcx	41054.99	lbfft
Mcy	41054.99	lbfft
Res. factor compression	0.90	
Res. factor flexure	0.90	

unity check = 0.03+0.18+0.00=0.21 (H1-1b)
Torsion is neglected since Tr < 0,20 Tc.

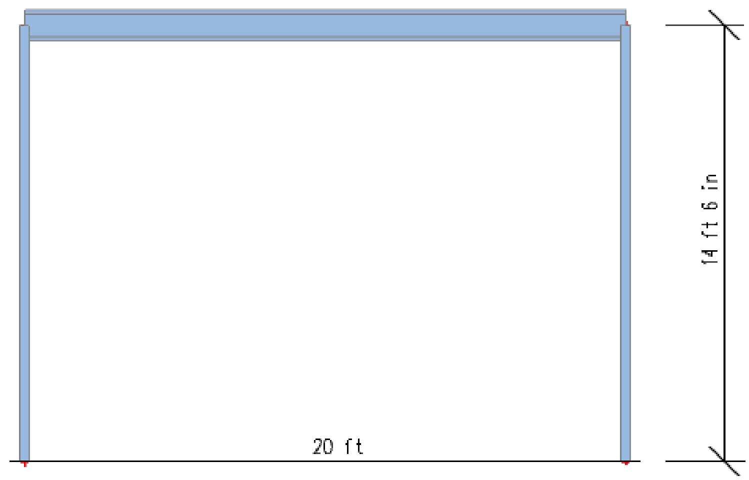
The member satisfies the check !

Unity check

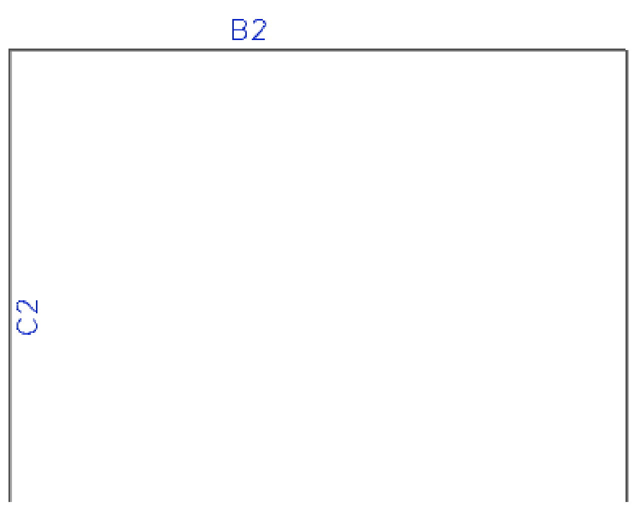


2.3.1.2 20FT - CANOPY ROOF BEAM AND COLUMN DESIGN

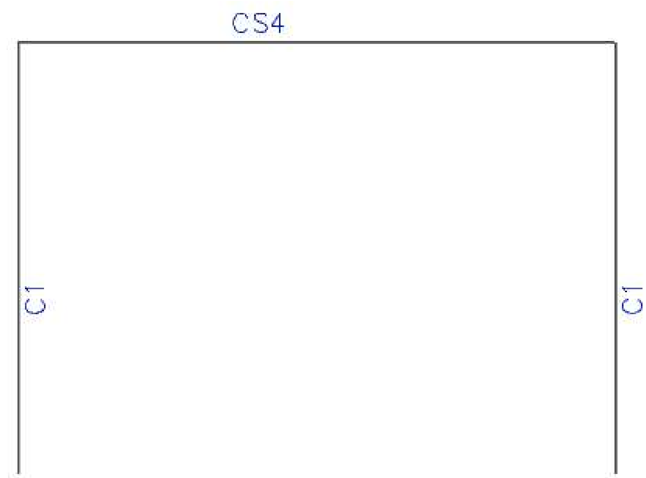
General scheme



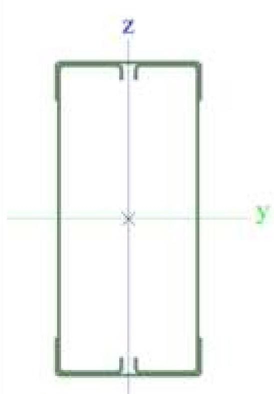
Members number



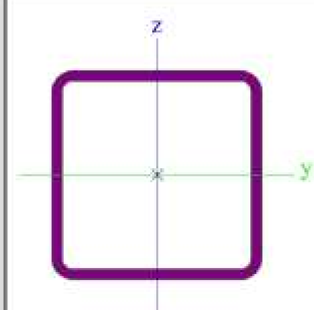
Members cross-sections



Cross-sections properties
CS4 - 2x1200S250-97 + 2x550T150-97

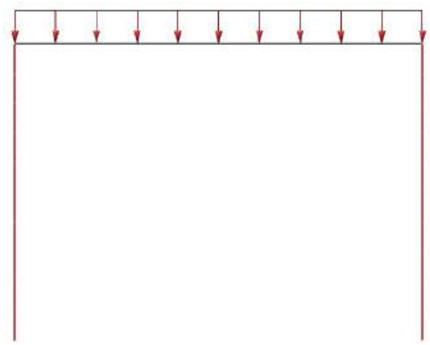
CS4		
Type	1200S250-97+550T150-97	
Shape type	Thin-walled	
Item material	A913 grade 50	
Fabrication	cold formed	
Colour		
A [inch^2]	5.170	
A_y [inch^2], A_z [inch^2]	2.042	2.598
A_L [inch^2/inch], A_D [inch^2/inch]	3.57e+01	7.89e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	6.431	-1.528
α [deg]	0.00	
I_y [inch^4], I_z [inch^4]	122.439	26.461
i_y [inch], i_z [inch]	4.867	2.262
$W_{el.y}$ [inch^3], $W_{el.z}$ [inch^3]	20.082	9.390
$W_{pl.y}$ [inch^3], $W_{pl.z}$ [inch^3]	23.238	10.832
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	1.16e+03	1.16e+03
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	5.42e+02	5.42e+02
d_y [inch], d_z [inch]	0.000	0.000
I_t [inch^4], I_w [inch^6]	55.297	186.273
β_y [inch], β_z [inch]	0.000	0.000
Picture		

Cross-sections properties
C1 - HSS5X5X1/4

C1		
Type	HSS5X5X1/4	
Formcode	2 - Rectangular hollow section	
Shape type	Thin-walled	
Item material	A500 grade C	
Fabrication	rolled	
Colour		
A [inch^2]	4.590	
A_y [inch^2], A_z [inch^2]	2.443	2.443
A_L [inch^2/inch], A_D [inch^2/inch]	1.91e+01	3.67e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	2.500	2.500
α [deg]	0.00	
I_y [inch^4], I_z [inch^4]	16.900	16.900
i_y [inch], i_z [inch]	1.919	1.919
$W_{el.y}$ [inch^3], $W_{el.z}$ [inch^3]	6.760	6.760
$W_{pl.y}$ [inch^3], $W_{pl.z}$ [inch^3]	8.070	8.070
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	3.71e+02	3.71e+02
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	3.71e+02	3.71e+02
d_y [inch], d_z [inch]	0.000	0.000
I_t [inch^4], I_w [inch^6]	26.563	0.066
β_y [inch], β_z [inch]	0.000	0.000
Picture		

APPLIED LOADS

LOAD ON ROOF BEAM		
Beam length, (ft)	20	Roof slope, α = 22.6
Loading width, (ft)	15.5	
Load	**Distr. Load, psf**	**Liner Load, plf**
Roof Dead Load	17.85	276.68
Roof LL	20.00	310.00
Roof Wind (up)	24.10	373.55
Roof Wind (down)	8.00	124.00



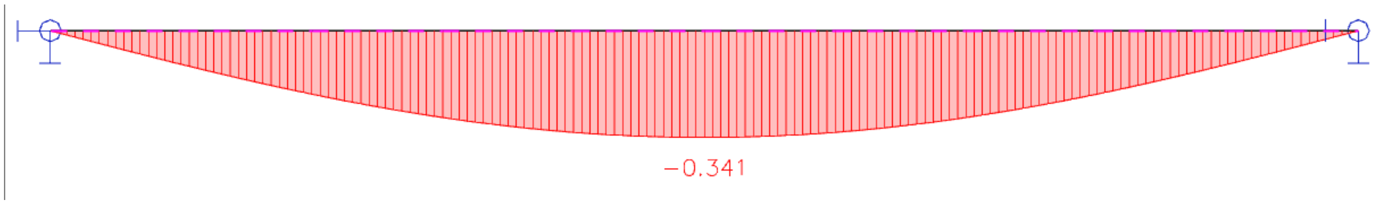
MAXIMUM FORCES

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B2	20' 0.000"	LRFD-Ult (auto)/1	0.0	0.0	**-9669.5**	0.0	0.0	0.0
B2	0.000"	LRFD-Ult (auto)/1	**0.0**	**0.0**	**9669.5**	**0.0**	0.0	**0.0**
B2	10' 0.000"-	LRFD-Ult (auto)/2	0.0	0.0	1.5	0.0	**-2531.6**	0.0
B2	10' 0.000"-	LRFD-Ult (auto)/1	0.0	0.0	2.0	0.0	**48357.8**	0.0
C2	14' 6.000"	LRFD-Ult (auto)/2	**507.9**	**0.0**	232.0	**0.0**	**0.0**	**0.0**
C2	0.000"	LRFD-Ult (auto)/3	-5741.5	0.0	**-304.5**	0.0	0.0	0.0
C2	14' 6.000"	LRFD-Ult (auto)/3	-5469.5	0.0	**304.5**	0.0	0.0	0.0
C2	7' 3.000"-	LRFD-Ult (auto)/3	-5605.5	0.0	0.0	0.0	**-1103.8**	0.0
C2	0.000"	LRFD-Ult (auto)/1	**-9941.5**	0.0	-152.3	0.0	0.0	**0.0**
C3	14' 6.000"	LRFD-Ult (auto)/2	**507.9**	**0.0**	232.0	**0.0**	**0.0**	**0.0**
C3	0.000"	LRFD-Ult (auto)/3	-5741.5	0.0	**-304.5**	0.0	0.0	0.0
C3	14' 6.000"	LRFD-Ult (auto)/3	-5469.5	0.0	**304.5**	0.0	0.0	0.0
C3	7' 3.000"-	LRFD-Ult (auto)/3	-5605.5	0.0	0.0	0.0	**-1103.8**	0.0
C3	0.000"	LRFD-Ult (auto)/1	**-9941.5**	0.0	-152.3	0.0	0.0	**0.0**

Name	Combination key
LRFD-Ult (auto)/1	1.20*DL1 + 1.60*Lr + 1.20*DL2 + 0.50*Wind (down)
LRFD-Ult (auto)/2	0.90*DL1 + 0.90*DL2 + Wind (up)
LRFD-Ult (auto)/3	1.20*DL1 + 1.20*DL2 + Wind (down)

Displacement

Load case D + Lr, inch:



The maximum deflection for a web header is 0.341”.

According to TABLE 1604.3 the code IBC 2018, maximum member deflection should not exceed - L/360.

L=20’=240”, 120”/360=0.667”. 0.341"< 0.667”. <u>Deflection is OK!</u>

<u>STEEL MEMBER B2 CHECK</u>

AISI S100-16 LRFD Check

Member B2	1200S250-97+550T150-97	A913 grade 50	LRFD-Ult (auto)	0.64

Material data		
Yield stress Fy	50.00	ksi
Tensile stress Fu	65.00	ksi
fabrication	cold formed	

The critical check is on position 10.00 ft

Axis definition :
- local x- axis in this code check is referring to the local y axis in Scia Engineer
- local y- axis in this code check is referring to the local z axis in Scia Engineer

Internal forces		
Pu	-0.00	lbf
Vux	0.00	lbf
Vuy	2.03	lbf
Mut	0.00	lbfft
Mux	48357.82	lbfft
Muy	-0.00	lbfft

...::Flexural Strength about X-axis::...

Nominal Flexural Strength

According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.574	49.2 44.4	0.90	0.465	382.4	0.359	1.000	0.574 -	- -	-	- -	-
2	2.398	49.6 49.6	1.00	4.000	719.8	0.262	1.000	2.398 -	- -	-	- -	-
3	9.194	38.0 -38.0	1.00	24.000	77.0	0.703	0.978	- 8.989	2.247 4.494	-	- -	-
4	2.398	-49.6 -49.6	-	-	-	-	-	- -	- -	-	- -	-
5	0.574	-44.4 -49.2	-	-	-	-	-	- -	- -	-	- -	-
6	0.099	50.0 49.2	0.98	4.033	100788.0	0.022	1.000	- 0.099	0.049 0.050	-	- -	-
7	0.099	50.0 50.0	1.00	4.000	99966.8	0.022	1.000	0.099 -	- -	-	- -	-
8	0.099	50.0 49.2	0.98	4.033	100788.0	0.022	1.000	- 0.099	0.049 0.050	-	- -	-
9	0.574	-44.4 -49.2	-	-	-	-	-	- -	- -	-	- -	-
10	2.398	-49.6 -49.6	-	-	-	-	-	- -	- -	-	- -	-
11	9.194	38.0 -38.0	1.00	24.000	77.0	0.703	0.978	- 8.989	2.247 4.494	-	- -	-
12	2.398	49.6 49.6	1.00	4.000	719.8	0.262	1.000	2.398 -	- -	-	- -	-
13	0.574	49.2 44.4	0.90	0.465	382.4	0.359	1.000	0.574 -	- -	-	- -	-
14	0.099	-49.2 -50.0	-	-	-	-	-	- -	- -	-	- -	-
15	0.099	-50.0 -50.0	-	-	-	-	-	- -	- -	-	- -	-
16	0.099	-49.2 -50.0	-	-	-	-	-	- -	- -	-	- -	-
17	0.544	50.0 50.0	1.00	4.000	3337.9	0.122	1.000	0.544 -	- -	-	- -	-
22	1.352	49.2 38.0	0.77	4.478	2535.3	0.139	1.000	- 1.352	0.607 0.745	-	- -	-
26	1.352	-38.0 -49.2	-	-	-	-	-	- -	- -	-	- -	-
30	0.099	-50.0 -50.0	-	-	-	-	-	- -	- -	-	- -	-
35	1.352	49.2 38.0	0.77	4.478	2535.3	0.139	1.000	- 1.352	0.607 0.745	-	- -	-
39	0.544	-50.0 -50.0	-	-	-	-	-	- -	- -	-	- -	-
44	1.352	-38.0 -49.2	-	-	-	-	-	- -	- -	-	- -	-
48	0.099	50.0 50.0	1.00	4.000	99966.8	0.022	1.000	0.099 -	- -	-	- -	-

Table of values		
Sxe	20.082	$inch^3$
Mnxo	83674.5	lbfft
Resistance factor	0.90	
Unity check	0.64	-

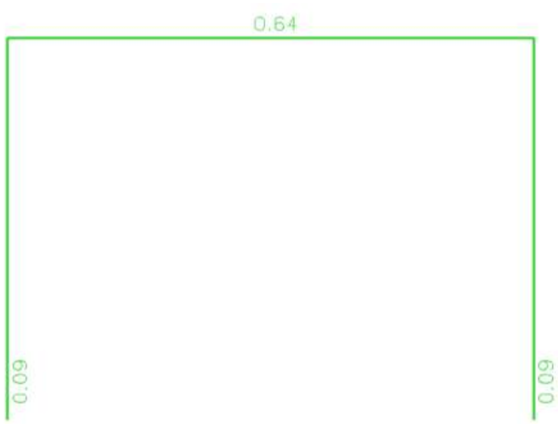
Lateral-Torsional Buckling Strength
According to article F2.1 and formula (F2.1-1),(F2.1.1-1).

Table of values		
Lltb	2' 0.000"	ft
Sigma,ey	inf	ksi
Kt	1.00	
Lt	2' 0.000"	ft
Sigma,t	4765.0	ksi
Cb	1.01	
Sfx	20.082	$inch^3$
Fcre	inf	ksi

Note: Lateral-Torsional buckling is not governing since Fe is greater than or equal to 2.78 Fy.

The member satisfies the check !

Unity check



Check of steel

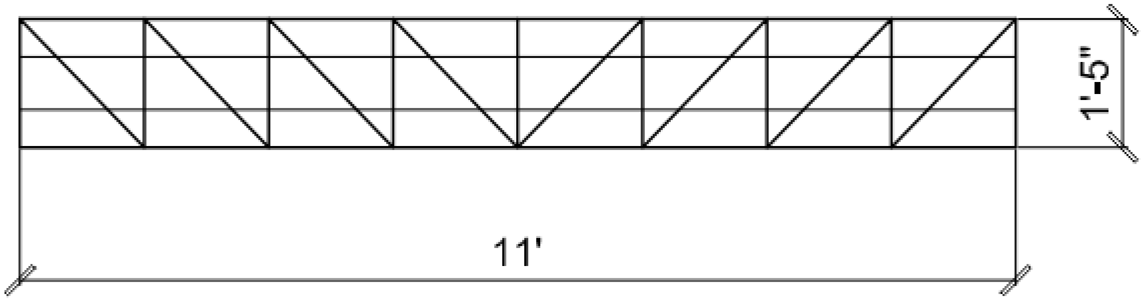
Linear calculation, Extreme : Member
Selection : All
Combinations : LRFD-Ult (auto)

Case	Member	css	mat	dx [ft]	un.check [-]
LRFD-Ult (auto)/1	B2	CS4 - 1200S250-97+550T150-97	A913 grade 50	10' 0.000"	0.64
LRFD-Ult (auto)/1	C2	C1 - HSS(Imp-A)5X5X1/4	A500 grade C	0.000"	0.09
LRFD-Ult (auto)/1	C3	C1 - HSS(Imp-A)5X5X1/4	A500 grade C	0.000"	0.09

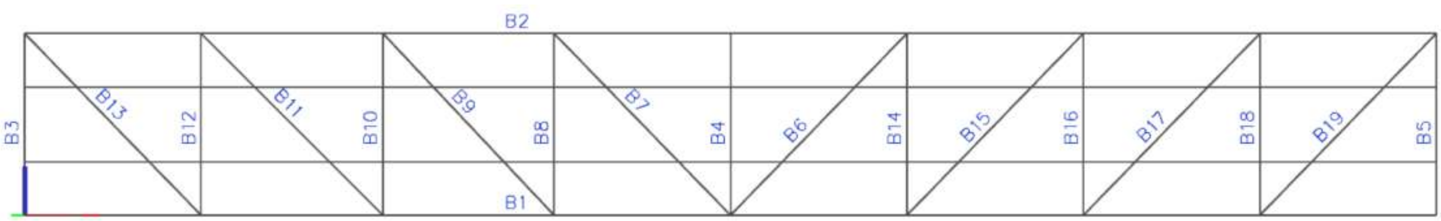
2.3.1.3 10 FT - DOOR OPENING WEB HEADER DESIGN

General scheme

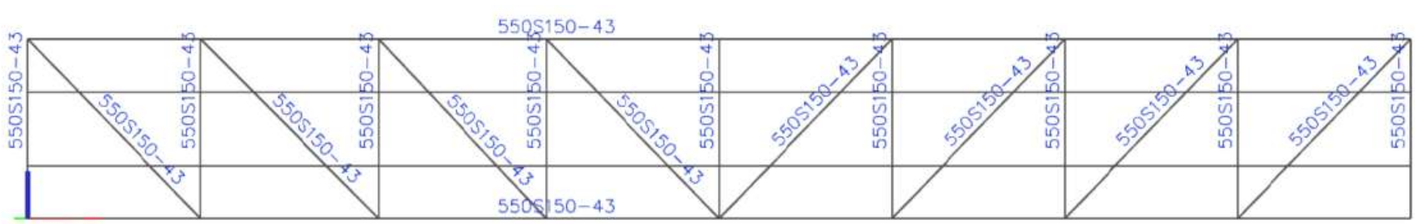
The top and bottom chord of the web header is reinforced with 5”x0.043” steel plates on both sides.



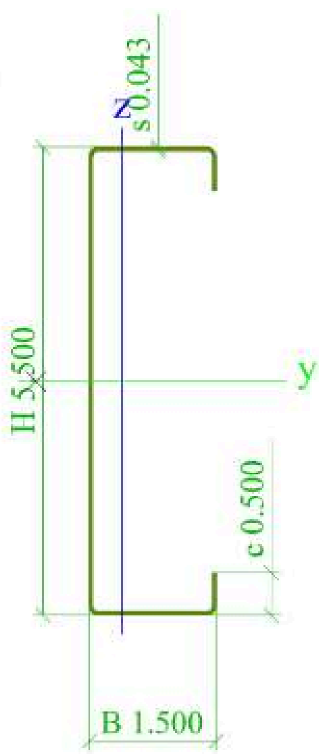
Members number



Members cross-sections



Cross-sections properties

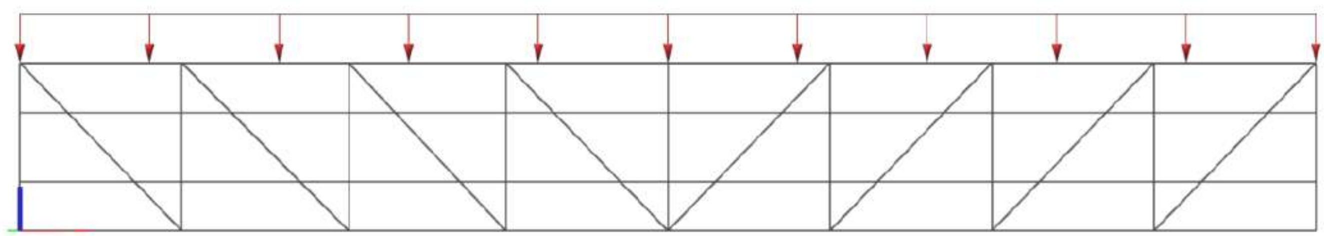
550S150-43		
Type	Cold formed C section	
Detailed	5.500; 1.500; 0.043; 0.065; 0.500	
Formcode	114 - Cold formed C section	
Shape type	Thin-walled	
Item material	A913 grade 50	
Fabrication	cold formed	
Colour		
A [$inch^2$]	0.395	
A_y [$inch^2$], A_z [$inch^2$]	0.130	0.243
A_L [$inch^2$/inch], A_D [$inch^2$/inch]	1.84e+01	1.84e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	0.393	2.750
α [deg]	0.00	
I_y [$inch^4$], I_z [$inch^4$]	1.722	0.115
i_y [inch], i_z [inch]	2.089	0.539
$W_{el.y}$ [$inch^3$], $W_{el.z}$ [$inch^3$]	0.626	0.104
$W_{pl.y}$ [$inch^3$], $W_{pl.z}$ [$inch^3$]	0.747	0.148
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	3.73e+01	3.73e+01
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	7.39e+00	7.39e+00
d_y [inch], d_z [inch]	-1.010	0.000
I_t [$inch^4$], I_w [$inch^6$]	0.000	0.721
$β_y$ [inch], $β_z$ [inch]	0.000	5.886
Picture		

Explanations of symbols	
Formcode	s - Thickness r - Inner radius b - Flange width h - Height c - Lip
A	Area
A_y	Shear Area in principal y-direction
A_z	Shear Area in principal z-direction
A_L	Circumference per unit length
A_D	Drying surface per unit length
$c_{Y.UCS}$	Centroid coordinate in Y-direction of Input axis system
$c_{Z.UCS}$	Centroid coordinate in Z-direction of Input axis system
$I_{Y.LCS}$	Second moment of area about the YLCS axis
$I_{Z.LCS}$	Second moment of area about the ZLCS axis
$I_{YZ.LCS}$	Product moment of area in the LCS system
α	Rotation angle of the principal axis system
I_y	Second moment of area about the principal y-axis
I_z	Second moment of area about the principal z-axis
i_y	Radius of gyration about the principal y-axis

Explanations of symbols	
i_z	Radius of gyration about the principal z-axis
$W_{el.y}$	Elastic section modulus about the principal y-axis
$W_{el.z}$	Elastic section modulus about the principal z-axis
$W_{pl.y}$	Plastic section modulus about the principal y-axis
$W_{pl.z}$	Plastic section modulus about the principal z-axis
$M_{pl.y.+}$	Plastic moment about the principal y-axis for a positive My moment
$M_{pl.y.-}$	Plastic moment about the principal y-axis for a negative My moment
$M_{pl.z.+}$	Plastic moment about the principal z-axis for a positive Mz moment
$M_{pl.z.-}$	Plastic moment about the principal z-axis for a negative Mz moment
d_y	Shear center coordinate in principal y-direction measured from the centroid
d_z	Shear center coordinate in principal z-direction measured from the centroid
I_t	Torsional constant
I_w	Warping constant
β_y	Mono-symmetry constant about the principal y-axis
β_z	Mono-symmetry constant about the principal z-axis

APPLIED LOADS

LOAD ON THE TOP CHORD OF WEB HEADER			
Truss length, (ft)	11		
Loading width, (ft)	14.55		
Load	**Distr. Load, psf**	**Liner Load, plf**	**Reactions, lb**
Roof Dead Load	17.85	259.72	1428.45
Roof LL	20	291.00	1600.50
Roof Wind (up)	23.12	336.40	1850.18
Roof Wind (down)	8	116.40	640.20



MAXIMUM FORCES

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B1	11' 0.000"	LRFD-Ult (auto)/1	-130.4	0.0	**-340.9**	0.0	3.8	0.0
B1	5' 10.853"-	LRFD-Ult (auto)/2	**-644.1**	0.0	0.4	0.0	**-2.7**	0.0
B1	5' 10.853"-	LRFD-Ult (auto)/1	**5798.5**	**0.0**	-3.0	**0.0**	**24.7**	**0.0**
B1	0.000"	LRFD-Ult (auto)/1	-130.5	0.0	**340.9**	0.0	3.8	**0.0**
B2	4' 10.235"-	LRFD-Ult (auto)/1	**-5955.0**	0.0	-6.9	0.0	26.1	0.0
B2	4' 10.235"-	LRFD-Ult (auto)/2	**662.0**	**0.0**	0.7	**0.0**	-2.9	**0.0**
B2	9' 7.500"-	LRFD-Ult (auto)/1	-3245.9	0.0	**-160.2**	0.0	-10.4	0.0
B2	1' 4.500"+	LRFD-Ult (auto)/1	-3242.3	0.0	**166.0**	0.0	-11.5	0.0
B2	1' 4.500"-	LRFD-Ult (auto)/1	-2207.5	0.0	-110.7	0.0	**-12.3**	0.0
B2	7' 9.176"-	LRFD-Ult (auto)/1	-5428.6	0.0	2.8	0.0	**26.8**	0.0

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B3	1' 0.000"-	LRFD-Ult (auto)/2	**464.3**	**0.0**	51.5	**0.0**	17.1	**0.0**
B3	5.000"+	LRFD-Ult (auto)/1	**-4164.4**	0.0	**-462.2**	0.0	116.3	0.0
B3	1' 1.000"-	LRFD-Ult (auto)/1	-3112.5	0.0	**499.2**	0.0	-110.3	0.0
B3	1' 0.000"+	LRFD-Ult (auto)/1	-3562.3	0.0	465.6	0.0	**-155.7**	0.0
B3	5.000"-	LRFD-Ult (auto)/1	-4089.6	0.0	-57.9	0.0	**125.7**	0.0
B4	5.000"-	LRFD-Ult (auto)/2	**117.6**	**0.0**	0.0	**0.0**	0.0	**0.0**
B4	1' 0.000"+	LRFD-Ult (auto)/1	-166.4	0.0	**-0.1**	0.0	0.0	0.0
B4	5.000"-	LRFD-Ult (auto)/1	-1030.1	0.0	0.0	0.0	**0.0**	0.0
B4	1' 0.000"-	LRFD-Ult (auto)/1	-975.6	0.0	**0.1**	0.0	**0.0**	0.0
B4	0.000"	LRFD-Ult (auto)/1	**-1030.8**	0.0	0.0	0.0	0.0	**0.0**
B5	5.000"+	LRFD-Ult (auto)/1	**-4164.5**	0.0	**462.1**	0.0	-116.2	0.0
B5	1' 0.000"-	LRFD-Ult (auto)/2	**464.3**	**0.0**	-51.5	**0.0**	-17.1	**0.0**
B5	1' 1.000"-	LRFD-Ult (auto)/1	-3112.4	0.0	**-499.4**	0.0	110.3	0.0
B5	5.000"-	LRFD-Ult (auto)/1	-4089.5	0.0	58.0	0.0	**-125.6**	0.0
B5	1' 0.000"+	LRFD-Ult (auto)/1	-3562.3	0.0	-465.8	0.0	**155.7**	0.0
B6	6.968"-	LRFD-Ult (auto)/1	**832.8**	**0.0**	13.2	**0.0**	7.8	**0.0**
B6	1' 11.691"	LRFD-Ult (auto)/1	92.5	0.0	**-75.2**	0.0	0.0	0.0
B6	6.968"+	LRFD-Ult (auto)/1	661.7	0.0	**44.4**	0.0	5.7	0.0
B6	1' 4.723"+	LRFD-Ult (auto)/2	-10.5	0.0	8.8	0.0	**-4.9**	0.0
B6	1' 4.723"+	LRFD-Ult (auto)/1	91.8	0.0	-74.6	0.0	**43.5**	0.0
B6	0.000"	LRFD-Ult (auto)/2	**-93.0**	0.0	-1.2	0.0	0.0	**0.0**
B7	1' 11.691"	LRFD-Ult (auto)/2	**-93.1**	0.0	1.2	0.0	0.0	0.0
B7	1' 4.723"+	LRFD-Ult (auto)/1	**833.4**	**0.0**	-13.1	**0.0**	7.8	**0.0**
B7	1' 4.723"-	LRFD-Ult (auto)/1	660.2	0.0	**-44.6**	0.0	5.6	0.0
B7	0.000"	LRFD-Ult	91.4	0.0	**75.4**	0.0	0.0	0.0

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
		(auto)/1						
B7	6.968"-	LRFD-Ult (auto)/2	-10.4	0.0	-8.8	0.0	**-5.0**	0.0
B7	6.968"-	LRFD-Ult (auto)/1	90.7	0.0	74.8	0.0	**43.6**	0.0
B8	1' 0.000"-	LRFD-Ult (auto)/2	**175.3**	**0.0**	18.4	**0.0**	5.1	**0.0**
B8	5.000"+	LRFD-Ult (auto)/1	**-1526.3**	0.0	**-164.4**	0.0	**50.8**	0.0
B8	1' 0.000"-	LRFD-Ult (auto)/1	-1525.3	0.0	-164.4	0.0	**-45.1**	0.0
B8	0.000"	LRFD-Ult (auto)/1	-1305.9	0.0	**120.8**	0.0	0.0	**0.0**
B9	1' 4.479"-	LRFD-Ult (auto)/2	**-247.2**	0.0	12.1	0.0	2.8	0.0
B9	6.866"+	LRFD-Ult (auto)/1	**2228.4**	**0.0**	-109.9	**0.0**	63.7	**0.0**
B9	0.000"	LRFD-Ult (auto)/1	1113.0	0.0	**117.2**	0.0	0.0	0.0
B9	1' 4.479"-	LRFD-Ult (auto)/1	2227.5	0.0	**-110.8**	0.0	**-24.7**	0.0
B9	6.866"-	LRFD-Ult (auto)/1	1112.4	0.0	116.6	0.0	**66.9**	0.0
B10	1' 0.000"-	LRFD-Ult (auto)/2	**299.2**	**0.0**	34.2	**0.0**	9.6	**0.0**
B10	5.000"+	LRFD-Ult (auto)/1	**-2640.3**	0.0	**-306.4**	0.0	**92.8**	0.0
B10	1' 0.000"-	LRFD-Ult (auto)/1	-2639.3	0.0	-306.4	0.0	**-85.9**	0.0
B10	0.000"	LRFD-Ult (auto)/1	-1898.9	0.0	**219.1**	0.0	0.0	**0.0**
B11	1' 4.971"-	LRFD-Ult (auto)/2	**-426.6**	0.0	17.9	0.0	5.8	0.0
B11	7.071"+	LRFD-Ult (auto)/1	**3845.3**	**0.0**	-161.9	**0.0**	82.1	**0.0**
B11	1' 4.971"-	LRFD-Ult (auto)/1	3844.3	0.0	**-162.8**	0.0	-51.8	0.0
B11	0.000"	LRFD-Ult (auto)/1	2180.2	0.0	**146.5**	0.0	0.0	0.0
B11	1' 4.971"+	LRFD-Ult (auto)/1	2566.6	0.0	91.3	0.0	**-53.6**	0.0
B11	7.071"-	LRFD-Ult (auto)/1	2179.5	0.0	145.9	0.0	**86.1**	0.0
B12	1' 0.000"-	LRFD-Ult (auto)/2	**431.1**	**0.0**	51.6	**0.0**	14.7	**0.0**
B12	5.000"+	LRFD-Ult (auto)/1	**-3822.3**	0.0	**-463.0**	0.0	**138.4**	0.0
B12	1' 0.000"-	LRFD-Ult (auto)/1	-3821.4	0.0	-463.0	0.0	**-131.6**	0.0
B12	0.000"	LRFD-Ult (auto)/1	-2468.0	0.0	**326.4**	0.0	0.0	**0.0**

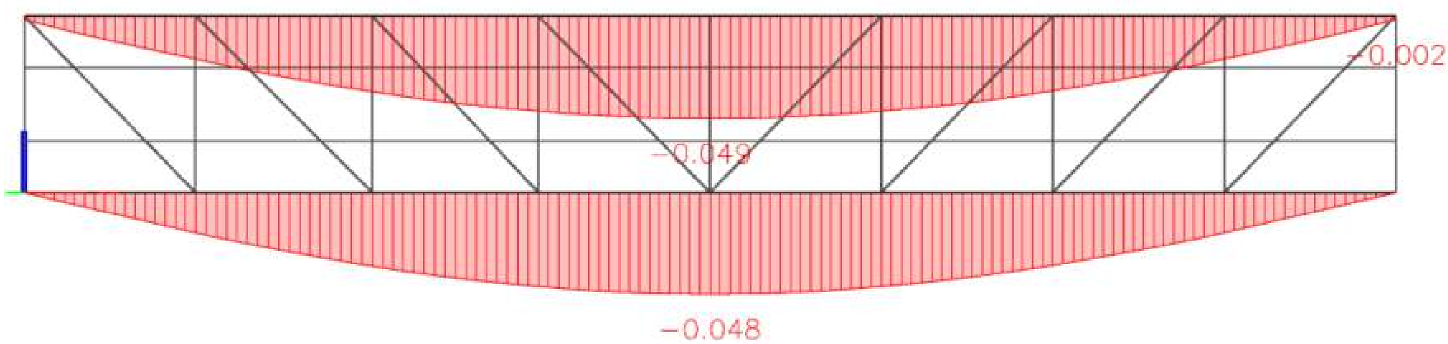
Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B13	1' 4.723"-	LRFD-Ult (auto)/2	**-554.8**	0.0	26.2	0.0	10.0	0.0
B13	6.968"+	LRFD-Ult (auto)/1	**4996.8**	**0.0**	-235.9	**0.0**	102.5	**0.0**
B13	1' 4.723"-	LRFD-Ult (auto)/1	4995.9	0.0	**-236.8**	0.0	-89.7	0.0
B13	0.000"	LRFD-Ult (auto)/1	2952.9	0.0	**184.7**	0.0	0.0	0.0
B13	1' 4.723"+	LRFD-Ult (auto)/1	3213.3	0.0	159.5	0.0	**-92.4**	0.0
B13	6.968"-	LRFD-Ult (auto)/1	2952.2	0.0	184.1	0.0	**107.1**	0.0
B14	1' 0.000"-	LRFD-Ult (auto)/2	**178.0**	**0.0**	-18.5	**0.0**	-5.1	**0.0**
B14	5.000"+	LRFD-Ult (auto)/1	**-1549.7**	0.0	165.2	0.0	**-51.3**	0.0
B14	1' 0.000"-	LRFD-Ult (auto)/1	-1548.8	0.0	**165.2**	0.0	**45.1**	0.0
B14	0.000"	LRFD-Ult (auto)/1	-1319.6	0.0	**-121.7**	0.0	0.0	**0.0**
B15	6.968"+	LRFD-Ult (auto)/2	**-253.2**	0.0	-12.0	0.0	2.8	0.0
B15	1' 4.723"-	LRFD-Ult (auto)/1	**2282.2**	**0.0**	108.8	**0.0**	64.2	**0.0**
B15	1' 11.691"	LRFD-Ult (auto)/1	1131.6	0.0	**-116.5**	0.0	0.0	0.0
B15	6.968"+	LRFD-Ult (auto)/1	2281.3	0.0	**109.7**	0.0	**-24.6**	0.0
B15	1' 4.723"+	LRFD-Ult (auto)/1	1130.9	0.0	-115.8	0.0	**67.4**	0.0
B16	1' 0.000"-	LRFD-Ult (auto)/2	**300.9**	**0.0**	-34.8	**0.0**	-9.8	**0.0**
B16	5.000"+	LRFD-Ult (auto)/1	**-2655.0**	0.0	312.2	0.0	**-93.9**	0.0
B16	1' 0.000"-	LRFD-Ult (auto)/1	-2654.1	0.0	**312.2**	0.0	**88.2**	0.0
B16	0.000"	LRFD-Ult (auto)/1	-1909.4	0.0	**-222.0**	0.0	0.0	**0.0**
B17	6.968"+	LRFD-Ult (auto)/2	**-423.4**	0.0	-18.4	0.0	6.0	0.0
B17	1' 4.723"-	LRFD-Ult (auto)/1	**3816.2**	**0.0**	166.8	**0.0**	82.7	**0.0**
B17	1' 11.691"	LRFD-Ult (auto)/1	2181.4	0.0	**-149.6**	0.0	0.0	0.0
B17	6.968"+	LRFD-Ult (auto)/1	3815.2	0.0	**167.7**	0.0	-53.2	0.0
B17	6.968"-	LRFD-Ult (auto)/1	2542.3	0.0	-95.2	0.0	**-55.1**	0.0
B17	1' 4.723"+	LRFD-Ult (auto)/1	2180.7	0.0	-148.9	0.0	**86.7**	0.0

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B18	1' 0.000"-	LRFD-Ult (auto)/2	**429.8**	**0.0**	-51.1	**0.0**	-14.5	**0.0**
B18	5.000"+	LRFD-Ult (auto)/1	**-3811.4**	0.0	459.1	0.0	**-137.7**	0.0
B18	1' 0.000"-	LRFD-Ult (auto)/1	-3810.5	0.0	**459.1**	0.0	**130.1**	0.0
B18	0.000"	LRFD-Ult (auto)/1	-2461.4	0.0	**-324.5**	0.0	0.0	**0.0**
B19	6.968"+	LRFD-Ult (auto)/2	**-553.5**	0.0	-26.2	0.0	10.0	0.0
B19	1' 4.723"-	LRFD-Ult (auto)/1	**4985.4**	**0.0**	236.0	**0.0**	102.5	**0.0**
B19	1' 11.691"	LRFD-Ult (auto)/1	2949.8	0.0	**-184.8**	0.0	0.0	0.0
B19	6.968"+	LRFD-Ult (auto)/1	4984.5	0.0	**236.9**	0.0	-89.7	0.0
B19	6.968"-	LRFD-Ult (auto)/1	3206.3	0.0	-159.5	0.0	**-92.4**	0.0
B19	1' 4.723"+	LRFD-Ult (auto)/1	2949.1	0.0	-184.2	0.0	**107.1**	0.0

Name	Combination key
LRFD-Ult (auto)/1	1.20*DL1 + 1.60*Lr + 1.20*DL2 + 0.50*W (down)
LRFD-Ult (auto)/2	0.90*DL1 + 0.90*DL2 + W (up)

Displacement

Load case Lr, inch:



The maximum deflection for a web header is 0.049".

According to TABLE 1604.3 the code IBC 2018, maximum member deflection should not exceed - L/360. L=11'=132", 132"/360=0.366". 0.049"< 0.366". <u>Deflection is OK!</u>

STEEL MEMBER B2 CHECK

AISI S100-16 LRFD Check

Member B2	Cold formed C section (5.500; 1.500; 0.043; 0.065; 0.500)	A913 grade 50	LRFD-Ult (auto)	0.91

Material data		
Yield stress Fy	50.00	ksi
Tensile stress Fu	65.00	ksi
fabrication	cold formed	

The critical check is on position 4.85 ft

Axis definition :
- local x- axis in this code check is referring to the local y axis in Scia Engineer
- local y- axis in this code check is referring to the local z axis in Scia Engineer

Internal forces		
Pu	-5955.00	lbf
Vux	6.87	lbf
Vuy	0.00	lbf
Mut	-0.00	lbfft
Mux	0.00	lbfft
Muy	-85.41	lbfft

Note: Mux and/or Muy include additional moments as defined in art. H1.2

...::Flexural Strength about Y-axis::...
Nominal Flexural Strength
According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch^4]	ds [inch]
1	0.393	-50.0 -50.0	-	-	-	-	-	- -	- -	-	- -	-
3	1.285	25.7 -45.3	1.76	51.660	1516.6	0.130	1.000	- 1.285	0.270 0.643	-	- -	-
5	5.285	30.4 30.4	1.00	4.000	6.9	2.094	0.427	2.259 -	- -	-	- -	-
7	1.285	25.7 -45.3	1.76	51.660	1516.6	0.130	1.000	- 1.285	0.270 0.643	-	- -	-
9	0.392	-50.0 -50.0	-	-	-	-	-	- -	- -	-	- -	-

Table of values		
Sye	0.095	inch^3
Mnyo	396.5	lbfft
Resistance factor	0.90	
Unity check	0.24	-

Lateral-Torsional Buckling Strength
According to article F2.1 and formula (F2.1-1),(F2.1.2-1).

Table of values		
Sigma,ex	4589.8	ksi
Kt	1.00	
Lt	1' 4.500"	ft
Sigma,t	339.8	ksi
Cs	1.00	
CTF	1.00	
Sfy	0.292	$inch^3$
j	3.034	inch
Fcre	38067.0	ksi

Note: Lateral-Torsional buckling is not governing since Fe is greater than or equal to 2.78 Fy.

...::Axial Compression Strength::...
Nominal Axial Strength
According to article E2 and formula (E2-1)

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [$inch^4$]	ds [inch]
1	0.393	50.0 50.0	1.00	0.430	135.3	0.608	1.000	0.236 -	- -	-	- -	-
3	1.285	50.0 50.0	1.00	2.850	83.7	0.773	0.925	1.189 -	0.358 0.831	30.83	0.000 0.000	0.236
5	5.285	50.0 50.0	1.00	4.000	6.9	2.684	0.342	1.808 -	- -	-	- -	-
7	1.285	50.0 50.0	1.00	2.850	83.7	0.773	0.925	1.189 -	0.358 0.831	30.83	0.000 0.000	0.236
9	0.392	50.0 50.0	1.00	0.430	135.3	0.608	1.000	0.236 -	- -	-	- -	-

Table of values		
Fn	50.0	ksi
Ae	0.224	$inch^2$
Pno	11177.0	lbf
Resistance factor	0.85	
Unity check	0.63	-

Buckling check
According to article E2 and formula (E2-1)
Flexural Buckling Strength
According to article E2.1 and formula (E2.1-1)

Buckling parameters	xx	yy	
Sway type	sway	sway	
Unbraced Length L	1 3/8	1 3/8	ft
Effective Length factor K	1.00	1.00	
Effective Length	1 3/8	1 3/8	ft
Slenderness	7.90	30.61	
Flexural Buckling stress Fcre	4589.8	305.7	ksi

Torsional (-Flexural) Buckling Strength
According to article E2.2, E2.3, E2.4

Table of values		
Sigma,ex	4589.8	ksi
Sigma,ey	305.7	ksi
Kt	1.00	
Lt	1 3/8	ft
Sigma,t	339.8	ksi
Sigma,TF	305.7	ksi
Torsional (-Flexural) buckling stress Fcre	305.7	ksi

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [$inch^4$]	ds [inch]
1	0.393	46.7 46.7	1.00	0.430	135.3	0.587	1.000	0.276 -	- -	-	- -	-
3	1.285	46.7 46.7	1.00	2.975	87.3	0.731	0.956	1.229 -	0.433 0.796	31.90	0.000 0.000	0.276
5	5.285	46.7 46.7	1.00	4.000	6.9	2.593	0.353	1.865 -	- -	-	- -	-
7	1.285	46.7 46.7	1.00	2.975	87.3	0.731	0.956	1.229 -	0.433 0.796	31.90	0.000 0.000	0.276
9	0.392	46.7 46.7	1.00	0.430	135.3	0.587	1.000	0.276 -	- -	-	- -	-

Table of values		
Fe	305.7	ksi
lambda, c	0.40	
Fn	46.7	ksi
Ae	0.233	$inch^2$
Pn	10871.5	lbf
Resistance factor	0.85	
Unity check	0.64	-

Distortional Buckling Strength
According to article E4 and formula (E4.1-2).

Table of values		
Py	19731.9	lbf
L	1' 4.025"	ft
k,phi,fe	97.8	lbf
k,phi,we	76.8	lbf
k,phi	0.0	lbf
k,phi,fg	0.004	$inch^2$
k,phi,wg	0.005	$inch^2$
Fd	21.5	ksi
Pcrd	8472.8	lbf

Table of values		
Lambda,d	1.53	
Pn	10093.1	lbf
Resistance factor	0.85	
Unity check	0.69	-

Data		
Lm	1' 4.500"	ft
Lcr	1' 4.025"	ft
h0	5.500	inch
Ixf	0.001	$inch^4$
Iyf	0.016	$inch^4$
Ixyf	0.003	$inch^4$
Cwf	0.000	$inch^6$
Jf	0.000	$inch^4$
x0f	0.509	inch
hxf	-0.938	inch
Af	0.078	$inch^2$
y0f	-0.058	inch

Number of compressed flanges: 2
Critical flange contains Initial shape parts: 2, 3, 1

Combined Compressive Axial Load and Bending
According to article H1.2 and formulas (H1.2-1)

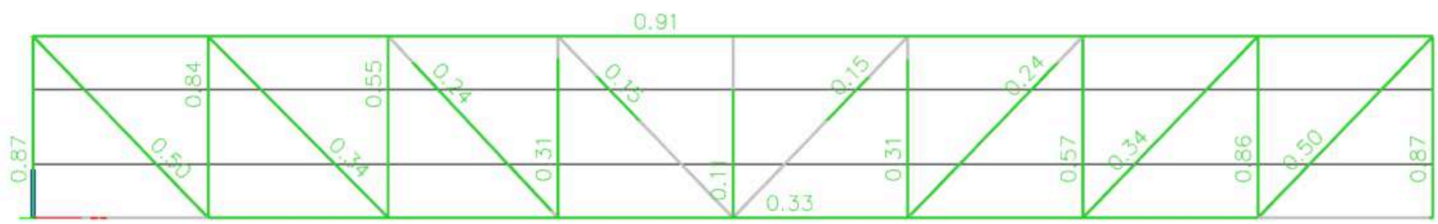
Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [$inch^4$]	ds [inch]
1	0.393	15.1 15.1	1.00	0.430	135.3	0.334	1.000	0.393 -	- -	-	- -	-
3	1.285	15.1 15.1	1.00	3.304	97.0	0.394	1.000	1.285 -	0.643 0.643	56.12	0.000 0.000	0.393
5	5.285	15.1 15.1	1.00	4.000	6.9	1.474	0.577	3.050 -	- -	-	- -	-
7	1.285	15.1 15.1	1.00	3.304	97.0	0.394	1.000	1.285 -	0.643 0.643	56.12	0.000 0.000	0.392
9	0.392	15.1 15.1	1.00	0.430	135.3	0.334	1.000	0.392 -	- -	-	- -	-

Table of values		
Centerline shift ex	0.120	inch
Centerline shift ey	0.000	inch
Additional moment Mx	0.0	lbfft
Additional moment My	-59.3	lbfft
Mny	396.5	lbfft
PEy	120621.2	lbf
Alfa y	0.95	
Cmy	0.85	
Pn	10093.1	lbf
Pno	11177.0	lbf
Resistance factor compression	0.85	
Resistance factor bending y	0.90	

Unity check = 0.69+0.00+0.21 = 0.91 - (H1.2-1)
Unity check = 0.63+0.00+0.24 = 0.87 -

The member satisfies the check !

Unity check



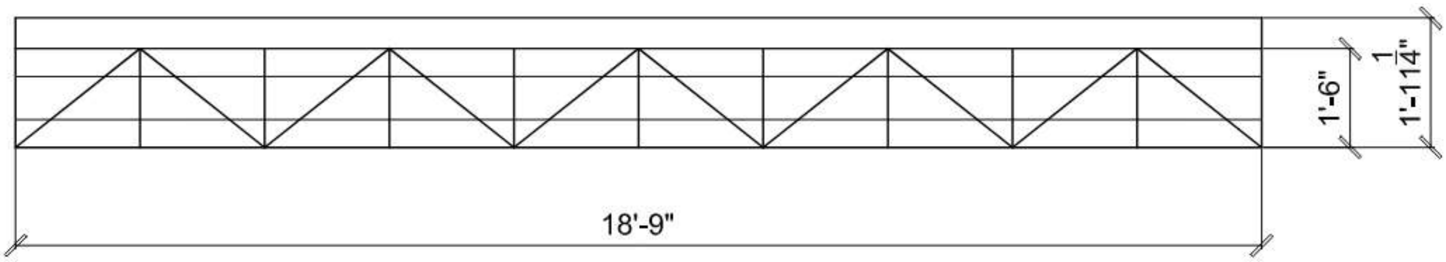
Combinations : LRFD-Ult (auto)

Case	Member	css	mat	dx [ft]	un.check [-]
LRFD-Ult (auto)/1	B1	550S150-43 - Cold formed C section	A913 grade 50	5' 10.853"	0.33
LRFD-Ult (auto)/1	B2	550S150-43 - Cold formed C section	A913 grade 50	4' 10.235"	0.91
LRFD-Ult (auto)/1	B3	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.87
LRFD-Ult (auto)/1	B4	550S150-43 - Cold formed C section	A913 grade 50	0.000"	0.11
LRFD-Ult (auto)/1	B5	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.87
LRFD-Ult (auto)/1	B6	550S150-43 - Cold formed C section	A913 grade 50	1' 4.723"	0.15
LRFD-Ult (auto)/1	B7	550S150-43 - Cold formed C section	A913 grade 50	6.968"	0.15
LRFD-Ult (auto)/1	B8	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.31
LRFD-Ult (auto)/1	B9	550S150-43 - Cold formed C section	A913 grade 50	6.866"	0.24
LRFD-Ult (auto)/1	B10	550S150-43 - Cold formed C section	A913 grade 50	1' 0.000"	0.55
LRFD-Ult (auto)/1	B11	550S150-43 - Cold formed C section	A913 grade 50	1' 4.971"	0.34
LRFD-Ult (auto)/1	B12	550S150-43 - Cold formed C section	A913 grade 50	1' 0.000"	0.84
LRFD-Ult (auto)/1	B13	550S150-43 - Cold formed C section	A913 grade 50	1' 4.723"	0.50
LRFD-Ult (auto)/1	B14	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.31
LRFD-Ult (auto)/1	B15	550S150-43 - Cold formed C section	A913 grade 50	1' 4.723"	0.24
LRFD-Ult (auto)/1	B16	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.57
LRFD-Ult (auto)/1	B17	550S150-43 - Cold formed C section	A913 grade 50	6.968"	0.34
LRFD-Ult (auto)/1	B18	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.86
LRFD-Ult (auto)/1	B19	550S150-43 - Cold formed C section	A913 grade 50	6.968"	0.50

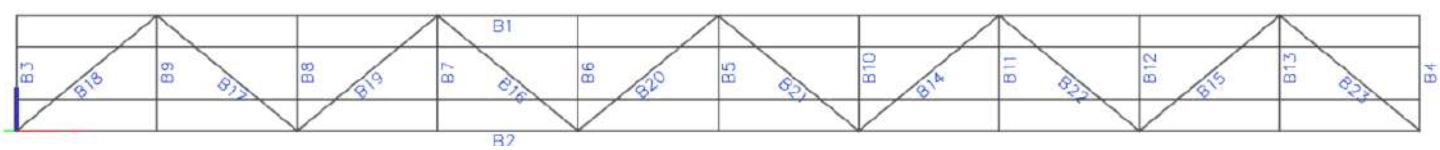
2.3.1.4 18 FT - GARAGE DOOR OPENING WEB HEADER DESIGN

General scheme

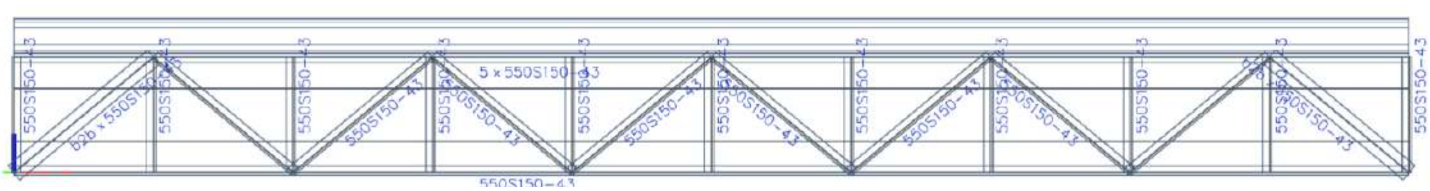
The top and bottom chord of the web header is reinforced with 5”x0.043” steel plates on both sides.



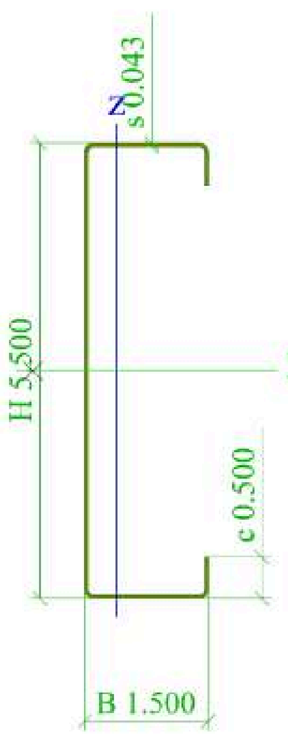
Members number



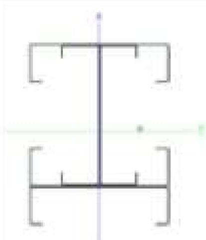
Members cross-sections



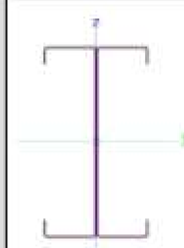
Cross-sections properties 550S150-43

550S150-43		
Type	Cold formed C section	
Detailed	5.500; 1.500; 0.043; 0.065; 0.500	
Formcode	114 - Cold formed C section	
Shape type	Thin-walled	
Item material	A913 grade 50	
Fabrication	cold formed	
Colour		
A [inch^2]	0.395	
A_y [inch^2], A_z [inch^2]	0.130	0.243
A_L [inch^2/inch], A_D [inch^2/inch]	1.84e+01	1.84e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	0.393	2.750
α [deg]	0.00	
I_y [inch^4], I_z [inch^4]	1.722	0.115
i_y [inch], i_z [inch]	2.089	0.539
$W_{el.y}$ [inch^3], $W_{el.z}$ [inch^3]	0.626	0.104
$W_{pl.y}$ [inch^3], $W_{pl.z}$ [inch^3]	0.747	0.148
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	3.73e+01	3.73e+01
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	7.39e+00	7.39e+00
d_y [inch], d_z [inch]	-1.010	0.000
I_t [inch^4], I_w [inch^6]	0.000	0.721
$β_y$ [inch], $β_z$ [inch]	0.000	5.886
Picture		

Cross-sections properties 5x550S150-43

5 x 550S150-43		
Type	5x550S150-43	
Shape type	Thin-walled	
Item material	A913 grade 50	
Fabrication	cold formed	
Colour		
A [inch^2]	1.973	
A_y [inch^2], A_z [inch^2]	1.122	0.708
A_L [inch^2/inch], A_D [inch^2/inch]	5.97e+01	6.08e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	1.016	4.163
α [deg]	0.00	
I_y [inch^4], I_z [inch^4]	11.539	5.518
i_y [inch], i_z [inch]	2.418	1.672
$W_{el.y}$ [inch^3], $W_{el.z}$ [inch^3]	3.156	2.006
$W_{pl.y}$ [inch^3], $W_{pl.z}$ [inch^3]	4.262	2.550
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	2.13e+02	2.13e+02
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	1.27e+02	1.27e+02
d_y [inch], d_z [inch]	1.609	0.099
I_t [inch^4], I_w [inch^6]	0.115	41.821
β_y [inch], β_z [inch]	0.348	-3.219
Picture		

Cross-sections properties b2b x 550S150-43

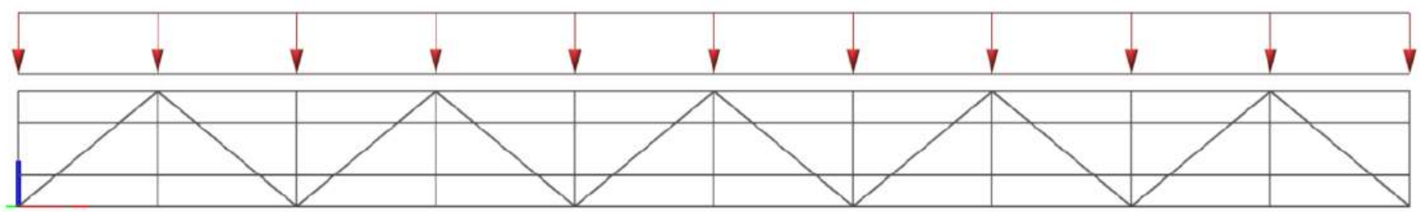
b2b x 550S150-43		
Type	2x550S150-43	
Shape type	Thin-walled	
Item material	A913 grade 50	
Fabrication	cold formed	
Colour		
A [inch^2]	0.789	
A_y [inch^2], A_z [inch^2]	0.265	0.486
A_L [inch^2/inch], A_D [inch^2/inch]	2.63e+01	2.63e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	1.016	4.800
α [deg]	0.00	
I_y [inch^4], I_z [inch^4]	3.444	0.351
i_y [inch], i_z [inch]	2.089	0.667
$W_{el.y}$ [inch^3], $W_{el.z}$ [inch^3]	1.252	0.234
$W_{pl.y}$ [inch^3], $W_{pl.z}$ [inch^3]	1.493	0.310
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	7.47e+01	7.47e+01
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	1.55e+01	1.55e+01
d_y [inch], d_z [inch]	0.000	0.000
I_t [inch^4], I_w [inch^6]	0.001	2.967
β_y [inch], β_z [inch]	0.000	0.000
Picture		

Explanations of symbols	
Formcode	s - Thickness r - Inner radius b - Flange width h - Height c - Lip
A	Area
A_y	Shear Area in principal y-direction
A_z	Shear Area in principal z-direction
A_L	Circumference per unit length
A_D	Drying surface per unit length
$c_{Y.UCS}$	Centroid coordinate in Y-direction of Input axis system
$c_{Z.UCS}$	Centroid coordinate in Z-direction of Input axis system
$I_{Y.LCS}$	Second moment of area about the YLCS axis
$I_{Z.LCS}$	Second moment of area about the ZLCS axis
$I_{YZ.LCS}$	Product moment of area in the LCS system
α	Rotation angle of the principal axis system
I_y	Second moment of area about the principal y-axis
I_z	Second moment of area about the principal z-axis
i_y	Radius of gyration about the principal y-axis

Explanations of symbols	
i_z	Radius of gyration about the principal z-axis
$W_{el.y}$	Elastic section modulus about the principal y-axis
$W_{el.z}$	Elastic section modulus about the principal z-axis
$W_{pl.y}$	Plastic section modulus about the principal y-axis
$W_{pl.z}$	Plastic section modulus about the principal z-axis
$M_{pl.y.+}$	Plastic moment about the principal y-axis for a positive My moment
$M_{pl.y.-}$	Plastic moment about the principal y-axis for a negative My moment
$M_{pl.z.+}$	Plastic moment about the principal z-axis for a positive Mz moment
$M_{pl.z.-}$	Plastic moment about the principal z-axis for a negative Mz moment
d_y	Shear center coordinate in principal y-direction measured from the centroid
d_z	Shear center coordinate in principal z-direction measured from the centroid
I_t	Torsional constant
I_w	Warping constant
β_y	Mono-symmetry constant about the principal y-axis
β_z	Mono-symmetry constant about the principal z-axis

APPLIED LOADS

LOAD ON THE TOP CHORD OF WEB HEADER			
Truss length, (ft)	18.75		
Loading width, (ft)	13.66		
Load	**Distr. Load, psf**	**Liner Load, plf**	**Reactions, lb**
Roof Dead Load	22.85	312.13	2926.23
Roof LL	20	273.20	2561.25
Roof Wind (up)	23.12	315.82	2960.81
Roof Wind (down)	8	109.28	1024.50



MAXIMUM FORCES

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B1	9' 4.500"-	LRFD-Ult (auto)/1	**-20663.3**	0.0	-4.0	0.0	**2137.4**	0.0
B1	9' 4.500"-	LRFD-Ult (auto)/2	**1665.6**	**0.0**	2.6	**0.0**	-171.7	**0.0**
B1	16' 10.500"-	LRFD-Ult (auto)/1	-9374.1	0.0	**-3154.2**	0.0	-338.1	0.0
B1	1' 10.500"+	LRFD-Ult (auto)/1	-9374.1	0.0	**3154.2**	0.0	**-338.1**	0.0
B2	9' 4.500"-	LRFD-Ult (auto)/2	**-881.0**	-13.4	0.0	0.0	0.0	-3.2
B2	9' 4.500"-	LRFD-Ult (auto)/1	**10887.3**	161.4	**0.0**	**0.0**	**0.0**	38.2
B2	15' 0.000"-	LRFD-Ult (auto)/1	7753.0	**-245.0**	0.0	0.0	0.0	-2.3
B2	3' 9.000"+	LRFD-Ult (auto)/1	7753.0	**245.0**	0.0	0.0	0.0	-2.3
B2	3' 3.375"-	LRFD-Ult (auto)/1	3754.7	17.9	0.0	0.0	0.0	**-16.9**
B2	2.813"-	LRFD-Ult (auto)/1	4094.5	57.0	0.0	0.0	0.0	**46.3**

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B3	0.000"	LRFD-Ult (auto)/2	**247.0**	27.8	**0.0**	**0.0**	**0.0**	0.0
B3	1' 1.500"+	LRFD-Ult (auto)/1	-1243.8	**-411.7**	0.0	0.0	0.0	103.6
B3	0.000"	LRFD-Ult (auto)/1	**-3071.0**	-346.7	0.0	0.0	**0.0**	0.0
B3	5.000"+	LRFD-Ult (auto)/1	-2019.7	382.9	0.0	0.0	0.0	**-149.6**
B3	1' 1.500"-	LRFD-Ult (auto)/1	-2018.6	**382.9**	0.0	0.0	0.0	**121.6**
B4	0.000"	LRFD-Ult (auto)/2	**247.0**	27.8	**0.0**	**0.0**	**0.0**	0.0
B4	1' 1.500"+	LRFD-Ult (auto)/1	-1243.8	**-411.7**	0.0	0.0	0.0	103.6
B4	0.000"	LRFD-Ult (auto)/1	**-3071.0**	-346.7	0.0	0.0	**0.0**	0.0
B4	5.000"+	LRFD-Ult (auto)/1	-2019.7	382.9	0.0	0.0	0.0	**-149.6**
B4	1' 1.500"-	LRFD-Ult (auto)/1	-2018.6	**382.9**	0.0	0.0	0.0	**121.6**
B5	5.000"-	LRFD-Ult (auto)/2	**83.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
B5	0.000"	LRFD-Ult (auto)/1	**-998.1**	0.0	0.0	0.0	0.0	**0.0**
B6	5.000"-	LRFD-Ult (auto)/2	**211.0**	-8.1	**0.0**	**0.0**	**0.0**	-3.4
B6	5.000"+	LRFD-Ult (auto)/1	-2226.7	**-155.2**	0.0	0.0	0.0	**60.6**
B6	0.000"	LRFD-Ult (auto)/1	**-2579.5**	**100.6**	0.0	0.0	**0.0**	0.0
B6	1' 1.500"-	LRFD-Ult (auto)/1	-2225.6	-155.2	0.0	0.0	0.0	**-49.4**
B7	5.000"-	LRFD-Ult (auto)/2	**70.0**	-9.9	**0.0**	**0.0**	**0.0**	-4.1
B7	5.000"+	LRFD-Ult (auto)/1	-186.3	**-199.5**	0.0	0.0	0.0	**64.3**
B7	1' 1.500"+	LRFD-Ult (auto)/1	-183.5	**133.7**	0.0	0.0	0.0	-55.7
B7	0.000"	LRFD-Ult (auto)/1	**-836.1**	122.4	0.0	0.0	**0.0**	0.0
B7	1' 1.500"-	LRFD-Ult (auto)/1	-185.1	-199.5	0.0	0.0	0.0	**-77.0**
B8	5.000"-	LRFD-Ult (auto)/2	**140.2**	-23.1	**0.0**	**0.0**	**0.0**	-9.6
B8	5.000"+	LRFD-Ult (auto)/1	-1457.7	**-442.2**	0.0	0.0	0.0	**171.9**
B8	0.000"	LRFD-Ult (auto)/1	**-1703.9**	**285.3**	0.0	0.0	**0.0**	0.0
B8	1' 1.500"-	LRFD-Ult	-1456.5	-442.2	0.0	0.0	0.0	**-141.3**

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
		(auto)/1						
B9	1' 6.500"	LRFD-Ult (auto)/1	**154.9**	**196.9**	**0.0**	**0.0**	**0.0**	0.0
B9	5.000"+	LRFD-Ult (auto)/1	-59.4	**-290.8**	0.0	0.0	0.0	**94.4**
B9	0.000"	LRFD-Ult (auto)/1	**-394.4**	179.0	0.0	0.0	**0.0**	0.0
B9	1' 1.500"-	LRFD-Ult (auto)/1	-58.2	-290.8	0.0	0.0	0.0	**-111.6**
B10	5.000"-	LRFD-Ult (auto)/2	**211.0**	8.1	**0.0**	**0.0**	**0.0**	3.4
B10	0.000"	LRFD-Ult (auto)/1	**-2579.5**	**-100.6**	0.0	0.0	**0.0**	0.0
B10	5.000"+	LRFD-Ult (auto)/1	-2226.7	155.2	0.0	0.0	0.0	**-60.6**
B10	1' 1.500"-	LRFD-Ult (auto)/1	-2225.6	**155.2**	0.0	0.0	0.0	**49.4**
B11	5.000"-	LRFD-Ult (auto)/2	**70.0**	9.9	**0.0**	**0.0**	**0.0**	4.1
B11	1' 1.500"+	LRFD-Ult (auto)/1	-183.5	**-133.7**	0.0	0.0	0.0	55.7
B11	0.000"	LRFD-Ult (auto)/1	**-836.1**	-122.4	0.0	0.0	**0.0**	0.0
B11	5.000"+	LRFD-Ult (auto)/1	-186.3	199.5	0.0	0.0	0.0	**-64.3**
B11	1' 1.500"-	LRFD-Ult (auto)/1	-185.1	**199.5**	0.0	0.0	0.0	**77.0**
B12	5.000"-	LRFD-Ult (auto)/2	**140.2**	23.1	**0.0**	**0.0**	**0.0**	9.6
B12	0.000"	LRFD-Ult (auto)/1	**-1703.9**	**-285.3**	0.0	0.0	**0.0**	0.0
B12	5.000"+	LRFD-Ult (auto)/1	-1457.7	442.2	0.0	0.0	0.0	**-171.9**
B12	1' 1.500"-	LRFD-Ult (auto)/1	-1456.5	**442.2**	0.0	0.0	0.0	**141.3**
B13	1' 6.500"	LRFD-Ult (auto)/1	**154.9**	**-196.9**	**0.0**	**0.0**	**0.0**	0.0
B13	0.000"	LRFD-Ult (auto)/1	**-394.4**	-179.0	0.0	0.0	**0.0**	0.0
B13	5.000"+	LRFD-Ult (auto)/1	-59.4	290.8	0.0	0.0	0.0	**-94.4**
B13	1' 1.500"-	LRFD-Ult (auto)/1	-58.2	**290.8**	0.0	0.0	0.0	**111.6**
B14	7.873"+	LRFD-Ult (auto)/2	**-310.4**	-3.4	0.0	0.0	0.0	0.8
B14	1' 9.256"-	LRFD-Ult (auto)/1	**3860.8**	46.1	**0.0**	**0.0**	**0.0**	42.8
B14	2' 5.129"	LRFD-Ult (auto)/1	1985.1	**-79.9**	0.0	0.0	0.0	0.0
B14	7.873"+	LRFD-Ult (auto)/1	3859.7	**47.5**	0.0	0.0	0.0	**-9.4**
B14	1' 9.256"+	LRFD-Ult (auto)/1	1984.4	-79.1	0.0	0.0	0.0	**52.2**

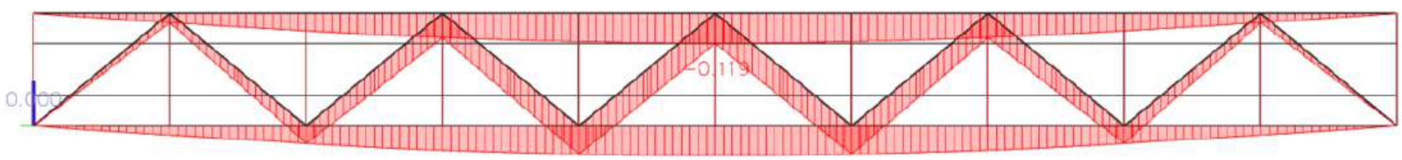
Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B15	7.873"+	LRFD-Ult (auto)/2	**-526.5**	-7.0	0.0	0.0	0.0	3.7
B15	1' 9.256"-	LRFD-Ult (auto)/1	**6536.2**	90.8	**0.0**	**0.0**	**0.0**	55.7
B15	2' 5.129"	LRFD-Ult (auto)/1	3152.1	**-106.8**	0.0	0.0	0.0	0.0
B15	7.873"+	LRFD-Ult (auto)/1	6535.1	**92.2**	0.0	0.0	0.0	**-46.3**
B15	1' 9.256"+	LRFD-Ult (auto)/1	3151.4	-106.0	0.0	0.0	0.0	**69.8**
B16	7.873"+	LRFD-Ult (auto)/2	**-310.4**	-3.4	0.0	0.0	0.0	0.8
B16	1' 9.256"-	LRFD-Ult (auto)/1	**3860.8**	46.1	**0.0**	**0.0**	**0.0**	42.8
B16	2' 5.129"	LRFD-Ult (auto)/1	1985.1	**-79.9**	0.0	0.0	0.0	0.0
B16	7.873"+	LRFD-Ult (auto)/1	3859.7	**47.5**	0.0	0.0	0.0	**-9.4**
B16	1' 9.256"+	LRFD-Ult (auto)/1	1984.4	-79.1	0.0	0.0	0.0	**52.2**
B17	7.873"+	LRFD-Ult (auto)/2	**-526.5**	-7.0	0.0	0.0	0.0	3.7
B17	1' 9.256"-	LRFD-Ult (auto)/1	**6536.2**	90.8	**0.0**	**0.0**	**0.0**	55.7
B17	2' 5.129"	LRFD-Ult (auto)/1	3152.1	**-106.8**	0.0	0.0	0.0	0.0
B17	7.873"+	LRFD-Ult (auto)/1	6535.1	**92.2**	0.0	0.0	0.0	**-46.3**
B17	1' 9.256"+	LRFD-Ult (auto)/1	3151.4	-106.0	0.0	0.0	0.0	**69.8**
B18	7.873"+	LRFD-Ult (auto)/1	**-9285.1**	-238.6	0.0	0.0	0.0	174.7
B18	1' 9.256"-	LRFD-Ult (auto)/2	**751.1**	17.8	**0.0**	**0.0**	**0.0**	7.1
B18	1' 9.256"-	LRFD-Ult (auto)/1	-9282.8	**-241.4**	0.0	0.0	0.0	-93.0
B18	0.000"	LRFD-Ult (auto)/1	-5966.2	**309.9**	0.0	0.0	**0.0**	0.0
B18	1' 9.256"+	LRFD-Ult (auto)/1	-5856.0	180.1	0.0	0.0	0.0	**-117.6**
B18	7.873"-	LRFD-Ult (auto)/1	-5964.8	308.3	0.0	0.0	0.0	**202.8**
B19	7.873"+	LRFD-Ult (auto)/1	**-4003.2**	-71.9	0.0	0.0	0.0	61.1
B19	1' 9.256"-	LRFD-Ult (auto)/2	**325.9**	5.2	**0.0**	**0.0**	**0.0**	1.4
B19	1' 9.256"-	LRFD-Ult (auto)/1	-4002.0	**-73.3**	0.0	0.0	0.0	-19.9
B19	0.000"	LRFD-Ult (auto)/1	-856.3	**137.6**	0.0	0.0	**0.0**	0.0
B19	1' 9.256"+	LRFD-Ult (auto)/1	-1852.6	37.9	0.0	0.0	0.0	**-24.6**

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B19	7.873"-	LRFD-Ult (auto)/1	-855.6	136.7	0.0	0.0	0.0	**90.0**
B20	2' 5.129"	LRFD-Ult (auto)/1	120.2	**-26.7**	0.0	0.0	0.0	0.0
B20	0.000"	LRFD-Ult (auto)/1	1772.0	**86.9**	**0.0**	**0.0**	**0.0**	0.0
B20	0.000"	LRFD-Ult (auto)/2	**-143.6**	-6.7	0.0	0.0	**0.0**	0.0
B20	7.873"-	LRFD-Ult (auto)/2	-143.1	-7.4	0.0	0.0	0.0	**-4.6**
B20	7.873"-	LRFD-Ult (auto)/1	**1772.7**	86.0	0.0	0.0	0.0	**56.7**
B21	2' 5.129"	LRFD-Ult (auto)/1	120.2	**-26.7**	0.0	0.0	0.0	0.0
B21	0.000"	LRFD-Ult (auto)/1	1772.0	**86.9**	**0.0**	**0.0**	**0.0**	0.0
B21	0.000"	LRFD-Ult (auto)/2	**-143.6**	-6.7	0.0	0.0	**0.0**	0.0
B21	7.873"-	LRFD-Ult (auto)/2	-143.1	-7.4	0.0	0.0	0.0	**-4.6**
B21	7.873"-	LRFD-Ult (auto)/1	**1772.7**	86.0	0.0	0.0	0.0	**56.7**
B22	7.873"+	LRFD-Ult (auto)/1	**-4003.2**	-71.9	0.0	0.0	0.0	61.1
B22	1' 9.256"-	LRFD-Ult (auto)/2	**325.9**	5.2	**0.0**	**0.0**	**0.0**	1.4
B22	1' 9.256"-	LRFD-Ult (auto)/1	-4002.0	**-73.3**	0.0	0.0	0.0	-19.9
B22	0.000"	LRFD-Ult (auto)/1	-856.3	**137.6**	0.0	0.0	**0.0**	0.0
B22	1' 9.256"+	LRFD-Ult (auto)/1	-1852.6	37.9	0.0	0.0	0.0	**-24.6**
B22	7.873"-	LRFD-Ult (auto)/1	-855.6	136.7	0.0	0.0	0.0	**90.0**
B23	7.873"+	LRFD-Ult (auto)/1	**-9285.1**	-238.6	0.0	0.0	0.0	174.7
B23	1' 9.256"-	LRFD-Ult (auto)/2	**751.1**	17.8	**0.0**	**0.0**	**0.0**	7.1
B23	1' 9.256"-	LRFD-Ult (auto)/1	-9282.8	**-241.4**	0.0	0.0	0.0	-93.0
B23	0.000"	LRFD-Ult (auto)/1	-5966.2	**309.9**	0.0	0.0	**0.0**	0.0
B23	1' 9.256"+	LRFD-Ult (auto)/1	-5856.0	180.1	0.0	0.0	0.0	**-117.6**
B23	7.873"-	LRFD-Ult (auto)/1	-5964.8	308.3	0.0	0.0	0.0	**202.8**

Name	Combination key
LRFD-Ult (auto)/1	1.20*DL1 + 1.60*Lr + 1.20*DL2 + 0.50*Wind Load (down)
LRFD-Ult (auto)/2	0.90*DL1 + 0.90*DL2 + Wind Load (Up)

Displacement

Load case D + Lr, inch:



The maximum deflection for a web header is 0.119”.

