TM AVIATION HANGAR

AT LXT

2525 NE Douglas St, Lee's Summit, MO, 64064

Prepared For: Ken Plautz, Wellner Architects + Engineers
816-221-0017

PEC Project No.: 250076-000

Prepared by: Shelby Ford, P.E.

Date: March 21, 2025

STATE OF MISSOURI
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03/21/2025
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Project Description

The following calculations are for a one-story pre-engineered metal building (PEMB) with a mezzanine located in Lee's Summit, Missouri. The main building framing consists of roof purlins supporting steel deck spanning between main building frames. The south elevation has a large overhead door. The mezzanine is concrete on steel deck with composite beams which is a delegated design completed by the PEMB engineer. The northeast corner has a vestibule that consists of steel decking supported by steel beams that connect back to the main building steel. The columns are supported by concrete spread footings that are connected by a grade beam around the exterior.

Design Criteria

Local jurisdictions require the TM Aviation Hangar at LXT Project to utilize the 2018 International Building Code for structural design. The following list of codes are permitted under this edition of the International Building Code, and were used for structural design:

- ASCE 7-16: Minimum Design Loads and Associated Criteria for Buildings and Other Structures
- AISC Steel Construction Manual: 15th Edition
- ACI 318-14: Building Code Requirements for Structural Concrete
- TMS 402/602-16: Building Code Requirements and Specifications for Masonry Structures
- Seismic Design Manual: 3rd Edition

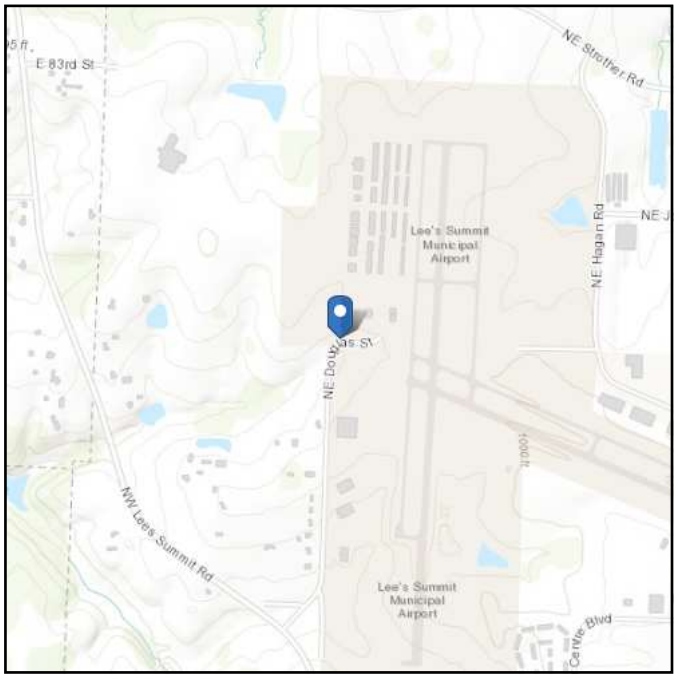
The following pages include additional design criteria that was used during design:

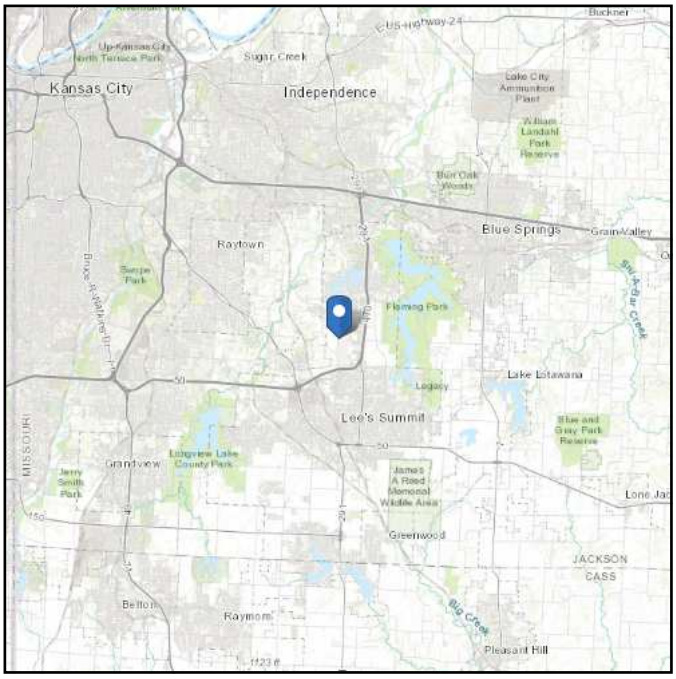
ASCE Hazards Report

Address:
2525 NE Douglas St
Lees Summit, Missouri
64064

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: D - Stiff Soil

Latitude: 38.961251
Longitude: -94.377245
Elevation: 962.3118831168139 ft (NAVD 88)





Wind

Results:

Wind Speed	109 Vmph
10-year MRI	76 Vmph
25-year MRI	83 Vmph
50-year MRI	88 Vmph
100-year MRI	94 Vmph

Data Source:	ASCE/SEI 7-16, Fig. 26.5-1B and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed:	Fri Jan 31 2025

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years).

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

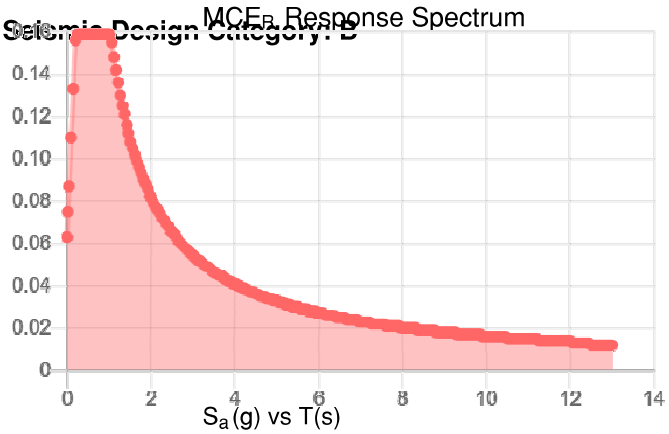
Seismic

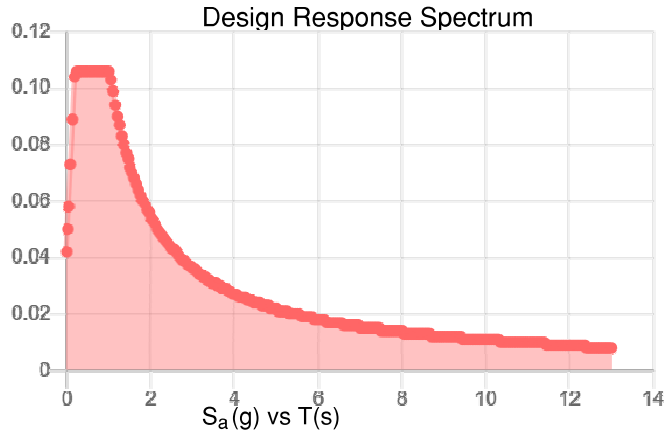
Site Soil Class: D - Stiff Soil

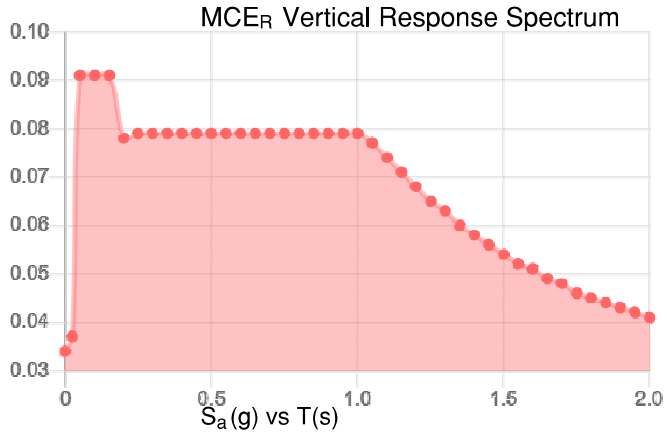
Results:

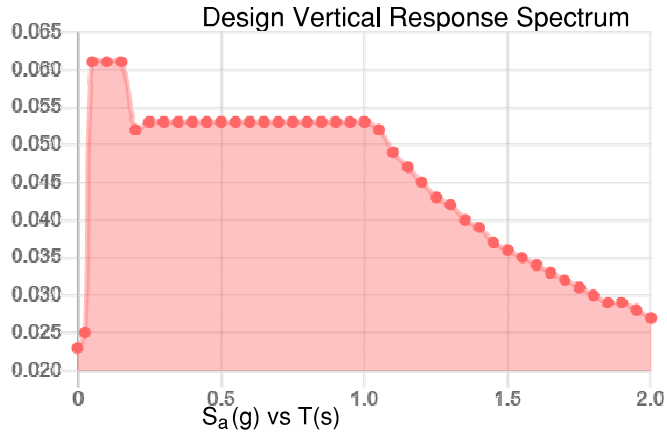
S_S :	0.099	S_{D1} :	0.108
S_1 :	0.068	T_L :	12
F_a :	1.6	PGA :	0.047
F_v :	2.4	PGA_M :	0.075
S_{MS} :	0.159	F_{PGA} :	1.6
S_{M1} :	0.163	I_e :	1
S_{DS} :	0.106	C_v :	0.7

Seismic Design Category: B









Data Accessed: **Fri Jan 31 2025**

Date Source:

USGS Seismic Design Maps based on ASCE/SEI 7-16 and ASCE/SEI 7-16 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-16 Ch. 21 are available from USGS.

Snow

Results:

Ground Snow Load, p_g :	20 lb/ft^2
Mapped Elevation:	962.3 ft
Data Source:	ASCE/SEI 7-16, Table 7.2-8
Date Accessed:	Fri Jan 31 2025

Values provided are ground snow loads. In areas designated "case study required," extreme local variations in ground snow loads preclude mapping at this scale. Site-specific case studies are required to establish ground snow loads at elevations not covered.

Snow load values are mapped to a 0.5 mile resolution. This resolution can create a mismatch between the mapped elevation and the site-specific elevation in topographically complex areas. Engineers should consult the local authority having jurisdiction in locations where the reported ‘elevation’ and ‘mapped elevation’ differ significantly from each other.

Code Search

Code: International Building Code 2018

Occupancy:

Occupancy Group = U Utility & Miscellaneous

Risk Category & Importance Factors:

Risk Category =	II
Wind Factor =	1.00
Importance Factor =	1.00
Seismic Importance factor =	1.00

Type of Construction:

Fire Rating:

Roof =	0.0 hr
Floor =	0.0 hr

Building Geometry:

Roof angle (θ)	0.25 / 12	1.2 deg
Building length	131.8 ft	
Least width	91.8 ft	
Mean Roof Ht (h)	34.4 ft	
Parapet ht above grd	0.0 ft	
Minimum parapet ht	0.0 ft	
hb for Elevated bldg	0.0 ft	

Live Loads:

Roof

0 to 200 sf:	20 psf
200 to 600 sf:	24 - 0.02Area, but not less than 12 psf
over 600 sf:	12 psf

Roofs used for roof gardens 100 psf

Floor:

Typical Floor	50 psf
Partitions	15 psf
Corridors above first floor	80 psf
Lobbies & first floor corridors	100 psf
Stairs and exit ways	100 psf

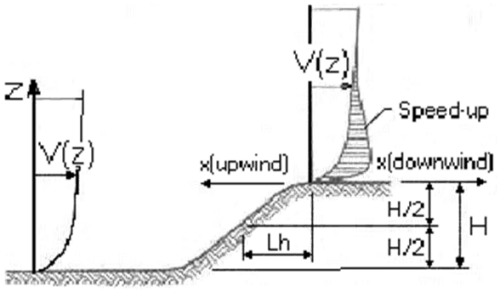
Wind Loads : ASCE 7- 16

Ultimate Wind Speed	109 mph
Nominal Wind Speed	84.4 mph
Risk Category	II
Exposure Category	C
Enclosure Classif.	Partially Open Building
Internal pressure	+/-0.18
Bldg Directionality (Kd)	0.85
Kh MWFRS<=60	1.011
Kh all other	1.011
Type of roof	Monoslope

Topographic Factor (Kzt)

Topography		Flat
Hill Height	(H)	80.0 ft
Half Hill Length (Lh)		100.0 ft
Actual H/Lh	=	0.80
Use H/Lh	=	0.50
Modified Lh	=	160.0 ft
From top of crest: x =		50.0 ft
Bldg up/down wind?		downwind

H/Lh= 0.50 K_1 = 0.000
x/Lh = 0.31 K_2 = 0.792
z/Lh = 0.21 K_3 = 1.000
At Mean Roof Ht:
Kzt = $(1+K_1K_2K_3)$^2 = 1.00



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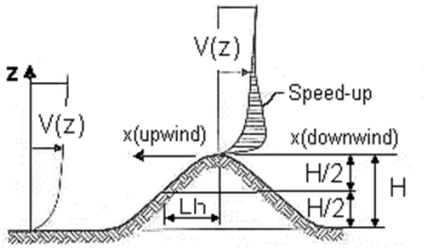

2D RIDGE or 3D AXISYMMETRICAL HILL

Gust Effect Factor

h =	34.4 ft
B =	91.8 ft
/z (0.6h) =	20.6 ft

Flexible structure if natural frequency < 1 Hz (T > 1 second).
If building h/B>4 then may be flexible and should be investigated.
h/B = 0.37 Rigid structure (low rise bldg)

G = 0.85 Using rigid structure default

Rigid Structure

$\bar{e}$ =	0.20
ℓ =	500 ft
z_{min} =	15 ft
c =	0.20
g_Q, g_v =	3.4
L_z =	455.1 ft
Q =	0.88
I_z =	0.22
G =	**0.87** use G = 0.85

Flexible or Dynamically Sensitive Structure

Natural Frequency (η_1) =	0.7 Hz				
Damping ratio (β) =	0.01				
/b =	0.650				
/α =	0.154				
Vz =	96.7				
N_1 =	3.30				
R_n =	0.066				
R_h =	0.531	η =	1.145	h =	34.4 ft
R_B =	0.274	η =	3.056		
R_L =	0.066	η =	14.692		
g_R =	4.104				
R =	0.733				
Gf =	1.054				

Ground Elevation Factor (Ke)

Grd level above sea level =	0 ft	Ke =	1.0000
Constant =	0.00256		
0.00256Ke =	0.00256		

Enclosure Classification

Test for Enclosed Building: Ao < 0.01Ag or 4 sf, whichever is smaller

Test for Open Building: All walls are at least 80% open.
Ao ≥ 0.8Ag

Test for Partially Enclosed Building: Predominately open on one side only

	Input			Test	
Ao	500.0	sf	Ao ≥ 1.1Aoi	NO	
Ag	600.0	sf	Ao > 4sf or 0.01Ag	YES	
Aoi	1000.0	sf	Aoi / Agi ≤ 0.20	YES	Building is NOT Partially Enclosed
Agi	10000.0	sf			

Conditions to qualify as Partially Enclosed Building. Must satisfy all of the following:
Ao ≥ 1.1Aoi
Ao > smaller of 4sf or 0.01 Ag
Aoi / Agi ≤ 0.20
Where:
Ao = the total area of openings in a wall that receives positive external pressure.
Ag = the gross area of that wall in which Ao is identified.
Aoi = the sum of the areas of openings in the building envelope (walls and roof) not including Ao.
Agi = the sum of the gross surface areas of the building envelope (walls and roof) not including Ag.

Test for Partially Open Building: A building that does not qualify as open, enclosed or partially enclosed.
(This type building will have same wind pressures as an enclosed building.)

Reduction Factor for large volume partially enclosed buildings (Ri) :

If the partially enclosed building contains a single room that is unpartitioned , the internal pressure coefficient may be multiplied by the reduction factor Ri.

Total area of all wall & roof openings (Aog): SF
Unpartitioned internal volume (Vi) : CF
Ri = 1.00

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JOB TITLE	TMA Hangar		
JOB NO.	250076-000	SHEET NO.	
CALCULATED BY	ZMJ	DATE	
CHECKED BY	WDL	DATE	

Wind Loads - MWFRS all h (Except for Open Buildings)

		Kh =	1.011	GCpi =	+/-0.18
Base pressure (qh) =	**26.1 psf**	Bldg dim parallel to ridge =	131.8 ft	G =	0.85
Roof Angle (θ) =	1.2 deg	Bldg dim normal to ridge =	91.8 ft	qi = qh	
Roof tributary area:		h =	34.4 ft		
Wind normal to ridge =(h/2)*L:	2264 sf	ridge ht =	35.3 ft		
Wind parallel to ridge =(h/2)*L:	1577 sf				

Ultimate Wind Surface Pressures (psf)

Surface	Wind Normal to Ridge L/B = 0.70 h/L = 0.37				Wind Parallel to Ridge L/B = 1.44 h/L = 0.26				
	Cp	q_hGC_p	w/+q_iGC_{pi}	w/-q_hGC_{pi}	Dist.*	Cp	q_hGC_p	w/ +q_iGC_{pi}	w/ -q_hGC_{pi}
Windward Wall (WW)	0.80	17.8	see table below			0.80	17.8	see table below	
Leeward Wall (LW)	-0.50	-11.1	-15.8	-6.4		-0.41	-9.2	-13.9	-4.5
Side Wall (SW)	-0.70	-15.5	-20.3	-10.8		-0.70	-15.5	-20.3	-10.8
Leeward Roof (LR)		**				Included in windward roof			
Neg Windward Roof: 0 to h/2*	-0.90	-20.0	-24.7	-15.3	0 to h/2*	-0.90	-20.0	-24.7	-15.3
h/2 to h*	-0.90	-20.0	-24.7	-15.3	h/2 to h*	-0.90	-20.0	-24.7	-15.3
h to 2h*	-0.50	-11.1	-15.8	-6.4	h to 2h*	-0.50	-11.1	-15.8	-6.4
> 2h*	-0.30	-6.7	-11.4	-2.0	> 2h*	-0.30	-6.7	-11.4	-2.0
Pos/min windward roof press.	-0.18	-4.0	-8.7	0.7	Min press.	-0.18	-4.0	-8.7	0.7

*Horizontal distance from windward edge
**Roof angle < 10 degrees. Therefore, leeward roof is included in windward roof pressure zones.

For monoslope roofs, entire roof surface is either windward or leeward surface.

Windward roof overhangs : 17.8 psf (upward : add to qhGCp windward roof pressure)

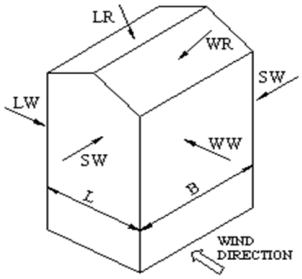
Parapet

z	Kz	Kzt	qp (psf)
0.0 ft	0.849	1.00	0.0

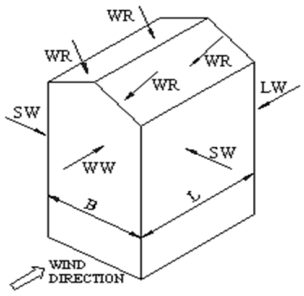
Windward parapet: 0.0 psf (GCpn = +1.5)
Leeward parapet: 0.0 psf (GCpn = -1.0)

Windward Wall Pressures at "z" (psf)

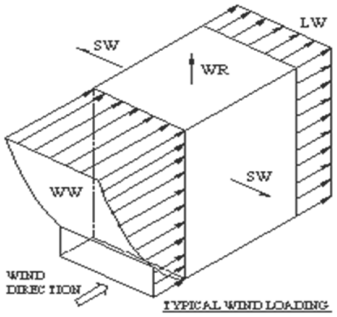
	z	Kz	Kzt	Windward Wall q_zGC_p	w/+q_iGC_{pi}	w/-q_hGC_{pi}	Combined WW + LW Wind Normal to Ridge	Wind Parallel to Ridge
	0 to 15'	0.85	1.00	14.9	10.2	19.6	26.0	24.1
	20.0 ft	0.90	1.00	15.9	11.2	20.6	27.0	25.0
	25.0 ft	0.95	1.00	16.6	11.9	21.3	27.7	25.8
	30.0 ft	0.98	1.00	17.3	12.6	22.0	28.4	26.4
h=	34.4 ft	1.01	1.00	17.8	13.1	22.5	28.9	26.9
ridge =	35.3 ft	1.02	1.00	17.9	13.2	22.6	29.0	27.0



WIND NORMAL TO RIDGE



WIND PARALLEL TO RIDGE



TYPICAL WIND LOADING

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Ultimate Wind Pressures

Wind Loads - Components & Cladding : h ≤ 60'

		Kh =	1.011	
Base pressure (qh) =	**26.1 psf**	h =	34.4 ft	0.2h = 6.9 ft
Minimum parapet ht =	0.0 ft	0.6h =	20.6 ft	
Roof Angle (θ) =	1.2 deg	GCpi =	+/-0.18	
Type of roof =	Monoslope	qi = qh =	26.1 psf	

Roof

	Surface Pressure (psf)								User input	
Area	10 sf	20 sf	50 sf	100 sf	200 sf	350 sf	500 sf	1000 sf	10 sf	44 sf
Negative Zone 1	-49.10	-45.90	-41.60	-38.40	-35.1	-32.5	-30.8	-30.8	-49.1	-42.2
Negative Zone 1'	-28.20	-28.20	-28.20	-28.20	-24.3	-21.1	-19.1	-16.0	-28.2	-28.2
Negative Zone 2	-64.80	-60.60	-55.10	-51.00	-46.8	-43.4	-41.3	-41.3	-64.8	-55.9
Negative Zone 3	-88.30	-80.00	-69.00	-60.60	-52.3	-45.6	-41.3	-41.3	-88.3	-70.5
Positive All Zones	16.00	16.00	16.00	16.00	16.0	16.0	16.0	16.0	16.0	16.0
Overhang Zone 1&1'	-44.40	-43.60	-42.60	-41.80	-35.1	-29.6	-26.1	-26.1	-44.4	-42.7
Overhang Zone 2	-60.10	-54.50	-47.20	-41.60	-36.1	-31.6	-28.7	-28.7	-60.1	-48.2
Overhang Zone 3	-83.60	-73.90	-61.00	-51.30	-41.6	-33.8	-28.7	-28.7	-83.6	-62.8

Overhang pressures in the table above assume an internal pressure coefficient (Gcpi) of 0.0
Overhang soffit pressure equals adj wall pressure (which includes internal pressure of 4.7 psf)

Parapet

qp = 0.0 psf

		Surface Pressure (psf)						User input
Solid Parapet Pressure		10 sf	20 sf	50 sf	100 sf	200 sf	500 sf	10 sf
CASE A:	Zone 2 :	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Zone 3 :	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CASE B:	Interior zone :	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Corner zone :	0.0	0.0	0.0	0.0	0.0	0.0	0.0

wall a = 9.2 ft

Walls

	GCp +/- GCpi				Surface Pressure at h				User input	
Area	10 sf	100 sf	200 sf	500 sf	10 sf	100 sf	200 sf	500 sf	9 sf	100 sf
Negative Zone 4	-1.17	-1.01	-0.96	-0.90	-30.6	-26.4	-25.2	-23.5	-30.6	-26.4
Negative Zone 5	-1.44	-1.12	-1.03	-0.90	-37.6	-29.3	-26.8	-23.5	-37.6	-29.3
Positive Zone 4 & 5	1.08	0.92	0.87	0.81	28.2	24.1	22.8	21.2	28.2	24.1

Note: GCp reduced by 10% due to roof angle <= 10 deg.

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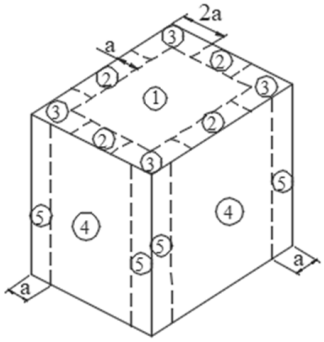
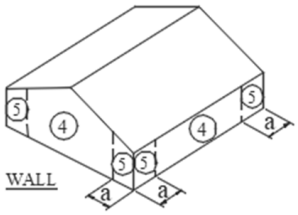
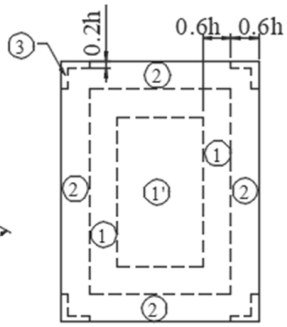
Location of C&C Wind Pressure Zones - ASCE 7-16



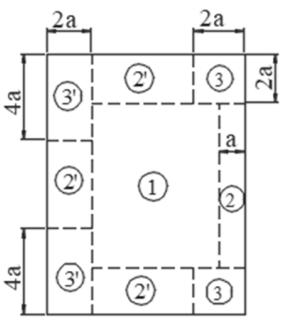
Roofs w/ θ ≤ 10°
and all walls
h > 60'



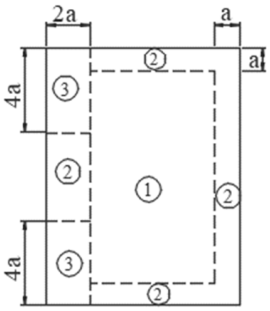
Walls h ≤ 60'
& alt design h<90'



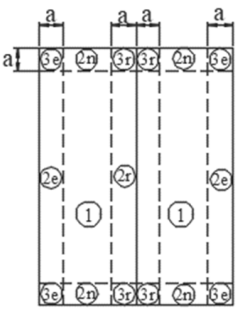
Multispan Gable & Sawtooth ≤ 10°
and Gable θ ≤ 7 degrees &
Monoslope ≤ 3 degrees
h ≤ 60' & alt design h<90'



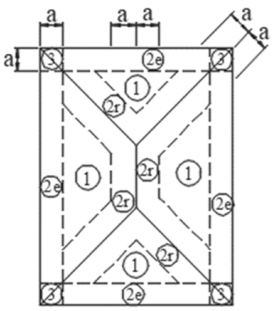
Monoslope roofs
3° < θ ≤ 10°
h ≤ 60' & alt design h<90'



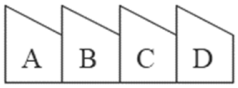
Monoslope roofs
10° < θ ≤ 30°
h ≤ 60' & alt design h<90'

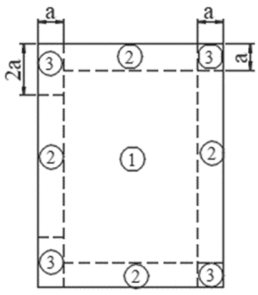


Multispan Gable > 10°
& Gable 7° < θ ≤ 45°

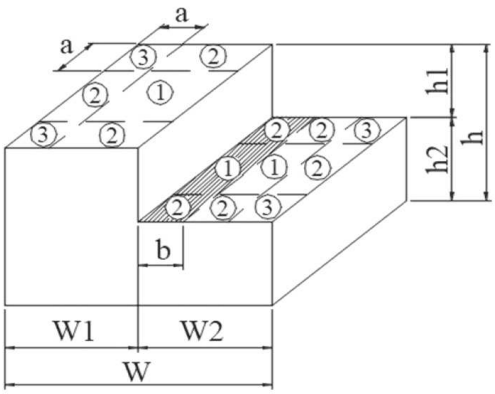


Hip 7° < θ ≤ 27°



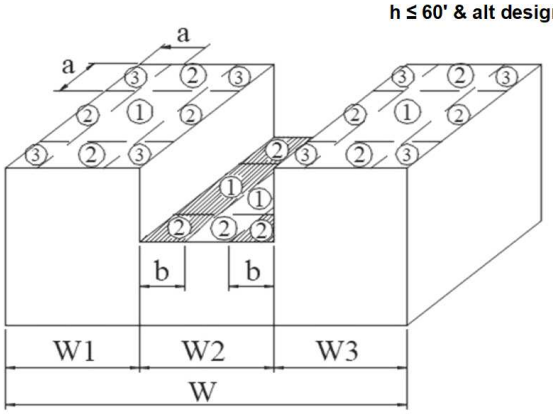


Sawtooth 10° < θ ≤ 45°
h ≤ 60' & alt design h<90'



Note: The hatched area indicates where roof positive pressures are equal to the adjacent wall positive pressure.

Stepped roofs θ ≤ 3°
h ≤ 60' & alt design h<90'



Note: The stepped roof zones above are as shown in ASCE 7-16 . Prior editions didn't show zones, but the notes sent you to the low slope gable figure. The note in ASCE 7-16 still sends you to the low slope gable figure, but for some reason the zones shown are per editions prior to ASCE 7-16. Therefore, the above zones may be a code mistake and the correct zone locations may be per the low slope gable roof shown at the top of this page.

