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Creech DRP Phase 1

Aircraft Operations Facility (AOF)

Structural Calculations

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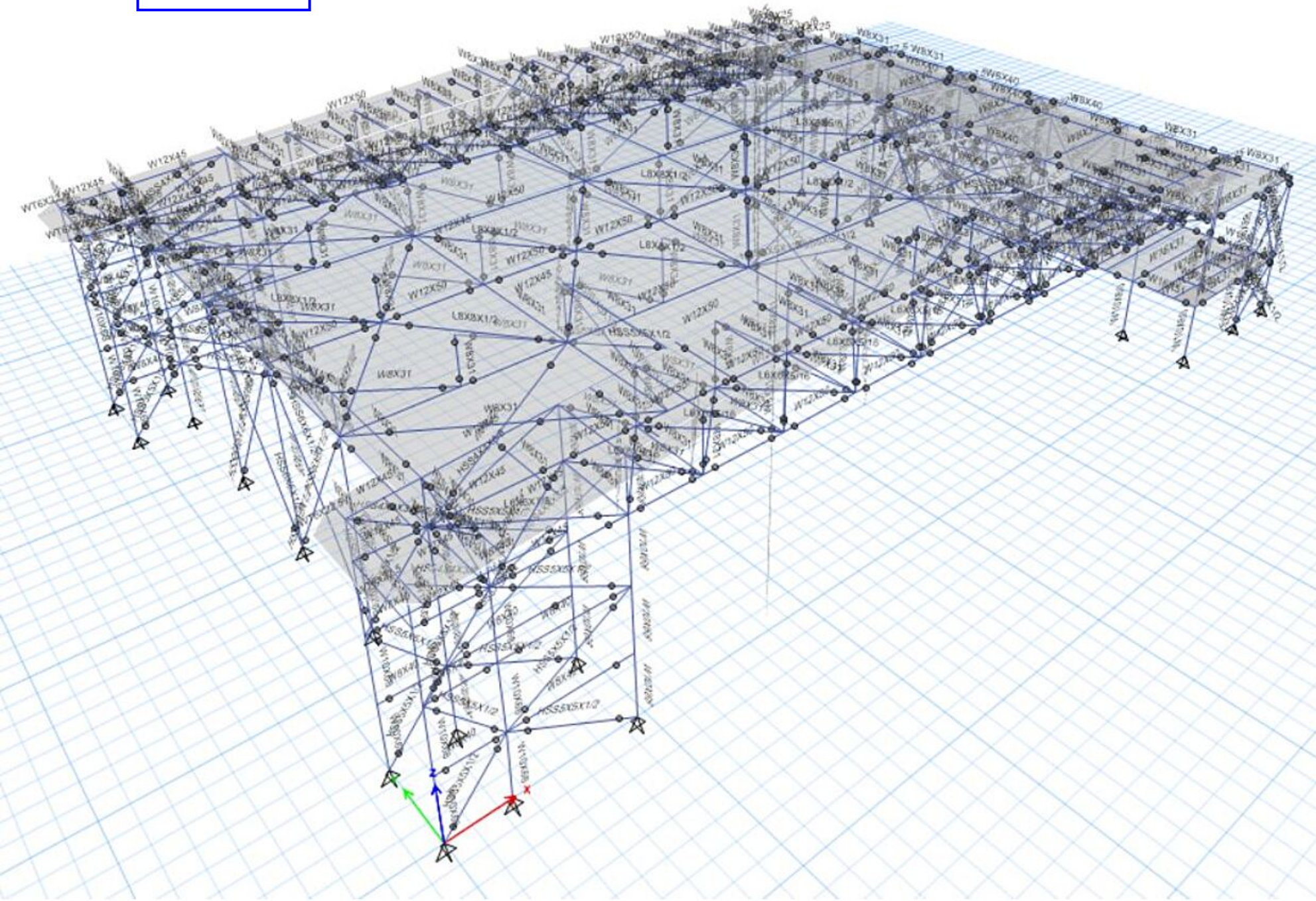
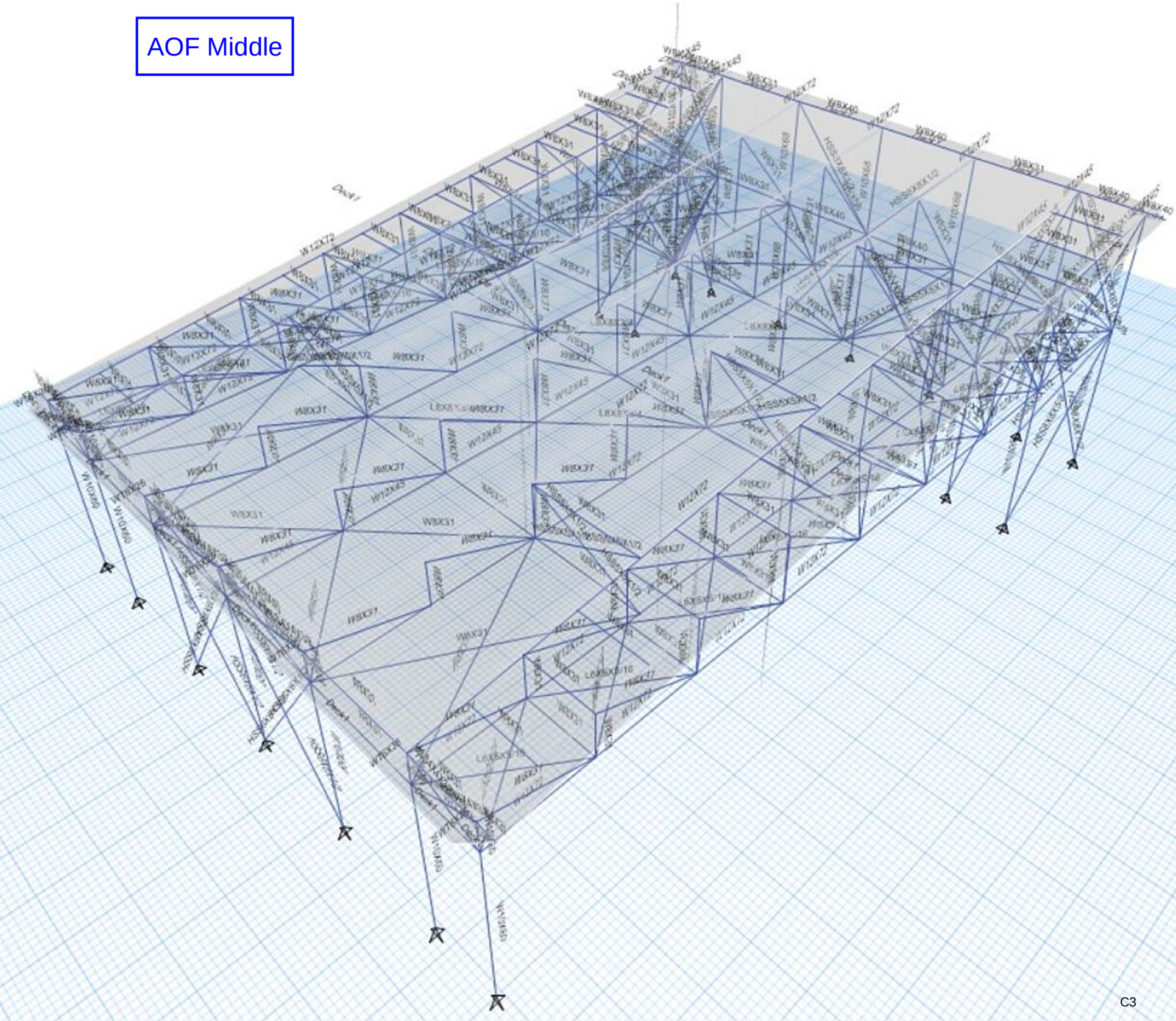
Criteria and Model Information