According to TABLE 1604.3 the code IBC 2018, maximum member deflection should not exceed - L/360.
L=18’-9”=225”, 225”/360=0.625”. 0.119"< 0.625”. <u>Deflection is OK!</u>

<u>STEEL MEMBER B1 CHECK</u>

AISI S100-16 LRFD Check

Member B1	5?550S150-43	A913 grade 50	LRFD-Ult (auto)	0.45

Material data		
Yield stress Fy	50.00	ksi
Tensile stress Fu	65.00	ksi
fabrication	cold formed	

The critical check is on position 9.38 ft

Axis definition :
- local x- axis in this code check is referring to the local y axis in Scia Engineer
- local y- axis in this code check is referring to the local z axis in Scia Engineer

Internal forces		
Pu	-20663.30	lbf
Vux	0.00	lbf
Vuy	-3.96	lbf
Mut	0.00	lbfft
Mux	2137.44	lbfft
Muy	-0.00	lbfft

...::Flexural Strength about X-axis::...
Nominal Flexural Strength
According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch⁴]	ds [inch]
1	0.479	-22.2 -28.8	-	-	-	-	-	- -	- -	-	- -	-
2	1.457	-29.3 -29.3	-	-	-	-	-	- -	- -	-	- -	-
3	5.457	46.4 -28.8	0.62	15.747	102.5	0.672	1.000	- 5.457	1.507 2.729	-	- -	-

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
4	1.457	46.7 46.7	1.00	4.000	365.4	0.357	1.000	1.457 -	- -	-	- -	-
5	0.478	46.4 39.8	0.86	0.482	102.2	0.674	1.000	0.478 -	- -	-	- -	-
6	0.479	46.4 39.8	0.86	0.482	102.2	0.674	1.000	0.478 -	- -	-	- -	-
7	1.457	46.7 46.7	1.00	4.000	365.4	0.357	1.000	- 1.457	0.728 0.728	-	- -	-
8	1.457	-29.3 -29.3	-	-	-	-	-	- -	- -	-	- -	-
9	0.478	-22.2 -28.8	-	-	-	-	-	- -	- -	-	- -	-
10	0.478	26.9 26.9	1.00	0.430	91.0	0.544	1.000	0.478 -	- -	-	- -	-
11	1.457	47.0 26.9	0.57	5.010	114.4	0.641	1.000	- 1.457	0.600 0.857	-	- -	-
12	1.250	47.0 47.0	1.00	4.000	124.1	0.615	1.000	1.250 -	- -	-	- -	-
13	1.457	47.0 26.9	0.57	5.010	114.4	0.641	1.000	- 1.457	0.600 0.857	-	- -	-
14	0.478	26.9 26.9	1.00	0.430	91.0	0.544	1.000	0.478 -	- -	-	- -	-
15	0.479	-9.3 -9.3	-	-	-	-	-	- -	- -	-	- -	-
16	1.457	-9.3 -29.3	-	-	-	-	-	- -	- -	-	- -	-
17	1.250	-29.6 -29.6	-	-	-	-	-	- -	- -	-	- -	-
18	1.457	-9.3 -29.3	-	-	-	-	-	- -	- -	-	- -	-
19	0.478	-9.3 -9.3	-	-	-	-	-	- -	- -	-	- -	-
20	0.478	-50.0 -50.0	-	-	-	-	-	- -	- -	-	- -	-
21	1.457	-29.9 -50.0	-	-	-	-	-	- -	- -	-	- -	-
22	1.250	-29.6 -29.6	-	-	-	-	-	- -	- -	-	- -	-
23	1.457	-29.9 -50.0	-	-	-	-	-	- -	- -	-	- -	-
24	0.478	-50.0 -50.0	-	-	-	-	-	- -	- -	-	- -	-
25	0.043	-29.6 -29.6	-	-	-	-	-	- -	- -	-	- -	-
36	1.250	47.0 47.0	1.00	4.000	124.1	0.615	1.000	1.250 -	- -	-	- -	-
41	0.043	47.0 47.0	1.00	4.000	104869.2	0.021	1.000	0.043 -	- -	-	- -	-

Table of values		
Sxe	3.158	$inch^3$
Mnxo	13160.1	lbfft
Resistance factor	0.90	
Unity check	0.18	-

Lateral-Torsional Buckling Strength
According to article F2.1 and formula (F2.1-1),(F2.1.1-1).

Table of values		
Lltb	1' 10.500"	ft
Sigma,ey	1581.5	ksi
Kt	1.00	
Lt	1' 10.500"	ft
Sigma,t	1123.8	ksi
Cb	1.07	
Sfx	3.364	$inch^3$
Fcre	2805.9	ksi

Note: Lateral-Torsional buckling is not governing since Fe is greater than or equal to 2.78 Fy.

Note: The Web Crippling Check is not executed since the specification does not give provisions for this type of cross-sectior

...::Axial Compression Strength::...
Nominal Axial Strength
According to article E2 and formula (E2-1)

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [$inch^4$]	ds [inch]
1	0.479	50.0 50.0	1.00	0.430	91.0	0.741	0.949	0.454 -	- -	-	- -	-
2	1.457	50.0 50.0	1.00	4.000	822.1	0.247	1.000	1.457 -	- -	-	- -	-
3	5.457	50.0 50.0	1.00	4.000	26.0	1.386	0.607	3.313 -	- -	-	- -	-
4	1.457	50.0 50.0	1.00	4.000	365.4	0.370	1.000	1.457 -	- -	-	- -	-
5	0.478	50.0 50.0	1.00	0.430	91.0	0.741	0.949	0.454 -	- -	-	- -	-
6	0.479	50.0 50.0	1.00	0.430	91.0	0.741	0.949	0.454 -	- -	-	- -	-
7	1.457	50.0 50.0	1.00	4.000	365.4	0.370	1.000	1.457 -	- -	-	- -	-
8	1.457	50.0 50.0	1.00	4.000	822.1	0.247	1.000	1.457 -	- -	-	- -	-
9	0.478	50.0 50.0	1.00	0.430	91.0	0.741	0.949	0.454 -	- -	-	- -	-
10	0.478	50.0 50.0	1.00	0.430	91.0	0.741	0.949	0.454 -	- -	-	- -	-
11	1.457	50.0 50.0	1.00	4.000	91.3	0.740	0.950	1.384 -	- -	-	- -	-
12	1.250	50.0 50.0	1.00	4.000	124.1	0.635	1.000	1.250 -	- -	-	- -	-
13	1.457	50.0 50.0	1.00	4.000	91.3	0.740	0.950	1.384 -	- -	-	- -	-
14	0.478	50.0 50.0	1.00	0.430	91.0	0.741	0.949	0.454 -	- -	-	- -	-

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
15	0.479	50.0 50.0	1.00	0.430	91.0	0.741	0.949	0.454 -	- -	-	- -	-
16	1.457	50.0 50.0	1.00	4.000	91.3	0.740	0.950	1.384 -	- -	-	- -	-
17	1.250	50.0 50.0	1.00	4.000	496.4	0.317	1.000	1.250 -	- -	-	- -	-
18	1.457	50.0 50.0	1.00	4.000	91.3	0.740	0.950	1.384 -	- -	-	- -	-
19	0.478	50.0 50.0	1.00	0.430	91.0	0.741	0.949	0.454 -	- -	-	- -	-
20	0.478	50.0 50.0	1.00	0.430	91.0	0.741	0.949	0.454 -	- -	-	- -	-
21	1.457	50.0 50.0	1.00	4.000	91.3	0.740	0.950	1.384 -	- -	-	- -	-
22	1.250	50.0 50.0	1.00	4.000	496.4	0.317	1.000	1.250 -	- -	-	- -	-
23	1.457	50.0 50.0	1.00	4.000	91.3	0.740	0.950	1.384 -	- -	-	- -	-
24	0.478	50.0 50.0	1.00	0.430	91.0	0.741	0.949	0.454 -	- -	-	- -	-
25	0.043	50.0 50.0	1.00	4.000	419476.9	0.011	1.000	0.043 -	- -	-	- -	-
36	1.250	50.0 50.0	1.00	4.000	124.1	0.635	1.000	1.250 -	- -	-	- -	-
41	0.043	50.0 50.0	1.00	4.000	104869.2	0.022	1.000	0.043 -	- -	-	- -	-

Table of values		
Fn	50.0	ksi
Ae	1.795	inch ^{2}
Pno	89754.6	lbf
Resistance factor	0.85	
Unity check	0.27	-

Buckling check
According to article E2 and formula (E2-1)
Flexural Buckling Strength
According to article E2.1 and formula (E2.1-1)

Buckling parameters	xx	yy	
Sway type	sway	sway	
Unbraced Length L	2	2	ft
Effective Length factor K	1.00	1.00	
Effective Length	2	2	ft
Slenderness	9.30	13.45	
Flexural Buckling stress Fcre	3307.4	1581.5	ksi

Torsional (-Flexural) Buckling Strength
According to article E2.2, E2.3, E2.4

Table of values		
Sigma,ex	3307.4	ksi
Sigma,ey	1581.5	ksi
Kt	1.00	
Lt	2	ft
Sigma,t	1123.8	ksi
Sigma,TF	1017.9	ksi
Torsional (-Flexural) buckling stress Fcre	1017.9	ksi

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.479	49.0 49.0	1.00	0.430	91.0	0.734	0.954	0.457 -	- -	-	- -	-
2	1.457	49.0 49.0	1.00	4.000	822.1	0.244	1.000	1.457 -	- -	-	- -	-
3	5.457	49.0 49.0	1.00	4.000	26.0	1.371	0.612	3.341 -	- -	-	- -	-
4	1.457	49.0 49.0	1.00	4.000	365.4	0.366	1.000	1.457 -	- -	-	- -	-
5	0.478	49.0 49.0	1.00	0.430	91.0	0.734	0.954	0.457 -	- -	-	- -	-
6	0.479	49.0 49.0	1.00	0.430	91.0	0.734	0.954	0.457 -	- -	-	- -	-
7	1.457	49.0 49.0	1.00	4.000	365.4	0.366	1.000	1.457 -	- -	-	- -	-
8	1.457	49.0 49.0	1.00	4.000	822.1	0.244	1.000	1.457 -	- -	-	- -	-
9	0.478	49.0 49.0	1.00	0.430	91.0	0.734	0.954	0.457 -	- -	-	- -	-
10	0.478	49.0 49.0	1.00	0.430	91.0	0.734	0.954	0.457 -	- -	-	- -	-
11	1.457	49.0 49.0	1.00	4.000	91.3	0.732	0.955	1.392 -	- -	-	- -	-
12	1.250	49.0 49.0	1.00	4.000	124.1	0.628	1.000	1.250 -	- -	-	- -	-
13	1.457	49.0 49.0	1.00	4.000	91.3	0.732	0.955	1.392 -	- -	-	- -	-
14	0.478	49.0 49.0	1.00	0.430	91.0	0.734	0.954	0.457 -	- -	-	- -	-
15	0.479	49.0 49.0	1.00	0.430	91.0	0.734	0.954	0.457 -	- -	-	- -	-
16	1.457	49.0 49.0	1.00	4.000	91.3	0.732	0.955	1.392 -	- -	-	- -	-
17	1.250	49.0 49.0	1.00	4.000	496.4	0.314	1.000	1.250 -	- -	-	- -	-
18	1.457	49.0 49.0	1.00	4.000	91.3	0.732	0.955	1.392 -	- -	-	- -	-
19	0.478	49.0 49.0	1.00	0.430	91.0	0.734	0.954	0.457 -	- -	-	- -	-
20	0.478	49.0 49.0	1.00	0.430	91.0	0.734	0.954	0.457 -	- -	-	- -	-

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
21	1.457	49.0 49.0	1.00	4.000	91.3	0.732	0.955	1.392 -	- -	-	- -	-
22	1.250	49.0 49.0	1.00	4.000	496.4	0.314	1.000	1.250 -	- -	-	- -	-
23	1.457	49.0 49.0	1.00	4.000	91.3	0.732	0.955	1.392 -	- -	-	- -	-
24	0.478	49.0 49.0	1.00	0.430	91.0	0.734	0.954	0.457 -	- -	-	- -	-
25	0.043	49.0 49.0	1.00	4.000	419476.9	0.011	1.000	0.043 -	- -	-	- -	-
36	1.250	49.0 49.0	1.00	4.000	124.1	0.628	1.000	1.250 -	- -	-	- -	-
41	0.043	49.0 49.0	1.00	4.000	104869.2	0.022	1.000	0.043 -	- -	-	- -	-

Table of values		
Fe	1017.9	ksi
lambda, c	0.22	
Fn	49.0	ksi
Ae	1.801	inch ^{2}
Pn	88205.0	lbf
Resistance factor	0.85	
Unity check	0.28	-

Combined Compressive Axial Load and Bending
According to article H1.2 and formulas (H1.2-1)

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.479	10.5 10.5	1.00	0.430	91.0	0.339	1.000	0.479 -	- -	-	- -	-
2	1.457	10.5 10.5	1.00	4.000	822.1	0.113	1.000	1.457 -	- -	-	- -	-
3	5.457	10.5 10.5	1.00	4.000	26.0	0.634	1.000	5.457 -	- -	-	- -	-
4	1.457	10.5 10.5	1.00	4.000	365.4	0.169	1.000	1.457 -	- -	-	- -	-
5	0.478	10.5 10.5	1.00	0.430	91.0	0.339	1.000	0.478 -	- -	-	- -	-
6	0.479	10.5 10.5	1.00	0.430	91.0	0.339	1.000	0.479 -	- -	-	- -	-
7	1.457	10.5 10.5	1.00	4.000	365.4	0.169	1.000	1.457 -	- -	-	- -	-
8	1.457	10.5 10.5	1.00	4.000	822.1	0.113	1.000	1.457 -	- -	-	- -	-
9	0.478	10.5 10.5	1.00	0.430	91.0	0.339	1.000	0.478 -	- -	-	- -	-
10	0.478	10.5 10.5	1.00	0.430	91.0	0.339	1.000	0.478 -	- -	-	- -	-
11	1.457	10.5 10.5	1.00	4.000	91.3	0.339	1.000	1.457 -	- -	-	- -	-
12	1.250	10.5 10.5	1.00	4.000	124.1	0.291	1.000	1.250 -	- -	-	- -	-

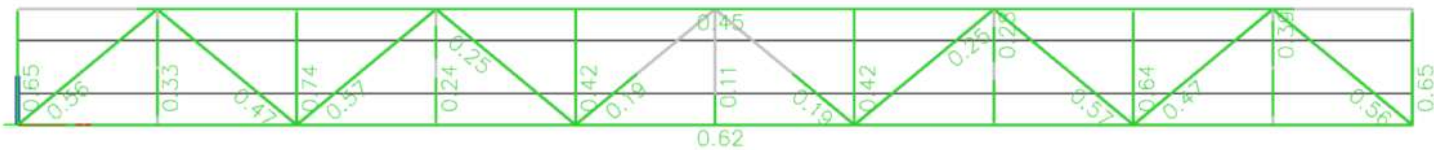
Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
13	1.457	10.5 10.5	1.00	4.000	91.3	0.339	1.000	1.457 -	- -	-	- -	-
14	0.478	10.5 10.5	1.00	0.430	91.0	0.339	1.000	0.478 -	- -	-	- -	-
15	0.479	10.5 10.5	1.00	0.430	91.0	0.339	1.000	0.479 -	- -	-	- -	-
16	1.457	10.5 10.5	1.00	4.000	91.3	0.339	1.000	1.457 -	- -	-	- -	-
17	1.250	10.5 10.5	1.00	4.000	496.4	0.145	1.000	1.250 -	- -	-	- -	-
18	1.457	10.5 10.5	1.00	4.000	91.3	0.339	1.000	1.457 -	- -	-	- -	-
19	0.478	10.5 10.5	1.00	0.430	91.0	0.339	1.000	0.478 -	- -	-	- -	-
20	0.478	10.5 10.5	1.00	0.430	91.0	0.339	1.000	0.478 -	- -	-	- -	-
21	1.457	10.5 10.5	1.00	4.000	91.3	0.339	1.000	1.457 -	- -	-	- -	-
22	1.250	10.5 10.5	1.00	4.000	496.4	0.145	1.000	1.250 -	- -	-	- -	-
23	1.457	10.5 10.5	1.00	4.000	91.3	0.339	1.000	1.457 -	- -	-	- -	-
24	0.478	10.5 10.5	1.00	0.430	91.0	0.339	1.000	0.478 -	- -	-	- -	-
25	0.043	10.5 10.5	1.00	4.000	419476.9	0.005	1.000	0.043 -	- -	-	- -	-
36	1.250	10.5 10.5	1.00	4.000	124.1	0.291	1.000	1.250 -	- -	-	- -	-
41	0.043	10.5 10.5	1.00	4.000	104869.2	0.010	1.000	0.043 -	- -	-	- -	-

Table of values		
Mnx	13160.1	lbfft
PEx	6525444.7	lbf
Alfa x	1.00	
Cmx	0.85	
Pn	88205.0	lbf
Pno	89754.6	lbf
Resistance factor compression	0.85	
Resistance factor bending x	0.90	

Unity check = 0.28+0.15+0.00 = 0.43 - (H1.2-1)
Unity check = 0.27+0.18+0.00 = 0.45 -

The member satisfies the check !

Unity check



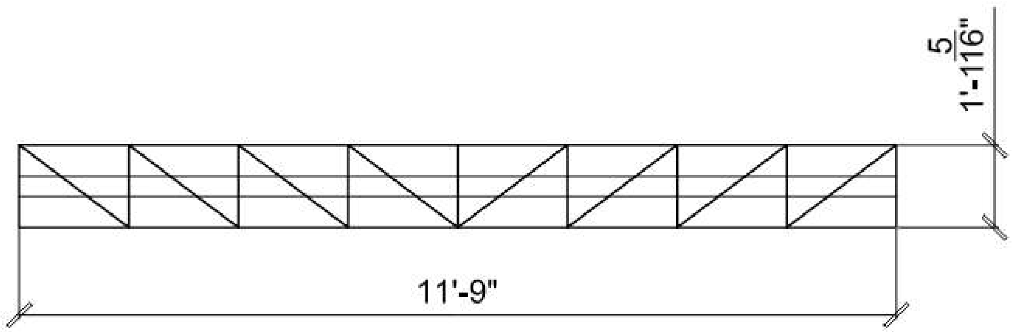
Combinations : LRFD-Ult (auto)

Case	Member	css	mat	dx [ft]	un.check [-]
LRFD-Ult (auto)/1	B1	5 x 550S150-43 - 5x550S150-43	A913 grade 50	9' 4.500"	0.44
LRFD-Ult (auto)/1	B2	550S150-43 - Cold formed C section	A913 grade 50	9' 4.500"	0.60
LRFD-Ult (auto)/1	B3	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.63
LRFD-Ult (auto)/1	B4	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.63
LRFD-Ult (auto)/1	B5	550S150-43 - Cold formed C section	A913 grade 50	0.000"	0.10
LRFD-Ult (auto)/1	B6	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.41
LRFD-Ult (auto)/1	B7	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.23
LRFD-Ult (auto)/1	B8	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.72
LRFD-Ult (auto)/1	B9	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.32
LRFD-Ult (auto)/1	B10	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.41
LRFD-Ult (auto)/1	B11	550S150-43 - Cold formed C section	A913 grade 50	1' 1.500"	0.28
LRFD-Ult (auto)/1	B12	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.62
LRFD-Ult (auto)/1	B13	550S150-43 - Cold formed C section	A913 grade 50	1' 1.500"	0.38
LRFD-Ult (auto)/1	B14	550S150-43 - Cold formed C section	A913 grade 50	1' 9.256"	0.24
LRFD-Ult (auto)/1	B15	550S150-43 - Cold formed C section	A913 grade 50	7.873"	0.46
LRFD-Ult (auto)/1	B16	550S150-43 - Cold formed C section	A913 grade 50	1' 9.256"	0.24
LRFD-Ult (auto)/1	B17	550S150-43 - Cold formed C section	A913 grade 50	7.873"	0.46
LRFD-Ult (auto)/1	B18	b2b x 550S150-43 - 2x550S150-43	A913 grade 50	7.873"	0.55
LRFD-Ult (auto)/1	B19	550S150-43 - Cold formed C section	A913 grade 50	7.873"	0.56
LRFD-Ult (auto)/1	B20	550S150-43 - Cold formed C section	A913 grade 50	7.873"	0.18
LRFD-Ult (auto)/1	B21	550S150-43 - Cold formed C section	A913 grade 50	7.873"	0.18
LRFD-Ult (auto)/1	B22	550S150-43 - Cold formed C section	A913 grade 50	7.873"	0.56
LRFD-Ult (auto)/1	B23	b2b x 550S150-43 - 2x550S150-43	A913 grade 50	7.873"	0.55

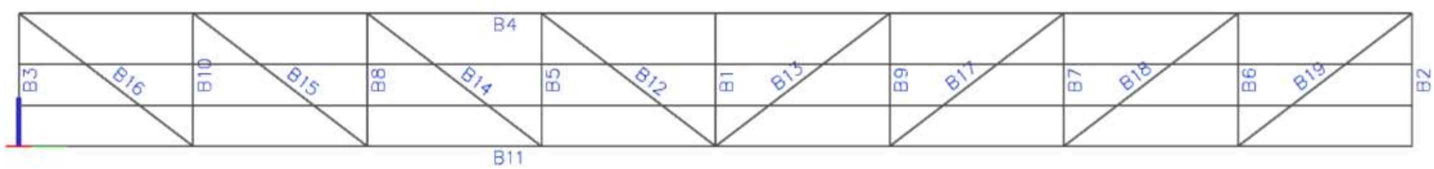
2.3.1.5 11 FT - WINDOW OPENING WEB HEADER DESIGN

General scheme

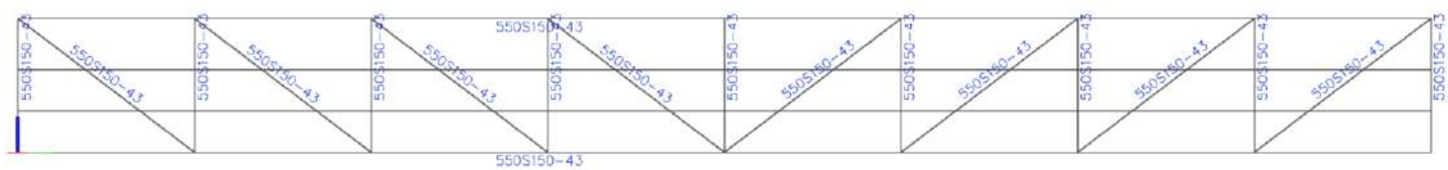
The top and bottom chord of the web header is reinforced with 5”x0.043” steel plates on both sides.



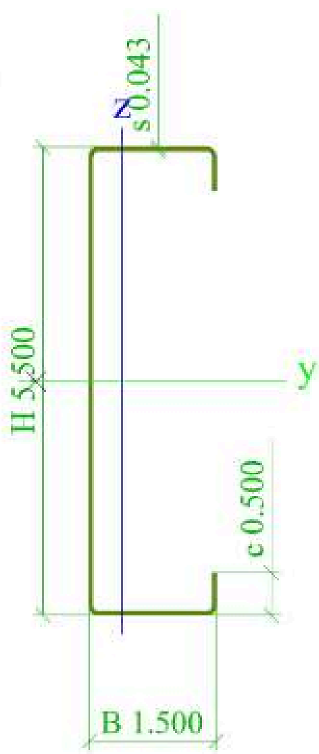
Members number



Members cross-sections



Cross-sections properties

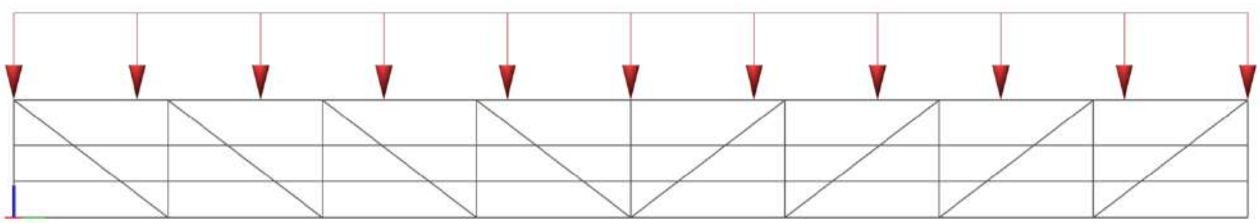
550S150-43		
Type	Cold formed C section	
Detailed	5.500; 1.500; 0.043; 0.065; 0.500	
Formcode	114 - Cold formed C section	
Shape type	Thin-walled	
Item material	A913 grade 50	
Fabrication	cold formed	
Colour		
A [$inch^2$]	0.395	
A_y [$inch^2$], A_z [$inch^2$]	0.130	0.243
A_L [$inch^2$/inch], A_D [$inch^2$/inch]	1.84e+01	1.84e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	0.393	2.750
α [deg]	0.00	
I_y [$inch^4$], I_z [$inch^4$]	1.722	0.115
i_y [inch], i_z [inch]	2.089	0.539
$W_{el.y}$ [$inch^3$], $W_{el.z}$ [$inch^3$]	0.626	0.104
$W_{pl.y}$ [$inch^3$], $W_{pl.z}$ [$inch^3$]	0.747	0.148
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	3.73e+01	3.73e+01
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	7.39e+00	7.39e+00
d_y [inch], d_z [inch]	-1.010	0.000
I_t [$inch^4$], I_w [$inch^6$]	0.000	0.721
$β_y$ [inch], $β_z$ [inch]	0.000	5.886
Picture		

Explanations of symbols	
Formcode	s - Thickness r - Inner radius b - Flange width h - Height c - Lip
A	Area
A_y	Shear Area in principal y-direction
A_z	Shear Area in principal z-direction
A_L	Circumference per unit length
A_D	Drying surface per unit length
$c_{Y.UCS}$	Centroid coordinate in Y-direction of Input axis system
$c_{Z.UCS}$	Centroid coordinate in Z-direction of Input axis system
$I_{Y.LCS}$	Second moment of area about the YLCS axis
$I_{Z.LCS}$	Second moment of area about the ZLCS axis
$I_{YZ.LCS}$	Product moment of area in the LCS system
α	Rotation angle of the principal axis system
I_y	Second moment of area about the principal y-axis
I_z	Second moment of area about the principal z-axis
i_y	Radius of gyration about the principal y-axis

Explanations of symbols	
i_z	Radius of gyration about the principal z-axis
$W_{el.y}$	Elastic section modulus about the principal y-axis
$W_{el.z}$	Elastic section modulus about the principal z-axis
$W_{pl.y}$	Plastic section modulus about the principal y-axis
$W_{pl.z}$	Plastic section modulus about the principal z-axis
$M_{pl.y.+}$	Plastic moment about the principal y-axis for a positive My moment
$M_{pl.y.-}$	Plastic moment about the principal y-axis for a negative My moment
$M_{pl.z.+}$	Plastic moment about the principal z-axis for a positive Mz moment
$M_{pl.z.-}$	Plastic moment about the principal z-axis for a negative Mz moment
d_y	Shear center coordinate in principal y-direction measured from the centroid
d_z	Shear center coordinate in principal z-direction measured from the centroid
I_t	Torsional constant
I_w	Warping constant
β_y	Mono-symmetry constant about the principal y-axis
β_z	Mono-symmetry constant about the principal z-axis

APPLIED LOADS

LOAD ON THE TOP CHORD OF WEB HEADER			
Truss length, (ft)	11.75	Roof slope, α =	22.6
Loading width, (ft)	11.5		
Load	**Distr. Load, psf**	**Liner Load, plf**	**Reactions, lb**
Roof Dead Load	17.85	205.28	1205.99
Roof LL	20.00	230.00	1351.25
Roof Wind (up)	22.25	255.87	1503.22
Roof Wind (down)	7.39	84.94	499.00



MAXIMUM FORCES

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B1	4.096"+	LRFD-Ult (auto)/1	**-567.6**	0.0	0.0	0.0	0.0	0.0
B1	1' 1.312"	LRFD-Ult (auto)/1	**214.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
B2	4.096"-	LRFD-Ult (auto)/2	**287.8**	-10.2	**0.0**	**0.0**	**0.0**	-3.5
B2	4.096"+	LRFD-Ult (auto)/1	-2958.2	**-676.2**	0.0	0.0	0.0	**63.7**
B2	8.192"+	LRFD-Ult (auto)/1	-1703.2	**520.4**	0.0	0.0	0.0	-121.7
B2	0.000"	LRFD-Ult (auto)/1	**-3028.0**	107.4	0.0	0.0	**0.0**	0.0
B2	8.192"-	LRFD-Ult (auto)/1	-2957.7	-676.2	0.0	0.0	0.0	**-167.1**
B3	4.096"-	LRFD-Ult (auto)/2	**287.8**	10.2	**0.0**	**0.0**	**0.0**	3.5
B3	8.192"+	LRFD-Ult (auto)/1	-1703.2	**-520.4**	0.0	0.0	0.0	121.7
B3	0.000"	LRFD-Ult (auto)/1	**-3028.0**	-107.4	0.0	0.0	**0.0**	0.0
B3	4.096"+	LRFD-Ult (auto)/1	-2958.2	676.2	0.0	0.0	0.0	**-63.7**
B3	8.192"-	LRFD-Ult (auto)/1	-2957.7	**676.2**	0.0	0.0	0.0	**167.1**

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B4	5' 4.625"-	LRFD-Ult (auto)/1	**-6390.6**	16.9	0.0	0.0	0.0	-20.1
B4	5' 4.625"-	LRFD-Ult (auto)/2	**606.8**	-1.6	**0.0**	**0.0**	**0.0**	1.9
B4	1' 5.625"+	LRFD-Ult (auto)/1	-2565.9	**-119.6**	0.0	0.0	0.0	19.4
B4	10' 3.375"-	LRFD-Ult (auto)/1	-2565.9	**119.6**	0.0	0.0	0.0	**19.4**
B4	5' 1.688"-	LRFD-Ult (auto)/1	-6359.8	7.3	0.0	0.0	0.0	**-23.6**
B5	1' 1.312"	LRFD-Ult (auto)/1	**109.9**	-96.1	**0.0**	**0.0**	**0.0**	0.0
B5	0.000"	LRFD-Ult (auto)/1	-686.1	**-147.5**	0.0	0.0	**0.0**	0.0
B5	4.096"+	LRFD-Ult (auto)/1	**-1077.3**	392.7	0.0	0.0	0.0	**-70.6**
B5	8.192"-	LRFD-Ult (auto)/1	-1076.8	**392.7**	0.0	0.0	0.0	**63.4**
B6	8.192"-	LRFD-Ult (auto)/2	**288.7**	93.4	**0.0**	**0.0**	**0.0**	14.7
B6	4.096"+	LRFD-Ult (auto)/1	**-2984.5**	**-982.1**	0.0	0.0	0.0	**180.2**
B6	0.000"	LRFD-Ult (auto)/1	-1255.7	**348.4**	0.0	0.0	**0.0**	0.0
B6	8.192"-	LRFD-Ult (auto)/1	-2984.0	-982.1	0.0	0.0	0.0	**-155.0**
B7	8.192"-	LRFD-Ult (auto)/2	**186.3**	63.1	**0.0**	**0.0**	**0.0**	10.4
B7	4.096"+	LRFD-Ult (auto)/1	**-1909.2**	**-662.9**	0.0	0.0	0.0	**116.7**
B7	0.000"	LRFD-Ult (auto)/1	-979.3	**233.7**	0.0	0.0	**0.0**	0.0
B7	8.192"-	LRFD-Ult (auto)/1	-1908.7	-662.9	0.0	0.0	0.0	**-109.6**
B8	8.192"-	LRFD-Ult (auto)/2	**186.3**	-63.1	**0.0**	**0.0**	**0.0**	-10.4
B8	0.000"	LRFD-Ult (auto)/1	-979.3	**-233.7**	0.0	0.0	**0.0**	0.0
B8	4.096"+	LRFD-Ult (auto)/1	**-1909.2**	662.9	0.0	0.0	0.0	**-116.7**
B8	8.192"-	LRFD-Ult (auto)/1	-1908.7	**662.9**	0.0	0.0	0.0	**109.6**
B9	1' 1.312"	LRFD-Ult (auto)/1	**109.9**	96.1	**0.0**	**0.0**	**0.0**	0.0
B9	4.096"+	LRFD-Ult (auto)/1	**-1077.3**	**-392.7**	0.0	0.0	0.0	**70.6**
B9	0.000"	LRFD-Ult (auto)/1	-686.1	**147.5**	0.0	0.0	**0.0**	0.0
B9	8.192"-	LRFD-Ult (auto)/1	-1076.8	-392.7	0.0	0.0	0.0	**-63.4**

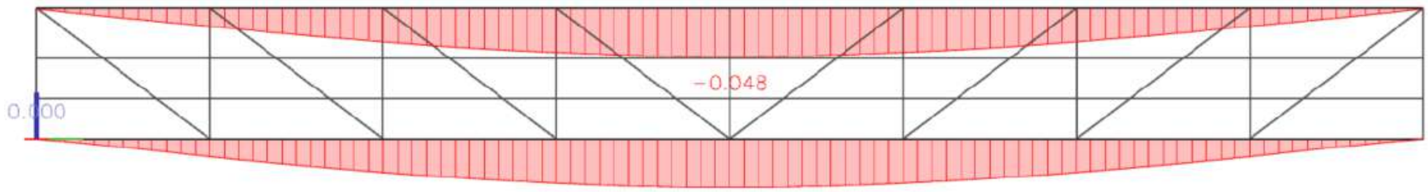
Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B10	8.192"-	LRFD-Ult (auto)/2	**288.7**	-93.4	**0.0**	**0.0**	**0.0**	-14.7
B10	0.000"	LRFD-Ult (auto)/1	-1255.7	**-348.4**	0.0	0.0	**0.0**	0.0
B10	4.096"+	LRFD-Ult (auto)/1	**-2984.5**	982.1	0.0	0.0	0.0	**-180.2**
B10	8.192"-	LRFD-Ult (auto)/1	-2984.0	**982.1**	0.0	0.0	0.0	**155.0**
B11	5' 10.500"-	LRFD-Ult (auto)/1	**2840.5**	-7.0	**0.0**	**0.0**	**0.0**	22.7
B11	10' 3.375"+	LRFD-Ult (auto)/1	-1471.1	**-212.7**	0.0	0.0	0.0	1.2
B11	1' 5.625"-	LRFD-Ult (auto)/1	-1471.1	**212.7**	0.0	0.0	0.0	1.2
B11	0.000"	LRFD-Ult (auto)/1	**-5717.3**	-59.0	0.0	0.0	**0.0**	-7.5
B11	2.937"-	LRFD-Ult (auto)/1	-5267.7	10.1	0.0	0.0	0.0	**-30.5**
B11	1' 5.625"+	LRFD-Ult (auto)/1	-448.1	15.4	0.0	0.0	0.0	**32.1**
B12	1' 1.592"+	LRFD-Ult (auto)/1	**-668.0**	-71.1	0.0	0.0	0.0	**50.7**
B12	6.796"-	LRFD-Ult (auto)/1	**447.2**	21.6	**0.0**	**0.0**	**0.0**	12.4
B12	1' 10.088"	LRFD-Ult (auto)/1	-667.3	**-72.0**	0.0	0.0	0.0	0.0
B12	6.796"+	LRFD-Ult (auto)/1	381.9	**70.9**	0.0	0.0	0.0	-0.2
B12	1' 1.592"+	LRFD-Ult (auto)/2	62.9	7.3	0.0	0.0	0.0	**-4.9**
B13	1' 1.592"+	LRFD-Ult (auto)/1	**-668.0**	-71.1	0.0	0.0	0.0	**50.7**
B13	6.796"-	LRFD-Ult (auto)/1	**447.2**	21.6	**0.0**	**0.0**	**0.0**	12.4
B13	1' 10.088"	LRFD-Ult (auto)/1	-667.3	**-72.0**	0.0	0.0	0.0	0.0
B13	6.796"+	LRFD-Ult (auto)/1	381.9	**70.9**	0.0	0.0	0.0	-0.2
B13	1' 1.592"+	LRFD-Ult (auto)/2	62.9	7.3	0.0	0.0	0.0	**-4.9**
B14	6.796"+	LRFD-Ult (auto)/2	**-182.6**	-14.5	0.0	0.0	0.0	2.8
B14	1' 1.592"-	LRFD-Ult (auto)/1	**1929.4**	151.3	**0.0**	**0.0**	**0.0**	57.7
B14	1' 10.088"	LRFD-Ult (auto)/1	215.0	**-93.3**	0.0	0.0	0.0	0.0
B14	6.796"+	LRFD-Ult (auto)/1	1928.9	**152.0**	0.0	0.0	0.0	**-28.2**
B14	1' 1.592"+	LRFD-Ult (auto)/1	214.3	-92.4	0.0	0.0	0.0	**65.8**

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B15	6.796"+	LRFD-Ult (auto)/2	**-323.6**	-19.2	0.0	0.0	0.0	4.6
B15	1' 1.592"-	LRFD-Ult (auto)/1	**3414.6**	200.7	**0.0**	**0.0**	**0.0**	66.5
B15	1' 10.088"	LRFD-Ult (auto)/1	1202.8	**-99.8**	0.0	0.0	0.0	0.0
B15	6.796"+	LRFD-Ult (auto)/1	3414.0	**201.4**	0.0	0.0	0.0	-47.4
B15	6.796"-	LRFD-Ult (auto)/1	1553.9	-93.9	0.0	0.0	0.0	**-52.9**
B15	1' 1.592"+	LRFD-Ult (auto)/1	1202.1	-98.9	0.0	0.0	0.0	**70.3**
B16	6.796"+	LRFD-Ult (auto)/2	**-397.3**	-38.5	0.0	0.0	0.0	11.9
B16	6.796"-	LRFD-Ult (auto)/1	1862.0	**-180.1**	0.0	0.0	0.0	-101.8
B16	6.796"+	LRFD-Ult (auto)/1	4190.4	**403.8**	0.0	0.0	0.0	**-124.4**
B16	1' 1.592"-	LRFD-Ult (auto)/1	**4191.0**	403.1	**0.0**	**0.0**	**0.0**	**104.0**
B17	6.796"+	LRFD-Ult (auto)/2	**-182.6**	-14.5	0.0	0.0	0.0	2.8
B17	1' 1.592"-	LRFD-Ult (auto)/1	**1929.4**	151.3	**0.0**	**0.0**	**0.0**	57.7
B17	1' 10.088"	LRFD-Ult (auto)/1	215.0	**-93.3**	0.0	0.0	0.0	0.0
B17	6.796"+	LRFD-Ult (auto)/1	1928.9	**152.0**	0.0	0.0	0.0	**-28.2**
B17	1' 1.592"+	LRFD-Ult (auto)/1	214.3	-92.4	0.0	0.0	0.0	**65.8**
B18	6.796"+	LRFD-Ult (auto)/2	**-323.6**	-19.2	0.0	0.0	0.0	4.6
B18	1' 1.592"-	LRFD-Ult (auto)/1	**3414.6**	200.7	**0.0**	**0.0**	**0.0**	66.5
B18	1' 10.088"	LRFD-Ult (auto)/1	1202.8	**-99.8**	0.0	0.0	0.0	0.0
B18	6.796"+	LRFD-Ult (auto)/1	3414.0	**201.4**	0.0	0.0	0.0	-47.4
B18	6.796"-	LRFD-Ult (auto)/1	1553.9	-93.9	0.0	0.0	0.0	**-52.9**
B18	1' 1.592"+	LRFD-Ult (auto)/1	1202.1	-98.9	0.0	0.0	0.0	**70.3**
B19	6.796"+	LRFD-Ult (auto)/2	**-397.3**	-38.5	0.0	0.0	0.0	11.9
B19	6.796"-	LRFD-Ult (auto)/1	1862.0	**-180.1**	0.0	0.0	0.0	-101.8
B19	6.796"+	LRFD-Ult (auto)/1	4190.4	**403.8**	0.0	0.0	0.0	**-124.4**
B19	1' 1.592"-	LRFD-Ult (auto)/1	**4191.0**	403.1	**0.0**	**0.0**	**0.0**	**104.0**

Name	Combination key
LRFD-Ult (auto)/1	1.20*DL1 + 1.60*Lr + 1.20*DL2 + 0.50*Wind load (Down)
LRFD-Ult (auto)/2	0.90*DL1 + 0.90*DL2 + Wind load (Up)

Displacement

Load case D + Lr, inch:



The maximum deflection for a web header is 0.048”.

According to TABLE 1604.3 the code IBC 2018, maximum member deflection should not exceed - L/360.

L=11.75’=141”, 141”/360=0.392”. 0.048"< 0.392”. <u>Deflection is OK!</u>

<u>STEEL MEMBER B4 CHECK</u>

AISI S100-16 LRFD Check

Member B4	**Cold formed C section (5.500; 1.500; 0.043; 0.062; 0.500)**	**A913 grade 50**	**LRFD-Ult (auto)**	**0.97**

Material data		
Yield stress Fy	50.00	ksi
Tensile stress Fu	65.00	ksi
fabrication	cold formed	

The critical check is on position 5.14 ft

Axis definition :

- local x- axis in this code check is referring to the local y axis in Scia Engineer
- local y- axis in this code check is referring to the local z axis in Scia Engineer

Internal forces		
Pu	-6359.79	lbf
Vux	7.32	lbf
Vuy	-0.00	lbf
Mut	0.00	lbfft
Mux	0.00	lbfft
Muy	-90.24	lbfft

Note: Mux and/or Muy include additional moments as defined in art. H1.2

...::Flexural Strength about Y-axis::...

Nominal Flexural Strength

According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch^4]	ds [inch]
1	0.395	-50.0 -50.0	-	-	-	-	-	- -	- -	-	- -	-
3	1.290	25.9 -45.4	1.75	51.262	1493.3	0.132	1.000	- 1.290	0.271 0.645	-	- -	-
5	5.290	30.5 30.5	1.00	4.000	6.9	2.098	0.427	2.257 -	- -	-	- -	-
7	1.290	25.9 -45.4	1.75	51.262	1493.3	0.132	1.000	- 1.290	0.271 0.645	-	- -	-
9	0.395	-50.0 -50.0	-	-	-	-	-	- -	- -	-	- -	-

Table of values		
Sye	0.095	inch^3
Mnyo	396.9	lbfft
Resistance factor	0.90	
Unity check	0.25	-

Lateral-Torsional Buckling Strength

According to article F2.1 and formula (F2.1-1),(F2.1.2-1).

Table of values		
Sigma,ex	4023.9	ksi
Kt	1.00	
Lt	1' 5.625"	ft
Sigma,t	297.7	ksi
Cs	1.00	
CTF	1.00	
Sfy	0.292	inch^3
j	3.031	inch
Fcre	33325.2	ksi

Note: Lateral-Torsional buckling is not governing since Fe is greater than or equal to 2.78 Fy.

...::Axial Compression Strength::...

Nominal Axial Strength

According to article E2 and formula (E2-1)

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch^4]	ds [inch]
1	0.395	50.0 50.0	1.00	0.430	133.6	0.612	1.000	0.238 -	- -	-	- -	-
3	1.290	50.0 50.0	1.00	2.858	83.3	0.775	0.924	1.192 -	0.360 0.833	30.83	0.000 0.000	0.238
5	5.290	50.0 50.0	1.00	4.000	6.9	2.686	0.342	1.808 -	- -	-	- -	-
7	1.290	50.0 50.0	1.00	2.858	83.3	0.775	0.924	1.192 -	0.360 0.833	30.83	0.000 0.000	0.238
9	0.395	50.0 50.0	1.00	0.430	133.6	0.612	1.000	0.238 -	- -	-	- -	-

Table of values		
Fn	50.0	ksi
Ae	0.223	$inch^2$
Pno	11164.2	lbf
Resistance factor	0.85	
Unity check	0.67	-

Buckling check
According to article E2 and formula (E2-1)
Flexural Buckling Strength
According to article E2.1 and formula (E2.1-1)

Buckling parameters	xx	yy	
Sway type	sway	sway	
Unbraced Length L	1 1/2	1 1/2	ft
Effective Length factor K	1.00	1.00	
Effective Length	1 1/2	1 1/2	ft
Slenderness	8.43	32.68	
Flexural Buckling stress Fcre	4023.9	268.1	ksi

Torsional (-Flexural) Buckling Strength
According to article E2.2, E2.3, E2.4

Table of values		
Sigma,ex	4023.9	ksi
Sigma,ey	268.1	ksi
Kt	1.00	
Lt	1 1/2	ft
Sigma,t	297.7	ksi
Sigma,TF	268.1	ksi
Torsional (-Flexural) buckling stress Fcre	268.1	ksi

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [$inch^4$]	ds [inch]
1	0.395	46.2 46.2	1.00	0.430	133.6	0.588	1.000	0.285 -	- -	-	- -	-
3	1.290	46.2 46.2	1.00	3.002	87.4	0.727	0.959	1.237 -	0.446 0.791	32.06	0.000 0.000	0.285
5	5.290	46.2 46.2	1.00	4.000	6.9	2.583	0.354	1.873 -	- -	-	- -	-
7	1.290	46.2 46.2	1.00	3.002	87.4	0.727	0.959	1.237 -	0.446 0.791	32.06	0.000 0.000	0.285
9	0.395	46.2 46.2	1.00	0.430	133.6	0.588	1.000	0.285 -	- -	-	- -	-

Table of values		
Fe	268.1	ksi
lambda, c	0.43	
Fn	46.2	ksi
Ae	0.234	$inch^2$
Pn	10820.3	lbf
Resistance factor	0.85	
Unity check	0.69	-

Distortional Buckling Strength
According to article E4 and formula (E4.1-2).

Table of values		
Py	19741.3	lbf
L	1' 4.036"	ft
k,phi,fe	97.8	lbf
k,phi,we	76.8	lbf
k,phi	0.0	lbf
k,phi,fg	0.004	$inch^2$
k,phi,wg	0.005	$inch^2$
Fd	21.5	ksi
Pcrd	8485.1	lbf

Table of values		
Lambda,d	1.53	
Pn	10102.8	lbf
Resistance factor	0.85	
Unity check	0.74	-

Data		
Lm	1' 5.625"	ft
Lcr	1' 4.036"	ft
h0	5.500	inch
Ixf	0.001	$inch^4$
Iyf	0.016	$inch^4$
Ixyf	0.003	$inch^4$
Cwf	0.000	$inch^6$
Jf	0.000	$inch^4$
x0f	0.510	inch
hxf	-0.937	inch
Af	0.078	$inch^2$
y0f	-0.058	inch

Number of compressed flanges: 2
Critical flange contains Initial shape parts: 2, 3, 1

Combined Compressive Axial Load and Bending
According to article H1.2 and formulas (H1.2-1)

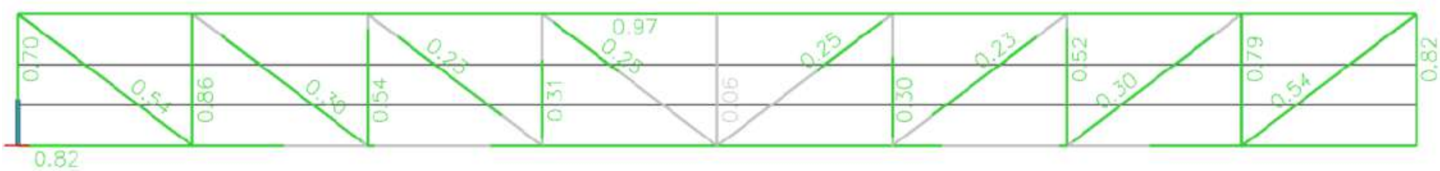
Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [$inch^4$]	ds [inch]
1	0.395	16.1 16.1	1.00	0.430	133.6	0.347	1.000	0.395 -	- -	-	- -	-
3	1.290	16.1 16.1	1.00	3.312	96.5	0.409	1.000	1.290 -	0.645 0.645	54.32	0.000 0.000	0.395
5	5.290	16.1 16.1	1.00	4.000	6.9	1.525	0.561	2.969 -	- -	-	- -	-
7	1.290	16.1 16.1	1.00	3.312	96.5	0.409	1.000	1.290 -	0.645 0.645	54.32	0.000 0.000	0.395
9	0.395	16.1 16.1	1.00	0.430	133.6	0.347	1.000	0.395 -	- -	-	- -	-

Table of values		
Centerline shift ex	0.126	inch
Centerline shift ey	0.000	inch
Additional moment Mx	0.0	lbfft
Additional moment My	-66.6	lbfft
Mny	396.9	lbfft
PEy	105834.9	lbf
Alfa y	0.94	
Cmy	0.85	
Pn	10102.8	lbf
Pno	11164.2	lbf
Resistance factor compression	0.85	
Resistance factor bending y	0.90	

Unity check = 0.74+0.00+0.23 = 0.97 - (H1.2-1)
Unity check = 0.67+0.00+0.25 = 0.92 -

The member satisfies the check !

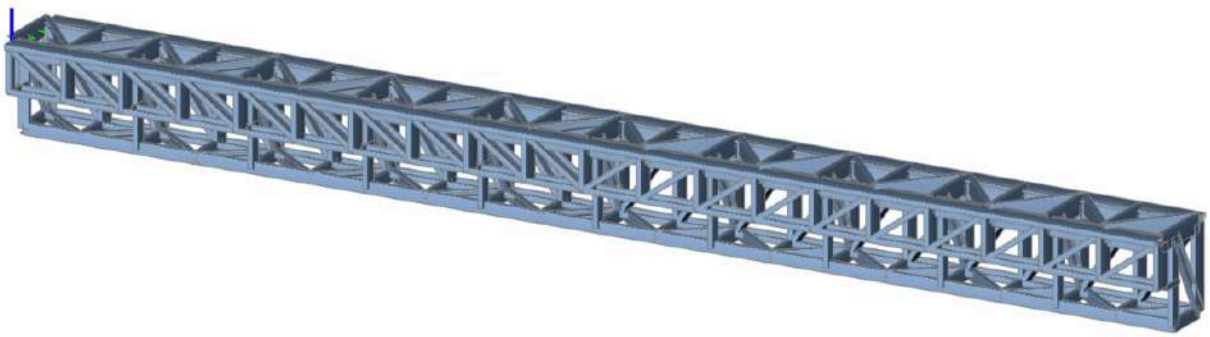
Unity check

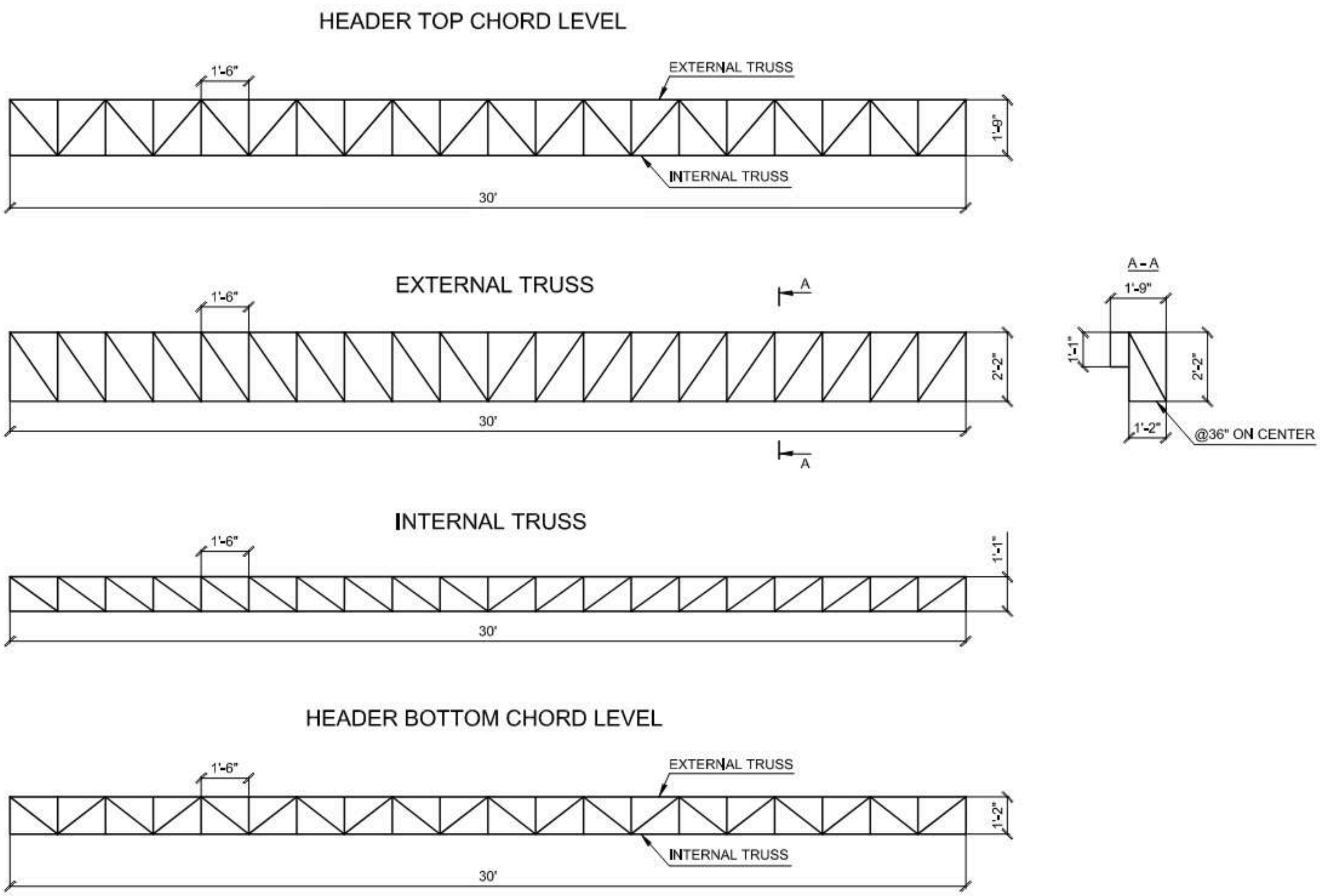


Combinations : LRFD-Ult (auto)

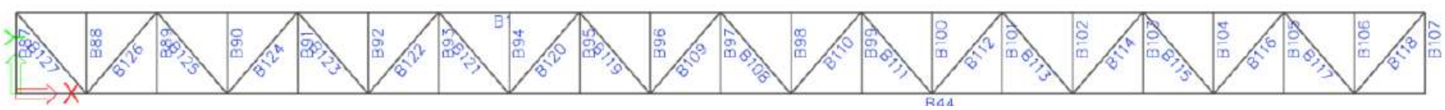
Case	Member	css	mat	dx [ft]	un.check [-]
LRFD-Ult (auto)/1	B1	550S150-43 - Cold formed C section	A913 grade 50	4.096"	0.06
LRFD-Ult (auto)/1	B2	550S150-43 - Cold formed C section	A913 grade 50	8.192"	0.82
LRFD-Ult (auto)/1	B3	550S150-43 - Cold formed C section	A913 grade 50	8.192"	0.70
LRFD-Ult (auto)/1	B4	550S150-43 - Cold formed C section	A913 grade 50	5' 1.688"	0.97
LRFD-Ult (auto)/1	B5	550S150-43 - Cold formed C section	A913 grade 50	4.096"	0.31
LRFD-Ult (auto)/1	B6	550S150-43 - Cold formed C section	A913 grade 50	8.192"	0.79
LRFD-Ult (auto)/1	B7	550S150-43 - Cold formed C section	A913 grade 50	8.192"	0.52
LRFD-Ult (auto)/1	B8	550S150-43 - Cold formed C section	A913 grade 50	4.096"	0.54
LRFD-Ult (auto)/1	B9	550S150-43 - Cold formed C section	A913 grade 50	4.096"	0.30
LRFD-Ult (auto)/1	B10	550S150-43 - Cold formed C section	A913 grade 50	4.096"	0.86
LRFD-Ult (auto)/1	B11	550S150-43 - Cold formed C section	A913 grade 50	0.000"	0.82
LRFD-Ult (auto)/1	B12	550S150-43 - Cold formed C section	A913 grade 50	1' 1.592"	0.25
LRFD-Ult (auto)/1	B13	550S150-43 - Cold formed C section	A913 grade 50	1' 1.592"	0.25
LRFD-Ult (auto)/1	B14	550S150-43 - Cold formed C section	A913 grade 50	1' 1.592"	0.23
LRFD-Ult (auto)/1	B15	550S150-43 - Cold formed C section	A913 grade 50	6.796"	0.30
LRFD-Ult (auto)/1	B16	550S150-43 - Cold formed C section	A913 grade 50	6.796"	0.54
LRFD-Ult (auto)/1	B17	550S150-43 - Cold formed C section	A913 grade 50	1' 1.592"	0.23
LRFD-Ult (auto)/1	B18	550S150-43 - Cold formed C section	A913 grade 50	6.796"	0.30
LRFD-Ult (auto)/1	B19	550S150-43 - Cold formed C section	A913 grade 50	6.796"	0.54

2.3.1.6 30 FT - DOOR OPENING WEB HEADER DESIGN
General scheme

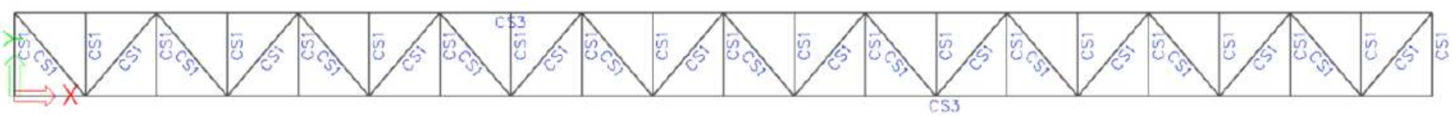




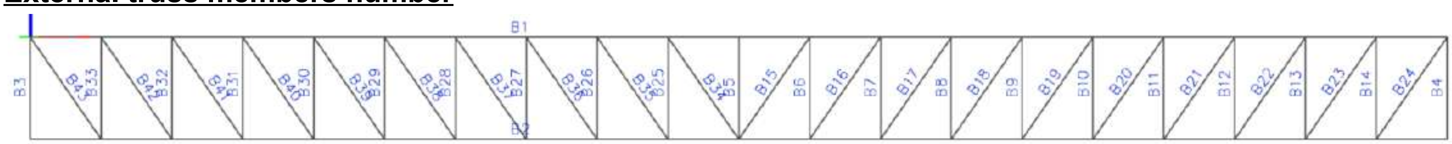
Header top chord level members number



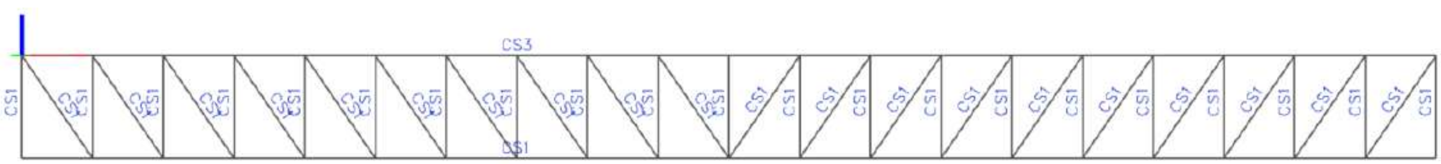
Header top chord level members cross-sections



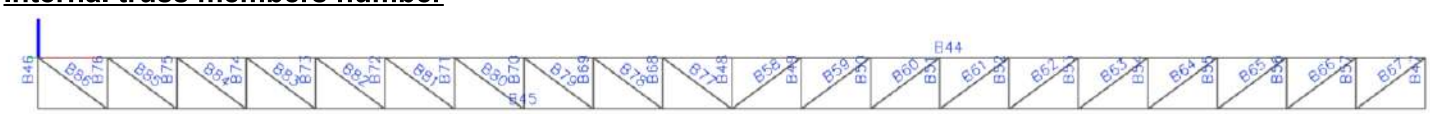
External truss members number



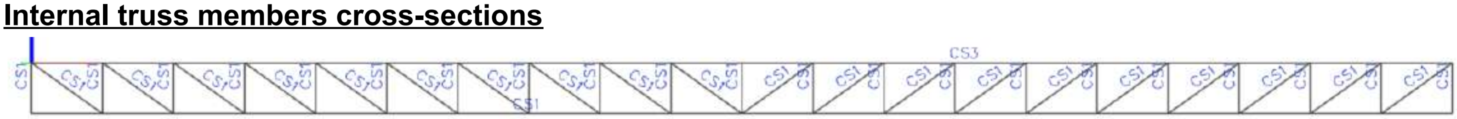
External truss members cross-sections



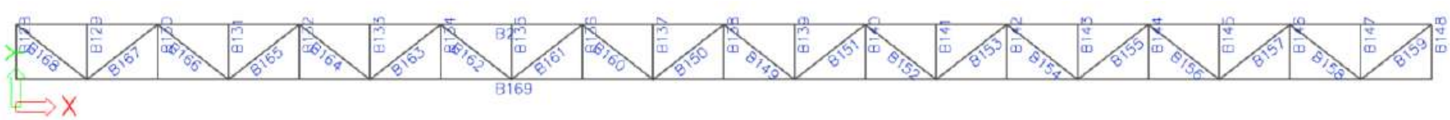
Internal truss members number



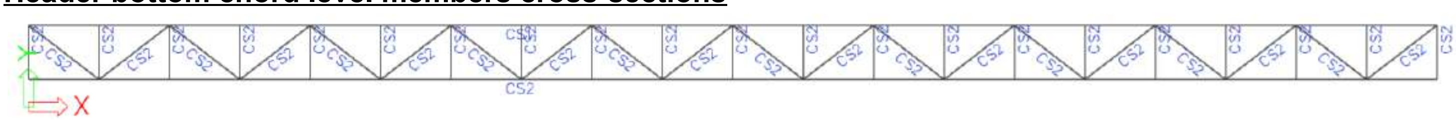
Internal truss members cross-sections



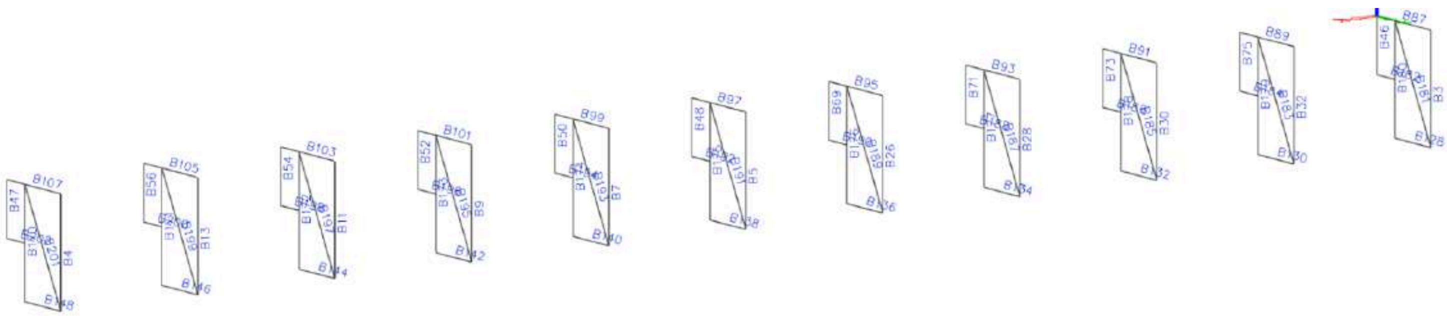
Header bottom chord level members number



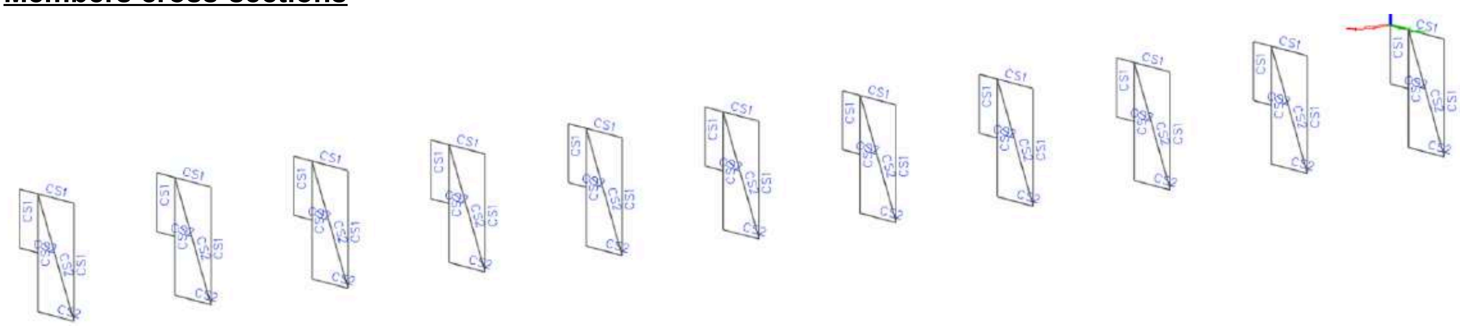
Header bottom chord level members cross-sections



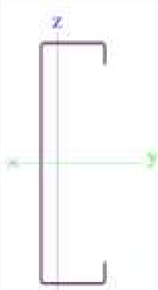
Members number



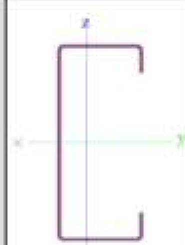
Members cross-sections



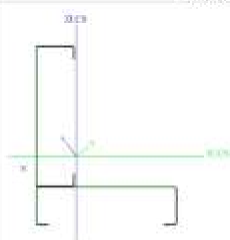
Cross-sections properties CS1

CS1		
Type	550S150-43	
Shape type	Thin-walled	
Item material	A913 grade 50	
Fabrication	cold formed	
Colour	■	
A [inch^2]	0.395	
A_y [inch^2], A_z [inch^2]	0.130	0.243
A_L [inch^2/inch], A_D [inch^2/inch]	1.84e+01	1.84e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	0.002	0.000
α [deg]	0.00	
I_y [inch^4], I_z [inch^4]	1.722	0.115
i_y [inch], i_z [inch]	2.089	0.539
$W_{el.y}$ [inch^3], $W_{el.z}$ [inch^3]	0.626	0.104
$W_{pl.y}$ [inch^3], $W_{pl.z}$ [inch^3]	0.747	0.148
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	3.73e+01	3.73e+01
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	7.39e+00	7.39e+00
d_y [inch], d_z [inch]	-1.010	0.000
I_t [inch^4], I_w [inch^6]	0.000	0.721
β_y [inch], β_z [inch]	0.000	5.887
Picture		

Cross-sections properties CS2

CS2		
Type	350S150-43	
Shape type	Thin-walled	
Item material	A653 grade 33	
Fabrication	cold formed	
Colour	■	
A [inch^2]	0.309	
A_y [inch^2], A_z [inch^2]	0.130	0.163
A_L [inch^2/inch], A_D [inch^2/inch]	1.44e+01	1.44e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	0.002	0.000
α [deg]	0.00	
I_y [inch^4], I_z [inch^4]	0.595	0.100
i_y [inch], i_z [inch]	1.388	0.568
$W_{el.y}$ [inch^3], $W_{el.z}$ [inch^3]	0.340	0.099
$W_{pl.y}$ [inch^3], $W_{pl.z}$ [inch^3]	0.395	0.146
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	1.30e+01	1.30e+01
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	4.80e+00	4.80e+00
d_y [inch], d_z [inch]	-1.208	0.000
I_t [inch^4], I_w [inch^6]	0.000	0.279
β_y [inch], β_z [inch]	0.000	3.917
Picture		

Cross-sections properties CS3

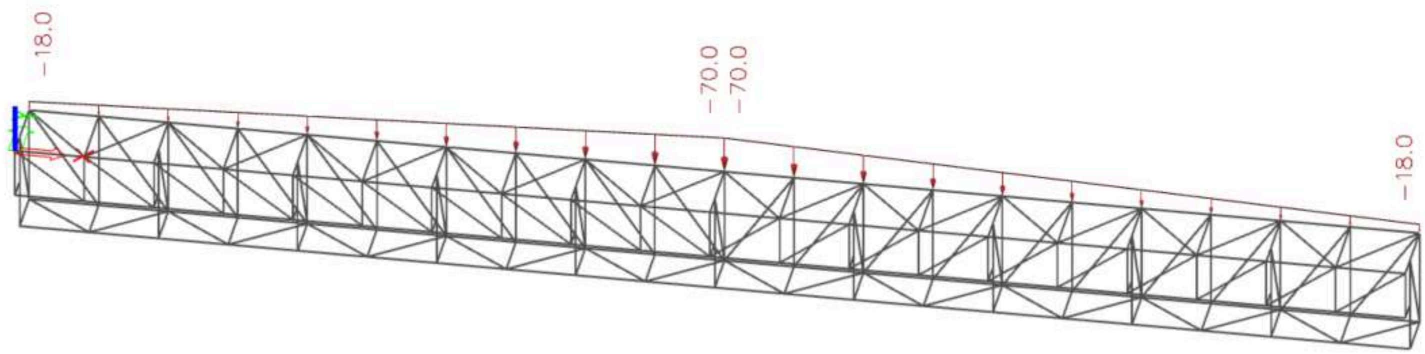
CS3		
Type	2xS50S150-54	
Shape type	Thin-walled	
Item material	A913 grade 50	
Fabrication	cold formed	
Colour		
A [$inch^2$]	0.793	
A_y [$inch^2$], A_z [$inch^2$]	0.621	0.536
A_L [$inch^2$/inch], A_D [$inch^2$/inch]	3.44e+01	3.44e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	0.090	3.127
$I_{Y.LCS}$ [$inch^4$], $I_{Z.LCS}$ [$inch^4$]	3.809	2.950
$I_{YZ.LCS}$ [$inch^4$]	-1.468	
α [deg]	36.84	
I_y [$inch^4$], I_z [$inch^4$]	4.909	1.851
i_y [inch], i_z [inch]	2.489	1.528
$W_{el.y}$ [$inch^3$], $W_{el.z}$ [$inch^3$]	1.100	0.654
$W_{pl.y}$ [$inch^3$], $W_{pl.z}$ [$inch^3$]	1.599	1.060
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	7.99e+01	7.99e+01
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	5.30e+01	5.30e+01
d_y [inch], d_z [inch]	-1.908	0.847
I_t [$inch^4$], I_w [$inch^6$]	0.001	3.217
$β_y$ [inch], $β_z$ [inch]	-1.458	7.164
Picture		

Explanations of symbols	
Formcode	s - Thickness r - Inner radius b - Flange width h - Height c - Lip
A	Area
A_y	Shear Area in principal y-direction
A_z	Shear Area in principal z-direction
A_L	Circumference per unit length
A_D	Drying surface per unit length
$c_{Y.UCS}$	Centroid coordinate in Y-direction of Input axis system
$c_{Z.UCS}$	Centroid coordinate in Z-direction of Input axis system
$I_{Y.LCS}$	Second moment of area about the YLCS axis
$I_{Z.LCS}$	Second moment of area about the ZLCS axis
$I_{YZ.LCS}$	Product moment of area in the LCS system
α	Rotation angle of the principal axis system
I_y	Second moment of area about the principal y-axis
I_z	Second moment of area about the principal z-axis
i_y	Radius of gyration about the principal y-axis

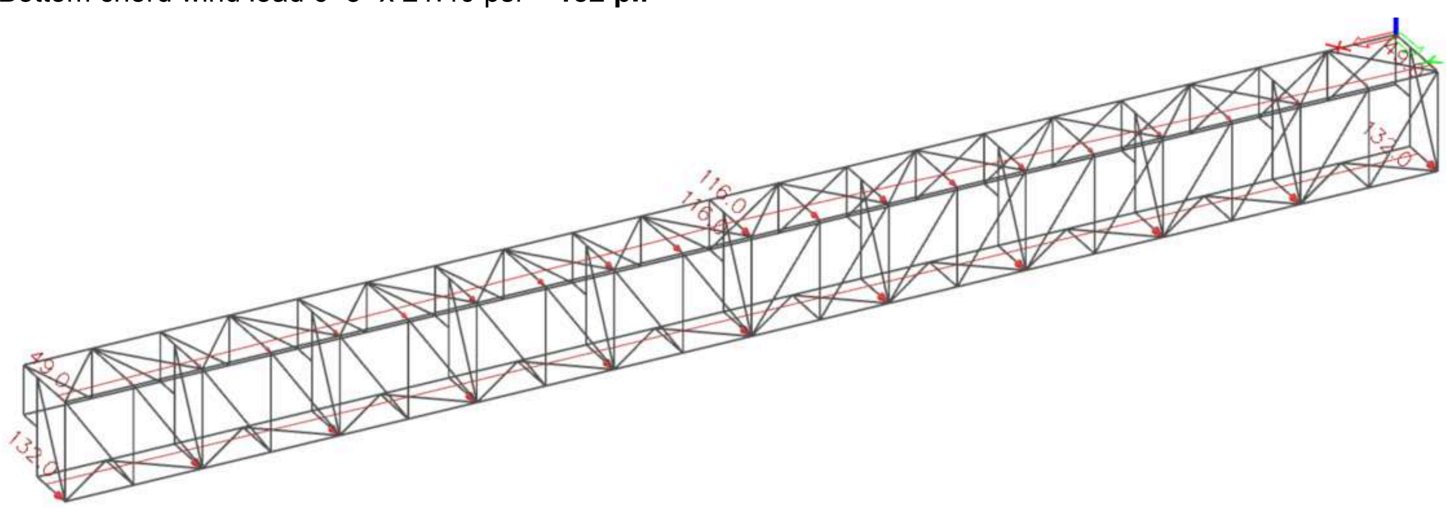
Explanations of symbols	
i_z	Radius of gyration about the principal z-axis
$W_{el.y}$	Elastic section modulus about the principal y-axis
$W_{el.z}$	Elastic section modulus about the principal z-axis
$W_{pl.y}$	Plastic section modulus about the principal y-axis
$W_{pl.z}$	Plastic section modulus about the principal z-axis
$M_{pl.y.+}$	Plastic moment about the principal y-axis for a positive My moment
$M_{pl.y.-}$	Plastic moment about the principal y-axis for a negative My moment
$M_{pl.z.+}$	Plastic moment about the principal z-axis for a positive Mz moment
$M_{pl.z.-}$	Plastic moment about the principal z-axis for a negative Mz moment
d_y	Shear center coordinate in principal y-direction measured from the centroid
d_z	Shear center coordinate in principal z-direction measured from the centroid
I_t	Torsional constant
I_w	Warping constant
β_y	Mono-symmetry constant about the principal y-axis
β_z	Mono-symmetry constant about the principal z-axis

APPLIED LOADS
DL2 - Window dead load

According to table Table C3.1-1a ASCE 7-16, Windows, glass dead load - 8 psf.
Window height 2'-2"¾ & 8'-8".   8psf x 2'-2"¾ = **17.83** plf. 8psf x 8'-8" = **69.33** plf



Wind Load - Wy+
Wall wind load - 21.04 psf.
Top Chord dead load, from 2'-4" x 21.04 psf = **49 plf** to 5'-6" x 21.04 psf = **116 plf**
Bottom chord wind load 6'-3" x 21.40 psf = **132 plf**

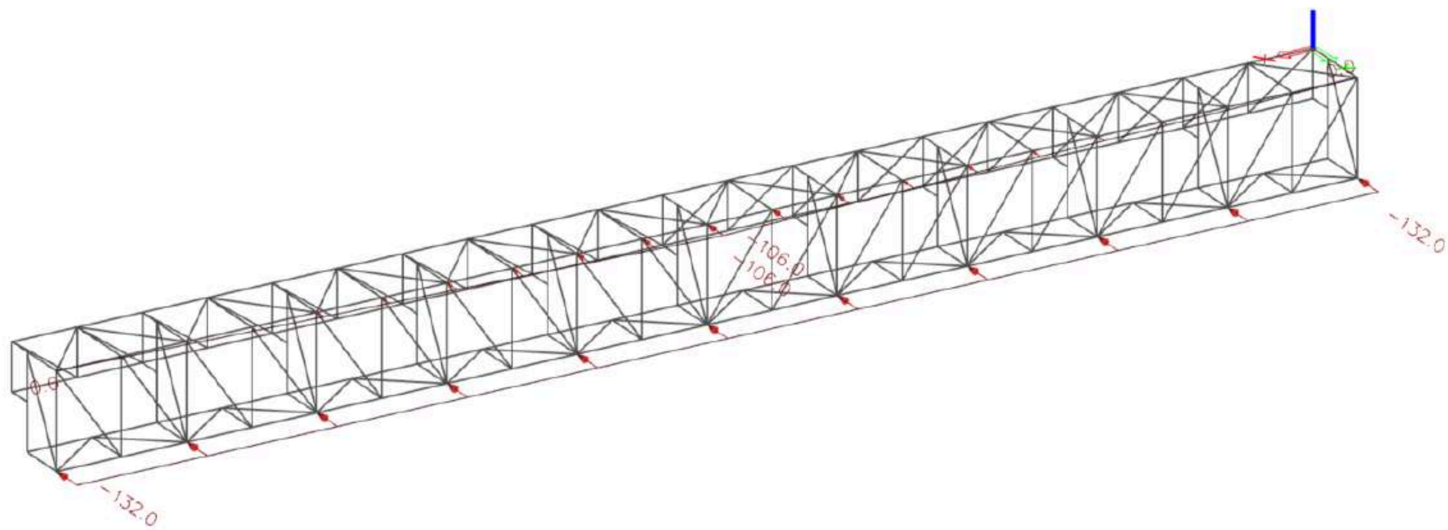


Wind Load - Wy-

Wall wind load - 21.04 psf.