Professional Engineering Consultants
1100 Main St. STE 1800
Kansas City, MO 64105
816-702-0000
www.pec1.com

Snow Loads : ASCE 7- 16

Nominal Snow Forces

Roof slope		=	1.2 deg
Horiz. eave to ridge dist (W)		=	91.8 ft
Roof length parallel to ridge (L)		=	131.8 ft
Type of Roof			Monoslope
Ground Snow Load	Pg	=	20.0 psf
Risk Category		=	II
Importance Factor	I	=	1.0
Roof R value	Rroof	=	30
Thermal Factor	Ct	=	1.100
Exposure Factor	Ce	=	1.00
Pf = 0.7*Ce*Ct*I*Pg		=	15.4 psf
Unobstructed Slippery Surface			yes
Sloped-roof Factor	Cs	=	1.00
Balanced Snow Load		**=**	**15.4 psf**
Rain on Snow Surcharge Angle			1.84 deg
Code Maximum Rain Surcharge			5.0 psf
Rain on Snow Surcharge		=	5.0 psf
Ps plus rain surcharge		=	20.4 psf
Minimum Snow Load	Pm	=	20.0 psf
Uniform Roof Design Snow Load		=	**20.4 psf**

Near ground level surface balanced snow load = **20.0 psf**

NOTE: Alternate spans of continuous beams shall be loaded with half the design roof snow load so as to produce the greatest possible effect - see code for loading diagrams and exceptions for gable roofs

~~0.55~~

Seismic Loads: IBC 2018

Strength Level Forces

Risk Category : II
Importance Factor (Ie) : 1.00
Site Class : D

Ss (0.2 sec) = 0.10 g Fa = 1.600
S1 (1.0 sec) = 0.07 g Fv = 2.400

Site specific ground motion analysis performed:

Sms = 0.158 S_{DS} = 0.106 Design Category = A
Sm1 = 0.163 S_{D1} = 0.109 Design Category = B

Seismic Design Category = **B**
Redundancy Coefficient ρ = 1.00
Number of Stories: 1

Structure Type: All other building systems
Horizontal Struct Irregularities: No plan Irregularity
Vertical Structural Irregularities: No vertical Irregularity
Flexible Diaphragms: Yes
Building System: **Structural steel systems not specifically detailed for seismic resistance**
Seismic resisting system: **Structural steel systems not specifically detailed for seismic resistance**
System Structural Height Limit: **Height not limited**
Actual Structural Height (hn) = 34.4 ft

DESIGN COEFFICIENTS AND FACTORS

Response Modification Coefficient (R) = 3
Over-Strength Factor (Ωo) = 2.5
Deflection Amplification Factor (Cd) = 3

To = 0.2(Sd1/Sds) = 0.206
Ts = Sd1/Sds = 1.030
Long Period Transition Period (TL) = 12 sec

S_{DS} = 0.106
S_{D1} = 0.109

Seismic Load Effect (E) = Eh +/-Ev = ρ Q_E +/- 0.2S_{DS} D = Qe +/- 0.000D Q_E = horizontal seismic force
Special Seismic Load Effect (Em) = Emh +/- Ev = Ωo Q_E +/- 0.2S_{DS} D = 2.5Qe +/- 0.021D D = dead load

ALLOWABLE STORY DRIFT

Structure Type: All other structures

Allowable story drift Δa = 0.020hsx where hsx is the story height below level x

PERMITTED ANALYTICAL PROCEDURES

Index Force Analysis - Method Not Permitted (only applies to Seismic Category A)

Model & Seismic Response Analysis - Permitted (see code for procedure)

Equivalent Lateral-Force (ELF) Analysis - Permitted

Building period coef. (C_T) = 0.020 Cu = 1.68
Approx fundamental period (Ta) = $C_T h_n^x$ = 0.284 sec x= 0.75 Tmax = CuTa = 0.478 sec
User calculated fundamental period = T = 0.284 sec

Seismic response coef. (Cs) = SdsI/R = 0.035
need not exceed Cs = Sd1 I /RT = 0.128
but not less than Cs = 0.044Sds*I = 0.010
USE Cs = 0.035

Design Base Shear V = 0.035W

SEISMIC FORCES AT FLOORS - ELF Procedure

Total Stories =	1	Floor Dead Load =	80.0 psf	Roof Snow Load =	0.0 psf
Building length L =	131.8 ft	Floor LL to include =	0.0 psf	Roof Equip wt =	0.0 kips
Building width W =	91.8 ft	Floor Equip wt =	0.0 kips	Parapet weight =	0.0 psf
hn =	34.4 ft	Partition weight =	10.0 psf	Parapet height =	0.0 ft
k =	1.000	Ext Wall Weight =	50.0 psf		
V =	0.035W	Roof Dead Load =	20.0 psf		

Bottom Floor (level 1) is a slab on grade

Diaphragm shall be designed for level force Fx, but not less than Fpx = (Σ Fi / Σ wi) wpx, but :
Fpx min = $0.2S_{DS}$ Ie wpx = 0.021 wpx
Fpx max = $0.4S_{DS}$ Ie wpx = 0.042 wpx

Seismic Forces (Including all exterior walls)

V = 13.6k

Level (x)	EL above Seismic Base hx (ft)	Level Weight Wx (kips)	Wx hx^k (ft-kips)	Cvx = Wx hx^k / Σ Wi hi^k	Base Shear Distribution Fx=CvxV	Σ Fx (k)	Story M	Diaphragm Force Fpx Σ Wi (k)	Fpx	Design Fpx
Roof	13.00	387	5,031	1.000	13.62	13.6	0	387	13.6	13.6
1	0.00	0	0	0.000	0.00	0.0	0	0	0.0	0.0
Base		387		1.000		13.6	177			
							177 = Base M			

Diaphragm Forces excluding parallel exterior walls

Diaphragm Force Fpx Parallel to Bldg Length V= 11k

Cvx =	Fx=CvxV	Σ Fx (k)	Σ Wi (k)	Fpx	Design Fpx
1.000	10.61	10.6	301	10.6	10.6
0.000	0.00	0.0	0	0.0	0.0
1.000		10.6			

Diaphragm Force Fpx Normal to Bldg Length V= 12k

Level (x)	Cvx =	Fx=CvxV	Σ Fx (k)	Σ Wi (k)	Fpx	Design Fpx
Roof	1.000	11.5	11.5	327	11.5	11.5
1	0.000	0.0	0.0	0	0.0	0.0
Base	1.000		11.5			

Foundation Design

General Footing

Project File: 250076-000 enercalc.ec6

LIC# : KW-06017529, Build:20.22.8.17 PEC (c) ENERCALC INC 1983-2022

DESCRIPTION: Building Frame Column Footing - Gravity

Code References

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Material Properties

f'c : Concrete 28 day strength	=	4.0	ksi
fy : Rebar Yield	=	60.0	ksi
Ec : Concrete Elastic Modulus	=	3,605.0	ksi
Concrete Density	=	145.0	pcf
φ Values Flexure	=	0.90	
Shear	=	0.750	

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.50 : 1
Min. Sliding Safety Factor	=	1.50 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	Yes
Add Pedestal Wt for Soil Pressure	:	No
Use Pedestal wt for stability, mom & shear	:	No

Soil Design Values

Allowable Soil Bearing	=	3.0	ksf
Soil Density	=	145.0	pcf
Increase Bearing By Footing Weight	=	No	
Soil Passive Resistance (for Sliding)	=	250.0	pcf
Soil/Concrete Friction Coeff.	=	0.30	

Increases based on footing Depth

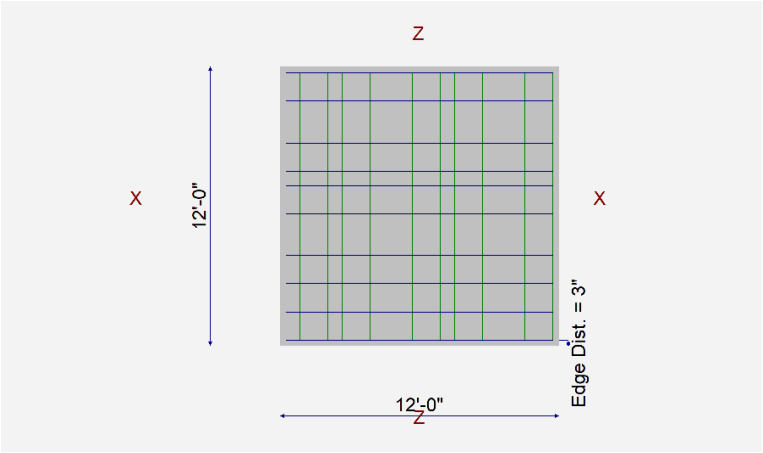
Footing base depth below soil surface	=	3.50	ft
Allow press. increase per foot of depth	=		ksf
when footing base is below	=		ft

Increases based on footing plan dimension

Allowable pressure increase per foot of depth	=		ksf
when max. length or width is greater than	=		ft

Dimensions

Width parallel to X-X Axis	=	12.0	ft
Length parallel to Z-Z Axis	=	12.0	ft
Footing Thickness	=	30.0	in



Pedestal dimensions...

px : parallel to X-X Axis	=		in
pz : parallel to Z-Z Axis	=		in
Height	=		in

Rebar Centerline to Edge of Concrete...

at Bottom of footing	=	3.0	in

Reinforcing

Bars parallel to X-X Axis			
Number of Bars	=		20
Reinforcing Bar Size	=	#	6
Bars parallel to Z-Z Axis			
Number of Bars	=		20
Reinforcing Bar Size	=	#	6

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation	n/a
# Bars required within zone	n/a
# Bars required on each side of zone	n/a

Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	17.590		30.720		0.0			k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=								k-ft
V-x	=								k
V-z	=								k

General Footing

Project File: 250076-000 enercalc.ec6

LIC# : KW-06017529, Build:20.22.8.17 PEC (c) ENERCALC INC 1983-2022

DESCRIPTION: Building Frame Column Footing - Gravity

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.2810	Soil Bearing	0.8430 ksf	3.0 ksf	+D+L about Z-Z axis
PASS	n/a	Overturning - X-X	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Overturning - Z-Z	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.1006	Z Flexure (+X)	8.783 k-ft/ft	87.321 k-ft/ft	+1.20D+1.60L
PASS	0.1006	Z Flexure (-X)	8.783 k-ft/ft	87.321 k-ft/ft	+1.20D+1.60L
PASS	0.1006	X Flexure (+Z)	8.783 k-ft/ft	87.321 k-ft/ft	+1.20D+1.60L
PASS	0.1006	X Flexure (-Z)	8.783 k-ft/ft	87.321 k-ft/ft	+1.20D+1.60L
PASS	0.05905	1-way Shear (+X)	5.602 psi	94.868 psi	+1.20D+1.60L
PASS	0.05905	1-way Shear (-X)	5.602 psi	94.868 psi	+1.20D+1.60L
PASS	0.05905	1-way Shear (+Z)	5.602 psi	94.868 psi	+1.20D+1.60L
PASS	0.05905	1-way Shear (-Z)	5.602 psi	94.868 psi	+1.20D+1.60L
PASS	0.1229	2-way Punching	23.314 psi	189.737 psi	+1.20D+1.60L

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc (in)	Zecc (in)	Actual Soil Bearing Stress @ Location Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, D Only	3.0	n/a	0.0	0.6297	0.6297	n/a	n/a	0.210
X-X, +D+L	3.0	n/a	0.0	0.8430	0.8430	n/a	n/a	0.281
X-X, +D+0.750L	3.0	n/a	0.0	0.7897	0.7897	n/a	n/a	0.263
X-X, +0.60D	3.0	n/a	0.0	0.3778	0.3778	n/a	n/a	0.126
Z-Z, D Only	3.0	0.0	n/a	n/a	n/a	0.6297	0.6297	0.210
Z-Z, +D+L	3.0	0.0	n/a	n/a	n/a	0.8430	0.8430	0.281
Z-Z, +D+0.750L	3.0	0.0	n/a	n/a	n/a	0.7897	0.7897	0.263
Z-Z, +0.60D	3.0	0.0	n/a	n/a	n/a	0.3778	0.3778	0.126

Overturning Stability

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
Footing Has NO Overturning				

All units k

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status
Footing Has NO Sliding				

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	3.078	+Z	Bottom	0.6480	AsMin	0.7333	87.321	OK
X-X, +1.40D	3.078	-Z	Bottom	0.6480	AsMin	0.7333	87.321	OK
X-X, +1.20D+1.60L	8.783	+Z	Bottom	0.6480	AsMin	0.7333	87.321	OK
X-X, +1.20D+1.60L	8.783	-Z	Bottom	0.6480	AsMin	0.7333	87.321	OK
X-X, +1.20D+0.50L	4.559	+Z	Bottom	0.6480	AsMin	0.7333	87.321	OK
X-X, +1.20D+0.50L	4.559	-Z	Bottom	0.6480	AsMin	0.7333	87.321	OK
X-X, +1.20D	2.639	+Z	Bottom	0.6480	AsMin	0.7333	87.321	OK
X-X, +1.20D	2.639	-Z	Bottom	0.6480	AsMin	0.7333	87.321	OK
X-X, +0.90D	1.979	+Z	Bottom	0.6480	AsMin	0.7333	87.321	OK
X-X, +0.90D	1.979	-Z	Bottom	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +1.40D	3.078	-X	Bottom	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +1.40D	3.078	+X	Bottom	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +1.20D+1.60L	8.783	-X	Bottom	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +1.20D+1.60L	8.783	+X	Bottom	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +1.20D+0.50L	4.559	-X	Bottom	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +1.20D+0.50L	4.559	+X	Bottom	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +1.20D	2.639	-X	Bottom	0.6480	AsMin	0.7333	87.321	OK

General Footing

Project File: 250076-000 enercalc.ec6

LIC# : KW-06017529, Build:20.22.8.17 PEC (c) ENERCALC INC 1983-2022

DESCRIPTION: Building Frame Column Footing - Gravity

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
Z-Z, +1.20D	2.639	+X	Bottom	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +0.90D	1.979	-X	Bottom	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +0.90D	1.979	+X	Bottom	0.6480	AsMin	0.7333	87.321	OK

One Way Shear

Load Combination...	Vu @ -X	Vu @ +X	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	1.96 psi	1.96 psi	1.96 psi	1.96 psi	1.96 psi	94.87 psi	0.02	OK
+1.20D+1.60L	5.60 psi	5.60 psi	5.60 psi	5.60 psi	5.60 psi	94.87 psi	0.06	OK
+1.20D+0.50L	2.91 psi	2.91 psi	2.91 psi	2.91 psi	2.91 psi	94.87 psi	0.03	OK
+1.20D	1.68 psi	1.68 psi	1.68 psi	1.68 psi	1.68 psi	94.87 psi	0.02	OK
+0.90D	1.26 psi	1.26 psi	1.26 psi	1.26 psi	1.26 psi	94.87 psi	0.01	OK

Two-Way "Punching" Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	8.17 psi	189.74 psi	0.04307	OK
+1.20D+1.60L	23.31 psi	189.74 psi	0.1229	OK
+1.20D+0.50L	12.10 psi	189.74 psi	0.06378	OK
+1.20D	7.00 psi	189.74 psi	0.03692	OK
+0.90D	5.25 psi	189.74 psi	0.02769	OK

General Footing

Project File: 250076-000 enercalc.ec6

LIC# : KW-06017529, Build:20.22.8.17 PEC (c) ENERCALC INC 1983-2022

DESCRIPTION: Building Frame Column Footing - Uplift

Code References

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Material Properties

f'c : Concrete 28 day strength	=	4.0	ksi
fy : Rebar Yield	=	60.0	ksi
Ec : Concrete Elastic Modulus	=	3,605.0	ksi
Concrete Density	=	145.0	pcf
φ Values Flexure	=	0.90	
Shear	=	0.750	

Analysis Settings

Min Steel % Bending Reinf.	=		
Min Allow % Temp Reinf.	=	0.00180	
Min. Overturning Safety Factor	=	1.50	: 1
Min. Sliding Safety Factor	=	1.50	: 1
Add Ftg Wt for Soil Pressure	:	Yes	
Use ftg wt for stability, moments & shears	:	Yes	
Add Pedestal Wt for Soil Pressure	:	No	
Use Pedestal wt for stability, mom & shear	:	No	

Soil Design Values

Allowable Soil Bearing	=	3.0	ksf
Soil Density	=	145.0	pcf
Increase Bearing By Footing Weight	=	No	
Soil Passive Resistance (for Sliding)	=	250.0	pcf
Soil/Concrete Friction Coeff.	=	0.30	

Increases based on footing Depth

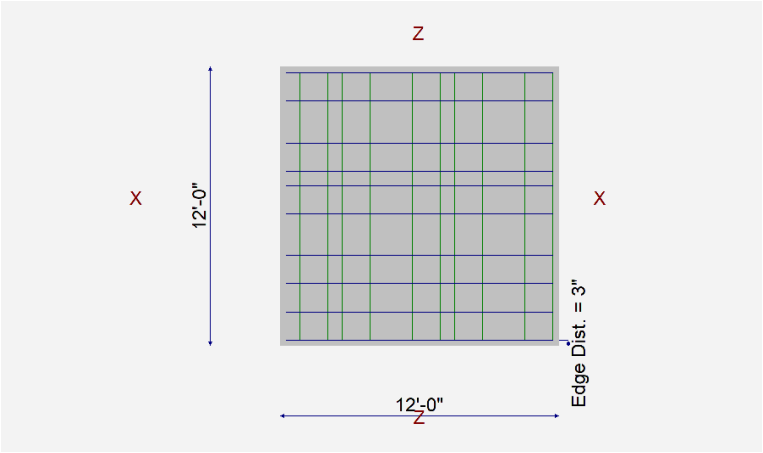
Footing base depth below soil surface	=	3.50	ft
Allow press. increase per foot of depth	=		ksf
when footing base is below	=		ft

Increases based on footing plan dimension

Allowable pressure increase per foot of depth	=		ksf
when max. length or width is greater than	=		ft

Dimensions

Width parallel to X-X Axis	=	12.0	ft
Length parallel to Z-Z Axis	=	12.0	ft
Footing Thickness	=	30.0	in



Pedestal dimensions...

px : parallel to X-X Axis	=		in
pz : parallel to Z-Z Axis	=		in
Height	=		in

Rebar Centerline to Edge of Concrete...

at Bottom of footing	=	3.0	in

Reinforcing

Bars parallel to X-X Axis

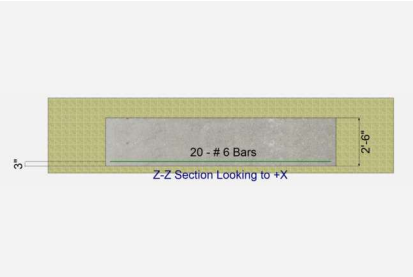
Number of Bars	=		20
Reinforcing Bar Size	=	#	6

Bars parallel to Z-Z Axis

Number of Bars	=		20
Reinforcing Bar Size	=	#	6

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation



bars required within zone

bars required on each side of zone

Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	17.0				-88.510			k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=								k-ft
V-x	=								k
V-z	=								k

General Footing

Project File: 250076-000 enercalc.ec6

LIC# : KW-06017529, Build:20.22.8.17 PEC (c) ENERCALC INC 1983-2022

DESCRIPTION: Building Frame Column Footing - Uplift

DESIGN SUMMARY

Design N.G.

Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	Soil Bearing	ksf	ksf	
FAIL	Overturning - X-X	k-ft	k-ft	
FAIL	Overturning - Z-Z	k-ft	k-ft	
FAIL	Sliding - X-X	k	k	
FAIL	Sliding - Z-Z	k	k	
FAIL	Uplift	k	k	
PASS	Z Flexure (+X)	k-ft/ft	k-ft/ft	
PASS	Z Flexure (-X)	k-ft/ft	k-ft/ft	
PASS	X Flexure (+Z)	k-ft/ft	k-ft/ft	
PASS	X Flexure (-Z)	k-ft/ft	k-ft/ft	
PASS	1-way Shear (+X)	psi	psi	
PASS	1-way Shear (-X)	psi	psi	
PASS	1-way Shear (+Z)	psi	psi	
PASS	1-way Shear (-Z)	psi	psi	
PASS	2-way Punching	psi	psi	

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc (in)	Zecc (in)	Actual Soil Bearing Stress @ Location Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, D Only	3.0	n/a	0.0	0.6256	0.6256	n/a	n/a	0.209
X-X, +D+0.60W	3.0	n/a	0.0	0.2568	0.2568	n/a	n/a	0.086
X-X, +D+0.450W	3.0	n/a	0.0	0.3490	0.3490	n/a	n/a	0.116
X-X, +0.60D+0.60W	3.0	n/a	0.0	0.006542	0.006542	n/a	n/a	0.002
X-X, +0.60D	3.0	n/a	0.0	0.3753	0.3753	n/a	n/a	0.125
Z-Z, D Only	3.0	0.0	n/a	n/a	n/a	0.6256	0.6256	0.209
Z-Z, +D+0.60W	3.0	0.0	n/a	n/a	n/a	0.2568	0.2568	0.086
Z-Z, +D+0.450W	3.0	0.0	n/a	n/a	n/a	0.3490	0.3490	0.116
Z-Z, +0.60D+0.60W	3.0	0.0	n/a	n/a	n/a	0.006542	0.006542	0.002
Z-Z, +0.60D	3.0	0.0	n/a	n/a	n/a	0.3753	0.3753	0.125

Overturning Stability

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
Footing Has NO Overturning				

All units k

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status
Footing Has NO Sliding				

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	2.975	+Z	Bottom	0.6480	AsMin	0.7333	87.321	OK
X-X, +1.40D	2.975	-Z	Bottom	0.6480	AsMin	0.7333	87.321	OK
X-X, +1.20D	2.550	+Z	Bottom	0.6480	AsMin	0.7333	87.321	OK
X-X, +1.20D	2.550	-Z	Bottom	0.6480	AsMin	0.7333	87.321	OK
X-X, +1.20D+0.50W	2.982	+Z	Top	0.6480	AsMin	0.7333	87.321	OK
X-X, +1.20D+0.50W	2.982	-Z	Top	0.6480	AsMin	0.7333	87.321	OK
X-X, +1.20D+W	8.514	+Z	Top	0.6480	AsMin	0.7333	87.321	OK
X-X, +1.20D+W	8.514	-Z	Top	0.6480	AsMin	0.7333	87.321	OK
X-X, +0.90D+W	9.151	+Z	Top	0.6480	AsMin	0.7333	87.321	OK
X-X, +0.90D+W	9.151	-Z	Top	0.6480	AsMin	0.7333	87.321	OK
X-X, +0.90D	1.913	+Z	Bottom	0.6480	AsMin	0.7333	87.321	OK
X-X, +0.90D	1.913	-Z	Bottom	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +1.40D	2.975	-X	Bottom	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +1.40D	2.975	+X	Bottom	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +1.20D	2.550	-X	Bottom	0.6480	AsMin	0.7333	87.321	OK

General Footing

Project File: 250076-000 enercalc.ec6

LIC# : KW-06017529, Build:20.22.8.17 PEC (c) ENERCALC INC 1983-2022

DESCRIPTION: Building Frame Column Footing - Uplift

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
Z-Z, +1.20D	2.550	+X	Bottom	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +1.20D+0.50W	2.982	-X	Top	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +1.20D+0.50W	2.982	+X	Top	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +1.20D+W	8.514	-X	Top	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +1.20D+W	8.514	+X	Top	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +0.90D+W	9.151	-X	Top	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +0.90D+W	9.151	+X	Top	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +0.90D	1.913	-X	Bottom	0.6480	AsMin	0.7333	87.321	OK
Z-Z, +0.90D	1.913	+X	Bottom	0.6480	AsMin	0.7333	87.321	OK

One Way Shear

Load Combination...	Vu @ -X	Vu @ +X	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	1.90 psi	1.90 psi	1.90 psi	1.90 psi	1.90 psi	94.87 psi	0.02	OK
+1.20D	1.63 psi	1.63 psi	1.63 psi	1.63 psi	1.63 psi	94.87 psi	0.02	OK
+1.20D+0.50W	1.90 psi	1.90 psi	1.90 psi	1.90 psi	1.90 psi	94.87 psi	0.02	OK
+1.20D+W	5.43 psi	5.43 psi	5.43 psi	5.43 psi	5.43 psi	94.87 psi	0.06	OK
+0.90D+W	5.84 psi	5.84 psi	5.84 psi	5.84 psi	5.84 psi	94.87 psi	0.06	OK
+0.90D	1.22 psi	1.22 psi	1.22 psi	1.22 psi	1.22 psi	94.87 psi	0.01	OK

Two-Way "Punching" Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	7.90 psi	189.74 psi	0.04162	OK
+1.20D	6.77 psi	189.74 psi	0.03568	OK
+1.20D+0.50W	7.92 psi	189.74 psi	0.04172	OK
+1.20D+W	22.60 psi	189.74 psi	0.1191	OK
+0.90D+W	24.29 psi	189.74 psi	0.128	OK
+0.90D	5.08 psi	189.74 psi	0.02676	OK

General Footing

Project File: 250076-000 enercalc.ec6

LIC# : KW-06017529, Build:20.22.8.17 PEC (c) ENERCALC INC 1983-2022

DESCRIPTION: Building Endwall Column

Code References

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Material Properties

f'c : Concrete 28 day strength	=	4.0	ksi
fy : Rebar Yield	=	60.0	ksi
Ec : Concrete Elastic Modulus	=	3,605.0	ksi
Concrete Density	=	145.0	pcf
φ Values Flexure	=	0.90	
Shear	=	0.750	

Analysis Settings

Min Steel % Bending Reinf.	=		
Min Allow % Temp Reinf.	=	0.00180	
Min. Overturning Safety Factor	=	1.50	: 1
Min. Sliding Safety Factor	=	1.50	: 1
Add Ftg Wt for Soil Pressure	:	Yes	
Use ftg wt for stability, moments & shears	:	Yes	
Add Pedestal Wt for Soil Pressure	:	No	
Use Pedestal wt for stability, mom & shear	:	No	

Soil Design Values

Allowable Soil Bearing	=	3.0	ksf
Soil Density	=	145.0	pcf
Increase Bearing By Footing Weight	=	No	
Soil Passive Resistance (for Sliding)	=	250.0	pcf
Soil/Concrete Friction Coeff.	=	0.30	

Increases based on footing Depth

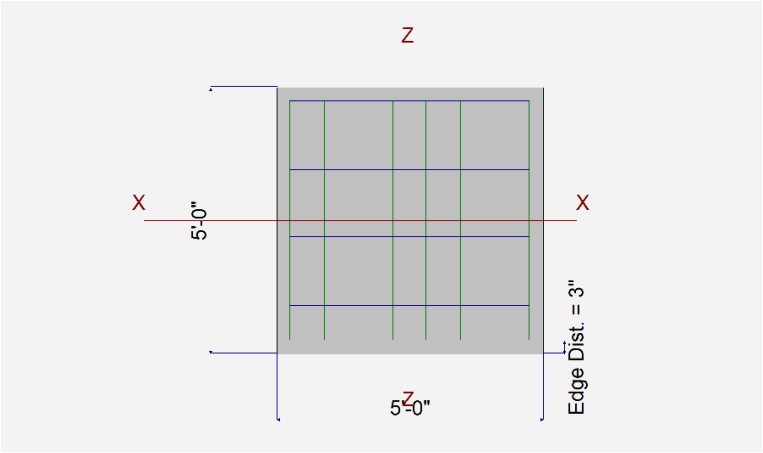
Footing base depth below soil surface	=	3.50	ft
Allow press. increase per foot of depth	=		ksf
when footing base is below	=		ft

Increases based on footing plan dimension

Allowable pressure increase per foot of depth	=		ksf
when max. length or width is greater than	=		ft

Dimensions

Width parallel to X-X Axis	=	5.0	ft
Length parallel to Z-Z Axis	=	5.0	ft
Footing Thickness	=	30.0	in



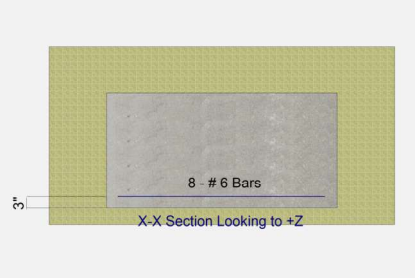
Pedestal dimensions...			
px : parallel to X-X Axis	=		in
pz : parallel to Z-Z Axis	=		in
Height	=		in
Rebar Centerline to Edge of Concrete...			
at Bottom of footing	=	3.0	in

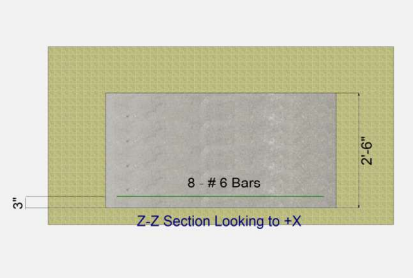
Reinforcing

Bars parallel to X-X Axis			
Number of Bars	=		8
Reinforcing Bar Size	=	#	6
Bars parallel to Z-Z Axis			
Number of Bars	=		8
Reinforcing Bar Size	=	#	6

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation	
	n/a
# Bars required within zone	n/a
# Bars required on each side of zone	n/a





Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	1.550	0.0	0.0		-8.570			k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=								k-ft
V-x	=					0.0			k
V-z	=								k

General Footing

Project File: 250076-000 enercalc.ec6

LIC# : KW-06017529, Build:20.22.8.17 PEC (c) ENERCALC INC 1983-2022

DESCRIPTION: Building Endwall Column

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.1898	Soil Bearing	0.5695 ksf	3.0 ksf	D Only about Z-Z axis
PASS	n/a	Overturning - X-X	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Overturning - Z-Z	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	1.661	Uplift	-5.142 k	8.543 k	+0.60D+0.60W
PASS	0.01069	Z Flexure (+X)	0.8969 k-ft/ft	83.896 k-ft/ft	+0.90D+W
PASS	0.01069	Z Flexure (-X)	0.8969 k-ft/ft	83.896 k-ft/ft	+0.90D+W
PASS	0.01069	X Flexure (+Z)	0.8969 k-ft/ft	83.896 k-ft/ft	+0.90D+W
PASS	0.01069	X Flexure (-Z)	0.8969 k-ft/ft	83.896 k-ft/ft	+0.90D+W
PASS	0.002334	1-way Shear (+X)	0.2215 psi	94.868 psi	+0.90D+W
PASS	0.002334	1-way Shear (-X)	0.2215 psi	94.868 psi	+0.90D+W
PASS	0.002334	1-way Shear (+Z)	0.2215 psi	94.868 psi	+0.90D+W
PASS	0.002334	1-way Shear (-Z)	0.2215 psi	94.868 psi	+0.90D+W
PASS	0.01046	2-way Punching	1.984 psi	189.737 psi	+0.90D+W

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc (in)	Zecc (in)	Actual Soil Bearing Stress @ Location Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, D Only	3.0	n/a	0.0	0.5695	0.5695	n/a	n/a	0.190
X-X, +D+0.60W	3.0	n/a	0.0	0.3638	0.3638	n/a	n/a	0.121
X-X, +D+0.450W	3.0	n/a	0.0	0.4152	0.4152	n/a	n/a	0.138
X-X, +0.60D+0.60W	3.0	n/a	0.0	0.1360	0.1360	n/a	n/a	0.045
X-X, +0.60D	3.0	n/a	0.0	0.3417	0.3417	n/a	n/a	0.114
Z-Z, D Only	3.0	0.0	n/a	n/a	n/a	0.5695	0.5695	0.190
Z-Z, +D+0.60W	3.0	0.0	n/a	n/a	n/a	0.3638	0.3638	0.121
Z-Z, +D+0.450W	3.0	0.0	n/a	n/a	n/a	0.4152	0.4152	0.138
Z-Z, +0.60D+0.60W	3.0	0.0	n/a	n/a	n/a	0.1360	0.1360	0.045
Z-Z, +0.60D	3.0	0.0	n/a	n/a	n/a	0.3417	0.3417	0.114