AOF End



AOF Middle



Steel Frame Design Data

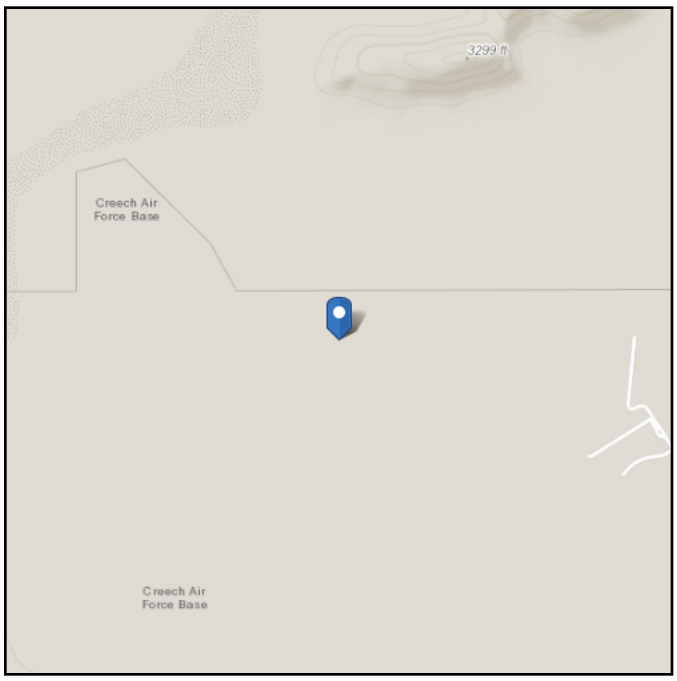
Steel Frame Design Preferences - AISC 360-16

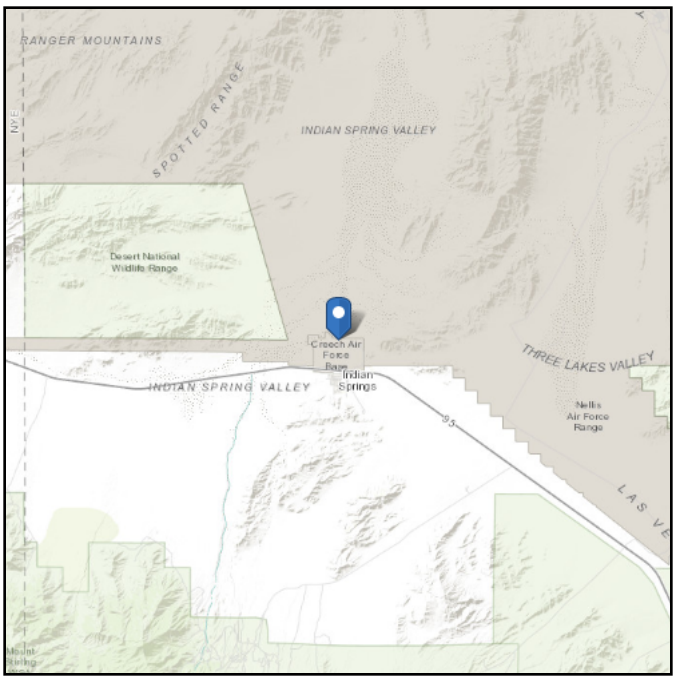
Item	Value
Multi-Response Design	Step-by-Step - All
Frame Type	SCBF
Seismic Design Category	D
Importance Factor	1.25
Design System Rho	1
Design System Sds	0.59
Design System R	6
Design System Omega0	2
Design System Cd	5
Design Provision	LRFD
Analysis Method	Direct Analysis
Second Order Method	General 2nd Order
Stiffness Reduction Method	Tau-b Fixed
Add Notional Load Case	Yes
Beta Factor	1.3
Beta Omega Factor	1.6
Phi (Bending)	0.9
Phi (Compression)	0.9
Phi (Tension-Yielding)	0.9
Phi (Tension-Fracture)	0.75
Phi (Shear)	0.9
Phi (Shear-Short Webbed Rolled I)	1
Phi (Torsion)	0.9
Ignore Seismic Code?	No
Ignore Special Seismic Load?	No
Doubler Plate Plug-Welded?	Yes
HSS Welding Type	ERW
Reduced HSS Thickness	No
Consider Deflection?	Yes
DL Ratio	120
SDL+LL Ratio	120
LL Ratio	360
Total Ratio	240
Total Camber Limit	240
Pattern Live Load Factor	0.75
D/C Ratio Limit	0.75
Maximum Iterations	1