Top Chord dead load, from 2'-4" x 21.04 psf = **49 plf** to 5'-6" x 21.04 psf = **116 plf**

Bottom chord wind load 6'-3" x 21.40 psf = **132 plf**



MAXIMUM FORCES

Extreme 1D: Cross-section

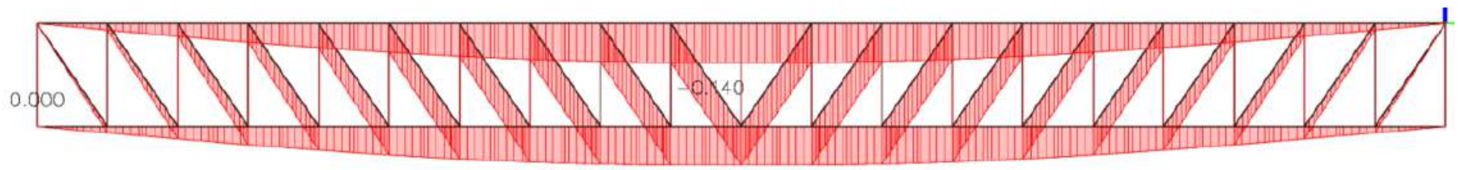
Selection: All

Name	dx [ft]	Case	Cross-section	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B44	28' 6.000"+	LRFD-Ult (auto)/1	CS3 - 2x550S150-54	**-8118.5**	**-308.8**	-606.1	0.1	484.5	141.5
B44	28' 6.000"+	LRFD-Ult (auto)/2	CS3 - 2x550S150-54	**10769.6**	335.0	**659.1**	-0.2	-479.7	-125.7
B1	0.000"	LRFD-Ult (auto)/2	CS3 - 2x550S150-54	-4412.6	246.9	391.8	**-0.2**	-401.8	-301.1
B1	28' 6.000"+	LRFD-Ult (auto)/2	CS3 - 2x550S150-54	-4472.7	-260.2	-355.0	**0.2**	226.2	120.0
B44	28' 6.000"+	LRFD-Ult (auto)/3	CS3 - 2x550S150-54	10390.9	331.3	651.6	-0.2	**-480.4**	-127.9
B44	18' 0.000"-	LRFD-Ult (auto)/2	CS3 - 2x550S150-54	-4216.7	44.8	66.4	0.0	**588.8**	-103.8
B44	30' 0.000"	LRFD-Ult (auto)/1	CS3 - 2x550S150-54	-8118.5	-305.9	**-608.3**	0.1	-426.3	**-319.5**
B44	30' 0.000"	LRFD-Ult (auto)/2	CS3 - 2x550S150-54	10769.6	**338.9**	656.2	-0.2	506.8	**379.8**
B127	0.000"	LRFD-Ult (auto)/2	CS1 - 550S150-43	**-4405.2**	0.0	1.9	0.0	0.0	0.0
B45	15' 0.000"+	LRFD-Ult (auto)/2	CS1 - 550S150-43	**5562.1**	6.5	-57.2	0.0	209.1	7.2
B45	28' 6.000"-	LRFD-Ult (auto)/2	CS1 - 550S150-43	1844.7	**-13.2**	-195.6	0.0	-150.8	-10.8

Name	dx [ft]	Case	Cross-section	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B105	7.000"-	LRFD-Ult (auto)/4	CS1 - 550S150-43	-238.8	0.1	**-579.7**	0.0	-337.9	0.0
B105	0.000"	LRFD-Ult (auto)/3	CS1 - 550S150-43	136.1	-0.1	**578.0**	-0.1	0.0	0.0
B105	0.000"	LRFD-Ult (auto)/2	CS1 - 550S150-43	121.4	-0.1	577.9	**-0.1**	0.0	0.0
B89	0.000"	LRFD-Ult (auto)/2	CS1 - 550S150-43	83.5	0.1	548.9	**0.1**	0.0	0.0
B43	2' 7.623"	LRFD-Ult (auto)/1	CS1 - 550S150-43	2016.6	-0.9	-160.1	0.0	**-734.6**	0.0
B43	2' 7.623"	LRFD-Ult (auto)/2	CS1 - 550S150-43	-18.2	-1.2	191.9	0.0	**882.0**	0.0
B45	1' 6.000"+	LRFD-Ult (auto)/2	CS1 - 550S150-43	1798.5	**13.1**	251.1	0.0	-178.2	**-11.1**
B45	16' 10.000"	LRFD-Ult (auto)/2	CS1 - 550S150-43	5488.7	-0.1	-16.2	0.0	159.9	**15.2**
B169	13' 6.000"+	LRFD-Ult (auto)/3	CS2 - 350S150-43	**-3904.4**	-0.4	-7.5	0.0	45.6	-14.6
B169	15' 0.000"+	LRFD-Ult (auto)/4	CS2 - 350S150-43	**5807.7**	**-26.3**	0.9	0.0	-11.3	32.6
B170	1' 1.000"+	LRFD-Ult (auto)/2	CS2 - 350S150-43	10.8	0.1	**-246.3**	0.0	266.9	-0.1
B200	0.000"	LRFD-Ult (auto)/2	CS2 - 350S150-43	-83.1	0.4	0.0	**-0.2**	0.0	0.0
B184	0.000"	LRFD-Ult (auto)/2	CS2 - 350S150-43	3.0	0.4	0.0	**0.2**	0.0	0.0
B170	1' 1.000"-	LRFD-Ult (auto)/1	CS2 - 350S150-43	-1.7	-0.1	-204.2	0.0	**-221.2**	-0.1
B170	1' 1.000"-	LRFD-Ult (auto)/2	CS2 - 350S150-43	10.4	0.1	**246.3**	0.0	**266.9**	0.1
B169	13' 6.000"-	LRFD-Ult (auto)/2	CS2 - 350S150-43	-3400.5	-3.9	-5.3	0.0	50.5	**-17.7**
B169	15' 0.000"-	LRFD-Ult (auto)/4	CS2 - 350S150-43	5807.7	**26.3**	-1.0	0.0	-11.3	**32.6**

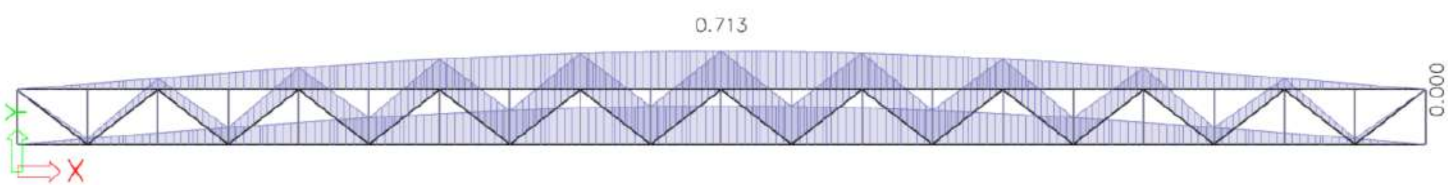
Name	Combination key
LRFD-Ult (auto)/1	0.90*DL1 + 0.90*DL2 + Wy-
LRFD-Ult (auto)/2	1.20*DL1 + 1.20*DL2 + Wy+
LRFD-Ult (auto)/3	0.90*DL1 + 0.90*DL2 + Wy+
LRFD-Ult (auto)/4	1.20*DL1 + 1.20*DL2 + Wy-

Displacement
Load case D + Lr, inch:



The maximum deflection for a web header is 0.140”.
According to TABLE 1604.3 the code IBC 2018, maximum member deflection should not exceed - L/360.
L=30’=360”, 360”/360=1”. 0.14"< 1”. <u>Deflection is OK!</u>

Displacement
Load case W, inch:



The maximum deflection for a web header is 0.713”.
According to TABLE 1604.3 the code IBC 2018, maximum member deflection should not exceed - L/360.
L=30’=360”, 360”/360=1”. 0.713"< 1”. <u>Deflection is OK!</u>

STEEL MEMBER B169 CHECK

AISI S100-16 LRFD Check

Member B169	350S150-43	A653 grade 33	LRFD-Ult (auto)	0.72

Material data		
Yield stress Fy	33.00	ksi
Tensile stress Fu	45.00	ksi
fabrication	cold formed	

The critical check is on position 13.50 ft

Axis definition :
- local x- axis in this code check is referring to the local y axis in Scia Engineer
- local y- axis in this code check is referring to the local z axis in Scia Engineer

Internal forces		
Pu	-3904.39	lbf
Vux	-0.42	lbf
Vuy	-7.46	lbf
Mut	-0.00	lbfft
Mux	45.60	lbfft
Muy	-26.51	lbfft

Note: Mux and/or Muy include additional moments as defined in art. H1.2

...::Flexural Strength about X-axis::...
Nominal Flexural Strength
According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch^4]	ds [inch]
1	0.479	-23.9 -33.0	-	-	-	-	-	- -	- -	-	- -	-
2	1.457	-33.0 -33.0	-	-	-	-	-	- -	- -	-	- -	-
3	3.457	33.0 -33.0	1.00	24.000	97.4	0.582	1.000	- 3.457	0.864 1.728	-	- -	-
4	1.457	33.0 33.0	1.00	4.000	91.3	0.601	1.000	1.457 -	- -	-	- -	-
5	0.479	33.0 23.9	0.72	0.544	115.1	0.535	1.000	0.479 -	- -	-	- -	-

Table of values		
Sxe	0.340	inch^3
Mnxo	934.7	lbfft
Resistance factor	0.90	
Unity check	0.05	-

Lateral-Torsional Buckling Strength

According to article F2.1 and formula (F2.1-1),(F2.1.1-1).

Table of values		
Lltb	1' 6.000"	ft
Sigma,ey	284.9	ksi
Kt	1.00	
Lt	1' 6.000"	ft
Sigma,t	217.5	ksi
Cb	1.12	
Sfx	0.340	$inch^3$
Fcre	485.5	ksi

Note: Lateral-Torsional buckling is not governing since Fe is greater than or equal to 2.78 Fy.

...::Flexural Strength about Y-axis::...

Nominal Flexural Strength

According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [$inch^4$]	ds [inch]
1	0.479	-33.0 -33.0	-	-	-	-	-	- -	- -	-	- -	-
2	1.457	19.9 -33.0	1.65	46.708	1066.6	0.137	1.000	- 1.457	0.313 0.728	-	- -	-
3	3.457	19.9 19.9	1.00	4.000	16.2	1.109	0.723	2.499 -	- -	-	- -	-
4	1.457	19.9 -33.0	1.65	46.708	1066.6	0.137	1.000	- 1.457	0.313 0.728	-	- -	-
5	0.479	-33.0 -33.0	-	-	-	-	-	- -	- -	-	- -	-

Table of values		
Sye	0.100	$inch^3$
Mnyo	274.7	lbfft
Resistance factor	0.90	
Unity check	0.11	-

Lateral-Torsional Buckling Strength

According to article F2.1 and formula (F2.1-1),(F2.1.1-1).

Table of values		
Sigma,ex	1703.2	ksi
Kt	1.00	
Lt	1' 6.000"	ft
Sigma,t	217.5	ksi
Cb	1.00	
Sfy	0.201	$inch^3$
Fcre	1803.7	ksi

Note: Lateral-Torsional buckling is not governing since Fe is greater than or equal to 2.78 Fy.

...::Axial Compression Strength::...

Nominal Axial Strength

According to article E2 and formula (E2-1)

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.479	33.0 33.0	1.00	0.430	91.0	0.602	1.000	0.479 -	- -	-	- -	-
2	1.457	33.0 33.0	1.00	4.000	91.3	0.601	1.000	1.457 -	- -	-	- -	-
3	3.457	33.0 33.0	1.00	4.000	16.2	1.426	0.593	2.050 -	- -	-	- -	-
4	1.457	33.0 33.0	1.00	4.000	91.3	0.601	1.000	1.457 -	- -	-	- -	-
5	0.479	33.0 33.0	1.00	0.430	91.0	0.602	1.000	0.479 -	- -	-	- -	-

Table of values		
Fn	33.0	ksi
Ae	0.255	inch ^{2}
Pno	8402.0	lbf
Resistance factor	0.85	
Unity check	0.55	-

Buckling check

According to article E2 and formula (E2-1)

Flexural Buckling Strength

According to article E2.1 and formula (E2.1-1)

Buckling parameters	xx	yy	
Sway type	sway	sway	
Unbraced Length L	1 5/8	1 5/8	ft
Effective Length factor K	1.00	1.00	
Effective Length	1 5/8	1 5/8	ft
Slenderness	12.97	31.70	
Flexural Buckling stress Fcre	1703.2	284.9	ksi

Torsional (-Flexural) Buckling Strength

According to article E2.2, E2.3, E2.4

Table of values		
Sigma,ex	1703.2	ksi
Sigma,ey	284.9	ksi
Kt	1.00	
Lt	1 5/8	ft
Sigma,t	217.5	ksi
Sigma,TF	206.3	ksi
Torsional (-Flexural) buckling stress Fcre	206.3	ksi

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.479	30.9 30.9	1.00	0.430	91.0	0.582	1.000	0.479 -	- -	-	- -	-
2	1.457	30.9 30.9	1.00	4.000	91.3	0.581	1.000	1.457 -	- -	-	- -	-

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
3	3.457	30.9 30.9	1.00	4.000	16.2	1.379	0.609	2.107 -	- -	-	- -	-
4	1.457	30.9 30.9	1.00	4.000	91.3	0.581	1.000	1.457 -	- -	-	- -	-
5	0.479	30.9 30.9	1.00	0.430	91.0	0.582	1.000	0.479 -	- -	-	- -	-

Table of values		
Fe	206.3	ksi
lambda, c	0.40	
Fn	30.9	ksi
Ae	0.257	inch ^{2}
Pn	7933.0	lbf
Resistance factor	0.85	
Unity check	0.58	-

Combined Compressive Axial Load and Bending

According to article H1.2 and formulas (H1.2-1)

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.479	12.7 12.7	1.00	0.430	91.0	0.373	1.000	0.479 -	- -	-	- -	-
2	1.457	12.7 12.7	1.00	4.000	91.3	0.372	1.000	1.457 -	- -	-	- -	-
3	3.457	12.7 12.7	1.00	4.000	16.2	0.883	0.850	2.940 -	- -	-	- -	-
4	1.457	12.7 12.7	1.00	4.000	91.3	0.372	1.000	1.457 -	- -	-	- -	-
5	0.479	12.7 12.7	1.00	0.430	91.0	0.373	1.000	0.479 -	- -	-	- -	-

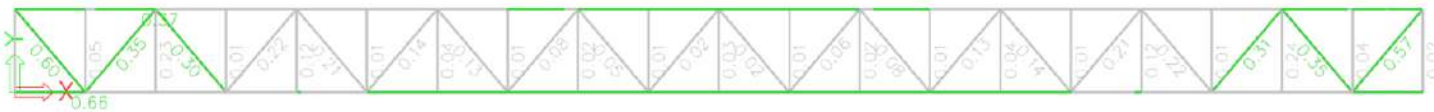
Table of values		
Centerline shift ex	0.036	inch
Centerline shift ey	0.000	inch
Additional moment Mx	0.0	lbfft
Additional moment My	-11.9	lbfft
Mnx	934.7	lbfft
Mny	274.7	lbfft
PEx	525600.6	lbf
PEy	87926.9	lbf
Alfa x	0.99	
Alfa y	0.96	
Cmx	0.85	
Cmy	0.85	
Pn	7933.0	lbf
Pno	8402.0	lbf

Resistance factor compression	0.85	
Resistance factor bending x	0.90	
Resistance factor bending y	0.90	

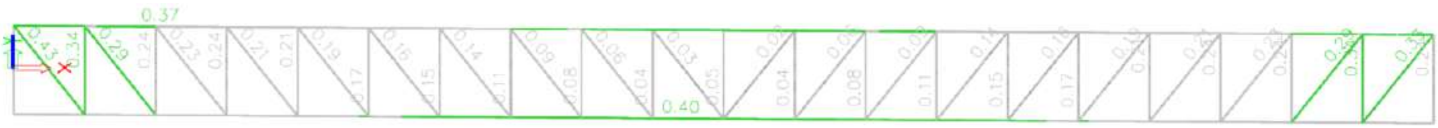
Unity check = 0.58+0.05+0.10 = 0.72 - (H1.2-1)
Unity check = 0.55+0.05+0.11 = 0.71 -

The member satisfies the check !

Header top chord level members unity check

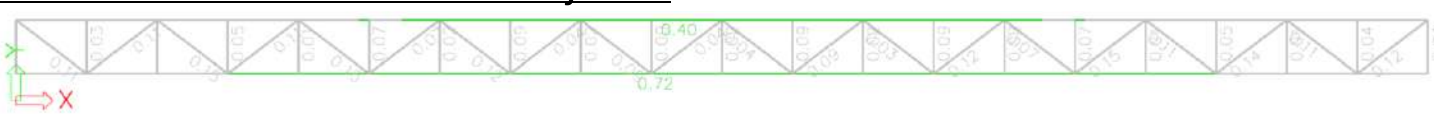


External truss members unity check

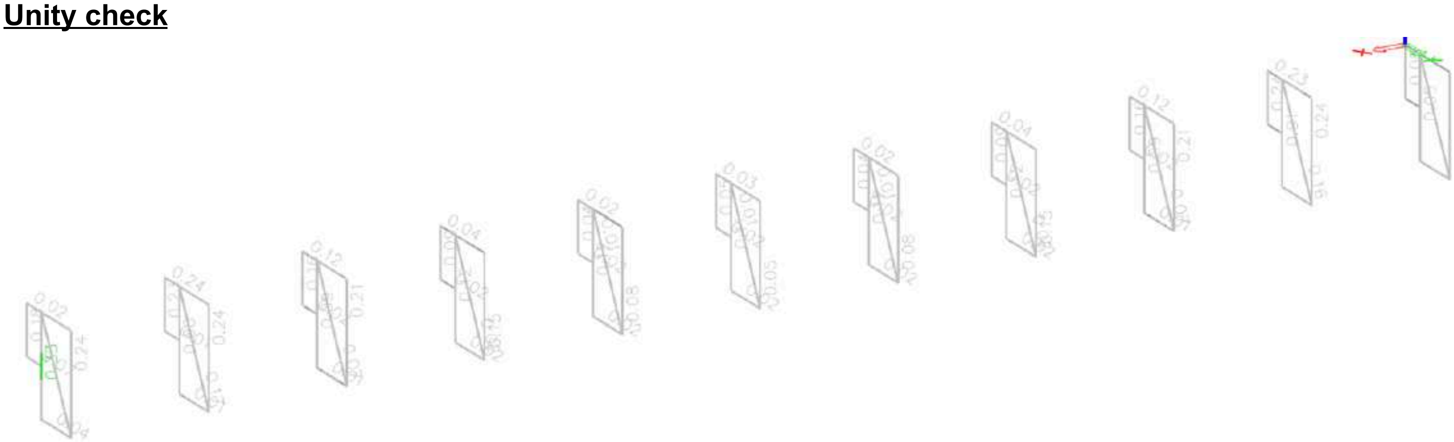


Internal truss members unity check

Header bottom chord level members unity check



Unity check



Combinations : LRFD-Ult (auto)

Case	Member	css	mat	dx [ft]	un.check [-]
LRFD-Ult (auto)/1	B1	CS3 - 2x550S150-54	A913 grade 50	3' 0.000"	0.37
LRFD-Ult (auto)/2	B2	CS1 - 550S150-43	A913 grade 50	14' 0.000"	0.40
LRFD-Ult (auto)/2	B3	CS1 - 550S150-43	A913 grade 50	2' 2.000"	0.00
LRFD-Ult (auto)/2	B4	CS1 - 550S150-43	A913 grade 50	2' 2.000"	0.24
LRFD-Ult (auto)/2	B5	CS1 - 550S150-43	A913 grade 50	0.000"	0.05
LRFD-Ult (auto)/2	B6	CS1 - 550S150-43	A913 grade 50	0.000"	0.04
LRFD-Ult (auto)/2	B7	CS1 - 550S150-43	A913 grade 50	0.000"	0.08
LRFD-Ult (auto)/2	B8	CS1 - 550S150-43	A913 grade 50	0.000"	0.11
LRFD-Ult (auto)/2	B9	CS1 - 550S150-43	A913 grade 50	0.000"	0.15
LRFD-Ult (auto)/2	B10	CS1 - 550S150-43	A913 grade 50	0.000"	0.17
LRFD-Ult (auto)/2	B11	CS1 - 550S150-43	A913 grade 50	2' 2.000"	0.21
LRFD-Ult (auto)/3	B12	CS1 - 550S150-43	A913 grade 50	2' 2.000"	0.24
LRFD-Ult (auto)/2	B13	CS1 - 550S150-43	A913 grade 50	2' 2.000"	0.24
LRFD-Ult (auto)/3	B14	CS1 - 550S150-43	A913 grade 50	2' 2.000"	0.34
LRFD-Ult (auto)/3	B15	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.02
LRFD-Ult (auto)/2	B16	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.06
LRFD-Ult (auto)/2	B17	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.09
LRFD-Ult (auto)/2	B18	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.14
LRFD-Ult (auto)/2	B19	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.16
LRFD-Ult (auto)/2	B20	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.19
LRFD-Ult (auto)/3	B21	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.21
LRFD-Ult (auto)/2	B22	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.23
LRFD-Ult (auto)/3	B23	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.29
LRFD-Ult (auto)/3	B24	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.33
LRFD-Ult (auto)/2	B25	CS1 - 550S150-43	A913 grade 50	0.000"	0.04
LRFD-Ult (auto)/2	B26	CS1 - 550S150-43	A913 grade 50	0.000"	0.08
LRFD-Ult (auto)/2	B27	CS1 - 550S150-43	A913 grade 50	0.000"	0.11
LRFD-Ult (auto)/2	B28	CS1 - 550S150-43	A913 grade 50	0.000"	0.15
LRFD-Ult (auto)/2	B29	CS1 - 550S150-43	A913 grade 50	0.000"	0.17
LRFD-Ult (auto)/2	B30	CS1 - 550S150-43	A913 grade 50	2' 2.000"	0.21
LRFD-Ult (auto)/3	B31	CS1 - 550S150-43	A913 grade 50	2' 2.000"	0.24
LRFD-Ult (auto)/2	B32	CS1 - 550S150-43	A913 grade 50	2' 2.000"	0.24
LRFD-Ult (auto)/3	B33	CS1 - 550S150-43	A913 grade 50	2' 2.000"	0.34
LRFD-Ult (auto)/3	B34	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.03
LRFD-Ult (auto)/2	B35	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.06
LRFD-Ult (auto)/2	B36	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.09
LRFD-Ult (auto)/2	B37	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.14
LRFD-Ult (auto)/2	B38	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.16
LRFD-Ult (auto)/2	B39	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.19
LRFD-Ult (auto)/3	B40	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.21
LRFD-Ult (auto)/2	B41	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.23
LRFD-Ult (auto)/3	B42	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.29
LRFD-Ult (auto)/3	B43	CS1 - 550S150-43	A913 grade 50	2' 7.623"	0.43
LRFD-Ult (auto)/4	B44	CS3 - 2x550S150-54	A913 grade 50	28' 6.000"	0.66
LRFD-Ult (auto)/4	B45	CS1 - 550S150-43	A913 grade 50	21' 0.000"	0.43
LRFD-Ult (auto)/2	B46	CS1 - 550S150-43	A913 grade 50	1' 1.000"	0.08
LRFD-Ult (auto)/2	B47	CS1 - 550S150-43	A913 grade 50	1' 1.000"	0.18
LRFD-Ult (auto)/2	B48	CS1 - 550S150-43	A913 grade 50	0.000"	0.05
LRFD-Ult (auto)/2	B49	CS1 - 550S150-43	A913 grade 50	0.000"	0.02

Case	Member	css	mat	dx [ft]	un.check [-]
LRFD-Ult (auto)/2	B50	CS1 - 550S150-43	A913 grade 50	0.000"	0.04
LRFD-Ult (auto)/2	B51	CS1 - 550S150-43	A913 grade 50	1' 1.000"	0.07
LRFD-Ult (auto)/2	B52	CS1 - 550S150-43	A913 grade 50	1' 1.000"	0.09
LRFD-Ult (auto)/2	B53	CS1 - 550S150-43	A913 grade 50	1' 1.000"	0.13
LRFD-Ult (auto)/2	B54	CS1 - 550S150-43	A913 grade 50	1' 1.000"	0.16
LRFD-Ult (auto)/2	B55	CS1 - 550S150-43	A913 grade 50	1' 1.000"	0.19
LRFD-Ult (auto)/2	B56	CS1 - 550S150-43	A913 grade 50	1' 1.000"	0.23
LRFD-Ult (auto)/2	B57	CS1 - 550S150-43	A913 grade 50	1' 1.000"	0.27
LRFD-Ult (auto)/2	B58	CS1 - 550S150-43	A913 grade 50	0.000"	0.04
LRFD-Ult (auto)/2	B59	CS1 - 550S150-43	A913 grade 50	1' 10.204"	0.05
LRFD-Ult (auto)/2	B60	CS1 - 550S150-43	A913 grade 50	1' 10.204"	0.10
LRFD-Ult (auto)/2	B61	CS1 - 550S150-43	A913 grade 50	1' 10.204"	0.14
LRFD-Ult (auto)/2	B62	CS1 - 550S150-43	A913 grade 50	1' 10.204"	0.18
LRFD-Ult (auto)/2	B63	CS1 - 550S150-43	A913 grade 50	1' 10.204"	0.21
LRFD-Ult (auto)/2	B64	CS1 - 550S150-43	A913 grade 50	1' 10.204"	0.26
LRFD-Ult (auto)/2	B65	CS1 - 550S150-43	A913 grade 50	1' 10.204"	0.28
LRFD-Ult (auto)/2	B66	CS1 - 550S150-43	A913 grade 50	1' 10.204"	0.32
LRFD-Ult (auto)/2	B67	CS1 - 550S150-43	A913 grade 50	1' 10.204"	0.37
LRFD-Ult (auto)/2	B68	CS1 - 550S150-43	A913 grade 50	0.000"	0.02
LRFD-Ult (auto)/2	B69	CS1 - 550S150-43	A913 grade 50	0.000"	0.04
LRFD-Ult (auto)/2	B70	CS1 - 550S150-43	A913 grade 50	1' 1.000"	0.07
LRFD-Ult (auto)/2	B71	CS1 - 550S150-43	A913 grade 50	1' 1.000"	0.09
LRFD-Ult (auto)/2	B72	CS1 - 550S150-43	A913 grade 50	1' 1.000"	0.13
LRFD-Ult (auto)/2	B73	CS1 - 550S150-43	A913 grade 50	1' 1.000"	0.16
LRFD-Ult (auto)/2	B74	CS1 - 550S150-43	A913 grade 50	1' 1.000"	0.19
LRFD-Ult (auto)/2	B75	CS1 - 550S150-43	A913 grade 50	1' 1.000"	0.24
LRFD-Ult (auto)/2	B76	CS1 - 550S150-43	A913 grade 50	1' 1.000"	0.28
LRFD-Ult (auto)/2	B77	CS1 - 550S150-43	A913 grade 50	0.000"	0.04
LRFD-Ult (auto)/2	B78	CS1 - 550S150-43	A913 grade 50	1' 10.204"	0.06
LRFD-Ult (auto)/2	B79	CS1 - 550S150-43	A913 grade 50	1' 10.204"	0.11
LRFD-Ult (auto)/2	B80	CS1 - 550S150-43	A913 grade 50	1' 10.204"	0.14
LRFD-Ult (auto)/2	B81	CS1 - 550S150-43	A913 grade 50	1' 10.204"	0.19
LRFD-Ult (auto)/2	B82	CS1 - 550S150-43	A913 grade 50	1' 10.204"	0.22
LRFD-Ult (auto)/2	B83	CS1 - 550S150-43	A913 grade 50	1' 10.204"	0.26
LRFD-Ult (auto)/2	B84	CS1 - 550S150-43	A913 grade 50	1' 10.204"	0.29
LRFD-Ult (auto)/2	B85	CS1 - 550S150-43	A913 grade 50	1' 10.204"	0.35
LRFD-Ult (auto)/2	B86	CS1 - 550S150-43	A913 grade 50	1' 10.204"	0.45
LRFD-Ult (auto)/2	B87	CS1 - 550S150-43	A913 grade 50	0.000"	0.00
LRFD-Ult (auto)/3	B88	CS1 - 550S150-43	A913 grade 50	0.000"	0.05
LRFD-Ult (auto)/3	B89	CS1 - 550S150-43	A913 grade 50	7.000"	0.23
LRFD-Ult (auto)/3	B90	CS1 - 550S150-43	A913 grade 50	0.000"	0.01
LRFD-Ult (auto)/2	B91	CS1 - 550S150-43	A913 grade 50	7.000"	0.12
LRFD-Ult (auto)/4	B92	CS1 - 550S150-43	A913 grade 50	0.000"	0.01
LRFD-Ult (auto)/2	B93	CS1 - 550S150-43	A913 grade 50	7.000"	0.04
LRFD-Ult (auto)/4	B94	CS1 - 550S150-43	A913 grade 50	0.000"	0.01
LRFD-Ult (auto)/2	B95	CS1 - 550S150-43	A913 grade 50	7.000"	0.02
LRFD-Ult (auto)/2	B96	CS1 - 550S150-43	A913 grade 50	0.000"	0.01
LRFD-Ult (auto)/5	B97	CS1 - 550S150-43	A913 grade 50	7.000"	0.03
LRFD-Ult (auto)/2	B98	CS1 - 550S150-43	A913 grade 50	0.000"	0.01
LRFD-Ult (auto)/2	B99	CS1 - 550S150-43	A913 grade 50	7.000"	0.02
LRFD-Ult (auto)/4	B100	CS1 - 550S150-43	A913 grade 50	0.000"	0.01

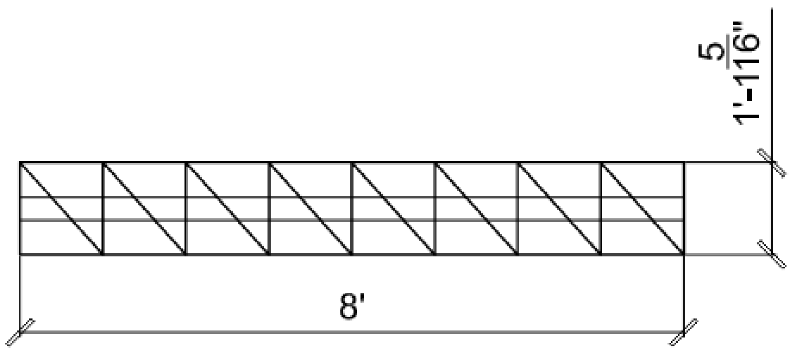
Case	Member	css	mat	dx [ft]	un.check [-]
LRFD-Ult (auto)/2	B101	CS1 - 550S150-43	A913 grade 50	7.000"	0.04
LRFD-Ult (auto)/4	B102	CS1 - 550S150-43	A913 grade 50	0.000"	0.01
LRFD-Ult (auto)/2	B103	CS1 - 550S150-43	A913 grade 50	7.000"	0.12
LRFD-Ult (auto)/3	B104	CS1 - 550S150-43	A913 grade 50	0.000"	0.01
LRFD-Ult (auto)/3	B105	CS1 - 550S150-43	A913 grade 50	7.000"	0.24
LRFD-Ult (auto)/3	B106	CS1 - 550S150-43	A913 grade 50	0.000"	0.04
LRFD-Ult (auto)/4	B107	CS1 - 550S150-43	A913 grade 50	7.000"	0.02
LRFD-Ult (auto)/3	B108	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.02
LRFD-Ult (auto)/3	B109	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.02
LRFD-Ult (auto)/2	B110	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.06
LRFD-Ult (auto)/4	B111	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.08
LRFD-Ult (auto)/2	B112	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.13
LRFD-Ult (auto)/4	B113	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.14
LRFD-Ult (auto)/2	B114	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.21
LRFD-Ult (auto)/4	B115	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.22
LRFD-Ult (auto)/2	B116	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.31
LRFD-Ult (auto)/4	B117	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.35
LRFD-Ult (auto)/2	B118	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.57
LRFD-Ult (auto)/2	B119	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.05
LRFD-Ult (auto)/4	B120	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.08
LRFD-Ult (auto)/2	B121	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.13
LRFD-Ult (auto)/4	B122	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.14
LRFD-Ult (auto)/2	B123	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.21
LRFD-Ult (auto)/4	B124	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.22
LRFD-Ult (auto)/2	B125	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.30
LRFD-Ult (auto)/4	B126	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.35
LRFD-Ult (auto)/2	B127	CS1 - 550S150-43	A913 grade 50	1' 1.829"	0.60
LRFD-Ult (auto)/2	B128	CS2 - 350S150-43	A653 grade 33	0.000"	0.00
LRFD-Ult (auto)/3	B129	CS2 - 350S150-43	A653 grade 33	0.000"	0.03
LRFD-Ult (auto)/3	B130	CS2 - 350S150-43	A653 grade 33	0.000"	0.00
LRFD-Ult (auto)/3	B131	CS2 - 350S150-43	A653 grade 33	0.000"	0.05
LRFD-Ult (auto)/3	B132	CS2 - 350S150-43	A653 grade 33	0.000"	0.01
LRFD-Ult (auto)/3	B133	CS2 - 350S150-43	A653 grade 33	0.000"	0.07
LRFD-Ult (auto)/3	B134	CS2 - 350S150-43	A653 grade 33	0.000"	0.02
LRFD-Ult (auto)/3	B135	CS2 - 350S150-43	A653 grade 33	0.000"	0.09
LRFD-Ult (auto)/3	B136	CS2 - 350S150-43	A653 grade 33	0.000"	0.02
LRFD-Ult (auto)/3	B137	CS2 - 350S150-43	A653 grade 33	0.000"	0.09
LRFD-Ult (auto)/3	B138	CS2 - 350S150-43	A653 grade 33	0.000"	0.02
LRFD-Ult (auto)/3	B139	CS2 - 350S150-43	A653 grade 33	0.000"	0.09
LRFD-Ult (auto)/3	B140	CS2 - 350S150-43	A653 grade 33	0.000"	0.02
LRFD-Ult (auto)/3	B141	CS2 - 350S150-43	A653 grade 33	0.000"	0.09
LRFD-Ult (auto)/3	B142	CS2 - 350S150-43	A653 grade 33	0.000"	0.02
LRFD-Ult (auto)/3	B143	CS2 - 350S150-43	A653 grade 33	0.000"	0.07
LRFD-Ult (auto)/3	B144	CS2 - 350S150-43	A653 grade 33	0.000"	0.01
LRFD-Ult (auto)/3	B145	CS2 - 350S150-43	A653 grade 33	0.000"	0.05
LRFD-Ult (auto)/2	B146	CS2 - 350S150-43	A653 grade 33	0.000"	0.01
LRFD-Ult (auto)/3	B147	CS2 - 350S150-43	A653 grade 33	0.000"	0.04
LRFD-Ult (auto)/2	B148	CS2 - 350S150-43	A653 grade 33	0.000"	0.04
LRFD-Ult (auto)/3	B149	CS2 - 350S150-43	A653 grade 33	0.000"	0.04
LRFD-Ult (auto)/3	B150	CS2 - 350S150-43	A653 grade 33	0.000"	0.04
LRFD-Ult (auto)/3	B151	CS2 - 350S150-43	A653 grade 33	0.000"	0.09
LRFD-Ult (auto)/2	B152	CS2 - 350S150-43	A653 grade 33	0.000"	0.03

Case	Member	css	mat	dx [ft]	un.check [-]
LRFD-Ult (auto)/3	B153	CS2 - 350S150-43	A653 grade 33	0.000"	0.12
LRFD-Ult (auto)/4	B154	CS2 - 350S150-43	A653 grade 33	0.000"	0.07
LRFD-Ult (auto)/3	B155	CS2 - 350S150-43	A653 grade 33	0.000"	0.15
LRFD-Ult (auto)/3	B156	CS2 - 350S150-43	A653 grade 33	0.000"	0.11
LRFD-Ult (auto)/3	B157	CS2 - 350S150-43	A653 grade 33	0.000"	0.14
LRFD-Ult (auto)/3	B158	CS2 - 350S150-43	A653 grade 33	0.000"	0.11
LRFD-Ult (auto)/3	B159	CS2 - 350S150-43	A653 grade 33	0.000"	0.12
LRFD-Ult (auto)/3	B160	CS2 - 350S150-43	A653 grade 33	0.000"	0.09
LRFD-Ult (auto)/2	B161	CS2 - 350S150-43	A653 grade 33	0.000"	0.04
LRFD-Ult (auto)/3	B162	CS2 - 350S150-43	A653 grade 33	0.000"	0.12
LRFD-Ult (auto)/4	B163	CS2 - 350S150-43	A653 grade 33	0.000"	0.07
LRFD-Ult (auto)/3	B164	CS2 - 350S150-43	A653 grade 33	0.000"	0.15
LRFD-Ult (auto)/3	B165	CS2 - 350S150-43	A653 grade 33	0.000"	0.11
LRFD-Ult (auto)/3	B166	CS2 - 350S150-43	A653 grade 33	0.000"	0.15
LRFD-Ult (auto)/3	B167	CS2 - 350S150-43	A653 grade 33	0.000"	0.11
LRFD-Ult (auto)/3	B168	CS2 - 350S150-43	A653 grade 33	0.000"	0.11
LRFD-Ult (auto)/1	B169	CS2 - 350S150-43	A653 grade 33	13' 6.000"	0.72
LRFD-Ult (auto)/2	B170	CS2 - 350S150-43	A653 grade 33	1' 1.000"	0.33
LRFD-Ult (auto)/2	B171	CS2 - 350S150-43	A653 grade 33	1' 1.000"	0.06
LRFD-Ult (auto)/2	B172	CS2 - 350S150-43	A653 grade 33	1' 1.000"	0.09
LRFD-Ult (auto)/2	B173	CS2 - 350S150-43	A653 grade 33	1' 1.000"	0.12
LRFD-Ult (auto)/2	B174	CS2 - 350S150-43	A653 grade 33	1' 1.000"	0.12
LRFD-Ult (auto)/2	B175	CS2 - 350S150-43	A653 grade 33	1' 1.000"	0.11
LRFD-Ult (auto)/2	B176	CS2 - 350S150-43	A653 grade 33	1' 1.000"	0.12
LRFD-Ult (auto)/2	B177	CS2 - 350S150-43	A653 grade 33	1' 1.000"	0.12
LRFD-Ult (auto)/2	B178	CS2 - 350S150-43	A653 grade 33	1' 1.000"	0.09
LRFD-Ult (auto)/3	B179	CS2 - 350S150-43	A653 grade 33	1' 1.000"	0.01
LRFD-Ult (auto)/2	B180	CS2 - 350S150-43	A653 grade 33	1' 1.000"	0.05
LRFD-Ult (auto)/2	B181	CS2 - 350S150-43	A653 grade 33	0.000"	0.00
LRFD-Ult (auto)/2	B182	CS2 - 350S150-43	A653 grade 33	0.000"	0.00
LRFD-Ult (auto)/3	B183	CS2 - 350S150-43	A653 grade 33	0.000"	0.16
LRFD-Ult (auto)/3	B184	CS2 - 350S150-43	A653 grade 33	0.000"	0.00
LRFD-Ult (auto)/4	B185	CS2 - 350S150-43	A653 grade 33	0.000"	0.07
LRFD-Ult (auto)/4	B186	CS2 - 350S150-43	A653 grade 33	0.000"	0.02
LRFD-Ult (auto)/4	B187	CS2 - 350S150-43	A653 grade 33	0.000"	0.02
LRFD-Ult (auto)/4	B188	CS2 - 350S150-43	A653 grade 33	0.000"	0.02
LRFD-Ult (auto)/2	B189	CS2 - 350S150-43	A653 grade 33	2' 5.530"	0.01
LRFD-Ult (auto)/4	B190	CS2 - 350S150-43	A653 grade 33	0.000"	0.02
LRFD-Ult (auto)/3	B191	CS2 - 350S150-43	A653 grade 33	2' 5.530"	0.01
LRFD-Ult (auto)/2	B192	CS2 - 350S150-43	A653 grade 33	0.000"	0.02
LRFD-Ult (auto)/2	B193	CS2 - 350S150-43	A653 grade 33	2' 5.530"	0.01
LRFD-Ult (auto)/4	B194	CS2 - 350S150-43	A653 grade 33	0.000"	0.02
LRFD-Ult (auto)/4	B195	CS2 - 350S150-43	A653 grade 33	0.000"	0.02
LRFD-Ult (auto)/4	B196	CS2 - 350S150-43	A653 grade 33	0.000"	0.02
LRFD-Ult (auto)/4	B197	CS2 - 350S150-43	A653 grade 33	0.000"	0.07
LRFD-Ult (auto)/4	B198	CS2 - 350S150-43	A653 grade 33	0.000"	0.02
LRFD-Ult (auto)/3	B199	CS2 - 350S150-43	A653 grade 33	0.000"	0.17
LRFD-Ult (auto)/2	B200	CS2 - 350S150-43	A653 grade 33	0.000"	0.01
LRFD-Ult (auto)/2	B201	CS2 - 350S150-43	A653 grade 33	0.000"	0.00
LRFD-Ult (auto)/2	B202	CS2 - 350S150-43	A653 grade 33	0.000"	0.07

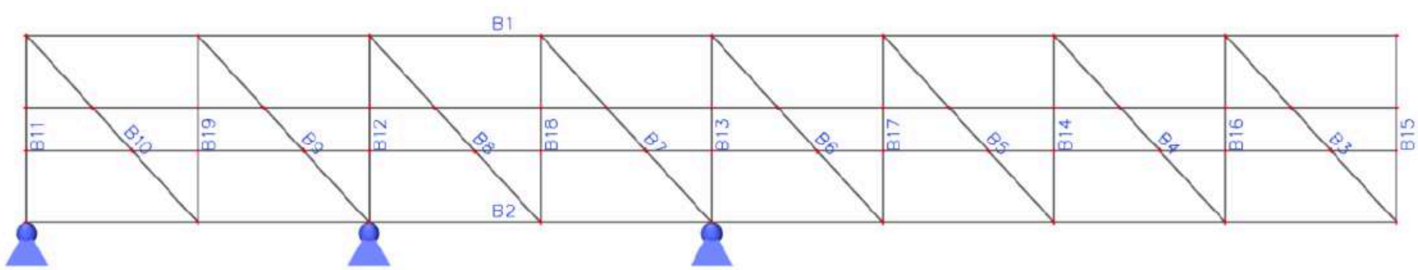
2.3.1.7 CANTILEVER ROOF TRUSS DESIGN

General scheme

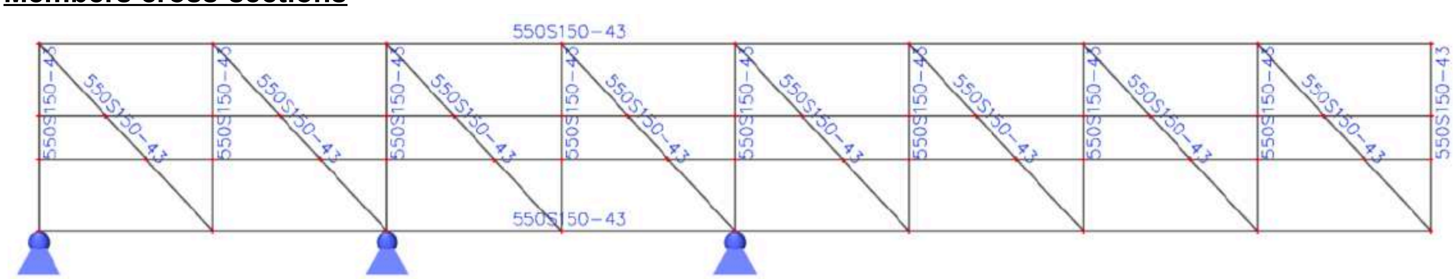
The top and bottom chord of the truss is reinforced with 5”x0.043” steel plates on both sides.



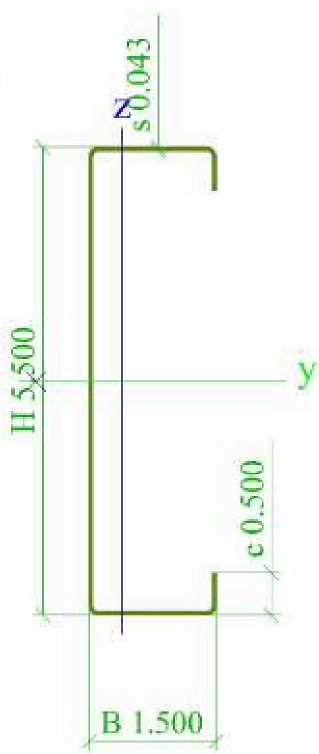
Members number



Members cross-sections



Cross-sections properties

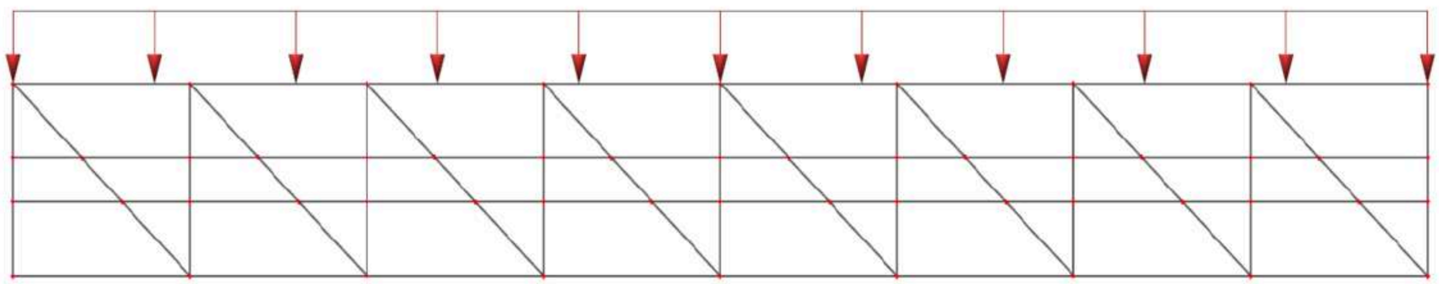
550S150-43		
Type	Cold formed C section	
Detailed	5.500; 1.500; 0.043; 0.065; 0.500	
Formcode	114 - Cold formed C section	
Shape type	Thin-walled	
Item material	A913 grade 50	
Fabrication	cold formed	
Colour		
A [inch^2]	0.395	
A_y [inch^2], A_z [inch^2]	0.130	0.243
A_L [inch^2/inch], A_D [inch^2/inch]	1.84e+01	1.84e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	0.393	2.750
α [deg]	0.00	
I_y [inch^4], I_z [inch^4]	1.722	0.115
i_y [inch], i_z [inch]	2.089	0.539
$W_{el.y}$ [inch^3], $W_{el.z}$ [inch^3]	0.626	0.104
$W_{pl.y}$ [inch^3], $W_{pl.z}$ [inch^3]	0.747	0.148
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	3.73e+01	3.73e+01
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	7.39e+00	7.39e+00
d_y [inch], d_z [inch]	-1.010	0.000
I_t [inch^4], I_w [inch^6]	0.000	0.721
$β_y$ [inch], $β_z$ [inch]	0.000	5.886
Picture		

Explanations of symbols	
Formcode	s - Thickness r - Inner radius b - Flange width h - Height c - Lip
A	Area
A_y	Shear Area in principal y-direction
A_z	Shear Area in principal z-direction
A_L	Circumference per unit length
A_D	Drying surface per unit length
$c_{Y.UCS}$	Centroid coordinate in Y-direction of Input axis system
$c_{Z.UCS}$	Centroid coordinate in Z-direction of Input axis system
$I_{Y.LCS}$	Second moment of area about the YLCS axis
$I_{Z.LCS}$	Second moment of area about the ZLCS axis
$I_{YZ.LCS}$	Product moment of area in the LCS system
α	Rotation angle of the principal axis system
I_y	Second moment of area about the principal y-axis
I_z	Second moment of area about the principal z-axis
i_y	Radius of gyration about the principal y-axis

Explanations of symbols	
i_z	Radius of gyration about the principal z-axis
$W_{el.y}$	Elastic section modulus about the principal y-axis
$W_{el.z}$	Elastic section modulus about the principal z-axis
$W_{pl.y}$	Plastic section modulus about the principal y-axis
$W_{pl.z}$	Plastic section modulus about the principal z-axis
$M_{pl.y.+}$	Plastic moment about the principal y-axis for a positive My moment
$M_{pl.y.-}$	Plastic moment about the principal y-axis for a negative My moment
$M_{pl.z.+}$	Plastic moment about the principal z-axis for a positive Mz moment
$M_{pl.z.-}$	Plastic moment about the principal z-axis for a negative Mz moment
d_y	Shear center coordinate in principal y-direction measured from the centroid
d_z	Shear center coordinate in principal z-direction measured from the centroid
I_t	Torsional constant
I_w	Warping constant
β_y	Mono-symmetry constant about the principal y-axis
β_z	Mono-symmetry constant about the principal z-axis

APPLIED LOADS

LOAD ON THE TOP CHORD OF TRUSS			
Truss length, (ft)	8	Roof slope, α =	22.6
Loading width, (ft)	11.5		
Load	**Distr. Load, psf**	**Liner Load, plf**	
Roof Dead Load	17.85	205.28	
Roof LL	20.00	230.00	
Roof Wind (up)	22.25	255.87	
Roof Wind (down)	7.39	84.94	



MAXIMUM FORCES

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B11	5.000"-	LRFD-Ult (auto)/1	**-10.1**	-2.3	0.0	0.0	0.0	-0.5
B11	5.000"+	LRFD-Ult (auto)/2	97.3	**-54.3**	0.0	0.0	0.0	5.7
B11	8.000"+	LRFD-Ult (auto)/2	36.3	25.2	0.0	0.0	0.0	**-8.2**
B11	5.000"-	LRFD-Ult (auto)/2	**124.1**	**25.7**	**0.0**	**0.0**	**0.0**	**6.2**
B12	5.000"+	LRFD-Ult (auto)/1	**-30.9**	26.4	0.0	0.0	0.0	-2.9
B12	5.000"+	LRFD-Ult (auto)/2	379.9	**-291.1**	0.0	0.0	0.0	**31.9**
B12	8.000"+	LRFD-Ult (auto)/2	140.2	**69.3**	**0.0**	**0.0**	**0.0**	-28.9
B12	8.000"-	LRFD-Ult (auto)/2	**380.3**	-291.1	0.0	0.0	0.0	**-40.9**
B13	5.000"+	LRFD-Ult (auto)/2	**-2428.1**	**21.1**	0.0	0.0	0.0	4.9
B13	8.000"-	LRFD-Ult (auto)/1	**226.4**	-2.2	**0.0**	**0.0**	**0.0**	-1.0
B13	8.000"+	LRFD-Ult (auto)/2	-1308.3	**-40.3**	0.0	0.0	0.0	**16.8**
B13	8.000"+	LRFD-Ult (auto)/1	121.4	3.8	0.0	0.0	0.0	**-1.6**

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B14	8.000"-	LRFD-Ult (auto)/1	**106.3**	-33.2	**0.0**	**0.0**	**0.0**	-4.0
B14	8.000"+	LRFD-Ult (auto)/2	-672.2	**-87.2**	0.0	0.0	0.0	36.3
B14	5.000"+	LRFD-Ult (auto)/2	**-1121.0**	360.8	0.0	0.0	0.0	**-46.7**
B14	8.000"-	LRFD-Ult (auto)/2	-1120.6	**360.8**	0.0	0.0	0.0	**43.5**
B15	8.000"+	LRFD-Ult (auto)/1	**21.5**	-0.6	**0.0**	**0.0**	**0.0**	0.5
B15	5.000"+	LRFD-Ult (auto)/2	-211.8	**-52.2**	0.0	0.0	0.0	**10.2**
B15	5.000"-	LRFD-Ult (auto)/2	-129.5	**34.1**	0.0	0.0	0.0	9.3
B15	8.000"+	LRFD-Ult (auto)/2	**-219.4**	7.2	0.0	0.0	0.0	**-5.7**
B1	4' 0.000"+	LRFD-Ult (auto)/2	2889.4	**-100.8**	0.0	0.0	0.0	33.3
B1	4' 0.000"-	LRFD-Ult (auto)/1	**-317.1**	-8.2	0.0	0.0	0.0	**-3.3**
B1	4' 0.000"-	LRFD-Ult (auto)/2	**3464.2**	**85.2**	**0.0**	**0.0**	**0.0**	**35.6**
B2	2' 0.000"+	LRFD-Ult (auto)/2	**994.3**	-14.1	**0.0**	**0.0**	**0.0**	2.0
B2	4' 0.000"-	LRFD-Ult (auto)/2	-1012.2	**-365.3**	0.0	0.0	0.0	-52.0
B2	4' 0.000"+	LRFD-Ult (auto)/2	**-4285.6**	**358.8**	0.0	0.0	0.0	**-63.2**
B2	4' 0.000"+	LRFD-Ult (auto)/1	391.2	-32.7	0.0	0.0	0.0	**5.8**
B16	8.000"-	LRFD-Ult (auto)/1	**70.6**	-17.7	**0.0**	**0.0**	**0.0**	-2.1
B16	0.000"	LRFD-Ult (auto)/2	-348.8	**-49.7**	0.0	0.0	**0.0**	0.0
B16	5.000"+	LRFD-Ult (auto)/2	**-730.5**	192.3	0.0	0.0	0.0	**-25.5**
B16	8.000"-	LRFD-Ult (auto)/2	-730.1	**192.3**	0.0	0.0	0.0	**22.5**
B17	8.000"-	LRFD-Ult (auto)/1	**142.4**	-46.4	**0.0**	**0.0**	**0.0**	-5.6
B17	8.000"+	LRFD-Ult (auto)/2	-963.9	**-119.8**	0.0	0.0	0.0	49.9
B17	5.000"+	LRFD-Ult (auto)/2	**-1513.1**	504.0	0.0	0.0	0.0	**-65.6**
B17	8.000"-	LRFD-Ult (auto)/2	-1512.7	**504.0**	0.0	0.0	0.0	**60.4**
B18	5.000"+	LRFD-Ult (auto)/1	**-65.1**	37.2	0.0	0.0	0.0	-4.8
B18	5.000"+	LRFD-Ult (auto)/2	751.5	**-409.5**	0.0	0.0	0.0	**52.9**
B18	0.000"	LRFD-Ult (auto)/2	436.7	**93.4**	**0.0**	**0.0**	**0.0**	0.0

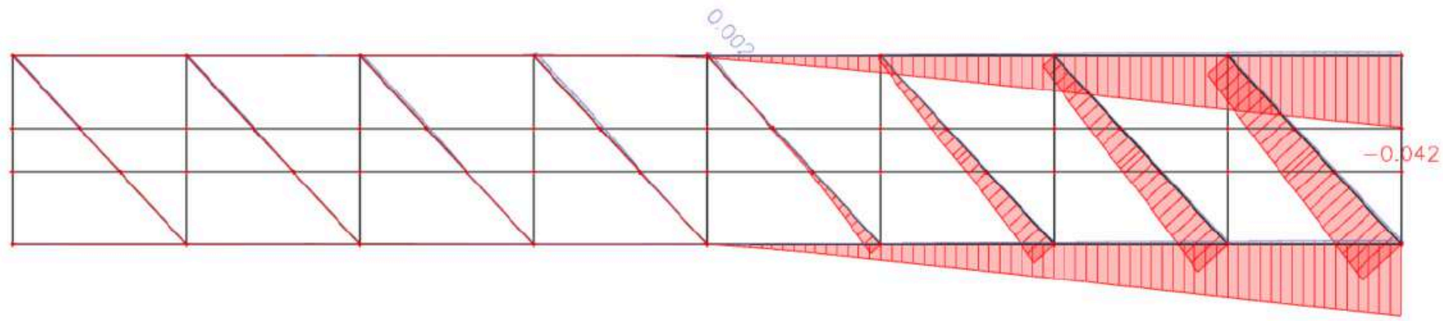
Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B18	8.000"-	LRFD-Ult (auto)/2	**751.9**	-409.5	0.0	0.0	0.0	**-49.5**
B19	5.000"+	LRFD-Ult (auto)/1	**-15.9**	18.6	0.0	0.0	0.0	-2.3
B19	5.000"+	LRFD-Ult (auto)/2	217.9	**-206.6**	0.0	0.0	0.0	**25.3**
B19	8.000"+	LRFD-Ult (auto)/2	118.8	**43.6**	**0.0**	**0.0**	**0.0**	-18.2
B19	8.000"-	LRFD-Ult (auto)/2	**218.3**	-206.6	0.0	0.0	0.0	**-26.3**
B3	6.805"+	LRFD-Ult (auto)/1	**-27.3**	-8.6	0.0	0.0	0.0	1.4
B3	6.805"-	LRFD-Ult (auto)/2	138.0	**-21.8**	0.0	0.0	0.0	-12.2
B3	6.805"+	LRFD-Ult (auto)/2	314.6	**91.5**	0.0	0.0	0.0	**-14.5**
B3	10.887"-	LRFD-Ult (auto)/2	**315.0**	91.1	**0.0**	**0.0**	**0.0**	**16.6**
B4	6.805"+	LRFD-Ult (auto)/1	**-86.7**	-16.0	0.0	0.0	0.0	2.8
B4	6.805"-	LRFD-Ult (auto)/2	468.9	**-45.9**	0.0	0.0	0.0	-25.9
B4	6.805"+	LRFD-Ult (auto)/2	958.2	**171.7**	0.0	0.0	0.0	**-29.6**
B4	10.887"-	LRFD-Ult (auto)/2	**958.6**	171.3	**0.0**	**0.0**	**0.0**	**28.8**
B5	6.805"+	LRFD-Ult (auto)/1	**-147.1**	-23.5	0.0	0.0	0.0	4.4
B5	6.805"-	LRFD-Ult (auto)/2	763.5	**-75.6**	0.0	0.0	0.0	-42.7
B5	6.805"+	LRFD-Ult (auto)/2	1615.4	**253.3**	0.0	0.0	0.0	**-47.3**
B5	10.887"-	LRFD-Ult (auto)/2	**1615.8**	252.9	**0.0**	**0.0**	**0.0**	**38.8**
B6	6.805"+	LRFD-Ult (auto)/1	**-129.3**	-31.1	0.0	0.0	0.0	6.9
B6	6.805"-	LRFD-Ult (auto)/2	888.8	**-89.7**	0.0	0.0	0.0	-50.7
B6	6.805"+	LRFD-Ult (auto)/2	1417.9	**335.8**	0.0	0.0	0.0	**-75.0**
B6	10.887"-	LRFD-Ult (auto)/2	**1418.3**	335.4	**0.0**	**0.0**	**0.0**	**39.1**
B7	6.805"+	LRFD-Ult (auto)/2	**-1865.4**	-130.5	0.0	0.0	0.0	**20.7**
B7	10.887"-	LRFD-Ult (auto)/1	**171.7**	11.3	**0.0**	**0.0**	**0.0**	2.1
B7	10.887"-	LRFD-Ult (auto)/2	-1865.0	**-130.9**	0.0	0.0	0.0	-23.7
B7	10.887"+	LRFD-Ult (auto)/2	-851.6	**51.7**	0.0	0.0	0.0	**-29.1**

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B8	6.805"+	LRFD-Ult (auto)/2	**-1306.8**	-195.0	0.0	0.0	0.0	**32.7**
B8	10.887"-	LRFD-Ult (auto)/1	**120.4**	17.2	**0.0**	**0.0**	**0.0**	3.0
B8	10.887"+	LRFD-Ult (auto)/2	-532.9	**57.7**	0.0	0.0	0.0	-32.5
B8	10.887"-	LRFD-Ult (auto)/2	-1306.4	**-195.4**	0.0	0.0	0.0	**-33.7**
B9	6.805"+	LRFD-Ult (auto)/2	**-1238.0**	-90.2	0.0	0.0	0.0	**15.1**
B9	10.887"-	LRFD-Ult (auto)/1	**114.2**	7.6	**0.0**	**0.0**	**0.0**	1.3
B9	10.887"-	LRFD-Ult (auto)/2	-1237.6	**-90.6**	0.0	0.0	0.0	-15.7
B9	10.887"+	LRFD-Ult (auto)/2	-511.4	**35.7**	0.0	0.0	0.0	**-20.0**
B10	6.805"+	LRFD-Ult (auto)/2	**-563.0**	-50.5	0.0	0.0	0.0	**10.9**
B10	10.887"-	LRFD-Ult (auto)/1	**52.1**	3.9	**0.0**	**0.0**	**0.0**	0.5
B10	10.887"-	LRFD-Ult (auto)/2	-562.6	**-50.9**	0.0	0.0	0.0	-6.4
B10	0.000"	LRFD-Ult (auto)/2	-319.2	**17.7**	0.0	0.0	**0.0**	0.0
B10	10.887"+	LRFD-Ult (auto)/2	-190.6	16.1	0.0	0.0	0.0	**-8.9**

Name	Combination key
LRFD-Ult (auto)/1	0.90*DL1 + 0.90*DL2 + Wind Load (Up)
LRFD-Ult (auto)/2	1.20*DL1 + 1.60*Lr + 1.20*DL2 + 0.50*Wind Load (Down)

Displacement

Load case D + Lr, inch:



The maximum deflection for a web header is 0.048”.

According to TABLE 1604.3 the code IBC 2018, maximum member deflection should not exceed - L/360.
L=4’ x 2=96”, 96/”/360=0.266”. 0.042"< 0.266”. <u>Deflection is OK!</u>

STEEL MEMBER B1 CHECK

AISI S100-16 LRFD Check

Member B1	Cold formed C section (5.500; 1.500; 0.043; 0.062; 0.500)	A913 grade 50	LRFD-Ult (auto)	0.22

Material data		
Yield stress Fy	50.00	ksi
Tensile stress Fu	65.00	ksi
fabrication	cold formed	

The critical check is on position 4.00 ft

Axis definition :
- local x- axis in this code check is referring to the local y axis in Scia Engineer
- local y- axis in this code check is referring to the local z axis in Scia Engineer

Internal forces		
Pu	3464.22	lbf
Vux	85.15	lbf
Vuy	-0.00	lbf
Mut	-0.00	lbfft
Mux	0.00	lbfft
Muy	35.59	lbfft

Nominal Tensile Strength
According to article D2 and formula (D2-1).

Table of values		
Tn	19741.3	lbf
Resistance factor	0.90	
Unity check	0.19	-

...::Flexural Strength about Y-axis::...
Nominal Flexural Strength
According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch⁴]	ds [inch]
1	0.395	50.0 50.0	1.00	0.430	133.6	0.612	1.000	0.395 -	- -	-	- -	-
3	1.290	46.2 -13.3	0.29	10.843	315.9	0.382	1.000	- 1.290	0.392 0.645	-	- -	-
5	5.290	-17.1 -17.1	-	-	-	-	-	- -	- -	-	- -	-
7	1.290	46.2 -13.3	0.29	10.843	315.9	0.382	1.000	- 1.290	0.392 0.645	-	- -	-
9	0.395	50.0 50.0	1.00	0.430	133.6	0.612	1.000	0.395 -	- -	-	- -	-

Table of values		
Sye	0.104	inch³
Mnyo	432.3	lbfft
Resistance factor	0.90	
Unity check	0.09	-

Lateral-Torsional Buckling Strength
According to article F2.1 and formula (F2.1-1),(F2.1.2-1).

Table of values		
Sigma,ex	2170.1	ksi
Kt	1.00	
Lt	1' 0.000"	ft
Sigma,t	640.8	ksi
Cs	-1.00	
CTF	0.74	
Sfy	0.104	inch³
j	3.031	inch
Fcre	2963.6	ksi

Note: Lateral-Torsional buckling is not governing since Fe is greater than or equal to 2.78 Fy.
Distortional Buckling Strength
According to article F4 and formula F4.1-2.

Table of values		
Sfy	0.104	inch³
My	432.2	lbfft
L	1' 0.000"	ft
Beta	1.00	
k,phi,fe	282.4	lbf
k,phi,we	141.1	lbf
k,phi	0.0	lbf
k,phi,fg	0.006	inch²
k,phi,wg	0.008	inch²
Fd	29.1	ksi
Sf	0.104	inch³
Mcrd	251.5	lbfft
Lambda,d	1.31	
Mn	274.4	lbfft
Resistance factor	0.90	
Unity check	0.14	-

Data		
Lm	1' 0.000"	ft
Lcr	1' 2.500"	ft
h0	5.500	inch
Ixf	0.001	inch⁴
Iyf	0.016	inch⁴
Ixyf	0.003	inch⁴
Cwf	0.000	inch⁶
Jf	0.000	inch⁴
x0f	0.510	inch
hxf	-0.937	inch
Af	0.078	inch²
y0f	-0.058	inch
Ksi,web	0.00	

Number of compressed flanges: 2
Critical flange contains Initial shape parts: 2, 3, 1

...::Shear Strength::...
Shear Strength
According to article G2.1 and formula (G2.1.1)
Shear force Vx

Element ID	Aw [inch ^{2}]	Vn [lbf]
3	0.055	1664.1
5	0.000	0.0
7	0.055	1664.1

Table of values		
Vn,x	3328.2	lbf
Resistance factor	0.95	
Unity check	0.03	-

Combined Bending and Shear
According to article H2 and formula (H2-1)

Table of values		
Mnyo	432.3	lbfft
Vnx	3328.2	lbf
Resistance factor shear	0.95	
Resistance factor bending y	0.90	

Unity check (My, Vx) = sqrt(0.01+0.00) = 0.10

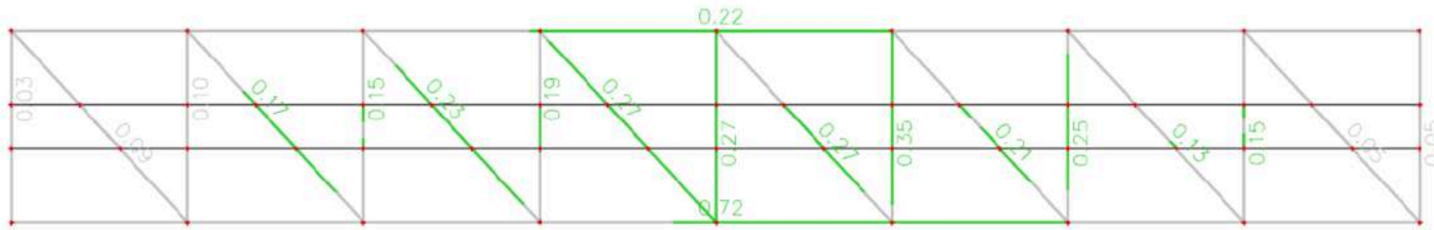
Combined Tensile Axial Load and Bending
According to article H1.1 and formulas (H1.1-1), (H1.1-2)

Table of values		
Sfty	0.292	inch ^{3}
Mnyt	1217.6	lbfft
Mny	274.4	lbfft
Tn	19741.3	lbf
Resistance factor tension	0.95	
Resistance factor bending y	0.90	

Unity check = 0.00+0.03+0.18 = 0.22 - (H1.1-1)
Unity check = 0.00+0.14-0.18 = -0.04 - (H1.1-2)

The member satisfies the check !

Unity check

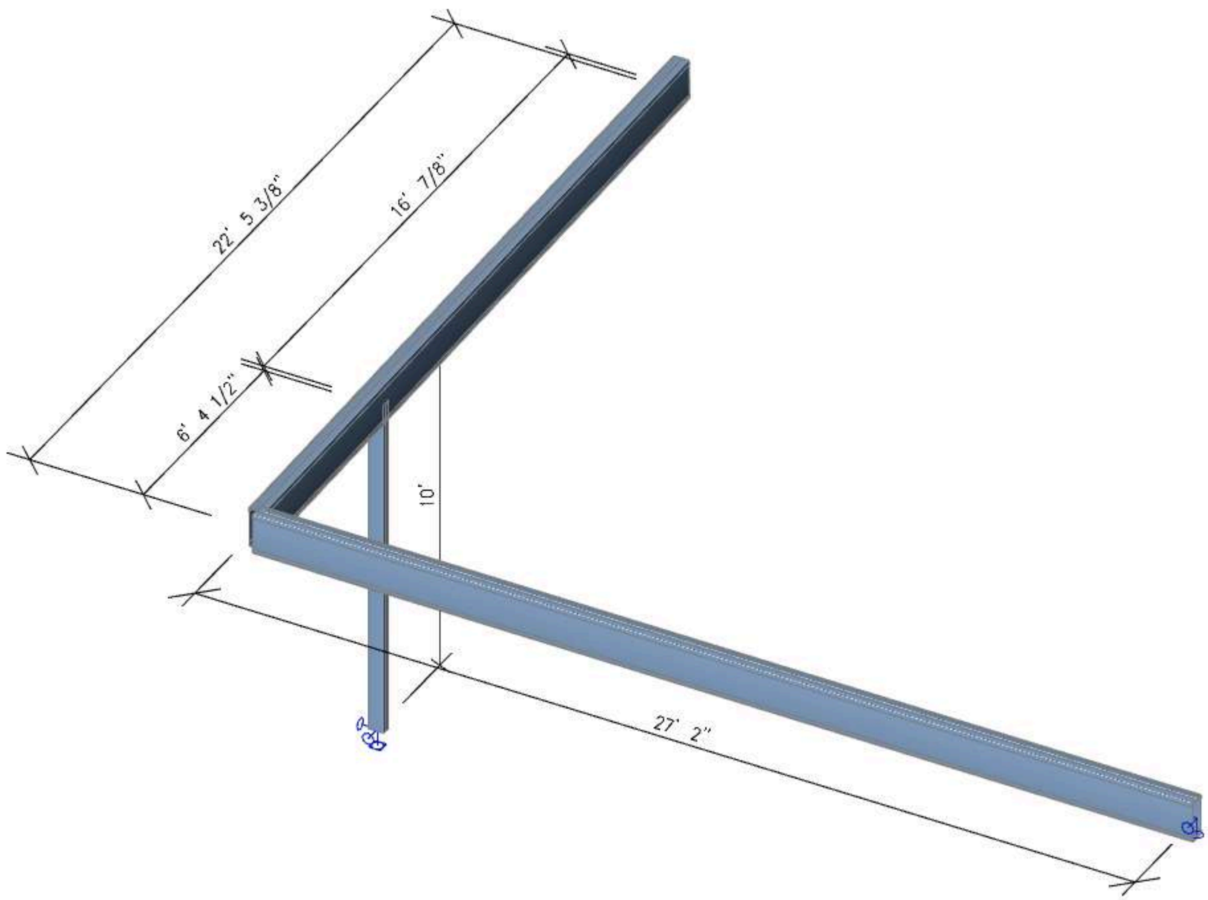


Combinations : LRFD-Ult (auto)

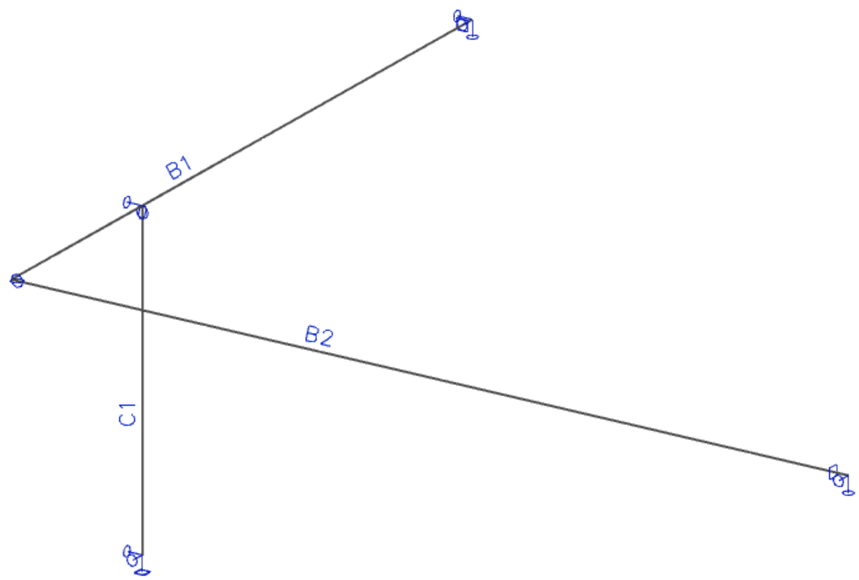
Case	Member	css	mat	dx [ft]	un.check [-]
LRFD-Ult (auto)/1	B11	550S150-43 - Cold formed C section	A913 grade 50	8.000"	0.03
LRFD-Ult (auto)/1	B12	550S150-43 - Cold formed C section	A913 grade 50	8.000"	0.15
LRFD-Ult (auto)/1	B13	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.27
LRFD-Ult (auto)/1	B14	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.25
LRFD-Ult (auto)/1	B15	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.05
LRFD-Ult (auto)/1	B1	550S150-43 - Cold formed C section	A913 grade 50	4' 0.000"	0.22
LRFD-Ult (auto)/1	B2	550S150-43 - Cold formed C section	A913 grade 50	4' 0.000"	0.72
LRFD-Ult (auto)/1	B16	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.15
LRFD-Ult (auto)/1	B17	550S150-43 - Cold formed C section	A913 grade 50	5.000"	0.35
LRFD-Ult (auto)/1	B18	550S150-43 - Cold formed C section	A913 grade 50	8.000"	0.19
LRFD-Ult (auto)/1	B19	550S150-43 - Cold formed C section	A913 grade 50	8.000"	0.10
LRFD-Ult (auto)/1	B3	550S150-43 - Cold formed C section	A913 grade 50	6.805"	0.05
LRFD-Ult (auto)/1	B4	550S150-43 - Cold formed C section	A913 grade 50	6.805"	0.13
LRFD-Ult (auto)/1	B5	550S150-43 - Cold formed C section	A913 grade 50	6.805"	0.21
LRFD-Ult (auto)/1	B6	550S150-43 - Cold formed C section	A913 grade 50	6.805"	0.27
LRFD-Ult (auto)/1	B7	550S150-43 - Cold formed C section	A913 grade 50	10.887"	0.27
LRFD-Ult (auto)/1	B8	550S150-43 - Cold formed C section	A913 grade 50	10.887"	0.23
LRFD-Ult (auto)/1	B9	550S150-43 - Cold formed C section	A913 grade 50	10.887"	0.17
LRFD-Ult (auto)/1	B10	550S150-43 - Cold formed C section	A913 grade 50	6.805"	0.09

2.3.1.8 PATIO ROOF BEAM AND COLUMN DESIGN

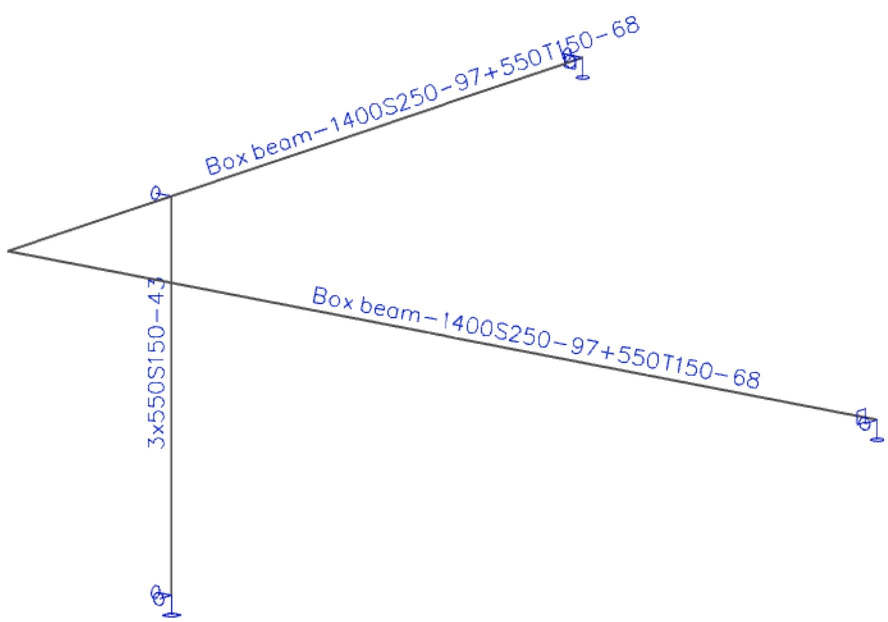
General scheme



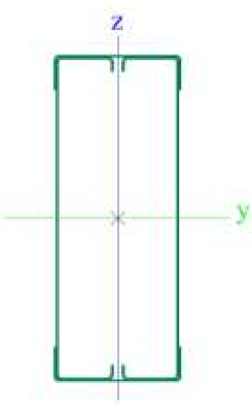
Members number



Members cross-sections



Cross-sections properties

Box beam		
Type	1400S250-97+550T150-68	
Shape type	Thin-walled	
Item material	A913 grade 50	
Fabrication	cold formed	
Colour		
A [$inch^2$]	5.085	
A_y [$inch^2$], A_z [$inch^2$]	1.575	2.917
A_L [$inch^2$/inch], A_D [$inch^2$/inch]	3.93e+01	8.63e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	1.673	7.961
α [deg]	0.00	
I_y [$inch^4$], I_z [$inch^4$]	151.132	26.436
i_y [inch], i_z [inch]	5.452	2.280
$W_{el.y}$ [$inch^3$], $W_{el.z}$ [$inch^3$]	21.382	9.613
$W_{pl.y}$ [$inch^3$], $W_{pl.z}$ [$inch^3$]	25.250	10.828
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	1.26e+03	1.26e+03
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	5.41e+02	5.41e+02
d_y [inch], d_z [inch]	0.000	0.000
I_t [$inch^4$], I_w [$inch^6$]	60.611	214.838
$β_y$ [inch], $β_z$ [inch]	0.000	0.000
Picture		

Explanations of symbols	
Formcode	s - Thickness r - Inner radius b - Flange width h - Height c - Lip
A	Area
A_y	Shear Area in principal y-direction
A_z	Shear Area in principal z-direction
A_L	Circumference per unit length
A_D	Drying surface per unit length
$c_{Y.UCS}$	Centroid coordinate in Y-direction of Input axis system
$c_{Z.UCS}$	Centroid coordinate in Z-direction of Input axis system
$I_{Y.LCS}$	Second moment of area about the YLCS axis
$I_{Z.LCS}$	Second moment of area about the ZLCS axis
$I_{YZ.LCS}$	Product moment of area in the LCS system
α	Rotation angle of the principal axis system
I_y	Second moment of area about the principal y-axis
I_z	Second moment of area about the principal z-axis
i_y	Radius of gyration about the principal y-axis

Explanations of symbols	
i_z	Radius of gyration about the principal z-axis
$W_{el.y}$	Elastic section modulus about the principal y-axis
$W_{el.z}$	Elastic section modulus about the principal z-axis
$W_{pl.y}$	Plastic section modulus about the principal y-axis
$W_{pl.z}$	Plastic section modulus about the principal z-axis
$M_{pl.y.+}$	Plastic moment about the principal y-axis for a positive My moment
$M_{pl.y.-}$	Plastic moment about the principal y-axis for a negative My moment
$M_{pl.z.+}$	Plastic moment about the principal z-axis for a positive Mz moment
$M_{pl.z.-}$	Plastic moment about the principal z-axis for a negative Mz moment
d_y	Shear center coordinate in principal y-direction measured from the centroid
d_z	Shear center coordinate in principal z-direction measured from the centroid
I_t	Torsional constant
I_w	Warping constant
β_y	Mono-symmetry constant about the principal y-axis
β_z	Mono-symmetry constant about the principal z-axis