Overturning Stability

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
Footing Has NO Overturning				

All units k

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status
Footing Has NO Sliding				

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	0.2713	+Z	Bottom	0.6480	AsMin	0.7040	83.896	OK
X-X, +1.40D	0.2713	-Z	Bottom	0.6480	AsMin	0.7040	83.896	OK
X-X, +1.20D	0.2325	+Z	Bottom	0.6480	AsMin	0.7040	83.896	OK
X-X, +1.20D	0.2325	-Z	Bottom	0.6480	AsMin	0.7040	83.896	OK
X-X, +1.20D+0.50W	0.3031	+Z	Top	0.6480	AsMin	0.7040	83.896	OK
X-X, +1.20D+0.50W	0.3031	-Z	Top	0.6480	AsMin	0.7040	83.896	OK
X-X, +1.20D+W	0.8388	+Z	Top	0.6480	AsMin	0.7040	83.896	OK
X-X, +1.20D+W	0.8388	-Z	Top	0.6480	AsMin	0.7040	83.896	OK
X-X, +0.90D+W	0.8969	+Z	Top	0.6480	AsMin	0.7040	83.896	OK
X-X, +0.90D+W	0.8969	-Z	Top	0.6480	AsMin	0.7040	83.896	OK
X-X, +0.90D	0.1744	+Z	Bottom	0.6480	AsMin	0.7040	83.896	OK
X-X, +0.90D	0.1744	-Z	Bottom	0.6480	AsMin	0.7040	83.896	OK
Z-Z, +1.40D	0.2713	-X	Bottom	0.6480	AsMin	0.7040	83.896	OK
Z-Z, +1.40D	0.2713	+X	Bottom	0.6480	AsMin	0.7040	83.896	OK
Z-Z, +1.20D	0.2325	-X	Bottom	0.6480	AsMin	0.7040	83.896	OK

General Footing

Project File: 250076-000 enercalc.ec6

LIC# : KW-06017529, Build:20.22.8.17 PEC (c) ENERCALC INC 1983-2022

DESCRIPTION: Building Endwall Column

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
Z-Z, +1.20D	0.2325	+X	Bottom	0.6480	AsMin	0.7040	83.896	OK
Z-Z, +1.20D+0.50W	0.3031	-X	Top	0.6480	AsMin	0.7040	83.896	OK
Z-Z, +1.20D+0.50W	0.3031	+X	Top	0.6480	AsMin	0.7040	83.896	OK
Z-Z, +1.20D+W	0.8388	-X	Top	0.6480	AsMin	0.7040	83.896	OK
Z-Z, +1.20D+W	0.8388	+X	Top	0.6480	AsMin	0.7040	83.896	OK
Z-Z, +0.90D+W	0.8969	-X	Top	0.6480	AsMin	0.7040	83.896	OK
Z-Z, +0.90D+W	0.8969	+X	Top	0.6480	AsMin	0.7040	83.896	OK
Z-Z, +0.90D	0.1744	-X	Bottom	0.6480	AsMin	0.7040	83.896	OK
Z-Z, +0.90D	0.1744	+X	Bottom	0.6480	AsMin	0.7040	83.896	OK

One Way Shear

Load Combination...	Vu @ -X	Vu @ +X	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	0.07 psi	0.07 psi	0.07 psi	0.07 psi	0.07 psi	94.87 psi	0.00	OK
+1.20D	0.06 psi	0.06 psi	0.06 psi	0.06 psi	0.06 psi	94.87 psi	0.00	OK
+1.20D+0.50W	0.07 psi	0.07 psi	0.07 psi	0.07 psi	0.07 psi	94.87 psi	0.00	OK
+1.20D+W	0.21 psi	0.21 psi	0.21 psi	0.21 psi	0.21 psi	94.87 psi	0.00	OK
+0.90D+W	0.22 psi	0.22 psi	0.22 psi	0.22 psi	0.22 psi	94.87 psi	0.00	OK
+0.90D	0.04 psi	0.04 psi	0.04 psi	0.04 psi	0.04 psi	94.87 psi	0.00	OK

Two-Way "Punching" Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	0.60 psi	189.74 psi	0.003163	OK
+1.20D	0.51 psi	189.74 psi	0.002711	OK
+1.20D+0.50W	0.67 psi	189.74 psi	0.003534	OK
+1.20D+W	1.86 psi	189.74 psi	0.00978	OK
+0.90D+W	1.98 psi	189.74 psi	0.01046	OK
+0.90D	0.39 psi	189.74 psi	0.002033	OK

General Footing

Project File: 250076-000 enercalc.ec6

LIC# : KW-06017529, Build:20.22.8.17 PEC (c) ENERCALC INC 1983-2022

DESCRIPTION: Building Mezzanine Column Footing

Code References

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Material Properties

f'c : Concrete 28 day strength	=	4.0	ksi
fy : Rebar Yield	=	60.0	ksi
Ec : Concrete Elastic Modulus	=	3,605.0	ksi
Concrete Density	=	145.0	pcf
φ Values Flexure	=	0.90	
Shear	=	0.750	

Analysis Settings

Min Steel % Bending Reinf.	=		
Min Allow % Temp Reinf.	=	0.00180	
Min. Overturning Safety Factor	=	1.50	: 1
Min. Sliding Safety Factor	=	1.50	: 1
Add Ftg Wt for Soil Pressure	:	Yes	
Use ftg wt for stability, moments & shears	:	Yes	
Add Pedestal Wt for Soil Pressure	:	No	
Use Pedestal wt for stability, mom & shear	:	No	

Soil Design Values

Allowable Soil Bearing	=	3.0	ksf
Soil Density	=	145.0	pcf
Increase Bearing By Footing Weight	=	No	
Soil Passive Resistance (for Sliding)	=	250.0	pcf
Soil/Concrete Friction Coeff.	=	0.30	

Increases based on footing Depth

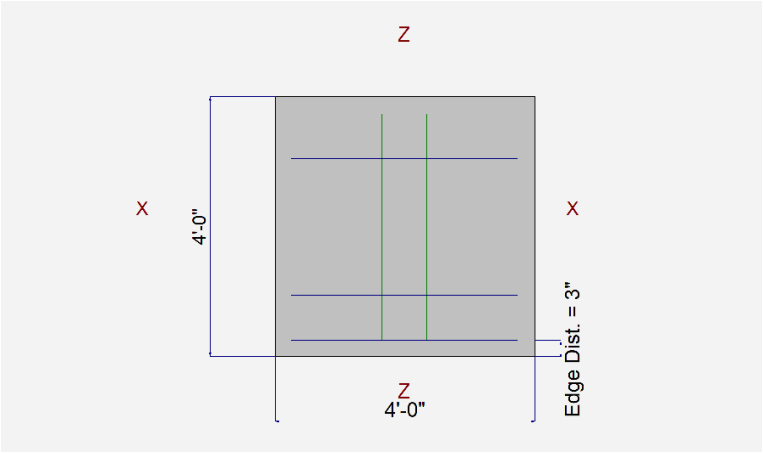
Footing base depth below soil surface	=	2.50	ft
Allow press. increase per foot of depth	=		ksf
when footing base is below	=		ft

Increases based on footing plan dimension

Allowable pressure increase per foot of depth	=		ksf
when max. length or width is greater than	=		ft

Dimensions

Width parallel to X-X Axis	=	4.0	ft
Length parallel to Z-Z Axis	=	4.0	ft
Footing Thickness	=	18.0	in



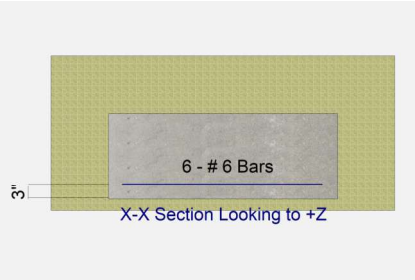
Pedestal dimensions...			
px : parallel to X-X Axis	=		in
pz : parallel to Z-Z Axis	=		in
Height	=		in
Rebar Centerline to Edge of Concrete...			
at Bottom of footing	=	3.0	in

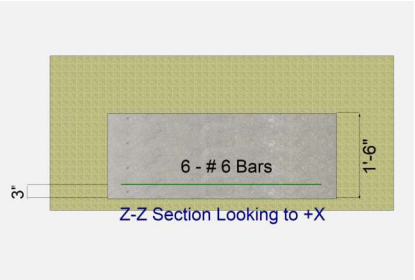
Reinforcing

Bars parallel to X-X Axis			
Number of Bars	=		6.0
Reinforcing Bar Size	=	#	6
Bars parallel to Z-Z Axis			
Number of Bars	=		6.0
Reinforcing Bar Size	=	#	6

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation	n/a
# Bars required within zone	n/a
# Bars required on each side of zone	n/a





Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	9.950	0.0	14.480		0.0			k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=								k-ft
V-x	=								k
V-z	=								k

General Footing

Project File: 250076-000 enercalc.ec6

LIC# : KW-06017529, Build:20.22.8.17 PEC (c) ENERCALC INC 1983-2022

DESCRIPTION: Building Mezzanine Column Footing

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.6297	Soil Bearing	1.889 ksf	3.0 ksf	+D+L about Z-Z axis
PASS	n/a	Overturning - X-X	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Overturning - Z-Z	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.1018	Z Flexure (+X)	4.389 k-ft/ft	43.109 k-ft/ft	+1.20D+1.60L
PASS	0.1018	Z Flexure (-X)	4.389 k-ft/ft	43.109 k-ft/ft	+1.20D+1.60L
PASS	0.1018	X Flexure (+Z)	4.389 k-ft/ft	43.109 k-ft/ft	+1.20D+1.60L
PASS	0.1018	X Flexure (-Z)	4.389 k-ft/ft	43.109 k-ft/ft	+1.20D+1.60L
PASS	0.09766	1-way Shear (+X)	9.265 psi	94.868 psi	+1.20D+1.60L
PASS	0.09766	1-way Shear (-X)	9.265 psi	94.868 psi	+1.20D+1.60L
PASS	0.09766	1-way Shear (+Z)	9.265 psi	94.868 psi	+1.20D+1.60L
PASS	0.09766	1-way Shear (-Z)	9.265 psi	94.868 psi	+1.20D+1.60L
PASS	0.1845	2-way Punching	35.014 psi	189.737 psi	+1.20D+1.60L

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc (in)	Zecc (in)	Actual Soil Bearing Stress @ Location Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, D Only	3.0	n/a	0.0	0.9844	0.9844	n/a	n/a	0.328
X-X, +D+L	3.0	n/a	0.0	1.889	1.889	n/a	n/a	0.630
X-X, +D+0.750L	3.0	n/a	0.0	1.663	1.663	n/a	n/a	0.554
X-X, +0.60D	3.0	n/a	0.0	0.5906	0.5906	n/a	n/a	0.197
Z-Z, D Only	3.0	0.0	n/a	n/a	n/a	0.9844	0.9844	0.328
Z-Z, +D+L	3.0	0.0	n/a	n/a	n/a	1.889	1.889	0.630
Z-Z, +D+0.750L	3.0	0.0	n/a	n/a	n/a	1.663	1.663	0.554
Z-Z, +0.60D	3.0	0.0	n/a	n/a	n/a	0.5906	0.5906	0.197

Overturning Stability

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
Footing Has NO Overturning				

All units k

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status
Footing Has NO Sliding				

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	1.741	+Z	Bottom	0.3888	AsMin	0.660	43.109	OK
X-X, +1.40D	1.741	-Z	Bottom	0.3888	AsMin	0.660	43.109	OK
X-X, +1.20D+1.60L	4.389	+Z	Bottom	0.3888	AsMin	0.660	43.109	OK
X-X, +1.20D+1.60L	4.389	-Z	Bottom	0.3888	AsMin	0.660	43.109	OK
X-X, +1.20D+0.50L	2.398	+Z	Bottom	0.3888	AsMin	0.660	43.109	OK
X-X, +1.20D+0.50L	2.398	-Z	Bottom	0.3888	AsMin	0.660	43.109	OK
X-X, +1.20D	1.493	+Z	Bottom	0.3888	AsMin	0.660	43.109	OK
X-X, +1.20D	1.493	-Z	Bottom	0.3888	AsMin	0.660	43.109	OK
X-X, +0.90D	1.119	+Z	Bottom	0.3888	AsMin	0.660	43.109	OK
X-X, +0.90D	1.119	-Z	Bottom	0.3888	AsMin	0.660	43.109	OK
Z-Z, +1.40D	1.741	-X	Bottom	0.3888	AsMin	0.660	43.109	OK
Z-Z, +1.40D	1.741	+X	Bottom	0.3888	AsMin	0.660	43.109	OK
Z-Z, +1.20D+1.60L	4.389	-X	Bottom	0.3888	AsMin	0.660	43.109	OK
Z-Z, +1.20D+1.60L	4.389	+X	Bottom	0.3888	AsMin	0.660	43.109	OK
Z-Z, +1.20D+0.50L	2.398	-X	Bottom	0.3888	AsMin	0.660	43.109	OK
Z-Z, +1.20D+0.50L	2.398	+X	Bottom	0.3888	AsMin	0.660	43.109	OK
Z-Z, +1.20D	1.493	-X	Bottom	0.3888	AsMin	0.660	43.109	OK

General Footing

Project File: 250076-000 enercalc.ec6

LIC# : KW-06017529, Build:20.22.8.17 PEC (c) ENERCALC INC 1983-2022

DESCRIPTION: Building Mezzanine Column Footing

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
Z-Z, +1.20D	1.493	+X	Bottom	0.3888	AsMin	0.660	43.109	OK
Z-Z, +0.90D	1.119	-X	Bottom	0.3888	AsMin	0.660	43.109	OK
Z-Z, +0.90D	1.119	+X	Bottom	0.3888	AsMin	0.660	43.109	OK

One Way Shear

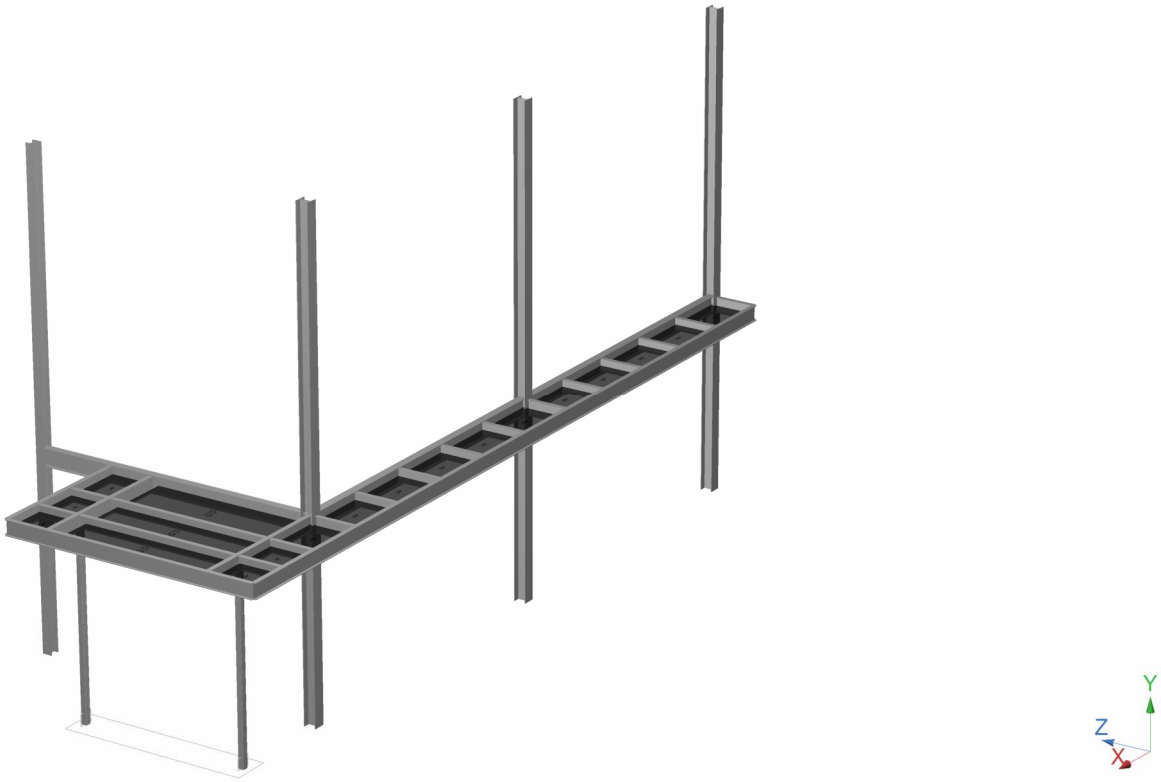
Load Combination...	Vu @ -X	Vu @ +X	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	3.68 psi	3.68 psi	3.68 psi	3.68 psi	3.68 psi	94.87 psi	0.04	OK
+1.20D+1.60L	9.27 psi	9.27 psi	9.27 psi	9.27 psi	9.27 psi	94.87 psi	0.10	OK
+1.20D+0.50L	5.06 psi	5.06 psi	5.06 psi	5.06 psi	5.06 psi	94.87 psi	0.05	OK
+1.20D	3.15 psi	3.15 psi	3.15 psi	3.15 psi	3.15 psi	94.87 psi	0.03	OK
+0.90D	2.36 psi	2.36 psi	2.36 psi	2.36 psi	2.36 psi	94.87 psi	0.02	OK

Two-Way "Punching" Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	13.89 psi	189.74 psi	0.07322	OK
+1.20D+1.60L	35.01 psi	189.74 psi	0.1845	OK
+1.20D+0.50L	19.13 psi	189.74 psi	0.1008	OK
+1.20D	11.91 psi	189.74 psi	0.06276	OK
+0.90D	8.93 psi	189.74 psi	0.04707	OK

Vestibule Design


Y
Z
X

Current Date: 3/21/2025 11:51 AM

Geometry data

Nodes

Node	X [ft]	Y [ft]	Z [ft]	Rigid Floor
1	0.00	0.00	0.00	0
2	22.25	0.00	0.00	0
3	45.00	0.00	0.00	0
4	45.00	0.00	19.67	0
5	0.00	13.00	0.00	0
6	22.25	13.00	0.00	0
7	45.00	13.00	0.00	0
8	45.00	13.00	19.67	0
9	4.45	13.00	-3.25	0
10	55.25	13.00	-3.25	0
11	8.90	13.00	-3.25	0
12	13.35	13.00	-3.25	0
13	17.80	13.00	-3.25	0
16	22.25	13.00	-3.25	0
17	26.80	13.00	-3.25	0
18	31.35	13.00	-3.25	0
19	35.90	13.00	-3.25	0
20	40.45	13.00	-3.25	0
23	45.00	13.00	-3.25	0
25	49.1029	13.00	-3.25	0
26	52.1765	13.00	-3.25	0
27	4.45	13.00	0.00	0
28	55.25	13.00	0.00	0
29	8.90	13.00	0.00	0
31	17.80	13.00	0.00	0
35	26.80	13.00	0.00	0
36	31.35	13.00	0.00	0
37	35.90	13.00	0.00	0
38	40.45	13.00	0.00	0
44	52.1765	13.00	0.00	0
45	52.1765	0.00	0.00	0
47	49.1029	13.00	0.00	0
48	52.1765	13.00	11.50	0
52	55.25	13.00	11.50	0
56	52.1765	13.00	14.50	0
57	55.25	13.00	14.50	0
59	49.1029	13.00	14.50	0
64	45.00	13.00	11.50	0
66	49.1029	13.00	11.50	0
71	45.00	13.00	14.50	0
72	0.00	33.00	0.00	0
73	22.25	33.00	0.00	0
74	45.00	33.00	0.00	0
75	45.00	33.00	19.67	0
76	0.00	13.00	-3.25	0
60	52.1765	0.00	11.50	0

Restraints

Node	TX	TY	TZ	RX	RY	RZ
1	1	1	1	0	0	0
2	1	1	1	0	0	0
3	1	1	1	0	0	0
4	1	1	1	0	0	0
45	1	1	1	1	1	1
72	1	1	1	0	0	0
73	1	1	1	0	0	0
74	1	1	1	0	0	0
75	1	1	1	0	0	0
60	1	1	1	1	1	1

Members

Member	NJ	NK	Description	Section	Material	d0 [in]	dL [in]	lg factor
8	44	45	8	HSS_SQR 5X5X1_2	A500 GrC rectangular	0.00	0.00	0.00
9	9	27	9	W 10X15	A992 Gr50	0.00	0.00	0.00
10	11	29	10	W 10X15	A992 Gr50	0.00	0.00	0.00
12	13	31	12	W 10X15	A992 Gr50	0.00	0.00	0.00
15	16	6	15	W 12X22	A992 Gr50	0.00	0.00	0.00
16	17	35	16	W 10X15	A992 Gr50	0.00	0.00	0.00
17	18	36	17	W 10X15	A992 Gr50	0.00	0.00	0.00
18	19	37	18	W 10X15	A992 Gr50	0.00	0.00	0.00
19	20	38	19	W 10X15	A992 Gr50	0.00	0.00	0.00
22	23	7	22	W 12X22	A992 Gr50	0.00	0.00	0.00
26	25	47	24	W 10X15	A992 Gr50	0.00	0.00	0.00
27	26	44	25	W 10X15	A992 Gr50	0.00	0.00	0.00
29	48	60	27	HSS_SQR 5X5X1_2	A500 GrC rectangular	0.00	0.00	0.00
30	44	48	28	W 10X15	A992 Gr50	0.00	0.00	0.00
35	48	56	29	W 10X15	A992 Gr50	0.00	0.00	0.00
42	66	59	32	W 10X15	A992 Gr50	0.00	0.00	0.00
49	7	28	39	W 12X22	A992 Gr50	0.00	0.00	0.00
50	64	52	40	W 12X22	A992 Gr50	0.00	0.00	0.00
57	10	57	57	W 12X22	A992 Gr50	0.00	0.00	0.00
63	5	76		W 12X22	A992 Gr50	0.00	0.00	0.00
64	76	16		W 12X22	A992 Gr50	0.00	0.00	0.00
65	16	23		W 12X22	A992 Gr50	0.00	0.00	0.00
66	57	71		W 12X22	A992 Gr50	0.00	0.00	0.00
67	10	23		W 12X22	A992 Gr50	0.00	0.00	0.00
68	66	47		W 10X15	A992 Gr50	0.00	0.00	0.00
11	12	30	11	W 10X15	A992 Gr50	0.00	0.00	0.00

Hinges

	Node-J				Node-K						
Member	M33	M22	V3	V2	M33	M22	V3	V2	TOR	AXL	Axial rigidity
9	1	1	0	0	1	1	0	0	0	0	Full
10	1	1	0	0	1	1	0	0	0	0	Full
12	1	1	0	0	1	1	0	0	0	0	Full
16	1	1	0	0	1	1	0	0	0	0	Full
17	1	1	0	0	1	1	0	0	0	0	Full
18	1	1	0	0	1	1	0	0	0	0	Full
19	1	1	0	0	1	1	0	0	0	0	Full

26	1	1	0	0	1	1	0	0	0	0	Full
27	1	1	0	0	1	1	0	0	0	0	Full
30	1	1	0	0	1	1	0	0	0	0	Full
35	1	1	0	0	1	1	0	0	0	0	Full
42	1	1	0	0	1	1	0	0	0	0	Full
49	1	1	0	0	0	0	0	0	0	0	Full
50	1	1	0	0	0	0	0	0	0	0	Full
57	1	1	0	0	1	1	0	0	0	0	Full
64	1	1	0	0	1	1	0	0	0	0	Full
65	1	1	0	0	1	1	0	0	0	0	Full
66	1	1	0	0	1	1	0	0	0	0	Full
67	1	1	0	0	1	1	0	0	0	0	Full
68	1	1	0	0	1	1	0	0	0	0	Full
11	1	1	0	0	1	1	0	0	0	0	Full

Glossary

Cb22, Cb33	: Moment gradient coefficients
Cm22, Cm33	: Coefficients applied to bending term in interaction formula
d0	: Tapered member section depth at J end of member
DJX	: Rigid end offset distance measured from J node in axis X
DJY	: Rigid end offset distance measured from J node in axis Y
DJZ	: Rigid end offset distance measured from J node in axis Z
DKX	: Rigid end offset distance measured from K node in axis X
DKY	: Rigid end offset distance measured from K node in axis Y
DKZ	: Rigid end offset distance measured from K node in axis Z
dL	: Tapered member section depth at K end of member
Ig factor	: Inertia reduction factor (Effective Inertia/Gross Inertia) for reinforced concrete members
K22	: Effective length factor about axis 2
K33	: Effective length factor about axis 3
L22	: Member length for calculation of axial capacity
L33	: Member length for calculation of axial capacity
LB pos	: Lateral unbraced length of the compression flange in the positive side of local axis 2
LB neg	: Lateral unbraced length of the compression flange in the negative side of local axis 2
RX	: Rotation about X
RY	: Rotation about Y
RZ	: Rotation about Z
TO	: 1 = Tension only member 0 = Normal member
TX	: Translation in X
TY	: Translation in Y
TZ	: Translation in Z

Current Date: 3/21/2025 11:50 AM

Load data

Load Conditions

Condition	Description	Comb.	Category
DL	Dead Load	No	DL
Lr	Live Roof Load	No	LLR
S	Snow Load	No	SNOW
DW	Downward Wind Load	No	WIND
UP	Uplift Load	No	WIND
WX	X Wind Load	No	WIND
WZ	Z Wind Load	No	WIND

Distributed force on members

Condition	Member	Dir1	Val1 [Kip/ft]	Val2 [Kip/ft]	Dist1 [ft]	%	Dist2 [ft]	%
DL	9	Y	-0.0534	-0.0534	0.00	No	3.25	No
	10	Y	-0.0534	-0.0534	0.00	No	3.25	No
	12	Y	-0.0534	-0.0534	0.00	No	3.25	No
	15	Y	-0.054	-0.054	0.00	No	3.25	No
	16	Y	-0.0546	-0.0546	0.00	No	3.25	No
	17	Y	-0.0546	-0.0546	0.00	No	3.25	No
	18	Y	-0.0546	-0.0546	0.00	No	3.25	No
	19	Y	-0.0546	-0.0546	0.00	No	3.25	No
	22	Y	-0.0519	-0.0519	0.00	No	3.25	No
	26	Y	-0.0431	-0.0431	0.00	No	3.25	No
	27	Y	-0.0369	-0.0369	0.00	No	3.25	No
	30	Y	-0.0369	-0.0369	0.00	No	11.50	No
	35	Y	-0.0369	-0.0369	0.00	No	3.00	No
	42	Y	-0.0431	-0.0431	0.00	No	3.00	No
	57	Y	-0.0184	-0.0184	0.00	No	17.75	No
	63	Y	-0.0267	-0.0267	0.00	Yes	100.00	Yes
	68	Y	-0.0431	-0.0431	0.00	No	11.50	No
	11	Y	-0.0534	-0.0534	0.00	No	3.25	No
Lr	9	Y	-0.089	-0.089	0.00	No	3.25	No
	10	Y	-0.089	-0.089	0.00	No	3.25	No
	12	Y	-0.089	-0.089	0.00	No	3.25	No
	15	Y	-0.09	-0.09	0.00	No	3.25	No
	16	Y	-0.091	-0.091	0.00	No	3.25	No
	17	Y	-0.091	-0.091	0.00	No	3.25	No
	18	Y	-0.091	-0.091	0.00	No	3.25	No
	19	Y	-0.091	-0.091	0.00	No	3.25	No
	22	Y	-0.0865	-0.0865	0.00	No	3.25	No
	26	Y	-0.0718	-0.0718	0.00	No	3.25	No
	27	Y	-0.0615	-0.0615	0.00	No	3.25	No
	30	Y	-0.0615	-0.0615	0.00	No	11.50	No
	35	Y	-0.0615	-0.0615	0.00	No	3.00	No
	42	Y	-0.0718	-0.0718	0.00	No	3.00	No
	57	Y	-0.0307	-0.0307	0.00	No	17.75	No
	63	Y	-0.0445	-0.0445	0.00	Yes	100.00	Yes
	68	Y	-0.0718	-0.0718	0.00	No	11.50	No

	11	Y	-0.089	-0.089	0.00	No	3.25	No
S	9	Y	-0.089	-0.089	0.00	No	3.25	No
	10	Y	-0.089	-0.089	0.00	No	3.25	No
	12	Y	-0.089	-0.089	0.00	No	3.25	No
	15	Y	-0.09	-0.09	0.00	No	3.25	No
	16	Y	-0.091	-0.091	0.00	No	3.25	No
	17	Y	-0.091	-0.091	0.00	No	3.25	No
	18	Y	-0.091	-0.091	0.00	No	3.25	No
	19	Y	-0.091	-0.091	0.00	No	3.25	No
	22	Y	-0.0865	-0.0865	0.00	No	3.25	No
	26	Y	-0.0718	-0.0718	0.00	No	3.25	No
	27	Y	-0.0615	-0.0615	0.00	No	3.25	No
	30	Y	-0.0615	-0.0615	0.00	No	11.50	No
	35	Y	-0.0615	-0.0615	0.00	No	3.00	No
	42	Y	-0.0718	-0.0718	0.00	No	3.00	No
	57	Y	-0.0307	-0.0307	0.00	No	17.75	No
	63	Y	-0.0445	-0.0445	0.00	Yes	100.00	Yes
	68	Y	-0.0718	-0.0718	0.00	No	11.50	No
	11	Y	-0.089	-0.089	0.00	No	3.25	No
DW	9	Y	-0.05	-0.05	0.00	Yes	100.00	Yes
		Y	-0.0712	-0.0712	0.00	No	3.25	No
	10	Y	-0.05	-0.05	0.00	Yes	100.00	Yes
		Y	-0.0712	-0.0712	0.00	No	3.25	No
	12	Y	-0.05	-0.05	0.00	Yes	100.00	Yes
		Y	-0.0712	-0.0712	0.00	No	3.25	No
	15	Y	-0.05	-0.05	0.00	Yes	100.00	Yes
		Y	-0.072	-0.072	0.00	No	3.25	No
	16	Y	-0.05	-0.05	0.00	Yes	100.00	Yes
		Y	-0.0728	-0.0728	0.00	No	3.25	No
	17	Y	-0.05	-0.05	0.00	Yes	100.00	Yes
		Y	-0.0728	-0.0728	0.00	No	3.25	No
	18	Y	-0.05	-0.05	0.00	Yes	100.00	Yes
		Y	-0.0728	-0.0728	0.00	No	3.25	No
	19	Y	-0.0728	-0.0728	0.00	No	3.25	No
	22	Y	-0.0692	-0.0692	0.00	No	3.25	No
	26	Y	-0.0574	-0.0574	0.00	No	3.25	No
	27	Y	-0.0492	-0.0492	0.00	No	3.25	No
	30	Y	-0.0492	-0.0492	0.00	No	11.50	No
	35	Y	-0.0492	-0.0492	0.00	No	3.00	No
	42	Y	-0.0574	-0.0574	0.00	No	3.00	No
	57	Y	-0.0246	-0.0246	0.00	No	17.75	No
	63	Y	-0.0356	-0.0356	0.00	Yes	100.00	Yes
	68	Y	-0.0574	-0.0574	0.00	No	11.50	No
	11	Y	-0.05	-0.05	0.00	Yes	100.00	Yes
		Y	-0.0712	-0.0712	0.00	No	3.25	No
UP	9	Y	0.3929	0.3929	0.00	No	3.25	No
	10	Y	0.3929	0.3929	0.00	No	3.25	No
	12	Y	0.3929	0.3929	0.00	No	3.25	No
	15	Y	0.3974	0.3974	0.00	No	3.25	No
	16	Y	0.4018	0.4018	0.00	No	3.25	No
	17	Y	0.4018	0.4018	0.00	No	3.25	No
	18	Y	0.4018	0.4018	0.00	No	3.25	No
	19	Y	0.4018	0.4018	0.00	No	3.25	No
	22	Y	0.382	0.382	0.00	No	3.25	No
	26	Y	0.3168	0.3168	0.00	No	3.25	No
	27	Y	0.2714	0.2714	0.00	No	3.25	No
	30	Y	0.2714	0.2714	0.00	No	11.50	No
	35	Y	0.2714	0.2714	0.00	No	3.00	No
	42	Y	0.3168	0.3168	0.00	No	3.00	No
	57	Y	0.1357	0.1357	0.00	No	17.75	No
	63	Y	0.1965	0.1965	0.00	Yes	100.00	Yes
	68	Y	0.3168	0.3168	0.00	No	11.50	No