ASCE Hazards Report

Address:
No Address at This Location

Standard:	ASCE/SEI 7-16	**Latitude:**	36.595097
Risk Category:	III	**Longitude:**	-115.671855
Soil Class:	D - Default (see Section 11.4.3)	**Elevation:**	3099.2047357952833 ft (NAVD 88)





Wind

Results:

Wind Speed	105 Vmph
10-year MRI	69 Vmph
25-year MRI	75 Vmph
50-year MRI	80 Vmph
100-year MRI	84 Vmph

Data Source: ASCE/SEI 7-16, Fig. 26.5-1C and Figs. CC.2-1–CC.2-4, and Section 26.5.2

Date Accessed: Fri Apr 26 2024

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

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

Seismic

Site Soil Class: D - Default (see Section 11.4.3)

Results:

S_S :	0.724	S_{D1} :	N/A
S_1 :	0.226	T_L :	6
F_a :	1.221	PGA :	0.318
F_v :	N/A	PGA_M :	0.408
S_{MS} :	0.884	F_{PGA} :	1.282
S_{M1} :	N/A	I_e :	1.25
S_{DS} :	0.589	C_v :	1.162

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Fri Apr 26 2024

Date Source: USGS Seismic Design Maps

Snow

Results:

Ground Snow Load, p_g:	5 lb/ft^2
Mapped Elevation:	3099.2 ft
Data Source:	ASCE/SEI 7-16, Table 7.2-8
Date Accessed:	Fri Apr 26 2024

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.

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PROJECT DESIGN CRITERIA

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AOF End

GENERAL DESIGN CRITERIA

Building Code:	IBC 2021	
Risk Category:	III	
Terrain Category:	Exposure C (All Others)	
Elevation:	4780 ft	

BUILDING GEOMETRY INFORMATION

Bldg/Diaphragm Levels:	2	
Building Length (L):	156.0 ft	
Least Width (B):	101.0 ft	
Overall Roof Height:	37.0 ft	
Mean Roof Height:	35.0 ft	
Parapet Height:	0.0 ft	
Roof Slope:	1.00 / 12	4.76°
Roof Type:	Monoslope	
Roof Material:	Not Slippery/Obstructed	
Roof Exposure:	Fully exposed	
Thermal Exposure:	All structures except as indicated below	

LATERAL LOADING CRITERIA

Seismic

Soil Site Class:	D (Default)	
Spectral Response (S_S):	0.724	
Spectral Response (S_1):	0.226	
Long Period (T_L):	6 sec	
Ground Motion Hazard Analysis Performed:	No	*ASCE 7-16 11.4.8*

Wind

Basic Wind Speed (V):	105 mph

Geotech

PROJECT DESIGN CRITERIA

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AOF Middle

GENERAL DESIGN CRITERIA

Building Code:	IBC 2021
Risk Category:	III
Terrain Category:	Exposure C (All Others)
Elevation:	4780 ft

BUILDING GEOMETRY INFORMATION

Bldg/Diaphragm Levels:	1	
Building Length (L):	137.0 ft	
Least Width (B):	101.0 ft	
Overall Roof Height:	48.0 ft	
Mean Roof Height:	42.0 ft	
Parapet Height:	0.0 ft	
Roof Slope:	1.00 / 12	4.76°
Roof Type:	Gable	
Roof Material:	Not Slippery/Obstructed	
Roof Exposure:	Fully exposed	
Thermal Exposure:	All structures except as indicated below	

LATERAL LOADING CRITERIA

Seismic

Soil Site Class:	D (Default)	
Spectral Response (S_S):	0.724	
Spectral Response (S_1):	0.226	
Long Period (T_L):	6 sec	
Ground Motion Hazard Analysis Performed:	No	*ASCE 7-16 11.4.8*

Wind

Basic Wind Speed (V):	105 mph

Geotech

PROJECT LOADING CRITERIA

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AOF

ROOF LOADING (high roof)

Dead Loads	Description	Mult.	Max	Min	Live Loads	
Roofing:	None	x1	0 psf	0 psf	Roof Live Load:	20 psf
Roof Insulation:	Rigid insulation, per 1"	x5	8 psf	4 psf	Flat Roof Snow Load:	6 psf
Roof Deck Collateral:	Stadning seam	x1	3 psf	3 psf	Sloped Roof Snow Load:	6 psf
Decking:	1.5" Metal Roof deck	x1	3 psf	2 psf		
Framing:	Steel roof joists & girders	x1	3 psf	2 psf		
Ceiling:	1/2" gypsum board	x1	3 psf	2 psf		
MEP:		x1	4 psf	0 psf	Roof Decking Dead Load:	14 psf
Sprinklers:		x1	2 psf	0 psf		
Misc:	trusses	x1	4 psf	0 psf		
		TOTAL LOAD:	**30 psf**	**13 psf**	**Total Roof Seismic Mass:**	**30 psf**
		TOTAL MODEL LOAD (superimposed):	27 psf	11 psf		

PROJECT LOADING CRITERIA

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AOF End

ROOF LOADING (low roof)