APPLIED LOADS

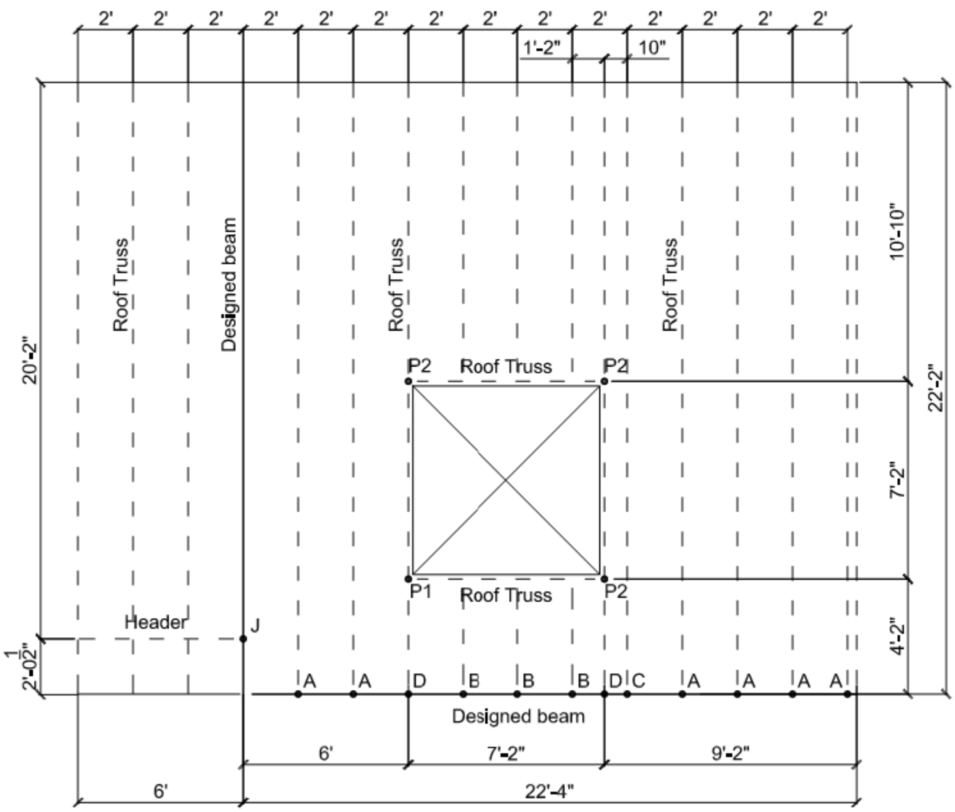
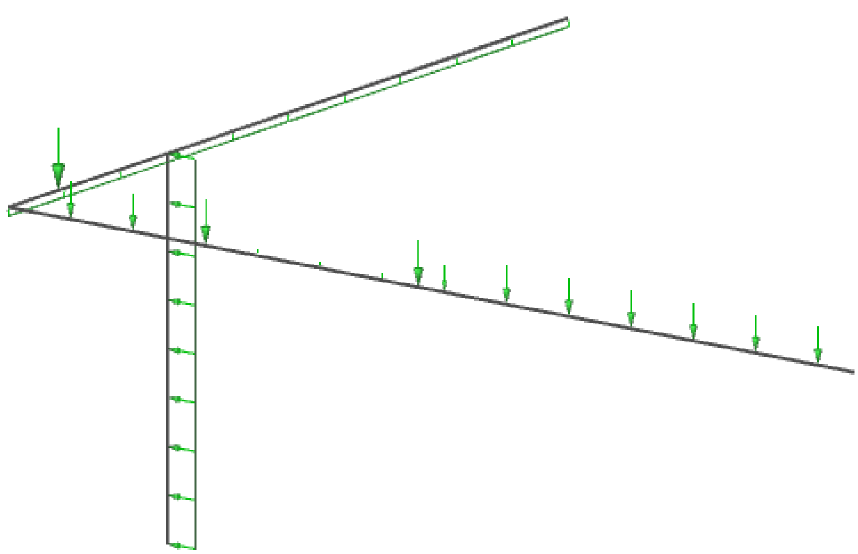


DIAGRAM OF POINT LOADS ON ROOF BEAMS



POINT LOAD ON THE ROOF BEAM AT POINT A			
Truss length, (ft)	22.167		
Loading width, (ft)	2		
Load	**Distr. Load, psf**	**Liner Load, plf**	**Reactions, lb**
Roof Dead Load	17.85	35.70	**395.68**
Roof LL	20	40.00	**443.34**
Roof Wind (up)	23.12	46.24	**512.50**
Roof Wind (down)	8	16.00	**177.34**

POINT LOAD ON THE ROOF BEAM AT POINT B			
Truss length, (ft)	4.167		
Loading width, (ft)	2		
Load	**Distr. Load, psf**	**Liner Load, plf**	**Reactions, lb**
Roof Dead Load	17.85	35.70	**74.38**
Roof LL	20	40.00	**83.34**
Roof Wind (up)	23.12	46.24	**96.34**
Roof Wind (down)	8	16.00	**33.34**

POINT LOAD ON THE ROOF BEAM AT POINT C			
Truss length, (ft)	22.167		
Loading width, (ft)	1.416		
Load	**Distr. Load, psf**	**Liner Load, plf**	**Reactions, lb**
Roof Dead Load	17.85	25.28	**280.14**
Roof LL	20	28.32	**313.88**
Roof Wind (up)	23.12	32.74	**362.85**
Roof Wind (down)	8	11.33	**125.55**

POINT LOAD ON THE ROOF BEAM AT POINT J			
Truss length, (ft)	6		
Loading width, (ft)	12.125		
Load	**Distr. Load, psf**	**Liner Load, plf**	**Reactions, lb**
Roof Dead Load	17.85	216.43	**649.29**
Roof LL	20	242.50	**727.50**
Roof Wind (up)	23.12	280.33	**840.99**
Roof Wind (down)	8	97.00	**291.00**

POINT LOAD FROM TRUSS TO TRUSS IN POINT P1			
Truss length, (ft)	7.17		
Loading width, (ft)	2.20		
Load	**Distr. Load, psf**	**Liner Load, plf**	**Reactions, lb**
Roof Dead Load	17.85	39.27	140.72
Roof LL	20	44.00	157.67
Roof Wind (up)	23.12	50.86	182.26
Roof Wind (down)	8	17.60	63.07

POINT LOAD FROM TRUSS TO TRUSS IN POINT P2			
Truss length, (ft)	7.17		
Loading width, (ft)	5.50		
Load	**Distr. Load, psf**	**Liner Load, plf**	**Reactions, lb**
Roof Dead Load	17.85	98.18	351.79
Roof LL	20	110.00	394.17
Roof Wind (up)	23.12	127.16	455.66
Roof Wind (down)	8	44.00	157.67

POINT LOAD ON THE ROOF BEAM AT POINT D			
Truss length, (ft)	22.167		
Loading width, (ft)	1		
Load	**Distr. Load, psf**	**Liner Load, plf**	**Reactions, lb**
Roof Dead Load	17.85	17.85	197.84
Roof LL	20	20.00	221.67
Roof Wind (up)	23.12	23.12	256.25
Roof Wind (down)	8	8.00	88.67

TOTAL POINT LOAD ON THE ROOF BEAM AT POINT D				
Truss length, (ft)		X1	X2	X3
22.167		4.17	7.17	10.83
Load	**P1, lb**	**P2, lb**	**Reactions D, lb**	**TOTAL POINT LOAD, lb**
Roof Dead Load	140.72	351.79	286.19	**484.03**
Roof LL	157.67	394.17	320.66	**542.33**
Roof Wind (up)	182.26	455.66	370.69	**626.94**
Roof Wind (down)	63.07	157.67	128.27	**216.93**

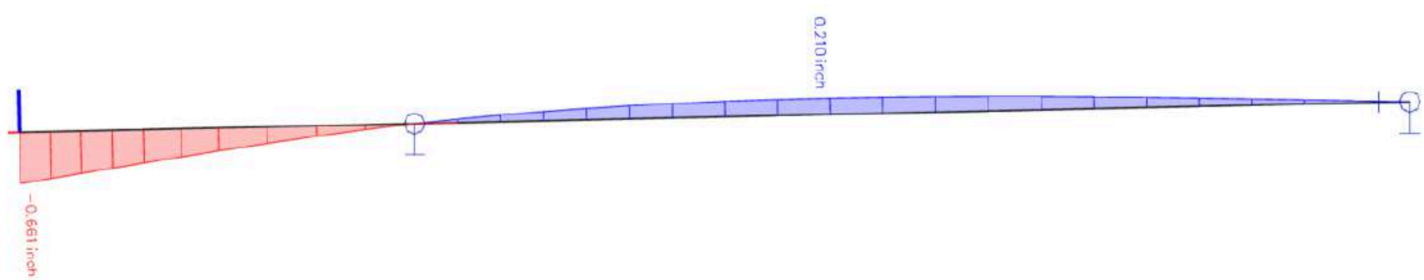
MAXIMUM FORCES

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B2	27' 2.000"	LRFD-Ult (auto)/1	0.00	0.00	**-8400.23**	2532.18	0.00	0.00
B2	0.000"	LRFD-Ult (auto)/1	**0.00**	**0.00**	**7232.23**	**2532.18**	0.00	**0.00**
B2	14' 0.000"-	LRFD-Ult (auto)/2	0.00	0.00	-68.56	**-233.63**	**-4942.99**	0.00
B2	14' 0.000"+	LRFD-Ult (auto)/1	0.00	0.00	-392.66	2532.18	**54664.01**	0.00
B1	6' 4.518"-	LRFD-Ult (auto)/1	**219.96**	0.00	**-10082.88**	0.00	-55149.59	0.00
B1	6' 4.518"+	LRFD-Ult (auto)/1	**-95.82**	0.00	**4392.50**	0.00	**-55149.59**	0.00
B1	6' 4.518"-	LRFD-Ult (auto)/2	-19.05	**0.00**	873.30	**0.00**	**4854.91**	**0.00**
C1	10' 0.000"	LRFD-Ult (auto)/2	**1163.82**	**0.00**	240.00	**0.00**	**0.00**	**0.00**
C1	0.000"	LRFD-Ult (auto)/3	-7409.61	0.00	**-315.00**	0.00	0.00	0.00
C1	10' 0.000"	LRFD-Ult (auto)/3	-7377.37	0.00	**315.00**	0.00	0.00	0.00
C1	5' 0.000"-	LRFD-Ult (auto)/3	-7393.49	0.00	0.00	0.00	**-787.50**	0.00
C1	0.000"	LRFD-Ult (auto)/1	**-14511.07**	0.00	-157.50	0.00	0.00	**0.00**

Name	Combination key
LRFD-Ult (auto)/1	1.20*Dl2 + 1.20*Dl3 + 1.60*Lr + 0.50*Wdown
LRFD-Ult (auto)/2	0.90*Dl2 + 0.90*Dl3 + Wup
LRFD-Ult (auto)/3	1.20*Dl2 + 1.20*Dl3 + Wdown

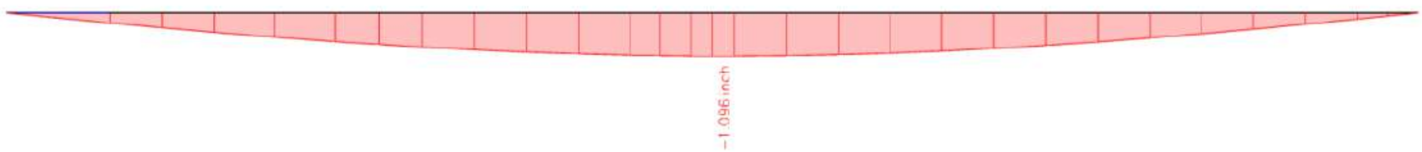
Displacement beam B2

Load case D + Lr, inch:



The maximum deflection for a web header is 0.661". According to TABLE 1604.3 the code IBC 2018, maximum member deflection should not exceed - L/180 for "Supporting nonplaster ceiling". L=6'-4" x 2 = 152", 152"180=0.84". 0.661"< 0.84". <u>Deflection is OK!</u>

Displacement beam B1
Load case D + Lr, inch:



The maximum deflection for a web header is 1.096”. According to TABLE 1604.3 the code IBC 2018, maximum member deflection should not exceed - L/180 for “Supporting nonplaster ceiling”. L=27’-2” = 326”, 326”/180=1.811”. 1.096"< 1.811”. <u>Deflection is OK!</u>

<u>STEEL MEMBER B1 CHECK</u>

AISI S100-16 LRFD Check

Member B1	1400S250-97+550T150-68	A913 grade 50	LRFD-Ult (auto)	0.72

Material data		
Yield stress Fy	50.00	ksi
Tensile stress Fu	65.00	ksi
fabrication	cold formed	

The critical check is on position 6.38 ft

Axis definition :
- local x- axis in this code check is referring to the local y axis in Scia Engineer
- local y- axis in this code check is referring to the local z axis in Scia Engineer

Internal forces		
Pu	219.96	lbf
Vux	0.00	lbf
Vuy	-10082.87	lbf
Mut	0.00	lbfft
Mux	-55213.43	lbfft
Muy	0.00	lbfft

...::Flexural Strength about X-axis::...
Nominal Flexural Strength
According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch^4]	ds [inch]
1	0.574	-44.038 -48.064	-	-	-	-	-	- -	- -	-	- -	-
2	2.398	-48.302 -48.302	-	-	-	-	-	- -	- -	-	- -	-
3	11.136	39.719 -38.378	0.97	23.136	50.589	0.886	0.848	- 9.447	2.382 2.423	-	- -	-
4	2.398	49.643 49.643	1.00	4.000	525.055	0.307	1.000	2.398 -	- -	-	- -	-

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
5	0.574	49.405 45.378	0.92	0.459	377.793	0.362	1.000	0.574 -	- -	-	- -	-
6	0.085	50.000 49.405	0.99	0.435	7328.238	0.083	1.000	0.085 -	- -	-	- -	-
7	0.085	50.000 50.000	1.00	4.000	67353.807	0.027	1.000	0.085 -	- -	-	- -	-
8	0.085	50.000 49.405	0.99	4.024	67754.656	0.027	1.000	- 0.085	0.042 0.043	-	- -	-
9	0.085	-48.064 -48.659	-	-	-	-	-	- -	- -	-	- -	-
10	0.085	-48.659 -48.659	-	-	-	-	-	- -	- -	-	- -	-
11	0.085	-48.064 -48.659	-	-	-	-	-	- -	- -	-	- -	-
12	0.574	49.405 45.378	0.92	4.164	3425.300	0.120	1.000	- 0.574	0.276 0.298	-	- -	-
13	2.398	49.643 49.643	1.00	4.000	525.055	0.307	1.000	- 2.398	1.199 1.199	-	- -	-
14	11.136	39.719 -38.378	0.97	23.136	50.589	0.886	0.848	- 9.447	2.382 2.423	-	- -	-
15	2.398	-48.302 -48.302	-	-	-	-	-	- -	- -	-	- -	-
16	0.574	-44.038 -48.064	-	-	-	-	-	- -	- -	-	- -	-
17	0.466	-48.659 -48.659	-	-	-	-	-	- -	- -	-	- -	-
22	1.381	49.405 39.719	0.80	4.407	1744.338	0.168	1.000	- 1.381	0.629 0.752	-	- -	-
26	1.381	-38.378 -48.064	-	-	-	-	-	- -	- -	-	- -	-
30	0.085	50.000 50.000	1.00	4.000	67353.807	0.027	1.000	0.085 -	- -	-	- -	-
35	1.381	49.405 39.719	0.80	4.407	1744.338	0.168	1.000	- 1.381	0.629 0.752	-	- -	-
40	0.051	50.000 49.643	0.99	4.014	630.877	0.282	1.000	- 0.051	0.025 0.026	-	- -	-
44	1.381	-38.378 -48.064	-	-	-	-	-	- -	- -	-	- -	-
48	0.085	-48.659 -48.659	-	-	-	-	-	- -	- -	-	- -	-

Table of values		
Sxe	21.095	inch ^{3}
Mnxo	87897.35	lbfft
Resistance factor	0.90	
Unity check	0.70	-

Lateral-Torsional Buckling Strength

According to article F2.1 and formula (F2.1-1),(F2.1.1-1).

Table of values		
Lltb	1' 7.005"	ft
Sigma,ey	inf	ksi
Kt	1.00	
Lt	1' 7.005"	ft
Sigma,t	4767.276	ksi
Cb	1.13	
Sfx	21.383	$inch^3$
Fcre	inf	ksi

Note: Lateral-Torsional buckling is not governing since Fe is greater than or equal to 2.78 Fy.

...::Shear Strength::...

Shear Strength

According to article G2.1 and formula (G2.1.1)

Shear force Vy

Element ID	Aw [$inch^2$]	Vn [lbf]
1	0.058	1751.73
2	0.000	0.00
3	1.133	13226.79
4	0.000	0.00
5	0.058	1751.73
6	0.006	173.09
7	0.000	0.00
8	0.006	173.09
9	0.006	173.09
10	0.000	0.00
11	0.006	173.09
12	0.058	1751.73
13	0.000	0.00
14	1.133	13226.79
15	0.000	0.00
16	0.058	1751.73
17	0.000	0.00
22	0.234	7031.44
26	0.234	7031.44
30	0.000	0.00
35	0.234	7031.44
40	0.000	6.01
44	0.234	7031.44
48	0.000	0.00

Table of values		
Vn,y	62284.62	lbf
Resistance factor	0.95	
Unity check	0.17	-

Combined Bending and Shear

According to article H2 and formula (H2-1)

Table of values		
Mnxo	87897.35	lbfft
Vny	62284.62	lbf
Resistance factor shear	0.95	
Resistance factor bending x	0.90	

Unity check (Mx, Vy) = sqrt(0.49+0.03) = 0.72

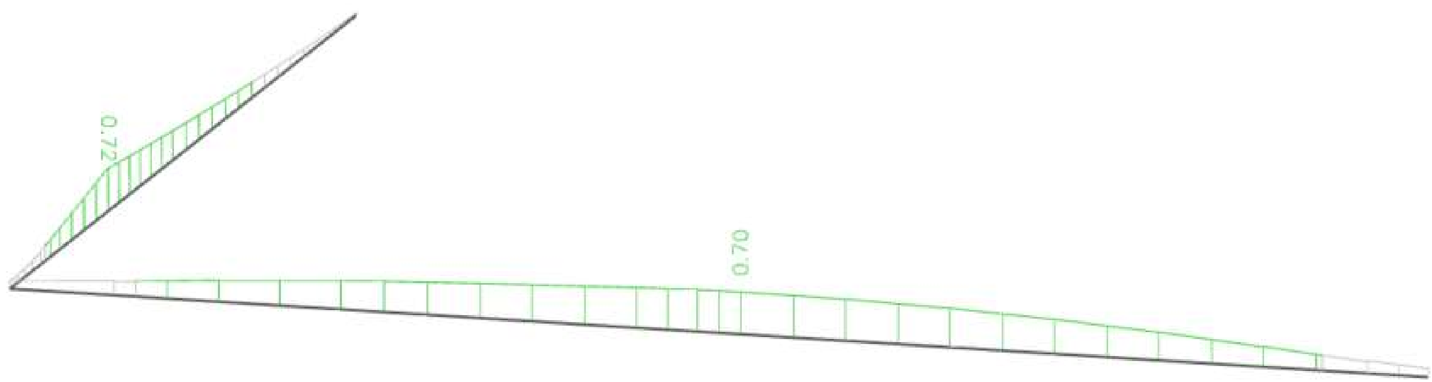
Combined Tensile Axial Load and Bending
According to article H1.1 and formulas (H1.1-1), (H1.1-2)

Table of values		
Sftx	21.382	$inch^3$
Mnxt	89092.31	lbfft
Mnx	87897.35	lbfft
Tn	254260.98	lbf
Resistance factor tension	0.95	
Resistance factor bending x	0.90	

Unity check = 0.69+0.00+0.00 = 0.69 - (H1.1-1)
Unity check = 0.70+0.00-0.00 = 0.70 - (H1.1-2)

The member satisfies the check !

Unity check

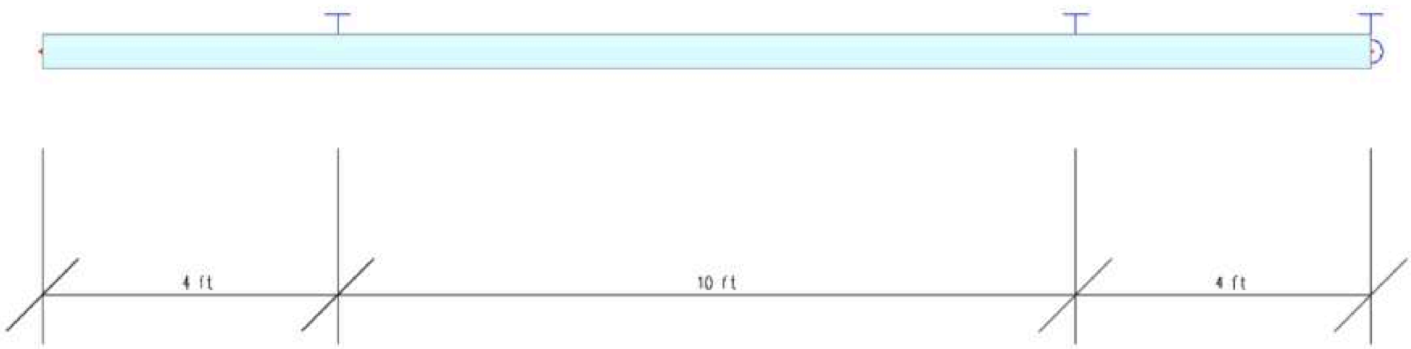


Linear calculation, Extreme : Member
Selection : B2, B1
Combinations : LRFD-Ult (auto)

Case	Member	css	mat	dx [ft]	un.check [-]
LRFD-Ult (auto)/1	B2	Box beam - 1400S250-97+550T150-68	A913 grade 50	14' 0.000"	0.70
LRFD-Ult (auto)/1	B1	Box beam - 1400S250-97+550T150-68	A913 grade 50	6' 4.518"	0.72

2.3.1.9 CORNER ROOF BEAM

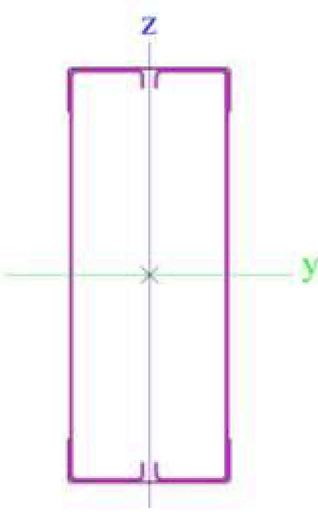
General scheme



Members number

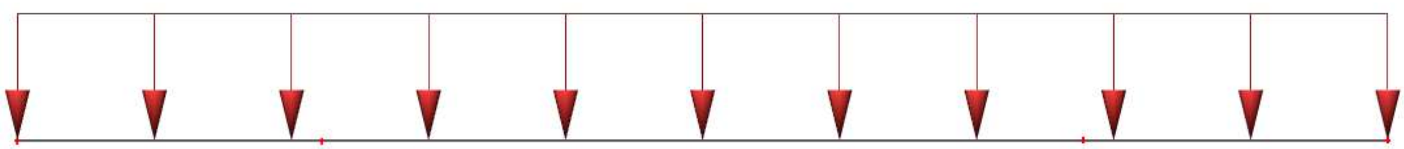
Members cross-sections

Cross-sections properties CS3 - 2x1400S250-97 + 2x550S150-68

CS3		
Type	2x1400S250-97 + 2x550T150-68	
Shape type	Thin-walled	
Item material	A572 grade 50	
Fabrication	cold formed	
Colour		
A [inch^2]	4.908	
A_y [inch^2], A_z [inch^2]	1.737	2.840
A_L [inch^2/inch], A_D [inch^2/inch]	3.92e+01	9.73e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	4.222	6.854
α [deg]	0.00	
I_y [inch^4], I_z [inch^4]	146.863	25.481
i_y [inch], i_z [inch]	5.470	2.279
$W_{el.y}$ [inch^3], $W_{el.z}$ [inch^3]	20.778	9.266
$W_{pl.y}$ [inch^3], $W_{pl.z}$ [inch^3]	24.479	10.436
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	1.22e+03	1.22e+03
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	5.22e+02	5.22e+02
d_y [inch], d_z [inch]	0.000	0.000
I_t [inch^4], I_w [inch^6]	0.097	0.000
β_y [inch], β_z [inch]	0.000	0.000
Picture		

APPLIED LOADS

LOAD ON ROOF BEAM		
Beam length, (ft)	8	Roof slope, α = 22.6
Loading width, (ft)	11.5	
Load	**Distr. Load, psf**	**Liner Load, plf**
Roof Dead Load	17.85	205.28
Roof LL	20.00	230.00
Roof Wind (up)	24.10	277.15
Roof Wind (down)	8.00	92.00



MAXIMUM FORCES

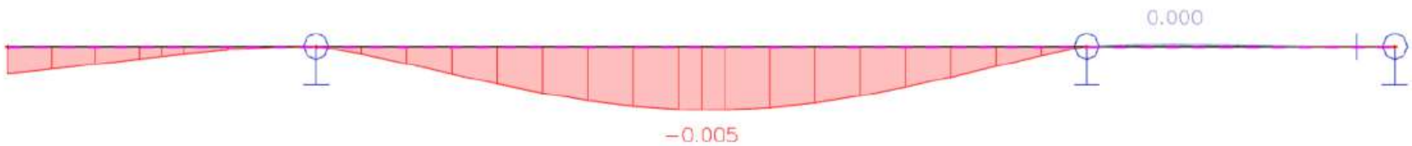
Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
B1	14' 0.000"-	LRFD-Ult (auto)/1	0.0	**0.0**	**-3277.5**	0.0	-4308.9	0.0
B1	4' 0.000"+	LRFD-Ult (auto)/1	**0.0**	**0.0**	**3500.1**	**0.0**	**-5422.0**	**0.0**
B1	9' 3.529"	LRFD-Ult (auto)/1	0.0	0.0	-88.0	0.0	**3609.9**	**0.0**

Name	Combination key
LRFD-Ult (auto)/1	1.20*DL1 + 1.60*Lr + 1.20*DL2 + 0.50*Wind Down

---

Displacement

Load case D + Lr, inch:



The maximum deflection for a web header is 0.005".

According to TABLE 1604.3 the code IBC 2018, maximum member deflection should not exceed - L/360.

L=10'=120", 120"/360=0.334". 0.005"< 0.334". Deflection is OK!

STEEL MEMBER B1 CHECK

AISI S100-16 LRFD Check

Member B1	2x1400S250-97 + 2x550T150-68	A572 grade 50	LRFD-Ult (auto)	0.13

Material data		
Yield stress Fy	50.00	ksi
Tensile stress Fu	65.00	ksi
fabrication	cold formed	

The critical check is on position 4.00 ft

Axis definition :
- local x- axis in this code check is referring to the local y axis in Scia Engineer
- local y- axis in this code check is referring to the local z axis in Scia Engineer

Internal forces		
Pu	0.00	lbf
Vux	0.01	lbf
Vuy	3500.08	lbf
Mut	0.00	lbfft
Mux	-5422.03	lbfft
Muy	-0.01	lbfft

...::Flexural Strength about X-axis::...

Nominal Flexural Strength

According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch^4]	ds [inch]
1	0.576	49.5 45.7	0.92	0.457	339.6	0.382	1.000	0.576 -	- -	-	- -	-
2	2.403	49.5 49.5	1.00	4.000	170.9	0.538	1.000	2.403 -	- -	-	- -	-
3	13.903	49.5 -41.9	0.85	20.284	25.9	1.382	0.608	- 8.457	2.199 4.229	-	- -	-
4	2.403	-41.9 -41.9	-	-	-	-	-	- -	- -	-	- -	-
5	0.577	-38.1 -41.9	-	-	-	-	-	- -	- -	-	- -	-
6	0.576	-38.1 -41.9	-	-	-	-	-	- -	- -	-	- -	-
7	2.403	-41.9 -41.9	-	-	-	-	-	- -	- -	-	- -	-
8	13.903	49.5 -41.9	0.85	20.284	25.9	1.382	0.608	- 8.457	2.199 4.229	-	- -	-
9	2.403	49.5 49.5	1.00	4.000	170.9	0.538	1.000	- 2.403	1.201 1.202	-	- -	-
10	0.576	49.5 45.7	0.92	0.457	339.6	0.382	1.000	0.576 -	- -	-	- -	-
11	1.466	-32.8 -42.4	-	-	-	-	-	- -	- -	-	- -	-
12	5.432	-42.4 -42.4	-	-	-	-	-	- -	- -	-	- -	-
13	1.466	-32.8 -42.4	-	-	-	-	-	- -	- -	-	- -	-
14	1.466	50.0 40.4	0.81	0.504	28.4	1.327	0.629	0.922 -	- -	-	- -	-
15	5.432	50.0 50.0	1.00	4.000	16.4	1.744	0.501	- 2.721	1.361 1.361	-	- -	-
16	1.466	50.0 40.4	0.81	0.504	28.4	1.327	0.629	0.922 -	- -	-	- -	-

Table of values		
Sxe	17.508	inch^3
Mnxo	72949.0	lbfft
Resistance factor	0.90	
Unity check	0.08	-

Lateral-Torsional Buckling Strength

According to article F2.1 and formula (F2.1-1),(F2.1.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch^4]	ds [inch]
1	0.576	43.5 40.1	0.92	0.458	339.9	0.358	1.000	0.576 -	- -	-	- -	-
2	2.403	43.5 43.5	1.00	4.000	170.9	0.505	1.000	2.403 -	- -	-	- -	-
3	13.903	43.5 -38.3	0.88	21.038	26.8	1.273	0.650	- 9.035	2.329 4.517	-	- -	-
4	2.403	-38.3 -38.3	-	-	-	-	-	- -	- -	-	- -	-
5	0.577	-34.9 -38.3	-	-	-	-	-	- -	- -	-	- -	-
6	0.576	-34.9 -38.3	-	-	-	-	-	- -	- -	-	- -	-
7	2.403	-38.3 -38.3	-	-	-	-	-	- -	- -	-	- -	-
8	13.903	43.5 -38.3	0.88	21.038	26.8	1.273	0.650	- 9.035	2.329 4.517	-	- -	-
9	2.403	43.5 43.5	1.00	4.000	170.9	0.505	1.000	- 2.403	1.202 1.202	-	- -	-
10	0.576	43.5 40.1	0.92	0.458	339.9	0.358	1.000	0.576 -	- -	-	- -	-
11	1.466	-30.1 -38.7	-	-	-	-	-	- -	- -	-	- -	-
12	5.432	-38.7 -38.7	-	-	-	-	-	- -	- -	-	- -	-
13	1.466	-30.1 -38.7	-	-	-	-	-	- -	- -	-	- -	-
14	1.466	44.0 35.4	0.80	0.505	28.5	1.242	0.662	0.971 -	- -	-	- -	-
15	5.432	44.0 44.0	1.00	4.000	16.4	1.636	0.529	- 2.874	1.437 1.437	-	- -	-
16	1.466	44.0 35.4	0.80	0.505	28.5	1.242	0.662	0.971 -	- -	-	- -	-

Table of values		
Lltb	10' 0.000"	ft
Sigma,ey	103.2	ksi
Kt	1.00	
Lt	10' 0.000"	ft
Sigma,t	6.3	ksi
Cb	1.87	
Sfx	20.778	inch^3
Fcre	66.7	ksi
Fc	44.0	ksi
Scx	18.235	inch^3
Mnx	66835.9	lbfft
Resistance factor	0.90	
Unity check	0.09	-

...::Shear Strength::...

Shear Strength

According to article G2.1 and formula (G2.1.1)

Shear force Vy

Element ID	Aw $[inch^2]$	Vn [lbf]
1	0.056	1677.6
2	0.000	0.0
3	1.349	9192.4
4	0.000	0.0
5	0.056	1677.6
6	0.056	1677.6
7	0.000	0.0
8	1.349	9192.4
9	0.000	0.0
10	0.056	1677.6
11	0.100	2990.6
12	0.000	0.0
13	0.100	2990.6
14	0.100	2990.6
15	0.000	0.0
16	0.100	2990.6

Table of values		
Vn,y	37057.8	lbf
Resistance factor	0.95	
Unity check	0.10	-

Combined Bending and Shear

According to article H2 and formula (H2-1)

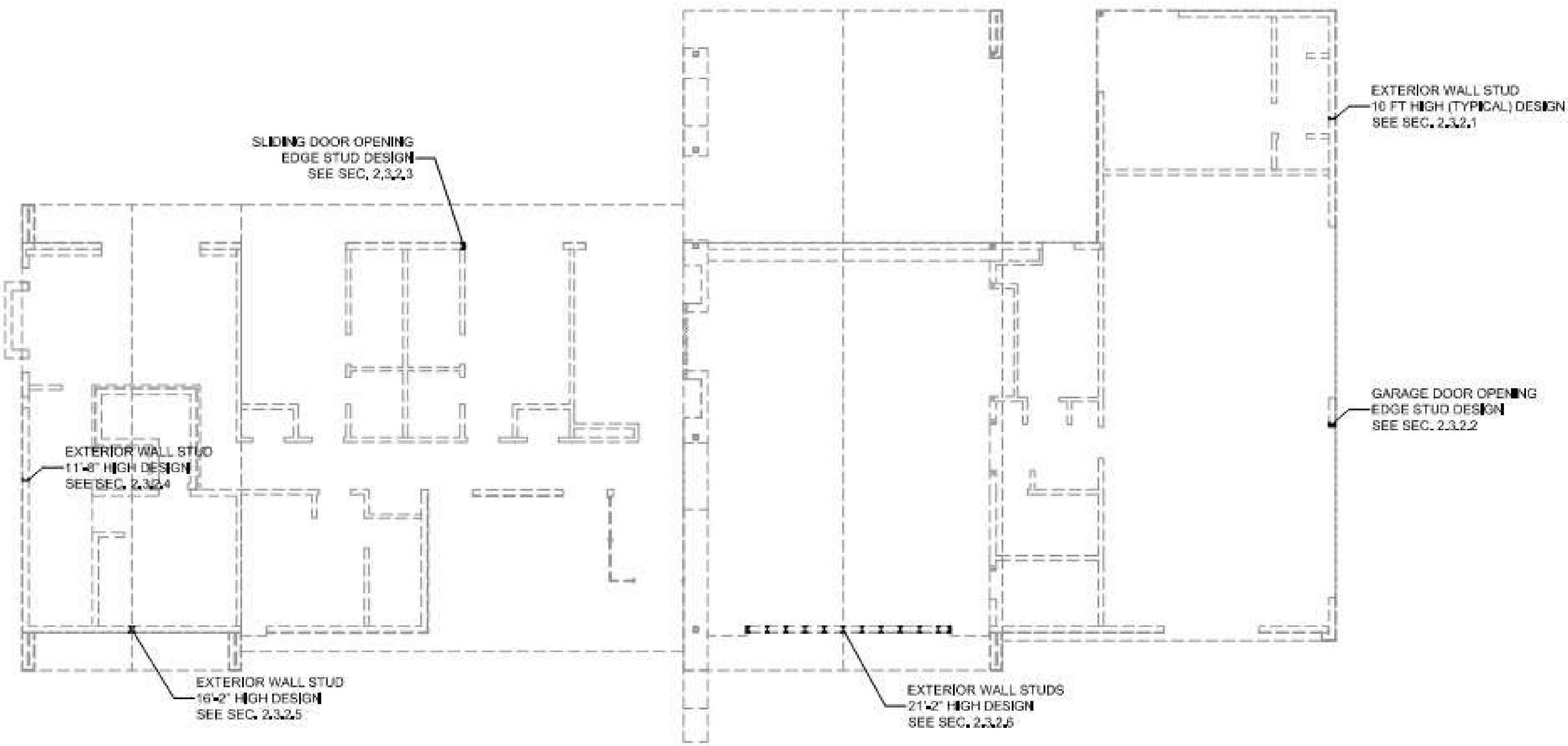
Table of values		
Mnxo	72949.0	lbfft
Vny	37057.8	lbf
Resistance factor shear	0.95	
Resistance factor bending x	0.90	

Unity check (Mx, Vy) = sqrt(0.01+0.01) = 0.13

The member satisfies the check !

Unity check

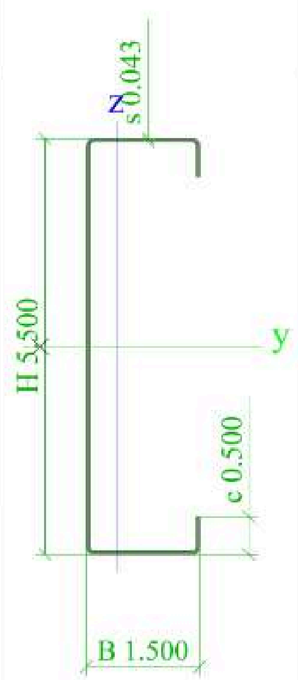
2.3.2 WALL STUD DESIGN



2.3.2.1 EXTERIOR WALL STUD 10 FT HIGH (TYPICAL) DESIGN

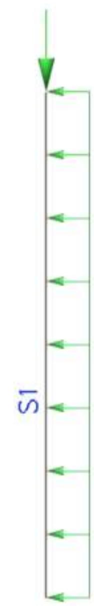
Wall stud spacing - 24”. Stud high - 10 ft.

Stud Cross-sections properties

CS3		
Type	Cold formed C section	
Detailed	5.500; 1.500; 0.043; 0.062; 0.500	
Formcode	114 - Cold formed C section	
Shape type	Thin-walled	
Item material	A913 grade 50	
Fabrication	cold formed	
Colour		
A [inch^2]	0.395	
A_y [inch^2], A_z [inch^2]	0.125	0.237
A_L [inch^2/inch], A_D [inch^2/inch]	1.85e+01	1.85e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	0.393	2.750
α [deg]	0.00	
I_y [inch^4], I_z [inch^4]	1.724	0.115
i_y [inch], i_z [inch]	2.090	0.539
$W_{el.y}$ [inch^3], $W_{el.z}$ [inch^3]	0.627	0.104
$W_{pl.y}$ [inch^3], $W_{pl.z}$ [inch^3]	0.747	0.148
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	3.74e+01	3.74e+01
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	7.40e+00	7.40e+00
d_y [inch], d_z [inch]	-1.001	0.000
I_t [inch^4], I_w [inch^6]	0.000	0.694
$β_y$ [inch], $β_z$ [inch]	0.000	5.866
Picture		

APPLIED LOADS

LOAD PER STUD S1					
Load	**Distr. Load, psf**	**Stud spacing, ft**	**Load width, ft**	**Load, lb or plf**	
Roof Dead Load	22.85	2	12.50	571.25	lb
Roof LL	20	2	12.50	500.00	lb
Roof Wind (up)	23.12	2	12.50	578.00	lb
Wall Wind	16	2		32.00	plf
Roof Wind (down)	8	2	12.50	200.00	lb
Wall Wind	21.04	2		42.08	plf



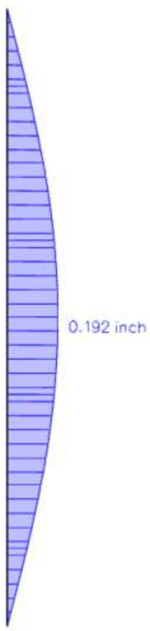
MAXIMUM FORCES

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
S1	10' 0.000"	LRFD-Ult (auto)/1	**64.10**	**0.00**	160.00	**0.00**	**0.00**	**0.00**
S1	0.000"	LRFD-Ult (auto)/2	-901.33	0.00	**-210.40**	0.00	0.00	0.00
S1	10' 0.000"	LRFD-Ult (auto)/2	-885.20	0.00	**210.40**	0.00	0.00	0.00
S1	5' 0.000"-	LRFD-Ult (auto)/2	-893.27	0.00	0.00	0.00	**-526.00**	0.00
S1	0.000"	LRFD-Ult (auto)/3	**-1601.33**	0.00	-105.20	0.00	0.00	**0.00**

Name	Combination key
LRFD-Ult (auto)/1	0.90*Dl1 + 0.90*Dl2 + Wind up
LRFD-Ult (auto)/2	1.20*Dl1 + 1.20*Dl2 + Wind down
LRFD-Ult (auto)/3	1.20*Dl1 + 1.20*Dl2 + 1.60*Lr + 0.50*Wind down

Displacement

Load case W, inch:



The maximum deflection for the Exterior wall is 0.192”. According to TABLE 1604.3 the code IBC 2018, maximum member deflection should not exceed - L/360.
L=10’=120”,   120”/360=0.334”.   0.192"< 0.334”. <u>Deflection is OK!</u>

<u>STEEL MEMBER S1 CHECK</u>

AISI S100-16 LRFD Check

Member S1	Cold formed C section (5.500; 1.500; 0.043; 0.062; 0.500)	A913 grade 50	LRFD-Ult (auto)	0.42

Material data		
Yield stress Fy	50.00	ksi
Tensile stress Fu	65.00	ksi
fabrication	cold formed	

The critical check is on position 5.00 ft

Axis definition :
- local x- axis in this code check is referring to the local y axis in Scia Engineer
- local y- axis in this code check is referring to the local z axis in Scia Engineer

Internal forces		
Pu	-1143.27	lbf
Vux	0.00	lbf
Vuy	0.00	lbf
Mut	0.00	lbfft
Mux	-526.00	lbfft
Muy	0.00	lbfft

...::Flexural Strength about X-axis::...
Nominal Flexural Strength
According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch^4]	ds [inch]
1	0.395	48.509 41.453	0.85	0.484	150.332	0.568	1.000	0.238 -	- -	-	- -	-
3	1.290	50.000 50.000	1.00	2.858	83.266	0.775	0.924	1.192 -	0.360 0.833	30.83	0.000 0.000	0.238
5	5.290	48.509 -45.980	0.95	22.677	39.282	1.111	0.722	- 3.818	0.967 1.909	-	- -	-
7	1.290	-47.471 -47.471	-	-	-	-	-	- -	- -	-	- -	-
9	0.395	-38.924 -45.980	-	-	-	-	-	- -	- -	-	- -	-

Table of values		
Sxe	0.587	inch^3
Mnxo	2444.18	lbfft
Resistance factor	0.90	
Unity check	0.24	-

Lateral-Torsional Buckling Strength
According to article F2.1 and formula (F2.1-1),(F2.1.1-1).

Table of values		
Lltb	2' 6.000"	ft
Sigma,ey	92.521	ksi
Kt	1.00	
Lt	2' 6.000"	ft
Sigma,t	99.968	ksi
Cb	1.06	
Sfx	0.627	inch^3
Fcre	152.965	ksi

Note: Lateral-Torsional buckling is not governing since Fe is greater than or equal to 2.78 Fy.

Distortional Buckling Strength
According to article F4 and formula F4.1-2.

Table of values		
Sfy	0.627	inch^3
My	2611.93	lbfft
L	1' 2.500"	ft
Beta	1.09	
k,phi,fe	140.58	lbf
k,phi,we	132.79	lbf
k,phi	0.00	lbf
k,phi,fg	0.004	inch^2

Table of values		
k,phi,wg	0.001	inch^2
Fd	56.393	ksi
Sf	0.627	inch^3
Mcrd	2945.89	lbfft
Lambda,d	0.94	
Mn	2125.79	lbfft
Resistance factor	0.90	
Unity check	0.27	-

Data		
Lm	2' 6.000"	ft
Lcr	1' 2.500"	ft
h0	5.500	inch
Ixf	0.001	inch^4
Iyf	0.016	inch^4
Ixyf	0.003	inch^4
Cwf	0.000	inch^6
Jf	0.000	inch^4
x0f	0.510	inch
hxf	-0.937	inch
Af	0.078	inch^2
y0f	-0.058	inch
Ksi,web	2.00	

Number of compressed flanges: 1
Critical flange contains Initial shape parts: 2, 3, 1

...::Axial Compression Strength::...
Nominal Axial Strength
According to article E2 and formula (E2-1)

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch^4]	ds [inch]
1	0.395	50.000 50.000	1.00	0.430	133.598	0.612	1.000	0.238 -	- -	-	- -	-
3	1.290	50.000 50.000	1.00	2.858	83.266	0.775	0.924	1.192 -	0.360 0.833	30.83	0.000 0.000	0.238
5	5.290	50.000 50.000	1.00	4.000	6.929	2.686	0.342	1.808 -	- -	-	- -	-
7	1.290	50.000 50.000	1.00	2.858	83.266	0.775	0.924	1.192 -	0.360 0.833	30.83	0.000 0.000	0.238
9	0.395	50.000 50.000	1.00	0.430	133.598	0.612	1.000	0.238 -	- -	-	- -	-

Table of values		
Fn	50.000	ksi
Ae	0.223	inch^2
Pno	11164.21	lbf
Resistance factor	0.85	
Unity check	0.12	-

Buckling check
According to article E2 and formula (E2-1)
Flexural Buckling Strength
According to article E2.1 and formula (E2.1-1)

Buckling parameters	xx	yy	
Sway type	sway	sway	
Unbraced Length L	10	2 1/2	ft
Effective Length factor K	1.00	1.00	
Effective Length	10	2 1/2	ft
Slenderness	57.43	55.63	
Flexural Buckling stress Fcre	86.806	92.521	ksi

Torsional (-Flexural) Buckling Strength
According to article E2.2, E2.3, E2.4

Table of values		
Sigma,ex	86.806	ksi
Sigma,ey	92.521	ksi
Kt	1.00	
Lt	2 1/2	ft
Sigma,t	99.968	ksi
Sigma,TF	65.182	ksi
Torsional (-Flexural) buckling stress Fcre	65.182	ksi

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.395	36.269 36.269	1.00	0.430	133.598	0.521	1.000	0.395 -	- -	-	- -	-
3	1.290	36.269 36.269	1.00	3.312	96.480	0.613	1.000	1.290 -	0.645 0.645	36.20	0.000 0.000	0.395
5	5.290	36.269 36.269	1.00	4.000	6.929	2.288	0.395	2.090 -	- -	-	- -	-
7	1.290	36.269 36.269	1.00	3.312	96.480	0.613	1.000	1.290 -	0.645 0.645	36.20	0.000 0.000	0.395
9	0.395	36.269 36.269	1.00	0.430	133.598	0.521	1.000	0.395 -	- -	-	- -	-

Table of values		
Fe	65.182	ksi
lambda, c	0.88	
Fn	36.269	ksi
Ae	0.257	inch ^{2}
Pn	9332.17	lbf
Resistance factor	0.85	
Unity check	0.14	-

Distortional Buckling Strength
According to article E4 and formula (E4.1-2).

Table of values		
Py	19741.27	lbf
L	1' 4.036"	ft
k,phi,fe	97.82	lbf
k,phi,we	76.80	lbf
k,phi	0.00	lbf
k,phi,fg	0.004	inch ^{2}
k,phi,wg	0.005	inch ^{2}
Fd	21.491	ksi
Pcrd	8485.06	lbf
Lambda,d	1.53	
Pn	10102.77	lbf
Resistance factor	0.85	
Unity check	0.13	-

Data		
Lm	2' 6.000"	ft
Lcr	1' 4.036"	ft
h0	5.500	inch
Ixf	0.001	inch ^{4}
Iyf	0.016	inch ^{4}
Ixyf	0.003	inch ^{4}
Cwf	0.000	inch ^{6}
Jf	0.000	inch ^{4}
x0f	0.510	inch
hxf	-0.937	inch
Af	0.078	inch ^{2}
y0f	-0.058	inch

Number of compressed flanges: 2
Critical flange contains Initial shape parts: 2, 3, 1

Combined Compressive Axial Load and Bending
According to article H1.2 and formulas (C5.2.1-3)

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.395	2.896 2.896	1.00	0.430	133.598	0.147	1.000	0.395 -	- -	-	- -	-
3	1.290	2.896 2.896	1.00	4.000	116.521	0.158	1.000	1.290 -	0.645 0.645	128.11	- 0.000	0.395
5	5.290	2.896 2.896	1.00	4.000	6.929	0.646	1.000	5.290 -	- -	-	- -	-
7	1.290	2.896 2.896	1.00	4.000	116.521	0.158	1.000	1.290 -	0.645 0.645	128.11	- 0.000	0.395
9	0.395	2.896 2.896	1.00	0.430	133.598	0.147	1.000	0.395 -	- -	-	- -	-

Table of values		
Mnx	2125.79	lbfft
Pn	9332.17	lbf
Resistance factor compression	0.85	
Resistance factor bending x	0.90	

Unity check = 0.14+0.27+0.00 = 0.42 - (C5.2.1-3)

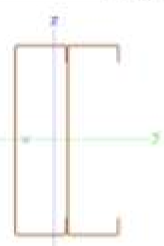
The member satisfies the check !

Unity check

2.3.2.2 GARAGE DOOR OPENING EDGE STUD DESIGN

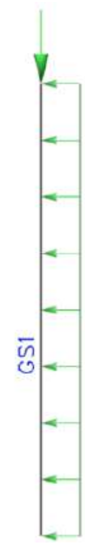
Garage door opening width - 18ft. Stud high - 10 ft.

Stud Cross-sections properties

GS1		
Type	2x550S150-43	
Shape type	Thin-walled	
Item material	A913 grade 50	
Fabrication	cold formed	
Colour		
A [inch^2]	0.790	
A_y [inch^2], A_z [inch^2]	0.241	0.474
A_L [inch^2/inch], A_D [inch^2/inch]	2.17e+01	3.53e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	0.752	0.000
α [deg]	0.00	
I_y [inch^4], I_z [inch^4]	3.448	0.674
i_y [inch], i_z [inch]	2.090	0.924
$W_{el.y}$ [inch^3], $W_{el.z}$ [inch^3]	1.254	0.363
$W_{pl.y}$ [inch^3], $W_{pl.z}$ [inch^3]	1.495	0.592
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	7.47e+01	7.47e+01
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	2.96e+01	2.96e+01
d_y [inch], d_z [inch]	-0.821	0.000
I_t [inch^4], I_w [inch^6]	0.822	2.050
$β_y$ [inch], $β_z$ [inch]	0.000	2.959
Picture		

APPLIED LOADS

LOAD PER STUD GS1					
Load	Distr. Load, psf	Stud spacing, ft	Load width, ft	Load, lb or plf	
Roof Dead Load	22.85	10	12.50	2856.25	lb
Roof LL	20	10	12.50	2500.00	lb
Roof Wind (up)	23.12	10	12.50	2890.00	lb
Wall Wind	16	10		160.00	plf
Roof Wind (down)	8	10	12.50	1000.00	lb
Wall Wind	21.04	10		210.40	plf



MAXIMUM FORCES

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
GS1	10' 0.000"	LRFD-Ult (auto)/1	**286.00**	**0.00**	800.00	**0.00**	**0.00**	**0.00**
GS1	0.000"	LRFD-Ult (auto)/2	-4464.27	0.00	**-1052.00**	0.00	0.00	0.00
GS1	10' 0.000"	LRFD-Ult (auto)/2	-4432.00	0.00	**1052.00**	0.00	0.00	0.00
GS1	5' 0.000"-	LRFD-Ult (auto)/2	-4448.13	0.00	0.00	0.00	**-2630.00**	0.00
GS1	0.000"	LRFD-Ult (auto)/3	**-7964.27**	0.00	-526.00	0.00	0.00	**0.00**

Name	Combination key
LRFD-Ult (auto)/1	0.90*Dl1 + 0.90*Dl2 + Wind up
LRFD-Ult (auto)/2	1.20*Dl1 + 1.20*Dl2 + Wind down
LRFD-Ult (auto)/3	1.20*Dl1 + 1.20*Dl2 + 1.60*Lr + 0.50*Wind down

Displacement

Load case W, inch:

The maximum deflection for the Exterior wall is 0.288”. According to TABLE 1604.3 the code IBC 2018, maximum member deflection should not exceed - L/360.
L=10’=120”, 120”/360=0.334”. 0.288"< 0.334”. <u>Deflection is OK!</u>

<u>STEEL MEMBER GS1 CHECK</u>

AISI S100-16 LRFD Check

Member GS1	2x550S150-43	A913 grade 50	LRFD-Ult (auto)	0.87

Material data		
Yield stress Fy	50.00	ksi
Tensile stress Fu	65.00	ksi
fabrication	cold formed	

The critical check is on position 5.00 ft

Axis definition :
- local x- axis in this code check is referring to the local y axis in Scia Engineer
- local y- axis in this code check is referring to the local z axis in Scia Engineer

Internal forces		
Pu	-5698.13	lbf
Vux	0.00	lbf
Vuy	-0.00	lbf
Mut	0.00	lbfft
Mux	-2630.00	lbfft
Muy	-36.85	lbfft

Note: Mux and/or Muy include additional moments as defined in art. H1.2

...::Flexural Strength about X-axis::...

Nominal Flexural Strength

According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch^4]	ds [inch]
1	0.479	50.000 41.303	0.83	4.358	3691.052	0.116	1.000	- 0.479	0.220 0.258	-	- -	-
2	1.457	50.000 50.000	1.00	4.000	91.341	0.740	0.950	1.384 -	- -	-	- -	-
3	5.457	50.000 -49.188	0.98	23.581	38.386	1.141	0.707	- 3.860	0.969 1.930	-	- -	-
4	1.457	-49.188 -49.188	-	-	-	-	-	- -	- -	-	- -	-
5	0.478	-40.491 -49.188	-	-	-	-	-	- -	- -	-	- -	-
6	0.479	50.000 41.303	0.83	0.496	104.947	0.690	0.987	0.472 -	- -	-	- -	-
7	1.457	50.000 50.000	1.00	4.000	91.341	0.740	0.950	1.384 -	- -	-	- -	-
8	4.500	41.303 -40.491	0.98	23.493	56.240	0.857	0.867	- 3.903	0.981 1.952	-	- -	-
9	1.457	-49.188 -49.188	-	-	-	-	-	- -	- -	-	- -	-
10	0.478	-40.491 -49.188	-	-	-	-	-	- -	- -	-	- -	-

Table of values		
Sxe	1.244	inch^3
Mnxo	5181.73	lbfft
Resistance factor	0.90	
Unity check	0.56	-

Lateral-Torsional Buckling Strength

According to article F2.1 and formula (F2.1-1),(F2.1.1-1).

Table of values		
Lltb	2' 6.000"	ft
Sigma,ey	271.454	ksi
Kt	1.00	
Lt	2' 6.000"	ft
Sigma,t	2111.583	ksi
Cb	1.06	
Sfx	1.254	inch^3
Fcre	1228.934	ksi

Note: Lateral-Torsional buckling is not governing since Fe is greater than or equal to 2.78 Fy.

...::Flexural Strength about Y-axis::...

Nominal Flexural Strength

According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.479	-2.882 -2.882	-	-	-	-	-	- -	- -	-	- -	-
2	1.457	44.237 -2.196	0.05	8.412	192.095	0.480	1.000	- 1.457	0.478 0.979	-	- -	-
3	5.457	44.237 44.237	1.00	4.000	6.511	2.606	0.351	1.917 -	- -	-	- -	-
4	1.457	44.237 -2.196	0.05	8.412	192.095	0.480	1.000	- 1.457	0.478 0.979	-	- -	-
5	0.478	-2.882 -2.882	-	-	-	-	-	- -	- -	-	- -	-
6	0.479	-50.000 -50.000	-	-	-	-	-	- -	- -	-	- -	-
7	1.457	-3.567 -50.000	-	-	-	-	-	- -	- -	-	- -	-
8	4.500	-3.567 -3.567	-	-	-	-	-	- -	- -	-	- -	-
9	1.457	-3.567 -50.000	-	-	-	-	-	- -	- -	-	- -	-
10	0.478	-50.000 -50.000	-	-	-	-	-	- -	- -	-	- -	-

Table of values		
Sye	0.284	inch ^{3}
Mnyo	1182.88	lbfft
Resistance factor	0.90	
Unity check	0.03	-

Lateral-Torsional Buckling Strength
According to article F2.1 and formula (F2.1-1),(F2.1.1-1).

Table of values		
Sigma,ex	86.806	ksi
Kt	1.00	
Lt	2' 6.000"	ft
Sigma,t	2111.583	ksi
Cb	1.00	
Sfy	0.590	inch ^{3}
Fcre	1392.143	ksi

Note: Lateral-Torsional buckling is not governing since Fe is greater than or equal to 2.78 Fy.

...::Axial Compression Strength::...
Nominal Axial Strength
According to article E2 and formula (E2-1)

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch^4]	ds [inch]
1	0.479	50.000 50.000	1.00	4.000	3387.513	0.121	1.000	0.479 -	- -	-	- -	-
2	1.457	50.000 50.000	1.00	4.000	91.341	0.740	0.950	1.384 -	- -	-	- -	-
3	5.457	50.000 50.000	1.00	4.000	6.511	2.771	0.332	1.813 -	- -	-	- -	-
4	1.457	50.000 50.000	1.00	4.000	91.341	0.740	0.950	1.384 -	- -	-	- -	-
5	0.478	50.000 50.000	1.00	4.000	3387.513	0.121	1.000	0.478 -	- -	-	- -	-
6	0.479	50.000 50.000	1.00	0.430	91.039	0.741	0.949	0.454 -	- -	-	- -	-
7	1.457	50.000 50.000	1.00	4.000	91.341	0.740	0.950	1.384 -	- -	-	- -	-
8	4.500	50.000 50.000	1.00	4.000	9.575	2.285	0.395	1.780 -	- -	-	- -	-
9	1.457	50.000 50.000	1.00	4.000	91.341	0.740	0.950	1.384 -	- -	-	- -	-
10	0.478	50.000 50.000	1.00	0.430	91.039	0.741	0.949	0.454 -	- -	-	- -	-

Table of values		
Fn	50.000	ksi
Ae	0.514	inch^2
Pno	25716.73	lbf
Resistance factor	0.85	
Unity check	0.26	-

Buckling check
According to article E2 and formula (E2-1)
Flexural Buckling Strength
According to article E2.1 and formula (E2.1-1)

Buckling parameters	xx	yy	
Sway type	sway	sway	
Unbraced Length L	10	2 1/2	ft
Effective Length factor K	1.00	1.00	
Effective Length	10	2 1/2	ft
Slenderness	57.43	32.48	
Flexural Buckling stress Fcre	86.806	271.454	ksi

Torsional (-Flexural) Buckling Strength
According to article E2.2, E2.3, E2.4

Table of values		
Sigma,ex	86.806	ksi
Sigma,ey	271.454	ksi
Kt	1.00	
Lt	2 1/2	ft
Sigma,t	2111.583	ksi
Sigma,TF	86.384	ksi
Torsional (-Flexural) buckling stress Fcre	86.384	ksi

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.479	39.243 39.243	1.00	4.000	3387.513	0.108	1.000	0.479 -	- -	-	- -	-
2	1.457	39.243 39.243	1.00	4.000	91.341	0.655	1.000	1.457 -	- -	-	- -	-
3	5.457	39.243 39.243	1.00	4.000	6.511	2.455	0.371	2.024 -	- -	-	- -	-
4	1.457	39.243 39.243	1.00	4.000	91.341	0.655	1.000	1.457 -	- -	-	- -	-
5	0.478	39.243 39.243	1.00	4.000	3387.513	0.108	1.000	0.478 -	- -	-	- -	-
6	0.479	39.243 39.243	1.00	0.430	91.039	0.657	1.000	0.479 -	- -	-	- -	-
7	1.457	39.243 39.243	1.00	4.000	91.341	0.655	1.000	1.457 -	- -	-	- -	-
8	4.500	39.243 39.243	1.00	4.000	9.575	2.024	0.440	1.981 -	- -	-	- -	-
9	1.457	39.243 39.243	1.00	4.000	91.341	0.655	1.000	1.457 -	- -	-	- -	-
10	0.478	39.243 39.243	1.00	0.430	91.039	0.657	1.000	0.478 -	- -	-	- -	-

Table of values		
Fe	86.384	ksi
lambda, c	0.76	
Fn	39.243	ksi
Ae	0.547	inch ^{2}
Pn	21456.99	lbf
Resistance factor	0.85	
Unity check	0.31	-

Combined Compressive Axial Load and Bending
According to article H1.2 and formulas (H1.2-1)

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.479	7.216 7.216	1.00	4.000	3387.513	0.046	1.000	0.479 -	- -	-	- -	-
2	1.457	7.216 7.216	1.00	4.000	91.341	0.281	1.000	1.457 -	- -	-	- -	-
3	5.457	7.216 7.216	1.00	4.000	6.511	1.053	0.751	4.100 -	- -	-	- -	-
4	1.457	7.216 7.216	1.00	4.000	91.341	0.281	1.000	1.457 -	- -	-	- -	-
5	0.478	7.216 7.216	1.00	4.000	3387.513	0.046	1.000	0.478 -	- -	-	- -	-
6	0.479	7.216 7.216	1.00	0.430	91.039	0.282	1.000	0.479 -	- -	-	- -	-
7	1.457	7.216 7.216	1.00	4.000	91.341	0.281	1.000	1.457 -	- -	-	- -	-
8	4.500	7.216 7.216	1.00	4.000	9.575	0.868	0.860	3.870 -	- -	-	- -	-
9	1.457	7.216	1.00	4.000	91.341	0.281	1.000	1.457	-	-	-	-

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch⁴]	ds [inch]
		7.216						-	-		-	
10	0.478	7.216 7.216	1.00	0.430	91.039	0.282	1.000	0.478 -	- -	-	- -	-

Table of values		
Centerline shift ex	0.078	inch
Centerline shift ey	0.000	inch
Additional moment Mx	0.00	lbfft
Additional moment My	-36.85	lbfft
Mnx	5181.73	lbfft
Mny	1182.88	lbfft
PEx	68546.20	lbf
PEy	214353.87	lbf
Alfa x	0.92	
Alfa y	0.97	
Cmx	0.85	
Cmy	0.85	
Pn	21456.99	lbf
Pno	25716.73	lbf
Resistance factor compression	0.85	
Resistance factor bending x	0.90	
Resistance factor bending y	0.90	

Unity check = 0.31+0.52+0.03 = 0.87 - (H1.2-1)
Unity check = 0.26+0.56+0.03 = 0.86 -

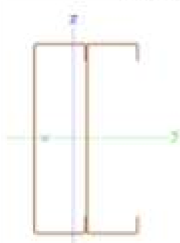
The member satisfies the check !

Unity check

2.3.2.3 SLIDING DOOR OPENING EDGE STUD DESIGN

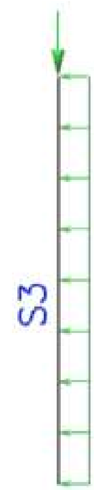
Sliding door opening width - 10ft. Stud high - 10 ft.

Stud Cross-sections properties

GS1		
Type	2x550S150-43	
Shape type	Thin-walled	
Item material	A913 grade 50	
Fabrication	cold formed	
Colour		
A [inch^2]	0.790	
A_y [inch^2], A_z [inch^2]	0.241	0.474
A_L [inch^2/inch], A_D [inch^2/inch]	2.17e+01	3.53e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	0.752	0.000
α [deg]	0.00	
I_y [inch^4], I_z [inch^4]	3.448	0.674
i_y [inch], i_z [inch]	2.090	0.924
$W_{el.y}$ [inch^3], $W_{el.z}$ [inch^3]	1.254	0.363
$W_{pl.y}$ [inch^3], $W_{pl.z}$ [inch^3]	1.495	0.592
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	7.47e+01	7.47e+01
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	2.96e+01	2.96e+01
d_y [inch], d_z [inch]	-0.821	0.000
I_t [inch^4], I_w [inch^6]	0.822	2.050
$β_y$ [inch], $β_z$ [inch]	0.000	2.959
Picture		

APPLIED LOADS

LOAD PER STUD S3					
Load	Distr. Load, psf	Stud spacing, ft	Load width, ft	Load, lb or plf	
Roof Dead Load	17.85	6	14.25	1526.18	lb
Roof LL	20	6	14.25	1710.00	lb
Roof Wind (up)	23.12	6	14.25	1976.76	lb
Wall Wind	16	6		96.00	plf
Roof Wind (down)	8	6	14.25	684.00	lb
Wall Wind	21.04	6		126.24	plf



MAXIMUM FORCES

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
S3	10' 0.000"	LRFD-Ult (auto)/1	**603.00**	**0.00**	480.00	**0.00**	**0.00**	**0.00**
S3	0.000"	LRFD-Ult (auto)/2	-2553.26	0.00	**-635.00**	0.00	0.00	0.00
S3	10' 0.000"	LRFD-Ult (auto)/2	-2521.00	0.00	**635.00**	0.00	0.00	0.00
S3	5' 0.000"-	LRFD-Ult (auto)/2	-2537.13	0.00	0.00	0.00	**-1587.50**	0.00
S3	0.000"	LRFD-Ult (auto)/3	**-4946.76**	0.00	-317.50	0.00	0.00	**0.00**

Name	Combination key
LRFD-Ult (auto)/1	0.90*Dl1 + 0.90*Dl2 + Wind up
LRFD-Ult (auto)/2	1.20*Dl1 + 1.20*Dl2 + Wind down
LRFD-Ult (auto)/3	1.20*Dl1 + 1.20*Dl2 + 1.60*Lr + 0.50*Wind down

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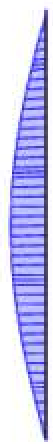
Displacement

Load case W, inch:



The maximum deflection for the Exterior wall is 0.174". According to TABLE 1604.3 the code IBC 2018, maximum member deflection should not exceed - L/360.
L=10'=120", 120"/360=0.334". 0.174"< 0.334". <u>Deflection is OK!</u>

STEEL MEMBER S3 CHECK

AISI S100-16 LRFD Check

Member S3	2x550S150-43	A913 grade 50	LRFD-Ult (auto)	0.50

Material data		
Yield stress Fy	50.00	ksi
Tensile stress Fu	65.00	ksi
fabrication	cold formed	

The critical check is on position 5.00 ft

Axis definition :
- local x- axis in this code check is referring to the local y axis in Scia Engineer
- local y- axis in this code check is referring to the local z axis in Scia Engineer

Internal forces		
Pu	-3392.13	lbf
Vux	0.00	lbf
Vuy	-0.00	lbf
Mut	0.00	lbfft
Mux	-1587.50	lbfft
Muy	-9.82	lbfft

Note: Mux and/or Muy include additional moments as defined in art. H1.2

...::Flexural Strength about X-axis::...

Nominal Flexural Strength

According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.479	50.000 41.303	0.83	4.358	3691.052	0.116	1.000	- 0.479	0.220 0.258	-	- -	-
2	1.457	50.000 50.000	1.00	4.000	91.341	0.740	0.950	1.384 -	- -	-	- -	-
3	5.457	50.000 -49.188	0.98	23.581	38.386	1.141	0.707	- 3.860	0.969 1.930	-	- -	-
4	1.457	-49.188 -49.188	-	-	-	-	-	- -	- -	-	- -	-
5	0.478	-40.491 -49.188	-	-	-	-	-	- -	- -	-	- -	-
6	0.479	50.000 41.303	0.83	0.496	104.947	0.690	0.987	0.472 -	- -	-	- -	-
7	1.457	50.000 50.000	1.00	4.000	91.341	0.740	0.950	1.384 -	- -	-	- -	-
8	4.500	41.303 -40.491	0.98	23.493	56.240	0.857	0.867	- 3.903	0.981 1.952	-	- -	-
9	1.457	-49.188 -49.188	-	-	-	-	-	- -	- -	-	- -	-
10	0.478	-40.491 -49.188	-	-	-	-	-	- -	- -	-	- -	-

Table of values		
Sxe	1.244	inch ^{3}
Mnxo	5181.73	lbfft
Resistance factor	0.90	
Unity check	0.34	-

Lateral-Torsional Buckling Strength

According to article F2.1 and formula (F2.1-1),(F2.1.1-1).

Table of values		
Lltb	2' 6.000"	ft
Sigma,ey	271.454	ksi
Kt	1.00	
Lt	2' 6.000"	ft
Sigma,t	2111.583	ksi
Cb	1.06	
Sfx	1.254	inch ^{3}
Fcre	1228.934	ksi

Note: Lateral-Torsional buckling is not governing since Fe is greater than or equal to 2.78 Fy.

...::Flexural Strength about Y-axis::...

Nominal Flexural Strength

According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.479	-2.882 -2.882	-	-	-	-	-	- -	- -	-	- -	-
2	1.457	44.237 -2.196	0.05	8.412	192.095	0.480	1.000	- 1.457	0.478 0.979	-	- -	-
3	5.457	44.237 44.237	1.00	4.000	6.511	2.606	0.351	1.917 -	- -	-	- -	-
4	1.457	44.237 -2.196	0.05	8.412	192.095	0.480	1.000	- 1.457	0.478 0.979	-	- -	-
5	0.478	-2.882 -2.882	-	-	-	-	-	- -	- -	-	- -	-
6	0.479	-50.000 -50.000	-	-	-	-	-	- -	- -	-	- -	-
7	1.457	-3.567 -50.000	-	-	-	-	-	- -	- -	-	- -	-
8	4.500	-3.567 -3.567	-	-	-	-	-	- -	- -	-	- -	-
9	1.457	-3.567 -50.000	-	-	-	-	-	- -	- -	-	- -	-
10	0.478	-50.000 -50.000	-	-	-	-	-	- -	- -	-	- -	-

Table of values		
Sye	0.284	inch ^{3}
Mnyo	1182.88	lbfft
Resistance factor	0.90	
Unity check	0.01	-

Lateral-Torsional Buckling Strength
According to article F2.1 and formula (F2.1-1),(F2.1.1-1).

Table of values		
Sigma,ex	86.806	ksi
Kt	1.00	
Lt	2' 6.000"	ft
Sigma,t	2111.583	ksi
Cb	1.00	
Sfy	0.590	inch ^{3}
Fcre	1392.143	ksi

Note: Lateral-Torsional buckling is not governing since Fe is greater than or equal to 2.78 Fy.

...::Axial Compression Strength::...

Nominal Axial Strength

According to article E2 and formula (E2-1)

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.479	50.000 50.000	1.00	4.000	3387.513	0.121	1.000	0.479 -	- -	-	- -	-
2	1.457	50.000 50.000	1.00	4.000	91.341	0.740	0.950	1.384 -	- -	-	- -	-
3	5.457	50.000 50.000	1.00	4.000	6.511	2.771	0.332	1.813 -	- -	-	- -	-
4	1.457	50.000 50.000	1.00	4.000	91.341	0.740	0.950	1.384 -	- -	-	- -	-
5	0.478	50.000 50.000	1.00	4.000	3387.513	0.121	1.000	0.478 -	- -	-	- -	-
6	0.479	50.000 50.000	1.00	0.430	91.039	0.741	0.949	0.454 -	- -	-	- -	-
7	1.457	50.000 50.000	1.00	4.000	91.341	0.740	0.950	1.384 -	- -	-	- -	-
8	4.500	50.000 50.000	1.00	4.000	9.575	2.285	0.395	1.780 -	- -	-	- -	-
9	1.457	50.000 50.000	1.00	4.000	91.341	0.740	0.950	1.384 -	- -	-	- -	-
10	0.478	50.000 50.000	1.00	0.430	91.039	0.741	0.949	0.454 -	- -	-	- -	-

Table of values		
Fn	50.000	ksi
Ae	0.514	inch ^{2}
Pno	25716.73	lbf
Resistance factor	0.85	
Unity check	0.16	-

Buckling check

According to article E2 and formula (E2-1)

Flexural Buckling Strength

According to article E2.1 and formula (E2.1-1)

Buckling parameters	xx	yy	
Sway type	sway	sway	
Unbraced Length L	10	2 1/2	ft
Effective Length factor K	1.00	1.00	
Effective Length	10	2 1/2	ft
Slenderness	57.43	32.48	
Flexural Buckling stress Fcre	86.806	271.454	ksi

Torsional (-Flexural) Buckling Strength
According to article E2.2, E2.3, E2.4

Table of values		
Sigma,ex	86.806	ksi
Sigma,ey	271.454	ksi
Kt	1.00	
Lt	2 1/2	ft
Sigma,t	2111.583	ksi
Sigma,TF	86.384	ksi
Torsional (-Flexural) buckling stress Fcre	86.384	ksi

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.479	39.243 39.243	1.00	4.000	3387.513	0.108	1.000	0.479 -	- -	-	- -	-
2	1.457	39.243 39.243	1.00	4.000	91.341	0.655	1.000	1.457 -	- -	-	- -	-
3	5.457	39.243 39.243	1.00	4.000	6.511	2.455	0.371	2.024 -	- -	-	- -	-
4	1.457	39.243 39.243	1.00	4.000	91.341	0.655	1.000	1.457 -	- -	-	- -	-
5	0.478	39.243 39.243	1.00	4.000	3387.513	0.108	1.000	0.478 -	- -	-	- -	-
6	0.479	39.243 39.243	1.00	0.430	91.039	0.657	1.000	0.479 -	- -	-	- -	-
7	1.457	39.243 39.243	1.00	4.000	91.341	0.655	1.000	1.457 -	- -	-	- -	-
8	4.500	39.243 39.243	1.00	4.000	9.575	2.024	0.440	1.981 -	- -	-	- -	-
9	1.457	39.243 39.243	1.00	4.000	91.341	0.655	1.000	1.457 -	- -	-	- -	-
10	0.478	39.243 39.243	1.00	0.430	91.039	0.657	1.000	0.478 -	- -	-	- -	-

Table of values		
Fe	86.384	ksi
lambda, c	0.76	
Fn	39.243	ksi
Ae	0.547	inch ^{2}
Pn	21456.99	lbf
Resistance factor	0.85	
Unity check	0.19	-

Combined Compressive Axial Load and Bending
According to article H1.2 and formulas (H1.2-1)

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.479	4.296 4.296	1.00	4.000	3387.513	0.036	1.000	0.479 -	- -	-	- -	-
2	1.457	4.296 4.296	1.00	4.000	91.341	0.217	1.000	1.457 -	- -	-	- -	-
3	5.457	4.296 4.296	1.00	4.000	6.511	0.812	0.898	4.899 -	- -	-	- -	-

4	1.457	4.296 4.296	1.00	4.000	91.341	0.217	1.000	1.457 -	- -	-	- -	-
5	0.478	4.296 4.296	1.00	4.000	3387.513	0.036	1.000	0.478 -	- -	-	- -	-
6	0.479	4.296 4.296	1.00	0.430	91.039	0.217	1.000	0.479 -	- -	-	- -	-
7	1.457	4.296 4.296	1.00	4.000	91.341	0.217	1.000	1.457 -	- -	-	- -	-
8	4.500	4.296 4.296	1.00	4.000	9.575	0.670	1.000	4.500 -	- -	-	- -	-
9	1.457	4.296 4.296	1.00	4.000	91.341	0.217	1.000	1.457 -	- -	-	- -	-
10	0.478	4.296 4.296	1.00	0.430	91.039	0.217	1.000	0.478 -	- -	-	- -	-

Table of values		
Centerline shift ex	0.035	inch
Centerline shift ey	0.000	inch
Additional moment Mx	0.00	lbfft
Additional moment My	-9.82	lbfft
Mnx	5181.73	lbfft
Mny	1182.88	lbfft
PEx	68546.20	lbf
PEy	214353.87	lbf
Alfa x	0.95	
Alfa y	0.98	
Cmx	0.85	
Cmy	0.85	
Pn	21456.99	lbf
Pno	25716.73	lbf
Resistance factor compression	0.85	
Resistance factor bending x	0.90	
Resistance factor bending y	0.90	

Unity check = 0.19+0.30+0.01 = 0.50 - (H1.2-1)
Unity check = 0.16+0.34+0.01 = 0.50 -

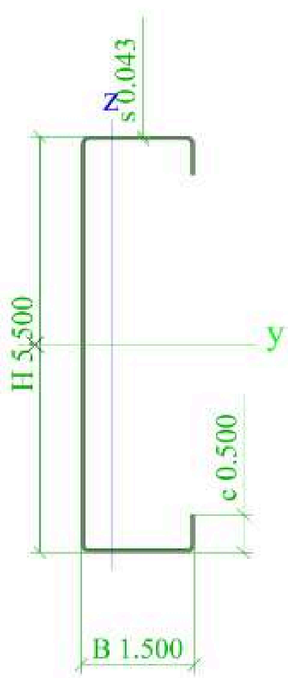
The member satisfies the check !

Unity check

2.3.2.4 EXTERIOR WALL STUD 11'-8" HIGH DESIGN

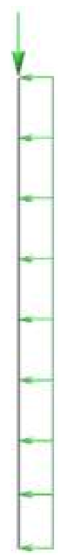
Wall stud spacing - 24". Stud high - 11'-8'..