	11	Y	0.3929	0.3929	0.00	No	3.25	No
WX	57	X	-0.28	-0.28	0.00	Yes	100.00	Yes
WZ	64	Z	0.115	0.115	0.00	Yes	100.00	Yes
	65	Z	0.115	0.115	0.00	Yes	100.00	Yes
	67	Z	0.28	0.28	0.00	Yes	100.00	Yes

Self weight multipliers for load conditions

		Self weight multiplier			
Condition	**Description**	**Comb.**	**MultX**	**MultY**	**MultZ**
DL	Dead Load	No	0.00	-1.00	0.00
Lr	Live Roof Load	No	0.00	0.00	0.00
S	Snow Load	No	0.00	0.00	0.00
DW	Downward Wind Load	No	0.00	0.00	0.00
UP	Uplift Load	No	0.00	0.00	0.00
WX	X Wind Load	No	0.00	0.00	0.00
WZ	Z Wind Load	No	0.00	0.00	0.00

Glossary

Comb : Indicates if load condition is a load combination

Current Date: 3/21/2025 11:48 AM

Steel Code Check
Comprehensive Report

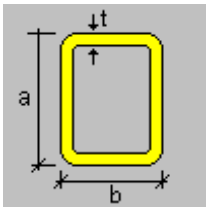
AISC 360-2016 LRFD (Hot-rolled)

Member : 8 (8) - OK

Section information

Section name: HSS_SQR 5X5X1_2 **(US)**

Dimensions



a	=	5.000	[in]	Height
b	=	5.000	[in]	Width
T	=	0.465	[in]	Thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	7.880	
Moment of Inertia (local axes) (I)	[in4]	26.000	26.000
Moment of Inertia (principal axes) (I')	[in4]	26.000	26.000
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	1.816	1.816
Radius of gyration (principal axes) (r')	[in]	1.816	1.816
Saint-Venant torsion constant. (J)	[in4]	44.600	
Section warping constant. (Cw)	[in6]	0.000	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	10.400	10.400
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	10.400	10.400
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	10.400	10.400
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	10.400	10.400
Plastic section modulus (local axis) (Z)	[in3]	13.100	13.100
Plastic section modulus (principal axis) (Z')	[in3]	13.100	13.100
Polar radius of gyration. (ro)	[in]	2.562	
Area for shear (Aw)	[in2]	3.353	3.353
Torsional constant. (C)	[in3]	18.729	

Material : A500 GrC rectangular

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	62.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	13.00

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
13.00	13.00

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
13.00	13.00	13.00	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.01			
Capacity	:	354.60 [Kip]	Reference	:	Cl.D2
Demand	:	4.38 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	354.60	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	394.00	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.02			
Capacity	:	206.79 [Kip]	Reference	:	Cl.E3
Demand	:	4.97 [Kip]	Ctrl Eq.	:	D10 at 100.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.75	
Unstiffened element limiting slenderness (λ_r)	--	33.72	Table.B4.1a.Case6
Stiffened element classification	--	Non slender	
Stiffened element slenderness (λ)	--	7.75	
Stiffened element limiting slenderness (λ_r)	--	33.72	Table.B4.1a.Case6
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	206.79	Cl.E3
Unbraced length (L_{33})	[ft]	13.00	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	85.88	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	38.81	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	7.88	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	29.16	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	229.77	Eq.E3-1

Compression in the minor axis 22

Ratio	:	0.02			
Capacity	:	206.79 [Kip]	Reference	:	Cl.E3
Demand	:	4.97 [Kip]	Ctrl Eq.	:	D10 at 100.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.75	
Unstiffened element limiting slenderness (λ_r)	--	33.72	Table.B4.1a.Case6
Stiffened element classification	--	Non slender	
Stiffened element slenderness (λ)	--	7.75	
Stiffened element limiting slenderness (λ_r)	--	33.72	Table.B4.1a.Case6
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	206.79	Cl.E3
Unbraced length (L_{22})	[ft]	13.00	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	85.88	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	38.81	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	7.88	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	29.16	Eq.E3-2
Nominal flexural buckling strength (P_{n22})	[Kip]	229.77	Eq.E3-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.10			
Capacity	:	49.13 [Kip*ft]	Reference	:	Cl.F7.1
Demand	:	-4.95 [Kip*ft]	Ctrl Eq.	:	D24 at 100.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.75	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	137.27	
Limiting slenderness for compact unstiffened element (λ_p)	--	58.28	

Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	7.75	
Limiting slenderness for noncompact stiffened element (λ_r)	--	33.72	
Limiting slenderness for compact stiffened element (λ_p)	--	26.97	
Factored yielding strength(ϕM_n):	[Kip*ft]	49.13	Cl.F7.1
Yielding (M_n)	[Kip*ft]	54.58	Eq.F7-1

Bending about minor axis, M22

Ratio	:	0.17		
Capacity	:	49.13 [Kip*ft]	Reference	: Cl.F7.1
Demand	:	8.39 [Kip*ft]	Ctrl Eq.	: D33 at 100.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.75	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	137.27	
Limiting slenderness for compact unstiffened element (λ_p)	--	58.28	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	7.75	
Limiting slenderness for noncompact stiffened element (λ_r)	--	33.72	
Limiting slenderness for compact stiffened element (λ_p)	--	26.97	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	49.13	Cl.F7.1
Yielding (M_n)	[Kip*ft]	54.58	Eq.F7-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.01		
Capacity	:	90.52 [Kip]	Reference	: Cl.G1
Demand	:	0.65 [Kip]	Ctrl Eq.	: D33 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	90.52	Cl.G1
Web buckling coefficient (k_v)	--	5.00	Cl.G4
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	100.58	Eq.G4-1

Shear in minor axis 22

Ratio	:	0.01		
Capacity	:	90.52 [Kip]	Reference	: Cl.G1
Demand	:	0.75 [Kip]	Ctrl Eq.	: D24 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	90.52	Cl.G1
Web buckling coefficient (k_v)	--	5.00	Cl.G4
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	100.58	Eq.G4-1

TORSION DESIGN ✔

Torsion

Ratio	:	0.03			
Capacity	:	42.14 [Kip*ft]	Reference	:	Cl.H3.1
Demand	:	-1.17 [Kip*ft]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Factored torsion capacity(ϕT_n):	[Kip*ft]	42.14	Cl.H3.1
Critical torsional buckling stress (F_{cr})	[Kip/in2]	30.00	Eq.H3-3
Nominal torsion capacity (T_n)	[Kip*ft]	46.82	Eq.H3-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.18			
Ctrl Eq.	:	D25 at 100.00%	Reference	:	Eq.H1-1b

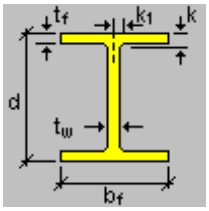
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.18	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	49.13	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	49.13	Cl.H1.1
Available axial strength (P_c)	[Kip]	206.79	Cl.H1.1

Member : 9 (9) - OK

Section information

Section name: W 10X15 **(US)**

Dimensions



bf	=	4.000	[in]	Width
d	=	10.000	[in]	Depth
k	=	0.570	[in]	Distance k
k1	=	0.563	[in]	Distance k1
tf	=	0.270	[in]	Flange thickness
tw	=	0.230	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	4.410	
Moment of Inertia (local axes) (I)	[in4]	68.900	2.890
Moment of Inertia (principal axes) (I')	[in4]	68.900	2.890
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	3.953	0.810
Radius of gyration (principal axes) (r')	[in]	3.953	0.810

Saint-Venant torsion constant. (J)	[in4]	0.104	
Section warping constant. (Cw)	[in6]	68.300	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	13.800	1.450
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	13.800	1.450
Plastic section modulus (local axis) (Z)	[in3]	16.000	2.300
Plastic section modulus (principal axis) (Z')	[in3]	16.000	2.300
Polar radius of gyration. (ro)	[in]	4.035	
Area for shear (Aw)	[in2]	2.160	2.300
Torsional constant. (C)	[in3]	0.341	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	3.25

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
3.25	3.25

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
3.25	3.25	3.25	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	198.45 [Kip]	Reference	:	Cl.D2
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D24 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	198.45	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	220.50	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	192.82 [Kip]	Reference	:	Cl.E3
Demand	:	0.48 [Kip]	Ctrl Eq.	:	D33 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	192.82	Cl.E3
Unbraced length (L_{33})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	9.87	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	2940.01	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.32	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	49.65	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	214.24	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	167.47 [Kip]	Reference	:	Cl.E3
Demand	:	0.48 [Kip]	Ctrl Eq.	:	D33 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	167.47	Cl.E3
Unbraced length (L_{22})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	48.18	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	123.32	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.41	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	42.20	Eq.E3-2
Nominal flexural buckling strength (P_{n22})	[Kip]	186.08	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	177.29	Cl.E4
Unbraced length (L_{11})	[ft]	3.25	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	195.19	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	4.39	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	44.92	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	196.99	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.01			
Capacity	:	60.00 [Kip*ft]	Reference	:	Cl.F2.1
Demand	:	-0.44 [Kip*ft]	Ctrl Eq.	:	D31 at 50.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.1
Yielding (M_n)	[Kip*ft]	66.67	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	2.86	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.01	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	8.60	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.14	Eq.F1-1
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	66.67	Eq.F2-2

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	8.63 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	0.00 [Kip*ft]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	8.63	Cl.F6.1
Yielding (M_n)	[Kip*ft]	9.58	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	58.32 [Kip]	Reference	:	Cl.G1
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	58.32	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	64.80	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.01			
Capacity	:	69.00 [Kip]	Reference	:	Cl.G1
Demand	:	0.54 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	69.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	69.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.01			
Ctrl Eq.	:	D31 at 50.00%	Reference	:	Eq.H1-1b

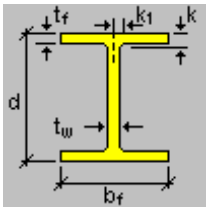
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.01	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	60.00	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	8.63	Cl.H1.1
Available axial strength (P_c)	[Kip]	167.47	Cl.H1.1

Member : 10 (10) - OK

Section information

Section name: W 10X15 **(US)**

Dimensions



bf	=	4.000	[in]	Width
d	=	10.000	[in]	Depth
k	=	0.570	[in]	Distance k
k1	=	0.563	[in]	Distance k1
tf	=	0.270	[in]	Flange thickness

tw = 0.230 [in] Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	4.410	
Moment of Inertia (local axes) (I)	[in4]	68.900	2.890
Moment of Inertia (principal axes) (I')	[in4]	68.900	2.890
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	3.953	0.810
Radius of gyration (principal axes) (r')	[in]	3.953	0.810
Saint-Venant torsion constant. (J)	[in4]	0.104	
Section warping constant. (Cw)	[in6]	68.300	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	13.800	1.450
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	13.800	1.450
Plastic section modulus (local axis) (Z)	[in3]	16.000	2.300
Plastic section modulus (principal axis) (Z')	[in3]	16.000	2.300
Polar radius of gyration. (ro)	[in]	4.035	
Area for shear (Aw)	[in2]	2.160	2.300
Torsional constant. (C)	[in3]	0.341	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	3.25

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
3.25	3.25

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
3.25	3.25	3.25	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	198.45 [Kip]	Reference	:	Cl.D2
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	198.45	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	220.50	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	192.82 [Kip]	Reference	:	Cl.E3
Demand	:	0.42 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	192.82	Cl.E3
Unbraced length (L_{33})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	9.87	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	2940.01	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.32	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	49.65	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	214.24	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	167.47 [Kip]	Reference	:	Cl.E3
Demand	:	0.42 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	167.47	Cl.E3
Unbraced length (L_{22})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	48.18	Cl.E2

Elastic critical buckling stress (F_{e22})	[Kip/in2]	123.32	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.41	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	42.20	Eq.E3-2
Nominal flexural buckling strength (P_{n22})	[Kip]	186.08	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	177.29	Cl.E4
Unbraced length (L_{11})	[ft]	3.25	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	195.19	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	4.39	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	44.92	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	196.99	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.01			
Capacity	:	60.00 [Kip*ft]	Reference	:	Cl.F2.1
Demand	:	-0.44 [Kip*ft]	Ctrl Eq.	:	D31 at 50.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.1
Yielding (M_n)	[Kip*ft]	66.67	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	2.86	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.01	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	8.60	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.14	Eq.F1-1
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	66.67	Eq.F2-2

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	8.63 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	0.00 [Kip*ft]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	8.63	Cl.F6.1
Yielding (M_n)	[Kip*ft]	9.58	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	58.32 [Kip]	Reference	:	Cl.G1
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	58.32	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	64.80	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.01			
Capacity	:	69.00 [Kip]	Reference	:	Cl.G1
Demand	:	0.54 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	69.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	69.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.01			
Ctrl Eq.	:	D31 at 50.00%	Reference	:	Eq.H1-1b

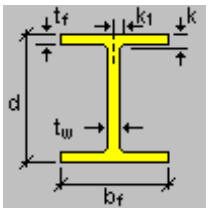
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.01	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	60.00	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	8.63	Cl.H1.1
Available axial strength (P_c)	[Kip]	198.45	Cl.H1.1

Member : 12 (12) - OK

Section information

Section name: W 10X15 **(US)**

Dimensions



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d	=	10.000	[in]	Depth
k	=	0.570	[in]	Distance k
k1	=	0.563	[in]	Distance k1
tf	=	0.270	[in]	Flange thickness
tw	=	0.230	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	4.410	
Moment of Inertia (local axes) (I)	[in4]	68.900	2.890
Moment of Inertia (principal axes) (I')	[in4]	68.900	2.890
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	3.953	0.810
Radius of gyration (principal axes) (r')	[in]	3.953	0.810
Saint-Venant torsion constant. (J)	[in4]	0.104	
Section warping constant. (Cw)	[in6]	68.300	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	13.800	1.450
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	13.800	1.450
Plastic section modulus (local axis) (Z)	[in3]	16.000	2.300
Plastic section modulus (principal axis) (Z')	[in3]	16.000	2.300
Polar radius of gyration. (ro)	[in]	4.035	
Area for shear (Aw)	[in2]	2.160	2.300
Torsional constant. (C)	[in3]	0.341	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	3.25

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
3.25	3.25

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
3.25	3.25	3.25	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	198.45 [Kip]	Reference	:	Cl.D2
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	198.45	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	220.50	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	192.82 [Kip]	Reference	:	Cl.E3
Demand	:	0.48 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	192.82	Cl.E3
Unbraced length (L_{33})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	9.87	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	2940.01	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.32	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	49.65	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	214.24	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	167.47 [Kip]	Reference	:	Cl.E3
Demand	:	0.48 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	167.47	Cl.E3
Unbraced length (L_{22})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	48.18	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	123.32	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.41	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	42.20	Eq.E3-2
Nominal flexural buckling strength (P_{n22})	[Kip]	186.08	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	177.29	Cl.E4
Unbraced length (L_{11})	[ft]	3.25	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	195.19	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	4.39	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	44.92	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	196.99	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.01			
Capacity	:	60.00 [Kip*ft]	Reference	:	Cl.F2.1
Demand	:	-0.44 [Kip*ft]	Ctrl Eq.	:	D31 at 50.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.1
Yielding (M_n)	[Kip*ft]	66.67	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	2.86	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.01	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	8.60	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.14	Eq.F1-1
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	66.67	Eq.F2-2

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	8.63 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	0.00 [Kip*ft]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	8.63	Cl.F6.1
Yielding (M_n)	[Kip*ft]	9.58	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	58.32 [Kip]	Reference	:	Cl.G1
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	58.32	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	64.80	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.01			
Capacity	:	69.00 [Kip]	Reference	:	Cl.G1
Demand	:	0.54 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	69.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	69.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.01			
Ctrl Eq.	:	D31 at 50.00%	Reference	:	Eq.H1-1b

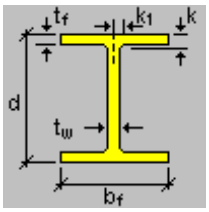
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.01	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	60.00	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	8.63	Cl.H1.1
Available axial strength (P_c)	[Kip]	198.45	Cl.H1.1

Member : 15 (15) - OK

Section information

Section name: W 12X22 **(US)**

Dimensions



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d	=	12.300	[in]	Depth
k	=	0.725	[in]	Distance k
k1	=	0.625	[in]	Distance k1
tf	=	0.425	[in]	Flange thickness
tw	=	0.260	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	6.480	
Moment of Inertia (local axes) (I)	[in4]	156.000	4.660
Moment of Inertia (principal axes) (I')	[in4]	156.000	4.660
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	4.907	0.848
Radius of gyration (principal axes) (r')	[in]	4.907	0.848
Saint-Venant torsion constant. (J)	[in4]	0.293	
Section warping constant. (Cw)	[in6]	164.000	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	25.400	2.310
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	25.400	2.310
Plastic section modulus (local axis) (Z)	[in3]	29.300	3.660
Plastic section modulus (principal axis) (Z')	[in3]	29.300	3.660
Polar radius of gyration. (ro)	[in]	4.979	
Area for shear (Aw)	[in2]	3.430	3.200
Torsional constant. (C)	[in3]	0.649	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	3.25

Distance between member lateral bracing points

Length (Lb) [ft] Top	Bottom
3.25	3.25

Laterally unbraced length

Length [ft] Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Effective length factor Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
3.25	3.25	3.25	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	291.60 [Kip]	Reference	:	Cl.D2
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	291.60	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	324.00	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	277.43 [Kip]	Reference	:	Cl.E3
Demand	:	0.77 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	277.43	Cl.E3
Unbraced length (L_{33})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	7.95	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	4530.21	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.19	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	49.77	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	308.26	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	244.31 [Kip]	Reference	:	Cl.E3
Demand	:	0.77 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	244.31	Cl.E3
Unbraced length (L_{22})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	45.99	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	135.33	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.34	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	42.84	Eq.E3-2
Nominal flexural buckling strength (P_{n22})	[Kip]	271.45	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	256.21	Cl.E4
Unbraced length (L_{11})	[ft]	3.25	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	212.43	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	6.28	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	45.31	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	284.68	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.09			
Capacity	:	109.88 [Kip*ft]	Reference	:	Cl.F2.1
Demand	:	-9.54 [Kip*ft]	Ctrl Eq.	:	D10 at 100.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	109.88	Cl.F2.1
Yielding (M_n)	[Kip*ft]	122.08	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	109.88	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	3.00	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.04	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	9.16	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.75	Eq.F1-1
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	122.08	Eq.F2-2

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	13.73 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	0.00 [Kip*ft]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	13.73	Cl.F6.1
Yielding (M_n)	[Kip*ft]	15.25	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	92.49 [Kip]	Reference	:	Cl.G1
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D20 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	92.49	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	102.77	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.04			
Capacity	:	96.00 [Kip]	Reference	:	Cl.G1
Demand	:	3.42 [Kip]	Ctrl Eq.	:	D10 at 100.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	96.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	96.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.09			
Ctrl Eq.	:	D10 at 100.00%	Reference	:	Eq.H1-1b

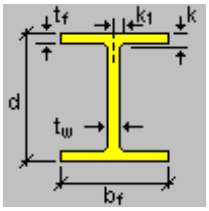
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.09	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	109.88	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	13.73	Cl.H1.1
Available axial strength (P_c)	[Kip]	244.31	Cl.H1.1

Member : 16 (16) - OK

Section information

Section name: W 10X15 **(US)**

Dimensions



bf	=	4.000	[in]	Width
d	=	10.000	[in]	Depth
k	=	0.570	[in]	Distance k
k1	=	0.563	[in]	Distance k1
tf	=	0.270	[in]	Flange thickness
tw	=	0.230	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	4.410	
Moment of Inertia (local axes) (I)	[in4]	68.900	2.890
Moment of Inertia (principal axes) (I')	[in4]	68.900	2.890
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	3.953	0.810
Radius of gyration (principal axes) (r')	[in]	3.953	0.810
Saint-Venant torsion constant. (J)	[in4]	0.104	

Section warping constant. (Cw)	[in6]	68.300	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	13.800	1.450
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	13.800	1.450
Plastic section modulus (local axis) (Z)	[in3]	16.000	2.300
Plastic section modulus (principal axis) (Z')	[in3]	16.000	2.300
Polar radius of gyration. (ro)	[in]	4.035	
Area for shear (Aw)	[in2]	2.160	2.300
Torsional constant. (C)	[in3]	0.341	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	3.25

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
3.25	3.25

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
3.25	3.25	3.25	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	198.45 [Kip]	Reference	:	Cl.D2
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D24 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	198.45	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	220.50	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	192.82 [Kip]	Reference	:	Cl.E3
Demand	:	0.49 [Kip]	Ctrl Eq.	:	D33 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	192.82	Cl.E3
Unbraced length (L_{33})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	9.87	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	2940.01	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.32	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	49.65	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	214.24	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	167.47 [Kip]	Reference	:	Cl.E3
Demand	:	0.49 [Kip]	Ctrl Eq.	:	D33 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	167.47	Cl.E3
Unbraced length (L_{22})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	48.18	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	123.32	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.41	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	42.20	Eq.E3-2
Nominal flexural buckling strength (P_{n22})	[Kip]	186.08	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	177.29	Cl.E4
Unbraced length (L_{11})	[ft]	3.25	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	195.19	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	4.39	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	44.92	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	196.99	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.01			
Capacity	:	60.00 [Kip*ft]	Reference	:	Cl.F2.1
Demand	:	-0.45 [Kip*ft]	Ctrl Eq.	:	D31 at 50.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.1
Yielding (M_n)	[Kip*ft]	66.67	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	2.86	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.01	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	8.60	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.14	Eq.F1-1
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	66.67	Eq.F2-2

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	8.63 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	0.00 [Kip*ft]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	8.63	Cl.F6.1
Yielding (M_n)	[Kip*ft]	9.58	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	58.32 [Kip]	Reference	:	Cl.G1
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	58.32	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	64.80	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.01			
Capacity	:	69.00 [Kip]	Reference	:	Cl.G1
Demand	:	0.55 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	69.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	69.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.01			
Ctrl Eq.	:	D31 at 50.00%	Reference	:	Eq.H1-1b

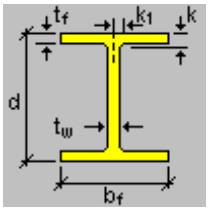
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.01	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	60.00	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	8.63	Cl.H1.1
Available axial strength (P_c)	[Kip]	167.47	Cl.H1.1

Member : 17 (17) - OK

Section information

Section name: W 10X15 **(US)**

Dimensions



bf	=	4.000	[in]	Width
d	=	10.000	[in]	Depth
k	=	0.570	[in]	Distance k
k1	=	0.563	[in]	Distance k1
tf	=	0.270	[in]	Flange thickness

tw = 0.230 [in] Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	4.410	
Moment of Inertia (local axes) (I)	[in4]	68.900	2.890
Moment of Inertia (principal axes) (I')	[in4]	68.900	2.890
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	3.953	0.810
Radius of gyration (principal axes) (r')	[in]	3.953	0.810
Saint-Venant torsion constant. (J)	[in4]	0.104	
Section warping constant. (Cw)	[in6]	68.300	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	13.800	1.450
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	13.800	1.450
Plastic section modulus (local axis) (Z)	[in3]	16.000	2.300
Plastic section modulus (principal axis) (Z')	[in3]	16.000	2.300
Polar radius of gyration. (ro)	[in]	4.035	
Area for shear (Aw)	[in2]	2.160	2.300
Torsional constant. (C)	[in3]	0.341	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	3.25

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
3.25	3.25

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
3.25	3.25	3.25	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	198.45 [Kip]	Reference	:	Cl.D2
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	198.45	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	220.50	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	192.82 [Kip]	Reference	:	Cl.E3
Demand	:	0.42 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	192.82	Cl.E3
Unbraced length (L_{33})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	9.87	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	2940.01	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.32	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	49.65	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	214.24	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	167.47 [Kip]	Reference	:	Cl.E3
Demand	:	0.42 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	167.47	Cl.E3
Unbraced length (L_{22})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	48.18	Cl.E2

Elastic critical buckling stress (F_{e22})	[Kip/in2]	123.32	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.41	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	42.20	Eq.E3-2
Nominal flexural buckling strength (P_{n22})	[Kip]	186.08	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	177.29	Cl.E4
Unbraced length (L_{11})	[ft]	3.25	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	195.19	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	4.39	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	44.92	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	196.99	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.01			
Capacity	:	60.00 [Kip*ft]	Reference	:	Cl.F2.1
Demand	:	-0.45 [Kip*ft]	Ctrl Eq.	:	D31 at 50.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.1
Yielding (M_n)	[Kip*ft]	66.67	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	2.86	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.01	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	8.60	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.14	Eq.F1-1
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	66.67	Eq.F2-2

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	8.63 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	0.00 [Kip*ft]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	8.63	Cl.F6.1
Yielding (M_n)	[Kip*ft]	9.58	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	58.32 [Kip]	Reference	:	Cl.G1
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	58.32	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	64.80	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.01			
Capacity	:	69.00 [Kip]	Reference	:	Cl.G1
Demand	:	0.55 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	69.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	69.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.01			
Ctrl Eq.	:	D31 at 50.00%	Reference	:	Eq.H1-1b

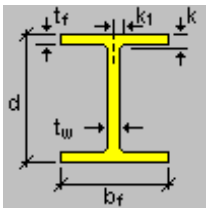
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.01	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	60.00	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	8.63	Cl.H1.1
Available axial strength (P_c)	[Kip]	198.45	Cl.H1.1

Member : 18 (18) - OK

Section information

Section name: W 10X15 **(US)**

Dimensions



bf	=	4.000	[in]	Width
d	=	10.000	[in]	Depth
k	=	0.570	[in]	Distance k
k1	=	0.563	[in]	Distance k1
tf	=	0.270	[in]	Flange thickness
tw	=	0.230	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	4.410	
Moment of Inertia (local axes) (I)	[in4]	68.900	2.890
Moment of Inertia (principal axes) (I')	[in4]	68.900	2.890
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	3.953	0.810
Radius of gyration (principal axes) (r')	[in]	3.953	0.810
Saint-Venant torsion constant. (J)	[in4]	0.104	
Section warping constant. (Cw)	[in6]	68.300	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	13.800	1.450
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	13.800	1.450
Plastic section modulus (local axis) (Z)	[in3]	16.000	2.300
Plastic section modulus (principal axis) (Z')	[in3]	16.000	2.300
Polar radius of gyration. (ro)	[in]	4.035	
Area for shear (Aw)	[in2]	2.160	2.300
Torsional constant. (C)	[in3]	0.341	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	3.25

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
3.25	3.25

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
3.25	3.25	3.25	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	198.45 [Kip]	Reference	:	Cl.D2
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D24 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	198.45	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	220.50	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	192.82 [Kip]	Reference	:	Cl.E3
Demand	:	0.42 [Kip]	Ctrl Eq.	:	D33 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	192.82	Cl.E3
Unbraced length (L_{33})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	9.87	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	2940.01	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.32	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	49.65	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	214.24	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	167.47 [Kip]	Reference	:	Cl.E3
Demand	:	0.42 [Kip]	Ctrl Eq.	:	D33 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	167.47	Cl.E3
Unbraced length (L_{22})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	48.18	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	123.32	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.41	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	42.20	Eq.E3-2
Nominal flexural buckling strength (P_{n22})	[Kip]	186.08	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	177.29	Cl.E4
Unbraced length (L_{11})	[ft]	3.25	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	195.19	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	4.39	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	44.92	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	196.99	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.01			
Capacity	:	60.00 [Kip*ft]	Reference	:	Cl.F2.1
Demand	:	-0.45 [Kip*ft]	Ctrl Eq.	:	D31 at 50.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.1
Yielding (M_n)	[Kip*ft]	66.67	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	2.86	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.01	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	8.60	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.14	Eq.F1-1
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	66.67	Eq.F2-2

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	8.63 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	0.00 [Kip*ft]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	8.63	Cl.F6.1
Yielding (M_n)	[Kip*ft]	9.58	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	58.32 [Kip]	Reference	:	Cl.G1
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	58.32	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	64.80	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.01			
Capacity	:	69.00 [Kip]	Reference	:	Cl.G1
Demand	:	0.55 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	69.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	69.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.01			
Ctrl Eq.	:	D31 at 50.00%	Reference	:	Eq.H1-1b