Dead Loads	Description	Mult.	Max	Min	Live Loads	
Roofing:	EPDM Membrane	x1	1 psf	1 psf	Roof Live Load:	20 psf
Roof Insulation:	Rigid insulation, per 1"	x5	8 psf	4 psf	Flat Roof Snow Load:	6 psf
Roof Deck Collateral:		x1	0 psf	0 psf	Sloped Roof Snow Load:	6 psf
Decking:	1.5" Metal Roof deck	x1	3 psf	2 psf		
Framing:	Steel roof joists & girders	x1	3 psf	2 psf		
Ceiling:	5/8" gypsum	x1	3 psf	3 psf		
MEP:		x1	4 psf	0 psf	Roof Decking Dead Load:	12 psf
Sprinklers:		x1	2 psf	0 psf		
Misc:	trusses	x1	1 psf	0 psf		
		TOTAL LOAD:	**25 psf**	**12 psf**	**Total Roof Seismic Mass:**	**25 psf**
		TOTAL MODEL LOAD (superimposed):	22 psf	10 psf		

FLOOR LOADING (mezzanine)						
Dead Loads	Description	Mult.	Max	Min	**Live Loads**	
Floor Finishes:	Carpet & pad	x1	1 psf	1 psf	Floor Live Load:	150 psf
Topping:	None	x1	0 psf	0 psf	Floor Partition Load:	15 psf
Deflected Concrete:		x1	8 psf	0 psf	Storage Load?	No
Floor Deck Collateral:		x1	0 psf	0 psf	Cooridor Load:	100 psf
Decking:	NW Conc 5.5" W2+3.5	x1	55 psf	55 psf	Construction Live Load:	20 psf
Framing:	Steel floor bms/joists & girders	x1	8 psf	5 psf		
Ceiling:	5/8" gypsum	x1	3 psf	3 psf	Pre-Composite Dead:	71 psf
MEP:		x1	5 psf	0 psf	Pre-Composite Live:	20 psf
Sprinklers:		x1	5 psf	0 psf	Superimposed Dead:	19 psf
Misc:		x1	5 psf	0 psf	Superimposed Live:	165 psf
		TOTAL LOAD:	**90 psf**	**64 psf**	**Total Floor Seismic Mass:**	**105 psf**
		TOTAL MODEL LOAD (superimposed):	27 psf	4 psf		

WALL LOADING						
Dead Loads	Description	Mult.	Max	Min		
Wall Type 1					Total Wall 1 Weight:	126 psf
Exterior Finish:	4" Clay Brick	x1	40 psf	38 psf	Height (Trib to Diaph.):	6.0 ft
Insulation:	Rigid insulation, per 1"	x1	2 psf	1 psf	Total Wall 1 Mass:	756 plf
Structure:	8" CMU @ Full Grout	x1	81 psf	60 psf		
Interior Finish:	5/8" gypsum	x1	3 psf	3 psf		
Misc:		x1	0 psf	0 psf		

CMU Walls	**Type 1**	**Type 2**
Size	8" CMU	12" CMU
Unit Density	Medium Weight (125 pcf)	Medium Weight (125 pc
Grout Spacing	Full Grout	24"
CMU Wall Weight	**81 psf**	**75 psf**

SEISMIC LOADING

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AOF End

SEISMIC DESIGN CRITERIA - ASCE 7-16 Ch.11

Section 11.4 - Seismic Ground Motions

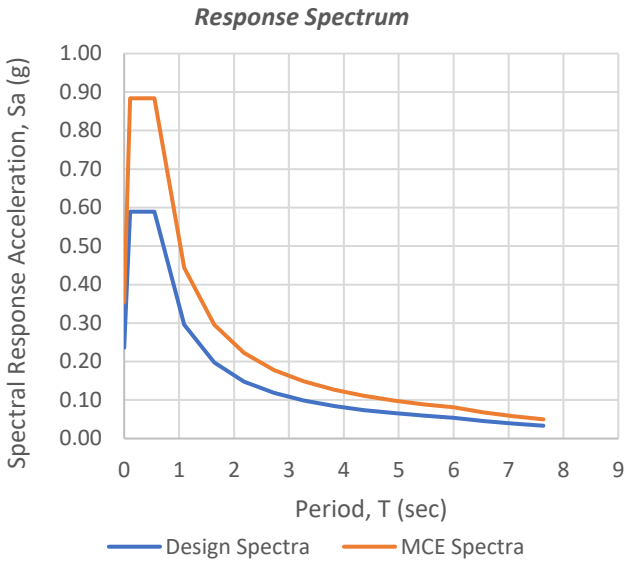
Short Period Map Acceleration, S_S: 0.72 g
1-Sec Period Map Acceleration, S_1: 0.23 g
Long Period, T_L: 6 sec
Site Class: D (Default)
Soil Modification, F_a: 1.22
Soil Modification, F_v: 2.15
Design Spectral Accelerations
S_{DS}: 0.59 g
S_{D1}: 0.32 g
Use Exception (11.4.8): Exception 2

Section 11.5 - Importance Factor

Risk Category: III
Importance, I_e: 1.25

Section 11.6 - Seismic Design Category

Design Category: D



SEISMIC DESIGN REQUIREMENTS - ASCE 7-16 Ch.12

Section 12.2 - Structural System

SFRS: B-Building Frame Systems
Steel Special Concentric Braced Frame (SCBF)

R	Ω_0	C_D
6	2	5

Section 12.3 - Redundancy Factor

Building Design: Table 12.3-3

Redundancy, ρ: 1.0

Section 12.8 - Equivalent Lateral Force

Fundamental Period, T: 0.288
Seismic Coefficient, C_S: 0.123
Base Shear, Q_E: 79.4 k
Base Shear, ρQ_e: 79.4 k
Amplified Base Shear, $\Omega_0 Q_e$: 158.7 k