Stud Cross-sections properties

CS3		
Type	Cold formed C section	
Detailed	5.500; 1.500; 0.043; 0.062; 0.500	
Formcode	114 - Cold formed C section	
Shape type	Thin-walled	
Item material	A913 grade 50	
Fabrication	cold formed	
Colour		
A [$inch^2$]	0.395	
A_y [$inch^2$], A_z [$inch^2$]	0.125	0.237
A_L [$inch^2$/inch], A_D [$inch^2$/inch]	1.85e+01	1.85e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	0.393	2.750
α [deg]	0.00	
I_y [$inch^4$], I_z [$inch^4$]	1.724	0.115
i_y [inch], i_z [inch]	2.090	0.539
$W_{el.y}$ [$inch^3$], $W_{el.z}$ [$inch^3$]	0.627	0.104
$W_{pl.y}$ [$inch^3$], $W_{pl.z}$ [$inch^3$]	0.747	0.148
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	3.74e+01	3.74e+01
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	7.40e+00	7.40e+00
d_y [inch], d_z [inch]	-1.001	0.000
I_t [$inch^4$], I_w [$inch^6$]	0.000	0.694
$β_y$ [inch], $β_z$ [inch]	0.000	5.866
Picture		

APPLIED LOADS

LOAD PER STUD S5					
Load	**Distr. Load, psf**	**Stud spacing, ft**	**Load width, ft**	**Load, lb or plf**	
Roof Dead Load	17.85	2	12.50	446.25	lb
Roof LL	20	2	12.50	500.00	lb
Roof Wind (up)	23.12	2	12.50	578.00	lb
Wall Wind	16	2		32.00	plf
Roof Wind (down)	8	2	12.50	200.00	lb
Wall Wind	21.04	2		42.08	plf



MAXIMUM FORCES

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
S5	11' 8.000"	LRFD-Ult (auto)/1	**173.00**	**0.00**	186.67	**0.00**	**0.00**	**0.00**
S5	0.000"	LRFD-Ult (auto)/2	-758.82	0.00	**-245.47**	0.00	0.00	0.00
S5	11' 8.000"	LRFD-Ult (auto)/2	-740.00	0.00	**245.47**	0.00	0.00	0.00
S5	5' 10.571"	LRFD-Ult (auto)/2	-749.33	0.00	2.00	0.00	**-715.90**	0.00
S5	0.000"	LRFD-Ult (auto)/3	**-1458.82**	0.00	-122.73	0.00	0.00	**0.00**

Name	Combination key
LRFD-Ult (auto)/1	0.90*Dl1 + 0.90*Dl2 + Wind up
LRFD-Ult (auto)/2	1.20*Dl1 + 1.20*Dl2 + Wind down
LRFD-Ult (auto)/3	1.20*Dl1 + 1.20*Dl2 + 1.60*Lr + 0.50*Wind down

---

Displacement

Load case W, inch:

The maximum deflection for the Exterior wall is 0.212”. According to TABLE 1604.3 the code IBC 2018, maximum member deflection should not exceed - L/360.
L=11’-8”=140”, 140”/360=0.389”. 0.212"< 0.389”. <u>Deflection is OK!</u>

<u>STEEL MEMBER S5 CHECK</u>

AISI S100-16 LRFD Check

Member S5	Cold formed C section (5.500; 1.500; 0.043; 0.062; 0.500)	A913 grade 50	LRFD-Ult (auto)	0.52

Material data		
Yield stress Fy	50.00	ksi
Tensile stress Fu	65.00	ksi
fabrication	cold formed	

The critical check is on position 5.88 ft

Axis definition :
- local x- axis in this code check is referring to the local y axis in Scia Engineer
- local y- axis in this code check is referring to the local z axis in Scia Engineer

Internal forces		
Pu	-999.33	lbf
Vux	0.00	lbf
Vuy	2.00	lbf
Mut	0.00	lbfft
Mux	-715.90	lbfft
Muy	0.00	lbfft

...::Flexural Strength about X-axis::...

Nominal Flexural Strength

According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.395	48.509 41.453	0.85	0.484	150.332	0.568	1.000	0.238 -	- -	-	- -	-
3	1.290	50.000 50.000	1.00	2.858	83.266	0.775	0.924	1.192 -	0.360 0.833	30.83	0.000 0.000	0.238
5	5.290	48.509 -45.980	0.95	22.677	39.282	1.111	0.722	- 3.818	0.967 1.909	-	- -	-
7	1.290	-47.471 -47.471	-	-	-	-	-	- -	- -	-	- -	-
9	0.395	-38.924 -45.980	-	-	-	-	-	- -	- -	-	- -	-

Table of values		
Sxe	0.587	inch ^{3}
Mnxo	2444.18	lbfft
Resistance factor	0.90	
Unity check	0.33	-

Lateral-Torsional Buckling Strength

According to article F2.1 and formula (F2.1-1),(F2.1.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.395	46.800 39.963	0.85	0.484	150.414	0.558	1.000	0.258 -	- -	-	- -	-
3	1.290	48.245 48.245	1.00	2.922	85.106	0.753	0.940	1.213 -	0.397 0.816	31.39	0.000 0.000	0.258
5	5.290	46.800 -44.764	0.96	22.891	39.654	1.086	0.734	- 3.883	0.982 1.942	-	- -	-
7	1.290	-46.209 -46.209	-	-	-	-	-	- -	- -	-	- -	-
9	0.395	-37.927 -44.764	-	-	-	-	-	- -	- -	-	- -	-

Table of values		
Lltb	3' 0.000"	ft
Sigma,ey	64.251	ksi
Kt	1.00	
Lt	3' 0.000"	ft
Sigma,t	69.780	ksi
Cb	1.05	
Sfx	0.627	inch ^{3}
Fcre	105.552	ksi

Fc	48.245	ksi
Scx	0.593	inch ^{3}
Mnx	2385.88	lbfft
Resistance factor	0.90	
Unity check	0.33	-

Distortional Buckling Strength
According to article F4 and formula F4.1-2.

Table of values		
Sfy	0.627	$inch^3$
My	2611.93	lbfft
L	1' 2.500"	ft
Beta	1.08	
k,phi,fe	140.58	lbf
k,phi,we	132.79	lbf
k,phi	0.00	lbf
k,phi,fg	0.004	$inch^2$
k,phi,wg	0.001	$inch^2$
Fd	55.657	ksi
Sf	0.627	$inch^3$
Mcrd	2907.42	lbfft
Lambda,d	0.95	
Mn	2116.08	lbfft
Resistance factor	0.90	
Unity check	0.38	-

Data		
Lm	3' 0.000"	ft
Lcr	1' 2.500"	ft
h0	5.500	inch
Ixf	0.001	$inch^4$
Iyf	0.016	$inch^4$
Ixyf	0.003	$inch^4$
Cwf	0.000	$inch^6$
Jf	0.000	$inch^4$
x0f	0.510	inch
hxf	-0.937	inch
Af	0.078	$inch^2$
y0f	-0.058	inch
Ksi,web	2.00	

Number of compressed flanges: 1
Critical flange contains Initial shape parts: 2, 3, 1

...::Axial Compression Strength::...
Nominal Axial Strength
According to article E2 and formula (E2-1)

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [$inch^4$]	ds [inch]
1	0.395	50.000 50.000	1.00	0.430	133.598	0.612	1.000	0.238 -	- -	-	- -	-
3	1.290	50.000 50.000	1.00	2.858	83.266	0.775	0.924	1.192 -	0.360 0.833	30.83	0.000 0.000	0.238
5	5.290	50.000 50.000	1.00	4.000	6.929	2.686	0.342	1.808 -	- -	-	- -	-
7	1.290	50.000 50.000	1.00	2.858	83.266	0.775	0.924	1.192 -	0.360 0.833	30.83	0.000 0.000	0.238
9	0.395	50.000 50.000	1.00	0.430	133.598	0.612	1.000	0.238 -	- -	-	- -	-

Table of values		
Fn	50.000	ksi
Ae	0.223	$inch^2$
Pno	11164.21	lbf
Resistance factor	0.85	
Unity check	0.11	-

Buckling check
According to article E2 and formula (E2-1)
Flexural Buckling Strength
According to article E2.1 and formula (E2.1-1)

Buckling parameters	xx	yy	
Sway type	sway	sway	
Unbraced Length L	11 3/4	3	ft
Effective Length factor K	1.00	1.00	
Effective Length	11 3/4	3	ft
Slenderness	67.00	66.75	
Flexural Buckling stress Fcre	63.776	64.251	ksi

Torsional (-Flexural) Buckling Strength
According to article E2.2, E2.3, E2.4

Table of values		
Sigma,ex	63.776	ksi
Sigma,ey	64.251	ksi
Kt	1.00	
Lt	3	ft
Sigma,t	69.780	ksi
Sigma,TF	46.841	ksi
Torsional (-Flexural) buckling stress Fcre	46.841	ksi

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.395	31.984 31.984	1.00	0.430	133.598	0.489	1.000	0.395 -	- -	-	- -	-
3	1.290	31.984 31.984	1.00	3.312	96.480	0.576	1.000	1.290 -	0.645 0.645	38.55	0.000 0.000	0.395
5	5.290	31.984 31.984	1.00	4.000	6.929	2.148	0.418	2.210 -	- -	-	- -	-
7	1.290	31.984 31.984	1.00	3.312	96.480	0.576	1.000	1.290 -	0.645 0.645	38.55	0.000 0.000	0.395
9	0.395	31.984 31.984	1.00	0.430	133.598	0.489	1.000	0.395 -	- -	-	- -	-

Table of values		
Fe	46.841	ksi
lambda, c	1.03	
Fn	31.984	ksi
Ae	0.262	inch ^{2}
Pn	8395.09	lbf
Resistance factor	0.85	
Unity check	0.14	-

Distortional Buckling Strength
According to article E4 and formula (E4.1-2).

Table of values		
Py	19741.27	lbf
L	1' 4.036"	ft
k,phi,fe	97.82	lbf
k,phi,we	76.80	lbf
k,phi	0.00	lbf
k,phi,fg	0.004	inch ^{2}
k,phi,wg	0.005	inch ^{2}
Fd	21.491	ksi
Pcrd	8485.06	lbf
Lambda,d	1.53	
Pn	10102.77	lbf
Resistance factor	0.85	
Unity check	0.12	-

Data		
Lm	3' 0.000"	ft
Lcr	1' 4.036"	ft
h0	5.500	inch
Ixf	0.001	inch ^{4}
Iyf	0.016	inch ^{4}
Ixyf	0.003	inch ^{4}
Cwf	0.000	inch ^{6}
Jf	0.000	inch ^{4}
x0f	0.510	inch
hxf	-0.937	inch
Af	0.078	inch ^{2}
y0f	-0.058	inch

Number of compressed flanges: 2
Critical flange contains Initial shape parts: 2, 3, 1

Combined Compressive Axial Load and Bending
According to article H1.2 and formulas (C5.2.1-3)

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch^4]	ds [inch]
1	0.395	2.531 2.531	1.00	0.430	133.598	0.138	1.000	0.395 -	- -	-	- -	-
3	1.290	2.531 2.531	1.00	4.000	116.521	0.147	1.000	1.290 -	0.645 0.645	137.03	- 0.000	0.395
5	5.290	2.531 2.531	1.00	4.000	6.929	0.604	1.000	5.290 -	- -	-	- -	-
7	1.290	2.531 2.531	1.00	4.000	116.521	0.147	1.000	1.290 -	0.645 0.645	137.03	- 0.000	0.395
9	0.395	2.531 2.531	1.00	0.430	133.598	0.138	1.000	0.395 -	- -	-	- -	-

Table of values		
Mnx	2116.08	lbfft
Pn	8395.09	lbf
Resistance factor compression	0.85	
Resistance factor bending x	0.90	

Unity check = 0.14+0.38+0.00 = 0.52 - (C5.2.1-3)

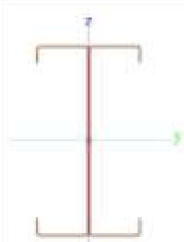
The member satisfies the check !

Unity check

2.3.2.5 EXTERIOR WALL STUD 16’-2” HIGH DESIGN

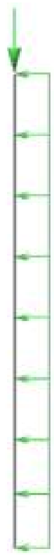
Wall stud spacing - 24”. Stud high - 16’-2’..

Stud Cross-sections properties

CS4		
Type	550S150-43	
Shape type	Thin-walled	
Item material	A913 grade 50	
Fabrication	cold formed	
Colour		
A [inch^2]	0.790	
A_y [inch^2], A_z [inch^2]	0.255	0.474
A_L [inch^2/inch], A_D [inch^2/inch]	2.63e+01	2.63e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	-0.391	0.000
α [deg]	0.00	
I_y [inch^4], I_z [inch^4]	3.448	0.352
i_y [inch], i_z [inch]	2.090	0.667
$W_{el.y}$ [inch^3], $W_{el.z}$ [inch^3]	1.254	0.234
$W_{pl.y}$ [inch^3], $W_{pl.z}$ [inch^3]	1.495	0.310
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	7.47e+01	7.47e+01
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	1.55e+01	1.55e+01
d_y [inch], d_z [inch]	0.000	0.000
I_t [inch^4], I_w [inch^6]	0.001	2.850
$β_y$ [inch], $β_z$ [inch]	0.000	0.000
Picture		

APPLIED LOADS

LOAD PER STUD S6					
Load	**Distr. Load, psf**	**Stud spacing, ft**	**Load width, ft**	**Load, lb or plf**	
Roof Dead Load	17.85	2	2.00	71.40	lb
Roof LL	20	2	2.00	80.00	lb
Roof Wind (up)	23.12	2	2.00	92.48	lb
Wall Wind	16	2		32.00	plf
Roof Wind (down)	8	2	2.00	32.00	lb
Wall Wind	21.04	2		42.08	plf



MAXIMUM FORCES

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
S6	16' 3.000"	LRFD-Ult (auto)/1	**28.20**	**0.00**	260.00	**0.00**	**0.00**	**0.00**
S6	0.000"	LRFD-Ult (auto)/2	-170.83	0.00	**-341.25**	0.00	0.00	0.00
S6	16' 3.000"	LRFD-Ult (auto)/2	-118.40	0.00	**341.25**	0.00	0.00	0.00
S6	8' 2.077"	LRFD-Ult (auto)/2	-144.46	0.00	2.02	0.00	**-1386.28**	0.00
S6	0.000"	LRFD-Ult (auto)/3	**-282.83**	0.00	-170.63	0.00	0.00	**0.00**

Name	Combination key
LRFD-Ult (auto)/1	0.90*Dl1 + 0.90*Dl2 + Wind up
LRFD-Ult (auto)/2	1.20*Dl1 + 1.20*Dl2 + Wind down
LRFD-Ult (auto)/3	1.20*Dl1 + 1.20*Dl2 + 1.60*Lr + 0.50*Wind down

---

Displacement

Load case W, inch:

The maximum deflection for the Exterior wall is 0.397". According to TABLE 1604.3 the code IBC 2018, maximum member deflection should not exceed - L/360.
L=16'-2"=200", 200"/360=0.556". 0.397"< 0.556". Deflection is OK!

STEEL MEMBER S6 CHECK

AISI S100-16 LRFD Check

Member S6	550S150-43	A913 grade 50	LRFD-Ult (auto)	0.31

Material data		
Yield stress Fy	50.00	ksi
Tensile stress Fu	65.00	ksi
fabrication	cold formed	

The critical check is on position 8.17 ft

Axis definition :
- local x- axis in this code check is referring to the local y axis in Scia Engineer
- local y- axis in this code check is referring to the local z axis in Scia Engineer

Internal forces		
Pu	-184.46	lbf
Vux	0.00	lbf
Vuy	2.02	lbf
Mut	0.00	lbfft
Mux	-1386.28	lbfft
Muy	0.00	lbfft

...::Flexural Strength about X-axis::...

Nominal Flexural Strength

According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.479	50.000 41.305	0.83	0.496	104.943	0.690	0.987	0.472 -	- -	-	- -	-
2	1.457	50.000 50.000	1.00	4.000	91.341	0.740	0.950	1.384 -	- -	-	- -	-
3	5.457	50.000 -49.161	0.98	23.567	153.455	0.571	1.000	- 5.457	1.370 2.729	-	- -	-
4	1.457	-49.161 -49.161	-	-	-	-	-	- -	- -	-	- -	-
5	0.478	-40.466 -49.161	-	-	-	-	-	- -	- -	-	- -	-
6	0.478	-40.466 -49.161	-	-	-	-	-	- -	- -	-	- -	-
7	1.457	-49.161 -49.161	-	-	-	-	-	- -	- -	-	- -	-
8	1.457	50.000 50.000	1.00	4.000	91.341	0.740	0.950	1.384 -	- -	-	- -	-
9	0.479	50.000 41.305	0.83	0.496	104.943	0.690	0.987	0.472 -	- -	-	- -	-

Table of values		
Sxe	1.243	inch ^{3}
Mnxo	5180.29	lbfft
Resistance factor	0.90	
Unity check	0.30	-

Lateral-Torsional Buckling Strength

According to article F2.1 and formula (F2.1-1),(F2.1.1-1).

Table of values		
Lltb	3' 0.000"	ft
Sigma,ey	98.364	ksi
Kt	1.00	
Lt	3' 0.000"	ft
Sigma,t	169.527	ksi
Cb	1.01	
Sfx	1.254	inch ^{3}
Fcre	180.023	ksi

Note: Lateral-Torsional buckling is not governing since Fe is greater than or equal to 2.78 Fy.

...::Axial Compression Strength::...

Nominal Axial Strength

According to article E2 and formula (E2-1)

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.479	50.000 50.000	1.00	0.430	91.039	0.741	0.949	0.454 -	- -	-	- -	-
2	1.457	50.000 50.000	1.00	4.000	91.341	0.740	0.950	1.384 -	- -	-	- -	-

3	5.457	50.000 50.000	1.00	4.000	26.046	1.386	0.607	3.313 -	- -	-	- -	-
4	1.457	50.000 50.000	1.00	4.000	91.341	0.740	0.950	1.384 -	- -	-	- -	-
5	0.478	50.000 50.000	1.00	0.430	91.039	0.741	0.949	0.454 -	- -	-	- -	-
6	0.478	50.000 50.000	1.00	0.430	91.039	0.741	0.949	0.454 -	- -	-	- -	-
7	1.457	50.000 50.000	1.00	4.000	91.341	0.740	0.950	1.384 -	- -	-	- -	-
8	1.457	50.000 50.000	1.00	4.000	91.341	0.740	0.950	1.384 -	- -	-	- -	-
9	0.479	50.000 50.000	1.00	0.430	91.039	0.741	0.949	0.454 -	- -	-	- -	-

Table of values		
Fn	50.000	ksi
Ae	0.601	$inch^2$
Pno	30067.90	lbf
Resistance factor	0.85	
Unity check	0.01	-

Buckling check
According to article E2 and formula (E2-1)

Flexural Buckling Strength
According to article E2.1 and formula (E2.1-1)

Buckling parameters	xx	yy	
Sway type	sway	sway	
Unbraced Length L	16 1/4	3	ft
Effective Length factor K	1.00	1.00	
Effective Length	16 1/4	3	ft
Slenderness	93.32	53.95	
Flexural Buckling stress Fcre	32.873	98.364	ksi

Torsional (-Flexural) Buckling Strength
According to article E2.2, E2.3, E2.4

Table of values		
Sigma,ex	32.873	ksi
Sigma,ey	98.364	ksi
Kt	1.00	
Lt	3	ft
Sigma,t	169.527	ksi
Sigma,TF	32.873	ksi
Torsional (-Flexural) buckling stress Fcre	32.873	ksi

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [$inch^4$]	ds [inch]
1	0.479	26.454 26.454	1.00	0.430	91.039	0.539	1.000	0.479 -	- -	-	- -	-
2	1.457	26.454 26.454	1.00	4.000	91.341	0.538	1.000	1.457 -	- -	-	- -	-
3	5.457	26.454 26.454	1.00	4.000	26.046	1.008	0.776	4.233 -	- -	-	- -	-
4	1.457	26.454 26.454	1.00	4.000	91.341	0.538	1.000	1.457 -	- -	-	- -	-
5	0.478	26.454 26.454	1.00	0.430	91.039	0.539	1.000	0.478 -	- -	-	- -	-
6	0.478	26.454 26.454	1.00	0.430	91.039	0.539	1.000	0.478 -	- -	-	- -	-
7	1.457	26.454 26.454	1.00	4.000	91.341	0.538	1.000	1.457 -	- -	-	- -	-
8	1.457	26.454 26.454	1.00	4.000	91.341	0.538	1.000	1.457 -	- -	-	- -	-
9	0.479	26.454 26.454	1.00	0.430	91.039	0.539	1.000	0.479 -	- -	-	- -	-

Table of values		
Fe	32.873	ksi
lambda, c	1.23	
Fn	26.454	ksi
Ae	0.697	$inch^2$
Pn	18445.30	lbf
Resistance factor	0.85	
Unity check	0.01	-

Combined Compressive Axial Load and Bending
According to article H1.2 and formulas (C5.2.1-3)

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [$inch^4$]	ds [inch]
1	0.479	0.234 0.234	1.00	0.430	91.039	0.051	1.000	0.479 -	- -	-	- -	-
2	1.457	0.234 0.234	1.00	4.000	91.341	0.051	1.000	1.457 -	- -	-	- -	-
3	5.457	0.234 0.234	1.00	4.000	26.046	0.095	1.000	5.457 -	- -	-	- -	-
4	1.457	0.234 0.234	1.00	4.000	91.341	0.051	1.000	1.457 -	- -	-	- -	-
5	0.478	0.234 0.234	1.00	0.430	91.039	0.051	1.000	0.478 -	- -	-	- -	-
6	0.478	0.234 0.234	1.00	0.430	91.039	0.051	1.000	0.478 -	- -	-	- -	-
7	1.457	0.234 0.234	1.00	4.000	91.341	0.051	1.000	1.457 -	- -	-	- -	-
8	1.457	0.234 0.234	1.00	4.000	91.341	0.051	1.000	1.457 -	- -	-	- -	-
9	0.479	0.234 0.234	1.00	0.430	91.039	0.051	1.000	0.479 -	- -	-	- -	-

Table of values		
Mnx	5180.29	lbfft
Pn	18445.30	lbf
Resistance factor compression	0.85	
Resistance factor bending x	0.90	

Unity check = 0.01+0.30+0.00 = 0.31 - (C5.2.1-3)

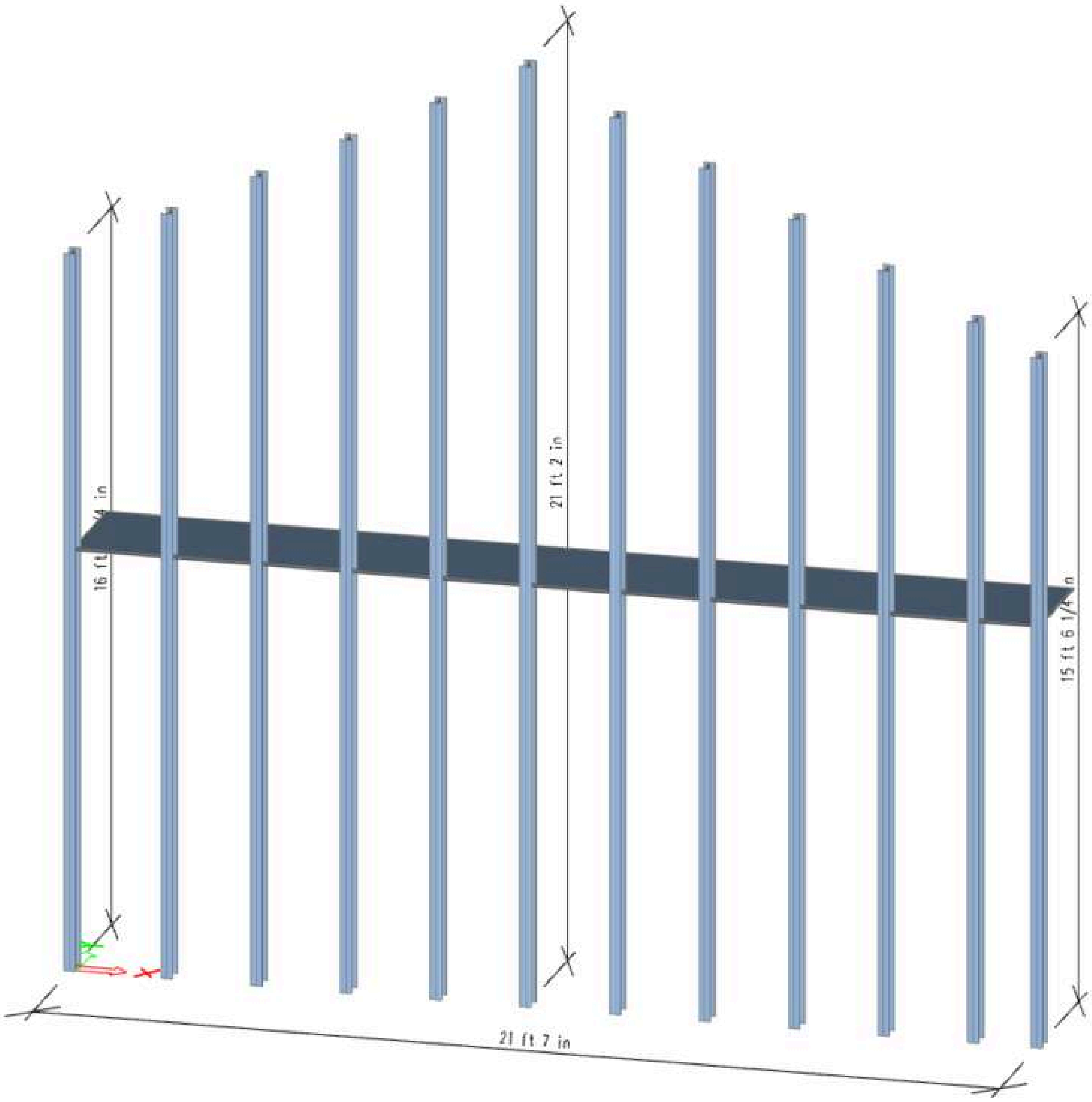
The member satisfies the check !

Unity check

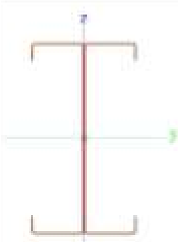
2.3.2.6 EXTERIOR WALL STUDS 21'-2" HIGH DESIGN

Wall stud spacing - 24". Stud high - from 15'-6" to 21'-2'.

General scheme

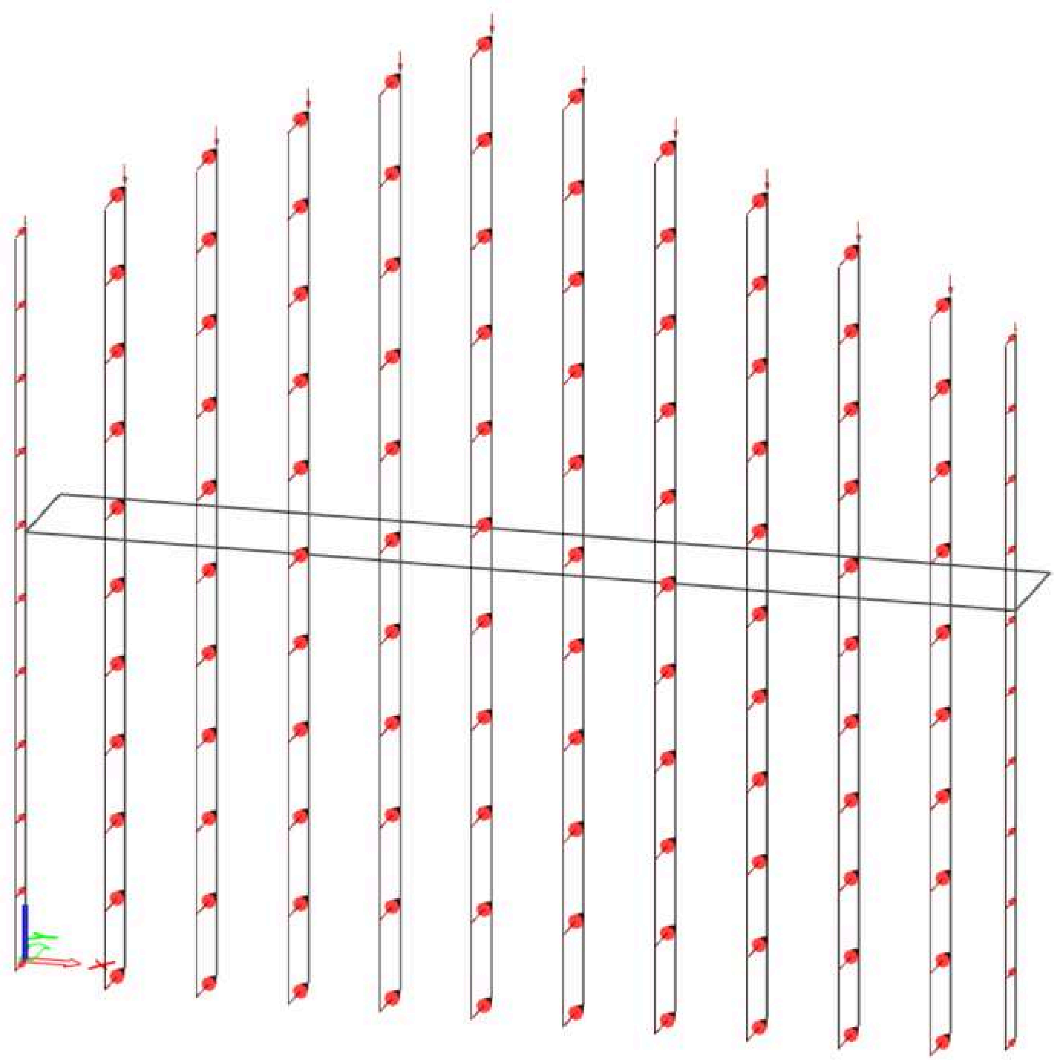


<u>Stud Cross-sections properties</u>

CS4		
Type	550S150-43	
Shape type	Thin-walled	
Item material	A913 grade 50	
Fabrication	cold formed	
Colour		
A [inch^2]	0.790	
A_y [inch^2], A_z [inch^2]	0.255	0.474
A_L [inch^2/inch], A_D [inch^2/inch]	2.63e+01	2.63e+01
$c_{Y.UCS}$ [inch], $c_{Z.UCS}$ [inch]	-0.391	0.000
α [deg]	0.00	
I_y [inch^4], I_z [inch^4]	3.448	0.352
i_y [inch], i_z [inch]	2.090	0.667
$W_{el.y}$ [inch^3], $W_{el.z}$ [inch^3]	1.254	0.234
$W_{pl.y}$ [inch^3], $W_{pl.z}$ [inch^3]	1.495	0.310
$M_{pl.y.+}$ [kipinch], $M_{pl.y.-}$ [kipinch]	7.47e+01	7.47e+01
$M_{pl.z.+}$ [kipinch], $M_{pl.z.-}$ [kipinch]	1.55e+01	1.55e+01
d_y [inch], d_z [inch]	0.000	0.000
I_t [inch^4], I_w [inch^6]	0.001	2.850
$β_y$ [inch], $β_z$ [inch]	0.000	0.000
Picture		

APPLIED LOADS

LOAD PER STUD S7					
Load	Distr. Load, psf	Stud spacing, ft	Load width, ft	Load, lb or plf	
Roof Dead Load	17.85	2	2.00	71.40	lb
Wall Dead Load	16	2		32.00	plf
Roof LL	20	2	2.00	80.00	lb
Roof Wind (up)	23.12	2	2.00	92.48	lb
Wall Wind	16	2		32.00	plf
Roof Wind (down)	8	2	2.00	32.00	lb
Wall Wind	21.04	2		42.08	plf



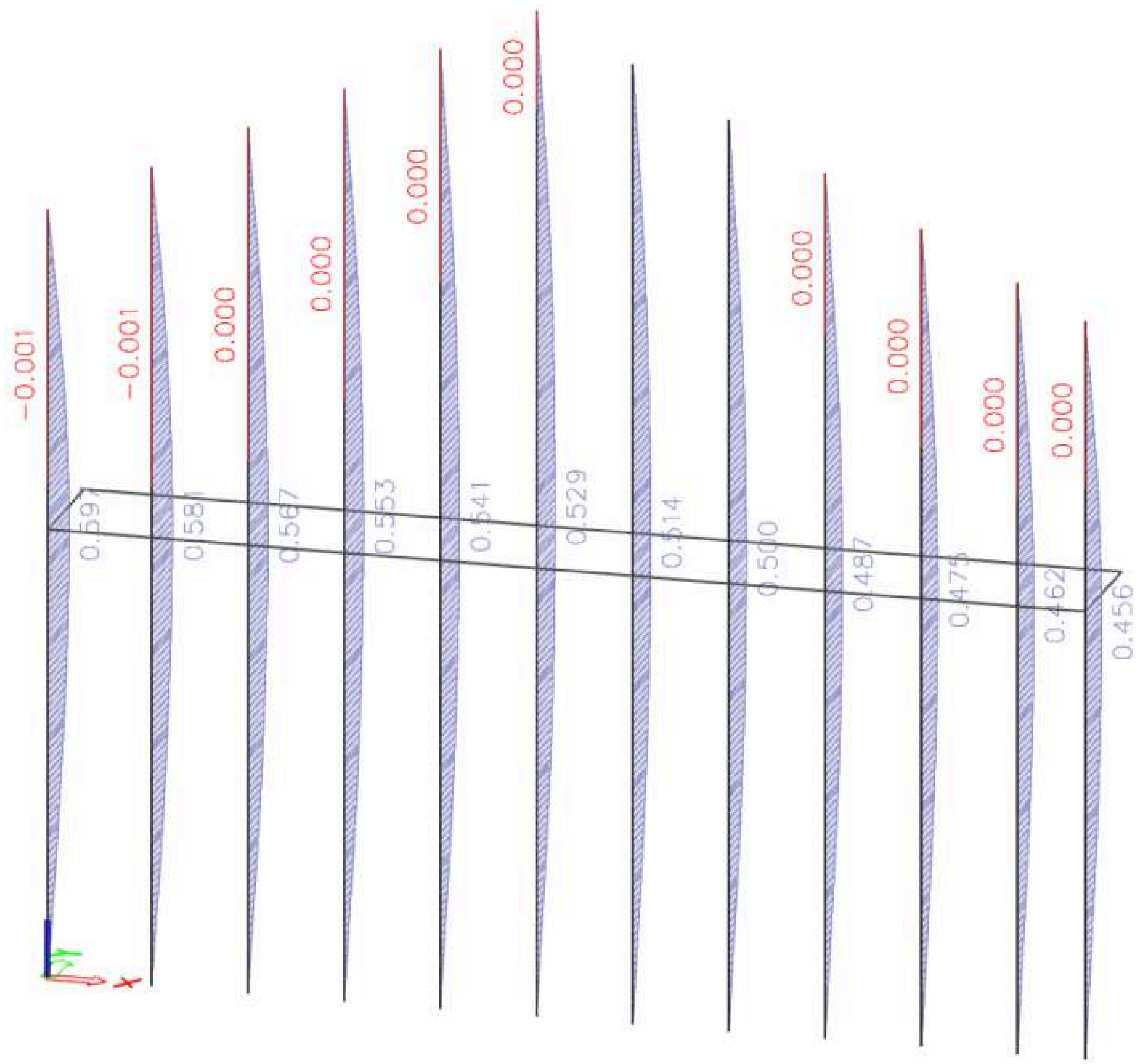
MAXIMUM FORCES

Name	dx [ft]	Case	N [lbf]	V_y [lbf]	V_z [lbf]	M_x [lbfft]	M_y [lbfft]	M_z [lbfft]
S6	0.000"	LRFD-Ult (auto)/1	**-1490.1**	-4.1	-158.1	0.0	0.0	0.0
S6	21' 2.000"	LRFD-Ult (auto)/2	**-8.7**	-0.6	219.8	0.0	0.0	0.0
S11	9' 5.000"+	LRFD-Ult (auto)/3	-476.5	**-56.9**	197.5	0.0	-2315.8	**22.5**
S1	16' 0.000"+	LRFD-Ult (auto)/4	-158.7	**101.4**	-3.3	0.0	0.5	-14.0
S2	0.000"	LRFD-Ult (auto)/3	-1374.9	-3.6	**-362.3**	0.0	0.0	0.0
S1	16' 1.656"	LRFD-Ult (auto)/5	-99.7	19.7	**546.4**	0.0	0.0	0.0
S6	14' 3.692"	LRFD-Ult (auto)/5	-418.6	2.8	0.4	**0.0**	-990.7	-2.3
S12	0.000"	LRFD-Ult (auto)/5	-983.8	-3.5	-268.1	**0.0**	0.0	0.0
S1	9' 5.000"+	LRFD-Ult (auto)/5	-349.5	-29.3	405.2	0.0	**-3197.9**	11.6
S1	9' 5.000"+	LRFD-Ult (auto)/6	-730.2	-2.6	-3.5	0.0	**23.4**	-2.9
S3	18' 0.000"-	LRFD-Ult (auto)/6	-340.6	-10.1	-1.2	0.0	0.2	**-14.1**

Name	Combination key
LRFD-Ult (auto)/1	1.20*DL1 + 1.60*Lr + 1.20*DL3 + 1.20*DL2 + 0.50*Wind (down)
LRFD-Ult (auto)/2	0.90*DL1 + 0.90*DL3 + 0.90*DL2 + Wind (up)
LRFD-Ult (auto)/3	1.20*DL1 + 0.50*Lr + 1.20*DL3 + 1.20*DL2 + Wind (down)
LRFD-Ult (auto)/4	1.40*DL1 + 1.40*DL3 + 1.40*DL2
LRFD-Ult (auto)/5	0.90*DL1 + 0.90*DL3 + 0.90*DL2 + Wind (down)
LRFD-Ult (auto)/6	1.20*DL1 + 1.60*Lr + 1.20*DL3 + 1.20*DL2

Displacement

Load case W, inch:



The maximum deflection for the Exterior wall is 0.530”. According to TABLE 1604.3 the code IBC 2018, maximum member deflection should not exceed - L/360.
L=21’-2”=254”, 254”/360=0.705”. 0.530"< 0.705”. <u>Deflection is OK!</u>

STEEL MEMBER S6 CHECK

AISI S100-16 LRFD Check

Member S6	550S150-43	A913 grade 50	LRFD-Ult (auto)	0.30

Material data		
Yield stress Fy	50.00	ksi
Tensile stress Fu	65.00	ksi
fabrication	cold formed	

The critical check is on position 8.00 ft

Axis definition :
- local x- axis in this code check is referring to the local y axis in Scia Engineer
- local y- axis in this code check is referring to the local z axis in Scia Engineer

Internal forces		
Pu	-918.68	lbf
Vux	8.84	lbf
Vuy	20.75	lbf
Mut	0.01	lbfft
Mux	-1178.03	lbfft
Muy	8.90	lbfft

...::Flexural Strength about X-axis::...
Nominal Flexural Strength
According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch⁴]	ds [inch]
1	0.479	50.0 41.3	0.83	0.496	104.9	0.690	0.987	0.472 -	- -	-	- -	-
2	1.457	50.0 50.0	1.00	4.000	91.3	0.740	0.950	1.384 -	- -	-	- -	-
3	5.457	50.0 -49.2	0.98	23.567	153.5	0.571	1.000	- 5.457	1.370 2.728	-	- -	-
4	1.457	-49.2 -49.2	-	-	-	-	-	- -	- -	-	- -	-
5	0.478	-40.5 -49.2	-	-	-	-	-	- -	- -	-	- -	-
6	0.478	-40.5 -49.2	-	-	-	-	-	- -	- -	-	- -	-
7	1.457	-49.2 -49.2	-	-	-	-	-	- -	- -	-	- -	-
8	1.457	50.0 50.0	1.00	4.000	91.3	0.740	0.950	- 1.384	0.692 0.692	-	- -	-
9	0.478	50.0 41.3	0.83	0.496	104.9	0.690	0.987	0.472 -	- -	-	- -	-

Table of values		
Sxe	1.242	$inch^3$
Mnxo	5175.1	lbfft
Resistance factor	0.90	
Unity check	0.25	-

Lateral-Torsional Buckling Strength
According to article F2.1 and formula (F2.1-1),(F2.1.1-1).

Table of values		
Lltb	2' 0.000"	ft
Sigma,ey	221.1	ksi
Kt	1.00	
Lt	2' 0.000"	ft
Sigma,t	392.6	ksi
Cb	1.01	
Sfx	1.252	$inch^3$
Fcre	409.5	ksi

Note: Lateral-Torsional buckling is not governing since Fe is greater than or equal to 2.78 Fy.

...::Flexural Strength about Y-axis::...

Nominal Flexural Strength
According to article F3.1 and formula (F3.1-1).

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [$inch^4$]	ds [inch]
1	0.479	50.0 50.0	1.00	0.430	91.0	0.741	0.949	0.454 -	- -	-	- -	-
2	1.457	50.0 0.7	0.01	7.885	180.1	0.527	1.000	- 1.457	0.488 0.969	-	- -	-
3	5.457	- -	-	8.000	52.1	-	1.000	- 5.457	1.819 3.638	-	- -	-
4	1.457	50.0 0.7	0.01	7.885	180.1	0.527	1.000	- 1.457	0.488 0.969	-	- -	-
5	0.478	50.0 50.0	1.00	0.430	91.0	0.741	0.949	0.454 -	- -	-	- -	-
6	0.478	-50.0 -50.0	-	-	-	-	-	- -	- -	-	- -	-
7	1.457	-0.7 -50.0	-	-	-	-	-	- -	- -	-	- -	-
8	1.457	-0.7 -50.0	-	-	-	-	-	- -	- -	-	- -	-
9	0.478	-50.0 -50.0	-	-	-	-	-	- -	- -	-	- -	-

Table of values		
Sye	0.233	$inch^3$
Mnyo	972.8	lbfft
Resistance factor	0.90	
Unity check	0.01	-

Lateral-Torsional Buckling Strength
According to article F2.1 and formula (F2.1-1),(F2.1.1-1).

Table of values		
Sigma,ex	97.9	ksi
Kt	1.00	
Lt	2' 0.000"	ft
Sigma,t	392.6	ksi
Cb	1.00	
Sfy	0.234	$inch^3$
Fcre	1449.3	ksi

Note: Lateral-Torsional buckling is not governing since Fe is greater than or equal to 2.78 Fy.

...::Axial Compression Strength::...

Nominal Axial Strength

According to article E2 and formula (E2-1)

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch^4]	ds [inch]
1	0.479	50.0 50.0	1.00	0.430	91.0	0.741	0.949	0.454 -	- -	-	- -	-
2	1.457	50.0 50.0	1.00	4.000	91.3	0.740	0.950	1.384 -	- -	-	- -	-
3	5.457	50.0 50.0	1.00	4.000	26.0	1.386	0.607	3.313 -	- -	-	- -	-
4	1.457	50.0 50.0	1.00	4.000	91.3	0.740	0.950	1.384 -	- -	-	- -	-
5	0.478	50.0 50.0	1.00	0.430	91.0	0.741	0.949	0.454 -	- -	-	- -	-
6	0.478	50.0 50.0	1.00	0.430	91.0	0.741	0.949	0.454 -	- -	-	- -	-
7	1.457	50.0 50.0	1.00	4.000	91.3	0.740	0.950	1.384 -	- -	-	- -	-
8	1.457	50.0 50.0	1.00	4.000	91.3	0.740	0.950	1.384 -	- -	-	- -	-
9	0.478	50.0 50.0	1.00	0.430	91.0	0.741	0.949	0.454 -	- -	-	- -	-

Table of values		
Fn	50.0	ksi
Ae	0.601	inch^2
Pno	30067.9	lbf
Resistance factor	0.85	
Unity check	0.04	-

Buckling check

According to article E2 and formula (E2-1)

Flexural Buckling Strength

According to article E2.1 and formula (E2.1-1)

Buckling parameters	xx	yy	
Sway type	sway	sway	
Unbraced Length L	9 1/2	2	ft
Effective Length factor K	1.00	1.00	
Effective Length	9 1/2	2	ft
Slenderness	54.09	35.98	
Flexural Buckling stress Fcre	97.9	221.1	ksi

Torsional (-Flexural) Buckling Strength

According to article E2.2, E2.3, E2.4

Table of values		
Sigma,ex	97.9	ksi
Sigma,ey	221.1	ksi
Kt	1.00	
Lt	2	ft
Sigma,t	392.6	ksi
Sigma,TF	97.9	ksi
Torsional (-Flexural) buckling stress Fcre	97.9	ksi

Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.479	40.4 40.4	1.00	0.430	91.0	0.666	1.000	0.479 -	- -	-	- -	-
2	1.457	40.4 40.4	1.00	4.000	91.3	0.665	1.000	1.457 -	- -	-	- -	-
3	5.457	40.4 40.4	1.00	4.000	26.0	1.245	0.661	3.609 -	- -	-	- -	-
4	1.457	40.4 40.4	1.00	4.000	91.3	0.665	1.000	1.457 -	- -	-	- -	-
5	0.478	40.4 40.4	1.00	0.430	91.0	0.666	1.000	0.478 -	- -	-	- -	-
6	0.478	40.4 40.4	1.00	0.430	91.0	0.666	1.000	0.478 -	- -	-	- -	-
7	1.457	40.4 40.4	1.00	4.000	91.3	0.665	1.000	1.457 -	- -	-	- -	-
8	1.457	40.4 40.4	1.00	4.000	91.3	0.665	1.000	1.457 -	- -	-	- -	-
9	0.478	40.4 40.4	1.00	0.430	91.0	0.666	1.000	0.478 -	- -	-	- -	-

Table of values		
Fe	97.9	ksi
lambda, c	0.71	
Fn	40.4	ksi
Ae	0.644	inch ^{2}
Pn	25983.1	lbf
Resistance factor	0.85	
Unity check	0.04	-

Combined Compressive Axial Load and Bending
According to article H1.2 and formulas (C5.2.1-3)

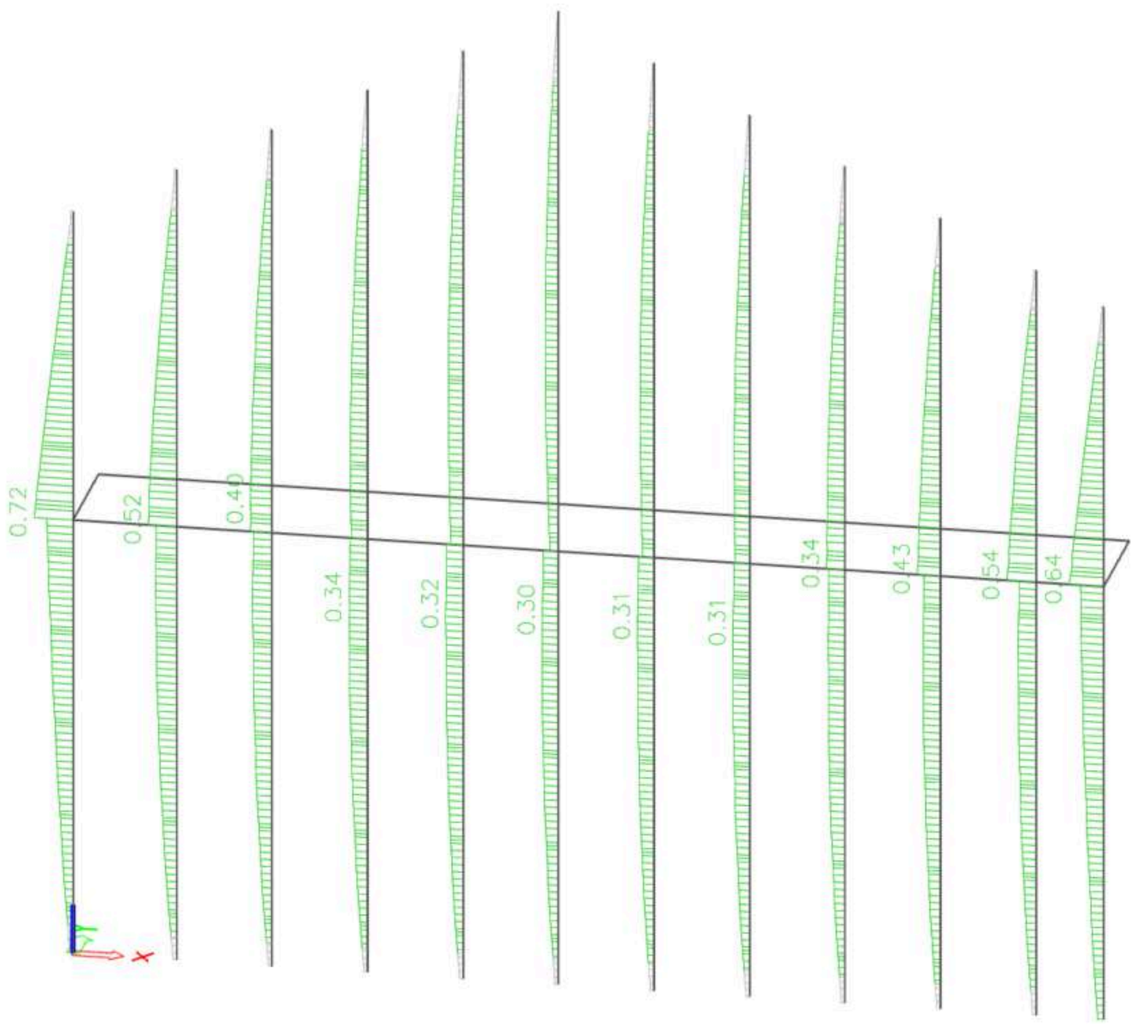
Id	w [inch]	f1 f2 [ksi]	psi [-]	k [-]	Fcr [ksi]	lambda [-]	rho [-]	b be [inch]	b1 b2 [inch]	S [-]	Ia Is [inch ^{4}]	ds [inch]
1	0.479	1.2 1.2	1.00	0.430	91.0	0.113	1.000	0.479 -	- -	-	- -	-
2	1.457	1.2 1.2	1.00	4.000	91.3	0.113	1.000	1.457 -	- -	-	- -	-
3	5.457	1.2 1.2	1.00	4.000	26.0	0.211	1.000	5.457 -	- -	-	- -	-
4	1.457	1.2 1.2	1.00	4.000	91.3	0.113	1.000	1.457 -	- -	-	- -	-
5	0.478	1.2 1.2	1.00	0.430	91.0	0.113	1.000	0.478 -	- -	-	- -	-
6	0.478	1.2 1.2	1.00	0.430	91.0	0.113	1.000	0.478 -	- -	-	- -	-
7	1.457	1.2 1.2	1.00	4.000	91.3	0.113	1.000	1.457 -	- -	-	- -	-
8	1.457	1.2 1.2	1.00	4.000	91.3	0.113	1.000	1.457 -	- -	-	- -	-
9	0.478	1.2 1.2	1.00	0.430	91.0	0.113	1.000	0.478 -	- -	-	- -	-

Table of values		
Mnx	5175.1	lbfft
Mny	972.8	lbfft
Pn	25983.1	lbf
Resistance factor compression	0.85	
Resistance factor bending x	0.90	
Resistance factor bending y	0.90	

Unity check = 0.04+0.25+0.01 = 0.30 - (C5.2.1-3)

The member satisfies the check !

Unity check



2.4 LATERAL ANALYSIS
2.4.1 BUILDING SEISMIC WEIGHT

Building Seismic Weight					
Type of constr.	h or w, ft	L, ft	Area, ft2	Weight, psf	Weight, kip
Roof	47.00	47.83	2248.17	17.85	40.13
	48.83	12.50	610.42	17.85	10.90
	48.83	12.50	610.42	17.85	10.90
	69.25	17.00	1177.25	17.85	21.01
	69.25	17.00	1177.25	17.85	21.01
	35.75	41.75	1492.56	22.85	34.11
	24.33	24.92	606.31	22.85	13.85
				Total roof seismic weight:	**151.91**
Exterior LGS wall	16.5	10.0	165.0	22.34	3.69
	66	10.0	660.0	22.34	14.74
	36	10.0	360.0	22.34	8.04
	46.5	10.0	465.0	22.34	10.39
	19.6	10.0	196.0	22.34	4.38
	12	10.0	120.0	22.34	2.68
	19.6	10.0	196.0	22.34	4.38
	48.83	11.6	565.7	22.34	12.64
	48.83	11.6	565.7	22.34	12.64
	42	10.0	420.0	22.34	9.38
	41	10.0	410.0	22.34	9.16
	43	10.0	430.0	22.34	9.61
				Total wall seismic weight:	**101.72**
				Total seismic weight:	**253.63**

2.4.2 SEISMIC BASE SHEAR FORCES ANALYSIS (ASCE 7-16)
2.4.2.1 SEISMIC BASE SHEAR FORCES, EQUIVALENT LATERAL FORCE ANALYSIS

Site parameters

Design Spectral Response Acceleration at 0.2 sec S_{DS} = **0.192**

Design Spectral Response Acceleration at 1.0 sec S_{D1} = **0.094**

Seismic Design Category **B**

Seismic occupancy category **II**

Approximate fundamental period

Top of wall hn = **12** ft

Structure type; All other systems

Building period parameter Ct; Ct = **0.028**

Building period parameter x; x= **0.75**

Approximate fundamental period (Eq 12.8-7); $T_a = C_t((h_n)^X) \times 1sec / (1ft)$= **0.1805** sec

Building fundamental period (Sect 12.8.2); $T = T_a$ = **0.181** sec

Long-period transition period; TL = **12** sec

Seismic response coefficient

Seismic force-resisting system (A-16 per Table 12.2-1 ASCE7);

Light-frame (cold-formed steel) walls sheathed with wood structural panels rated for shear resistance or steel sheets

Response modification factor; R = **6.5**

Seismic importance factor; I_e = **1**

Seismic response coefficient (Sect 12.8.1.1)

Calculated (Eq 12.8-3); $C_{s\_calc} = S_{DS} / (R / I_e)$ = **0.0295**

Maximum ((Eq 12.8-3)); $C_{s\_max} = S_{D1} / ((T / 1\ sec) \times (R / I_e))$ = **0.0801**

Minimum: (Eq 9.5.5.2.1-3)

$C_{s\_min1} = \max(0.044 \times S_{DS} \times I_e, 0.01)$ = **0.010**

Seismic response coefficient; C_s = **0.030**

Seismic base shear (Sect 12.8.1)

Effective seismic weight of the structure W = **253.63** kips

Seismic response coefficient; C_s = **0.0295**

Seismic base shear (Eq 12.8-1); $V = C_s \times W$ = **7.49** kips

2.4.2.2 WIND BASE SHEAR FORCES

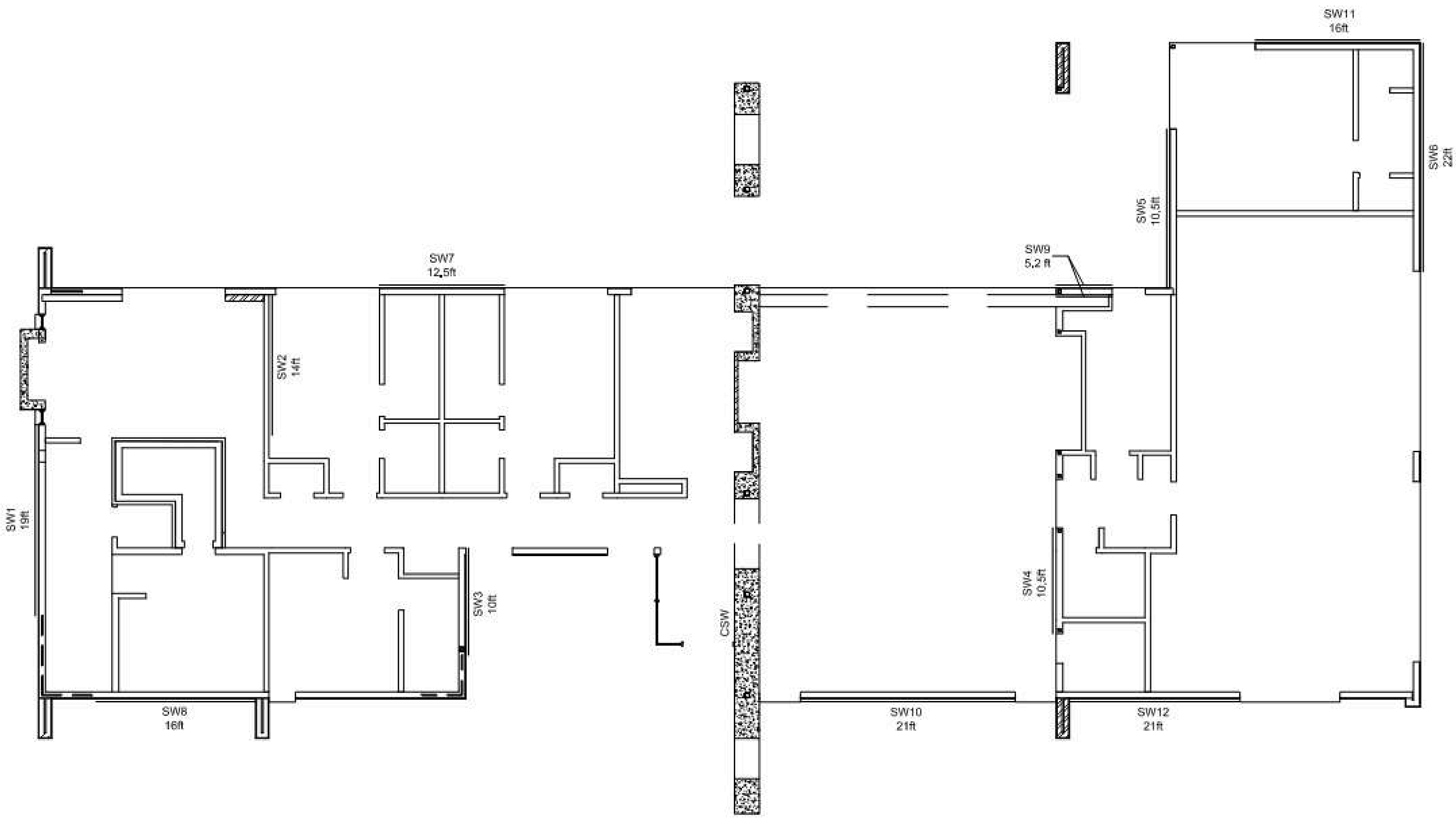
Direction	Surface type	Wind pressure on surface, psf	Wind load height, ft	Wind liner load, plf	Wind load weight, ft	Wind load per surface type, lbs	Total wind base shear, lbs
Transverse	Wall	27.5	9	247.50	22.75	5630.63	29489.17
	Wall	27.5	6	165.00	19.50	3217.50	
	Wall	27.5	6	165.00	28.50	4702.50	
	Wall	27.5	11.33	311.58	31.25	9736.72	
	Wall	27.5	6.25	171.88	11.42	1962.24	
	Wall	27.5	6.25	171.88	24.67	4239.58	
Longitudinal	Wall	27.5	6	165.00	24.50	4042.50	33432.37
	Roof	8	12.5	38.46	24.50	942.31	
	Roof	8.5	12.5	40.87	24.50	1001.21	
	Wall	27.5	6	165.00	24.50	4042.50	
	Roof	8	12.5	38.46	24.50	942.31	
	Roof	8.5	12.5	40.87	24.50	1001.21	
	Roof	23.9	18.83	173.12	24.50	4241.51	
	Wall	27.5	2	55.00	45.00	2475.00	
	Roof	8	18.83	57.95	45.00	2607.71	
	Roof	8.5	18.83	61.57	45.00	2770.69	
	Wall	27.5	5	137.50	32.63	4485.94	
	Roof	8	36.00	6.03	32.63	196.77	
	Wall	27.5	5	137.50	32.63	4485.94	
	Roof	8	36.00	6.03	32.63	196.77	

Total wind shear:

Transverse direction wind base shear	**33.43 kip**
Longitudinal direction base shear	**29.49 kip**
Seismic base shear	**7.49 kip**

According to the calculation results, wind actions affect the calculation in longitudinal and transverse directions.

2.4.3 SHEAR WALL ANALYSIS AND DESIGN



Shear wall location

2.4.3.1 SHEAR WALL FORCES ANALYSIS DESIGN

Shear wall mark	Surface type	Wind pressure on wall, psf	Wind load height, ft	Wind liner load, plf	Wind load weight, ft	Wind load per zone, lbs	Total wind load per shear wall, lbs	Shear wall length, ft	Shear wall height, ft	Aspect ratio, h/b<2	Shear wall material	Number of shear panel	Holdown uplift force, lbs	Holdown	Stud member thick. Mil	Stud Faste-ners	Anchor bolt diameter, in	Anchor bolt note
SW1	Wall	27.5	9	247.50	11.38	2815.31	2815.31	16	11.6	0.73	1/2" OSB	1	2041	S/HDU4	43	(6) #14	5/8"	5/8-DIA F1554 GR36 WITH SIMPSON EPOXY ADHESIVE "SET-3G". MIN 4" EMBEDMENT
SW2	Wall	27.5	9	247.50	11.38	2815.31	4424.06	14	11.6	0.83	1/2" OSB	1	3666	S/HDU6	43	(12) #14	5/8"	5/8-DIA F1554 GR36 WITH SIMPSON EPOXY ADHESIVE "SET-3G". MIN 6" EMBEDMENT
	Wall	27.5	6	165.00	9.75	1608.75												
SW3	Wall	27.5	6	165.00	9.75	1608.75	3960.00	10.5	10	0.95	1/2" OSB	1	3771	S/HDU6	43	(12) #14	5/8"	5/8-DIA F1554 GR36 WITH SIMPSON EPOXY ADHESIVE "SET-3G". MIN 6" EMBEDMENT
	Wall	27.5	6	165.00	14.25	2351.25												
CSW	Wall	27.5	6	165.00	14.25	2351.25	7219.61	-			CONCRETE	-	-	-				
	Wall	27.5	11.33	311.58	15.63	4868.36												
SW4	Wall	27.5	11.33	311.58	15.63	4868.36	5849.48	10	15.7	1.57	1/2" OSB	1	9184	S/HDU6	(2) x 43	(12) #14	5/8"	5/8-DIA F1554 GR36 WITH SIMPSON EPOXY ADHESIVE "SET-3G". MIN 10" EMBEDMENT
	Wall	27.5	6.25	171.88	5.71	981.12												
SW5	Wall	27.5	6.25	171.88	5.71	981.12	3100.91	15	10	0.67	1/2" OSB	1	2067	S/HDU4	43	(6) #14	5/8"	5/8-DIA F1554 GR36 WITH SIMPSON EPOXY ADHESIVE "SET-3G". MIN 4" EMBEDMENT
	Wall	27.5	6.25	171.88	12.33	2119.79												
SW6	Wall	27.5	6.25	171.88	12.33	2119.79	2119.79	22	10	0.45	1/2" OSB	1	964	S/HDU4	43	(6) #14	5/8"	5/8-DIA F1554 GR36 WITH SIMPSON EPOXY ADHESIVE "SET-3G". MIN 4" EMBEDMENT
SW7	Wall	27.5	6	165.00	24.50	4042.50	5986.02	12.5	10.0	0.80	1/2" OSB	1	4789	S/HDU6	43	(12) #14	5/8"	5/8-DIA F1554 GR36 WITH SIMPSON EPOXY ADHESIVE "SET-3G". MIN 6" EMBEDMENT
	Roof	8	12.5	38.46	24.50	942.31												
	Roof	8.5	12.5	40.87	24.50	1001.21												
SW8	Wall	27.5	6	165.00	24.50	4042.50	5986.02	17	13.8	0.81	1/2" OSB	1	4856	S/HDU6	43	(12) #14	5/8"	5/8-DIA F1554 GR36 WITH SIMPSON EPOXY ADHESIVE "SET-3G". MIN 6" EMBEDMENT
	Roof	8	12.5	38.46	24.50	942.31												
	Roof	8.5	12.5	40.87	24.50	1001.21												
SW9	Wall	27.5	2	55.00	22.50	1237.50	4736.38	5.17	10.0	1.94	1/2" OSB	2	9167	S/HDU6	(2) x 43	(12) #14	5/8"	5/8-DIA F1554 GR36 WITH SIMPSON EPOXY ADHESIVE "SET-3G". MIN 10" EMBEDMENT
	Roof	8.5	18.83	61.57	22.50	1385.34												
	Roof	23.9	18.83	173.12	12.21	2113.54												
SW10	Wall	27.5	2	55.00	22.50	1237.50	3926.70	21	16.0	0.76	1/2" OSB	1	2992	S/HDU6	43	(12) #14	5/8"	5/8-DIA F1554 GR36 WITH SIMPSON EPOXY ADHESIVE "SET-3G". MIN 6" EMBEDMENT
	Roof	8	18.83	57.95	22.50	1303.85												
	Roof	8.5	18.83	61.57	22.50	1385.34												
SW11	Wall	27.5	5	137.50	32.63	4485.94	4682.71	16	10.0	0.63	1/2" OSB	1	2927	S/HDU6	43	(12) #14	5/8"	5/8-DIA F1554 GR36 WITH SIMPSON EPOXY ADHESIVE "SET-3G". MIN 6" EMBEDMENT
	Roof	8	36.00	6.03	32.63	196.77												
SW12	Wall	27.5	5	137.50	32.63	4485.94	4682.71	21	10.0	0.48	1/2" OSB	1	2230	S/HDU4	43	(6) #14	5/8"	5/8-DIA F1554 GR36 WITH SIMPSON EPOXY ADHESIVE "SET-3G". MIN 4" EMBEDMENT
	Roof	8	36.00	6.03	32.63	196.77												

2.4.3.2 SHEAR WALL DESIGN

The report shows the most loaded shear walls

SW4 - SHEAR WALL DESIGN

Panel details			Loading details		
1/2" OSB Structural Sheathing			Shear wind load, W		
Panel height, H;	**15.70**	ft	W =	**5850.00**	lbs
Panel length, L;	**10.00**	ft			

Design criteria **V < ϕvVn**

From AISI240 table B5.2.2.3-2 **Fastener Spacing at Panel Edges/Field (inches) 6/12**

In AISI240 there is no nominal shear value for 1/2" OSB, we take the calculated shear value for 7/16" OSB as the calculated shear value.

Nominal unit shear capacity for wind design	Vn =	**910**	lb/ft
LRFD design	for LRFD ϕv =	**0.65**	
Available Strength capacity for wind design	ϕvVn =	**591.5**	lb/ft

From AISI240 table B5.2.2.3-2, Maximum Shear Wall Aspect Ratios

Maximum shear wall aspect ratio H/B;		**2.0**	
Shear wall aspect ratio H/B;		**1.57**	
The unit shear force, V = W/L, (Eq. B5.2.4-2]	**V =**	**585.0**	lb/ft

W = Shear force determined in accordance with applicable ASD, LRFD

L = Length of shear wall, ft

585.0 lb/ft < **591.5** lb/ft **PASS!**

SW9 - SHEAR WALL DESIGN

Panel details			Loading details			# of shear panel	Shear wind load per panel, W	
1/2" OSB Structural Sheathing			Shear wind load, W					
Panel height, H;	**10.00**	ft	W =	**4737.00**	lbs	2	**2368.50**	lbs
Panel length, L;	**5.17**	ft						

Design criteria	**V < ϕvVn**				
From AISI240 table B5.2.2.3-2	**Fastener Spacing at Panel Edges/Field (inches) 6/12**				

In AISI240 there is no nominal shear value for 1/2" OSB, we take the calculated shear value for 7/16" OSB as the calculated shear value.