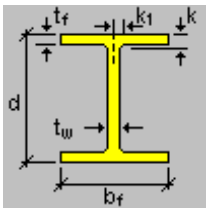
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.01	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	60.00	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	8.63	Cl.H1.1
Available axial strength (P_c)	[Kip]	167.47	Cl.H1.1

Member : 19 (19) - OK

Section information

Section name: W 10X15 **(US)**

Dimensions



bf	=	4.000	[in]	Width
d	=	10.000	[in]	Depth
k	=	0.570	[in]	Distance k
k1	=	0.563	[in]	Distance k1
tf	=	0.270	[in]	Flange thickness
tw	=	0.230	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	4.410	
Moment of Inertia (local axes) (I)	[in4]	68.900	2.890
Moment of Inertia (principal axes) (I')	[in4]	68.900	2.890
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	3.953	0.810
Radius of gyration (principal axes) (r')	[in]	3.953	0.810
Saint-Venant torsion constant. (J)	[in4]	0.104	
Section warping constant. (Cw)	[in6]	68.300	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	13.800	1.450
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	13.800	1.450
Plastic section modulus (local axis) (Z)	[in3]	16.000	2.300
Plastic section modulus (principal axis) (Z')	[in3]	16.000	2.300
Polar radius of gyration. (ro)	[in]	4.035	
Area for shear (Aw)	[in2]	2.160	2.300
Torsional constant. (C)	[in3]	0.341	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	3.25

Distance between member lateral bracing points

Length (Lb) [ft] Top	Bottom
3.25	3.25

Laterally unbraced length

Length [ft] Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Effective length factor Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
3.25	3.25	3.25	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	198.45 [Kip]	Reference	:	Cl.D2
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	198.45	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	220.50	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	192.82 [Kip]	Reference	:	Cl.E3
Demand	:	0.49 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	192.82	Cl.E3
Unbraced length (L_{33})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	9.87	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	2940.01	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.32	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	49.65	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	214.24	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	167.47 [Kip]	Reference	:	Cl.E3
Demand	:	0.49 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	167.47	Cl.E3
Unbraced length (L_{22})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	48.18	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	123.32	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.41	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	42.20	Eq.E3-2
Nominal flexural buckling strength (P_{n22})	[Kip]	186.08	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	177.29	Cl.E4
Unbraced length (L_{11})	[ft]	3.25	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	195.19	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	4.39	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	44.92	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	196.99	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.01			
Capacity	:	60.00 [Kip*ft]	Reference	:	Cl.F2.1
Demand	:	-0.45 [Kip*ft]	Ctrl Eq.	:	D31 at 50.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.1
Yielding (M_n)	[Kip*ft]	66.67	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	2.86	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.01	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	8.60	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.14	Eq.F1-1
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	66.67	Eq.F2-2

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	8.63 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	0.00 [Kip*ft]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	8.63	Cl.F6.1
Yielding (M_n)	[Kip*ft]	9.58	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	58.32 [Kip]	Reference	:	Cl.G1
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	58.32	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	64.80	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.01			
Capacity	:	69.00 [Kip]	Reference	:	Cl.G1
Demand	:	0.55 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	69.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	69.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.01			
Ctrl Eq.	:	D31 at 50.00%	Reference	:	Eq.H1-1b

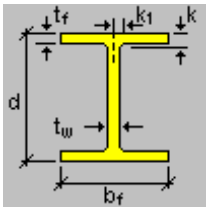
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.01	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	60.00	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	8.63	Cl.H1.1
Available axial strength (P_c)	[Kip]	198.45	Cl.H1.1

Member : 22 (22) - OK

Section information

Section name: W 12X22 **(US)**

Dimensions



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k	=	0.725	[in]	Distance k
k1	=	0.625	[in]	Distance k1
tf	=	0.425	[in]	Flange thickness
tw	=	0.260	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	6.480	
Moment of Inertia (local axes) (I)	[in4]	156.000	4.660
Moment of Inertia (principal axes) (I')	[in4]	156.000	4.660
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	4.907	0.848
Radius of gyration (principal axes) (r')	[in]	4.907	0.848
Saint-Venant torsion constant. (J)	[in4]	0.293	

Section warping constant. (Cw)	[in6]	164.000	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	25.400	2.310
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	25.400	2.310
Plastic section modulus (local axis) (Z)	[in3]	29.300	3.660
Plastic section modulus (principal axis) (Z')	[in3]	29.300	3.660
Polar radius of gyration. (ro)	[in]	4.979	
Area for shear (Aw)	[in2]	3.430	3.200
Torsional constant. (C)	[in3]	0.649	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	3.25

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
3.25	3.25

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
3.25	3.25	3.25	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	291.60 [Kip]	Reference	:	Cl.D2
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	291.60	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	324.00	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	277.43 [Kip]	Reference	:	Cl.E3
Demand	:	1.14 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	277.43	Cl.E3
Unbraced length (L_{33})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	7.95	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	4530.21	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.19	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	49.77	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	308.26	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	244.31 [Kip]	Reference	:	Cl.E3
Demand	:	1.14 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	244.31	Cl.E3
Unbraced length (L_{22})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	45.99	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	135.33	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.34	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	42.84	Eq.E3-2
Nominal flexural buckling strength (P_{n22})	[Kip]	271.45	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	256.21	Cl.E4
Unbraced length (L_{11})	[ft]	3.25	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	212.43	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	6.28	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	45.31	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	284.68	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.06			
Capacity	:	109.88 [Kip*ft]	Reference	:	Cl.F2.1
Demand	:	-6.72 [Kip*ft]	Ctrl Eq.	:	D10 at 100.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	109.88	Cl.F2.1
Yielding (M_n)	[Kip*ft]	122.08	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	109.88	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	3.00	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.04	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	9.16	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.77	Eq.F1-1
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	122.08	Eq.F2-2

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	13.73 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	0.00 [Kip*ft]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	13.73	Cl.F6.1
Yielding (M_n)	[Kip*ft]	15.25	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	92.49 [Kip]	Reference	:	Cl.G1
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D24 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	92.49	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	102.77	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.03			
Capacity	:	96.00 [Kip]	Reference	:	Cl.G1
Demand	:	2.49 [Kip]	Ctrl Eq.	:	D10 at 100.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	96.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	96.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.06			
Ctrl Eq.	:	D10 at 100.00%	Reference	:	Eq.H1-3a(H1-1b)

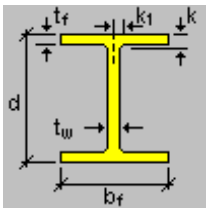
Intermediate results	Unit	Value	Reference
Interaction for doubly symmetric members for in-plane bending:	--	0.06	Eq.H1-3a(H1-1b)
In-plane available flexural strength (M_{c33})	[Kip*ft]	109.88	Cl.H1.3
In-plane available axial compressive strength (P_c)	[Kip]	277.43	Cl.H1.3
Interaction for doubly symmetric members for out-of-plane bending:	--	0.00	Eq.H1-3b
Out-of-plane available flexural-torsional strength (M_{c33})	[Kip*ft]	108.09	Cl.H1.3
Out-of-plane available axial compressive strength (P_{co})	[Kip]	244.31	Cl.H1.3

Member : 26 (24) - OK

Section information

Section name: W 10X15 **(US)**

Dimensions



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d	=	10.000	[in]	Depth
k	=	0.570	[in]	Distance k
k1	=	0.563	[in]	Distance k1
tf	=	0.270	[in]	Flange thickness
tw	=	0.230	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	4.410	
Moment of Inertia (local axes) (I)	[in4]	68.900	2.890
Moment of Inertia (principal axes) (I')	[in4]	68.900	2.890
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	3.953	0.810
Radius of gyration (principal axes) (r')	[in]	3.953	0.810
Saint-Venant torsion constant. (J)	[in4]	0.104	
Section warping constant. (Cw)	[in6]	68.300	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	13.800	1.450
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	13.800	1.450
Plastic section modulus (local axis) (Z)	[in3]	16.000	2.300
Plastic section modulus (principal axis) (Z')	[in3]	16.000	2.300
Polar radius of gyration. (ro)	[in]	4.035	
Area for shear (Aw)	[in2]	2.160	2.300
Torsional constant. (C)	[in3]	0.341	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	3.25

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
3.25	3.25

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
3.25	3.25	3.25	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	198.45 [Kip]	Reference	:	Cl.D2
Demand	:	0.02 [Kip]	Ctrl Eq.	:	D24 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	198.45	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	220.50	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	192.82 [Kip]	Reference	:	Cl.E3
Demand	:	0.82 [Kip]	Ctrl Eq.	:	D33 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	192.82	Cl.E3
Unbraced length (L_{33})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	9.87	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	2940.01	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.32	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	49.65	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	214.24	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	167.47 [Kip]	Reference	:	Cl.E3
Demand	:	0.82 [Kip]	Ctrl Eq.	:	D33 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	167.47	Cl.E3
Unbraced length (L_{22})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	48.18	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	123.32	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.41	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	42.20	Eq.E3-2
Nominal flexural buckling strength (P_{n22})	[Kip]	186.08	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	177.29	Cl.E4
Unbraced length (L_{11})	[ft]	3.25	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	195.19	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	4.39	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	44.92	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	196.99	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.01			
Capacity	:	60.00 [Kip*ft]	Reference	:	Cl.F2.1
Demand	:	-0.35 [Kip*ft]	Ctrl Eq.	:	D31 at 50.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.1
Yielding (M_n)	[Kip*ft]	66.67	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	2.86	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.01	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	8.60	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.14	Eq.F1-1
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	66.67	Eq.F2-2

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	8.63 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	0.00 [Kip*ft]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	8.63	Cl.F6.1
Yielding (M_n)	[Kip*ft]	9.58	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	58.32 [Kip]	Reference	:	Cl.G1
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	58.32	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	64.80	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.01			
Capacity	:	69.00 [Kip]	Reference	:	Cl.G1
Demand	:	0.43 [Kip]	Ctrl Eq.	:	D31 at 100.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	69.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	69.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.01			
Ctrl Eq.	:	D31 at 50.00%	Reference	:	Eq.H1-3a(H1-1b)

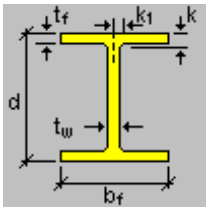
Intermediate results	Unit	Value	Reference
Interaction for doubly symmetric members for in-plane bending:	--	0.01	Eq.H1-3a(H1-1b)
In-plane available flexural strength (M_{c33})	[Kip*ft]	60.00	Cl.H1.3
In-plane available axial compressive strength (P_c)	[Kip]	192.82	Cl.H1.3
Interaction for doubly symmetric members for out-of-plane bending:	--	0.00	Eq.H1-3b
Out-of-plane available flexural-torsional strength (M_{c33})	[Kip*ft]	58.38	Cl.H1.3
Out-of-plane available axial compressive strength (P_{co})	[Kip]	167.47	Cl.H1.3

Member : 27 (25) - OK

Section information

Section name: W 10X15 **(US)**

Dimensions



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d	=	10.000	[in]	Depth
k	=	0.570	[in]	Distance k
k1	=	0.563	[in]	Distance k1
tf	=	0.270	[in]	Flange thickness
tw	=	0.230	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	4.410	
Moment of Inertia (local axes) (I)	[in4]	68.900	2.890
Moment of Inertia (principal axes) (I')	[in4]	68.900	2.890
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	3.953	0.810
Radius of gyration (principal axes) (r')	[in]	3.953	0.810
Saint-Venant torsion constant. (J)	[in4]	0.104	
Section warping constant. (Cw)	[in6]	68.300	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	13.800	1.450
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	13.800	1.450
Plastic section modulus (local axis) (Z)	[in3]	16.000	2.300
Plastic section modulus (principal axis) (Z')	[in3]	16.000	2.300
Polar radius of gyration. (ro)	[in]	4.035	
Area for shear (Aw)	[in2]	2.160	2.300
Torsional constant. (C)	[in3]	0.341	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	3.25

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
3.25	3.25

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
3.25	3.25	3.25	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	198.45 [Kip]	Reference	:	Cl.D2
Demand	:	0.01 [Kip]	Ctrl Eq.	:	D10 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	198.45	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	220.50	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	192.82 [Kip]	Reference	:	Cl.E3
Demand	:	0.64 [Kip]	Ctrl Eq.	:	D33 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	192.82	Cl.E3
Unbraced length (L_{33})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	9.87	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	2940.01	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.32	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	49.65	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	214.24	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	167.47 [Kip]	Reference	:	Cl.E3
Demand	:	0.64 [Kip]	Ctrl Eq.	:	D33 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	167.47	Cl.E3
Unbraced length (L_{22})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	48.18	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	123.32	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.41	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	42.20	Eq.E3-2
Nominal flexural buckling strength (P_{n22})	[Kip]	186.08	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	177.29	Cl.E4
Unbraced length (L_{11})	[ft]	3.25	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	195.19	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	4.39	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	44.92	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	196.99	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.00			
Capacity	:	60.00 [Kip*ft]	Reference	:	Cl.F2.1
Demand	:	-0.30 [Kip*ft]	Ctrl Eq.	:	D31 at 50.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.1
Yielding (M_n)	[Kip*ft]	66.67	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	2.86	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.01	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	8.60	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.14	Eq.F1-1
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	66.67	Eq.F2-2

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	8.63 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	0.00 [Kip*ft]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	8.63	Cl.F6.1
Yielding (M_n)	[Kip*ft]	9.58	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	58.32 [Kip]	Reference	:	Cl.G1
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	58.32	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	64.80	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.01			
Capacity	:	69.00 [Kip]	Reference	:	Cl.G1
Demand	:	0.37 [Kip]	Ctrl Eq.	:	D31 at 100.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	69.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	69.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.00			
Ctrl Eq.	:	D31 at 50.00%	Reference	:	Eq.H1-3a(H1-1b)

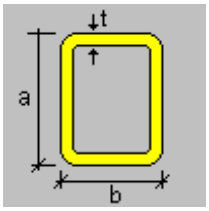
Intermediate results	Unit	Value	Reference
Interaction for doubly symmetric members for in-plane bending:	--	0.00	Eq.H1-3a(H1-1b)
In-plane available flexural strength (M_{c33})	[Kip*ft]	60.00	Cl.H1.3
In-plane available axial compressive strength (P_c)	[Kip]	192.82	Cl.H1.3
Interaction for doubly symmetric members for out-of-plane bending:	--	0.00	Eq.H1-3b
Out-of-plane available flexural-torsional strength (M_{c33})	[Kip*ft]	58.38	Cl.H1.3
Out-of-plane available axial compressive strength (P_{co})	[Kip]	167.47	Cl.H1.3

Member : 29 (27) - OK

Section information

Section name: HSS_SQR 5X5X1_2 **(US)**

Dimensions



a	=	5.000	[in]	Height
b	=	5.000	[in]	Width
T	=	0.465	[in]	Thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	7.880	
Moment of Inertia (local axes) (I)	[in4]	26.000	26.000
Moment of Inertia (principal axes) (I')	[in4]	26.000	26.000
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	1.816	1.816
Radius of gyration (principal axes) (r')	[in]	1.816	1.816
Saint-Venant torsion constant. (J)	[in4]	44.600	
Section warping constant. (Cw)	[in6]	0.000	

Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	10.400	10.400
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	10.400	10.400
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	10.400	10.400
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	10.400	10.400
Plastic section modulus (local axis) (Z)	[in3]	13.100	13.100
Plastic section modulus (principal axis) (Z')	[in3]	13.100	13.100
Polar radius of gyration. (ro)	[in]	2.562	
Area for shear (Aw)	[in2]	3.353	3.353
Torsional constant. (C)	[in3]	18.729	

Material : A500 GrC rectangular

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	62.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	13.00

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
13.00	13.00

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
13.00	13.00	13.00	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.01			
Capacity	:	354.60 [Kip]	Reference	:	Cl.D2
Demand	:	4.26 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	354.60	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	394.00	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.02			
Capacity	:	206.79 [Kip]	Reference	:	Cl.E3
Demand	:	4.87 [Kip]	Ctrl Eq.	:	D10 at 100.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.75	
Unstiffened element limiting slenderness (λ_r)	--	33.72	Table.B4.1a.Case6
Stiffened element classification	--	Non slender	
Stiffened element slenderness (λ)	--	7.75	
Stiffened element limiting slenderness (λ_r)	--	33.72	Table.B4.1a.Case6
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	206.79	Cl.E3
Unbraced length (L_{33})	[ft]	13.00	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	85.88	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	38.81	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	7.88	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	29.16	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	229.77	Eq.E3-1

Compression in the minor axis 22

Ratio	:	0.02			
Capacity	:	206.79 [Kip]	Reference	:	Cl.E3
Demand	:	4.87 [Kip]	Ctrl Eq.	:	D10 at 100.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.75	
Unstiffened element limiting slenderness (λ_r)	--	33.72	Table.B4.1a.Case6
Stiffened element classification	--	Non slender	
Stiffened element slenderness (λ)	--	7.75	
Stiffened element limiting slenderness (λ_r)	--	33.72	Table.B4.1a.Case6
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	206.79	Cl.E3
Unbraced length (L_{22})	[ft]	13.00	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	85.88	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	38.81	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	7.88	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	29.16	Eq.E3-2
Nominal flexural buckling strength (P_{n22})	[Kip]	229.77	Eq.E3-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.18			
Capacity	:	49.13 [Kip*ft]	Reference	:	Cl.F7.1
Demand	:	-8.64 [Kip*ft]	Ctrl Eq.	:	D32 at 100.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.75	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	33.72	
Limiting slenderness for compact unstiffened element (λ_p)	--	26.97	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	7.75	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	58.28	
Factored yielding strength(ϕM_n):	[Kip*ft]	49.13	Cl.F7.1
Yielding (M_n)	[Kip*ft]	54.58	Eq.F7-1

Bending about minor axis, M22

Ratio	:	0.17			
Capacity	:	49.13 [Kip*ft]	Reference	:	Cl.F7.1
Demand	:	8.39 [Kip*ft]	Ctrl Eq.	:	D33 at 100.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.75	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	33.72	
Limiting slenderness for compact unstiffened element (λ_p)	--	26.97	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	7.75	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	58.28	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	49.13	Cl.F7.1
Yielding (M_n)	[Kip*ft]	54.58	Eq.F7-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.01			
Capacity	:	90.52 [Kip]	Reference	:	Cl.G1
Demand	:	0.65 [Kip]	Ctrl Eq.	:	D33 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	90.52	Cl.G1
Web buckling coefficient (k_v)	--	5.00	Cl.G4
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	100.58	Eq.G4-1

Shear in minor axis 22

Ratio	:	0.01			
Capacity	:	90.52 [Kip]	Reference	:	Cl.G1
Demand	:	1.26 [Kip]	Ctrl Eq.	:	D32 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	90.52	Cl.G1
Web buckling coefficient (k_v)	--	5.00	Cl.G4
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	100.58	Eq.G4-1

TORSION DESIGN ✔

Torsion

Ratio	:	0.03			
Capacity	:	42.14 [Kip*ft]	Reference	:	Cl.H3.1
Demand	:	-1.24 [Kip*ft]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Factored torsion capacity(ϕT_n):	[Kip*ft]	42.14	Cl.H3.1
Critical torsional buckling stress (F_{cr})	[Kip/in2]	30.00	Eq.H3-3
Nominal torsion capacity (T_n)	[Kip*ft]	46.82	Eq.H3-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.18			
Ctrl Eq.	:	D25 at 100.00%	Reference	:	Eq.H1-1b

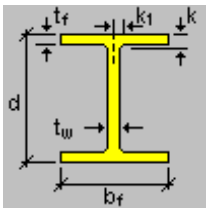
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.18	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	49.13	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	49.13	Cl.H1.1
Available axial strength (P_c)	[Kip]	206.79	Cl.H1.1

Member : 30 (28) - OK

Section information

Section name: W 10X15 **(US)**

Dimensions



bf	=	4.000	[in]	Width
d	=	10.000	[in]	Depth
k	=	0.570	[in]	Distance k
k1	=	0.563	[in]	Distance k1
tf	=	0.270	[in]	Flange thickness
tw	=	0.230	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	4.410	
Moment of Inertia (local axes) (I)	[in4]	68.900	2.890
Moment of Inertia (principal axes) (I')	[in4]	68.900	2.890
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	3.953	0.810
Radius of gyration (principal axes) (r')	[in]	3.953	0.810
Saint-Venant torsion constant. (J)	[in4]	0.104	
Section warping constant. (Cw)	[in6]	68.300	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	13.800	1.450
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	13.800	1.450
Plastic section modulus (local axis) (Z)	[in3]	16.000	2.300
Plastic section modulus (principal axis) (Z')	[in3]	16.000	2.300
Polar radius of gyration. (ro)	[in]	4.035	
Area for shear (Aw)	[in2]	2.160	2.300
Torsional constant. (C)	[in3]	0.341	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	11.50

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
11.50	11.50

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
11.50	11.50	11.50	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.01			
Capacity	:	198.45 [Kip]	Reference	:	Cl.D2
Demand	:	1.05 [Kip]	Ctrl Eq.	:	D24 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	198.45	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	220.50	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	180.00 [Kip]	Reference	:	Cl.E3
Demand	:	0.19 [Kip]	Ctrl Eq.	:	D33 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	180.00	Cl.E3
Unbraced length (L_{33})	[ft]	11.50	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	34.91	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	234.81	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.37	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	45.74	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	200.00	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.01			
Capacity	:	34.28 [Kip]	Reference	:	Cl.E3
Demand	:	0.19 [Kip]	Ctrl Eq.	:	D33 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	34.28	Cl.E3
Unbraced length (L_{22})	[ft]	11.50	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	170.47	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	9.85	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.41	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	8.64	Eq.E3-3
Nominal flexural buckling strength (P_{n22})	[Kip]	38.09	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	99.83	Cl.E4
Unbraced length (L_{11})	[ft]	11.50	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	30.46	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	4.41	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	25.15	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	110.92	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.14			
Capacity	:	26.26 [Kip*ft]	Reference	:	Cl.F2.2
Demand	:	-3.72 [Kip*ft]	Ctrl Eq.	:	D31 at 50.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.1
Yielding (M_n)	[Kip*ft]	66.67	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	26.26	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	2.86	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.01	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	8.60	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.14	Eq.F1-1
Critical stress (F_{cr})	[Kip/in2]	25.38	Eq.F2-4
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	29.18	Eq.F2-3

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	8.63 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	0.00 [Kip*ft]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	8.63	Cl.F6.1
Yielding (M_n)	[Kip*ft]	9.58	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	58.32 [Kip]	Reference	:	Cl.G1
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D24 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	58.32	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	64.80	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.02			
Capacity	:	69.00 [Kip]	Reference	:	Cl.G1
Demand	:	1.29 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	69.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	69.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.12			
Ctrl Eq.	:	D10 at 50.00%	Reference	:	Eq.H1-1b

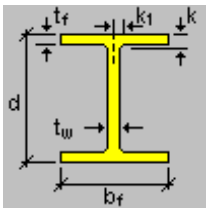
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.12	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	26.27	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	8.63	Cl.H1.1
Available axial strength (P_c)	[Kip]	198.45	Cl.H1.1

Member : 35 (29) - OK

Section information

Section name: W 10X15 **(US)**

Dimensions



bf	=	4.000	[in]	Width
d	=	10.000	[in]	Depth
k	=	0.570	[in]	Distance k
k1	=	0.563	[in]	Distance k1
tf	=	0.270	[in]	Flange thickness
tw	=	0.230	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	4.410	
Moment of Inertia (local axes) (I)	[in4]	68.900	2.890
Moment of Inertia (principal axes) (I')	[in4]	68.900	2.890
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	3.953	0.810
Radius of gyration (principal axes) (r')	[in]	3.953	0.810
Saint-Venant torsion constant. (J)	[in4]	0.104	
Section warping constant. (Cw)	[in6]	68.300	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	13.800	1.450
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	13.800	1.450
Plastic section modulus (local axis) (Z)	[in3]	16.000	2.300
Plastic section modulus (principal axis) (Z')	[in3]	16.000	2.300
Polar radius of gyration. (ro)	[in]	4.035	
Area for shear (Aw)	[in2]	2.160	2.300
Torsional constant. (C)	[in3]	0.341	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	3.00

Distance between member lateral bracing points

Length (Lb) [ft] Top	Bottom
3.00	3.00

Laterally unbraced length

Length [ft] Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Effective length factor Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
3.00	3.00	3.00	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	198.45 [Kip]	Reference	:	Cl.D2
Demand	:	0.01 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	198.45	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	220.50	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	192.99 [Kip]	Reference	:	Cl.E3
Demand	:	0.24 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	192.99	Cl.E3
Unbraced length (L_{33})	[ft]	3.00	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	9.11	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	3450.43	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.31	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	49.70	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	214.43	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	171.73 [Kip]	Reference	:	Cl.E3
Demand	:	0.24 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	171.73	Cl.E3
Unbraced length (L_{22})	[ft]	3.00	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	44.47	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	144.73	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.41	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	43.27	Eq.E3-2
Nominal flexural buckling strength (P_{n22})	[Kip]	190.81	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	179.49	Cl.E4
Unbraced length (L_{11})	[ft]	3.00	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	226.27	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	4.38	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	45.58	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	199.44	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.00			
Capacity	:	60.00 [Kip*ft]	Reference	:	Cl.F2.1
Demand	:	-0.25 [Kip*ft]	Ctrl Eq.	:	D31 at 50.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.1
Yielding (M_n)	[Kip*ft]	66.67	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	2.86	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.01	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	8.60	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.14	Eq.F1-1
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	66.67	Eq.F2-2

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	8.63 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	0.00 [Kip*ft]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	8.63	Cl.F6.1
Yielding (M_n)	[Kip*ft]	9.58	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	58.32 [Kip]	Reference	:	Cl.G1
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D24 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	58.32	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	64.80	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.00			
Capacity	:	69.00 [Kip]	Reference	:	Cl.G1
Demand	:	0.34 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	69.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	69.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.00			
Ctrl Eq.	:	D31 at 50.00%	Reference	:	Eq.H1-1b

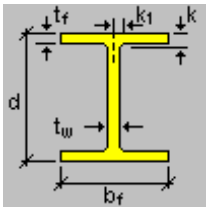
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.00	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	60.00	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	8.63	Cl.H1.1
Available axial strength (P_c)	[Kip]	198.45	Cl.H1.1

Member : 42 (32) - OK

Section information

Section name: W 10X15 **(US)**

Dimensions



bf	=	4.000	[in]	Width
d	=	10.000	[in]	Depth
k	=	0.570	[in]	Distance k
k1	=	0.563	[in]	Distance k1
tf	=	0.270	[in]	Flange thickness
tw	=	0.230	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	4.410	
Moment of Inertia (local axes) (I)	[in4]	68.900	2.890
Moment of Inertia (principal axes) (I')	[in4]	68.900	2.890
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	3.953	0.810
Radius of gyration (principal axes) (r')	[in]	3.953	0.810
Saint-Venant torsion constant. (J)	[in4]	0.104	

Section warping constant. (Cw)	[in6]	68.300	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	13.800	1.450
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	13.800	1.450
Plastic section modulus (local axis) (Z)	[in3]	16.000	2.300
Plastic section modulus (principal axis) (Z')	[in3]	16.000	2.300
Polar radius of gyration. (ro)	[in]	4.035	
Area for shear (Aw)	[in2]	2.160	2.300
Torsional constant. (C)	[in3]	0.341	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	3.00

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
3.00	3.00

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
3.00	3.00	3.00	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	198.45 [Kip]	Reference	:	Cl.D2
Demand	:	0.01 [Kip]	Ctrl Eq.	:	D32 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	198.45	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	220.50	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	192.99 [Kip]	Reference	:	Cl.E3
Demand	:	0.35 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	192.99	Cl.E3
Unbraced length (L_{33})	[ft]	3.00	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	9.11	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	3450.43	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.31	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	49.70	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	214.43	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	171.73 [Kip]	Reference	:	Cl.E3
Demand	:	0.35 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	171.73	Cl.E3
Unbraced length (L_{22})	[ft]	3.00	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	44.47	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	144.73	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.41	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	43.27	Eq.E3-2
Nominal flexural buckling strength (P_{n22})	[Kip]	190.81	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	179.49	Cl.E4
Unbraced length (L_{11})	[ft]	3.00	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	226.27	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	4.38	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	45.58	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	199.44	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.00			
Capacity	:	60.00 [Kip*ft]	Reference	:	Cl.F2.1
Demand	:	-0.30 [Kip*ft]	Ctrl Eq.	:	D31 at 50.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.1
Yielding (M_n)	[Kip*ft]	66.67	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	2.86	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.01	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	8.60	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.14	Eq.F1-1
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	66.67	Eq.F2-2

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	8.63 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	0.00 [Kip*ft]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	8.63	Cl.F6.1
Yielding (M_n)	[Kip*ft]	9.58	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	58.32 [Kip]	Reference	:	Cl.G1
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D24 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	58.32	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	64.80	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.01			
Capacity	:	69.00 [Kip]	Reference	:	Cl.G1
Demand	:	0.40 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	69.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	69.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.00			
Ctrl Eq.	:	D31 at 50.00%	Reference	:	Eq.H1-1b

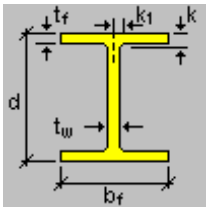
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.00	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	60.00	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	8.63	Cl.H1.1
Available axial strength (P_c)	[Kip]	198.45	Cl.H1.1

Member : 49 (39) - OK

Section information

Section name: W 12X22 **(US)**

Dimensions



bf	=	4.030	[in]	Width
d	=	12.300	[in]	Depth
k	=	0.725	[in]	Distance k
k1	=	0.625	[in]	Distance k1
tf	=	0.425	[in]	Flange thickness

tw = 0.260 [in] Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	6.480	
Moment of Inertia (local axes) (I)	[in4]	156.000	4.660
Moment of Inertia (principal axes) (I')	[in4]	156.000	4.660
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	4.907	0.848
Radius of gyration (principal axes) (r')	[in]	4.907	0.848
Saint-Venant torsion constant. (J)	[in4]	0.293	
Section warping constant. (Cw)	[in6]	164.000	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	25.400	2.310
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	25.400	2.310
Plastic section modulus (local axis) (Z)	[in3]	29.300	3.660
Plastic section modulus (principal axis) (Z')	[in3]	29.300	3.660
Polar radius of gyration. (ro)	[in]	4.979	
Area for shear (Aw)	[in2]	3.430	3.200
Torsional constant. (C)	[in3]	0.649	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	10.25