Section 12.8.3 - Vertical Distribution of Seismic Forces

Number of Diaphragm Levels: 2
Period Factor-k: 1.00

Diaphragm	Story Height	Height Above Base	Diaphragm Area	Diaphragm Weight	Perimeter Wall Length	Perimeter Wall Weight	Seismic Weight	Force @ Floor Level	Story Shear	Diaphragm Force
ROOF	11.0 ft	35.0 ft	12300 ft2	30 psf	381 ft	525 plf	569 k	72.6 k	72.6 k	83.8 k
LEVEL 1	24.0 ft	24.0 ft	2433 ft2	25 psf	56 ft	298 plf	78 k	6.8 k	79.4 k	11.4 k
BASE		0.0 ft					0 k	0.0 k	79.4 k	0.0 k
TOTALS:		35.0 ft	14733 ft2				646 k	79.4 k		95.2 k

Wind base shear = 175 k > Seismic base shear = 79 k ,so wind load governs.

SEISMIC LOADING

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AOF Middle

SEISMIC DESIGN CRITERIA - ASCE 7-16 Ch.11

Section 11.4 - Seismic Ground Motions

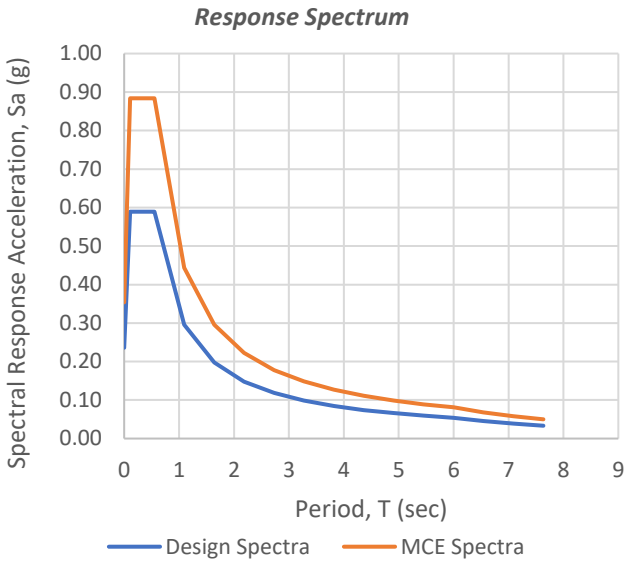
Short Period Map Acceleration, S_S: 0.72 g
1-Sec Period Map Acceleration, S_1: 0.23 g
Long Period, T_L: 6 sec
Site Class: D (Default)
Soil Modification, F_a: 1.22
Soil Modification, F_v: 2.15
Design Spectral Accelerations
S_{DS}: 0.59 g
S_{D1}: 0.32 g
Use Exception (11.4.8): Exception 2

Section 11.5 - Importance Factor

Risk Category: III
Importance, I_e: 1.25

Section 11.6 - Seismic Design Category

Design Category: D



SEISMIC DESIGN REQUIREMENTS - ASCE 7-16 Ch.12

Section 12.2 - Structural System

SFRS: B-Building Frame Systems
Steel Special Concentric Braced Frame (SCBF)

R	Ω_0	C_D
6	2	5

Section 12.3 - Redundancy Factor

Building Design: Table 12.3-3

Redundancy, ρ: 1.0

Section 12.8 - Equivalent Lateral Force

Fundamental Period, T: 0.330
Seismic Coefficient, C_S: 0.123
Base Shear, Q_E: 76.9 k
Base Shear, ρQ_e: 76.9 k
Amplified Base Shear, $\Omega_0 Q_e$: 153.8 k

Section 12.8.3 - Vertical Distribution of Seismic Forces

Number of Diaphragm Levels: 1
Period Factor-k: 1.00

Diaphragm	Story Height	Height Above Base	Diaphragm Area	Diaphragm Weight	Perimeter Wall Length	Perimeter Wall Weight	Seismic Weight	Force @ Floor Level	Story Shear	Diaphragm Force
ROOF	42.0 ft	42.0 ft	14321 ft2	30 psf	375 ft	525 plf	626 k	76.9 k	76.9 k	92.3 k
BASE	0.0 ft	0.0 ft	0 ft2	0 psf	0 ft	0 plf	0 k	0.0 k	76.9 k	0.0 k
TOTALS:		42.0 ft	14321 ft2				626 k	76.9 k		92.3 k

Wind base shear = 184 k > Seismic base shear = 77 k ,so wind load governs.

WIND LOADING - DIRECTIONAL PROCEDURE

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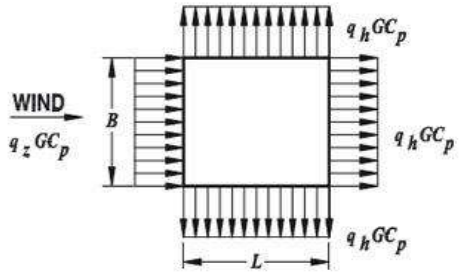
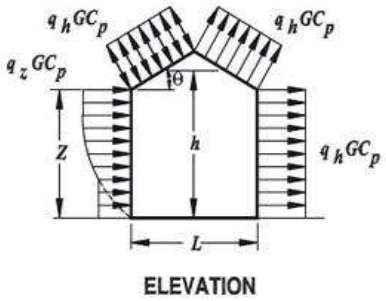
AOF End N/S Direction