Nominal unit shear capacity for wind design	Vn =	**910**	lb/ft	
LRFD design	for LRFD ϕv =	**0.65**		
Available Strength capacity for wind design	ϕvVn =	**591.5**	lb/ft	

From AISI240 table B5.2.2.3-2, Maximum Shear Wall Aspect Ratios

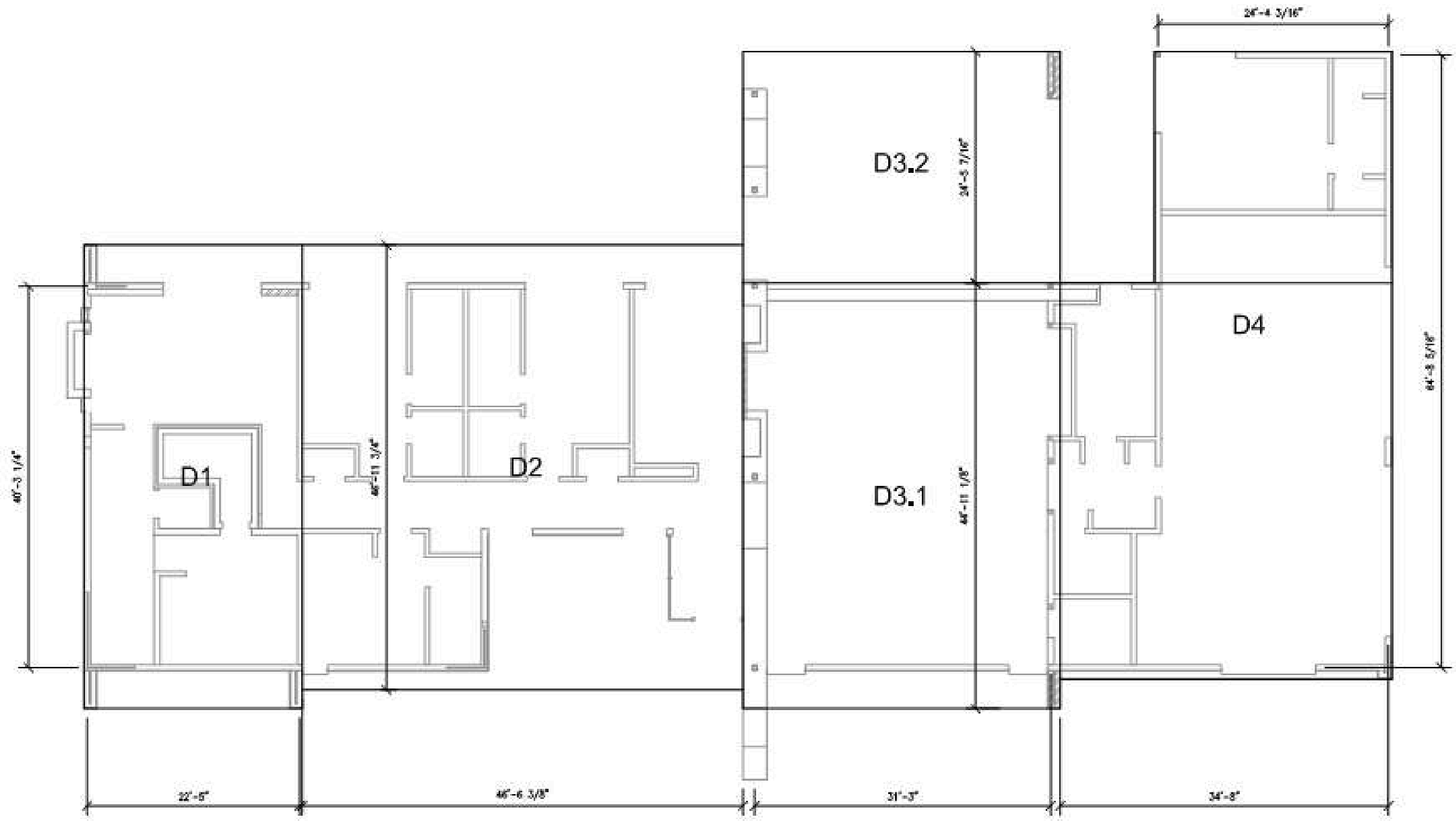
Maximum shear wall aspect ratio H/B;		**2.0**	
Shear wall aspect ratio H/B;		**1.94**	
The unit shear force, V = W/L, (Eq. B5.2.4-2)	**V =**	**458.4**	lb/ft

W = Shear force determined in accordance with applicable ASD, LRFD

L = Length of shear wall, ft

458.4	lb/ft	<	**591.5**	lb/ft	**PASS!**

2.4.4 DIAPHRAGM DESIGN
2.4.4.1 ROOF DIAPHRAGM DESIGN ANALYSIS



ROOF DIAPHRAGM LOCATIONS

2.4.4.2 ROOF DIAPHRAGM FORCES ANALYSIS DESIGN

Shear wall mark	Direction	Surface type	Wind pressure on wall, psf	Wind load height, ft	Wind liner load, plf	Total wind liner load, plf
D1	Transverse	Wall	27.5	9	247.50	**247.50**
	Longitudinal	Wall	27.5	6	165.00	**244.33**
		Roof	8	12.5	38.46	
		Roof	8.5	12.5	40.87	
D2	Transverse		27.5	6	165.00	**165.00**
	Longitudinal	Wall	27.5	6	165.00	**244.33**
		Roof	8	12.5	38.46	
		Roof	8.5	12.5	40.87	
D3.1	Transverse	Wall	27.5	11.33	311.58	**311.58**
	Longitudinal	Wall	27.5	2	55.00	**174.52**
		Roof	8	18.83	57.95	
		Roof	8.5	18.83	61.57	
D3.2	Longitudinal	Roof	23.9	18.83	173.12	**234.69**
		Roof	8.5	18.83	61.57	
D4	Transverse	Wall	27.5	6.25	171.88	**171.88**
	Longitudinal	Wall	27.5	5	137.50	**143.53**
		Roof	8	36.00	6.03	

2.4.4.3 ROOF DIAPHRAGM DESIGN

D1 - ROOF DIAPHRAGM DESIGN

Diaphragm Dimensions

Diaphragm Length	L =	**40.25**	ft
Diaphragm Width	B =	**22.50**	ft
Distributed linear load in transverse directio	Wt =	**247.50**	lb/ft
Distributed linear load in longitudinal directi	W_L =	**244.33**	lb/ft

15/32" OSB Sheathing (per AISI240 Table B5.4.2-1 Unblocked Wood Structural Panel Diaphragms)

Fastener Spacing Edge/Field - 6/12

Nominal shear capacity for wind design	Vn =	**615**	lb/ft

The design factors for wind Design	LRFD ϕv =	**0.65**	**(AISI240 Section B5.4.3)**	
Design shear capacity for wind design	ϕv Vnw =	**399.75**	lb/ft	

Design criteria **$V < \phi v V_n$**

<u>The maximum diaphragm wind shear in the roof diaphragm is:</u>

Transverse direction	$V_t = (W_t * B) / 2L$ =	**69.18**	lb/ft
Longitudinal direction	$V_L = (W_L * L) / 2B$ =	**218.54**	lb/ft

<u>Shear capacity for wind loading:</u>

$\max(V_t; V_L) \leq \phi v$ Vnw				**218.54**	lb/ft	
	218.54	lb/ft	<	**399.75**	lb/ft	**PASS!**

D2 - ROOF DIAPHRAGM DESIGN

<u>Diaphragm Dimensions</u>

Diaphragm Length	L =	**46.92**	ft
Diaphragm Width	B =	**46.50**	ft
Distributed linear load in transverse directio	Wt =	**165.00**	lb/ft
Distributed linear load in longitudinal directi	W_L =	**244.33**	lb/ft

15/32" OSB Sheathing (per AISI240 Table B5.4.2-1 Unblocked Wood Structural Panel Diaphragms)

Fastener Spacing Edge/Field - 6/12

Nominal shear capacity for wind design	Vn =	**615**	lb/ft
The design factors for wind Design	LRFD ϕv =	**0.65**	**(AISI240 Section B5.4.3)**
Design shear capacity for wind design	ϕv Vnw =	**399.75**	lb/ft

Design criteria **$V < \phi v V_n$**

<u>The maximum diaphragm wind shear in the roof diaphragm is:</u>

Transverse direction	$V_t = (W_t * B) / 2L$ =	**81.77**	lb/ft
Longitudinal direction	$V_L = (W_L * L) / 2B$ =	**123.26**	lb/ft

<u>Shear capacity for wind loading:</u>

$\max(V_t; V_L) \leq \phi v$ Vnw				**123.26**	lb/ft	
	123.26	lb/ft	<	**399.75**	lb/ft	**PASS!**

D3.1 - ROOF DIAPHRAGM DESIGN

Diaphragm Dimensions

Diaphragm Length	L =	**40.58**	ft
Diaphragm Width	B =	**31.25**	ft
Distributed linear load in transverse directio	Wt =	**311.58**	lb/ft
Distributed linear load in longitudinal directi	W_L =	**174.52**	lb/ft

15/32" OSB Sheathing (per AISI240 Table B5.4.2-1 Unblocked Wood Structural Panel Diaphragms)

Fastener Spacing Edge/Field - 6/12

Nominal shear capacity for wind design	Vn =	**615**	lb/ft
The design factors for wind Design	LRFD ϕv =	**0.65**	**(AISI240 Section B5.4.3)**
Design shear capacity for wind design	ϕv Vnw =	**399.75**	lb/ft

Design criteria **V < ϕvVn**

The maximum diaphragm wind shear in the roof diaphragm is:

Transverse direction	$V_t = (W_t * B) / 2L$ =	**119.96**	lb/ft
Longitudinal direction	$V_L = (W_L * L) / 2B$ =	**113.32**	lb/ft

Shear capacity for wind loading;

$_{max}(V_t; V_L) \le ϕv\ Vnw$				**119.96**	lb/ft	
	119.96	lb/ft	<	**399.75**	lb/ft	**PASS!**

D3.2 - ROOF DIAPHRAGM DESIGN

Diaphragm Dimensions

Diaphragm Length	L =	**24.50**	ft
Diaphragm Width	B =	**31.25**	ft
Distributed linear load in transverse directio	Wt =	**0.00**	lb/ft
Distributed linear load in longitudinal directi	W_L =	**234.69**	lb/ft

15/32" OSB Sheathing (per AISI240 Table B5.4.2-1 Unblocked Wood Structural Panel Diaphragms)

Fastener Spacing Edge/Field - 6/12

Nominal shear capacity for wind design	Vn =	**615**	lb/ft
The design factors for wind Design	LRFD ϕv =	**0.65**	**(AISI240 Section B5.4.3)**
Design shear capacity for wind design	ϕv Vnw =	**399.75**	lb/ft

Design criteria **V < ϕvVn**

The maximum diaphragm wind shear in the roof diaphragm is:

Transverse direction	$V_t = (W_t * B) / 2L =$	**0.00**	lb/ft	
Longitudinal direction	$V_L = (W_L * L) / 2B =$	**92.00**	lb/ft	

Shear capacity for wind loading;

$\max(V_t; V_L) \le \phi v\ Vnw$				**92.00**	lb/ft	
	92.00	lb/ft	<	**399.75**	lb/ft	**PASS!**

D4 - ROOF DIAPHRAGM DESIGN

Diaphragm Dimensions

Diaphragm Length	L =	**64.67**	ft
Diaphragm Width	B =	**24.33**	ft
Distributed linear load in transverse directio	Wt =	**171.88**	lb/ft
Distributed linear load in longitudinal directi	W_L =	**143.53**	lb/ft

15/32" OSB Sheathing (per AISI240 Table B5.4.2-1 Unblocked Wood Structural Panel Diaphragms)

Fastener Spacing Edge/Field - 6/12

Nominal shear capacity for wind design	Vn =	**615**	lb/ft
The design factors for wind Design	LRFD ϕv =	**0.65**	**(AISI240 Section B5.4.3)**
Design shear capacity for wind design	ϕv Vnw =	**399.75**	lb/ft

Design criteria **$V < \phi v Vn$**

The maximum diaphragm wind shear in the roof diaphragm is:

Transverse direction	$V_t = (W_t * B) / 2L =$	**32.34**	lb/ft	
Longitudinal direction	$V_L = (W_L * L) / 2B =$	**190.72**	lb/ft	

Shear capacity for wind loading;

$\max(V_t; V_L) \le \phi v\ Vnw$				**190.72**	lb/ft	
	190.72	lb/ft	<	**399.75**	lb/ft	**PASS!**

2.5 CONNECTION DESIGN
2.5.1 RIDGE RAFTER CONNECTION DESIGN

Project: **Hawkins**
Project no: **24-111**
Author: **DZ**

Project data

Project name	Hawkins
Project number	24-111
Author	DZ
Description	Ridge rafter connection
Date	5/29/2024
Design code	AISC 360-16

Material

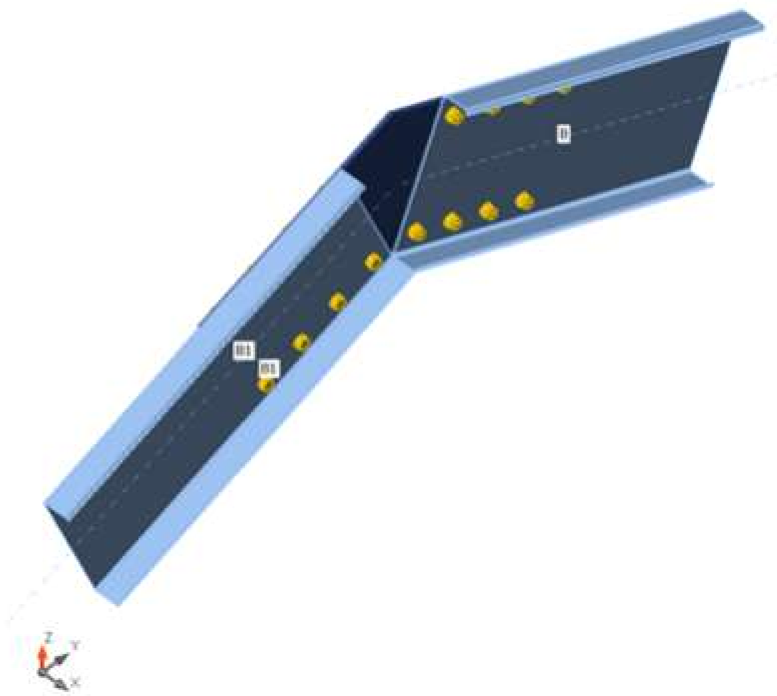
Steel	A913 Gr.50

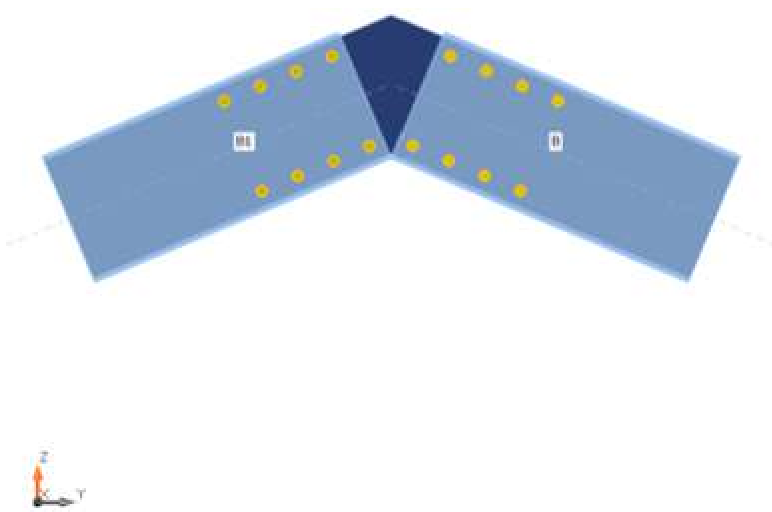
Design

Name	Hwkns
Description	
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC - LRFD 2016

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]	Forces in	X [in]
B	5 - 1400S250-97(CFC355x63)	90.0	22.7	0.0	0.000	0.000	0.000	Bolts	10.423
B1	5 - 1400S250-97(CFC355x63)	-90.0	22.7	0.0	0.000	0.000	0.000	Bolts	10.500

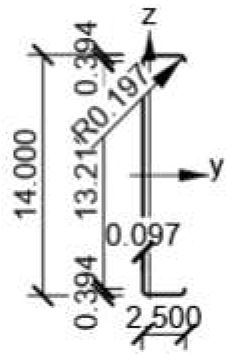




Cross-sections

Name	Material
5 - 1400S250-97(CFC355x63)	A913 Gr.50

Cross-sections

Name	Material	Drawing
5 - 1400S250-97(CFC355x63)	A913 Gr.50	

Bolts

Name	Bolt assembly	Diameter [in]	fu [ksi]	Gross area [in^2]
1/2 A325	1/2 A325	0.500	120.0	0.196

Load effects (forces in equilibrium)

Name	Member	N [lbf]	Vy [lbf]	Vz [lbf]	Mx [lbf.ft]	My [lbf.ft]	Mz [lbf.ft]
LE1	B	1000.000	0.000	0.000	0.00	20120.00	0.00
	B1	-1000.000	0.000	0.000	0.00	20120.00	0.00

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	3.9 < 5.0%	OK
Bolts	95.3 < 100%	OK
Buckling	Not calculated	

Plates

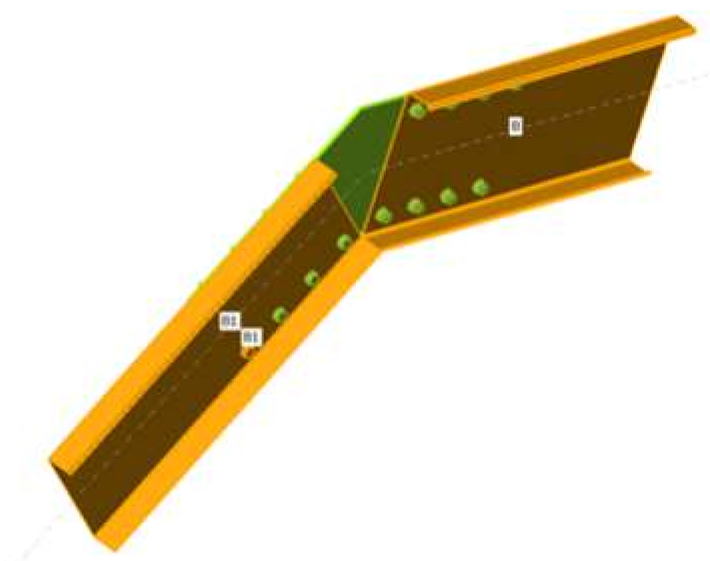
Name	f_y [ksi]	Thickness [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	σc_{Ed} [ksi]	Check status
B	50.0	1/8	LE1	46.0	3.6	0.0	OK
B1	50.0	1/8	LE1	46.1	3.9	0.0	OK
SP2	50.0	5/16	LE1	45.0	0.1	11.7	OK

Design data

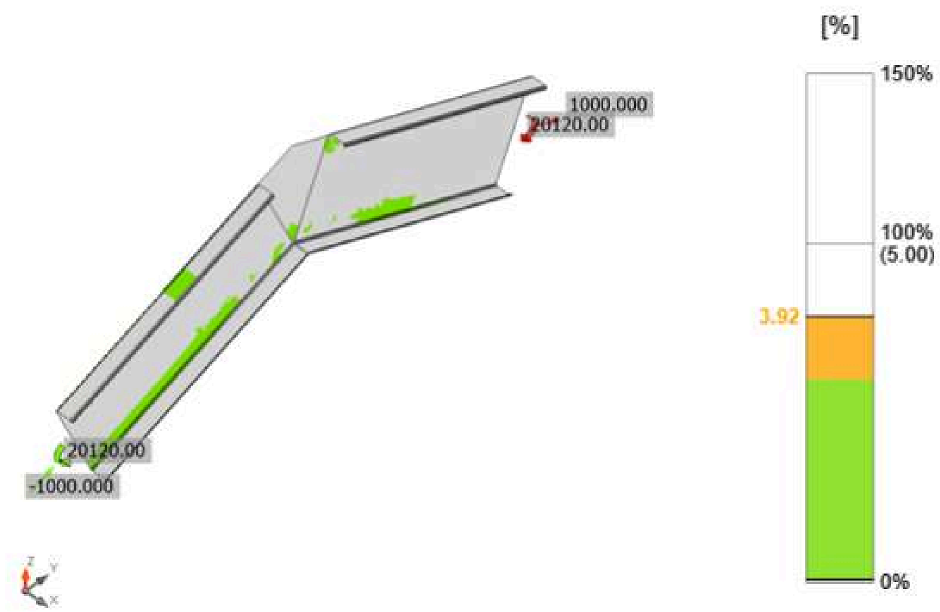
Material	f_y [ksi]	ε_{lim} [%]
A913 Gr.50	50.0	5.0

Symbol explanation

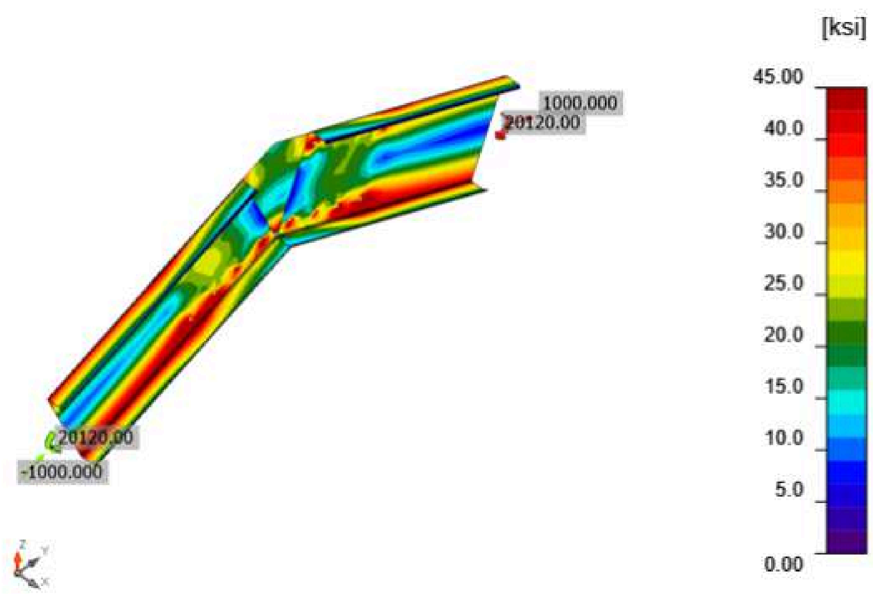
ε_{Pl}	Plastic strain
σc_{Ed}	Contact stress
σ_{Ed}	Eq. stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain



Overall check, LE1

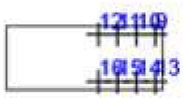


Strain check, LE1



Equivalent stress, LE1

Bolts

Shape	Item	Grade	Loads	F_t [lbf]	V [lbf]	$\phi R_{n,bearing}$ [lbf]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	1/2 A325 - 1	LE1	3097.035	4924.010	5674.509	23.4	86.8	-	OK
	B2	1/2 A325 - 1	LE1	1479.313	3495.754	5674.509	11.2	61.6	-	OK
	B3	1/2 A325 - 1	LE1	1078.686	3496.281	5674.509	8.1	61.6	-	OK
	B4	1/2 A325 - 1	LE1	1921.397	5006.836	5674.509	14.5	88.2	-	OK
	B5	1/2 A325 - 1	LE1	2443.210	4931.986	5674.509	18.4	86.9	-	OK
	B6	1/2 A325 - 1	LE1	1310.087	3554.995	5674.509	9.9	62.6	-	OK
	B7	1/2 A325 - 1	LE1	1651.494	3742.092	5674.509	12.5	65.9	-	OK
	B8	1/2 A325 - 1	LE1	2578.208	5257.672	5674.509	19.5	92.7	-	OK
	B9	1/2 A325 - 1	LE1	3621.554	5145.420	5674.509	27.3	90.7	-	OK
	B10	1/2 A325 - 1	LE1	1743.625	3592.118	5674.509	13.2	63.3	-	OK
	B11	1/2 A325 - 1	LE1	1120.688	3507.779	5674.509	8.5	61.8	-	OK
	B12	1/2 A325 - 1	LE1	2019.690	5097.171	5674.509	15.3	89.8	-	OK
	B13	1/2 A325 - 1	LE1	2718.126	5200.128	5674.509	20.5	91.6	-	OK
	B14	1/2 A325 - 1	LE1	1512.423	3696.157	5674.509	11.4	65.1	-	OK
	B15	1/2 A325 - 1	LE1	2090.038	3834.016	5674.509	15.8	67.6	-	OK
	B16	1/2 A325 - 1	LE1	3282.099	5405.471	5674.509	24.8	95.3	-	OK

Design data

Grade	$\phi R_{n,tension}$ [lbf]	$\phi R_{n,shear}$ [lbf]
1/2 A325 - 1	13242.639	7945.584

Detailed result for B16

Tension resistance check (AISC 360-16: J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = 13242.639 \text{ lbf} \geq F_t = 3282.099 \text{ lbf}$$

Where:

$F_{nt} = 89.9$ ksi – nominal tensile stress from AISC 360-16 Table J3.2

$A_b = 0.196$ in^2 – gross bolt cross-sectional area

$\phi = 0.75$ – resistance factor

Shear resistance check (AISC 360-16: J3-1)

$\phi R_n = \phi \cdot F_{nv} \cdot A_b =$ 7945.584 lbf ≥ $V =$ 5405.471 lbf

Where:

$F_{nv} =$ 54.0 ksi – nominal shear stress from AISC 360-16 Table J3.2

$A_b =$ 0.196 in^2 – gross bolt cross-sectional area

$\phi =$ 0.75 – resistance factor

Bearing resistance check (AISC 360-16: J3-6)

$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$

$\phi R_n =$ 5674.509 lbf ≥ $V =$ 5405.471 lbf

Where:

$l_c =$ 14.743 in – clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material

$t =$ 0.097 in – thickness of the plate

$d =$ 0.500 in – diameter of a bolt

$F_u =$ 65.0 ksi – tensile strength of the connected material

$\phi =$ 0.75 – resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-16: J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

2.5.2 ROOF RAFTER TO WALL STUD CONNECTION DESIGN

Project:	**ROOF RAFTER TO WALL STUD CONNECTION DESIGN**
Project no:	**24-111**
Author:	**DZ**

Project data

Project name	Hawkins
Project number	24-111
Author	DZ
Description	ROOF RAFTER TO WALL STUD CONNECTION DESIGN
Date	5/30/2024
Design code	AISC 360-16

Material

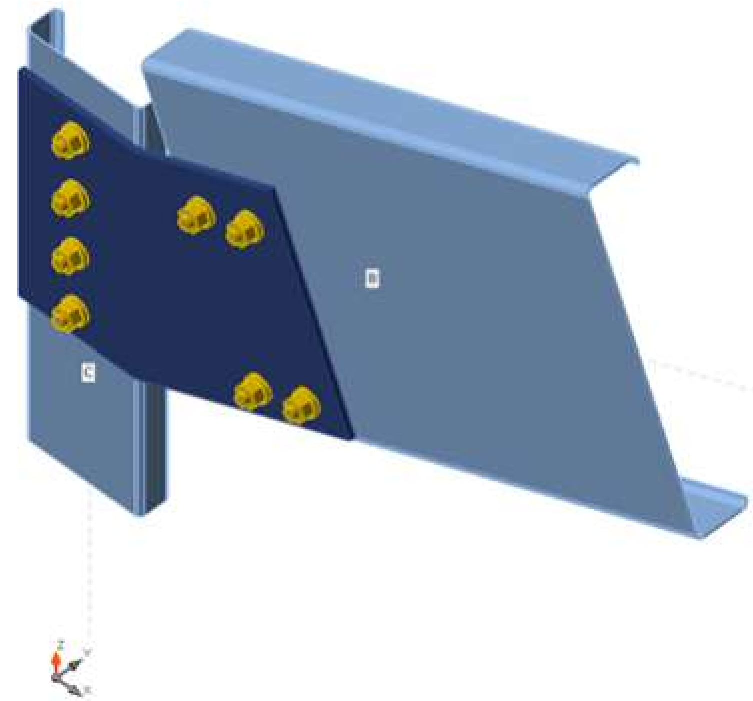
Steel	A913 Gr.50

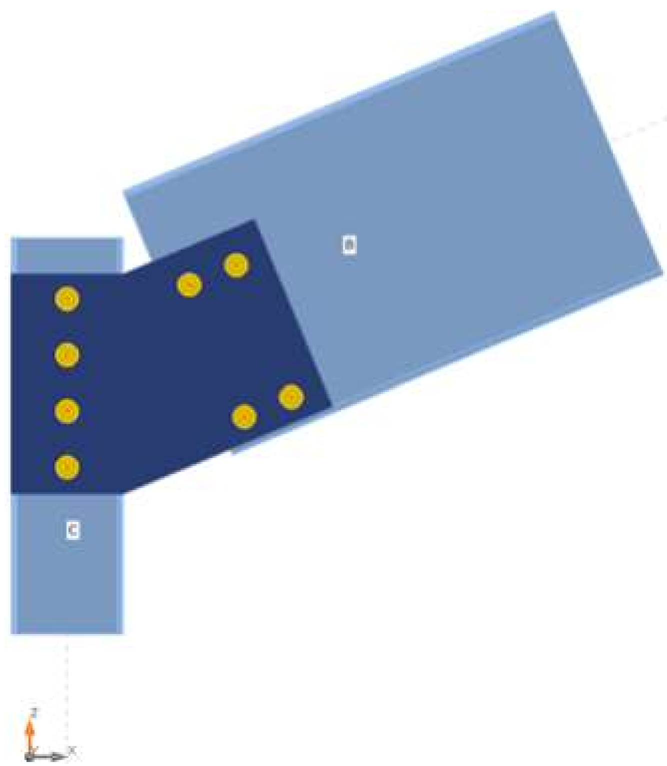
Design

Name	CON1
Description	
Analysis	Stress, strain/ simplified loading
Design code	AISC - LRFD 2016

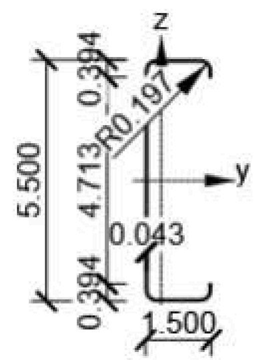
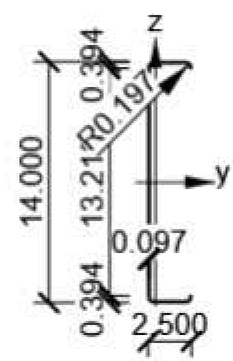
Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]	Forces in	X [in]
C	3 - 550S150-43(CFC139x38)	0.0	90.0	0.0	0.000	-0.055	0.000	Node	0.000
B	4 - 1400S250-97(CFC355x63)	0.0	-22.7	0.0	0.000	0.000	0.000	Bolts	8.386


B
C


B
C

Cross-sections

Name	Material	Drawing
3 - 550S150-43(CFC139x38)	A913 Gr.50	
4 - 1400S250-97(CFC355x63)	A913 Gr.50	

Bolts

Name	Bolt assembly	Diameter [in]	fu [ksi]	Gross area [in^2]
1/2 A325	1/2 A325	0.500	120.0	0.196

Load effects (equilibrium not required)

Name	Member	N [lbf]	Vy [lbf]	Vz [lbf]	Mx [lbf.ft]	My [lbf.ft]	Mz [lbf.ft]
LE1	B	-1560.000	0.000	-1430.000	0.00	0.00	0.00
LE2	B	-860.000	0.000	-2172.000	0.00	0.00	0.00

Check

Summary

Name	Value	Check status
Analysis	100,0%	OK
Plates	2,4 < 5,0%	OK
Bolts	82,6 < 100%	OK
Buckling	Not calculated	

Plates

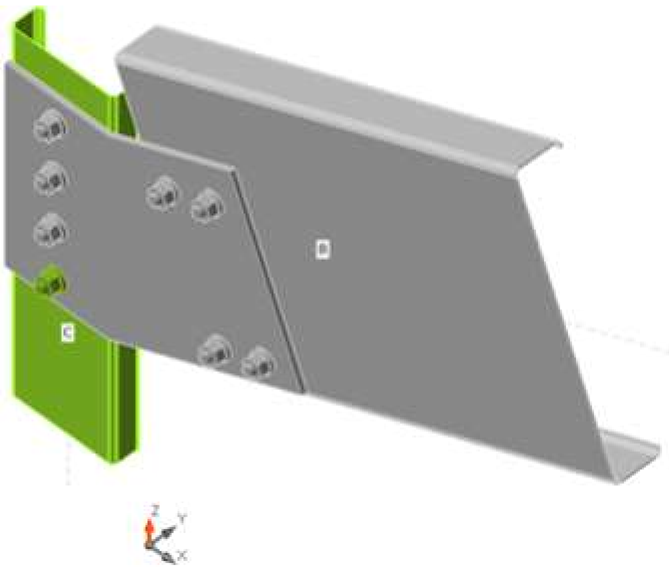
Name	f_y [ksi]	Thickness [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	σc_{Ed} [ksi]	Check status
C	50,0	1/16	LE1	45,7	2,4	0,0	OK
B	50,0	1/8	LE2	45,0	0,0	0,0	OK
SP2	50,0	1/4	LE1	19,3	0,0	3,7	OK

Design data

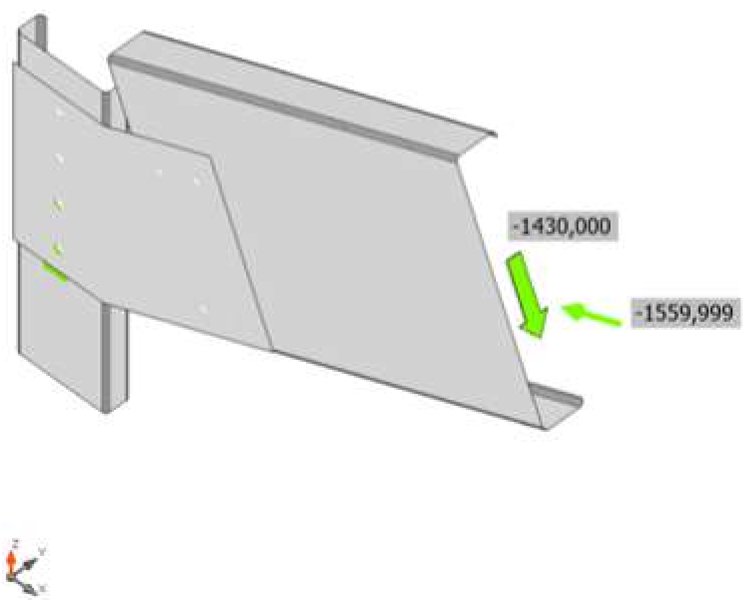
Material	f_y [ksi]	ε_{lim} [%]
A913 Gr.50	50,0	5,0

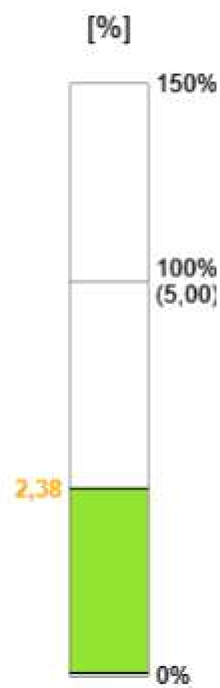
Symbol explanation

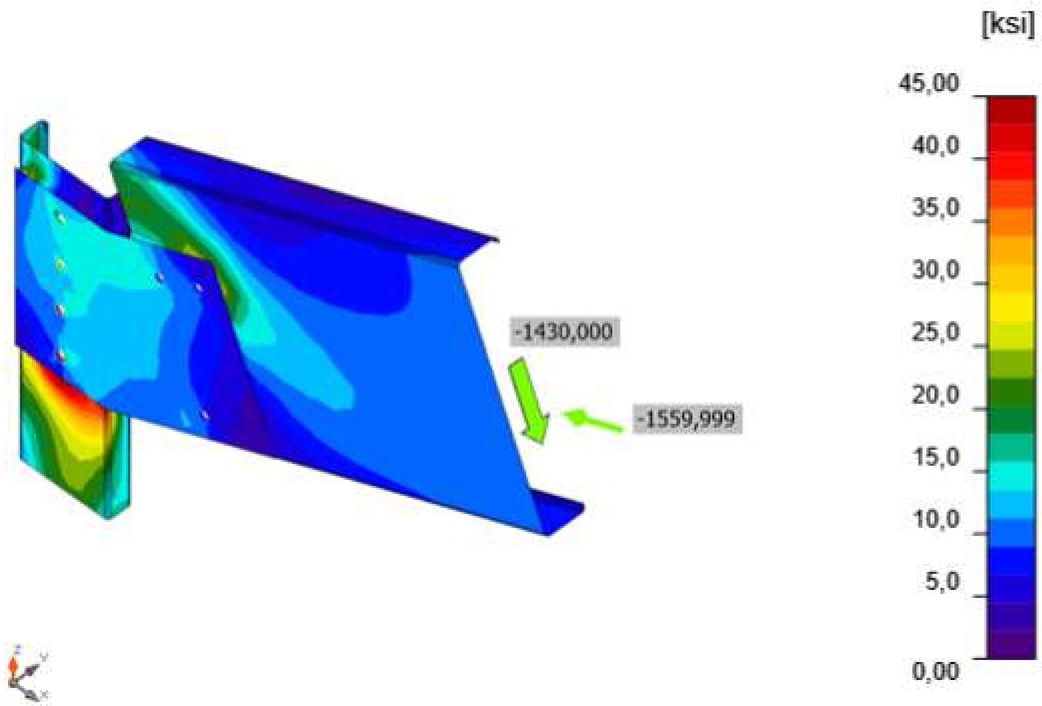
ε_{Pl}	Plastic strain
σc_{Ed}	Contact stress
σ_{Ed}	Eq. stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain



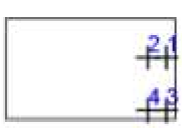
Overall check, LE1







Bolts

Shape	Item	Grade	Loads	F_t [lbf]	V [lbf]	$\phi R_{n,bearing}$ [lbf]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	1/2 A325 - 1	LE1	341,654	789,437	5674,509	2,6	13,9	-	OK
	B2	1/2 A325 - 1	LE2	1976,662	539,266	5674,509	14,9	9,5	-	OK
	B3	1/2 A325 - 1	LE2	167,199	620,462	5674,509	1,3	10,9	-	OK
	B4	1/2 A325 - 1	LE2	182,244	432,730	5674,509	1,4	7,6	-	OK
	B5	1/2 A325 - 1	LE2	730,995	2037,143	2515,504	5,5	81,0	-	OK
	B6	1/2 A325 - 1	LE2	697,790	956,118	2515,504	5,3	38,0	-	OK
	B7	1/2 A325 - 1	LE2	639,439	890,857	2515,504	4,8	35,4	-	OK
	B8	1/2 A325 - 1	LE2	731,941	2077,673	2515,504	5,5	82,6	-	OK

Design data

Grade	$\phi R_{n,tension}$ [lbf]	$\phi R_{n,shear}$ [lbf]
1/2 A325 - 1	13242.639	7945.584

Symbol explanation

F_t	Tension force
V	Resultant of shear forces Vy, Vz in bolt
$\phi R_{n,bearing}$	Bolt bearing resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
$\phi R_{n,tension}$	Bolt tension resistance AISC 360-16 J3.6
$\phi R_{n,shear}$	Bolt shear resistance AISC 360-16 – J3.8

Detailed result for B8

Tension resistance check (AISC 360-16: J3-1)

$\phi R_n = \phi \cdot F_{nt} \cdot A_b =$ 13242,639 lbf ≥ $F_t =$ 731,941 lbf

Where:

$F_{nt} = 89{,}9$ ksi – nominal tensile stress from AISC 360-16 Table J3.2

$A_b = 0{,}196$ in^2 – gross bolt cross-sectional area

$\phi = 0{,}75$ – resistance factor

Shear resistance check (AISC 360-16: J3-1)

$\phi R_n = \phi \cdot F_{nv} \cdot A_b =$ 7945,584 lbf ≥ $V =$ 2077,673 lbf

Where:

$F_{nv} = 54{,}0$ ksi – nominal shear stress from AISC 360-16 Table J3.2

$A_b = 0{,}196$ in^2 – gross bolt cross-sectional area

$\phi = 0{,}75$ – resistance factor

Bearing resistance check (AISC 360-16: J3-6)

$R_n = 1,20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2,40 \cdot d \cdot t \cdot F_u$

$\phi R_n =$ 2515,504 lbf ≥ $V =$ 2077,673 lbf

Where:

$l_c = 2{,}328$ in – clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material

$t = 0{,}043$ in – thickness of the plate

$d = 0{,}500$ in – diameter of a bolt

$F_u = 65{,}0$ ksi – tensile strength of the connected material

$\phi = 0{,}75$ – resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-16: J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

2.5.3 ROOF RAFTER TO ROOF BEAM CONNECTION DESIGN

Project:	**Hawkins**
Project no:	**24-111**
Author:	**DZ**

IDEA StatiCa®
Calculate yesterday's estimates

Project data

Project name	Hawkins
Project number	24-111
Author	DZ
Description	2.5.3 ROOF RAFTER TO ROOF BEAM CONNECTION DESIGN
Date	5/13/2024
Design code	AISC 360-16

Material

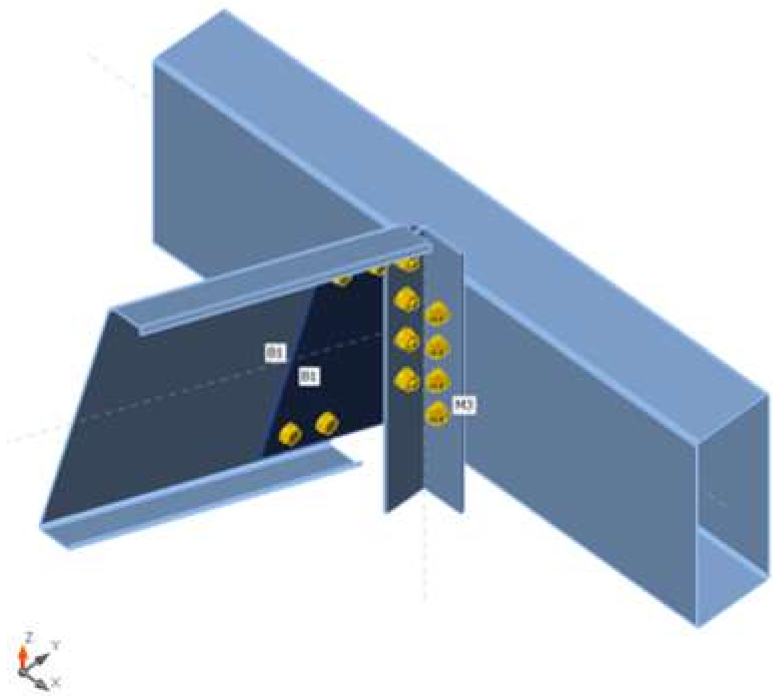
Steel	A913 Gr.50, A36

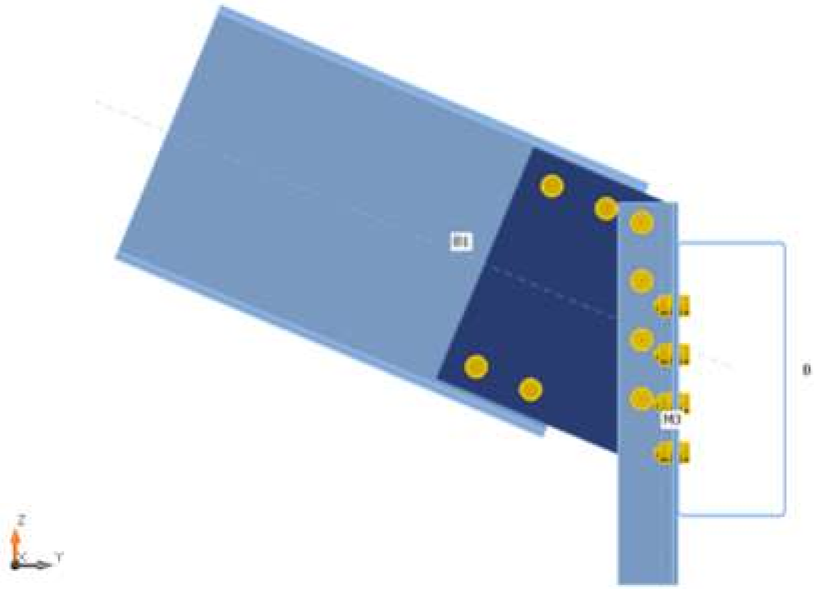
Design

Name	Hwkns
Description	
Analysis	Stress, strain/ simplified loading
Design code	AISC - LRFD 2016

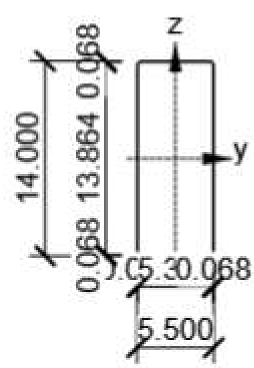
Beams and columns

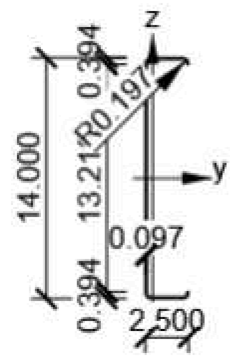
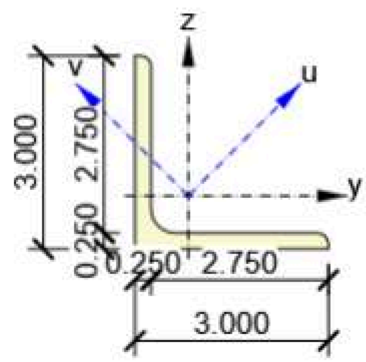
Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]	Forces in	X [in]
B	9 - BOX1400-68(RHS355x139)	0.0	0.0	0.0	0.000	0.000	0.000	Node	0.000
B1	5 - 1400S250-97(CFC355x63)	-90.0	-22.7	0.0	0.000	0.000	0.563	Bolts	10.750
M3	3 - L3X3X1/4	-90.0	90.0	0.0	-8.000	0.760	3.580	Bolts	6.250





Cross-sections

Name	Material	Drawing
9 - BOX1400-68(RHS355x139)	A913 Gr.50	

Name	Material	Drawing
5 - 1400S250-97(CFC355x63)	A913 Gr.50	
3 - L3X3X1/4	A36	

Bolts

Name	Bolt assembly	Diameter [in]	fu [ksi]	Gross area [in^2]
1/2 A325	1/2 A325	0.500	120.0	0.196

Load effects (equilibrium not required)

Name	Member	N [lbf]	Vy [lbf]	Vz [lbf]	Mx [lbf.ft]	My [lbf.ft]	Mz [lbf.ft]
LE1	B1	-1560.000	0.000	-1430.000	0.00	533.33	0.00
	M3	0.000	0.000	0.000	0.00	0.00	0.00
LE3	B1	-860.000	0.000	-2172.000	0.00	533.33	0.00
	M3	0.000	0.000	0.000	0.00	0.00	0.00

Check

Summary

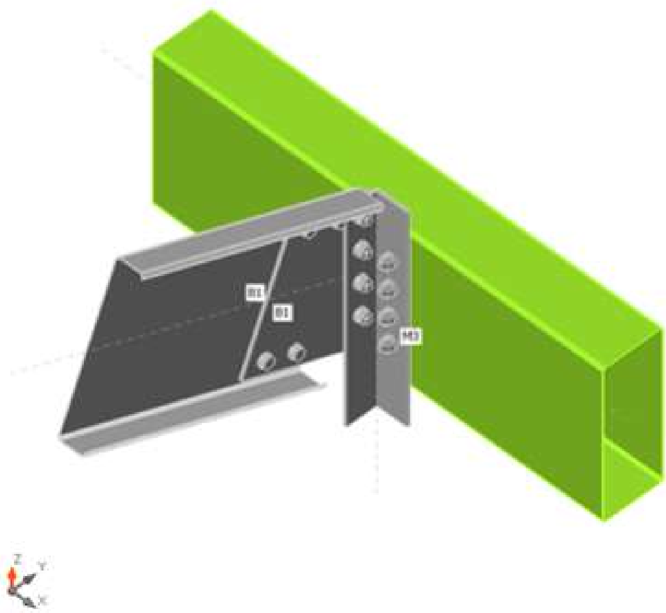
Name	Value	Check status
Analysis	100.0%	OK
Plates	0.1 < 5.0%	OK
Bolts	23.9 < 100%	OK
Buckling	Not calculated	
GMNA	Calculated	

Plates

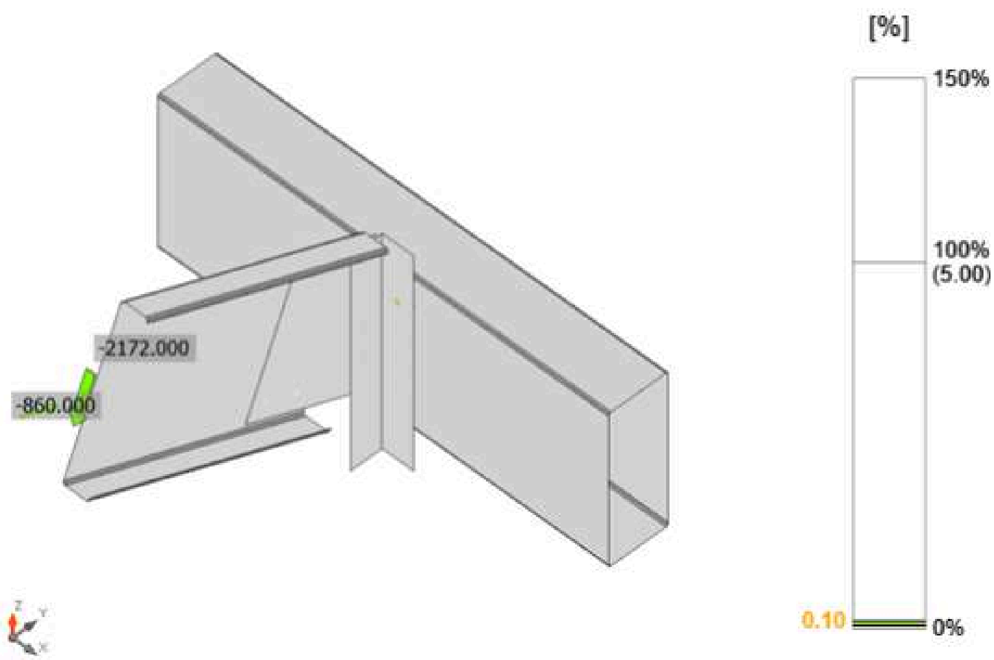
Name	Material	f_y [ksi]	Thickness [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	σc_{Ed} [ksi]	Check status
B	A913 Gr.50	50.0	1/16	LE3	45.0	0.1	0.0	OK
B1	A913 Gr.50	50.0	1/8	LE3	32.1	0.0	0.0	OK
M3-bfl 1	A36	36.0	1/4	LE3	12.0	0.0	6.5	OK
M3-w 1	A36	36.0	1/4	LE3	13.7	0.0	1.6	OK
SP1	A36	36.0	1/4	LE3	15.4	0.0	4.3	OK

Design data

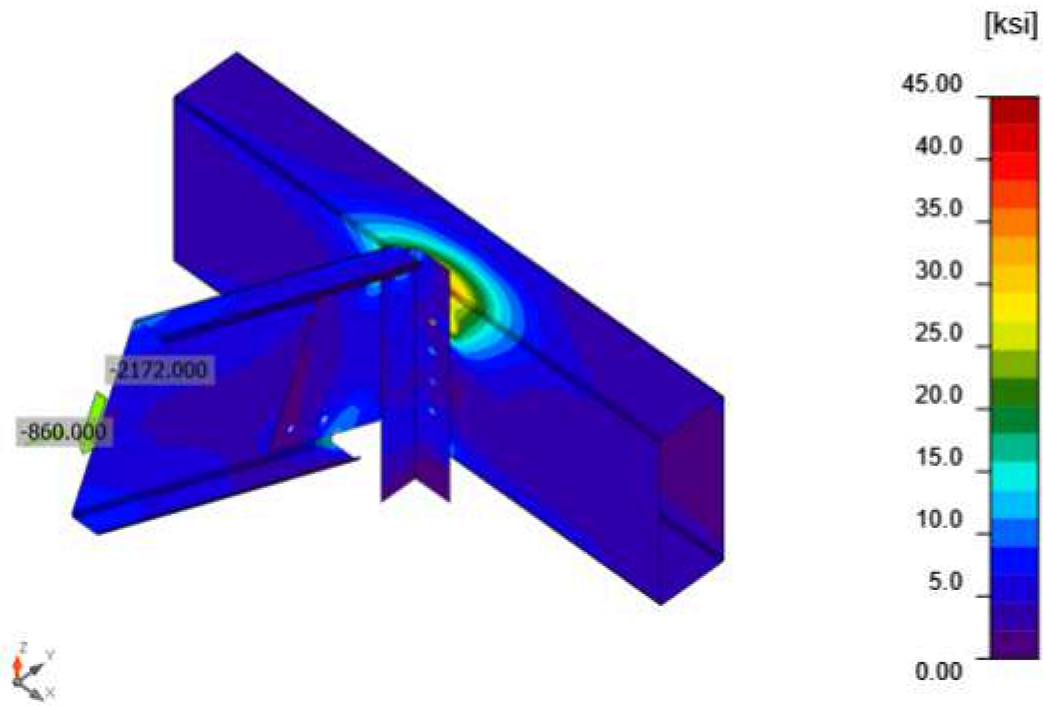
Material	f_y [ksi]	ε_{lim} [%]
A913 Gr.50	50.0	5.0
A36	36.0	5.0



Overall check, LE3

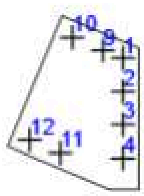
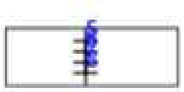


Strain check, LE3



Equivalent stress, LE3

Bolts

Shape	Item	Grade	Loads	F_t [lbf]	V [lbf]	$\phi R_{n,bearing}$ [lbf]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	1/2 A325 - 1	LE3	713.176	519.276	13053.395	5.4	6.5	-	OK
	B2	1/2 A325 - 1	LE3	103.211	585.567	13053.395	0.8	7.4	-	OK
	B3	1/2 A325 - 1	LE3	38.578	613.900	13053.395	0.3	7.7	-	OK
	B4	1/2 A325 - 1	LE1	146.055	969.848	13053.395	1.1	12.2	-	OK
	B9	1/2 A325 - 1	LE3	1493.244	1114.003	5674.509	11.3	19.6	-	OK
	B10	1/2 A325 - 1	LE3	461.183	925.895	5674.509	3.5	16.3	-	OK
	B11	1/2 A325 - 1	LE3	446.758	834.099	5674.509	3.4	14.7	-	OK
	B12	1/2 A325 - 1	LE3	260.276	560.120	5674.509	2.0	9.9	-	OK
	B5	1/2 A325 - 1	LE3	1669.264	949.897	3978.007	12.6	23.9	-	OK
	B6	1/2 A325 - 1	LE3	180.136	612.346	3978.007	1.4	15.4	-	OK
	B7	1/2 A325 - 1	LE3	151.033	611.694	3978.007	1.1	15.4	-	OK
	B8	1/2 A325 - 1	LE3	321.308	909.962	3978.007	2.4	22.9	-	OK

Design data

Grade	$\phi R_{n,tension}$ [lbf]	$\phi R_{n,shear}$ [lbf]
1/2 A325 - 1	13242.639	7945.584

Detailed result for B5

Tension resistance check (AISC 360-16: J3-1)

$\phi R_n = \phi \cdot F_{nt} \cdot A_b =$ 13242.639 lbf ≥ $F_t =$ 1669.264 lbf

Where:

$F_{nt} = 89.9$ ksi – nominal tensile stress from AISC 360-16 Table J3.2

$A_b = 0.196$ in^2 – gross bolt cross-sectional area

$\phi = 0.75$ – resistance factor

Shear resistance check (AISC 360-16: J3-1)

$\phi R_n = \phi \cdot F_{nv} \cdot A_b =$ 7945.584 lbf ≥ $V =$ 949.897 lbf

Where:

$F_{nv} = 54.0$ ksi – nominal shear stress from AISC 360-16 Table J3.2

$A_b = 0.196$ in^2 – gross bolt cross-sectional area

$\phi = 0.75$ – resistance factor

Bearing resistance check (AISC 360-16: J3-6)

$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$

$\phi R_n =$ 3978.007 lbf ≥ $V =$ 949.897 lbf

Where:

$l_c = 15.688$ in – clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material

$t = 0.068$ in – thickness of the plate

$d = 0.500$ in – diameter of a bolt

$F_u = 65.0$ ksi – tensile strength of the connected material

$\phi = 0.75$ – resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-16: J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

2.5.4 EMBED PLATE DESIGN

HAWKINS EMBED PLATE

Anchor bolt design in accordance with ACI318-14

Anchor bolt geometry

Anchor bolt	Cast-in headed stud anchor
Diameter of anchor bolt	d_a = **0.625** in
Number of bolts in x direction	N_{boltx} = **2**
Number of bolts in y direction	N_{bolty} = **2**
Total number of bolts	$n_{total} = (N_{boltx} \times 2) + (N_{bolty} - 2) \times 2$ = **4**
Total number of bolts in tension	$n_{tens} = (N_{boltN} \times 2) + (N_{bolty} - 2)$ = **2**
Spacing of bolts in x direction	s_{boltx} = **10** in
Spacing of bolts in y direction	s_{bolty} = **10** in
Effective cross-sectional area of anchor	$A_{se} = \pi \times d_a^2 / 4$ = **0.307** in^2
Embedded depth of each anchor bolt	h_{ef} = **8** in

Foundation geometry

Member thickness	h_a = **48** in
Dist center of baseplate to left edge foundation	x_{ce1} = **15** in
Dist center of baseplate to right edge foundation	x_{ce2} = **15** in
Dist center of baseplate to bot. edge foundation	y_{ce1} = **48** in
Dist center of baseplate to top edge foundation	y_{ce2} = **48** in

Material details

Minimum yield strength of steel	f_{ya} = **36** ksi
Nominal tensile strength of steel	f_{uta} = **58** ksi
Compressive strength of concrete	f'_c = **3** ksi
Concrete modification factor	λ = **1.00**
Modification factor for cast-in anchor concrete failure	
	$\lambda_a = 1.0 \times \lambda$ = **1.00**

Strength reduction factors

Tension of steel element	$\phi_{t,s}$ = **0.75**
Shear of steel element	$\phi_{v,s}$ = **0.70**
Concrete tension	$\phi_{t,c}$ = **0.65**
Concrete shear	$\phi_{v,c}$ = **0.70**
Concrete tension for pullout	$\phi_{t,cB}$ = **0.70**
Concrete shear for pryout	$\phi_{v,cB}$ = **0.70**

Anchor forces

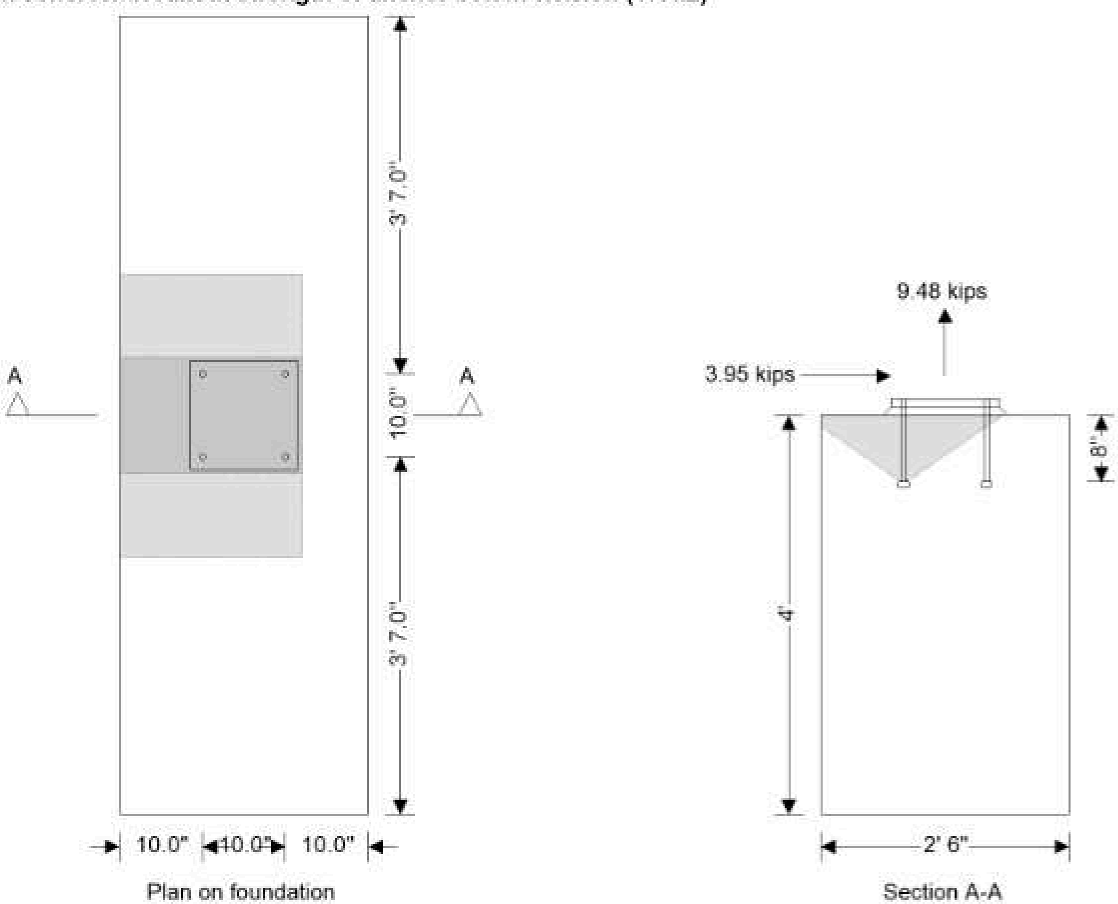
Number of bolt rows in tension	N_{boltN} = **1**
Axial force in bolts for row 1	N_1 = **9.48** kips
Total axial force on bolt group	N_R = **9.48** kips
Maximum axial force to single bolt	$N_{max,s}$ = **4.74** kips
Eccentricity of axial load (from bolt group centroid)	e'_N = **0.00** in
Shear force applied to bolt group	V = **3.95** kips

Steel strength of anchor in tension (17.4.1)

Nominal strength of anchor in tension	$N_{sa} = A_{se} \times f_{uta}$ = **17.79** kips
Steel strength of anchor in tension	$\phi N_{sa} = \phi_{t,s} \times N_{sa}$ = **13.35** kips

PASS - Steel strength of anchor exceeds max tension in single bolt

Check concrete breakout strength of anchor bolt in tension (17.4.2)



Concrete breakout - tension

Coeff for basic breakout strength in tension	k_c = **24**
Breakout strength for single anchor in tension	$N_b = k_c \times \lambda_a \times \sqrt{(f'_c \times 1\ psi)} \times h_{ef}^{1.5} \times 1\ in^{0.5}$ = **29.74** kips

Projected area for groups of anchors	A_{Nc} = **748** in^2
Projected area of a single anchor	$A_{Nco} = 9 \times h_{ef}^2$ = **576** in^2
Min dist center of anchor to edge of concrete	$c_{a,min}$ = **10** in
Mod factor for groups loaded eccentrically	$\psi_{ec,N} = \min(1 / (1 + ((2 \times e'_N) / (3 \times h_{ef}))), 1)$ = **1.000**
Modification factor for edge effects	$\psi_{ed,N} = 0.7 + 0.3 \times (c_{a,min} / (1.5 \times h_{ef}))$ = **0.950**
Modification factor for no cracking at service loads	$\psi_{c,N}$ = **1.000**
Modification factor for cracked concrete	$\psi_{cp,N}$ = **1.000**
Nominal concrete breakout strength	$N_{cbg} = A_{Nc} / A_{Nco} \times \psi_{ed,N} \times \psi_{c,N} \times \psi_{cp,N} \times N_b$ = **36.70** kips
Concrete breakout strength	$\phi N_{cbg} = \phi_{t,c} \times N_{cbg}$ = **23.85** kips

PASS - Breakout strength exceeds tension in bolts

Pullout strength (17.4.3)

Net bearing area of the head of anchor	A_{brg} = **1** in^2
Mod factor for no cracking at service loads	$\psi_{c,P}$ = **1.000**
Pullout strength for single anchor	$N_p = 8 \times A_{brg} \times f'_c$ = **24.00** kips
Nominal pullout strength of single anchor	$N_{pn} = \psi_{c,P} \times N_p$ = **24.00** kips
Pullout strength of single anchor	$\phi N_{pn} = \phi_{t,cB} \times N_{pn}$ = **16.80** kips

PASS - Pullout strength of single anchor exceeds maximum axial force in single bolt

Side face blowout strength (17.4.4)

As $h_{ef} <= 2.5 \times \min(c_{a1}, c_{a2})$ the edge distance is considered to be far from an edge and blowout strength need not be considered

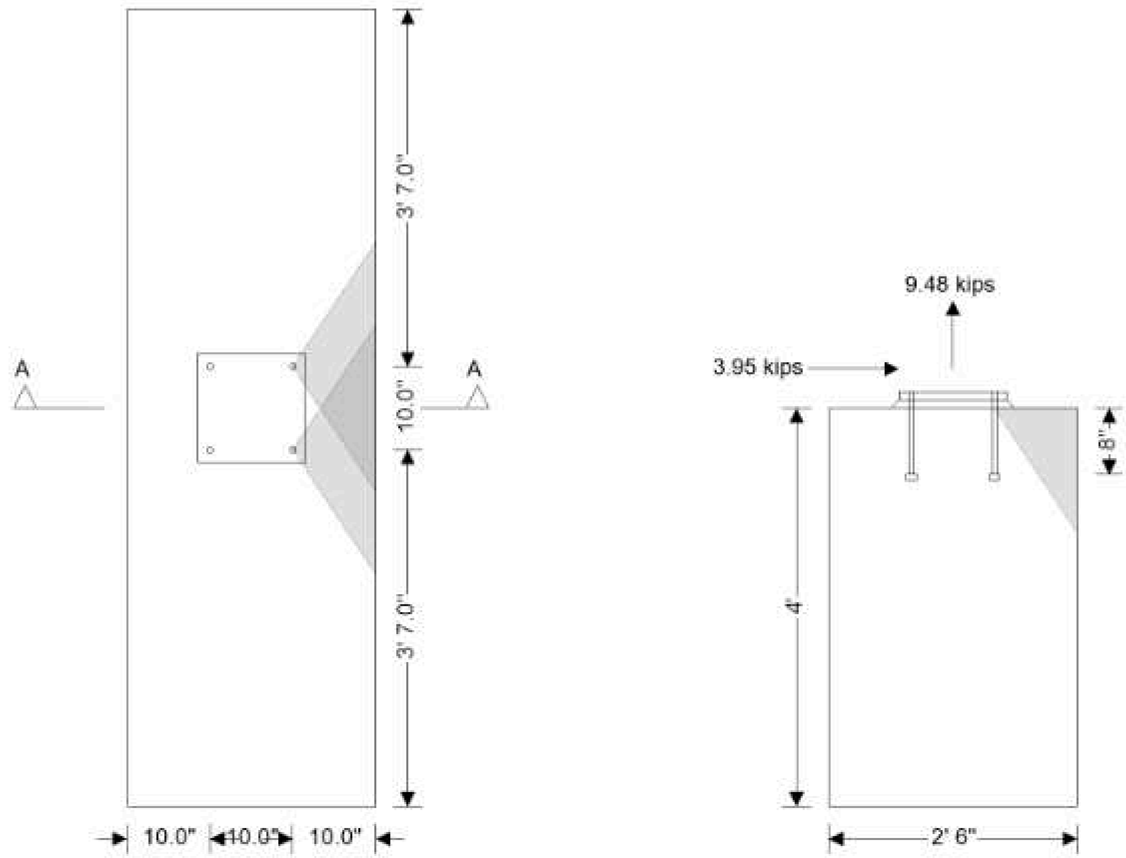
Steel strength of anchor in shear (17.5.1)

Built-up grout pads are used so nominal strength will be multiplied by 0.8 (17.5.1.3)

Effective number of anchors in shear	N_{boltV} = **4**
Nom strength of anchor in shear	$V_{sa} = 0.8 \times N_{boltV} \times A_{se} \times f_{uta}$ = **56.94** kips
Steel strength of anchor in shear	$\phi V_{sa} = \phi_{v,s} \times V_{sa}$ = **39.86** kips

PASS - Steel strength of anchor exceeds shear in bolts

Concrete breakout strength in shear - Case 1. Half of shear resisted by front bolts (17.5.3)



Plan on foundation

Section A-A

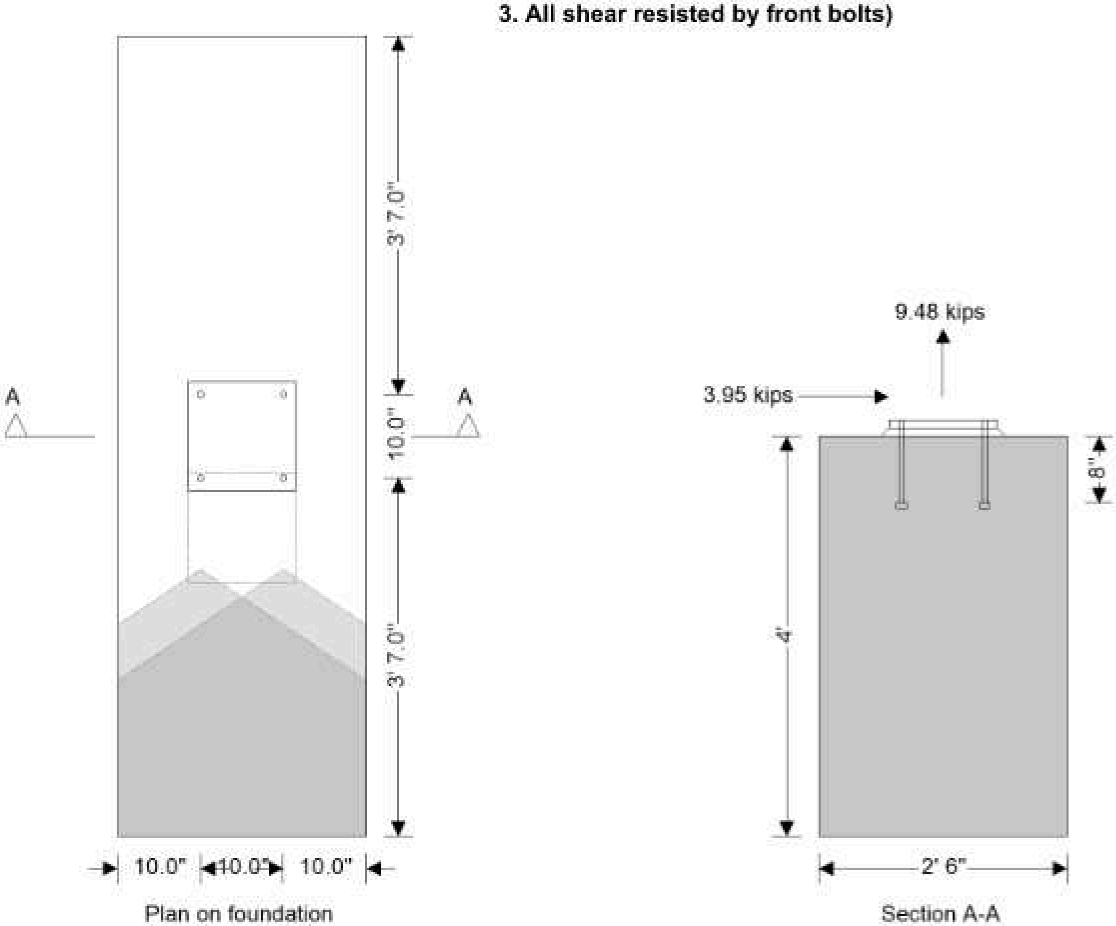
Concrete breakout - shear

Applied shear	$V_{app} = V / 2 =$ **1.98** kips
Edge distance x for shear near corner	$c_{a1} =$ **10** in
Edge distance y for shear near corner	$c_{a2} = \min(y_{ce1}, y_{ce2}) - (((N_{bolty} - 1)/2) \times s_{bolty}) =$ **43** in
Load bearing length of anchor	$l_e = \min(h_{ef}, 8 \times d_a) =$ **5** in
Basic concrete breakout strength	$V_{b1} = 7 \times (l_e / d_a)^{0.2} \times \sqrt{(d_a)} \times \lambda_a \times \sqrt{(f'_c \times 1psi)} \times (c_{a1})^{1.5} =$ **14.53** kips
	$V_{b2} = 9 \times \lambda_a \times \sqrt{(f'_c \times 1psi \times 1 in)} \times (c_{a1})^{1.5} =$ **15.59** kips
Basic concrete breakout strength	$V_b = \mathrm{Min}(V_{b1}, V_{b2}) =$ **14.53** kips
Projected area of a single anchor	$A_{Vco} = 4.5 \times c_{a1}^2 =$ **450** in^2
Projected area of a group of anchors	$A_{Vc} =$ **600** in^2
Mod factor for edge effect	$\psi_{ed.V} = 1.000 =$ **1.000**
Eccentricity of loading	$e'_V =$ **0** in

Modification factor of eccentric loading	$\psi_{ec,V} = \min(1, 1 / (1 + ((2 \times e'_V) / (3 \times c_{a1})))) =$ **1.000**
Modification factor for cracking	$\psi_{c,V} =$ **1.400**
Modification factor for edge distance	$\psi_{h,V} = 1.0 =$ **1.000**
Nominal concrete break out strength in shear	$V_{cbg} = A_{Vc} / A_{Vco} \times \psi_{ec,V} \times \psi_{ed,V} \times \psi_{c,V} \times \psi_{h,V} \times V_b =$ **27.12** kips
Concrete break out strength in shear	$\phi V_{cbg} = \phi_{v,c} \times V_{cbg} =$ **18.98** kips

PASS - Shear breakout perpendicular to edge strength exceeds shear in bolts

Concrete breakout strength in shear parallel to edge - Case 3. All shear resisted by front bolts (parallel to edge - Case 3. All shear resisted by front bolts)



Concrete breakout - side shear

The anchors are influenced by three or more edges where any edge distance is less than $1.5c_{a1,p}$ so value of $c_{a1,p}$ is limited to $c'_{a1,p}$

Bolt offset for limiting shear	$y_{V,f,p} =$ **11.00** in
Limiting edge distance	$c'_{a1,p} =$ **32** in
Applied shear	$V_{app} = V =$ **3.95** kips
Edge distance x for shear near corner	$c_{a1,p} =$ **43** in

Edge distance y for shear near corner	$c_{a2,p} = \min(x_{ce1}, x_{ce2}) - (((N_{boltx} - 1)/2) \times s_{boltx})$ = **10** in
Load bearing length of anchor	$l_e = \min(h_{ef}, 8 \times d_a)$ = **5** in
Basic concrete breakout strength	$V_{b,p1} = 7 \times (l_e / d_a)^{0.2} \times \sqrt{(d_a)} \times \lambda_a \times \sqrt{(f'_c \times 1psi)} \times (c'_{a1,p})^{1.5}$ = **83.17** kips
	$V_{b,p2} = 9 \times \lambda_a \times \sqrt{(f'_c \times 1psi \times 1in)} \times (c'_{a1,p})^{1.5}$ = **89.23** kips
Basic concrete breakout strength	$V_{b,p} = \mathrm{Min}(V_{b,p1}, V_{b,p2})$ = **83.17** kips
Projected area of a single anchor	$A_{Vco,p} = 4.5 \times c'_{a1,p}{}^2$ = **4608** in^2
Projected area of a group of anchors	$A_{Vc,p}$ = **1440** in^2
Mod factor for edge effect	$\psi_{ed,V,p}$ = **1.000**
Eccentricity of loading	$e'_{V,p}$ = **0** in
Modification factor of eccentric loading	$\psi_{ec,V,p} = \min(1, 1 / (1 + ((2 \times e'_{V,p}) / (3 \times c'_{a1,p}))))$ = **1.000**
Modification factor for cracking	$\psi_{c,V}$ = **1.400**
Modification factor for edge distance	$\psi_{h,V,p}$ = 1.0 = **1.000**
Nominal concrete break out strength in shear	$V_{cbg,p} = 2 \times A_{Vc,p} / A_{Vco,p} \times \psi_{ec,V,p} \times \psi_{ed,V,p} \times \psi_{c,V} \times \psi_{h,V,p} \times V_{b,p}$ = **72.77** kips
Concrete break out strength in shear	$\phi V_{cbg,p} = \phi_{v,c} \times V_{cbg,p}$ = **50.94** kips
	PASS - Shear breakout strength parallel to edge exceeds shear in bolts

Pryout strength of anchor in shear (17.5.3)

Coefficient of pryout strength	k_{cp} = **2.0**
Nominal pryout strength of anchor in shear	$V_{cpg} = k_{cp} \times N_{cbg}$ = **73.39** kips
Pryout strength of anchor in shear	$\phi V_{cpg} = \phi_{v,cB} \times V_{cpg}$ = **51.37** kips
	PASS - Pryout strength of anchor exceeds shear in bolts

Interaction of tensile and shear forces

Critical design strength in tension	$\phi N_n = \phi N_{cbg}$ = **23.85** kips
Critical applied tensile force	$N_{ua} = N_R$ = **9.48** kips
	$N_{ua} / \phi N_n$ = **0.397**
Critical design strength in shear	$\phi V_n = \phi V_{cbg,f}$ = **18.98** kips
Critical applied shear force	$V_{ua} = \mathrm{abs}(V)$ = **3.95** kips
	$V_{ua} / \phi V_n$ = **0.208**
	$V_{ua} / \phi V_n > 0.2$ and $N_{ua} / \phi N_n > 0.2$,
	Interaction check is in accordance with 17.6.3 requirements
Interaction	$I_b = N_{ua} / \phi N_n + V_{ua} / \phi V_n$ = **0.606**
	PASS - interaction of forces is less than or equal to 1.2

2.5.5 HSS COLUMN TO FOUNDATION CONNECTION DESIGN

Anchor Designer™
Software
Version 3.2.2309.2

Company:		Date:	2/22/2023
Engineer:		Page:	1/6
Project:	Hawkins		
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description: HSS COLUMN TO FOUNDATION CONNECTION DESIGN

2. Input Data & Anchor Parameters

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

Anchor Information:
Anchor type: Bonded anchor
Material: F1554 Grade 36
Diameter (inch): 0.625
Effective Embedment depth, h_{ef} (inch): 10.000
Code report: ICC-ES ESR-4057
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 11.38
c_{ac} (inch): 22.57
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 18.00
State: Uncracked
Compressive strength, f'_c (psi): 2500
$\Psi_{c,V}$: 1.4
Reinforcement condition: Supplementary reinforcement not present
Supplemental edge reinforcement: No
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Continuous
Temperature range, Short/Long: 150/110°F
Reduced installation torque (for AT-3G): Not applicable
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 5.00 x 5.00 x 0.50
Yield stress: 36000 psi

Profile type/size: HSS5X5X1/4

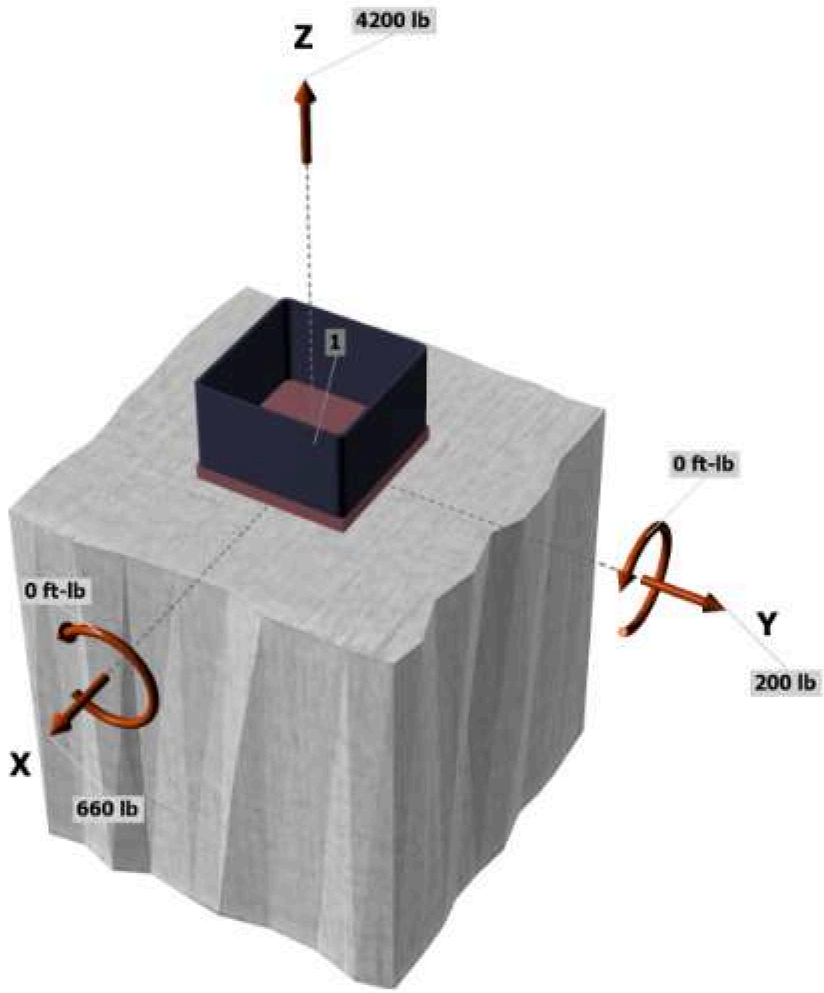
Recommended Anchor
Anchor Name: SET-3G™ - SET-3G w/ 5/8"Ø F1554 Gr. 36
Code Report: ICC-ES ESR-4057

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

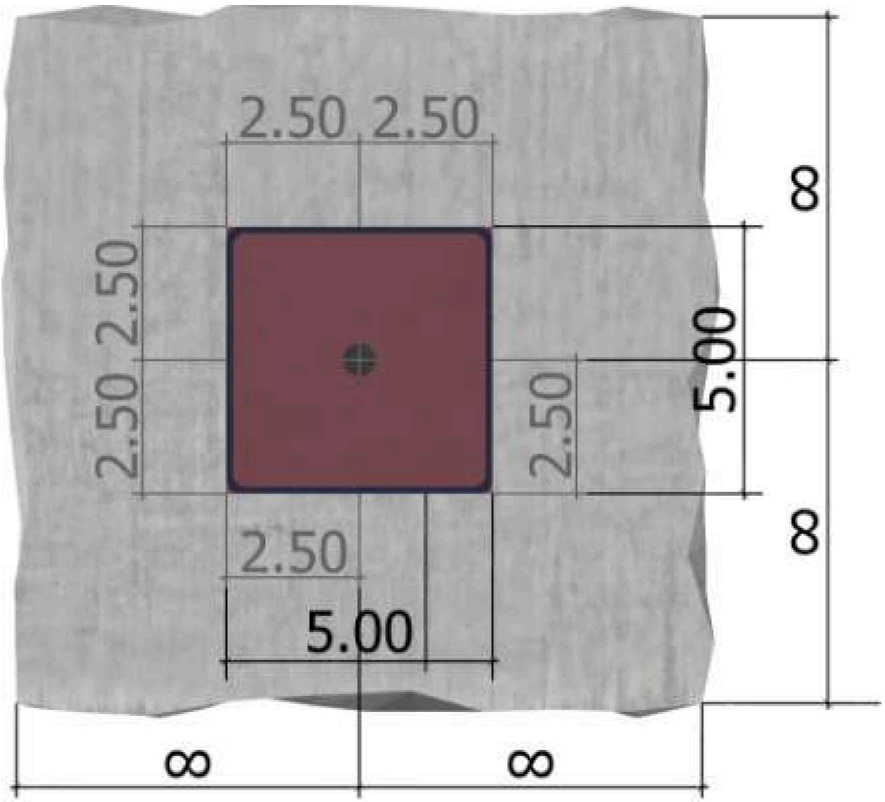
Strength level loads:

N_{ua} [lb]: 4200
V_{uax} [lb]: 660
V_{uay} [lb]: 200
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0

<Figure 1>



<Figure 2>

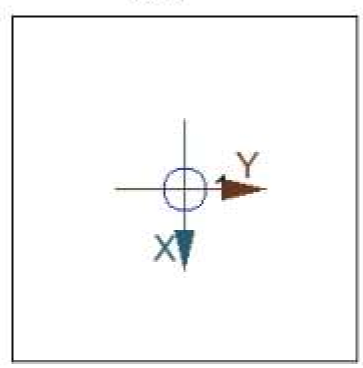


3. Resulting Anchor Forces

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	4200.0	660.0	200.0	689.6
Sum	4200.0	660.0	200.0	689.6

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 4200
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

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.6.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
13110	0.75	9833

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.6.2)

$N_b = k_c \lambda_a \sqrt{f'_c}\, h_{ef}^{1.5}$ (Eq. 17.6.2.2.1)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
24.0	1.00	2500	10.000	37947

$\phi N_{cb} = \phi\,(A_{Nc} / A_{Nco})\,\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.5.1.2 & Eq. 17.6.2.1a)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cb} (lb)
900.00	900.00	-	1.000	1.00	1.000	37947	0.65	24666

6. Adhesive Strength of Anchor in Tension (Sec. 17.6.5)

$\tau_{k,uncr} = \tau_{k,uncr} f_{short\text{-}term} K_{sat} (f'_c / 2{,}500)^n$

$\tau_{k,uncr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	f'_c (psi)	n	$\tau_{k,uncr}$ (psi)
2162	1.00	1.00	2500	0.35	2162

$N_{ba} = \lambda_a \tau_{uncr} \pi d_a h_{ef}$ (Eq. 17.6.5.2.1)

λ_a	τ_{uncr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	2162	0.63	10.000	42451

$\phi N_a = \phi\,(A_{Na} / A_{Na0})\,\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}$ (Sec. 17.5.1.2 & Eq. 17.6.5.1a)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	ϕ	ϕN_a (lb)
307.10	307.10	8.76	-	1.000	1.000	42451	0.65	27593

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

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
7865	1.0	0.65	5112

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

$\phi V_{cp} = \phi\,\min|k_{cp}N_a\,;\,k_{cp}N_{cb}| = \phi\,\min|k_{cp}(A_{Na} / A_{Na0})\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\,;\,k_{cp}(A_{Nc} / A_{Nco})\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.5.1.2 & Eq. 17.7.3.1a)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	307.10	307.10	1.000	1.000	42451	42451

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ	ϕV_{cp} (lb)
900.00	900.00	1.000	1.000	1.000	37947	37947	0.70	53126

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.8)

Tension	Factored Load, N_{ua} (lb)	Design Strength, $øN_n$ (lb)	Ratio	Status
Steel	**4200**	**9833**	**0.43**	**Pass (Governs)**
Concrete breakout	4200	24666	0.17	Pass
Adhesive	4200	27593	0.15	Pass

Shear	Factored Load, V_{ua} (lb)	Design Strength, $øV_n$ (lb)	Ratio	Status
Steel	**690**	**5112**	**0.13**	**Pass (Governs)**
Pryout	690	53126	0.01	Pass

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.8.1	0.43	0.00	42.7%	1.0	Pass

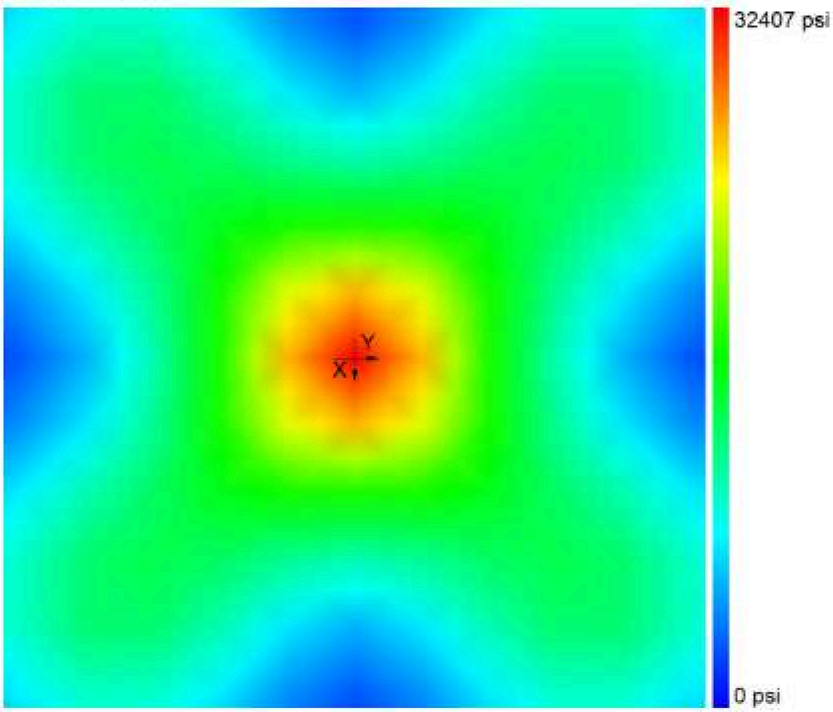
SET-3G w/ 5/8"Ø F1554 Gr. 36 with hef = 10.000 inch meets the selected design criteria.