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
10.25	10.25

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
10.25	10.25	10.25	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	291.60 [Kip]	Reference	:	Cl.D2
Demand	:	0.15 [Kip]	Ctrl Eq.	:	D33 at 70.01%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	291.60	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	324.00	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.01			
Capacity	:	267.89 [Kip]	Reference	:	Cl.E3
Demand	:	2.68 [Kip]	Ctrl Eq.	:	D24 at 70.01%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	267.89	Cl.E3
Unbraced length (L_{33})	[ft]	10.25	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	25.07	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	455.45	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.23	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	47.75	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	297.65	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.04			
Capacity	:	69.58 [Kip]	Reference	:	Cl.E3
Demand	:	2.68 [Kip]	Ctrl Eq.	:	D24 at 70.01%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	69.58	Cl.E3
Unbraced length (L_{22})	[ft]	10.25	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	145.04	Cl.E2

Elastic critical buckling stress (F_{e22})	[Kip/in2]	13.60	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.48	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	11.93	Eq.E3-3
Nominal flexural buckling strength (P_{n22})	[Kip]	77.32	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	172.02	Cl.E4
Unbraced length (L_{11})	[ft]	10.25	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	39.65	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	6.48	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	29.50	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	191.14	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.04			
Capacity	:	109.88 [Kip*ft]	Reference	:	Cl.F2.1
Demand	:	-4.73 [Kip*ft]	Ctrl Eq.	:	D10 at 70.01%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Factored yielding strength(ϕM_n):	[Kip*ft]	109.88	Cl.F2.1
Yielding (M_n)	[Kip*ft]	122.08	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	109.88	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	3.00	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.04	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	9.16	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	2.02	Eq.F1-1
Critical stress (F_{cr})	[Kip/in2]	59.61	Eq.F2-4
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	122.08	Eq.F2-3

Bending about minor axis, M22

Ratio	:	0.16			
Capacity	:	13.73 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	2.17 [Kip*ft]	Ctrl Eq.	:	D24 at 100.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Limiting slenderness for noncompact stiffened element (λ_r)	--	10000.00	
Limiting slenderness for compact stiffened element (λ_p)	--	10000.00	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	13.73	Cl.F6.1
Yielding (M_n)	[Kip*ft]	15.25	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.01			
Capacity	:	92.49 [Kip]	Reference	:	Cl.G1
Demand	:	0.89 [Kip]	Ctrl Eq.	:	D24 at 70.01%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	92.49	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	102.77	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.02			
Capacity	:	96.00 [Kip]	Reference	:	Cl.G1
Demand	:	1.61 [Kip]	Ctrl Eq.	:	D10 at 70.01%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	96.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	96.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.18			
Ctrl Eq.	:	D24 at 100.00%	Reference	:	Eq.H1-1b

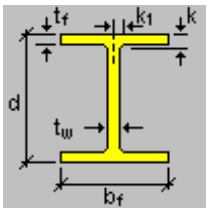
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.18	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	69.94	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	13.73	Cl.H1.1
Available axial strength (P_c)	[Kip]	69.58	Cl.H1.1

Member : 50 (40) - OK

Section information

Section name: W 12X22 **(US)**

Dimensions



bf	=	4.030	[in]	Width
d	=	12.300	[in]	Depth
k	=	0.725	[in]	Distance k
k1	=	0.625	[in]	Distance k1
tf	=	0.425	[in]	Flange thickness
tw	=	0.260	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	6.480	
Moment of Inertia (local axes) (I)	[in4]	156.000	4.660
Moment of Inertia (principal axes) (I')	[in4]	156.000	4.660
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	4.907	0.848
Radius of gyration (principal axes) (r')	[in]	4.907	0.848
Saint-Venant torsion constant. (J)	[in4]	0.293	
Section warping constant. (Cw)	[in6]	164.000	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	25.400	2.310
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	25.400	2.310
Plastic section modulus (local axis) (Z)	[in3]	29.300	3.660
Plastic section modulus (principal axis) (Z')	[in3]	29.300	3.660
Polar radius of gyration. (ro)	[in]	4.979	
Area for shear (Aw)	[in2]	3.430	3.200
Torsional constant. (C)	[in3]	0.649	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	10.25

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
10.25	10.25

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
10.25	10.25	10.25	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	291.60 [Kip]	Reference	:	Cl.D2
Demand	:	0.27 [Kip]	Ctrl Eq.	:	D33 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	291.60	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	324.00	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.01			
Capacity	:	267.89 [Kip]	Reference	:	Cl.E3
Demand	:	1.79 [Kip]	Ctrl Eq.	:	D32 at 70.01%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	267.89	Cl.E3
Unbraced length (L_{33})	[ft]	10.25	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	25.07	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	455.45	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.23	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	47.75	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	297.65	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.03			
Capacity	:	69.58 [Kip]	Reference	:	Cl.E3
Demand	:	1.79 [Kip]	Ctrl Eq.	:	D32 at 70.01%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	69.58	Cl.E3
Unbraced length (L_{22})	[ft]	10.25	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	145.04	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	13.60	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.48	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	11.93	Eq.E3-3
Nominal flexural buckling strength (P_{n22})	[Kip]	77.32	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	172.02	Cl.E4
Unbraced length (L_{11})	[ft]	10.25	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	39.65	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	6.48	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	29.50	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	191.14	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.07			
Capacity	:	91.47 [Kip*ft]	Reference	:	Cl.F2.2
Demand	:	6.19 [Kip*ft]	Ctrl Eq.	:	D32 at 70.01%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Factored yielding strength(ϕM_n):	[Kip*ft]	109.88	Cl.F2.1
Yielding (M_n)	[Kip*ft]	122.08	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	91.47	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	3.00	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.04	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	9.16	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.63	Eq.F1-1
Critical stress (F_{cr})	[Kip/in2]	48.01	Eq.F2-4
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	101.63	Eq.F2-3

Bending about minor axis, M22

Ratio	:	0.15			
Capacity	:	13.73 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	-2.13 [Kip*ft]	Ctrl Eq.	:	D24 at 100.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Limiting slenderness for noncompact stiffened element (λ_r)	--	10000.00	
Limiting slenderness for compact stiffened element (λ_p)	--	10000.00	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	13.73	Cl.F6.1
Yielding (M_n)	[Kip*ft]	15.25	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.01			
Capacity	:	92.49 [Kip]	Reference	:	Cl.G1
Demand	:	0.89 [Kip]	Ctrl Eq.	:	D24 at 70.01%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	92.49	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	102.77	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.02			
Capacity	:	96.00 [Kip]	Reference	:	Cl.G1
Demand	:	1.64 [Kip]	Ctrl Eq.	:	D10 at 70.01%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	96.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	96.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.17			
Ctrl Eq.	:	D24 at 100.00%	Reference	:	Eq.H1-1b

Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.17	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	76.40	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	13.73	Cl.H1.1
Available axial strength (P_c)	[Kip]	69.58	Cl.H1.1

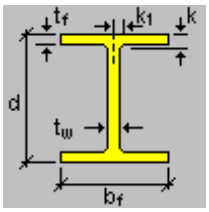
Member : 57 (57) - With warnings

- The slenderness ratio KL/r of the member in compression should not exceed 200

Section information

Section name: W 12X22 **(US)**

Dimensions



bf	=	4.030	[in]	Width
d	=	12.300	[in]	Depth
k	=	0.725	[in]	Distance k
k1	=	0.625	[in]	Distance k1
tf	=	0.425	[in]	Flange thickness
tw	=	0.260	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	6.480	
Moment of Inertia (local axes) (I)	[in4]	156.000	4.660
Moment of Inertia (principal axes) (I')	[in4]	156.000	4.660
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	4.907	0.848
Radius of gyration (principal axes) (r')	[in]	4.907	0.848
Saint-Venant torsion constant. (J)	[in4]	0.293	
Section warping constant. (Cw)	[in6]	164.000	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	25.400	2.310
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	25.400	2.310
Plastic section modulus (local axis) (Z)	[in3]	29.300	3.660
Plastic section modulus (principal axis) (Z')	[in3]	29.300	3.660
Polar radius of gyration. (ro)	[in]	4.979	
Area for shear (Aw)	[in2]	3.430	3.200
Torsional constant. (C)	[in3]	0.649	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	17.75

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
17.75	17.75

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
17.75	17.75	17.75	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	291.60 [Kip]	Reference	:	Cl.D2
Demand	:	0.31 [Kip]	Ctrl Eq.	:	D25 at 83.10%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	291.60	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	324.00	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	247.82 [Kip]	Reference	:	Cl.E3
Demand	:	0.88 [Kip]	Ctrl Eq.	:	D24 at 18.31%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	247.82	Cl.E3
Unbraced length (L_{33})	[ft]	17.75	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	43.41	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	151.88	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.32	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	43.56	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	275.36	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.04			
Capacity	:	23.20 [Kip]	Reference	:	Cl.E3
Demand	:	0.88 [Kip]	Ctrl Eq.	:	D24 at 18.31%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	23.20	Cl.E3
Unbraced length (L_{22})	[ft]	17.75	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	251.17	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	4.54	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.48	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	3.98	Eq.E3-3
Nominal flexural buckling strength (P_{n22})	[Kip]	25.78	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	133.48	Cl.E4
Unbraced length (L_{11})	[ft]	17.75	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	26.78	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	6.48	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	22.89	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	148.31	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.04			
Capacity	:	51.90 [Kip*ft]	Reference	:	Cl.F2.2
Demand	:	-2.15 [Kip*ft]	Ctrl Eq.	:	D10 at 18.31%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Factored yielding strength(ϕM_n):	[Kip*ft]	109.88	Cl.F2.1
Yielding (M_n)	[Kip*ft]	122.08	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	51.90	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	3.00	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.04	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	9.16	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.95	Eq.F1-1
Critical stress (F_{cr})	[Kip/in2]	27.25	Eq.F2-4
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	57.67	Eq.F2-3

Bending about minor axis, M22

Ratio	:	0.27			
Capacity	:	13.73 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	3.65 [Kip*ft]	Ctrl Eq.	:	D24 at 18.31%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Limiting slenderness for noncompact stiffened element (λ_r)	--	10000.00	
Limiting slenderness for compact stiffened element (λ_p)	--	10000.00	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	13.73	Cl.F6.1
Yielding (M_n)	[Kip*ft]	15.25	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.02			
Capacity	:	92.49 [Kip]	Reference	:	Cl.G1
Demand	:	1.77 [Kip]	Ctrl Eq.	:	D24 at 18.31%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	92.49	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	102.77	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.01			
Capacity	:	96.00 [Kip]	Reference	:	Cl.G1
Demand	:	0.84 [Kip]	Ctrl Eq.	:	D10 at 18.31%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	96.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	96.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.31			
Ctrl Eq.	:	D24 at 18.31%	Reference	:	Eq.H1-1b

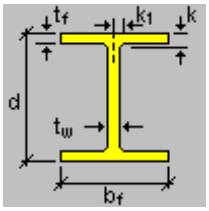
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.31	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	48.79	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	13.73	Cl.H1.1
Available axial strength (P_c)	[Kip]	23.20	Cl.H1.1

Member : 63 - OK

Section information

Section name: W 12X22 **(US)**

Dimensions



bf	=	4.030	[in]	Width
d	=	12.300	[in]	Depth
k	=	0.725	[in]	Distance k
k1	=	0.625	[in]	Distance k1
tf	=	0.425	[in]	Flange thickness
tw	=	0.260	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	6.480	
Moment of Inertia (local axes) (I)	[in4]	156.000	4.660
Moment of Inertia (principal axes) (I')	[in4]	156.000	4.660
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	4.907	0.848
Radius of gyration (principal axes) (r')	[in]	4.907	0.848
Saint-Venant torsion constant. (J)	[in4]	0.293	

Section warping constant. (Cw)	[in6]	164.000	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	25.400	2.310
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	25.400	2.310
Plastic section modulus (local axis) (Z)	[in3]	29.300	3.660
Plastic section modulus (principal axis) (Z')	[in3]	29.300	3.660
Polar radius of gyration. (ro)	[in]	4.979	
Area for shear (Aw)	[in2]	3.430	3.200
Torsional constant. (C)	[in3]	0.649	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	3.25

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
3.25	3.25

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
3.25	3.25	3.25	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	291.60 [Kip]	Reference	:	Cl.D2
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	291.60	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	324.00	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	277.43 [Kip]	Reference	:	Cl.E3
Demand	:	0.38 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	277.43	Cl.E3
Unbraced length (L_{33})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	7.95	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	4530.21	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.19	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	49.77	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	308.26	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	244.31 [Kip]	Reference	:	Cl.E3
Demand	:	0.38 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	244.31	Cl.E3
Unbraced length (L_{22})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	45.99	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	135.33	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.34	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	42.84	Eq.E3-2
Nominal flexural buckling strength (P_{n22})	[Kip]	271.45	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	256.21	Cl.E4
Unbraced length (L_{11})	[ft]	3.25	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	212.43	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	6.28	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	45.31	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	284.68	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.04			
Capacity	:	109.88 [Kip*ft]	Reference	:	Cl.F2.1
Demand	:	-4.74 [Kip*ft]	Ctrl Eq.	:	D10 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	109.88	Cl.F2.1
Yielding (M_n)	[Kip*ft]	122.08	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	109.88	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	3.00	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.04	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	9.16	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.75	Eq.F1-1
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	122.08	Eq.F2-2

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	13.73 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	0.00 [Kip*ft]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	13.73	Cl.F6.1
Yielding (M_n)	[Kip*ft]	15.25	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	92.49 [Kip]	Reference	:	Cl.G1
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D20 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	92.49	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	102.77	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.02			
Capacity	:	96.00 [Kip]	Reference	:	Cl.G1
Demand	:	1.70 [Kip]	Ctrl Eq.	:	D10 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	96.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	96.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.04			
Ctrl Eq.	:	D10 at 0.00%	Reference	:	Eq.H1-1b

Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.04	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	109.88	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	13.73	Cl.H1.1
Available axial strength (P_c)	[Kip]	244.31	Cl.H1.1

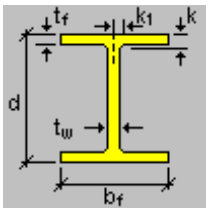
Member : 64 - With warnings

- The slenderness ratio L/r of the member in tension should not exceed 300

Section information

Section name: W 12X22 **(US)**

Dimensions



bf	=	4.030	[in]	Width
d	=	12.300	[in]	Depth
k	=	0.725	[in]	Distance k
k1	=	0.625	[in]	Distance k1
tf	=	0.425	[in]	Flange thickness
tw	=	0.260	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	6.480	
Moment of Inertia (local axes) (I)	[in4]	156.000	4.660
Moment of Inertia (principal axes) (I')	[in4]	156.000	4.660
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	4.907	0.848
Radius of gyration (principal axes) (r')	[in]	4.907	0.848
Saint-Venant torsion constant. (J)	[in4]	0.293	
Section warping constant. (Cw)	[in6]	164.000	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	25.400	2.310
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	25.400	2.310
Plastic section modulus (local axis) (Z)	[in3]	29.300	3.660
Plastic section modulus (principal axis) (Z')	[in3]	29.300	3.660
Polar radius of gyration. (ro)	[in]	4.979	
Area for shear (Aw)	[in2]	3.430	3.200
Torsional constant. (C)	[in3]	0.649	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	22.25

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
22.25	22.25

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
22.25	22.25	22.25	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	291.60 [Kip]	Reference	:	Cl.D2
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D20 at 40.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	291.60	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	324.00	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	231.82 [Kip]	Reference	:	Cl.E3
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D19 at 20.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	231.82	Cl.E3
Unbraced length (L_{33})	[ft]	22.25	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	54.42	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	96.66	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.40	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	40.27	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	257.58	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	14.77 [Kip]	Reference	:	Cl.E3
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D19 at 20.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	14.77	Cl.E3
Unbraced length (L_{22})	[ft]	22.25	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	314.85	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	2.89	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.48	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	2.53	Eq.E3-3
Nominal flexural buckling strength (P_{n22})	[Kip]	16.41	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	123.85	Cl.E4
Unbraced length (L_{11})	[ft]	22.25	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	24.44	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	6.48	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	21.24	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	137.62	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.34			
Capacity	:	23.10 [Kip*ft]	Reference	:	Cl.F2.2
Demand	:	7.81 [Kip*ft]	Ctrl Eq.	:	D10 at 50.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	109.88	Cl.F2.1
Yielding (M_n)	[Kip*ft]	122.08	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	23.10	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	3.00	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.04	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	9.16	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.14	Eq.F1-1
Critical stress (F_{cr})	[Kip/in2]	12.13	Eq.F2-4
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	25.67	Eq.F2-3

Bending about minor axis, M22

Ratio	:	0.09			
Capacity	:	13.73 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	-1.27 [Kip*ft]	Ctrl Eq.	:	D25 at 50.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	13.73	Cl.F6.1
Yielding (M_n)	[Kip*ft]	15.25	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	92.49 [Kip]	Reference	:	Cl.G1
Demand	:	0.38 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	92.49	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	102.77	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.01			
Capacity	:	96.00 [Kip]	Reference	:	Cl.G1
Demand	:	1.22 [Kip]	Ctrl Eq.	:	D10 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	96.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	96.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.34			
Ctrl Eq.	:	D10 at 50.00%	Reference	:	Eq.H1-1b

Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.34	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	23.10	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	13.73	Cl.H1.1
Available axial strength (P_c)	[Kip]	291.60	Cl.H1.1

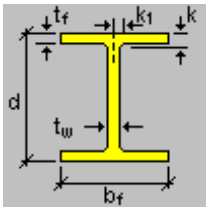
Member : 65 - With warnings

- The slenderness ratio KL/r of the member in compression should not exceed 200
- The slenderness ratio L/r of the member in tension should not exceed 300

Section information

Section name: W 12X22 **(US)**

Dimensions



bf	=	4.030	[in]	Width
d	=	12.300	[in]	Depth
k	=	0.725	[in]	Distance k
k1	=	0.625	[in]	Distance k1
tf	=	0.425	[in]	Flange thickness
tw	=	0.260	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	6.480	
Moment of Inertia (local axes) (I)	[in4]	156.000	4.660
Moment of Inertia (principal axes) (I')	[in4]	156.000	4.660
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	4.907	0.848
Radius of gyration (principal axes) (r')	[in]	4.907	0.848
Saint-Venant torsion constant. (J)	[in4]	0.293	
Section warping constant. (Cw)	[in6]	164.000	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	25.400	2.310
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	25.400	2.310
Plastic section modulus (local axis) (Z)	[in3]	29.300	3.660
Plastic section modulus (principal axis) (Z')	[in3]	29.300	3.660
Polar radius of gyration. (ro)	[in]	4.979	
Area for shear (Aw)	[in2]	3.430	3.200
Torsional constant. (C)	[in3]	0.649	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	22.75

Distance between member lateral bracing points

Length (Lb) [ft] Top	Bottom
4.55	22.75
4.55	
4.55	
4.55	
4.55	

Laterally unbraced length

Length [ft] Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Effective length factor Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
4.55	22.75	4.55	1.0	1.0	1.0
4.55		4.55	1.0		1.0
4.55		4.55	1.0		1.0
4.55		4.55	1.0		1.0
4.55		4.55	1.0		1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	291.60 [Kip]	Reference	:	Cl.D2
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D25 at 80.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	291.60	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	324.00	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	276.39 [Kip]	Reference	:	Cl.E3
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D32 at 80.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	276.39	Cl.E3
Unbraced length (L_{33})	[ft]	4.55	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	11.13	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	2311.33	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.20	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	49.55	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	307.10	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	14.13 [Kip]	Reference	:	Cl.E3
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D32 at 80.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	14.13	Cl.E3
Unbraced length (L_{22})	[ft]	22.75	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	321.93	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	2.76	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.48	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	2.42	Eq.E3-3
Nominal flexural buckling strength (P_{n22})	[Kip]	15.69	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	239.75	Cl.E4
Unbraced length (L_{11})	[ft]	4.55	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	118.35	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	6.36	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	41.90	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	266.39	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.28			
Capacity	:	22.65 [Kip*ft]	Reference	:	Cl.F2.2
Demand	:	-6.30 [Kip*ft]	Ctrl Eq.	:	D31 at 60.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	109.88	Cl.F2.1
Yielding (M_n)	[Kip*ft]	122.08	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	22.65	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	3.00	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.04	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	9.16	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.14	Eq.F1-1
Critical stress (F_{cr})	[Kip/in2]	11.89	Eq.F2-4
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	25.17	Eq.F2-3

Bending about minor axis, M22

Ratio	:	0.10			
Capacity	:	13.73 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	-1.33 [Kip*ft]	Ctrl Eq.	:	D25 at 50.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	13.73	Cl.F6.1
Yielding (M_n)	[Kip*ft]	15.25	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	92.49 [Kip]	Reference	:	Cl.G1
Demand	:	0.39 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	92.49	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	102.77	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.01			
Capacity	:	96.00 [Kip]	Reference	:	Cl.G1
Demand	:	1.23 [Kip]	Ctrl Eq.	:	D10 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	96.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	96.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.14			
Ctrl Eq.	:	D25 at 50.00%	Reference	:	Eq.H1-1b

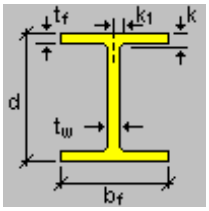
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.14	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	99.17	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	13.73	Cl.H1.1
Available axial strength (P_c)	[Kip]	291.60	Cl.H1.1

Member : 66 - OK

Section information

Section name: W 12X22 **(US)**

Dimensions



bf	=	4.030	[in]	Width
d	=	12.300	[in]	Depth
k	=	0.725	[in]	Distance k
k1	=	0.625	[in]	Distance k1
tf	=	0.425	[in]	Flange thickness

tw = 0.260 [in] Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	6.480	
Moment of Inertia (local axes) (I)	[in4]	156.000	4.660
Moment of Inertia (principal axes) (I')	[in4]	156.000	4.660
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	4.907	0.848
Radius of gyration (principal axes) (r')	[in]	4.907	0.848
Saint-Venant torsion constant. (J)	[in4]	0.293	
Section warping constant. (Cw)	[in6]	164.000	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	25.400	2.310
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	25.400	2.310
Plastic section modulus (local axis) (Z)	[in3]	29.300	3.660
Plastic section modulus (principal axis) (Z')	[in3]	29.300	3.660
Polar radius of gyration. (ro)	[in]	4.979	
Area for shear (Aw)	[in2]	3.430	3.200
Torsional constant. (C)	[in3]	0.649	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	10.25

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
10.25	10.25

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
10.25	10.25	10.25	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	291.60 [Kip]	Reference	:	Cl.D2
Demand	:	0.02 [Kip]	Ctrl Eq.	:	D31 at 29.99%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	291.60	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	324.00	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	267.89 [Kip]	Reference	:	Cl.E3
Demand	:	0.51 [Kip]	Ctrl Eq.	:	D24 at 29.99%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	267.89	Cl.E3
Unbraced length (L_{33})	[ft]	10.25	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	25.07	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	455.45	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.23	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	47.75	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	297.65	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.01			
Capacity	:	69.58 [Kip]	Reference	:	Cl.E3
Demand	:	0.51 [Kip]	Ctrl Eq.	:	D24 at 29.99%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	69.58	Cl.E3
Unbraced length (L_{22})	[ft]	10.25	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	145.04	Cl.E2

Elastic critical buckling stress (F_{e22})	[Kip/in2]	13.60	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.48	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	11.93	Eq.E3-3
Nominal flexural buckling strength (P_{n22})	[Kip]	77.32	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	172.02	Cl.E4
Unbraced length (L_{11})	[ft]	10.25	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	39.65	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	6.48	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	29.50	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	191.14	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.02			
Capacity	:	66.16 [Kip*ft]	Reference	:	Cl.F2.2
Demand	:	1.46 [Kip*ft]	Ctrl Eq.	:	D10 at 59.97%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Factored yielding strength(ϕM_n):	[Kip*ft]	109.88	Cl.F2.1
Yielding (M_n)	[Kip*ft]	122.08	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	66.16	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	3.00	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.04	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	9.16	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.18	Eq.F1-1
Critical stress (F_{cr})	[Kip/in2]	34.73	Eq.F2-4
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	73.51	Eq.F2-3

Bending about minor axis, M22

Ratio	:	0.08			
Capacity	:	13.73 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	1.14 [Kip*ft]	Ctrl Eq.	:	D25 at 59.97%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Limiting slenderness for noncompact stiffened element (λ_r)	--	10000.00	
Limiting slenderness for compact stiffened element (λ_p)	--	10000.00	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	13.73	Cl.F6.1
Yielding (M_n)	[Kip*ft]	15.25	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	92.49 [Kip]	Reference	:	Cl.G1
Demand	:	0.31 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	92.49	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	102.77	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.00			
Capacity	:	96.00 [Kip]	Reference	:	Cl.G1
Demand	:	0.46 [Kip]	Ctrl Eq.	:	D10 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	96.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	96.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.10			
Ctrl Eq.	:	D25 at 59.97%	Reference	:	Eq.H1-1b

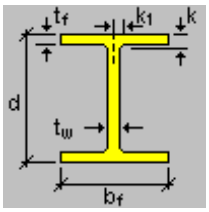
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.10	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	65.26	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	13.73	Cl.H1.1
Available axial strength (P_c)	[Kip]	69.58	Cl.H1.1

Member : 67 - OK

Section information

Section name: W 12X22 **(US)**

Dimensions



bf	=	4.030	[in]	Width
d	=	12.300	[in]	Depth
k	=	0.725	[in]	Distance k
k1	=	0.625	[in]	Distance k1
tf	=	0.425	[in]	Flange thickness
tw	=	0.260	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	6.480	
Moment of Inertia (local axes) (I)	[in4]	156.000	4.660
Moment of Inertia (principal axes) (I')	[in4]	156.000	4.660
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	4.907	0.848
Radius of gyration (principal axes) (r')	[in]	4.907	0.848
Saint-Venant torsion constant. (J)	[in4]	0.293	
Section warping constant. (Cw)	[in6]	164.000	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	25.400	2.310
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	25.400	2.310
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	25.400	2.310
Plastic section modulus (local axis) (Z)	[in3]	29.300	3.660
Plastic section modulus (principal axis) (Z')	[in3]	29.300	3.660
Polar radius of gyration. (ro)	[in]	4.979	
Area for shear (Aw)	[in2]	3.430	3.200
Torsional constant. (C)	[in3]	0.649	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	10.25

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
10.25	10.25

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
10.25	10.25	10.25	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	291.60 [Kip]	Reference	:	Cl.D2
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D32 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	291.60	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	324.00	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	267.89 [Kip]	Reference	:	Cl.E3
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D33 at 29.99%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	267.89	Cl.E3
Unbraced length (L_{33})	[ft]	10.25	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	25.07	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	455.45	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.23	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	47.75	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	297.65	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	69.58 [Kip]	Reference	:	Cl.E3
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D33 at 29.99%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	4.74	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	41.73	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	69.58	Cl.E3
Unbraced length (L_{22})	[ft]	10.25	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	145.04	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	13.60	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	6.48	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	11.93	Eq.E3-3
Nominal flexural buckling strength (P_{n22})	[Kip]	77.32	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	172.02	Cl.E4
Unbraced length (L_{11})	[ft]	10.25	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	39.65	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	6.48	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	29.50	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	191.14	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.02			
Capacity	:	66.22 [Kip*ft]	Reference	:	Cl.F2.2
Demand	:	1.55 [Kip*ft]	Ctrl Eq.	:	D10 at 59.97%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Factored yielding strength(ϕM_n):	[Kip*ft]	109.88	Cl.F2.1
Yielding (M_n)	[Kip*ft]	122.08	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	66.22	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	3.00	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.04	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	9.16	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.18	Eq.F1-1
Critical stress (F_{cr})	[Kip/in2]	34.76	Eq.F2-4
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	73.58	Eq.F2-3

Bending about minor axis, M22

Ratio	:	0.08			
Capacity	:	13.73 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	1.04 [Kip*ft]	Ctrl Eq.	:	D25 at 46.64%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	4.74	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	41.73	
Limiting slenderness for noncompact stiffened element (λ_r)	--	10000.00	
Limiting slenderness for compact stiffened element (λ_p)	--	10000.00	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	13.73	Cl.F6.1
Yielding (M_n)	[Kip*ft]	15.25	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.01			
Capacity	:	92.49 [Kip]	Reference	:	Cl.G1
Demand	:	0.75 [Kip]	Ctrl Eq.	:	D25 at 100.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	92.49	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	102.77	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.01			
Capacity	:	96.00 [Kip]	Reference	:	Cl.G1
Demand	:	0.48 [Kip]	Ctrl Eq.	:	D10 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	96.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	96.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.09			
Ctrl Eq.	:	D25 at 46.64%	Reference	:	Eq.H1-1b

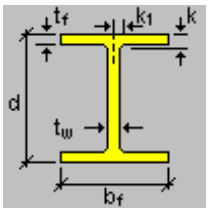
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.09	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	65.38	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	13.73	Cl.H1.1
Available axial strength (P_c)	[Kip]	69.58	Cl.H1.1

Member : 68 - OK

Section information

Section name: W 10X15 **(US)**

Dimensions



bf	=	4.000	[in]	Width
d	=	10.000	[in]	Depth
k	=	0.570	[in]	Distance k
k1	=	0.563	[in]	Distance k1
tf	=	0.270	[in]	Flange thickness
tw	=	0.230	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	4.410	
Moment of Inertia (local axes) (I)	[in4]	68.900	2.890
Moment of Inertia (principal axes) (I')	[in4]	68.900	2.890
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	3.953	0.810
Radius of gyration (principal axes) (r')	[in]	3.953	0.810
Saint-Venant torsion constant. (J)	[in4]	0.104	
Section warping constant. (Cw)	[in6]	68.300	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	13.800	1.450
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	13.800	1.450
Plastic section modulus (local axis) (Z)	[in3]	16.000	2.300
Plastic section modulus (principal axis) (Z')	[in3]	16.000	2.300
Polar radius of gyration. (ro)	[in]	4.035	
Area for shear (Aw)	[in2]	2.160	2.300
Torsional constant. (C)	[in3]	0.341	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	11.50