WIND CRITERIA - ASCE 7-16 Ch.26

Basic Wind Speed, V:	105 mph	*26.5*	Direction Factor, K_d:	0.85	*26.6*
Risk Category:	III		K_1:	1.00	
Exposure Category:	Exposure C (All Others)	*26.7*	K_2:	1.00	
Enclosure Classification:	Partially Enclosed	*26.12*	K_3:	1.00	
Elevation:	4780 ft		Topographic Factor, K_{zt}:	1.00	*26.8*
Mean Roof Height, h:	35 ft		Elevation Factor, K_e:	0.84	*26.9*
Wall Height, z:	35 ft		Velocity Factor, K_h:	1.01	*26.10*
Topography:	Flat		Velocity Factor, K_z:	1.01	*26.10*
Hill Height (H):			Gust Effect Fator, G:	0.85	*26.11*
Half Hill Length (Lh):			Internal Coeff, Gcpi:	± 0.55	*26.13*
From Top of Crest (x):			**Velocity Pressure, q_h:**	**20.5 psf**	
Bldg Up/Down Wind:			**Velocity Pressure, q_z:**	**20.5 psf**	

MWFRS - DIRECTIONAL PROCEDURE - ASCE 7-16 Ch.27 (All Heights)



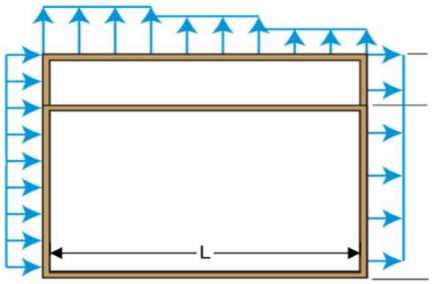


Building ‖ to Wind, L:	101 ft	101 ft	override
Building ⊥ to Wind, B:	156 ft	156 ft	override
Roof Angle, θ:	4.76°		
Wind Direction:	Parallel to Ridge		

Wind parallel to ridge

Walls	qz or qh	Cp	p (psf)
Windward Wall	20.5	0.80	16.0
Leeward Wall	20.5	-0.50	-16.0
Side Wall	20.5	-0.70	-16.0

Roof Region	qz or qh	Cp	p (psf)
0 to 17.5	20.5	-0.90	-15.7
17.5 to 35	20.5	-0.90	-15.7
35 to 70	20.5	-0.50	-8.7
70 to 70	20.5	-0.30	-8.0



Base Shear: 174.72 k

Force in Diaphragm: 87.36 k half assumed

WIND LOADING - DIRECTIONAL PROCEDURE

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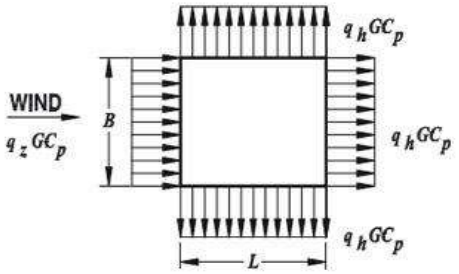
AOF End E/W Direction

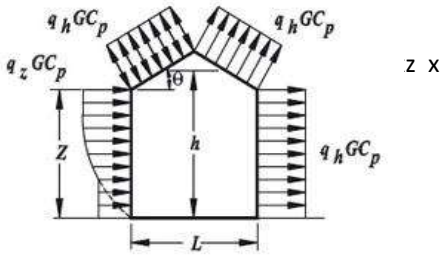
WIND CRITERIA - ASCE 7-16 Ch.26

Basic Wind Speed, V:	105 mph	*26.5*	Direction Factor, K_d:	0.85	*26.6*
Risk Category:	III		K_1:	1.00	
Exposure Category:	Exposure C (All Others)	*26.7*	K_2:	1.00	
Enclosure Classification:	Partially Enclosed	*26.12*	K_3:	1.00	
Elevation:	4780 ft		Topographic Factor, K_{zt}:	1.00	*26.8*
Mean Roof Height, h:	35 ft		Elevation Factor, K_e:	0.84	*26.9*
Wall Height, z:	35 ft		Velocity Factor, K_h:	1.01	*26.10*
Topography:	Flat		Velocity Factor, K_z:	1.01	*26.10*
Hill Height (H):			Gust Effect Fator, G:	0.85	*26.11*
Half Hill Length (Lh):			Internal Coeff, Gcpi:	± 0.55	*26.13*
From Top of Crest (x):			**Velocity Pressure, q_h:**	**20.5 psf**	
Bldg Up/Down Wind:			**Velocity Pressure, q_z:**	**20.5 psf**	

MWFRS - DIRECTIONAL PROCEDURE - ASCE 7-16 Ch.27 (All Heights)

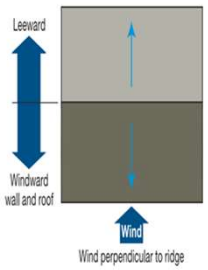


PLAN



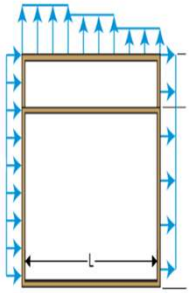
ELEVATION

Building ∥ to Wind, L:	156 ft	156 ft	override
Building ⊥ to Wind, B:	101 ft	101 ft	override
Roof Angle, θ:	4.76°		
Wind Direction:	Normal to Ridge		



Walls	qz or qh	Cp	p (psf)
Windward Wall	20.5	0.80	16.0
Leeward Wall	20.5	-0.39	-16.0
Side Wall	20.5	-0.70	-16.0

Roof Region	qz or qh	Cp	p (psf)
0 to 17.5	20.5	-0.90	-15.7
17.5 to 35	20.5	-0.90	-15.7
35 to 70	20.5	-0.50	-8.7
70 to 70	20.5	-0.30	-8.0