Base Plate Thickness

Required base plate thickness: 0.403 inch

Steel	**36000 psi**
Maximum stress	**32407 psi**
Calculated plate thickness	**0.403 inch**

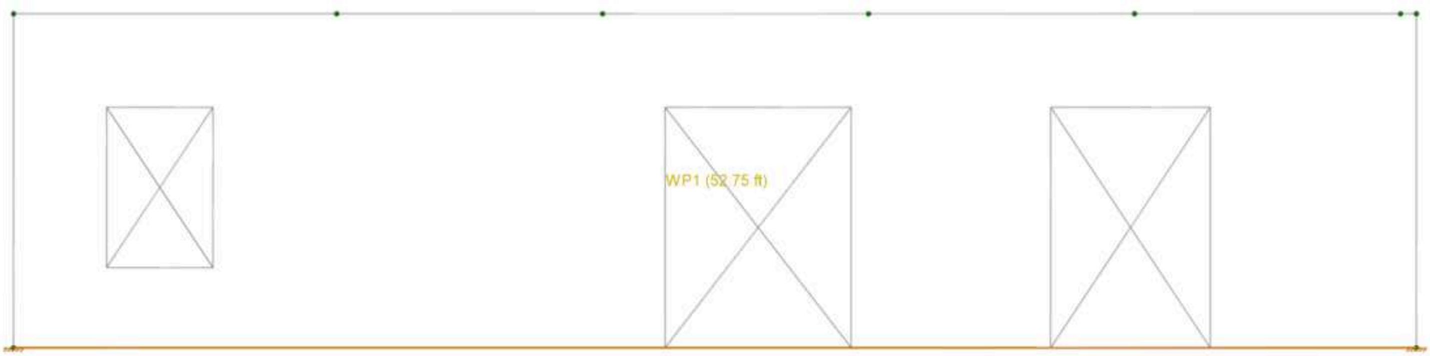
Stress distribution



For ACI and CSA design methods, maximum base plate stress is limited to 0.9 times yield stress.
For ETAG design method, maximum base plate stress is limited to yield stress divide by 1.5.
Plate stress is derived using Von Mises theory.

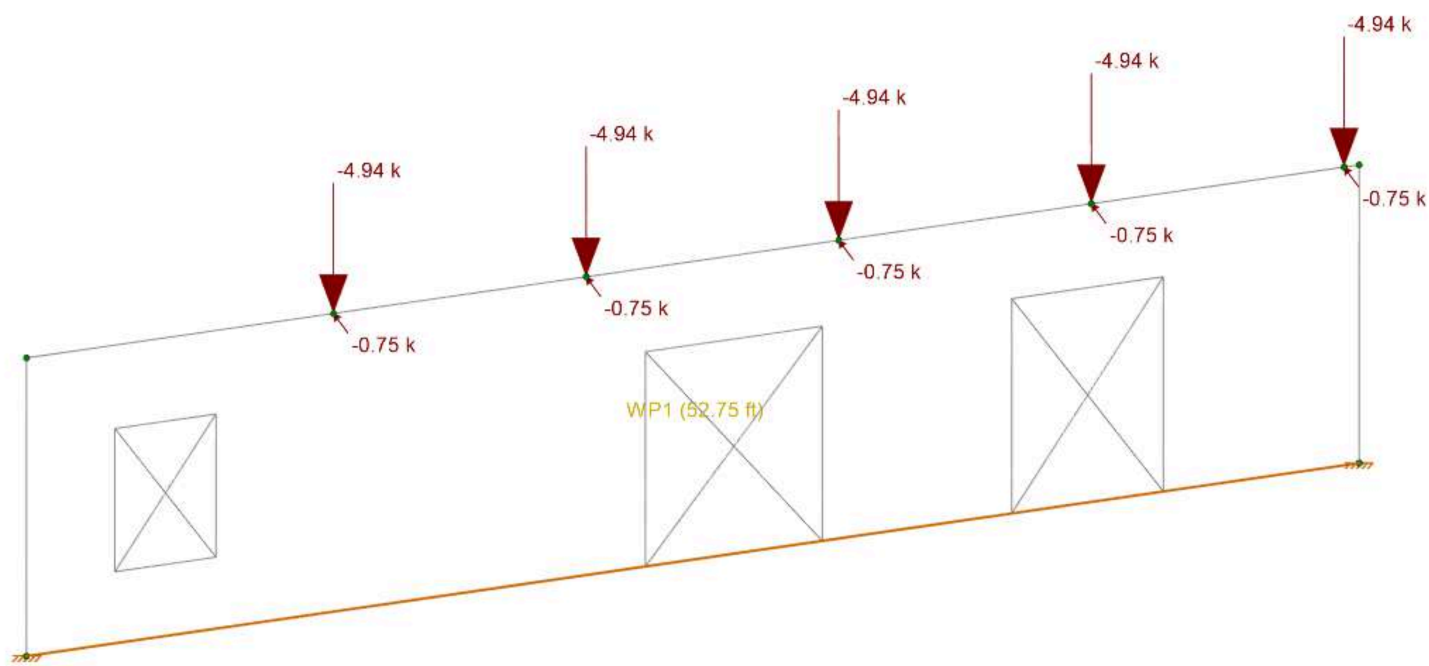
2.6 CONCRETE WALL DESIGN

Analytical view / Walls numbers

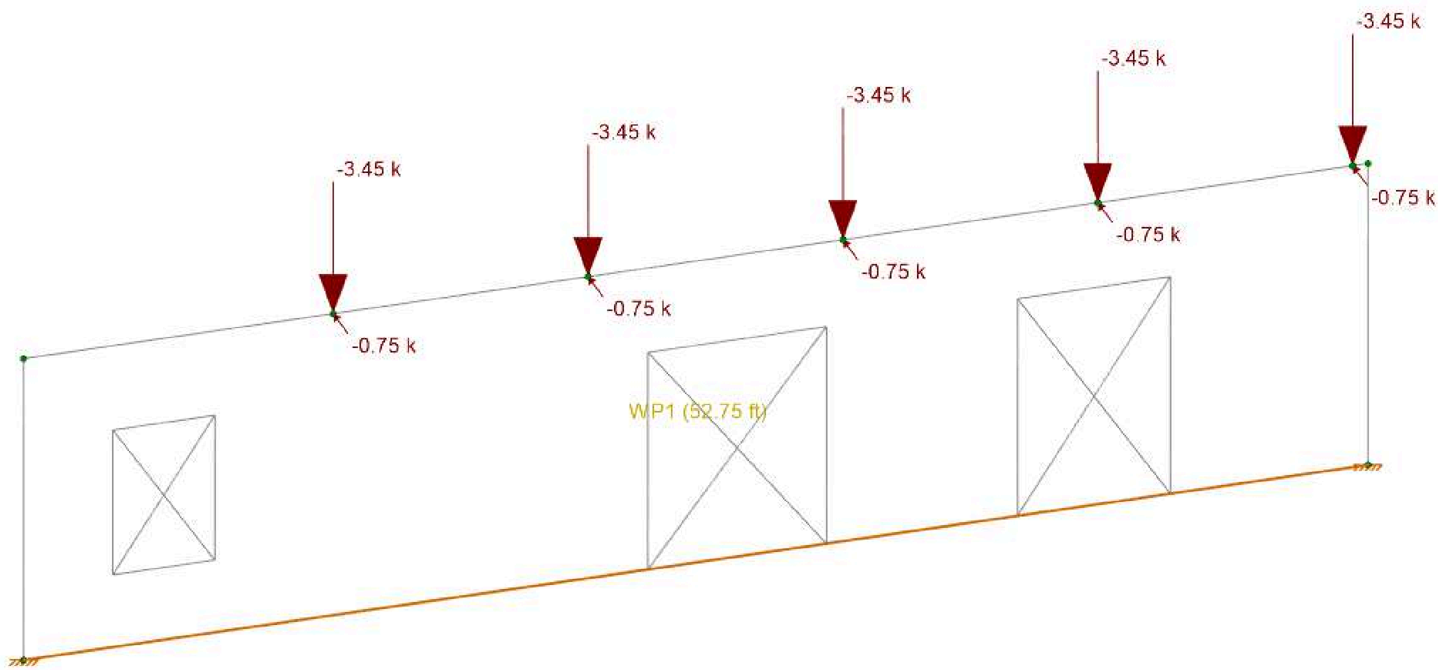


APPLIED LOADS

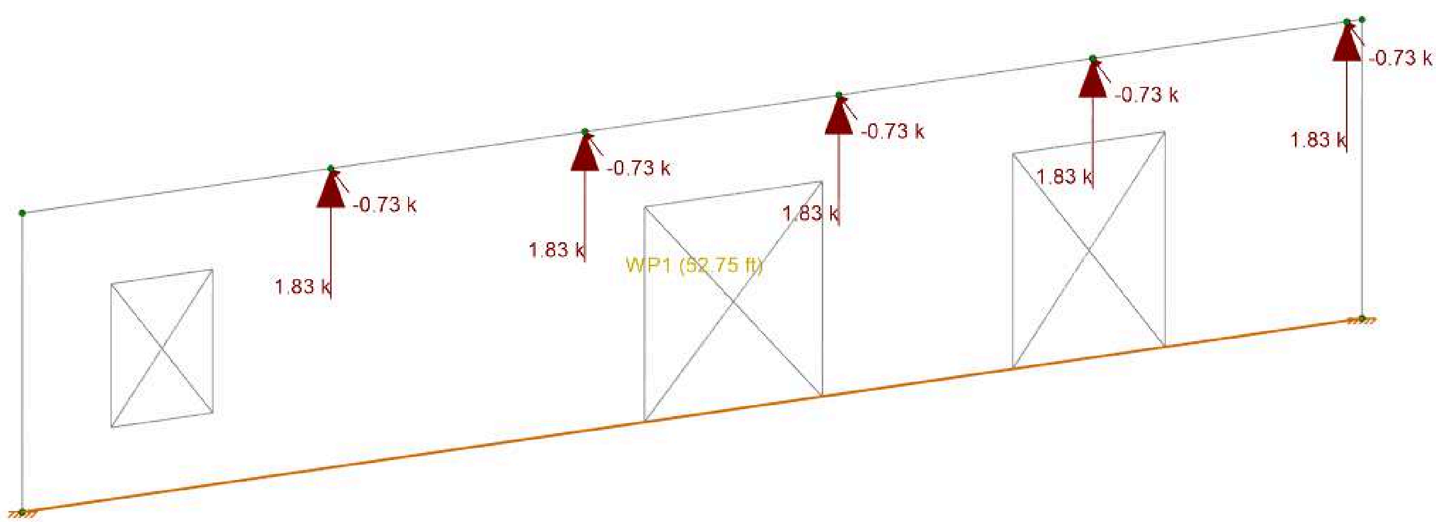
1. **DL1 - Dead weight of concrete wall (automatically)**
2. **DL2 - Roof dead loads**



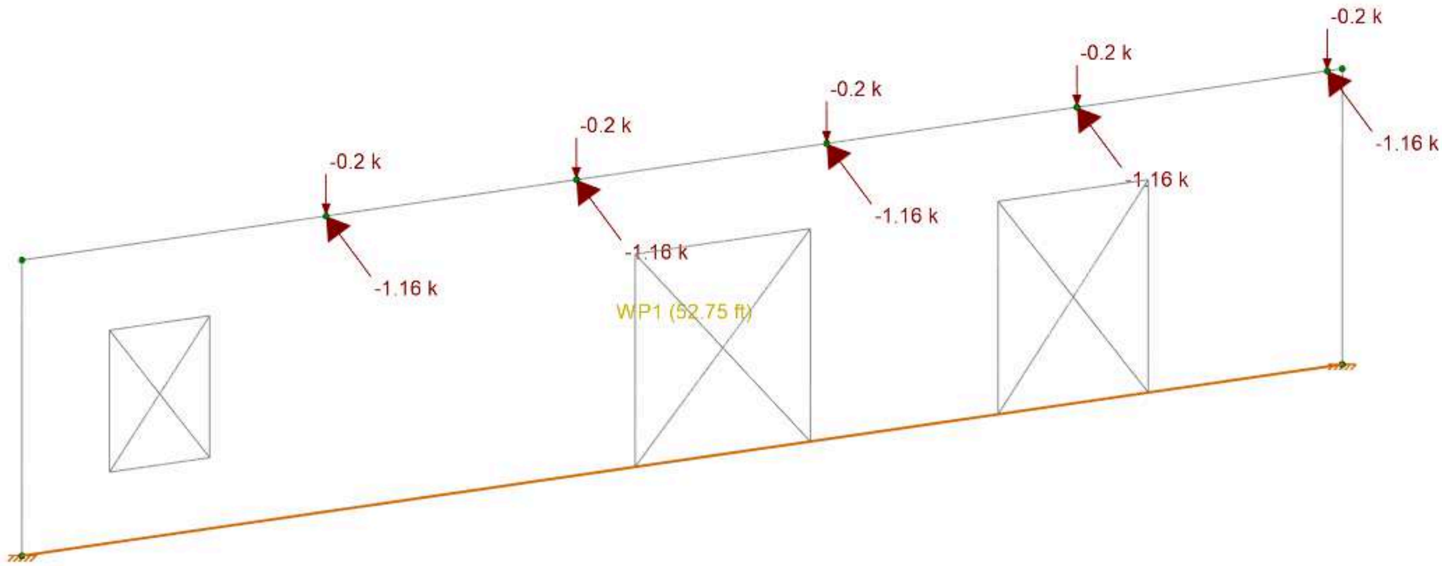
3. Lr - Roof live load



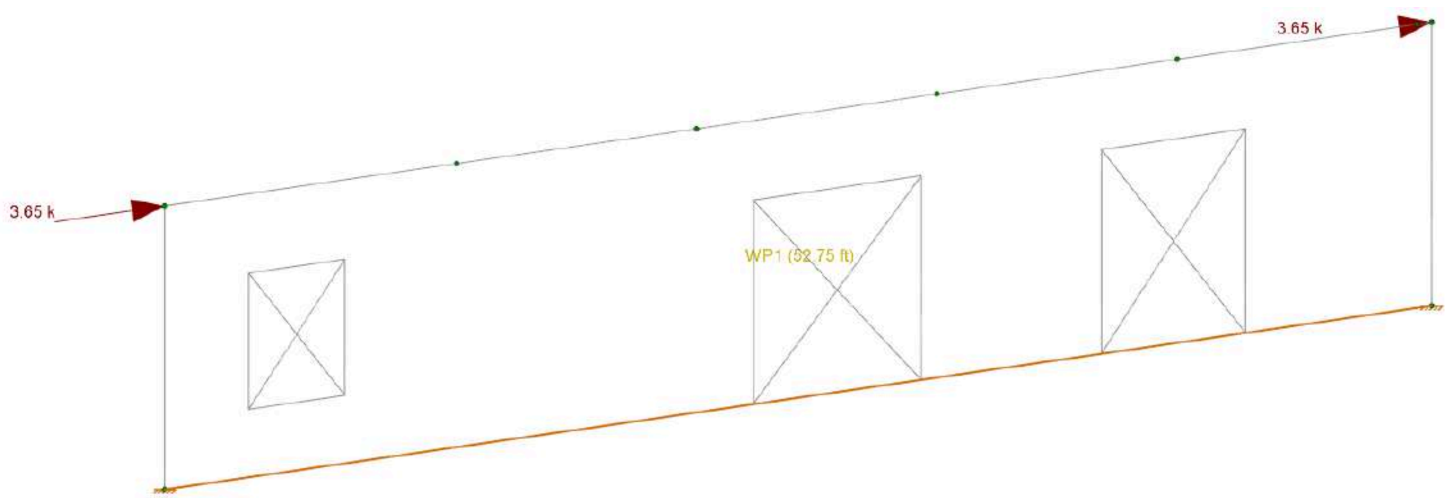
4. WLZ (Wind up)



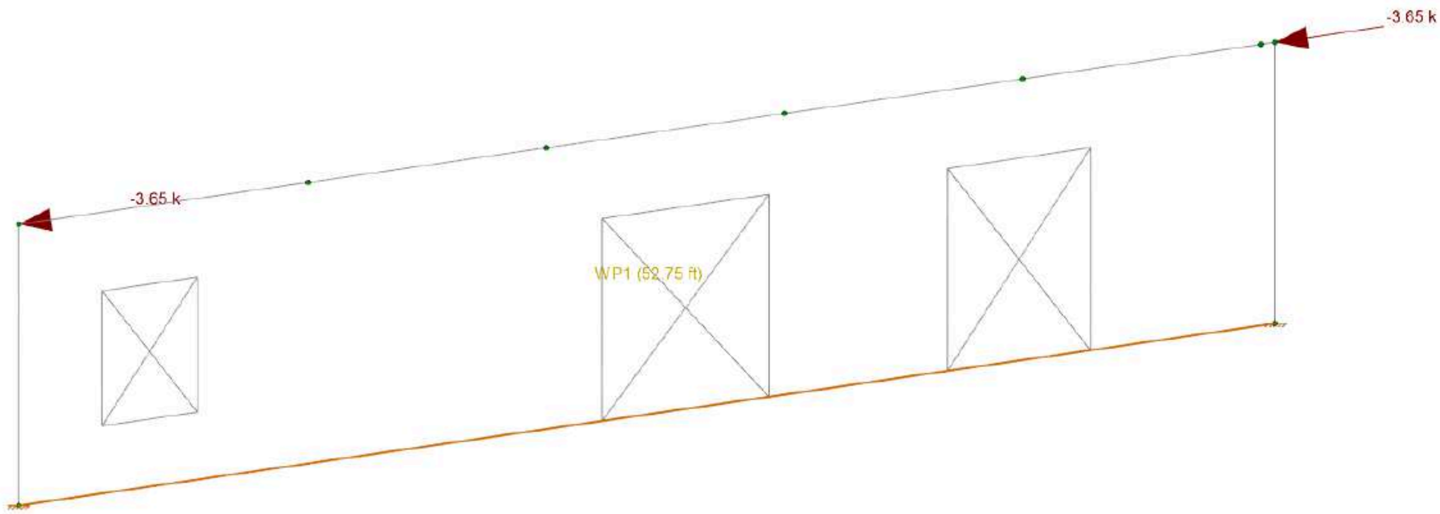
5. WLZ (Wind down)



6. Wx+ (shear)



7. Wx- (shear)



Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Nodal
1	DL1	DL		-1		
2	DL2	DL				31
3	Lr	RLL				10
4	Wind up	WLZ				10
5	Wind down	WLZ				10
6	Wx+ (shear)	WLX				2
7	Wx- (shear)	WLX				2

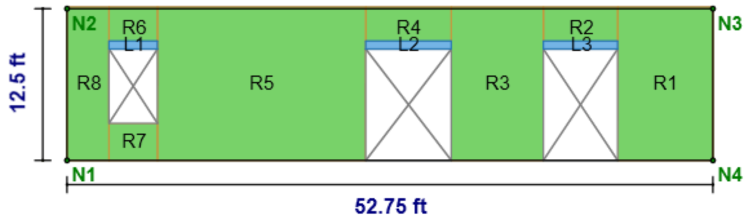
Load Combinations

	Description	Solve	P-Delta	SRSS	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	IBC 21/ASCE Strength 3 (b) (a)	✓	Y		DL	1.2	RLL	1.6	WLX	0.5				
2	IBC 21/ASCE Strength 3 (b) (b)	✓	Y		DL	1.2	RLL	1.6	WLZ	0.5				
3	IBC 21/ASCE Strength 3 (d) (a)	✓	Y		DL	1.2	WLX	0.5						
4	IBC 21/ASCE Strength 3 (d) (b)	✓	Y		DL	1.2	WLZ	0.5						
5	IBC 21/ASCE Strength 4 (a) (a)	✓	Y		DL	1.2	WLX	1	LL	0.5	LLS	1	RLL	0.5
6	IBC 21/ASCE Strength 4 (a) (b)	✓	Y		DL	1.2	WLZ	1	LL	0.5	LLS	1	RLL	0.5
7	IBC 21/ASCE Strength 4 (b) (a)	✓	Y		DL	1.2	WLX	1	LL	0.5	LLS	1		
8	IBC 21/ASCE Strength 4 (b) (b)	✓	Y		DL	1.2	WLZ	1	LL	0.5	LLS	1		
9	IBC 21/ASCE Strength 5 (a)	✓	Y		DL	0.9	WLX	1						
10	IBC 21/ASCE Strength 5 (b)	✓	Y		DL	0.9	WLZ	1						

CONCRETE WALLS CHECK

Detail Report: WP1

Concrete Wall



CRITERIA		GEOMETRY		MATERIALS	
Code:	ACI 318-19	**Total Height (ft):**	12.5	**Material Set:**	Conc4000NW
Design Rule:	CSW	**Total Length (ft):**	52.75	**Concrete f'c (ksi):**	4
Seismic Rule:	None	**Thickness (in):**	30	**Concrete E (ksi):**	3644
Loc of r/f:	Each Face	**Int Cover (-z) (in):**	1	**Concrete G (ksi):**	1584
Outer Bars:	Vertical	**Ext Cover (+z) (in):**	1	**Conc Density (k/ft^3):**	0.145
Vert Bar Size:	#7	**Cover Open/Edge (in):**	2	**Lambda:**	1
Horz Bar Size:	#7	**K:**	1	**Conc Str Blk:**	Rectangular
Transfer In?:	No	**Use Cracked?:**	Yes	**Vert Bar Fy (ksi):**	60
Transfer Out?:	No	**In Icr Factor:**	0.7	**Horz Bar Fy (ksi):**	60
Group Wall?:	No	**Out Icr Factor:**	0.35	**Steel E (ksi):**	29000

REGION RESULTS

Region	UC Max In Plane	LC	UC Shear In Plane	LC	Delta Max In Plane(in)	LC	UC Max Out Plane	LC	UC Shear Out Plane	LC	Delta Max Out Plane(in)	LC
R1	0.021	1	0.003	1	0	1	0.161	6	0.065	6	0.021	6
R2	0.002	1	0.001	1	0	8	0.007	6	0.038	6	0.012	6
R3	0.02	1	0.003	1	0	1	0.141	6	0.058	6	0.019	6
R4	0.005	1	0.002	1	0	1	0.004	6	0.01	6	0.01	6
R5	0.009	1	0.002	1	0	1	0.087	6	0.039	6	0.013	6
R6	0.001	8	0.002	8	0	1	0.003	6	0.004	6	0.005	6
R7	0.005	1	0.004	1	0	1	0.036	6	0.035	6	0.008	6
R8	0.012	1	0.002	8	0	1	0.033	6	0.02	6	0.007	6

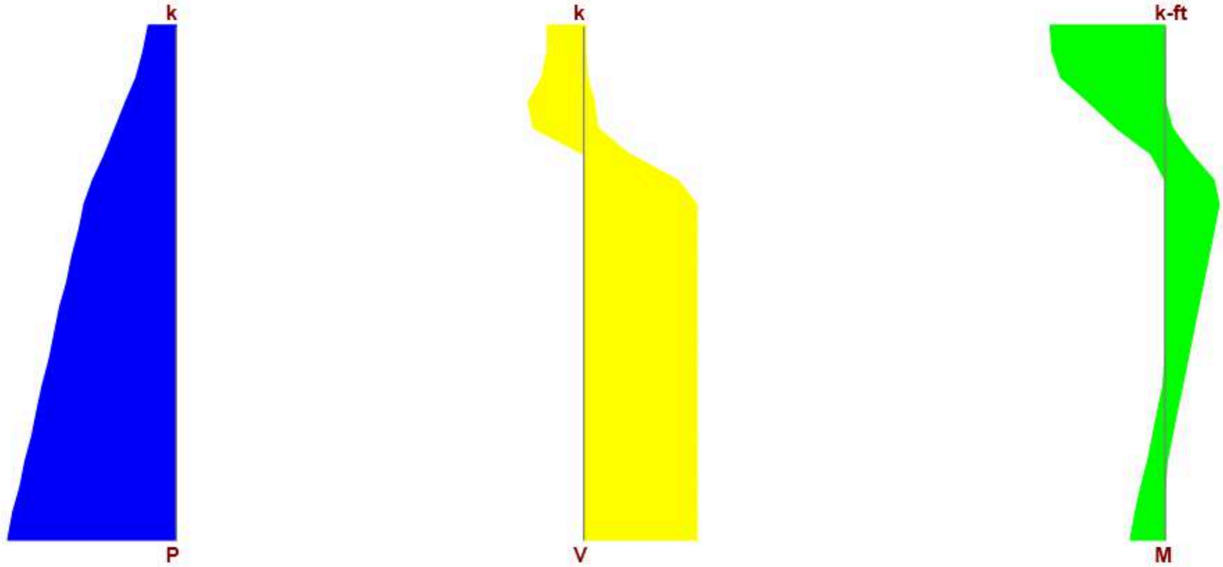
REINFORCEMENT RESULTS

Region	Vertical Reinforcement	Horizontal Reinforcement	Diagonal Reinforcement
R1	#7@18in oc e.f.	#7@18in oc e.f.	N/A
R2	#7@18in oc e.f.	#7@18in oc e.f.	N/A
R3	#7@18in oc e.f.	#7@18in oc e.f.	N/A
R4	#7@18in oc e.f.	#7@18in oc e.f.	N/A
R5	#7@18in oc e.f.	#7@18in oc e.f.	N/A
R6	#7@18in oc e.f.	#7@18in oc e.f.	N/A
R7	#7@18in oc e.f.	#7@18in oc e.f.	N/A
R8	#7@18in oc e.f.	#7@18in oc e.f.	N/A

Detail Report: WP1 (In-Plane, Region R1)

CRITERIA		GEOMETRY		MATERIALS	
Code:	ACI 318-19	**Total Height (ft):**	12.5	**Material Set:**	Conc4000NW
Design Rule:	CSW	**Total Length (ft):**	7.75	**Concrete f'c (ksi):**	4
Seismic Rule:	None	**Thickness (in):**	30	**Concrete E (ksi):**	3644
Loc of r/f:	Each Face	**Int Cover (-z) (in):**	1	**Concrete G (ksi):**	1584
Outer Bars:	Vertical	**Ext Cover (+z) (in):**	1	**Conc Density (k/ft^3):**	0.145
Vert Bar Size:	#7	**Cover Open/Edge (in):**	2	**Lambda:**	1
Horz Bar Size:	#7	**K:**	1	**Conc Str Blk:**	Rectangular
Vert Bar Spac (in):	18	**Use Cracked?:**	Yes	**Vert Bar Fy (ksi):**	60
Horz Bar Spac (in):	18	**Icr Factor:**	0.7	**Horz Bar Fy (ksi):**	60
Group Wall?:	No			**Steel E (ksi):**	29000

ENVELOPE DIAGRAMS



Min: 9.138 at 12.5 ft
Max: 59.832 at 0 ft

Min: -1.923 at 3.75 ft
Max: 0.901 at 10.625 ft

Min: -12.135 at 8.125 ft
Max: 25.478 at 12.5 ft

ACI 318-19 Code Check

AXIAL/BENDING DETAILS					
UC Max:	0.021	**phi*Pn:**	NC	**phi eff.:**	0.9
Location (ft):	12.5	**Gov Mu (k-ft):**	25.478	**Gov LC:**	1
Gov Pu (k):	0	**phi*Mn (k-ft):**	1207.968		

SHEAR DETAILS					
UC Max:	0.003	**phi*Vn (k):**	646.754	**Vs (k):**	372.819
Location (ft):	0	**Vnmax (k):**	1411.641	**Gov LC:**	1
Gov Vu (k):	-1.923	**Vc (k):**	489.521		

DEFLECTION DETAILS			
Delta max (in):	4.978e-5	**Location (ft):**	12.5
Deflection Ratio:	H/10000	**Gov LC:**	1

REINFORCEMENT DETAILS

As Provided (H) (in^2):	10.824	**rho min (H):**	0.002	**As min (V) (in^2):**	4.185
rho Provided (H):	0.002	**As Provided (V) (in^2):**	6.013	**rho min (V):**	0.002
As min (H) (in^2):	9	**rho Provided (V):**	0.002		

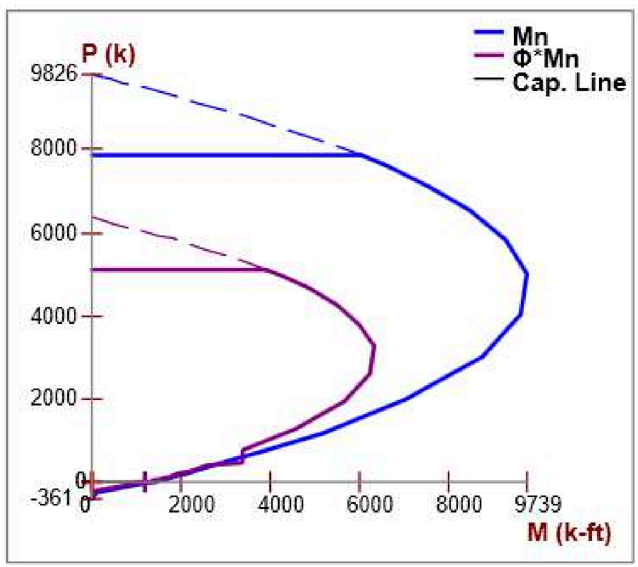
WALL SEGMENT SECTION PROPERTIES

Total Length (ft):	7.75	**Icracked (in^4):**	1.408e+6	**KL/r:**	5.587
A (in^2):	2790	**Cracked Mom, Mcr (k-ft):**	1709.409		
Igross (in^4):	2.011e+6	**r (in):**	22.462		

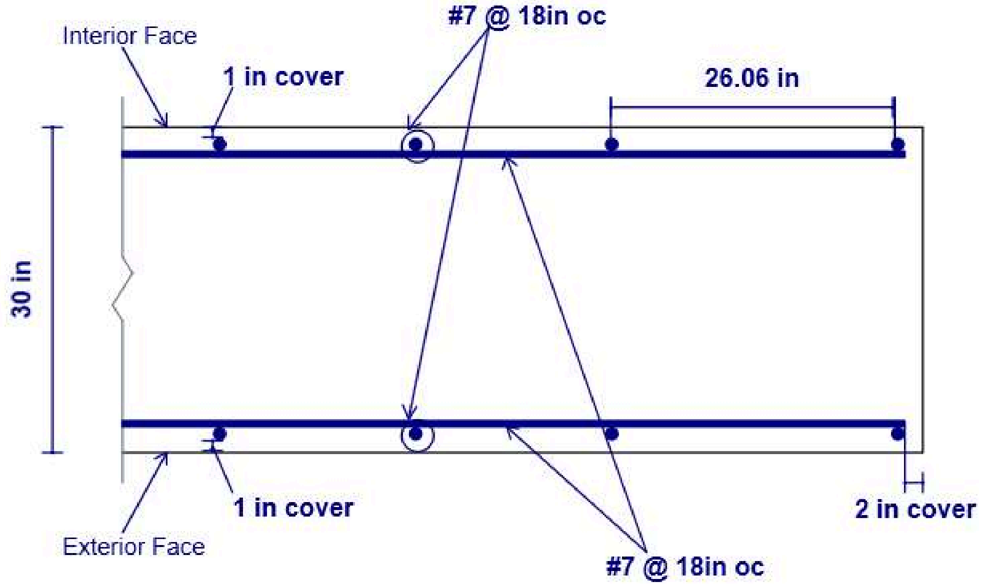
SLENDER BENDING SPAN RESULTS

KL/r in	Cm in	Lu in (ft)	Pc (k)	deltaNS	M act (k-ft)	M2 min (k-ft)	Mc in (k-ft)
5.587	0.715	12.5	0	N/A	0	0	N/A

IN-PLANE WALL INTERACTION DIAGRAM



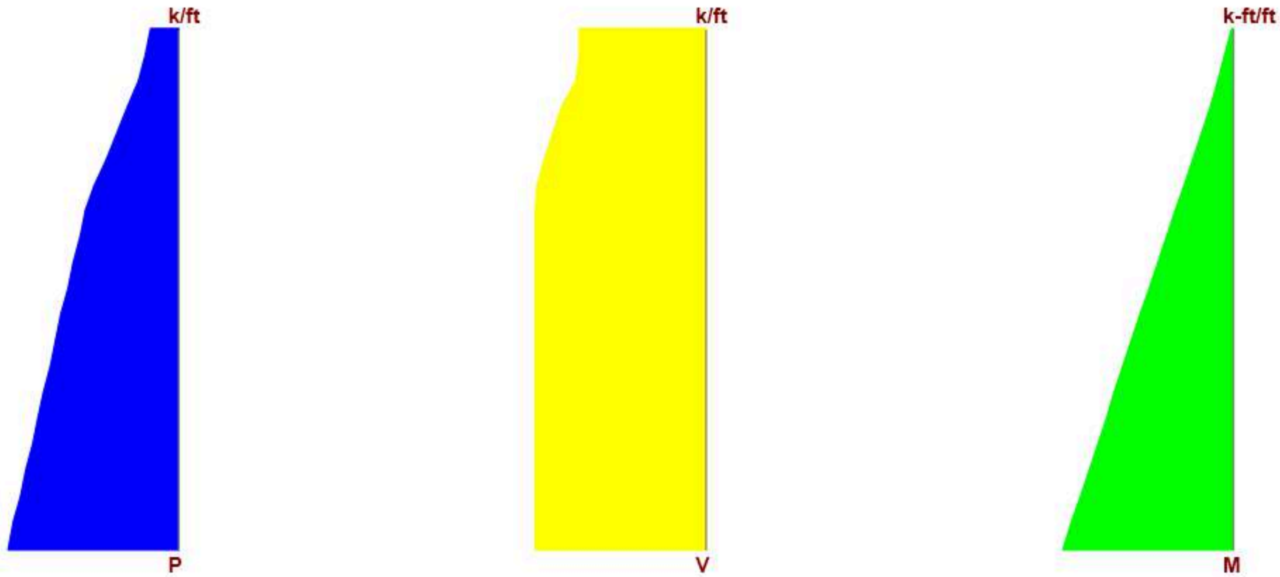
CROSS SECTION DETAILING



Detail Report: WP1 (Out-of-Plane, Region R1)

CRITERIA		GEOMETRY		MATERIALS	
Code:	ACI 318-19	**Total Height (ft):**	12.5	**Material Set:**	Conc4000NW
Design Rule:	CSW	**Total Length (ft):**	7.75	**Concrete f'c (ksi):**	4
Seismic Rule:	None	**Thickness (in):**	30	**Concrete E (ksi):**	3644
Loc of r/f:	Each Face	**Int Cover (-z) (in):**	1	**Concrete G (ksi):**	1584
Outer Bars:	Vertical	**Ext Cover (+z) (in):**	1	**Conc Density (k/ft^3):**	0.145
Vert Bar Size:	#7	**Cover Open/Edge (in):**	2	**Lambda:**	1
Horz Bar Size:	#7	**K:**	1	**Conc Str Blk:**	Rectangular
Vert Bar Spac (in):	18	**Use Cracked?:**	Yes	**Vert Bar Fy (ksi):**	60
Horz Bar Spac (in):	18	**Icr Factor:**	0.35	**Horz Bar Fy (ksi):**	60
Group Wall?:	No			**Steel E (ksi):**	29000

ENVELOPE DIAGRAMS



Min: 1.179 at 12.5 ft
Max: 7.72 at 0 ft

Min: 0.488 at 11.875 ft
Max: 0.659 at 3.75 ft

Min: 0.009 at 12.5 ft
Max: 8.067 at 0 ft

SHEAR DETAILS

UC Max:	0.065	**Gov Vu (k/ft):**	659.143	**phi*Vns (k/ft):**	0
Location (ft):	8.125	**phi*Vnc (k/ft):**	10148.51	**Gov LC:**	6

AXIAL/BENDING DETAILS

UC Max Int (-z):	0	**phi eff. Int (-z):**	0.65	**Gov Mu Ext (+z) (k-ft/ft):**	8.067
Location (ft):	0	**Gov LC Int (-z):**	10	**phi*Mn Ext (+z) (k-ft/ft):**	50.049
Gov Pu Int (-z) (k/ft):	0	**UC Max Ext (+z):**	0.161	**phi eff. Ext (+z):**	0.9
phi*Pn Int (-z) (k/ft):	659.316	**Location (ft):**	0	**Gov LC Ext (+z):**	6
Gov Mu Int (-z) (k-ft/ft):	0	**Gov Pu Ext (+z) (k/ft):**	0		
phi*Mn Int (-z):	NC	**phi*Pn Ext (+z):**	NC		

DEFLECTION DETAILS

Delta max (in):	0.021	**Location (ft):**	12.5
Deflection Ratio:	H/7138	**Gov LC:**	6

REINFORCEMENT DETAILS

As Provided (V) (in^2):	6.013	**As min (V) (in^2):**	4.185
rho Provided (V):	0.002	**rho min (V):**	0.002

WALL SEGMENT SECTION PROPERTIES

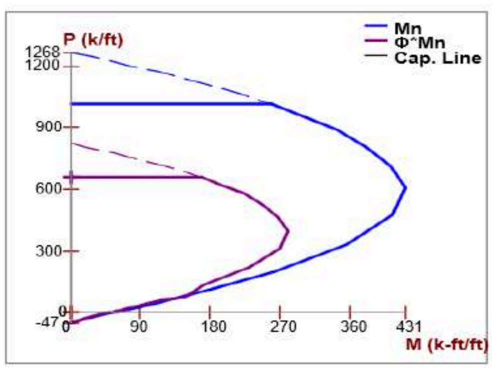
Total Width (in):	18	**Icracked (in^4):**	14175	**KL/r:**	17.321
A (in^2):	540	**Cracked Mom, Mcr (k-ft):**	551.422		
Igross (in^4):	40500	**r (in):**	5.123		

SLENDER BENDING SPAN RESULTS

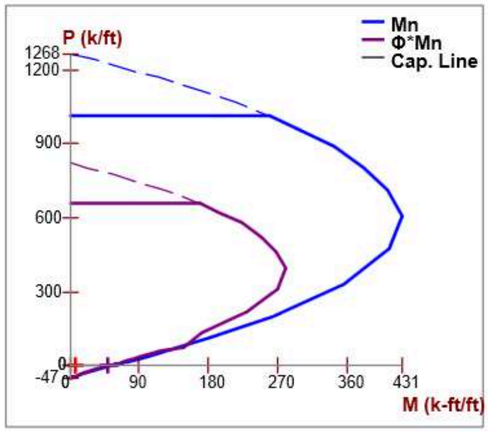
	KL/r out	Cm out	Lu out (ft)	Pc (lb/ft)	deltaNS	M act (k-ft/ft)	M2 min (k-ft/ft)	Mc out (k-ft/ft)
Interior	17.321	0.6	12.5	0	N/A	0	0	N/A(0ft)
Exterior				0	N/A	0	0	N/A(0ft)

OUT-PLANE WALL INTERACTION DIAGRAM

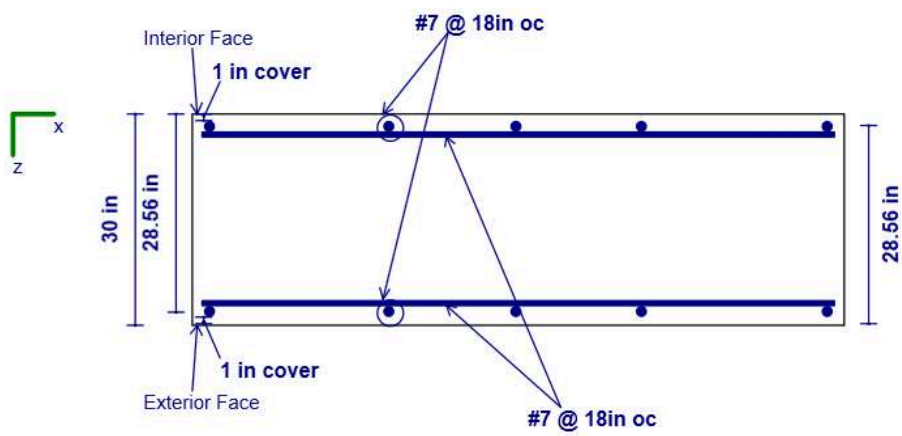
Interior (-z) Face Wall Interaction Diagram



Exterior (+z) Face Wall Interaction Diagram



CROSS SECTION DETAILING



Detail Report: WP1 (In-Plane, Region R2)

CRITERIA		GEOMETRY		MATERIALS	
Code:	ACI 318-19	**Total Height (ft):**	3.5	**Material Set:**	Conc4000NW
Design Rule:	CSW	**Total Length (ft):**	6	**Concrete f'c (ksi):**	4
Seismic Rule:	None	**Thickness (in):**	30	**Concrete E (ksi):**	3644
Loc of r/f:	Each Face	**Int Cover (-z) (in):**	1	**Concrete G (ksi):**	1584
Outer Bars:	Vertical	**Ext Cover (+z) (in):**	1	**Conc Density (k/ft^3):**	0.145
Vert Bar Size:	#7	**Cover Open/Edge (in):**	2	**Lambda:**	1
Horz Bar Size:	#7	**K:**	1	**Conc Str Blk:**	Rectangular
Vert Bar Spac (in):	18	**Use Cracked?:**	Yes	**Vert Bar Fy (ksi):**	60
Horz Bar Spac (in):	18	**Icr Factor:**	0.7	**Horz Bar Fy (ksi):**	60
Group Wall?:	No			**Steel E (ksi):**	29000

ENVELOPE DIAGRAMS

Min: 4.96 at 0 ft
Max: 8.202 at 1.925 ft

Min: -0.265 at 1.75 ft
Max: 0.146 at 1.75 ft

Min: 0.662 at 0 ft
Max: 1.293 at 3.5 ft

ACI 318-19 Code Check

AXIAL/BENDING DETAILS					
UC Max:	0.002	**phi*Pn:**	NC	**phi eff.:**	0.9
Location (ft):	3.5	**Gov Mu (k-ft):**	1.293	**Gov LC:**	1
Gov Pu (k):	0	**phi*Mn (k-ft):**	744.115		

SHEAR DETAILS

UC Max:	0.001	**phi*Vn (k):**	523.849	**Vs (k):**	288.634
Location (ft):	1.75	**Vnmax (k):**	1092.883	**Gov LC:**	1
Gov Vu (k):	-0.265	**Vc (k):**	409.831		

DEFLECTION DETAILS

Delta max (in):	2.173e-5	**Location (ft):**	12.5
Deflection Ratio:	H/10000	**Gov LC:**	8

REINFORCEMENT DETAILS

As Provided (H) (in^2):	6.013	**rho min (H):**	0.002	**As min (V) (in^2):**	3.24
rho Provided (H):	0.005	**As Provided (V) (in^2):**	4.811	**rho min (V):**	0.001
As min (H) (in^2):	2.52	**rho Provided (V):**	0.002		

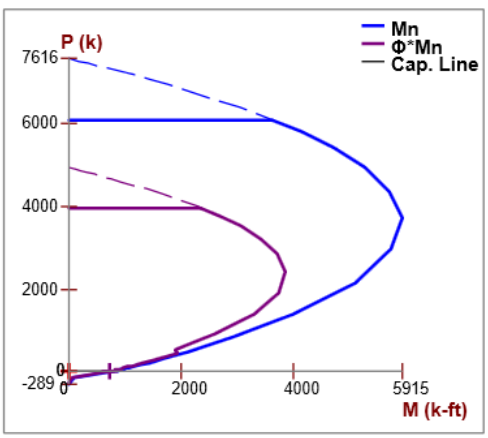
WALL SEGMENT SECTION PROPERTIES

Total Length (ft):	6	**Icracked (in^4):**	6.532e+5	**KL/r:**	2.021
A (in^2):	2160	**Cracked Mom, Mcr (k-ft):**	1024.578		
Igross (in^4):	9.331e+5	**r (in):**	17.39		

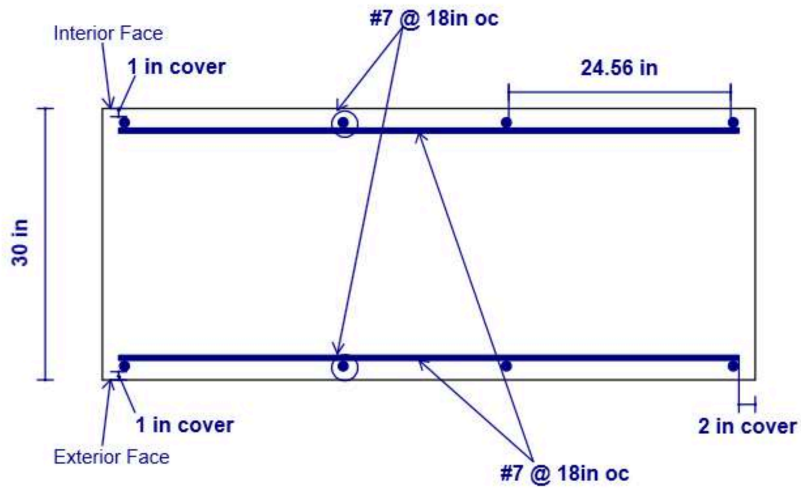
SLENDER BENDING SPAN RESULTS

-Slenderness(P - Little Delta) and minimum moment considerations are only done for full - height regions.

IN-PLANE WALL INTERACTION DIAGRAM



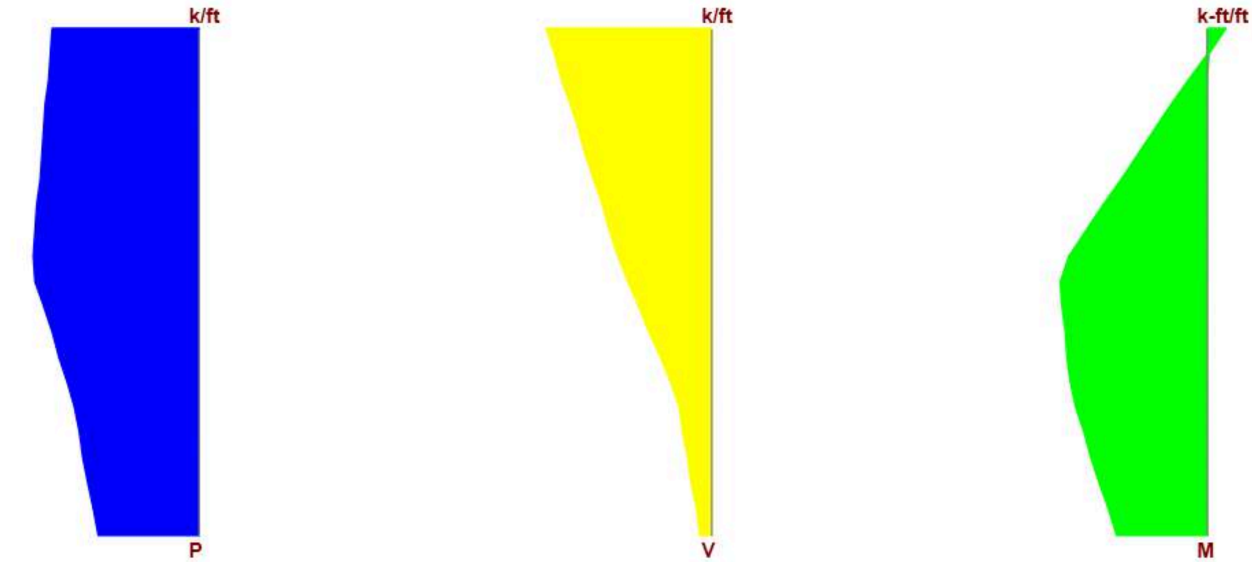
CROSS SECTION DETAILING



Detail Report: WP1 (Out-of-Plane, Region R2)

CRITERIA		GEOMETRY		MATERIALS	
Code:	ACI 318-19	**Total Height (ft):**	3.5	**Material Set:**	Conc4000NW
Design Rule:	CSW	**Total Length (ft):**	6	**Concrete f'c (ksi):**	4
Seismic Rule:	None	**Thickness (in):**	30	**Concrete E (ksi):**	3644
Loc of r/f:	Each Face	**Int Cover (-z) (in):**	1	**Concrete G (ksi):**	1584
Outer Bars:	Vertical	**Ext Cover (+z) (in):**	1	**Conc Density (k/ft^3):**	0.145
Vert Bar Size:	#7	**Cover Open/Edge (in):**	2	**Lambda:**	1
Horz Bar Size:	#7	**K:**	1	**Conc Str Blk:**	Rectangular
Vert Bar Spac (in):	18	**Use Cracked?:**	Yes	**Vert Bar Fy (ksi):**	60
Horz Bar Spac (in):	18	**Icr Factor:**	0.35	**Horz Bar Fy (ksi):**	60
Group Wall?:	No			**Steel E (ksi):**	29000

ENVELOPE DIAGRAMS



Min: 0.827 at 0 ft
Max: 1.367 at 1.925 ft

Min: 0.022 at 0 ft
Max: 0.382 at 3.5 ft

Min: -0.046 at 3.5 ft
Max: 0.366 at 1.75 ft

AXIAL/BENDING DETAILS

UC Max Int (-z):	0.001	**phi eff. Int (-z):**	0.9	**Gov Mu Ext (+z) (k-ft/ft):**	0.366
Location (ft):	3.5	**Gov LC Int (-z):**	6	**phi*Mn Ext (+z) (k-ft/ft):**	51.649
Gov Pu Int (-z) (k/ft):	0	**UC Max Ext (+z):**	0.007	**phi eff. Ext (+z):**	0.9
phi*Pn Int (-z):	NC	**Location (ft):**	1.75	**Gov LC Ext (+z):**	6
Gov Mu Int (-z) (k-ft/ft):	-0.046	**Gov Pu Ext (+z) (k/ft):**	0		
phi*Mn Int (-z) (k-ft/ft):	51.649	**phi*Pn Ext (+z):**	NC		

SHEAR DETAILS

UC Max:	0.038	**Gov Vu (k/ft):**	381.58	**phi*Vns (k/ft):**	0
Location (ft):	3.5	**phi*Vnc (k/ft):**	9927.974	**Gov LC:**	6

DEFLECTION DETAILS

Delta max (in):	0.012	**Location (ft):**	0.625
Deflection Ratio:	H/3570	**Gov LC:**	6

REINFORCEMENT DETAILS

As Provided (V) (in^2):	4.811	**As min (V) (in^2):**	3.24
rho Provided (V):	0.002	**rho min (V):**	0.001

WALL SEGMENT SECTION PROPERTIES

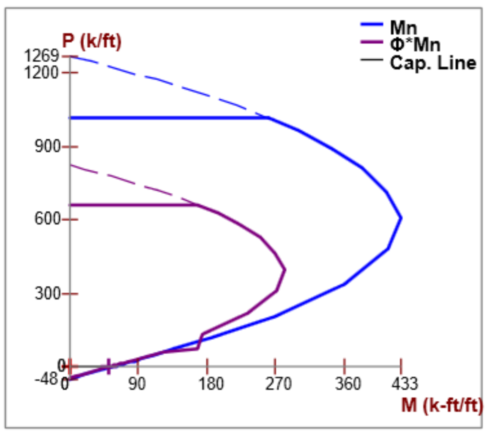
Total Width (in):	18	**Icracked (in^4):**	14175	**KL/r:**	4.85
A (in^2):	540	**Cracked Mom, Mcr (k-ft):**	426.907		
Igross (in^4):	40500	**r (in):**	5.123		

SLENDER BENDING SPAN RESULTS

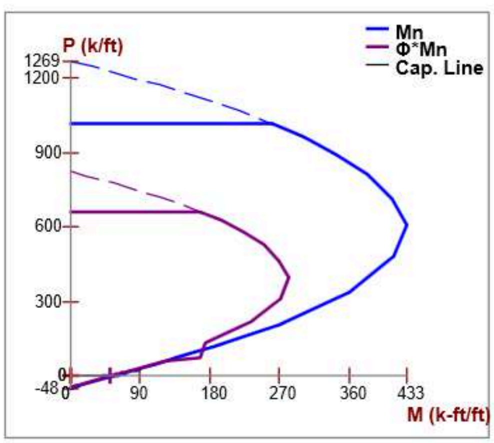
-Slenderness(P - Little Delta) and minimum moment considerations are only done for full - height regions.

OUT-PLANE WALL INTERACTION DIAGRAM

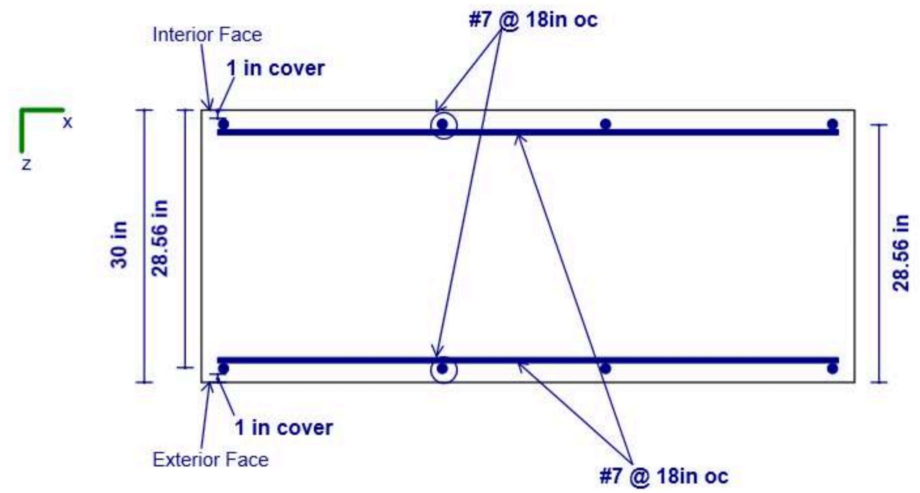
Interior (-z) Face Wall Interaction Diagram



Exterior (+z) Face Wall Interaction Diagram



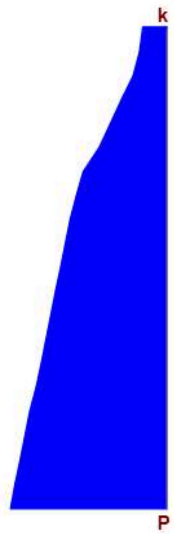
CROSS SECTION DETAILING



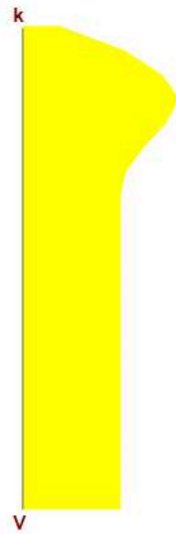
Detail Report: WP1 (In-Plane, Region R3)

CRITERIA		**GEOMETRY**		**MATERIALS**	
Code:	ACI 318-19	**Total Height (ft):**	12.5	**Material Set:**	Conc4000NW
Design Rule:	CSW	**Total Length (ft):**	7.5	**Concrete f'c (ksi):**	4
Seismic Rule:	None	**Thickness (in):**	30	**Concrete E (ksi):**	3644
Loc of r/f:	Each Face	**Int Cover (-z) (in):**	1	**Concrete G (ksi):**	1584
Outer Bars:	Vertical	**Ext Cover (+z) (in):**	1	**Conc Density (k/ft^3):**	0.145
Vert Bar Size:	#7	**Cover Open/Edge (in):**	2	**Lambda:**	1
Horz Bar Size:	#7	**K:**	1	**Conc Str Blk:**	Rectangular
Vert Bar Spac (in):	18	**Use Cracked?:**	Yes	**Vert Bar Fy (ksi):**	60
Horz Bar Spac (in):	18	**Icr Factor:**	0.7	**Horz Bar Fy (ksi):**	60
Group Wall?:	No			**Steel E (ksi):**	29000

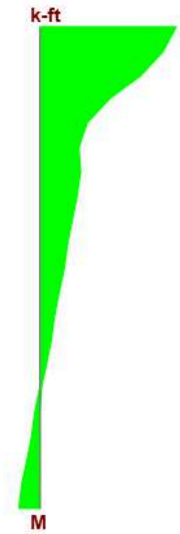
ENVELOPE DIAGRAMS



Min: 9.122 at 12.5 ft
Max: 62.752 at 0 ft



Min: -1.983 at 10.625 ft
Max: -0.467 at 12.5 ft



Min: -23.965 at 12.5 ft
Max: 3.582 at 0 ft

ACI 318-19 Code Check

AXIAL/BENDING DETAILS

UC Max:	0.02	**phi*Pn:**	NC	**phi eff.:**	0.9
Location (ft):	12.5	**Gov Mu (k-ft):**	-23.965	**Gov LC:**	1
Gov Pu (k):	0	**phi*Mn (k-ft):**	1181.585		

SHEAR DETAILS

UC Max:	0.003	**phi*Vn (k):**	612.12	**Vs (k):**	360.792
Location (ft):	10.625	**Vnmax (k):**	1366.104	**Gov LC:**	1
Gov Vu (k):	-1.983	**Vc (k):**	455.368		

DEFLECTION DETAILS

Delta max (in):	7.042e-5	**Location (ft):**	12.5
Deflection Ratio:	H/10000	**Gov LC:**	1

REINFORCEMENT DETAILS

As Provided (H) (in^2):	10.824	**rho min (H):**	0.002	**As min (V) (in^2):**	4.05
rho Provided (H):	0.002	**As Provided (V) (in^2):**	6.013	**rho min (V):**	0.002
As min (H) (in^2):	9	**rho Provided (V):**	0.002		

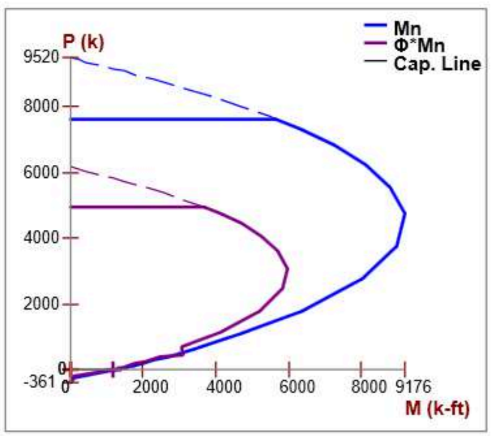
WALL SEGMENT SECTION PROPERTIES

Total Length (ft):	7.5	**Icracked (in^4):**	1.276e+6	**KL/r:**	5.774
A (in^2):	2700	**Cracked Mom, Mcr (k-ft):**	1600.903		
Igross (in^4):	1.822e+6	**r (in):**	21.737		

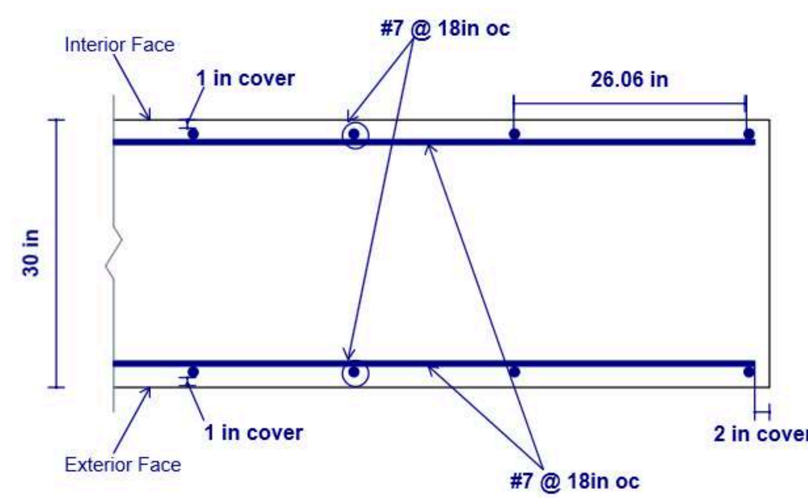
SLENDER BENDING SPAN RESULTS

KL/r in	Cm in	Lu in (ft)	Pc (k)	deltaNS	M act (k-ft)	M2 min (k-ft)	Mc in (k-ft)
5.774	0.54	12.5	0	N/A	0	0	N/A

IN-PLANE WALL INTERACTION DIAGRAM



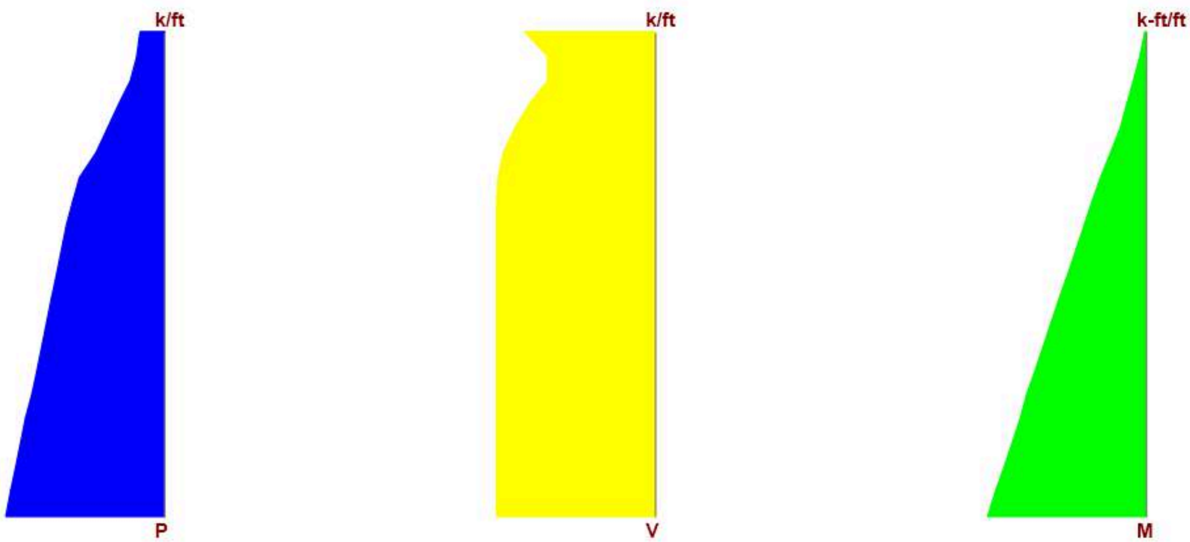
CROSS SECTION DETAILING



Detail Report: WP1 (Out-of-Plane, Region R3)

CRITERIA		GEOMETRY		MATERIALS	
Code:	ACI 318-19	**Total Height (ft):**	12.5	**Material Set:**	Conc4000NW
Design Rule:	CSW	**Total Length (ft):**	7.5	**Concrete f'c (ksi):**	4
Seismic Rule:	None	**Thickness (in):**	30	**Concrete E (ksi):**	3644
Loc of r/f:	Each Face	**Int Cover (-z) (in):**	1	**Concrete G (ksi):**	1584
Outer Bars:	Vertical	**Ext Cover (+z) (in):**	1	**Conc Density (k/ft^3):**	0.145
Vert Bar Size:	#7	**Cover Open/Edge (in):**	2	**Lambda:**	1
Horz Bar Size:	#7	**K:**	1	**Conc Str Blk:**	Rectangular
Vert Bar Spac (in):	18	**Use Cracked?:**	Yes	**Vert Bar Fy (ksi):**	60
Horz Bar Spac (in):	18	**Icr Factor:**	0.35	**Horz Bar Fy (ksi):**	60
Group Wall?:	No			**Steel E (ksi):**	29000

ENVELOPE DIAGRAMS



Min: 1.216 at 12.5 ft
Max: 8.367 at 0 ft

Min: 0.405 at 11.25 ft
Max: 0.595 at 3.75 ft

Min: 0.02 at 12.5 ft
Max: 7.29 at 0 ft

SHEAR DETAILS					
UC Max:	0.058	**Gov Vu (k/ft):**	595.324	**phi*Vns (k/ft):**	0
Location (ft):	8.125	**phi*Vnc (k/ft):**	10340.804	**Gov LC:**	6

AXIAL/BENDING DETAILS

UC Max Int (-z):	0	**phi eff. Int (-z):**	0.65	**Gov Mu Ext (+z) (k-ft/ft):**	7.29
Location (ft):	0	**Gov LC Int (-z):**	10	**phi*Mn Ext (+z) (k-ft/ft):**	51.649
Gov Pu Int (-z) (k/ft):	0	**UC Max Ext (+z):**	0.141	**phi eff. Ext (+z):**	0.9
phi*Pn Int (-z) (k/ft):	660.077	**Location (ft):**	0	**Gov LC Ext (+z):**	6
Gov Mu Int (-z) (k-ft/ft):	0	**Gov Pu Ext (+z) (k/ft):**	0		
phi*Mn Int (-z):	NC	**phi*Pn Ext (+z):**	NC		

DEFLECTION DETAILS

Delta max (in):	0.019	**Location (ft):**	12.5
Deflection Ratio:	H/7945	**Gov LC:**	6

REINFORCEMENT DETAILS

As Provided (V) (in^2):	6.013	**As min (V) (in^2):**	4.05
rho Provided (V):	0.002	**rho min (V):**	0.002

WALL SEGMENT SECTION PROPERTIES

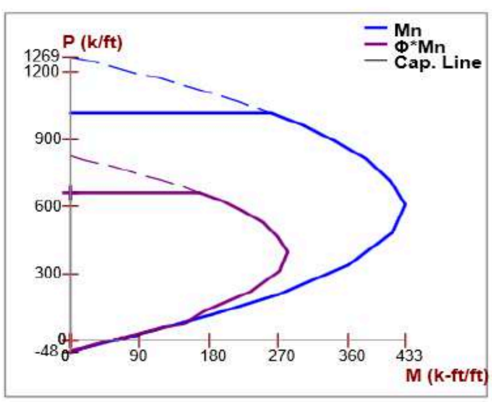
Total Width (in):	18	**Icracked (in^4):**	14175	**KL/r:**	17.321
A (in^2):	540	**Cracked Mom, Mcr (k-ft):**	533.634		
Igross (in^4):	40500	**r (in):**	5.123		

SLENDER BENDING SPAN RESULTS

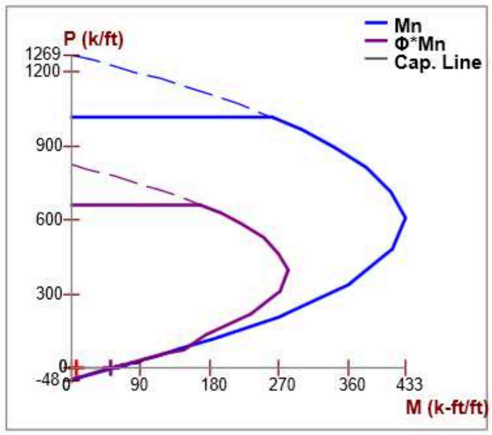
	KL/r out	Cm out	Lu out (ft)	Pc (lb/ft)	deltaNS	M act (k-ft/ft)	M2 min (k-ft/ft)	Mc out (k-ft/ft)
Interior	17.321	0.601	12.5	0	N/A	0	0	N/A(0ft)
Exterior				0	N/A	0	0	N/A(0ft)

OUT-PLANE WALL INTERACTION DIAGRAM

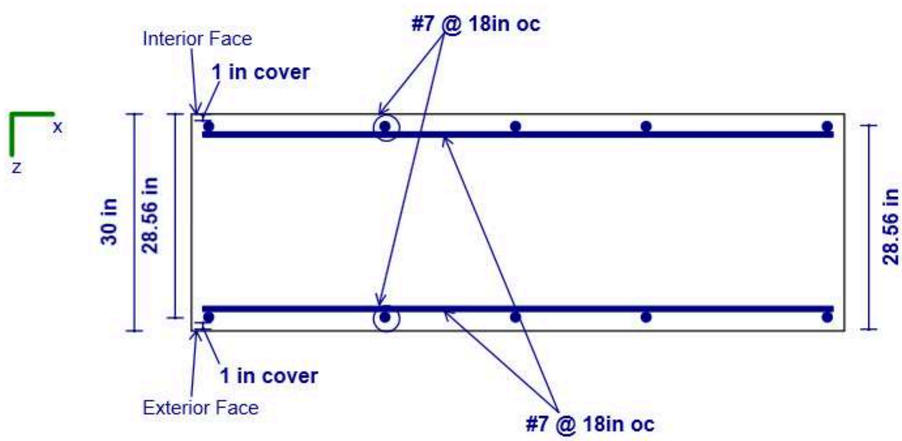
Interior (-z) Face Wall Interaction Diagram



Exterior (+z) Face Wall Interaction Diagram



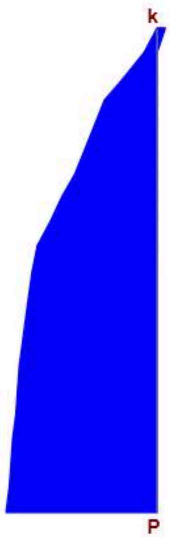
CROSS SECTION DETAILING



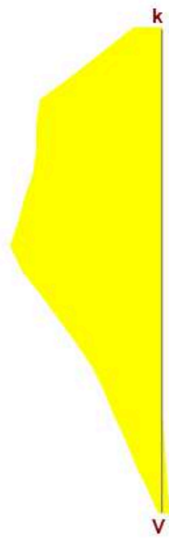
Detail Report: WP1 (In-Plane, Region R4)

CRITERIA		GEOMETRY		MATERIALS	
Code:	ACI 318-19	**Total Height (ft):**	3.5	**Material Set:**	Conc4000NW
Design Rule:	CSW	**Total Length (ft):**	7	**Concrete f'c (ksi):**	4
Seismic Rule:	None	**Thickness (in):**	30	**Concrete E (ksi):**	3644
Loc of r/f:	Each Face	**Int Cover (-z) (in):**	1	**Concrete G (ksi):**	1584
Outer Bars:	Vertical	**Ext Cover (+z) (in):**	1	**Conc Density (k/ft^3):**	0.145
Vert Bar Size:	#7	**Cover Open/Edge (in):**	2	**Lambda:**	1
Horz Bar Size:	#7	**K:**	1	**Conc Str Blk:**	Rectangular
Vert Bar Spac (in):	18	**Use Cracked?:**	Yes	**Vert Bar Fy (ksi):**	60
Horz Bar Spac (in):	18	**Icr Factor:**	0.7	**Horz Bar Fy (ksi):**	60
Group Wall?:	No			**Steel E (ksi):**	29000

ENVELOPE DIAGRAMS



Min: -0.3 at 3.5 ft
Max: 5.018 at 0 ft



Min: -0.066 at 0 ft
Max: 1.181 at 1.925 ft

Min: 1.144 at 3.5 ft
Max: 5.798 at 2.45 ft

ACI 318-19 Code Check

AXIAL/BENDING DETAILS					
UC Max:	0.005	**phi*Pn:**	NC	**phi eff.:**	0.9
Location (ft):	2.45	**Gov Mu (k-ft):**	5.798	**Gov LC:**	1
Gov Pu (k):	0	**phi*Mn (k-ft):**	1086.201		

SHEAR DETAILS

UC Max:	0.002	**phi*Vn (k):**	611.157	**Vs (k):**	336.739
Location (ft):	1.925	**Vnmax (k):**	1275.03	**Gov LC:**	1
Gov Vu (k):	1.181	**Vc (k):**	478.136		

DEFLECTION DETAILS

Delta max (in):	2.899e-5	**Location (ft):**	12.5
Deflection Ratio:	H/10000	**Gov LC:**	1

REINFORCEMENT DETAILS

As Provided (H) (in^2):	6.013	**rho min (H):**	0.002	**As min (V) (in^2):**	3.78
rho Provided (H):	0.005	**As Provided (V) (in^2):**	6.013	**rho min (V):**	0.002
As min (H) (in^2):	2.52	**rho Provided (V):**	0.002		

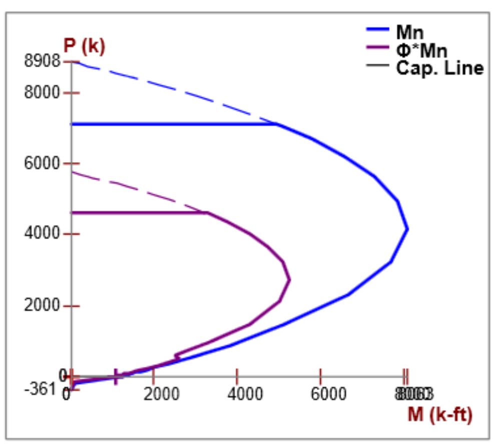
WALL SEGMENT SECTION PROPERTIES

Total Length (ft):	7	**Icracked (in^4):**	1.037e+6	**KL/r:**	1.732
A (in^2):	2520	**Cracked Mom, Mcr (k-ft):**	1394.564		
Igross (in^4):	1.482e+6	**r (in):**	20.288		

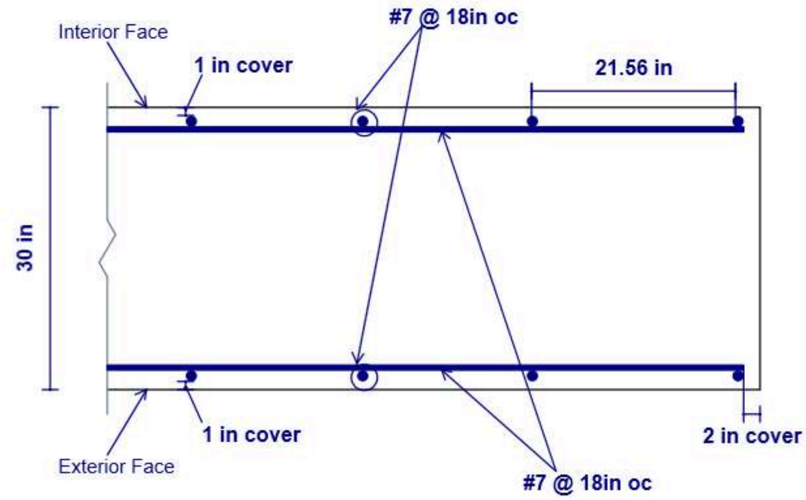
SLENDER BENDING SPAN RESULTS

-Slenderness(P - Little Delta) and minimum moment considerations are only done for full - height regions.