Distance between member lateral bracing points

Length (Lb) [ft] Top	Bottom
11.50	11.50

Laterally unbraced length

Length [ft] Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Effective length factor Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
11.50	11.50	11.50	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	198.45 [Kip]	Reference	:	Cl.D2
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	198.45	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	220.50	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	180.00 [Kip]	Reference	:	Cl.E3
Demand	:	0.63 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	180.00	Cl.E3
Unbraced length (L_{33})	[ft]	11.50	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	34.91	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	234.81	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.37	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	45.74	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	200.00	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.02			
Capacity	:	34.28 [Kip]	Reference	:	Cl.E3
Demand	:	0.63 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	34.28	Cl.E3
Unbraced length (L_{22})	[ft]	11.50	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	170.47	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	9.85	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.41	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	8.64	Eq.E3-3
Nominal flexural buckling strength (P_{n22})	[Kip]	38.09	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	99.83	Cl.E4
Unbraced length (L_{11})	[ft]	11.50	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	30.46	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	4.41	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	25.15	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	110.92	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.17			
Capacity	:	26.26 [Kip*ft]	Reference	:	Cl.F2.2
Demand	:	-4.38 [Kip*ft]	Ctrl Eq.	:	D31 at 50.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.1
Yielding (M_n)	[Kip*ft]	66.67	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	26.26	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	2.86	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.01	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	8.60	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.14	Eq.F1-1
Critical stress (F_{cr})	[Kip/in2]	25.38	Eq.F2-4
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	29.18	Eq.F2-3

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	8.63 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	0.00 [Kip*ft]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	8.63	Cl.F6.1
Yielding (M_n)	[Kip*ft]	9.58	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	58.32 [Kip]	Reference	:	Cl.G1
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D24 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	58.32	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	64.80	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.02			
Capacity	:	69.00 [Kip]	Reference	:	Cl.G1
Demand	:	1.52 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	69.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	69.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.17			
Ctrl Eq.	:	D31 at 50.00%	Reference	:	Eq.H1-1b

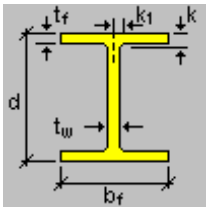
Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.17	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	26.27	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	8.63	Cl.H1.1
Available axial strength (P_c)	[Kip]	198.45	Cl.H1.1

Member : 11 (11) - OK

Section information

Section name: W 10X15 **(US)**

Dimensions



bf	=	4.000	[in]	Width
d	=	10.000	[in]	Depth
k	=	0.570	[in]	Distance k
k1	=	0.563	[in]	Distance k1
tf	=	0.270	[in]	Flange thickness
tw	=	0.230	[in]	Web thickness

Properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	4.410	
Moment of Inertia (local axes) (I)	[in4]	68.900	2.890
Moment of Inertia (principal axes) (I')	[in4]	68.900	2.890
Bending constant for moments (principal axis) (J')	[in]	0.000	0.000
Radius of gyration (local axes) (r)	[in]	3.953	0.810
Radius of gyration (principal axes) (r')	[in]	3.953	0.810
Saint-Venant torsion constant. (J)	[in4]	0.104	
Section warping constant. (Cw)	[in6]	68.300	
Distance from centroid to shear center (principal axis) (xo,yo)	[in]	0.000	0.000
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (local axis) (Sinf)	[in3]	13.800	1.450
Top elastic section modulus of the section (principal axis) (S'sup)	[in3]	13.800	1.450
Bottom elastic section modulus of the section (principal axis) (S'inf)	[in3]	13.800	1.450
Plastic section modulus (local axis) (Z)	[in3]	16.000	2.300
Plastic section modulus (principal axis) (Z')	[in3]	16.000	2.300
Polar radius of gyration. (ro)	[in]	4.035	
Area for shear (Aw)	[in2]	2.160	2.300
Torsional constant. (C)	[in3]	0.341	

Material : A992 Gr50

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	50.00
Tensile strength (Fu):	[Kip/in2]	65.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11153.85

Design Criteria

Description	Unit	Value
Length for tension slenderness ratio (L)	[ft]	3.25

Distance between member lateral bracing points

Length (Lb) [ft]	
Top	Bottom
3.25	3.25

Laterally unbraced length

Length [ft]			Effective length factor		
Major axis(L33)	Minor axis(L22)	Torsional axis(Lt)	Major axis(K33)	Minor axis(K22)	Torsional axis(Kt)
3.25	3.25	3.25	1.0	1.0	1.0

Additional assumptions

Continuous lateral torsional restraint	No
Tension field action	No
Continuous flexural torsional restraint	No
Effective length factor value type	None
Major axis frame type	Sway
Minor axis frame type	Sway

Design Checks

Axial Tension Design ✔

Axial tension

Ratio	:	0.00			
Capacity	:	198.45 [Kip]	Reference	:	Cl.D2
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D24 at 0.00%

Intermediate results	Unit	Value	Reference
Factored axial tension capacity(ϕP_n):	[Kip]	198.45	Cl.D2
Nominal axial tension capacity (P_n)	[Kip]	220.50	Eq.D2-1

Axial Compression Design ✔

Compression in the major axis 33

Ratio	:	0.00			
Capacity	:	192.82 [Kip]	Reference	:	Cl.E3
Demand	:	0.42 [Kip]	Ctrl Eq.	:	D33 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n33}):	[Kip]	192.82	Cl.E3
Unbraced length (L_{33})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{33}$)	--	9.87	Cl.E2
Elastic critical buckling stress (F_{e33})	[Kip/in2]	2940.01	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.32	
Critical stress for flexural buckling (F_{cr33})	[Kip/in2]	49.65	Eq.E3-2
Nominal flexural buckling strength (P_{n33})	[Kip]	214.24	Eq.E7-1

Compression in the minor axis 22

Ratio	:	0.00			
Capacity	:	167.47 [Kip]	Reference	:	Cl.E3
Demand	:	0.42 [Kip]	Ctrl Eq.	:	D33 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Non slender	
Unstiffened element slenderness (λ)	--	7.41	
Unstiffened element limiting slenderness (λ_r)	--	13.49	Table.B4.1a.Case1
Stiffened element classification	--	Slender	
Stiffened element slenderness (λ)	--	38.52	
Stiffened element limiting slenderness (λ_r)	--	35.88	Table.B4.1a.Case5
Factored flexural buckling strength(ϕP_{n22}):	[Kip]	167.47	Cl.E3
Unbraced length (L_{22})	[ft]	3.25	Cl.E2
Effective slenderness ($(KL/r)_{22}$)	--	48.18	Cl.E2
Elastic critical buckling stress (F_{e22})	[Kip/in2]	123.32	Eq.E3-4
Effective area of the cross section based on the effective width (A...	[in2]	4.41	
Critical stress for flexural buckling (F_{cr22})	[Kip/in2]	42.20	Eq.E3-2

Nominal flexural buckling strength (P_{n22})	[Kip]	186.08	Eq.E7-1
Factored torsional or flexural-torsional buckling strength(ϕP_{n11}):	[Kip]	177.29	Cl.E4
Unbraced length (L_{11})	[ft]	3.25	Cl.E2
Torsional or flexural-torsional elastic buckling stress (F_{e11})	[Kip/in2]	195.19	Eq.E4-2
Effective area of the cross section based on the effective width (A...	[in2]	4.39	
Critical stress for torsional or flexural-torsional buckling (F_{cr11})	[Kip/in2]	44.92	Eq.E3-2
Nominal torsional or flexural-torsional buckling strength (P_{n11})	[Kip]	196.99	Eq.E7-1

Flexural Design ✔

Bending about major axis, M33

Ratio	:	0.01			
Capacity	:	60.00 [Kip*ft]	Reference	:	Cl.F2.1
Demand	:	-0.44 [Kip*ft]	Ctrl Eq.	:	D31 at 50.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.1
Yielding (M_n)	[Kip*ft]	66.67	Eq.F2-1
Factored lateral-torsional buckling strength(ϕM_n):	[Kip*ft]	60.00	Cl.F2.2
Limiting laterally unbraced length for yielding (L_p)	[ft]	2.86	Eq.F2-5
Effective radius of gyration used in the determination of Lr (r_{ts})	[in]	1.01	Eq.F2-7
Lateral-torsional factor (c)	--	1.00	Eq.F2-8a
Limiting laterally unbraced length for inelastic lateral-torsional bucklin...	[ft]	8.60	Eq.F2-6
Lateral-torsional buckling modification factor (C_b)	--	1.14	Eq.F1-1
Nominal lateral-torsional buckling moment strength (M_n)	[Kip*ft]	66.67	Eq.F2-2

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	8.63 [Kip*ft]	Reference	:	Cl.F6.1
Demand	:	0.00 [Kip*ft]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Section classification			
Unstiffened element classification	--	Compact	
Unstiffened element slenderness (λ)	--	7.41	
Limiting slenderness for noncompact unstiffened element (λ_r)	--	24.08	
Limiting slenderness for compact unstiffened element (λ_p)	--	9.15	
Stiffened element classification	--	Compact	
Stiffened element slenderness (λ)	--	38.52	
Limiting slenderness for noncompact stiffened element (λ_r)	--	137.27	
Limiting slenderness for compact stiffened element (λ_p)	--	90.55	
Factored yielding strength about a geometric axis(ϕM_n):	[Kip*ft]	8.63	Cl.F6.1
Yielding (M_n)	[Kip*ft]	9.58	Eq.F6-1

Shear Design ✔

Shear in major axis 33

Ratio	:	0.00			
Capacity	:	58.32 [Kip]	Reference	:	Cl.G1
Demand	:	0.00 [Kip]	Ctrl Eq.	:	D25 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	58.32	Cl.G1
Web buckling coefficient (k_v)	--	1.20	Cl.G6
Web buckling coefficient (C_v)	--	1.00	Eq.G2-9
Nominal shear strength (V_n)	[Kip]	64.80	Eq.G6-1

Shear in minor axis 22

Ratio	:	0.01			
Capacity	:	69.00 [Kip]	Reference	:	Cl.G1
Demand	:	0.54 [Kip]	Ctrl Eq.	:	D31 at 0.00%

Intermediate results	Unit	Value	Reference
Factored shear capacity(ϕV_n):	[Kip]	69.00	Cl.G1
Web buckling coefficient (k_v)	--	5.34	Eq.G2-5
Web buckling coefficient (C_v)	--	1.00	-
Nominal shear strength (V_n)	[Kip]	69.00	Eq.G2-1

Combined Actions Design ✔

Combined flexure and axial

Ratio	:	0.01			
Ctrl Eq.	:	D31 at 50.00%	Reference	:	Eq.H1-1b

Intermediate results	Unit	Value	Reference
Interaction of flexure and axial force:	--	0.01	Eq.H1-1b
Available flexural strength about strong axis (M_{c33})	[Kip*ft]	60.00	Cl.H1.1
Available flexural strength about weak axis (M_{c22})	[Kip*ft]	8.63	Cl.H1.1
Available axial strength (P_c)	[Kip]	167.47	Cl.H1.1

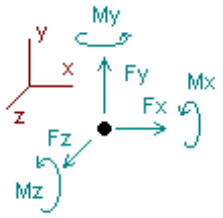
Current Date: 3/21/2025 11:52 AM

Analysis result

Nodes

Envelope for nodal reactions

Note.- **lc** is the controlling load condition



Direction of positive forces and moments

Envelope of nodal reactions for :

D1=1.4DL
D2=1.2DL+0.5Lr
D3=1.2DL+0.5S
D4=1.2DL+1.6Lr
D5=1.2DL+1.6S
D6=1.2DL+0.5DW
D7=1.2DL+0.5UP
D8=1.2DL+0.5WX
D9=1.2DL+0.5WZ
D10=1.2DL+1.6Lr+0.5DW
D11=1.2DL+1.6Lr+0.5UP
D12=1.2DL+1.6Lr+0.5WX
D13=1.2DL+1.6Lr+0.5WZ
D14=1.2DL+1.6S+0.5DW
D15=1.2DL+1.6S+0.5UP
D16=1.2DL+1.6S+0.5WX
D17=1.2DL+1.6S+0.5WZ
D18=1.2DL+DW
D19=1.2DL+UP
D20=1.2DL+WX
D21=1.2DL+WZ
D22=1.2DL+0.5Lr+DW
D23=1.2DL+0.5Lr+UP
D24=1.2DL+0.5Lr+WX
D25=1.2DL+0.5Lr+WZ
D26=1.2DL+0.5S+DW
D27=1.2DL+0.5S+UP
D28=1.2DL+0.5S+WX
D29=1.2DL+0.5S+WZ
D30=0.9DL+DW
D31=0.9DL+UP
D32=0.9DL+WX
D33=0.9DL+WZ
D34=1.2DL+0.2S

Node		Forces						Moments					
		Fx [Kip]	**lc**	**Fy** [Kip]	**lc**	**Fz** [Kip]	**lc**	**Mx** [Kip*ft]	**lc**	**My** [Kip*ft]	**lc**	**Mz** [Kip*ft]	**lc**
45	Max	0.746	D24	4.972	D10	0.007	D10	0.09022	D10	1.17301	D25	0.23085	D33
	Min	-0.029	D33	-4.070	D31	-0.654	D33	-8.39462	D33	-0.09464	D32	-4.94746	D24
60	Max	1.265	D32	4.873	D10	0.007	D10	0.09148	D10	1.23508	D25	0.07664	D10
	Min	-0.033	D10	-3.947	D31	-0.654	D33	-8.39371	D33	-0.02615	D31	-8.64383	D32

Connection Design

Current Date: 3/21/2025 10:41 AM

VESTIBULE COLUMN BP

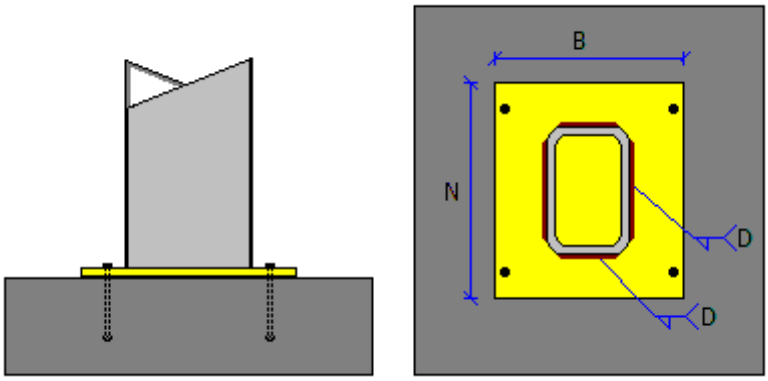
Steel Connections Data

Connection: 2 - Fixed uniaxial both axis BP

Family:	Column - Base (CB)
Type:	Base plate
Description:	Smart Fixed Uniaxial Both Axis Base Plate 1

General information

Connector



Members

Column

Column type	:	Prismatic member
Section	:	HSS_SQR 4X4X1_4
Material	:	A500 GrC rectangular

Base plate

Base plate

Plate shape	:	Rectangular
Connection type	:	Unstiffened
Position on the support	:	Center
N: Longitudinal dimension	:	12 in
B: Transversal dimension	:	12 in
Thickness	:	0.75 in
Material	:	A36
Column weld	:	E70XX
D: Column weld size (1/16 in)	:	4
Override A2/A1 ratio	:	No
Include shear lug	:	No

Support

With pedestal	:	No
Longitudinal dimension	:	30 in

Transversal dimension	:	30 in
Thickness	:	30 in
Material	:	C 4-60
Include grouting	:	Yes
Grout thickness	:	2 in

Anchor

Anchor position	:	Longitudinal position
Rows number per side	:	1
Anchors per row	:	2
Longitudinal edge distance on the plate	:	1.5 in
Transverse edge distance on the plate	:	1.5 in
Anchor type	:	Headed
Head type	:	Hexagonal
Include lock nut	:	No
Anchor	:	3/4"
Effective embedment depth	:	12 in
Total length	:	15.74 in
Material	:	F1554 Gr36
Fy	:	36 kip/in2
Fu	:	58 kip/in2
Cracked concrete	:	No
Brittle steel	:	No
Anchors welded to base plate	:	No

Anchor reinforcement

Type of reinforcement	:	Primary
Tension reinforcement	:	No
Shear reinforcement	:	No

Current Date: 3/21/2025 10:41 AM

Steel Connections Results

Connection: 2 - Fixed uniaxial both axis BP

Family:	Column - Base (CB)
Type:	Base plate
Description:	Smart Fixed Uniaxial Both Axis Base Plate 1

Design code: AISC 360-16 LRFD, ACI 318-19

Demands

Description	Pu [kip]	Mu22 [kip*ft]	Mu33 [kip*ft]	Vu2 [kip]	Vu3 [kip]	Load type
DL	-1.63	0.02	-0.02	-0.01	0.00	Design
Lr	-1.28	0.01	-0.01	0.00	0.00	Design
S	-1.28	0.01	-0.01	0.00	0.00	Design
DW	-1.02	0.01	-0.01	0.00	0.00	Design
UP	5.64	-0.06	0.07	0.02	0.00	Design
WX	0.69	0.03	5.08	0.77	0.00	Design
WZ	0.03	-5.56	0.36	0.06	0.44	Design
D1	-2.28	0.03	-0.03	-0.01	0.00	Design
D2	-2.59	0.03	-0.03	-0.01	0.00	Design
D3	-2.59	0.03	-0.03	-0.01	0.00	Design
D4	-4.00	0.04	-0.05	-0.01	0.00	Design
D5	-4.00	0.04	-0.05	-0.01	0.00	Design
D6	-2.46	0.03	-0.03	-0.01	0.00	Design
D7	0.86	-0.01	0.01	0.00	0.00	Design
D8	-1.61	0.04	2.52	0.38	0.00	Design
D9	-1.94	-2.76	0.16	0.02	0.22	Design
D10	-4.51	0.05	-0.05	-0.01	0.00	Design
D11	-1.18	0.01	-0.01	0.00	0.00	Design
D12	-3.65	0.06	2.49	0.37	0.00	Design
D13	-3.98	-2.74	0.13	0.02	0.22	Design
D14	-4.51	0.05	-0.05	-0.01	0.00	Design
D15	-1.18	0.01	-0.01	0.00	0.00	Design
D16	-3.65	0.06	2.49	0.37	0.00	Design
D17	-3.98	-2.74	0.13	0.02	0.22	Design
D18	-2.97	0.03	-0.04	-0.01	0.00	Design
D19	3.68	-0.04	0.04	0.01	0.00	Design
D20	-1.27	0.05	5.06	0.76	0.00	Design
D21	-1.93	-5.54	0.34	0.05	0.44	Design
D22	-3.61	0.04	-0.04	-0.01	0.00	Design
D23	3.04	-0.03	0.03	0.01	0.00	Design
D24	-1.91	0.06	5.05	0.76	0.00	Design
D25	-2.57	-5.53	0.33	0.05	0.44	Design
D26	-3.61	0.04	-0.04	-0.01	0.00	Design
D27	3.04	-0.03	0.03	0.01	0.00	Design
D28	-1.91	0.06	5.05	0.76	0.00	Design
D29	-2.57	-5.53	0.33	0.05	0.44	Design
D30	-2.49	0.03	-0.03	-0.01	0.00	Design
D31	4.17	-0.04	0.05	0.01	0.00	Design

D32	-0.78	0.05	5.07	0.76	0.00	Design
D33	-1.44	-5.55	0.34	0.05	0.44	Design
D34	-2.21	0.02	-0.03	-0.01	0.00	Design

Design calculations

Design for major axis
Base plate (AISC 360-16 LRFD)

Geometric Considerations

Dimensions	Unit	Value	Min.	Max.	Sta.	References
Base plate						
Distance from anchor to edge	[in]	1.12	0.25	--	✔	
Weld size	[1/16in]	4	2	--	✔	table J2.4

Design Check

Verification	Unit	Capacity	Demand	Ctrl EQ	Ratio	References
Concrete base						
Axial bearing	[Kip/in2]	4.42	0.25	D24	**0.06**	DG1 3.1.1
Base plate						
Flexural yielding (bearing interface)	[Kip*ft/ft]	4.56	1.77	D24	**0.39**	DG1 Sec 3.1.2
Flexural yielding (tension interface)	[Kip*ft/ft]	4.56	2.16	WX	**0.47**	DG1 Eq. 3.3.13
Column						
Weld capacity	[Kip/ft]	100.23	8.18	WX	**0.08**	HSS Manual p. 7-10
Elastic method weld shear and axial capacity	[Kip/ft]	100.23	45.83	WX	**0.46**	Sec. J2.4
Ratio	**0.47**					

Anchors

Geometric Considerations

Dimensions	Unit	Value	Min.	Max.	Sta.	References
Anchors						
Anchor spacing	[in]	9.00	3.00	--	✔	Sec. 17.9.2
Concrete cover	[in]	10.12	3.00	--	✔	Sec. 20.5.1.3.1
Effective length	[in]	12.49	--	29.51	✔	

Design Check

Verification	Unit	Capacity	Demand	Ctrl EQ	Ratio	References
Anchor tension	[Kip]	14.55	3.41	WX	**0.23**	Eq. 17.6.1.2
Breakout of anchor in tension	[Kip]	30.54	3.41	WX	**0.11**	Sec. 17.5.2
Breakout of group of anchors in tension	[Kip]	35.14	6.82	WX	**0.19**	Sec. 17.5.2
Pullout of anchor in tension	[Kip]	20.51	3.41	WX	**0.17**	Sec. 17.5.2
Anchor shear	[Kip]	6.05	0.19	WX	**0.03**	Eq. 17.7.1.2b, Sec. 17.7.1.2.1
Breakout of anchor in shear	[Kip]	14.23	0.19	WX	**0.01**	Sec. 17.5.2
Breakout of group of anchors in shear	[Kip]	16.27	0.77	WX	**0.05**	Sec. 17.5.2
Pryout of anchor in shear	[Kip]	61.08	0.19	WX	**0.00**	Sec. 17.5.2
Pryout of group of anchors in shear	[Kip]	100.40	0.77	WX	**0.01**	Sec. 17.5.2
Interaction of tensile and shear forces	[Kip]	1.20	0.00	UP	**0.00**	Sec. 17.8.1

Ratio	0.23

Design for minor axis

Base plate (AISC 360-16 LRFD)

Geometric Considerations

Dimensions	Unit	Value	Min.	Max.	Sta.	References
Base plate						
Distance from anchor to edge	[in]	1.12	0.25	--	✔	
Weld size	[1/16in]	4	2	--	✔	table J2.4

Design Check

Verification	Unit	Capacity	Demand	Ctrl EQ	Ratio	References
Concrete base						
Axial bearing	[Kip/in2]	4.42	0.27	D25	**0.06**	DG1 3.1.1
Base plate						
Flexural yielding (bearing interface)	[Kip*ft/ft]	4.56	1.98	D25	**0.43**	DG1 Sec 3.1.2
Flexural yielding (tension interface)	[Kip*ft/ft]	4.56	2.26	WZ	**0.50**	DG1 Eq. 3.3.13
Column						
Weld capacity	[Kip/ft]	100.23	8.54	WZ	**0.09**	HSS Manual p. 7-10
Elastic method weld shear and axial capacity	[Kip/ft]	100.23	49.46	WZ	**0.49**	Sec. J2.4

Ratio	0.50

Anchors

Geometric Considerations

Dimensions	Unit	Value	Min.	Max.	Sta.	References
Anchors						
Anchor spacing	[in]	9.00	3.00	--	✔	Sec. 17.9.2
Concrete cover	[in]	10.12	3.00	--	✔	Sec. 20.5.1.3.1
Effective length	[in]	12.49	--	29.51	✔	

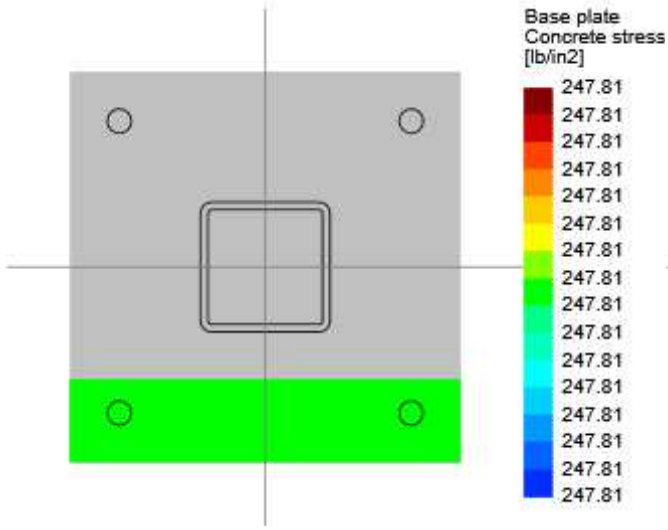
Design Check

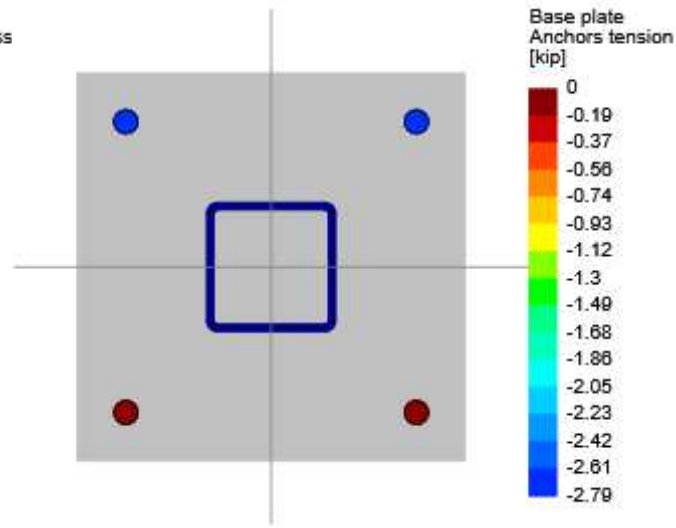
Verification	Unit	Capacity	Demand	Ctrl EQ	Ratio	References
Anchor tension	[Kip]	14.55	3.56	WZ	**0.24**	Eq. 17.6.1.2
Breakout of anchor in tension	[Kip]	30.54	3.56	WZ	**0.12**	Sec. 17.5.2
Breakout of group of anchors in tension	[Kip]	35.14	7.12	WZ	**0.20**	Sec. 17.5.2
Pullout of anchor in tension	[Kip]	20.51	3.56	WZ	**0.17**	Sec. 17.5.2
Anchor shear	[Kip]	6.05	0.11	WZ	**0.02**	Eq. 17.7.1.2b, Sec. 17.7.1.2.1
Breakout of anchor in shear	[Kip]	14.23	0.11	WZ	**0.01**	Sec. 17.5.2
Breakout of group of anchors in shear	[Kip]	16.27	0.44	WZ	**0.03**	Sec. 17.5.2
Pryout of anchor in shear	[Kip]	61.08	0.11	WZ	**0.00**	Sec. 17.5.2
Pryout of group of anchors in shear	[Kip]	100.40	0.44	WZ	**0.00**	Sec. 17.5.2
Interaction of tensile and shear forces	[Kip]	1.20	0.00	UP	**0.00**	Sec. 17.8.1

Ratio	**0.24**
Global critical strength ratio	**0.50**

Major axis

Maximum compression (D24)



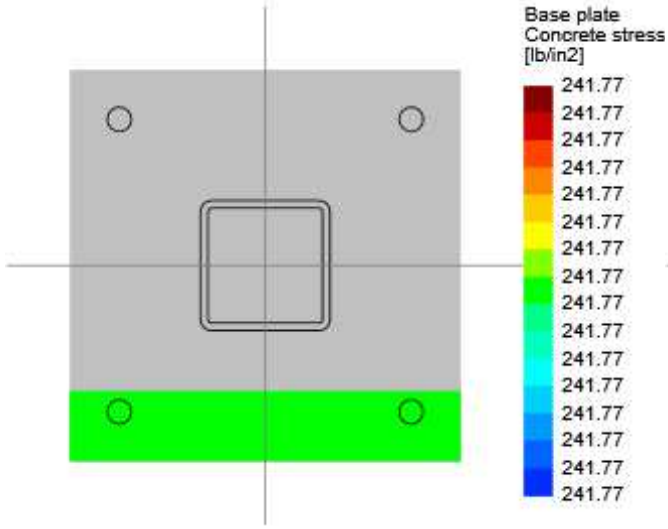


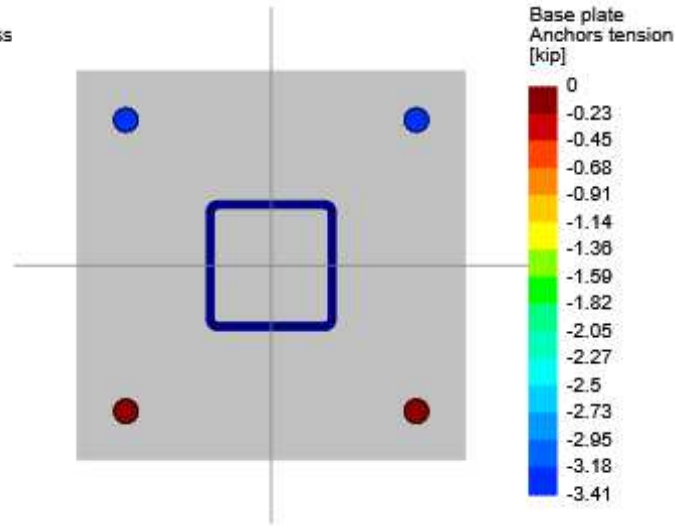
Maximum bearing pressure	247.81	[lb/in2]
Minimum bearing pressure	247.81	[lb/in2]
Maximum anchor tension	2.79	[kip]
Minimum anchor tension	0.00	[kip]
Neutral axis angle	0.00	[deg]
Neutral axis location	2.52	[in]
Bearing length	2.52	[in]

Anchors tensions

Anchor	Transverse [in]	Longitudinal [in]	Shear [kip]	Tension [kip]
1	-4.50	-4.50	0.19	0.00
2	-4.50	4.50	0.19	2.79
3	4.50	4.50	0.19	2.79
4	4.50	-4.50	0.19	0.00

Maximum tension (WX)