Base Shear: 113.12 k

Force in Diaphragm: 56.56 k half assumed

WIND LOADING - DIRECTIONAL PROCEDURE

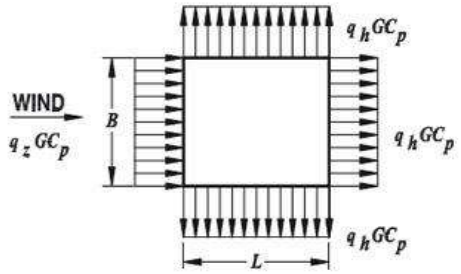
Michael Baker INTERNATIONAL

AOF Middle N/S Direction

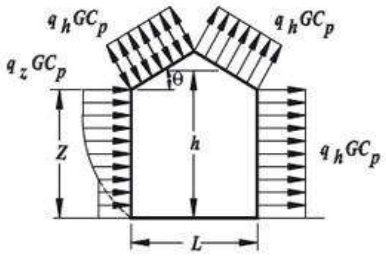
WIND CRITERIA - ASCE 7-16 Ch.26

Basic Wind Speed, V:	105 mph	*26.5*	Direction Factor, K_d:	0.85	*26.6*
Risk Category:	III		K_1:	1.00	
Exposure Category:	Exposure C (All Others)	*26.7*	K_2:	1.00	
Enclosure Classification:	Partially Enclosed	*26.12*	K_3:	1.00	
Elevation:	4780 ft		Topographic Factor, K_{zt}:	1.00	*26.8*
Mean Roof Height, h:	35 ft		Elevation Factor, K_e:	0.84	*26.9*
Wall Height, z:	42 ft		Velocity Factor, K_h:	1.01	*26.10*
Topography:	Flat		Velocity Factor, K_z:	1.05	*26.10*
Hill Height (H):			Gust Effect Fator, G:	0.85	*26.11*
Half Hill Length (Lh):			Internal Coeff, Gcpi:	± 0.55	*26.13*
From Top of Crest (x):			**Velocity Pressure, q_h:**	**20.5 psf**	
Bldg Up/Down Wind:			**Velocity Pressure, q_z:**	**21.3 psf**	

MWFRS - DIRECTIONAL PROCEDURE - ASCE 7-16 Ch.27 (All Heights)

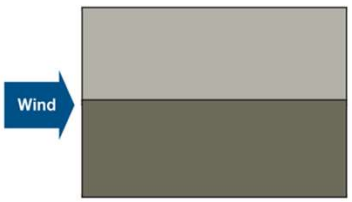


PLAN



ELEVATION

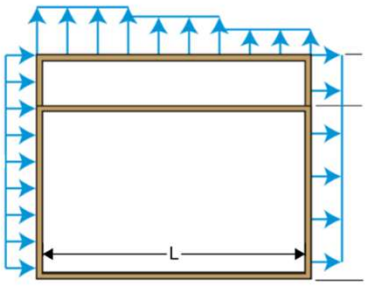
Building ∥ to Wind, L:	101 ft	101 ft	override
Building ⊥ to Wind, B:	137 ft	137 ft	override
Roof Angle, θ:	4.76°		
Wind Direction:	Parallel to Ridge		



Wind parallel to ridge

Walls	qz or qh	Cp	p (psf)
Windward Wall	21.3	0.80	16.0
Leeward Wall	20.5	-0.50	-16.0
Side Wall	20.5	-0.70	-16.0

Roof Region	qz or qh	Cp	p (psf)
0 to 17.5	20.5	-0.90	-15.7
17.5 to 35	20.5	-0.90	-15.7
35 to 70	20.5	-0.50	-8.7
70 to 70	20.5	-0.30	-8.0



Base Shear: 184.13 k

Force in Diaphragm: 92.06 k half assumed

WIND LOADING - DIRECTIONAL PROCEDURE

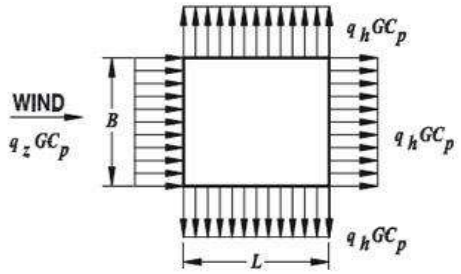
Michael Baker INTERNATIONAL

AOF Middle E/W Direction

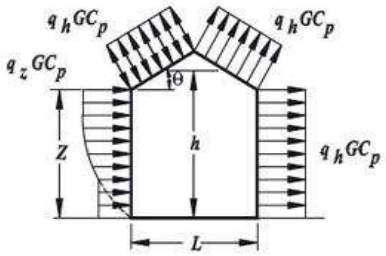
WIND CRITERIA - ASCE 7-16 Ch.26

Basic Wind Speed, V:	105 mph	*26.5*	Direction Factor, K_d:	0.85	*26.6*
Risk Category:	III		K_1:	1.00	
Exposure Category:	Exposure C (All Others)	*26.7*	K_2:	1.00	
Enclosure Classification:	Partially Enclosed	*26.12*	K_3:	1.00	
Elevation:	4780 ft		Topographic Factor, K_{zt}:	1.00	*26.8*
Mean Roof Height, h:	35 ft		Elevation Factor, K_e:	0.84	*26.9*
Wall Height, z:	42 ft		Velocity Factor, K_h:	1.01	*26.10*
Topography:	Flat		Velocity Factor, K_z:	1.05	*26.10*
Hill Height (H):			Gust Effect Fator, G:	0.85	*26.11*
Half Hill Length (Lh):			Internal Coeff, Gcpi:	± 0.55	*26.13*
From Top of Crest (x):			**Velocity Pressure, q_h:**	**20.5 psf**	
Bldg Up/Down Wind:			**Velocity Pressure, q_z:**	**21.3 psf**	

MWFRS - DIRECTIONAL PROCEDURE - ASCE 7-16 Ch.27 (All Heights)