IN-PLANE WALL INTERACTION DIAGRAM



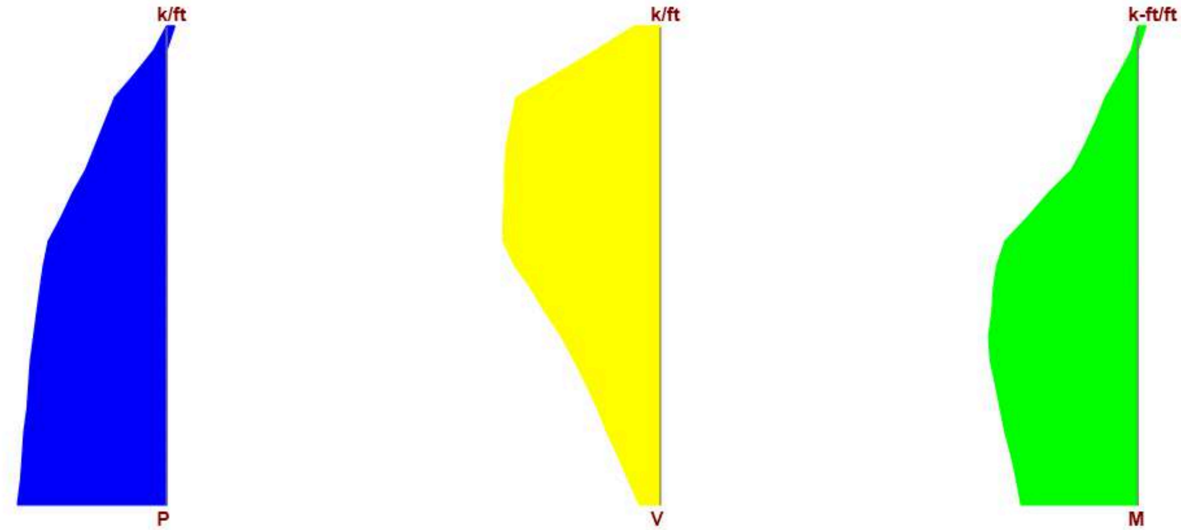
CROSS SECTION DETAILING



Detail Report: WP1 (Out-of-Plane, Region R4)

CRITERIA		GEOMETRY		MATERIALS	
Code:	ACI 318-19	**Total Height (ft):**	3.5	**Material Set:**	Conc4000NW
Design Rule:	CSW	**Total Length (ft):**	7	**Concrete f'c (ksi):**	4
Seismic Rule:	None	**Thickness (in):**	30	**Concrete E (ksi):**	3644
Loc of r/f:	Each Face	**Int Cover (-z) (in):**	1	**Concrete G (ksi):**	1584
Outer Bars:	Vertical	**Ext Cover (+z) (in):**	1	**Conc Density (k/ft^3):**	0.145
Vert Bar Size:	#7	**Cover Open/Edge (in):**	2	**Lambda:**	1
Horz Bar Size:	#7	**K:**	1	**Conc Str Blk:**	Rectangular
Vert Bar Spac (in):	18	**Use Cracked?:**	Yes	**Vert Bar Fy (ksi):**	60
Horz Bar Spac (in):	18	**Icr Factor:**	0.35	**Horz Bar Fy (ksi):**	60
Group Wall?:	No			**Steel E (ksi):**	29000

ENVELOPE DIAGRAMS



Min: -0.043 at 3.5 ft
Max: 0.717 at 0 ft

Min: 0.013 at 0 ft
Max: 0.105 at 2.1 ft

Min: -0.013 at 3.5 ft
Max: 0.215 at 1.05 ft

AXIAL/BENDING DETAILS

UC Max Int (-z):	0	**phi eff. Int (-z):**	0.9	**Gov Mu Ext (+z) (k-ft/ft):**	0.215
Location (ft):	3.5	**Gov LC Int (-z):**	6	**phi*Mn Ext (+z) (k-ft/ft):**	55.188
Gov Pu Int (-z) (k/ft):	0	**UC Max Ext (+z):**	0.004	**phi eff. Ext (+z):**	0.9
phi*Pn Int (-z):	NC	**Location (ft):**	1.225	**Gov LC Ext (+z):**	6
Gov Mu Int (-z) (k-ft/ft):	-0.013	**Gov Pu Ext (+z) (k/ft):**	0		
phi*Mn Int (-z) (k-ft/ft):	55.188	**phi*Pn Ext (+z):**	NC		

SHEAR DETAILS

UC Max:	0.01	**Gov Vu (k/ft):**	105.769	**phi*Vns (k/ft):**	0
Location (ft):	1.925	**phi*Vnc (k/ft):**	10152.432	**Gov LC:**	6

DEFLECTION DETAILS

Delta max (in):	0.01	**Location (ft):**	0.625
Deflection Ratio:	H/4151	**Gov LC:**	6

REINFORCEMENT DETAILS

As Provided (V) (in^2):	6.013	**As min (V) (in^2):**	3.78
rho Provided (V):	0.002	**rho min (V):**	0.002

REINFORCEMENT DETAILS

As Provided (V) (in^2):	6.013	**As min (V) (in^2):**	3.78
rho Provided (V):	0.002	**rho min (V):**	0.002

WALL SEGMENT SECTION PROPERTIES

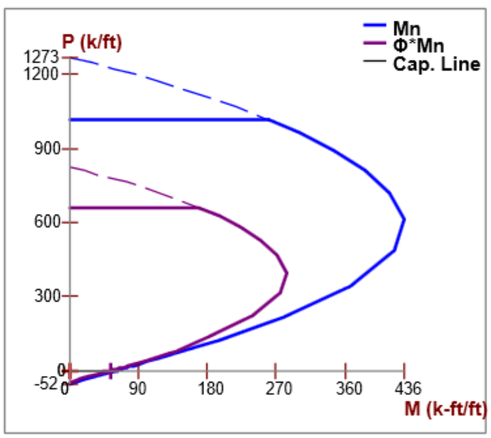
Total Width (in):	18	**Icracked (in^4):**	14175	**KL/r:**	4.85
A (in^2):	540	**Cracked Mom, Mcr (k-ft):**	498.059		
Igross (in^4):	40500	**r (in):**	5.123		

SLENDER BENDING SPAN RESULTS

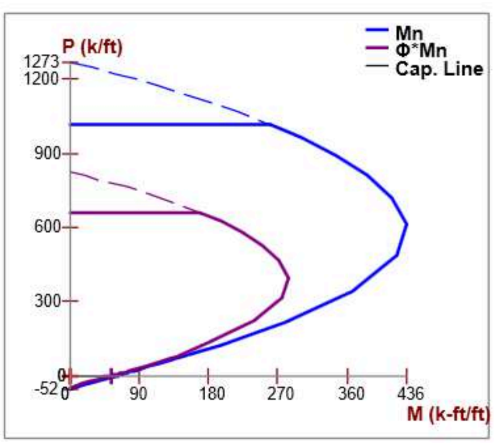
-Slenderness(P - Little Delta) and minimum moment considerations are only done for full - height regions.

OUT-PLANE WALL INTERACTION DIAGRAM

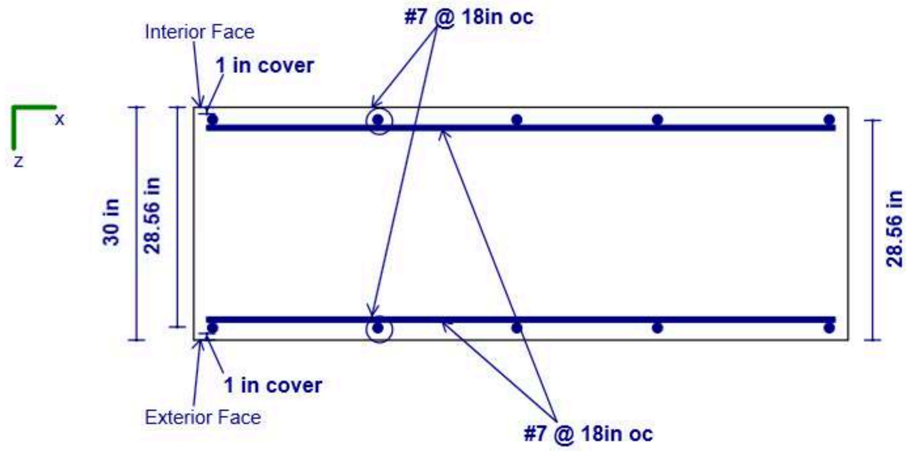
Interior (-z) Face Wall Interaction Diagram



Exterior (+z) Face Wall Interaction Diagram



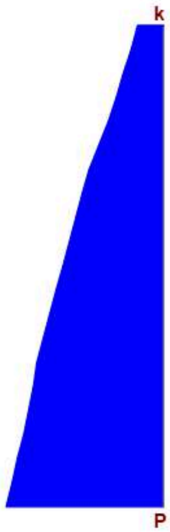
CROSS SECTION DETAILING



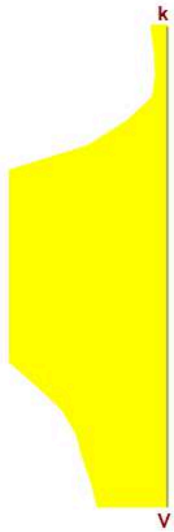
Detail Report: WP1 (In-Plane, Region R5)

CRITERIA		GEOMETRY		MATERIALS	
Code:	ACI 318-19	**Total Height (ft):**	12.5	**Material Set:**	Conc4000NW
Design Rule:	CSW	**Total Length (ft):**	17	**Concrete f'c (ksi):**	4
Seismic Rule:	None	**Thickness (in):**	30	**Concrete E (ksi):**	3644
Loc of r/f:	Each Face	**Int Cover (-z) (in):**	1	**Concrete G (ksi):**	1584
Outer Bars:	Vertical	**Ext Cover (+z) (in):**	1	**Conc Density (k/ft^3):**	0.145
Vert Bar Size:	#7	**Cover Open/Edge (in):**	2	**Lambda:**	1
Horz Bar Size:	#7	**K:**	1	**Conc Str Blk:**	Rectangular
Vert Bar Spac (in):	18	**Use Cracked?:**	Yes	**Vert Bar Fy (ksi):**	60
Horz Bar Spac (in):	18	**Icr Factor:**	0.7	**Horz Bar Fy (ksi):**	60
Group Wall?:	No			**Steel E (ksi):**	29000

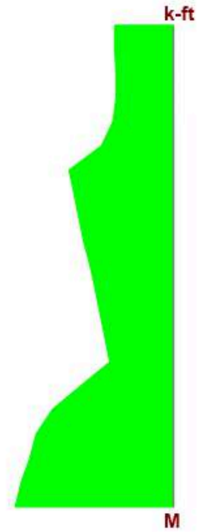
ENVELOPE DIAGRAMS



Min: 17.581 at 12.5 ft
Max: 113.779 at 0 ft



Min: 0.179 at 11.25 ft
Max: 2.993 at 6.25 ft



Min: 19.69 at 10.625 ft
Max: 55.117 at 0 ft

ACI 318-19 Code Check

AXIAL/BENDING DETAILS

UC Max:	0.009	**phi*Pn:**	NC	**phi eff.:**	0.9
Location (ft):	0	**Gov Mu (k-ft):**	55.117	**Gov LC:**	1
Gov Pu (k):	0	**phi*Mn (k-ft):**	6383.049		

SHEAR DETAILS

UC Max:	0.002	**phi*Vn (k):**	1484.238	**Vs (k):**	817.796
Location (ft):	4.375	**Vnmax (k):**	3096.502	**Gov LC:**	1
Gov Vu (k):	2.993	**Vc (k):**	1161.188		

DEFLECTION DETAILS

Delta max (in):	8.261e-5	**Location (ft):**	12.5
Deflection Ratio:	H/10000	**Gov LC:**	1

REINFORCEMENT DETAILS

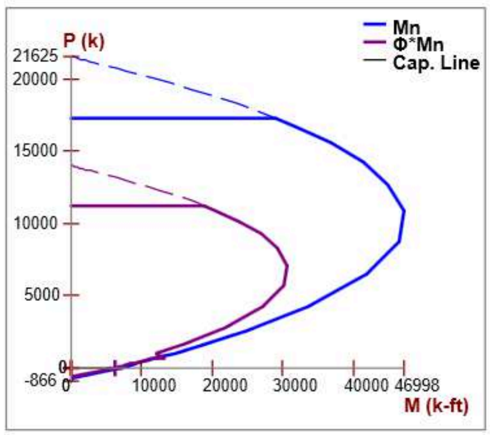
As Provided (H) (in^2):	10.824	**rho min (H):**	0.002	**As min (V) (in^2):**	9.18
rho Provided (H):	0.002	**As Provided (V) (in^2):**	14.432	**rho min (V):**	0.002
As min (H) (in^2):	9	**rho Provided (V):**	0.002		

WALL SEGMENT SECTION PROPERTIES					
Total Length (ft):	17	**Icracked (in^4):**	1.486e+7	**KL/r:**	2.547
A (in^2):	6120	**Cracked Mom, Mcr (k-ft):**	8225.084		
Igross (in^4):	2.122e+7	**r (in):**	49.271		

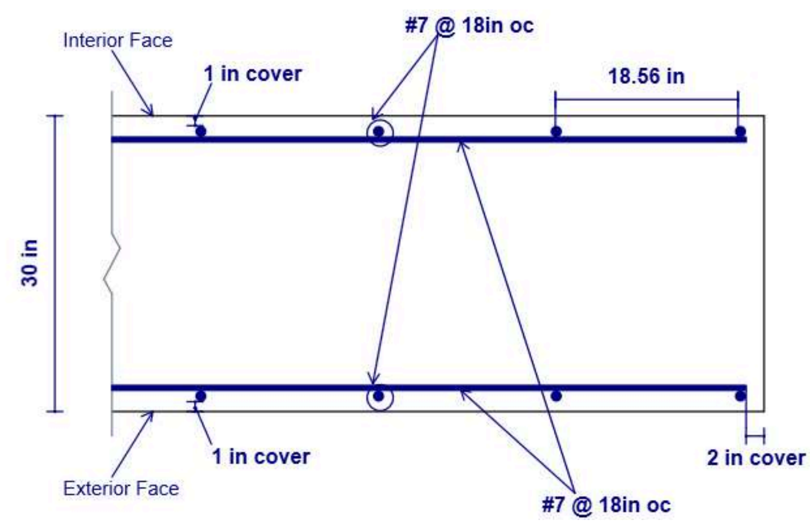
SLENDER BENDING SPAN RESULTS

KL/r in	Cm in	Lu in (ft)	Pc (k)	deltaNS	M act (k-ft)	M2 min (k-ft)	Mc in (k-ft)
2.547	0.746	12.5	0	N/A	0	0	N/A

IN-PLANE WALL INTERACTION DIAGRAM



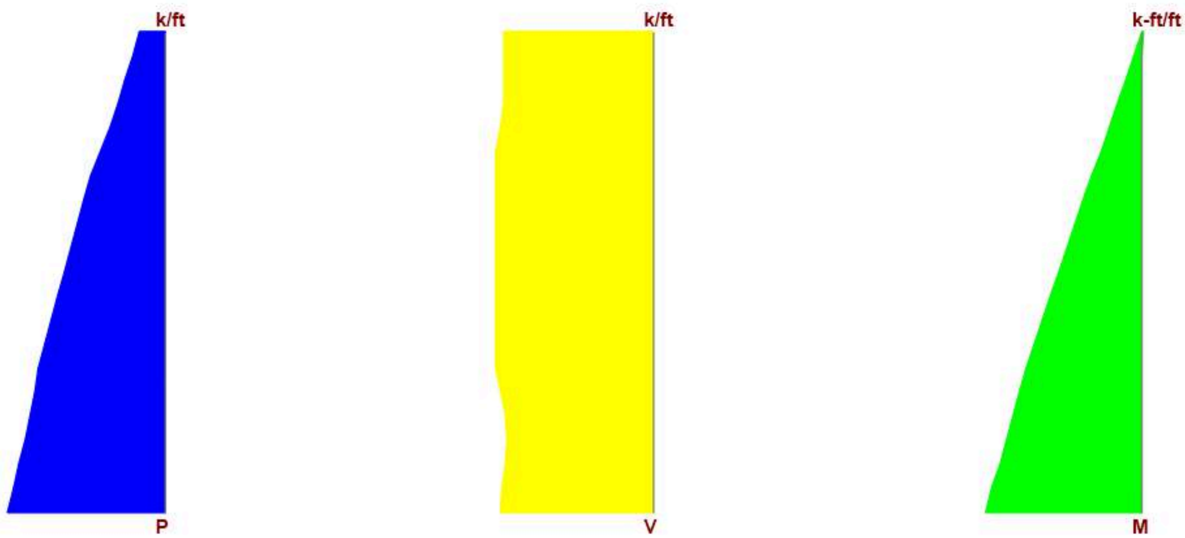
CROSS SECTION DETAILING



Detail Report: WP1 (Out-of-Plane, Region R5)

CRITERIA		GEOMETRY		MATERIALS	
Code:	ACI 318-19	**Total Height (ft):**	12.5	**Material Set:**	Conc4000NW
Design Rule:	CSW	**Total Length (ft):**	17	**Concrete f'c (ksi):**	4
Seismic Rule:	None	**Thickness (in):**	30	**Concrete E (ksi):**	3644
Loc of r/f:	Each Face	**Int Cover (-z) (in):**	1	**Concrete G (ksi):**	1584
Outer Bars:	Vertical	**Ext Cover (+z) (in):**	1	**Conc Density (k/ft^3):**	0.145
Vert Bar Size:	#7	**Cover Open/Edge (in):**	2	**Lambda:**	1
Horz Bar Size:	#7	**K:**	1	**Conc Str Blk:**	Rectangular
Vert Bar Spac (in):	18	**Use Cracked?:**	Yes	**Vert Bar Fy (ksi):**	60
Horz Bar Spac (in):	18	**Icr Factor:**	0.35	**Horz Bar Fy (ksi):**	60
Group Wall?:	No			**Steel E (ksi):**	29000

ENVELOPE DIAGRAMS



Min: 1.034 at 12.5 ft
Max: 6.693 at 0 ft

Min: 0.372 at 1.875 ft
Max: 0.4 at 6.25 ft

Min: -0.035 at 12.5 ft
Max: 4.74 at 0 ft

SHEAR DETAILS					
UC Max:	0.039	**Gov Vu (k/ft):**	398.589	**phi*Vns (k/ft):**	0
Location (ft):	9.375	**phi*Vnc (k/ft):**	10314.172	**Gov LC:**	6

AXIAL/BENDING DETAILS

UC Max Int (-z):	0.001	**phi eff. Int (-z):**	0.9	**Gov Mu Ext (+z) (k-ft/ft):**	4.74
Location (ft):	12.5	**Gov LC Int (-z):**	6	**phi*Mn Ext (+z) (k-ft/ft):**	54.564
Gov Pu Int (-z) (k/ft):	0	**UC Max Ext (+z):**	0.087	**phi eff. Ext (+z):**	0.9
phi*Pn Int (-z):	NC	**Location (ft):**	0	**Gov LC Ext (+z):**	6
Gov Mu Int (-z) (k-ft/ft):	-0.035	**Gov Pu Ext (+z) (k/ft):**	0		
phi*Mn Int (-z) (k-ft/ft):	54.564	**phi*Pn Ext (+z):**	NC		

DEFLECTION DETAILS

Delta max (in):	0.013	**Location (ft):**	12.5
Deflection Ratio:	H/10000	**Gov LC:**	6

REINFORCEMENT DETAILS

As Provided (V) (in^2):	14.432	**As min (V) (in^2):**	9.18
rho Provided (V):	0.002	**rho min (V):**	0.002

WALL SEGMENT SECTION PROPERTIES

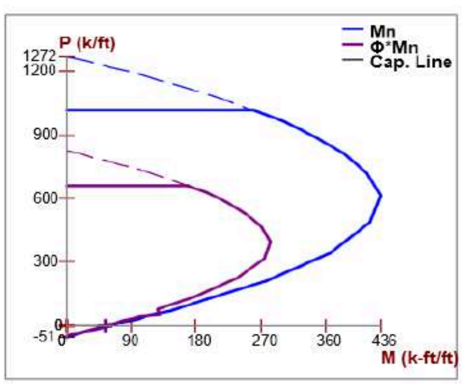
Total Width (in):	18	**Icracked (in^4):**	14175	**KL/r:**	17.321
A (in^2):	540	**Cracked Mom, Mcr (k-ft):**	1209.571		
Igross (in^4):	40500	**r (in):**	5.123		

SLENDER BENDING SPAN RESULTS

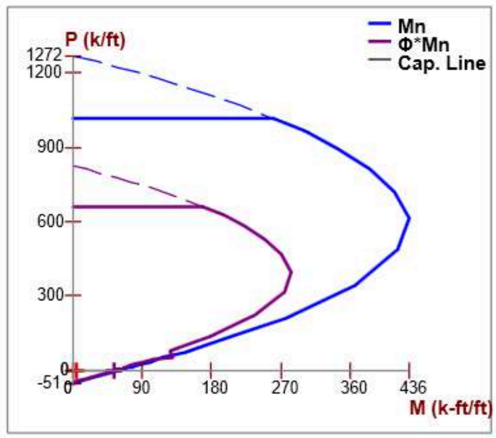
	KL/r out	Cm out	Lu out (ft)	Pc (lb/ft)	deltaNS	M act (k-ft/ft)	M2 min (k-ft/ft)	Mc out (k-ft/ft)
Interior	17.321	0.597	12.5	0	N/A	0	0	N/A(12.5ft)
Exterior				0	N/A	0	0	N/A(0ft)

OUT-PLANE WALL INTERACTION DIAGRAM

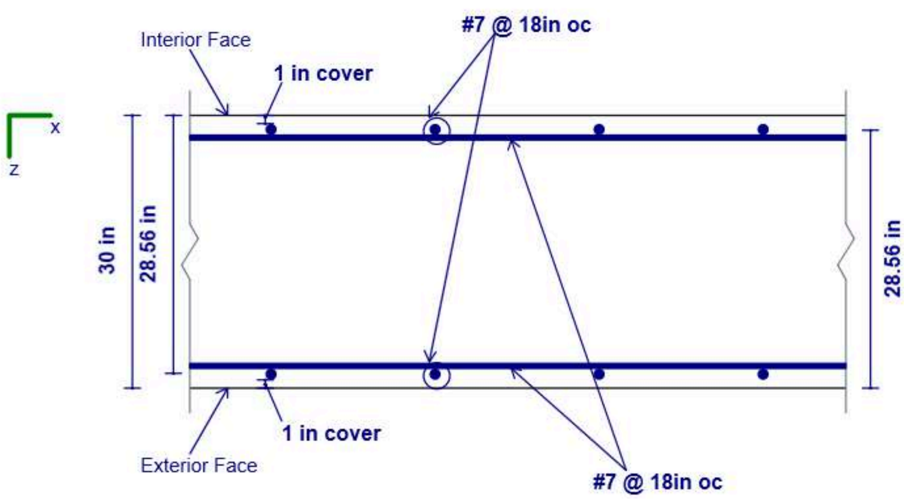
Interior (-z) Face Wall Interaction Diagram



Exterior (+z) Face Wall Interaction Diagram



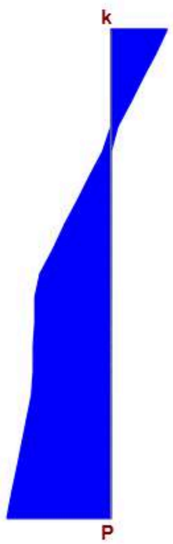
CROSS SECTION DETAILING



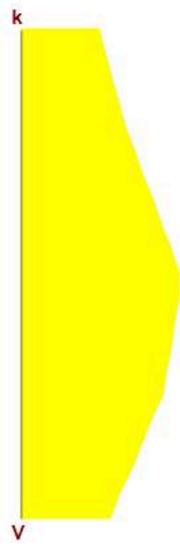
Detail Report: WP1 (In-Plane, Region R6)

CRITERIA		GEOMETRY		MATERIALS	
Code:	ACI 318-19	**Total Height (ft):**	3.5	**Material Set:**	Conc4000NW
Design Rule:	CSW	**Total Length (ft):**	4	**Concrete f'c (ksi):**	4
Seismic Rule:	None	**Thickness (in):**	30	**Concrete E (ksi):**	3644
Loc of r/f:	Each Face	**Int Cover (-z) (in):**	1	**Concrete G (ksi):**	1584
Outer Bars:	Vertical	**Ext Cover (+z) (in):**	1	**Conc Density (k/ft^3):**	0.145
Vert Bar Size:	#7	**Cover Open/Edge (in):**	2	**Lambda:**	1
Horz Bar Size:	#7	**K:**	1	**Conc Str Blk:**	Rectangular
Vert Bar Spac (in):	18	**Use Cracked?:**	Yes	**Vert Bar Fy (ksi):**	60
Horz Bar Spac (in):	18	**Icr Factor:**	0.7	**Horz Bar Fy (ksi):**	60
Group Wall?:	No			**Steel E (ksi):**	29000

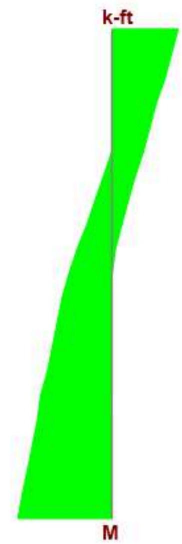
ENVELOPE DIAGRAMS



Min: -0.898 at 3.5 ft
Max: 1.608 at 0 ft



Min: -0.539 at 1.75 ft
Max: -0.264 at 3.5 ft



Min: -0.199 at 3.5 ft
Max: 0.278 at 0 ft

ACI 318-19 Code Check

AXIAL/BENDING DETAILS					
UC Max:	0.001	**phi*Pn:**	NC	**phi eff.:**	0.9
Location (ft):	0	**Gov Mu (k-ft):**	0.278	**Gov LC:**	8
Gov Pu (k):	0	**phi*Mn (k-ft):**	389.806		

SHEAR DETAILS

UC Max:	0.002	**phi*Vn (k):**	349.233	**Vs (k):**	192.423
Location (ft):	1.75	**Vnmax (k):**	728.589	**Gov LC:**	8
Gov Vu (k):	-0.539	**Vc (k):**	273.221		

DEFLECTION DETAILS

Delta max (in):	4.624e-5	**Location (ft):**	12.5
Deflection Ratio:	H/10000	**Gov LC:**	1

REINFORCEMENT DETAILS

As Provided (H) (in^2):	6.013	**rho min (H):**	0.002	**As min (V) (in^2):**	2.16
rho Provided (H):	0.005	**As Provided (V) (in^2):**	3.608	**rho min (V):**	0.002
As min (H) (in^2):	2.52	**rho Provided (V):**	0.003		

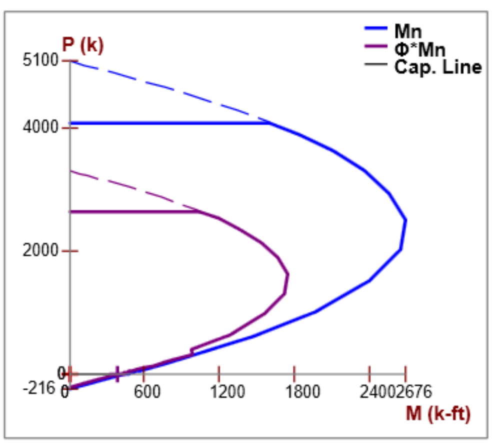
WALL SEGMENT SECTION PROPERTIES

Total Length (ft):	4	**Icracked (in^4):**	1.935e+5	**KL/r:**	3.031
A (in^2):	1440	**Cracked Mom, Mcr (k-ft):**	455.368		
Igross (in^4):	2.765e+5	**r (in):**	11.593		

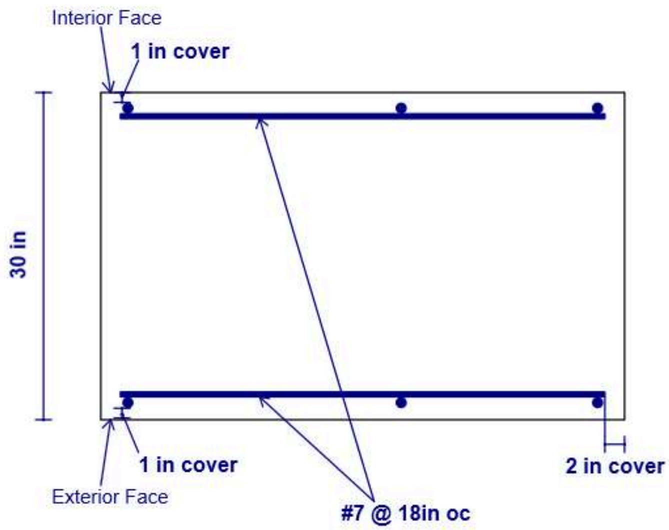
SLENDER BENDING SPAN RESULTS

-Slenderness(P - Little Delta) and minimum moment considerations are only done for full - height regions.

IN-PLANE WALL INTERACTION DIAGRAM



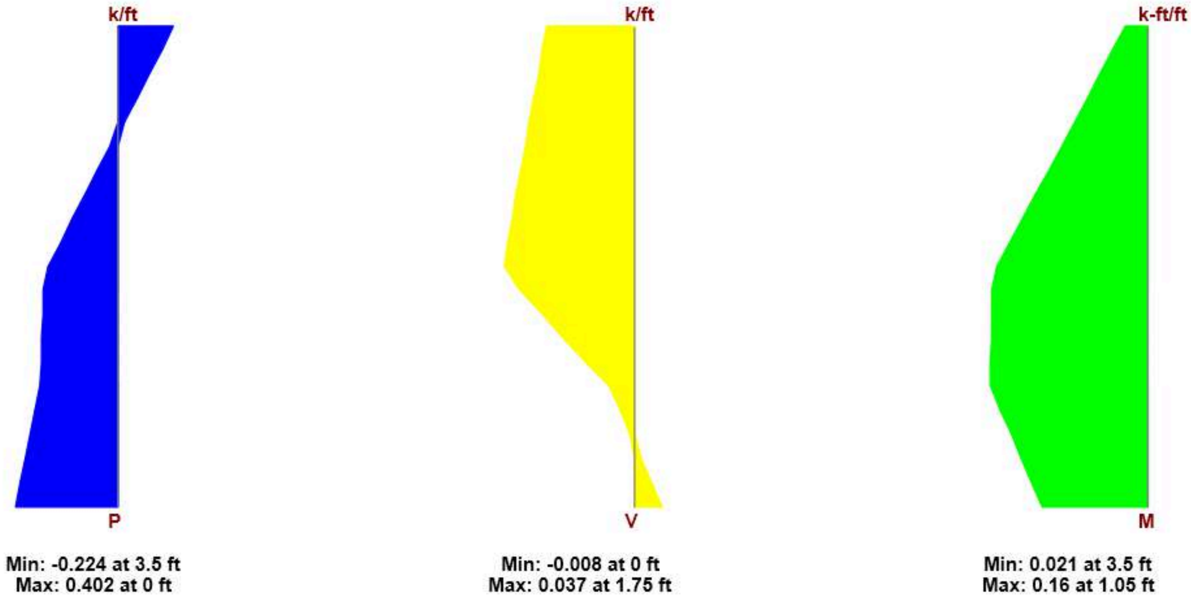
CROSS SECTION DETAILING



Detail Report: WP1 (Out-of-Plane, Region R6)

CRITERIA		GEOMETRY		MATERIALS	
Code:	ACI 318-19	**Total Height (ft):**	3.5	**Material Set:**	Conc4000NW
Design Rule:	CSW	**Total Length (ft):**	4	**Concrete f'c (ksi):**	4
Seismic Rule:	None	**Thickness (in):**	30	**Concrete E (ksi):**	3644
Loc of r/f:	Each Face	**Int Cover (-z) (in):**	1	**Concrete G (ksi):**	1584
Outer Bars:	Vertical	**Ext Cover (+z) (in):**	1	**Conc Density (k/ft^3):**	0.145
Vert Bar Size:	#7	**Cover Open/Edge (in):**	2	**Lambda:**	1
Horz Bar Size:	#7	**K:**	1	**Conc Str Blk:**	Rectangular
Vert Bar Spac (in):	18	**Use Cracked?:**	Yes	**Vert Bar Fy (ksi):**	60
Horz Bar Spac (in):	18	**Icr Factor:**	0.35	**Horz Bar Fy (ksi):**	60
Group Wall?:	No			**Steel E (ksi):**	29000

ENVELOPE DIAGRAMS



AXIAL/BENDING DETAILS

UC Max Int (-z):	0	**phi eff. Int (-z):**	0.65	**Gov Mu Ext (+z) (k-ft/ft):**	0.161
Location (ft):	0	**Gov LC Int (-z):**	10	**phi*Mn Ext (+z) (k-ft/ft):**	57.84
Gov Pu Int (-z) (k/ft):	0	**UC Max Ext (+z):**	0.003	**phi eff. Ext (+z):**	0.9
phi*Pn Int (-z) (k/ft):	663.027	**Location (ft):**	0.875	**Gov LC Ext (+z):**	6
Gov Mu Int (-z) (k-ft/ft):	0	**Gov Pu Ext (+z) (k/ft):**	0		
phi*Mn Int (-z):	NC	**phi*Pn Ext (+z):**	NC		

SHEAR DETAILS

UC Max:	0.004	**Gov Vu (k/ft):**	36.713	**phi*Vns (k/ft):**	0
Location (ft):	1.75	**phi*Vnc (k/ft):**	10296.563	**Gov LC:**	6

DEFLECTION DETAILS

Delta max (in):	0.005	**Location (ft):**	0.625
Deflection Ratio:	H/8884	**Gov LC:**	6

REINFORCEMENT DETAILS

As Provided (V) (in^2):	3.608	**As min (V) (in^2):**	2.16
rho Provided (V):	0.003	**rho min (V):**	0.002

WALL SEGMENT SECTION PROPERTIES

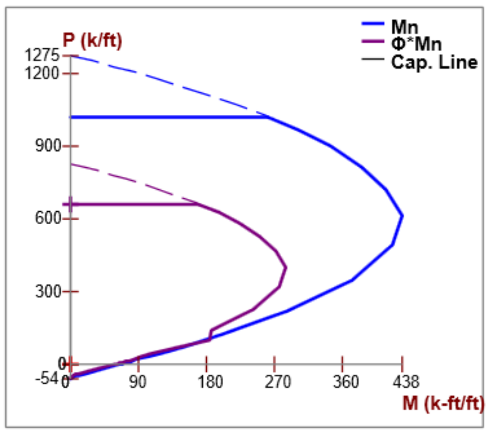
Total Width (in):	18	**Icracked (in^4):**	14175	**KL/r:**	4.85
A (in^2):	540	**Cracked Mom, Mcr (k-ft):**	284.605		
Igross (in^4):	40500	**r (in):**	5.123		

SLENDER BENDING SPAN RESULTS

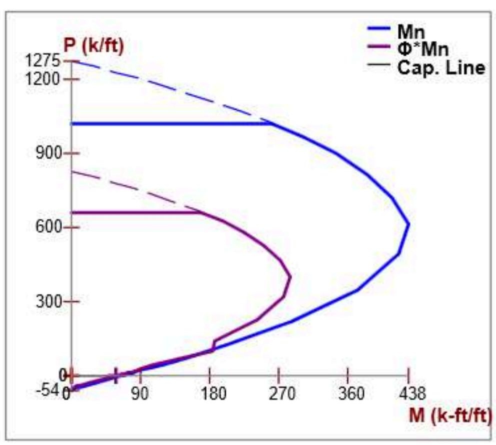
-Slenderness(P - Little Delta) and minimum moment considerations are only done for full - height regions.

OUT-PLANE WALL INTERACTION DIAGRAM

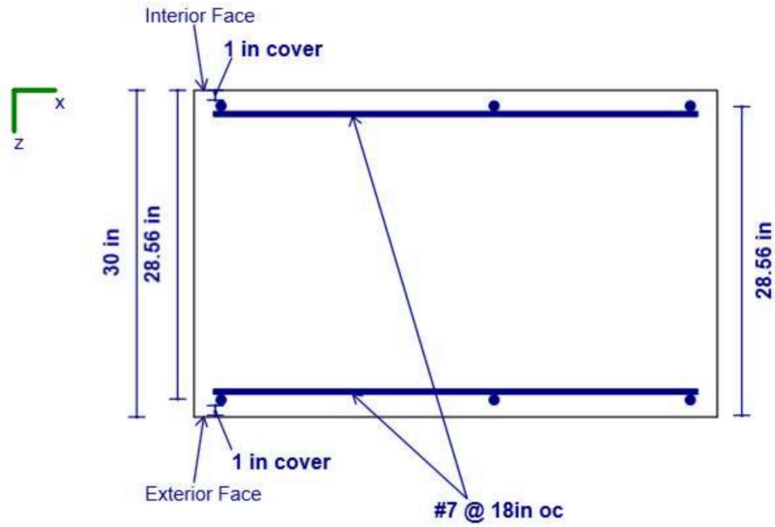
Interior (-z) Face Wall Interaction Diagram



Exterior (+z) Face Wall Interaction Diagram



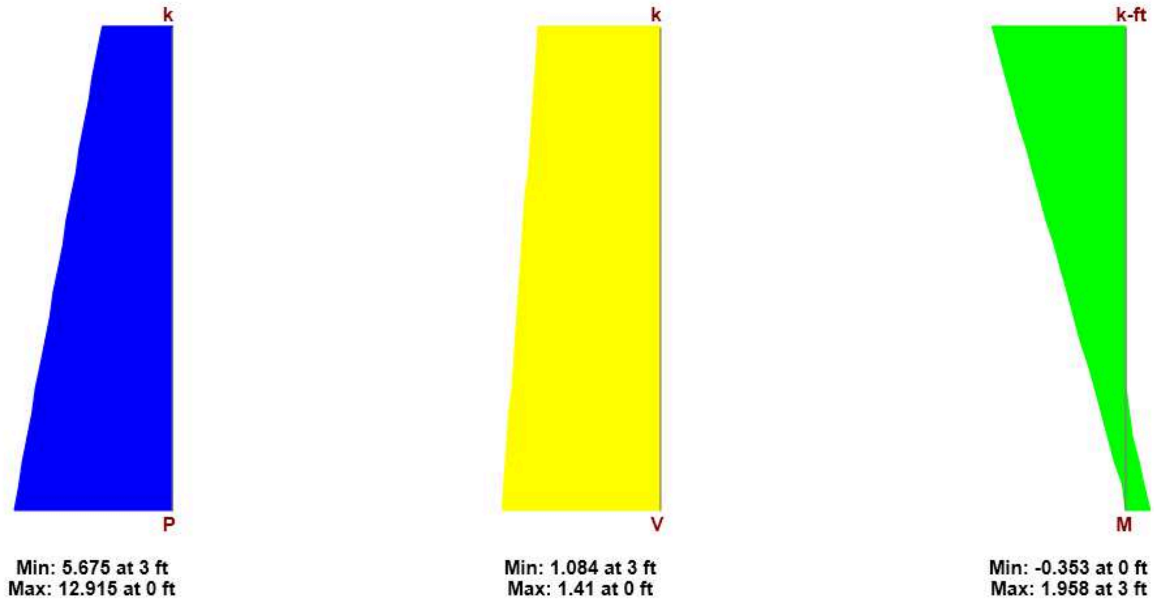
CROSS SECTION DETAILING



Detail Report: WP1 (In-Plane, Region R7)

CRITERIA		GEOMETRY		MATERIALS	
Code:	ACI 318-19	**Total Height (ft):**	3	**Material Set:**	Conc4000NW
Design Rule:	CSW	**Total Length (ft):**	4	**Concrete f'c (ksi):**	4
Seismic Rule:	None	**Thickness (in):**	30	**Concrete E (ksi):**	3644
Loc of r/f:	Each Face	**Int Cover (-z) (in):**	1	**Concrete G (ksi):**	1584
Outer Bars:	Vertical	**Ext Cover (+z) (in):**	1	**Conc Density (k/ft^3):**	0.145
Vert Bar Size:	#7	**Cover Open/Edge (in):**	2	**Lambda:**	1
Horz Bar Size:	#7	**K:**	1	**Conc Str Blk:**	Rectangular
Vert Bar Spac (in):	18	**Use Cracked?:**	Yes	**Vert Bar Fy (ksi):**	60
Horz Bar Spac (in):	18	**Icr Factor:**	0.7	**Horz Bar Fy (ksi):**	60
Group Wall?:	No			**Steel E (ksi):**	29000

ENVELOPE DIAGRAMS



ACI 318-19 Code Check

AXIAL/BENDING DETAILS

UC Max:	0.005	**phi*Pn:**	NC	**phi eff.:**	0.9
Location (ft):	3	**Gov Mu (k-ft):**	1.958	**Gov LC:**	1
Gov Pu (k):	0	**phi*Mn (k-ft):**	389.806		

SHEAR DETAILS

UC Max:	0.004	**phi*Vn (k):**	349.233	**Vs (k):**	192.423
Location (ft):	0	**Vnmax (k):**	728.589	**Gov LC:**	1
Gov Vu (k):	1.41	**Vc (k):**	273.221		

DEFLECTION DETAILS

Delta max (in):	2.336e-5	**Location (ft):**	12.5
Deflection Ratio:	H/10000	**Gov LC:**	1

REINFORCEMENT DETAILS

As Provided (H) (in^2):	4.811	**rho min (H):**	0.002	**As min (V) (in^2):**	2.16
rho Provided (H):	0.004	**As Provided (V) (in^2):**	3.608	**rho min (V):**	0.002
As min (H) (in^2):	2.16	**rho Provided (V):**	0.003		

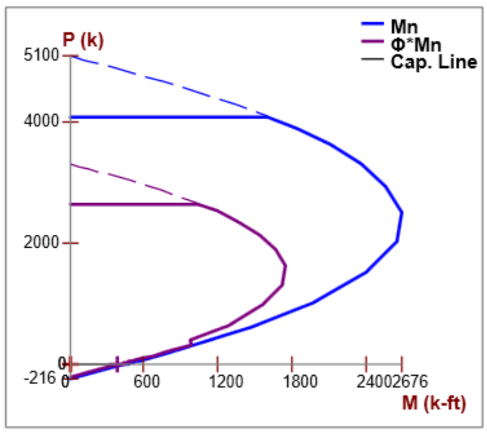
WALL SEGMENT SECTION PROPERTIES

Total Length (ft):	4	**Icracked (in^4):**	1.935e+5	**KL/r:**	2.598
A (in^2):	1440	**Cracked Mom, Mcr (k-ft):**	455.368		
Igross (in^4):	2.765e+5	**r (in):**	11.593		

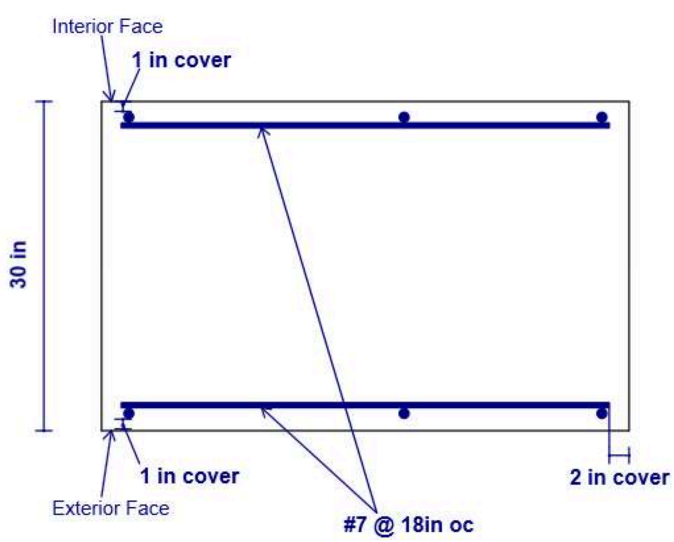
SLENDER BENDING SPAN RESULTS

-Slenderness(P - Little Delta) and minimum moment considerations are only done for full - height regions.

IN-PLANE WALL INTERACTION DIAGRAM



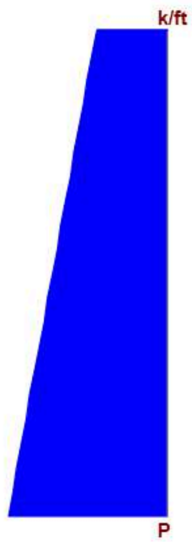
CROSS SECTION DETAILING



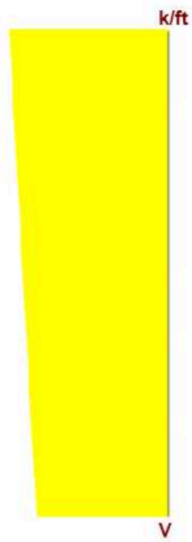
Detail Report: WP1 (Out-of-Plane, Region R7)

CRITERIA		GEOMETRY		MATERIALS	
Code:	ACI 318-19	**Total Height (ft):**	3	**Material Set:**	Conc4000NW
Design Rule:	CSW	**Total Length (ft):**	4	**Concrete f'c (ksi):**	4
Seismic Rule:	None	**Thickness (in):**	30	**Concrete E (ksi):**	3644
Loc of r/f:	Each Face	**Int Cover (-z) (in):**	1	**Concrete G (ksi):**	1584
Outer Bars:	Vertical	**Ext Cover (+z) (in):**	1	**Conc Density (k/ft^3):**	0.145
Vert Bar Size:	#7	**Cover Open/Edge (in):**	2	**Lambda:**	1
Horz Bar Size:	#7	**K:**	1	**Conc Str Blk:**	Rectangular
Vert Bar Spac (in):	18	**Use Cracked?:**	Yes	**Vert Bar Fy (ksi):**	60
Horz Bar Spac (in):	18	**Icr Factor:**	0.35	**Horz Bar Fy (ksi):**	60
Group Wall?:	No			**Steel E (ksi):**	29000

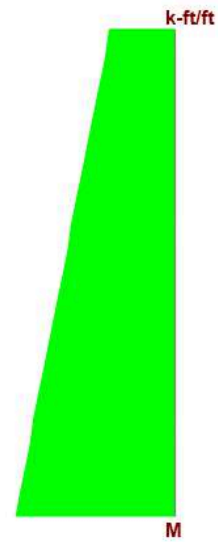
ENVELOPE DIAGRAMS



Min: 1.419 at 3 ft
Max: 3.229 at 0 ft



Min: 0.299 at 0 ft
Max: 0.361 at 3 ft



Min: 0.828 at 3 ft
Max: 2.063 at 0 ft

SHEAR DETAILS					
UC Max:	0.035	**Gov Vu (k/ft):**	361.498	**phi*Vns (k/ft):**	0
Location (ft):	3	**phi*Vnc (k/ft):**	10424.956	**Gov LC:**	6

AXIAL/BENDING DETAILS

UC Max Int (-z):	0	**phi eff. Int (-z):**	0.65	**Gov Mu Ext (+z) (k-ft/ft):**	2.063
Location (ft):	0	**Gov LC Int (-z):**	10	**phi*Mn Ext (+z) (k-ft/ft):**	57.84
Gov Pu Int (-z) (k/ft):	0	**UC Max Ext (+z):**	0.036	**phi eff. Ext (+z):**	0.9
phi*Pn Int (-z) (k/ft):	663.027	**Location (ft):**	0	**Gov LC Ext (+z):**	6
Gov Mu Int (-z) (k-ft/ft):	0	**Gov Pu Ext (+z) (k/ft):**	0		
phi*Mn Int (-z):	NC	**phi*Pn Ext (+z):**	NC		

DEFLECTION DETAILS

Delta max (in):	0.008	**Location (ft):**	11.875
Deflection Ratio:	H/4344	**Gov LC:**	6

REINFORCEMENT DETAILS

As Provided (V) (in^2):	3.608	**As min (V) (in^2):**	2.16
rho Provided (V):	0.003	**rho min (V):**	0.002

WALL SEGMENT SECTION PROPERTIES

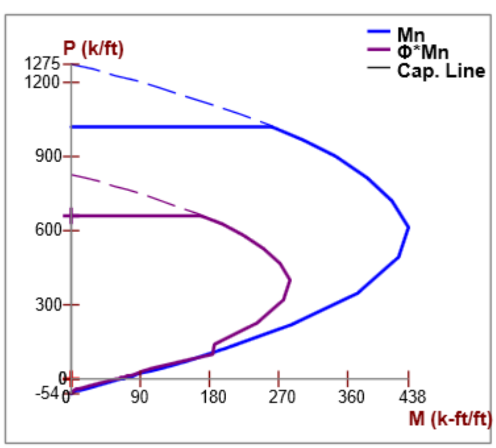
Total Width (in):	18	**Icracked (in^4):**	14175	**KL/r:**	4.157
A (in^2):	540	**Cracked Mom, Mcr (k-ft):**	284.605		
Igross (in^4):	40500	**r (in):**	5.123		

SLENDER BENDING SPAN RESULTS

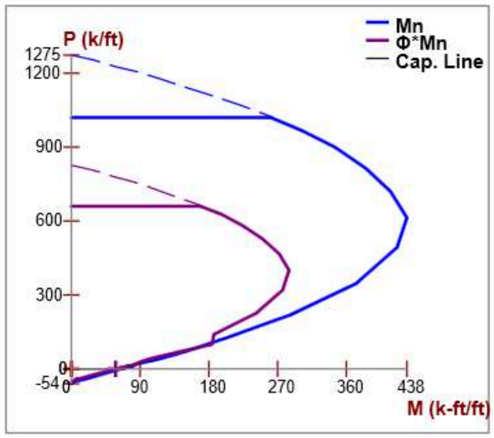
-Slenderness(P - Little Delta) and minimum moment considerations are only done for full - height regions.

OUT-PLANE WALL INTERACTION DIAGRAM

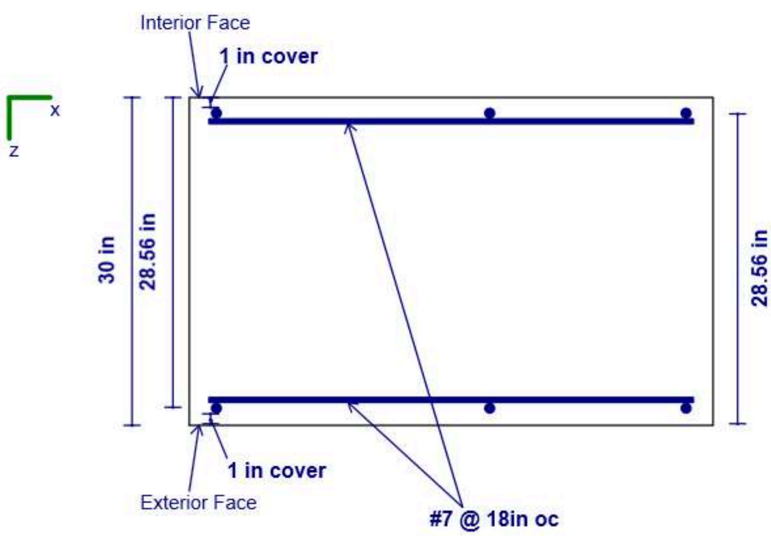
Interior (-z) Face Wall Interaction Diagram



Exterior (+z) Face Wall Interaction Diagram



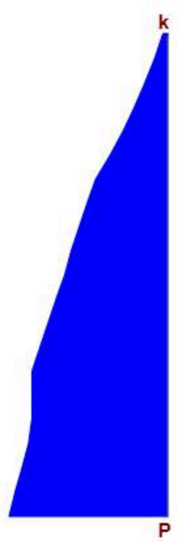
CROSS SECTION DETAILING



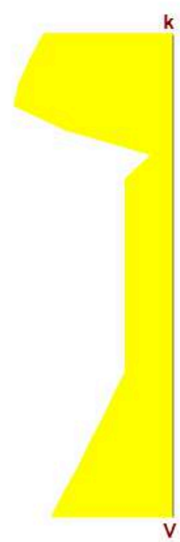
Detail Report: WP1 (In-Plane, Region R8)

CRITERIA		GEOMETRY		MATERIALS	
Code:	ACI 318-19	**Total Height (ft):**	12.5	**Material Set:**	Conc4000NW
Design Rule:	CSW	**Total Length (ft):**	3.5	**Concrete f'c (ksi):**	4
Seismic Rule:	None	**Thickness (in):**	30	**Concrete E (ksi):**	3644
Loc of r/f:	Each Face	**Int Cover (-z) (in):**	1	**Concrete G (ksi):**	1584
Outer Bars:	Vertical	**Ext Cover (+z) (in):**	1	**Conc Density (k/ft^3):**	0.145
Vert Bar Size:	#7	**Cover Open/Edge (in):**	2	**Lambda:**	1
Horz Bar Size:	#7	**K:**	1	**Conc Str Blk:**	Rectangular
Vert Bar Spac (in):	18	**Use Cracked?:**	Yes	**Vert Bar Fy (ksi):**	60
Horz Bar Spac (in):	18	**Icr Factor:**	0.7	**Horz Bar Fy (ksi):**	60
Group Wall?:	No			**Steel E (ksi):**	29000

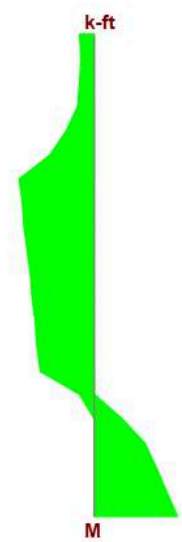
ENVELOPE DIAGRAMS



Min: 0.331 at 12.5 ft
Max: 18.795 at 0 ft



Min: 0.074 at 9.375 ft
Max: 0.603 at 10.625 ft



Min: -3.917 at 0 ft
Max: 3.401 at 8.75 ft

ACI 318-19 Code Check

AXIAL/BENDING DETAILS					
UC Max:	0.012	**phi*Pn:**	NC	**phi eff.:**	0.9
Location (ft):	0	**Gov Mu (k-ft):**	-3.917	**Gov LC:**	1
Gov Pu (k):	0	**phi*Mn (k-ft):**	318.775		

SHEAR DETAILS

UC Max:	0.002	**phi*Vn (k):**	245.811	**Vs (k):**	168.37
Location (ft):	10.625	**Vnmax (k):**	637.515	**Gov LC:**	8
Gov Vu (k):	0.603	**Vc (k):**	159.379		

DEFLECTION DETAILS

Delta max (in):	4.012e-5	**Location (ft):**	12.5
Deflection Ratio:	H/10000	**Gov LC:**	1

REINFORCEMENT DETAILS

As Provided (H) (in^2):	10.824	**rho min (H):**	0.002	**As min (V) (in^2):**	1.89
rho Provided (H):	0.002	**As Provided (V) (in^2):**	3.608	**rho min (V):**	0.002
As min (H) (in^2):	9	**rho Provided (V):**	0.003		

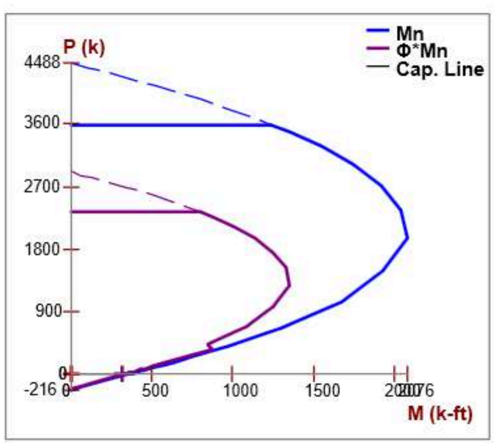
WALL SEGMENT SECTION PROPERTIES

Total Length (ft):	3.5	**Icracked (in^4):**	1.297e+5	**KL/r:**	12.372
A (in^2):	1260	**Cracked Mom, Mcr (k-ft):**	348.641		
Igross (in^4):	1.852e+5	**r (in):**	10.144		

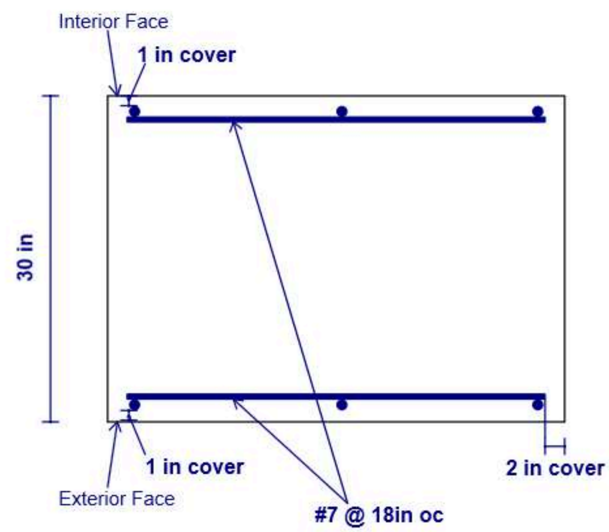
SLENDER BENDING SPAN RESULTS

KL/r in	Cm in	Lu in (ft)	Pc (k)	deltaNS	M act (k-ft)	M2 min (k-ft)	Mc in (k-ft)
12.372	0.544	12.5	0	N/A	0	0	N/A

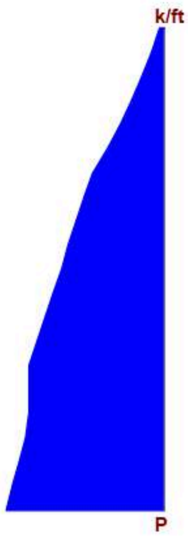
IN-PLANE WALL INTERACTION DIAGRAM



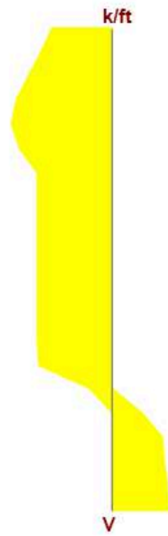
CROSS SECTION DETAILING



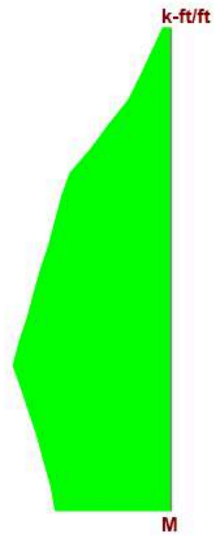
ENVELOPE DIAGRAMS



Min: 0.095 at 12.5 ft
Max: 5.37 at 0 ft



Min: -0.121 at 0 ft
Max: 0.213 at 10 ft



Min: 0.079 at 12.5 ft
Max: 2.15 at 3.75 ft

AXIAL/BENDING DETAILS

UC Max Int (-z):	0	**phi eff. Int (-z):**	0.65	**Gov Mu Ext (+z) (k-ft/ft):**	2.15
Location (ft):	0	**Gov LC Int (-z):**	10	**phi*Mn Ext (+z) (k-ft/ft):**	65.783
Gov Pu Int (-z) (k/ft):	0	**UC Max Ext (+z):**	0.033	**phi eff. Ext (+z):**	0.9
phi*Pn Int (-z) (k/ft):	666.82	**Location (ft):**	3.75	**Gov LC Ext (+z):**	6
Gov Mu Int (-z) (k-ft/ft):	0	**Gov Pu Ext (+z) (k/ft):**	0		
phi*Mn Int (-z):	NC	**phi*Pn Ext (+z):**	NC		

SHEAR DETAILS

UC Max:	0.02	**Gov Vu (k/ft):**	213.315	**phi*Vns (k/ft):**	0
Location (ft):	10	**phi*Vnc (k/ft):**	10906.129	**Gov LC:**	6

DEFLECTION DETAILS

Delta max (in):	0.007	**Location (ft):**	11.875
Deflection Ratio:	H/10000	**Gov LC:**	6

DEFLECTION DETAILS

Delta max (in):	0.007	**Location (ft):**	11.875
Deflection Ratio:	H/10000	**Gov LC:**	6

WALL SEGMENT SECTION PROPERTIES

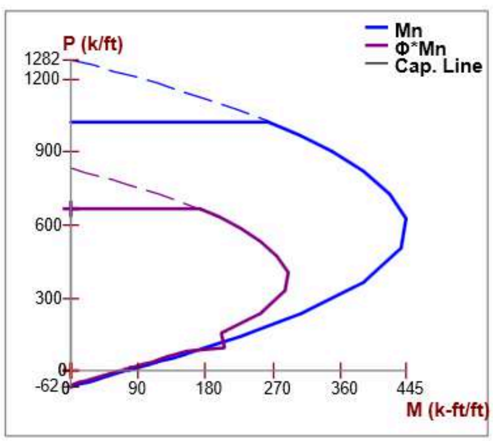
Total Width (in):	18	**Icracked (in^4):**	14175	**KL/r:**	17.321
A (in^2):	540	**Cracked Mom, Mcr (k-ft):**	249.029		
Igross (in^4):	40500	**r (in):**	5.123		

SLENDER BENDING SPAN RESULTS

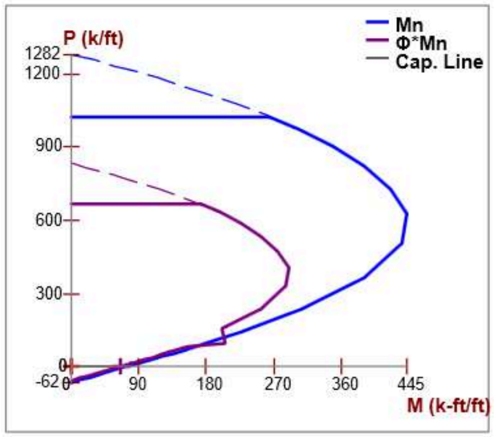
	KL/r out	Cm out	Lu out (ft)	Pc (lb/ft)	deltaNS	M act (k-ft/ft)	M2 min (k-ft/ft)	Mc out (k-ft/ft)
Interior	17.321	0.62	12.5	0	N/A	0	0	N/A(0ft)
Exterior				0	N/A	0	0	N/A(3.75ft)

OUT-PLANE WALL INTERACTION DIAGRAM

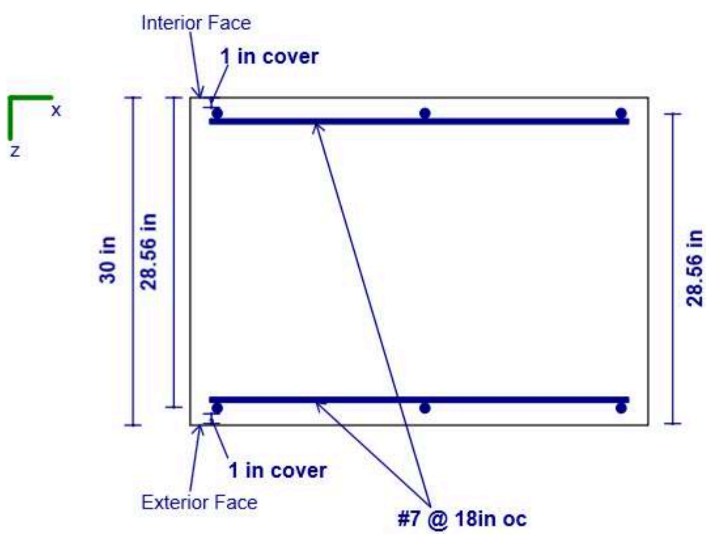
Interior (-z) Face Wall Interaction Diagram



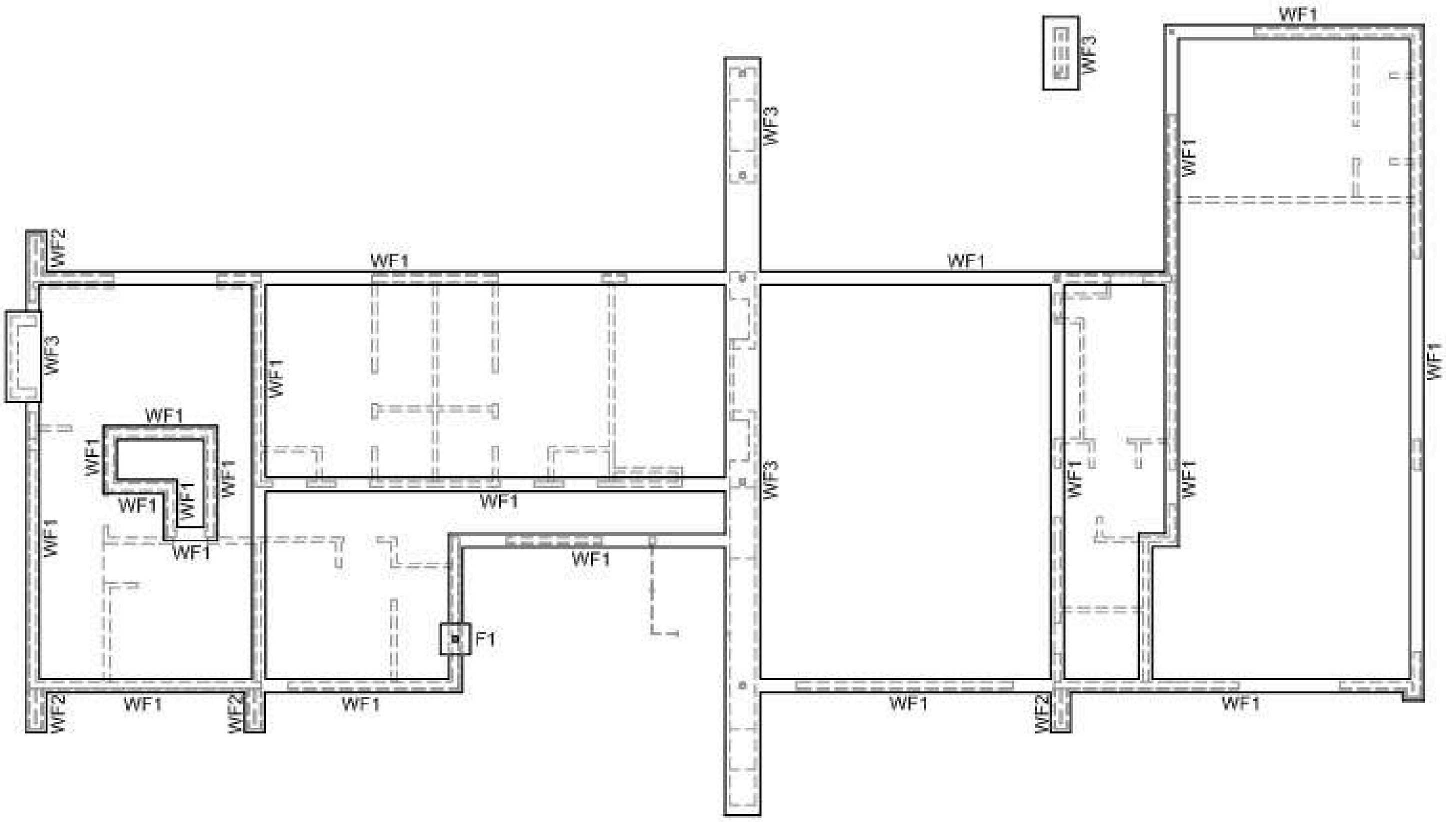
Exterior (+z) Face Wall Interaction Diagram



CROSS SECTION DETAILING



3.0 FOUNDATION ANALYSIS

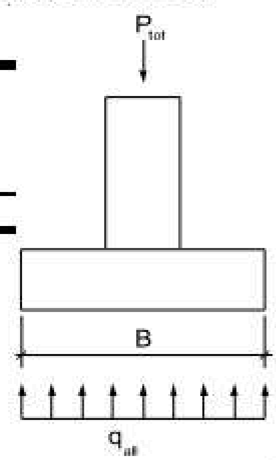


FOUNDATION PLAN

3.1 FOOTINGS ANALYSIS & DESIGN

FOOTING F1 ANALYSIS & DESIGN

Pad Footing Calculation



Reactions on Footing		D	L	E	W	
F1 Load		4.05	4.52	--	1.81	kips
	SUM:	4.05	4.52	0.00	1.81	kips

Required Strength: U = **13.0** kips

P = **8.6** kips

U = 1.2D + 1.6L	ASD:	
U = 1.2D + 1.6L + 0.5W	P = D + L	
U = 1.2D + 1.6W + 0.5L	P = D + 0.6W	P = D + 0.75[L+0.6W]
U = 1.2D + 1.0E + 1.0L	P = D + 0.7E	P = D + 0.75[L+0.7E]

Pad Footing Design Parameters:

Allowable Bearing Pressure ⟶ 1500 psf — per soils rep. by VANN ENG. (Project 27683)

Seismic or Wind Loading? ⟶ N ⟶ 1500 psf

Footing Width Design:

Try Square Footing Width, B = 30 inches

q_{bear} = 1371.2 psf

q_{allow} = 1500.0 psf

q_{allow}/q_{bear} = 1.09

Reinforcement Design:

Mu = 0.04 kips - in

q_U = 0.01 psi

$A_{s\ Req'd}$ 0.000078 in^2

Reinforcement Req'd (3) #5 Bars Spaced Evenly (12" o.c)

FOUNDATION WF1 ANALYSIS & DESIGN

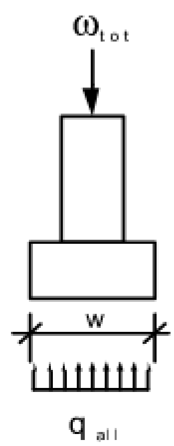
Footing **Exterior Wall Foundation** **WF1**

Description of Variables:			DL	LL	
	1r = 1 ft of roof trib	Roof	17.85	20	psf
	2f = 2 ft of floor trib	Floor	0	0	psf
	3g = 3 ft of garage trib	Garage	0	0	psf
	4l = 4 ft of lgs wall trib	LGS Wall	22.34	0	psf
	5w = 5 ft of wall trib	Wall	0	0	psf

Conventional Footing Design Parameters:

Allowable Bearing Pressure 1500 psf per soils rep. by VANN ENG. (Project 27683)

FT	TRIB	Wdl	Wll
	(ft)	(plf)	(plf)
WF1	23.5 r	419	470
	0.0 f	0	0
	0.0 g		0
	10.0 w	223	0
	0.0 w	0	0
	TL	**643**	**470**



w_{tot} 1113 plf

Try Footing Width, w = 16 inches

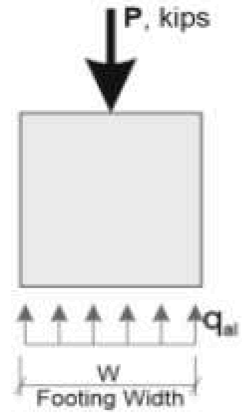
q_{bear} 835 psf

q_{allow} 1500 psf

q_{allow}/q_{bear} 1.80 Footing OK

Footing **Exterior wall Foundation** **WF1**

Reactions on Footing	D	L	E	W	
Load	0.6	0.5	0.0	0.0	kips
Total	0.6	0.5	0.0	0.0	kips
			U =	**1.5**	kips
			P =	**1.1**	kips



Required Strength:	ASD:	
U = 1.2D + 1.6L	P = D + L	
U = 1.2D + 1.6L + 0.5W	P = D + 0.6W	P = D + 0.75[L+0.6W]
U = 1.2D + 1.6W + 0.5L	P = D + 0.7E	P = D + 0.75[L+0.7E]
U = 1.2D + 1.0E + 1.0L		

Conventional Footing Design Parameters:

Allowable Bearing Pressure 1500 psf — per soils rep. by VANN ENG. (Project 27683)

Seismic or Wind Loading? N ---> 1500 psf

Footing Width 16 inches

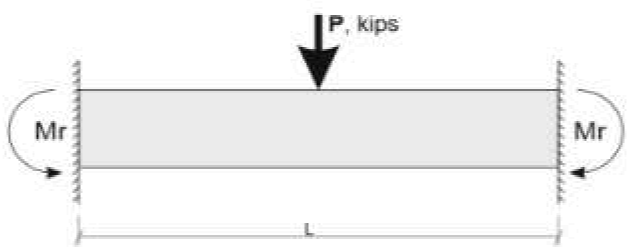
A_{req} 0.7 ft^2

L_{req} **0.6** ft

Model Foundation as Fixed/Fixed Member

Eqn. 1: $M_u = PL/8$

$M_u =$ **0.106** k-ft



Steel Reinforcing Design:

Steel Depth 9 in

Bar size (#) 4 bar

# of bars 3

$øM_n$ =	22.5	kip-ft	*(Design Cap.)*
M_u=	0.106	kip-ft	*(From Eqn. 1)*
øMn/Mu =	**212.1**	OK	

Therefore use 16 inch x 12 inch footing, with (3) #4 bar bottom. See Details.

FOUNDATION WF2 ANALYSIS & DESIGN

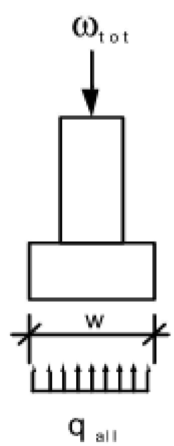
Footing **Exterior Wall Foundation** **WF2**

Description of Variables:			**DL**	**LL**	
	1g = 1 ft of garage roof trib	Garage Roof	22.85	20	psf
	2r = 2 ft of roof trib	Roof	17.85	20	psf
	3f = 3 ft of floor trib	Floor	0	0	psf
	4l = 4 ft of lgs wall trib	LGS Wall	22.34	0	psf
	5r = 5 ft of roof wind trib	Wall	0	0	psf

Conventional Footing Design Parameters:

Allowable Bearing Pressure 1500 psf per soils rep. by VANN ENG. (Project 27683)

FT	TRIB	Wdl	Wll
	(ft)	(plf)	(plf)
WF2	5.0 g	114	100
	16.1 r	288	323
	0.0 f		0
	31.3 w	700	0
	0.0 w	0	0
	TL	**1102**	**423**



w_{tot} 1525 plf

Try Footing Width, *w* = 24 inches

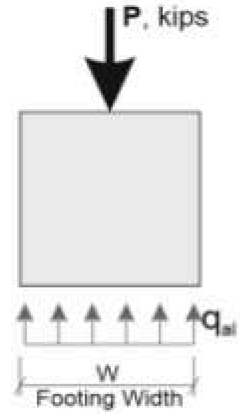
q_{bear} 762 psf

q_{allow} 1500 psf

q_{allow}/q_{bear} 1.97 Footing OK

Footing **<u>Exterior wall Foundation</u>** **WF2**

Reactions on Footing	**D**	**L**	**E**	**W**	
Pt Load from F1	1.1	0.5	0.0	0.0	kips
Total	1.1	0.5	0.0	0.0	kips
			U =	**2.1**	kips



Required Strength:	ASD:		P = **1.6** kips
U = 1.2D + 1.6L	P = D + L		
U = 1.2D + 1.6L + 0.5W	P = D + 0.6W	P = D + 0.75[L+0.6W]	
U = 1.2D + 1.6W + 0.5L	P = D + 0.7E	P = D + 0.75[L+0.7E]	
U = 1.2D + 1.0E + 1.0L			

<u>Conventional Footing Design Parameters:</u>

Allowable Bearing Pressure 1500 psf per soils rep. by VANN ENG. (Project 27683)

Seismic or Wind Loading? N ---> 1500 psf

Footing Width 24 inches

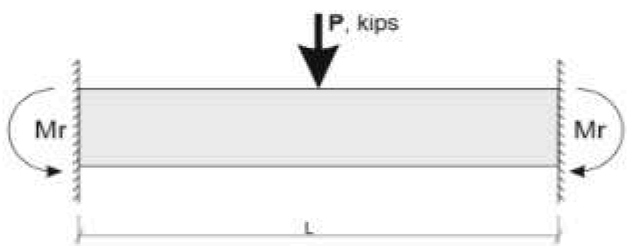
A_{req} 1.0 ft^2

L_{req} **0.5** ft

<u>Model Foundation as Fixed/Fixed Member</u>

Eqn. 1: M_u = PL/8

M_u = **0.136** k-ft



<u>Steel Reinforcing Design:</u>

Steel Depth 9 in

Bar size (#) 5 bar

# of bars 4

ϕM_n =	45.7	kip-ft	*(Design Cap.)*
M_u=	0.136	kip-ft	*(From Eqn. 1)*
ØMn/Mu =	**336.5**	OK	

Therefore use 24 inch x 12 inch footing, with (4) #5 bar bottom. See Details.

FOUNDATION WF3 ANALYSIS & DESIGN

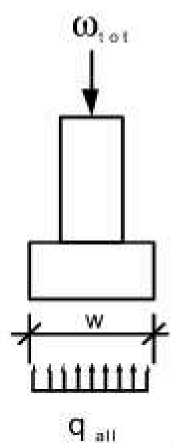
Footing **Exterior Wall Foundation** **WF3**

Description of Variables:			DL	LL	
	1r = 1 ft of roof trib	Roof	17.85	20	psf
	2f = 2 ft of floor trib	Floor	0	0	psf
	3g = 3 ft of garage trib	Garage	0	0	psf
	4c = 4 ft of concrete wall trib	Concrete Wall	362.5	0	psf
	5w = 5 ft of wall trib	Wall	0	0	psf

Conventional Footing Design Parameters:

Allowable Bearing Pressure 1500 psf per soils rep. by VANN ENG. (Project 27683)

FT	TRIB	Wdl	Wll
	(ft)	(plf)	(plf)
WF3	16.1 r	288	323
	0.0 f	0	0
	0.0 g		0
	12.5 w	4531	0
	0.0 w	0	0
	TL	**4819**	**323**



w_{tot} 5142 plf

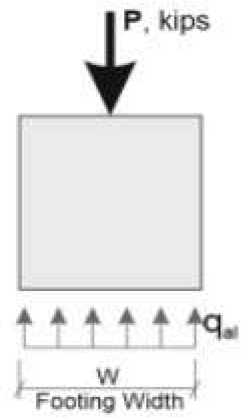
Try Footing Width, w = 42 inches

q_{bear} 1469 psf

q_{allow} 1500 psf

q_{allow}/q_{bear} 1.02 Footing OK

Footing **Exterior wall Foundation** **WF3**



Reactions on Footing	**D**	**L**	**E**	**W**	
Load	4.8	0.3	0.0	0.0	kips
Total	4.8	0.3	0.0	0.0	kips
			U =	**6.3**	kips
			P =	**5.1**	kips

Required Strength:
U = 1.2D + 1.6L
U = 1.2D + 1.6L + 0.5W
U = 1.2D + 1.6W + 0.5L
U = 1.2D + 1.0E + 1.0L

ASD:
P = D + L
P = D + 0.6W   P = D + 0.75[L+0.6W]
P = D + 0.7E   P = D + 0.75[L+0.7E]

Conventional Footing Design Parameters:

Allowable Bearing Pressure   1500 psf   per soils rep. by VANN ENG. (Project 27683)

Seismic or Wind Loading?   N   --->   1500 psf

Footing Width   42   inches

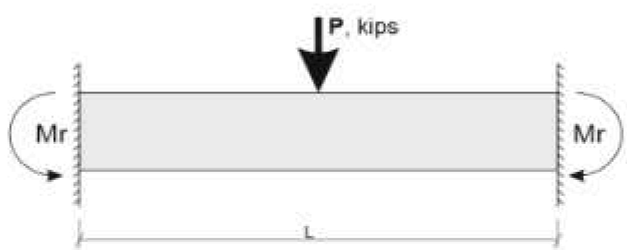
A_{req} 3.4 ft^2

L_{req} **1.0**   ft

Model Foundation as Fixed/Fixed Member

Eqn. 1: $M_u = PL/8$

$M_u =$ **0.772** k-ft



Steel Reinforcing Design:

Steel Depth   9   in

Bar size (#)   5   bar

# of bars   5

$\text{ø}M_n$ =	58.6	kip-ft	*(Design Cap.)*
M_u=	0.772	kip-ft	*(From Eqn. 1)*
øMn/Mu =	**75.9**	OK	

Therefore use 42 inch x 12 inch footing, with (5) #5 bar bottom. See Details.

3.2 SLAB ON GRADE REINFORCEMENT ANALYSIS

For Grade 60 reinforcing bars:

As = F L w / 2 fs where F (friction factor) = 1.5 (commonly used value), L = 30 ft, w = 40 psf and

fs = 2/3 fy where fy is 65,000 psi.

As = 0.024 sq.in./ft of slab width, required each way.

Use W1.4 (ASTM A185) wire at 6-in, spacings in each direction, designated as: 6 x 6 - W1.4 x W1.4

As = 2 x 0.014 sq.in./ft = 2 x 0.028 sq.in./ft.