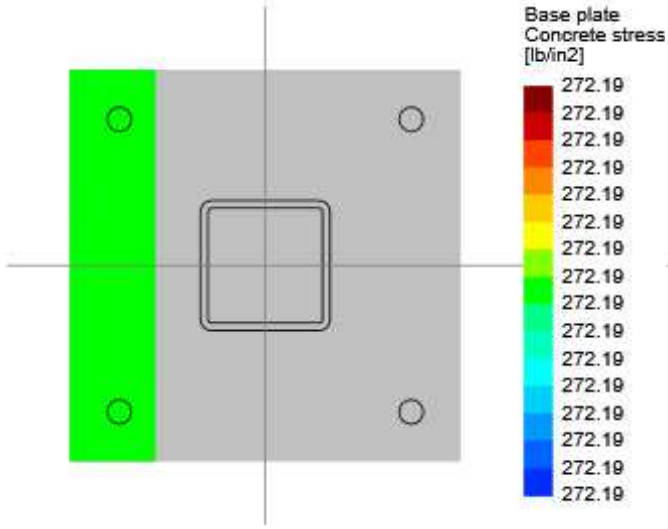
Maximum bearing pressure	241.77	[lb/in2]
Minimum bearing pressure	241.77	[lb/in2]
Maximum anchor tension	3.41	[kip]
Minimum anchor tension	0.00	[kip]
Neutral axis angle	0.00	[deg]
Neutral axis location	2.11	[in]
Bearing length	2.11	[in]

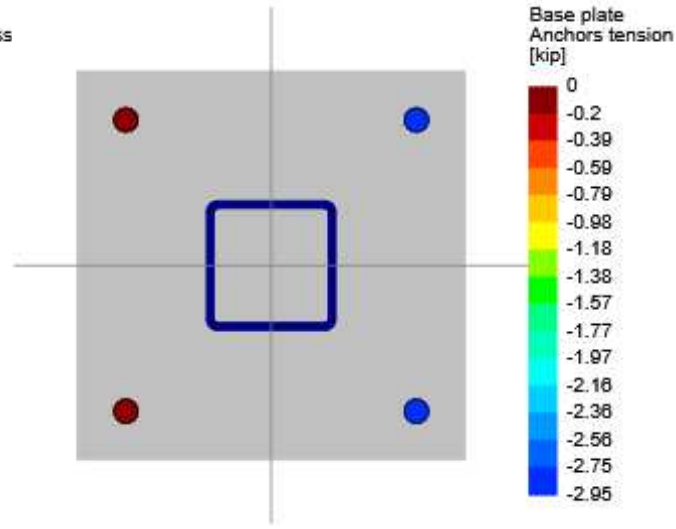
Anchors tensions

Anchor	Transverse [in]	Longitudinal [in]	Shear [kip]	Tension [kip]
1	-4.50	-4.50	0.19	0.00
2	-4.50	4.50	0.19	3.41
3	4.50	4.50	0.19	3.41
4	4.50	-4.50	0.19	0.00

Minor axis

Maximum compression (D25)



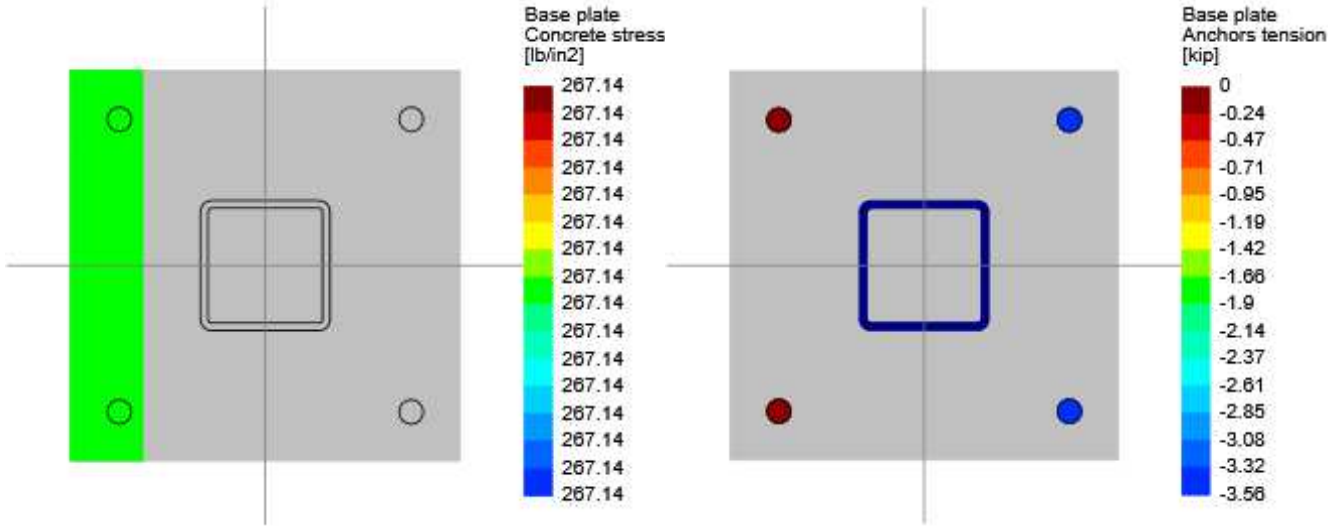


Maximum bearing pressure	272.19	[lb/in2]
Minimum bearing pressure	272.19	[lb/in2]
Maximum anchor tension	2.95	[kip]
Minimum anchor tension	0.00	[kip]
Neutral axis angle	0.00	[deg]
Neutral axis location	2.59	[in]
Bearing length	2.59	[in]

Anchors tensions

Anchor	Transverse [in]	Longitudinal [in]	Shear [kip]	Tension [kip]
1	-4.50	-4.50	0.11	0.00
2	-4.50	4.50	0.11	0.00
3	4.50	4.50	0.11	2.95
4	4.50	-4.50	0.11	2.95

Maximum tension (WZ)



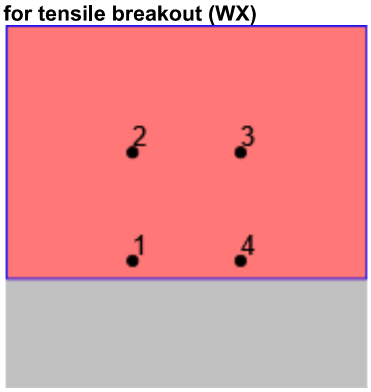
Maximum bearing pressure	267.14	[lb/in2]
Minimum bearing pressure	267.14	[lb/in2]
Maximum anchor tension	3.56	[kip]
Minimum anchor tension	0.00	[kip]
Neutral axis angle	0.00	[deg]
Neutral axis location	2.21	[in]
Bearing length	2.21	[in]

Anchors tensions

Anchor	Transverse [in]	Longitudinal [in]	Shear [kip]	Tension [kip]
1	-4.50	-4.50	0.11	0.00
2	-4.50	4.50	0.11	0.00
3	4.50	4.50	0.11	3.56
4	4.50	-4.50	0.11	3.56

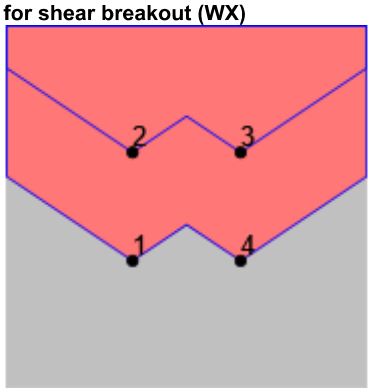
Major axis

Results for tensile breakout (WX)



Group	Area [in2]	Tension [kip]	Anchors
1	630.00	6.82	2, 3

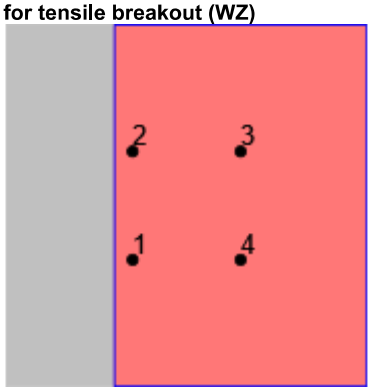
Results for shear breakout (WX)



Group	Area [in2]	Shear [kip]	Anchors
1	877.50	0.77	1, 2, 3, 4
2	472.50	0.38	2, 3

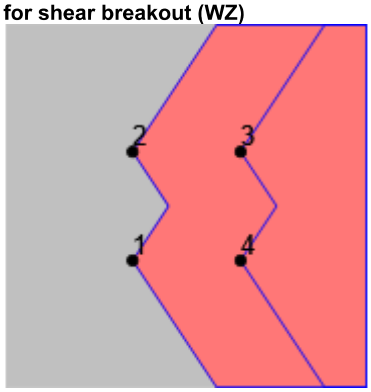
Minor axis

Results for tensile breakout (WZ)



Group	Area [in2]	Tension [kip]	Anchors
1	630.00	7.12	3, 4

Results for shear breakout (WZ)



Group	Area [in2]	Shear [kip]	Anchors
1	877.50	0.44	1, 2, 3, 4
2	472.50	0.22	3, 4

Current Date: 3/21/2025 11:59 AM

Canopy Moment Connection

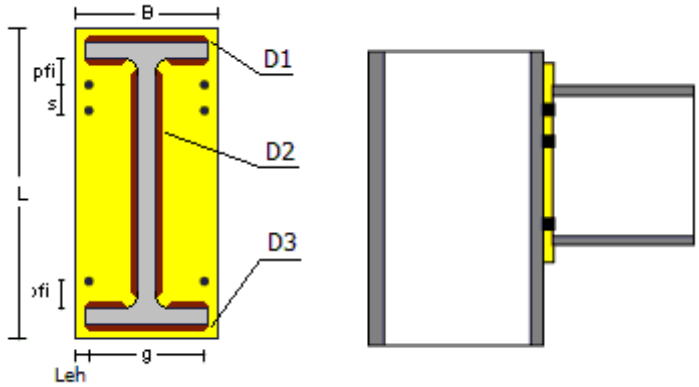
Steel Connections Data

Connection: 39 - MEP_BCF_DG16_F_1/4PL_1B_1B1/2

Family:	Beam - Column flange (BCF)
Type:	Moment end plate
Description:	Basic MEP Flush (DG16) 1

General information

Connector



Members

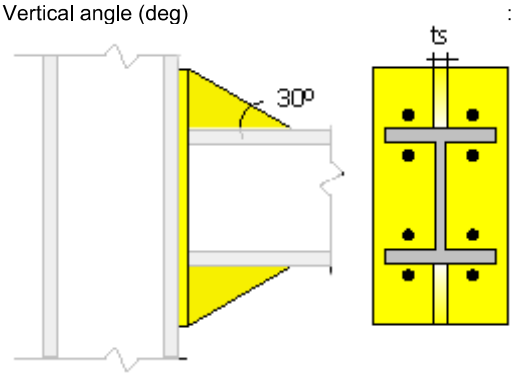
Configuration

Exists opposite connection	:	No

Beam

General

Beam type	:	Prismatic member
Beam section	:	W 12X22
Beam material	:	A992 Gr50
Horizontal angle (deg)	:	0
Vertical angle (deg)	:	0



Column

General

Support section	:	W 10X49
Support material	:	A572 Gr50
Column end	:	No

Moment end plate

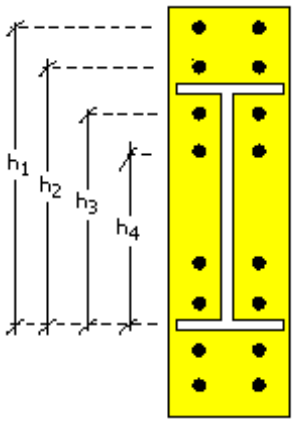
Connector

Plate extension	:	Flush
B: Width	:	7 in
L: Length	:	12.8 in
tp: Plate thickness	:	0.75 in
Plate material	:	A36
Fy	:	36 kip/in2
Fu	:	58 kip/in2
Hole type on plate	:	Standard (STD)
Flush extension length	:	0.25 in

Beam side

Top flange weld type	:	Full penetration
D1: Weld size to top beam flange (1/16in)	:	3
Bottom flange weld type	:	Full penetration
D3: Weld size to bottom beam flange (1/16in)	:	3
Welding electrode to beam web	:	E70XX
D2: Weld size to beam web (1/16in)	:	4

Support side



Bolts	:	3/4" A325 N
Bolt columns	:	2
g: Bolt gage between column groups	:	4 in
Lev: Vertical edge distance	:	1.5 in
Leh: Horizontal edge distance	:	1.5 in
Hole type on support	:	Standard (STD)

Bolt group (top flange)

Bolts rows number	:	2
pfi t: Distance from bolt rows to flange	:	1.5 in
s t: Vertical spacing between inner bolt rows	:	3 in

Bolt group (bottom flange)

Bolts rows number	:	1
pfi b: Distance from bolt rows to flange	:	1.5 in

Stiffeners

Beam web stiffener (top flange)

Include stiffener	:	No

Transverse stiffeners

Position	:	None

Web panel stiffeners

Stiffener type	:	Without stiffener

Current Date: 3/21/2025 11:59 AM

Steel Connections Results

Connection: 39 - MEP_BCF_DG16_F_1/4PL_1B_1B1/2

Family: Beam - Column flange (BCF)
Type: Moment end plate
Description: Basic MEP Flush (DG16) 1

Design code: AISC 360-16 LRFD

Demands

Description	Beam Ru [kip]	Beam Pu [kip]	Beam Mu [kip*ft]	Right beam PufTop [kip]	Right beam PufBot [kip]	Left beam PufTop [kip]	Left beam PufBot [kip]	Column Pu [kip]	Panel Vu [kip]	Load type
DL	0.62	0.00	-1.77	1.79	-1.79	0.00	0.00	-0.91	1.74	Design
Lr	0.43	0.00	-1.18	1.19	-1.19	0.00	0.00	-0.44	1.15	Design
S	0.43	0.00	-1.18	1.19	-1.19	0.00	0.00	-0.44	1.15	Design
DW	0.51	0.00	-1.47	1.48	-1.48	0.00	0.00	-0.55	1.44	Design
UP	-1.92	0.00	5.19	-5.24	5.24	0.00	0.00	1.93	5.09	Design
WX	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Design
WZ	0.00	-0.38	0.00	-0.19	-0.19	0.00	0.00	0.00	0.58	Design
D1	0.87	0.00	-2.48	2.51	-2.51	0.00	0.00	-1.28	2.43	Design
D2	0.97	0.00	-2.71	2.74	-2.74	0.00	0.00	-1.32	2.66	Design
D3	0.97	0.00	-2.71	2.74	-2.74	0.00	0.00	-1.32	2.66	Design
D4	1.44	0.00	-4.01	4.05	-4.05	0.00	0.00	-1.80	3.93	Design
D5	1.44	0.00	-4.01	4.05	-4.05	0.00	0.00	-1.80	3.93	Design
D6	1.00	0.00	-2.86	2.89	-2.89	0.00	0.00	-1.37	2.80	Design
D7	-0.21	0.00	0.47	-0.47	0.47	0.00	0.00	-0.13	0.46	Design
D8	0.75	0.00	-2.12	2.15	-2.15	0.00	0.00	-1.10	2.08	Design
D9	0.75	-0.19	-2.12	2.05	-2.24	0.00	0.00	-1.10	1.79	Design
D10	1.70	0.00	-4.74	4.79	-4.79	0.00	0.00	-2.07	4.65	Design
D11	0.48	0.00	-1.41	1.43	-1.43	0.00	0.00	-0.83	1.38	Design
D12	1.44	0.00	-4.01	4.05	-4.05	0.00	0.00	-1.80	3.93	Design
D13	1.44	-0.19	-4.01	3.95	-4.14	0.00	0.00	-1.80	3.63	Design
D14	1.70	0.00	-4.74	4.79	-4.79	0.00	0.00	-2.07	4.65	Design
D15	0.48	0.00	-1.41	1.43	-1.43	0.00	0.00	-0.83	1.38	Design
D16	1.44	0.00	-4.01	4.05	-4.05	0.00	0.00	-1.80	3.93	Design
D17	1.44	-0.19	-4.01	3.95	-4.14	0.00	0.00	-1.80	3.63	Design
D18	1.26	0.00	-3.59	3.63	-3.63	0.00	0.00	-1.64	3.52	Design
D19	-1.17	0.00	3.06	-3.10	3.10	0.00	0.00	0.84	3.00	Design
D20	0.75	0.00	-2.12	2.15	-2.15	0.00	0.00	-1.10	2.08	Design
D21	0.75	-0.38	-2.12	1.96	-2.34	0.00	0.00	-1.10	1.50	Design
D22	1.48	0.00	-4.18	4.22	-4.22	0.00	0.00	-1.86	4.10	Design
D23	-0.95	0.00	2.48	-2.50	2.50	0.00	0.00	0.62	2.43	Design
D24	0.97	0.00	-2.71	2.74	-2.74	0.00	0.00	-1.32	2.66	Design
D25	0.97	-0.38	-2.71	2.55	-2.93	0.00	0.00	-1.32	2.07	Design
D26	1.48	0.00	-4.18	4.22	-4.22	0.00	0.00	-1.86	4.10	Design
D27	-0.95	0.00	2.48	-2.50	2.50	0.00	0.00	0.62	2.43	Design
D28	0.97	0.00	-2.71	2.74	-2.74	0.00	0.00	-1.32	2.66	Design
D29	0.97	-0.38	-2.71	2.55	-2.93	0.00	0.00	-1.32	2.07	Design
D30	1.07	0.00	-3.06	3.09	-3.09	0.00	0.00	-1.37	3.00	Design

D31	-1.35	0.00	3.59	-3.63	3.63	0.00	0.00	1.11	3.52	Design
D32	0.56	0.00	-1.59	1.61	-1.61	0.00	0.00	-0.82	1.56	Design
D33	0.56	-0.38	-1.59	1.42	-1.80	0.00	0.00	-0.82	0.98	Design
D34	0.84	0.00	-2.36	2.38	-2.38	0.00	0.00	-1.18	2.31	Design

Geometric Considerations

Dimensions	Unit	Value	Min.	Max.	Sta.	References
Extended end plate						
Vertical edge distance	[in]	1.50	1.00	6.00	✔	Sec. J3.5
Horizontal edge distance	[in]	1.50	1.00	6.00	✔	Sec. J3.5
Vertical bolt spacing (external flange)	[in]	3.00	2.00	--	✔	Sec. J3.3
Horizontal center-to-center spacing (gage)	[in]	4.00	3.12	4.03	✔	DG4 Sec. 2.1, 2.4, DG16 Sec. 2.5
Inner bolt distance (external flange)	[in]	1.50	1.25	--	✔	DG4 Sec. 2.1
Inner bolt distance (internal flange)	[in]	1.50	1.25	--	✔	DG4 Sec. 2.1
Bolt diameter	[in]	0.75	--	1.50	✔	DG4 Sec. 1.1
Beam						
Web	[1/16in]	4	3	--	✔	table J2.4
Support						
Horizontal edge distance	[in]	3.00	1.00	6.00	✔	Sec. J3.5

Plate / Column Behavior

End plate behavior (external flange)

Thin plate behavior controlled by plate yielding

End plate behavior (internal flange)

Thick plate behavior controlled by no prying bolt rupture

Column flange behavior (external flange)

Thin plate behavior controlled by plate yielding

Column flange behavior (internal flange)

Thick plate behavior controlled by no prying bolt rupture

Design Check

Verification	Unit	Capacity	Demand	Ctrl EQ	Ratio	References
Moment end plate (external flange)						
Flexural yielding	[Kip*ft]	70.66	4.74	D10	**0.07**	DG16 Sec 2.5
No prying bolt moment strength	[Kip*ft]	86.15	4.74	D10	**0.06**	DG16 Sec 2.5
Bolt rupture with prying moment strength	[Kip*ft]	81.78	4.74	D10	**0.06**	DG16 Sec 2.5
Bolts shear	[Kip]	71.60	1.92	UP	**0.03**	Tables (7-1..14)
Bolt bearing under shear load	[Kip]	203.09	1.92	UP	**0.01**	Eq. J3-6
Shear yielding	[Kip]	102.06	2.62	UP	**0.03**	DG4 Eq. 3.12
Moment end plate (internal flange)						
Flexural yielding	[Kip*ft]	58.86	5.19	UP	**0.09**	DG16 Sec 2.5
No prying bolt moment strength	[Kip*ft]	50.53	5.19	UP	**0.10**	DG16 Sec 2.5
Bolts shear	[Kip]	35.80	1.70	D10	**0.05**	Tables (7-1..14)
Bolt bearing under shear load	[Kip]	85.64	1.70	D10	**0.02**	Eq. J3-6
Shear yielding	[Kip]	102.06	2.62	UP	**0.03**	DG4 Eq. 3.12

Beam						
Web weld shear strength	[Kip]	60.42	1.70	D10	**0.03**	Eq. J2-4
Web weld strength to reach yield stress	[Kip/ft]	200.46	140.40	DL	**0.70**	Eq. J4-1
Shear yielding	[Kip]	95.94	1.70	D10	**0.02**	Eq. J4-3
Support						
Flexural yielding (external flange)	[Kip*ft]	85.34	4.74	D10	**0.06**	DG4 Eq. 3.21
Bolt rupture with prying moment strength	[Kip*ft]	62.97	4.74	D10	**0.08**	DG16 Sec 2.5
Support bolt bearing (external flange)	[Kip]	196.56	1.92	UP	**0.01**	Eq. J3-6
Flexural yielding (internal flange)	[Kip*ft]	77.17	5.19	UP	**0.07**	DG4 Eq. 3.21
Support bolt bearing (internal flange)	[Kip]	98.28	1.70	D10	**0.02**	Eq. J3-6
Panel web shear	[Kip]	91.80	5.09	UP	**0.06**	Eq. J10-9
Support - right side						
Local web yielding	[Kip]	140.85	5.24	UP	**0.04**	DG4 eq. 3.24
Top web bearing	[Kip]	113.65	5.24	UP	**0.05**	Eq. J10-4
Bottom web bearing	[Kip]	113.65	4.79	D10	**0.04**	Eq. J10-4

Global critical strength ratio **0.70**

Miscellaneous Design

Current Date: 3/21/2025 8:59 AM

Design Results
Masonry wall

General Information

Global status : OK

Design code	:	TMS 402-16 ASD

Materials:

Material	:	CMU 2.0-60
Mortar type	:	Port/Mort - M/S
Grouting type	:	Partial grouting
Mortar bed type	:	Full bed
Masonry compression strength (F`m)	:	2 [Kip/in2]
Steel tension strength (fy)	:	60 [Kip/in2]
Steel allowable tension strength (Fs)	:	32 [Kip/in2]
Steel elasticity modulus (Es)	:	29000 [Kip/in2]
Masonry elasticity modulus (Em)	:	1800 [Kip/in2]
Masonry unit weight	:	0.135 [Kip/ft3]

Geometry

Total height	:	8.67 [ft]
Total length	:	20.67 [ft]
Foundation type	:	Continuous
Wall bottom restraint	:	Fixed
Column bottom restraint	:	Fixed
Rigidity elements	:	None

Number of stories: 1

Story	Story height [ft]	Wall thickness [in]	Effective unit weight [Kip/ft3]
1	8.67	7.63	0.14

Load Conditions

ID	Comb.	Category	Description
DL	No	DL	Dead Load
W	No	WIND	Wind Load
D1	Yes		DL
D2	Yes		DL+0.6W
D3	Yes		0.6DL+0.6W
S1	Yes		DL
S2	Yes		DL+0.6W
S3	Yes		0.6DL+0.6W

Loads

Distributed loads:

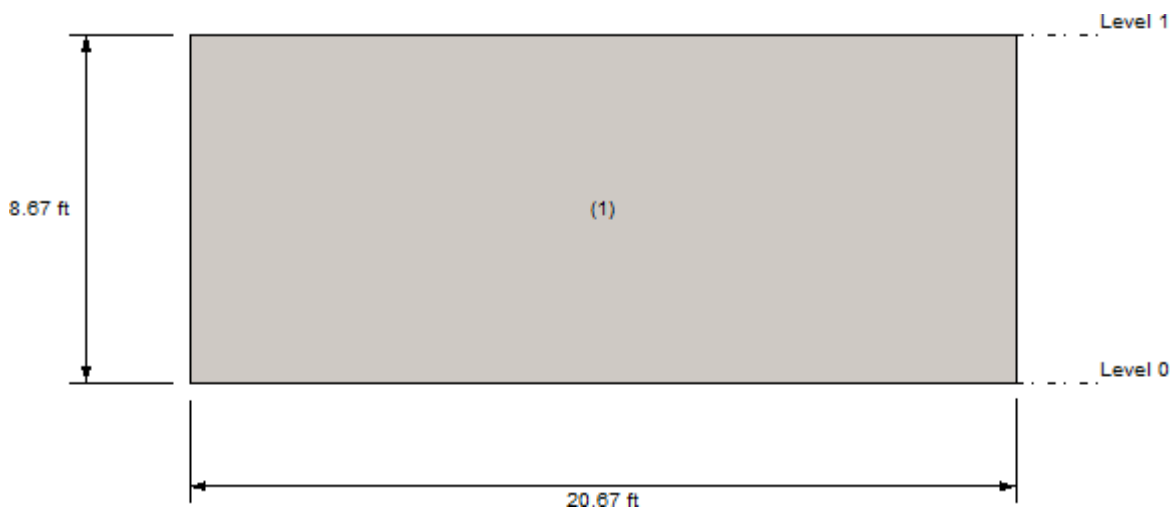
Consider self weight : DL

Out-of-plane loads:

Story	Condition	Magnitude [Kip/ft2]
1	W	0.03
Parapet	W	0.03

Bearing Wall Design

Status : OK



Geometry

Level	Segment	X Coordinate [ft]	Y Coordinate [ft]	Width [ft]	Height [ft]
0	1	0.00	0.00	20.67	8.67

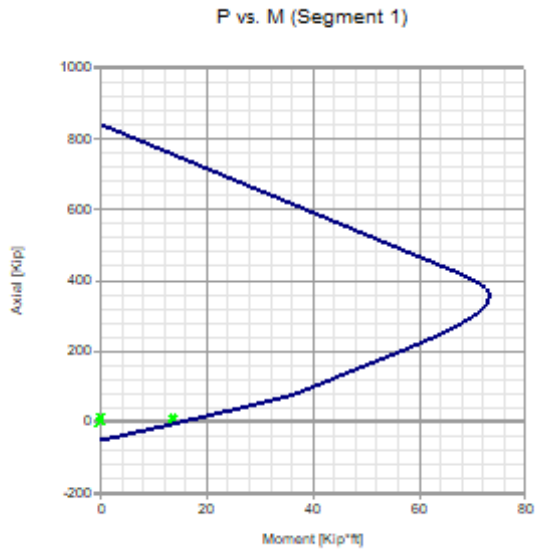
Vertical reinforcement

Segment	Bars	Spacing [in]	Ld [in]
1	6-#5	48.00	34.07

Combined axial flexure

Segment	Condition	P [Kip]	M [Kip*ft]	Ma [Kip*ft]	Ratio
1	D3(Max)	8.64	13.63	17.60	0.77

Interaction diagrams, P vs. M



Axial compression

Segment	Condition	P [Kip]	Pa [Kip]	Ratio
1	D1(Bottom)	14.39	452.91	0.03

Axial tension

Segment	Condition	ft [Kip/in2]	Fs [Kip/in2]	Ratio
1	D1(Top)	0.00	32.00	0.00

Shear

Segment	Condition	fv [Kip/in2]	Fv [Kip/in2]	Ratio
1	D3(Bottom)	0.003	0.053	0.06

Shear Wall Design

Status : OK

Geometry

Level	Segment	X Coordinate [ft]	Y Coordinate [ft]	Width [ft]	Height [ft]
0	1	0.00	0.00	20.67	8.67

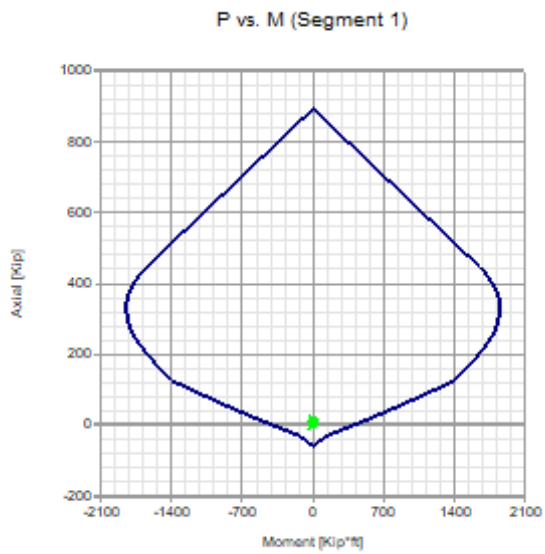
Reinforcement

	Vertical reinforcement			Horizontal reinforcement		
Segment	Bars	Spacing [in]	Ld [in]	Bars	Spacing [in]	Ld [in]
1	6-#5	48.00	34.07	--	0.00	0.00

Combined axial flexure

Segment	Condition	P [Kip]	M [Kip*ft]	Ma [Kip*ft]	Ratio
1	D2(Bottom)	14.39	0.00	527.80	0.00

Interaction diagrams, P vs. M



Axial compression

Segment	Condition	P [Kip]	Pa [Kip]	Ratio
1	D1(Bottom)	14.39	458.65	0.03

Axial tension

Segment	Condition	ft [Kip/in2]	Fs [Kip/in2]	Ratio
1	D1(Top)	0.00	32.00	0.00

Shear

Segment	Condition	fv [Kip/in2]	Fv [Kip/in2]	Ratio
1	D1(Max)	0.000	0.068	0.00

Notes

* P = Axial load
* Pa = Allowable compressive force due to axial load.
* M = Moment at the section under consideration.
* Ma = Wall allowable moment due to axial force or lintel pure flexure allowable moment
* fa = Calculated compressive stress due to axial load only
* fb = Calculated compressive stress due to axial flexure only
* ft = Calculated axial tension
* Fa = Allowable compressive stress due to axial load only
* Fb = Allowable compressive stress due to axial flexure only
* fv = Calculated shear stress
* Fs = Allowable tensile or compressive stress
* Fv = Allowable shear stress
* ld = Embedment length

* As = Effective cross sectional area of reinforcement
* δ_s = Calculated deflection
* δ_{max} = Maximum allowable deflection