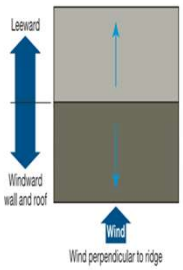


PLAN



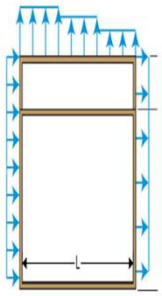
ELEVATION

Building ‖ to Wind, L:	137 ft	137 ft	override
Building ⊥ to Wind, B:	101 ft	101 ft	override
Roof Angle, θ:	4.76°		
Wind Direction:	Normal to Ridge		



Walls	qz or qh	Cp	p (psf)
Windward Wall	21.3	0.80	16.0
Leeward Wall	20.5	-0.43	-16.0
Side Wall	20.5	-0.70	-16.0

Roof Region	qz or qh	Cp	p (psf)
0 to 17.5	20.5	-0.90	-15.7
17.5 to 35	20.5	-0.90	-15.7
35 to 70	20.5	-0.50	-8.7
70 to 70	20.5	-0.30	-8.0



Base Shear: 135.74 k

Force in Diaphragm: 67.87 k half assumed

Wind Pressure for Components and Cladding

p_{min} = 16 psf

if trib area is greater than 700 sf, design pressure is permitted to be per the MWFRS methods

LOW RISE < = 60 ft OR h < smallest horizontal dim

$p = q_h[(GC_p) - (GC_{pi})]$

b = 156 ft
l = 101 ft
h = 37 ft

Direction 1
h/B = 0.24
LOW-RISE

qh = 20.5 psf
Gcpi = -0.18

roof angle 4.76°
Gable

a = 10.1 ft

Walls	Zone 4	Zone 5
Effective wind area	15	15
GC_p =	0.997	0.997
	-1.09694	-1.39388
p =	24.1 psf	24.1 psf
	-18.8 psf	-24.9 psf

Flat Roof

	Roof					
	Zone 1'	Zone 1	Zone 2	Zone 3		
Effective wind area	40	40	15	15	15	15
GC_p =	0.267	0.267	0.294	0.294		
	-0.900	-1.700	-2.300	-3.200		
p =	**16.0 psf**	**16.0 psf**	**16.0 psf**	**16.0 psf**		
	-16.0 psf	**-31.1 psf**	**-43.4 psf**	**-61.8 psf**		

	Overhang					
	Zone 1'	Zone 1	Zone 2	Zone 3		
	40	40	15	15	15	15
GC_p =	-1.657	-1.657	-2.288	-3.179		
p =	**-30.2 psf**	**-30.2 psf**	**-43.2 psf**	**-61.4 psf**		

Flat Roof ROOF

Positive	Eff Area Low	10	10	10	10	0	0	0
	Eff Area High	100	100	100	100	0	0	0
	GCp high	0.3	0.3	0.3	0.3	0	0	0
	GCp low	0.2	0.2	0.2	0.2	0	0	0
Negative	Eff Area Low	100	100	100	100	0	0	10
	Eff Area High	1000	1000	1000	1000	0	0	500
	GCp high	-0.9	-1.7	-2.3	-3.2	0	0	-1.7
	GCp low	-0.4	-1	-1.4	-1.4	0	0	-1

Flat Roof

		Zone 1'	Zone 1	Zone 2	Zone 3			Zone 1'
Positive	Eff Area Low	10	10	10	10			
	Eff Area High	100	100	100	100			
	GCp high	0.3	0.3	0.3	0.3			
	GCp low	0.2	0.2	0.2	0.2			
Negative	Eff Area Low	100	100	100	100			10
	Eff Area High	1000	1000	1000	1000			500
	GCp high	-0.9	-1.7	-2.3	-3.2			-1.7
	GCp low	-0.4	-1	-1.4	-1.4			-1

Gable Roof 7 - 20

		Zone 1	Zone 2e	Zone 2n	Zone 2r	Zone 3e	Zone 3r	Zone 1
Positive	Eff Area Low	2	2	2	2	2	2	
	Eff Area High	100	100	100	100	100	100	
	GCp high	0.7	0.7	0.7	0.7	0.7	0.7	
	GCp low	0.3	0.3	0.3	0.3	0.3	0.3	
Negative	Eff Area Low	20	20	10	10	10	10	20
	Eff Area High	100	100	250	250	250	100	100
	GCp high	-2	-2	-3	-3	-3	-3.6	-2.5
	GCp low	-0.5	-0.5	-1	-1	-1	-1.8	-1.5

Gable Roof 20 - 27

		Zone 1	Zone 2e	Zone 2n	Zone 2r	Zone 3e	Zone 3r	Zone 1
Positive	Eff Area Low	2	2	2	2	2	2	
	Eff Area High	100	100	100	100	100	100	
	GCp high	0.7	0.7	0.7	0.7	0.7	0.7	
	GCp low	0.3	0.3	0.3	0.3	0.3	0.3	
Negative	Eff Area Low	20	20	10	10	10	4	20
	Eff Area High	300	300	150	150	150	50	350
	GCp high	-1.5	-1.5	-2.5	-2.5	-2.5	-3.6	-2

N	GCp low	-0.8	-0.8	-1.2	-1.2	-1.2	-1.8	-1.8

Gable Roof 27 - 45

		Zone 1	Zone 2e	Zone 2n	Zone 2r	Zone 3e	Zone 3r	Zone 1
Positive	Eff Area Low	10	10	10	10	10	10	
	Eff Area High	100	100	100	100	100	100	
	GCp high	0.9	0.9	0.9	0.9	0.9	0.9	
	GCp low	0.5	0.5	0.5	0.5	0.5	0.5	
Negative	Eff Area Low	10	10	10	10	10	2	10
	Eff Area High	100	100	200	100	200	300	100
	GCp high	-1.8	-1.8	-2	-1.8	-2	-3.2	-2.6
	GCp low	-0.8	-0.8	-1	-0.8	-1	-1	-1.6

Hip Roof 7 - 20 h/B = 0.5

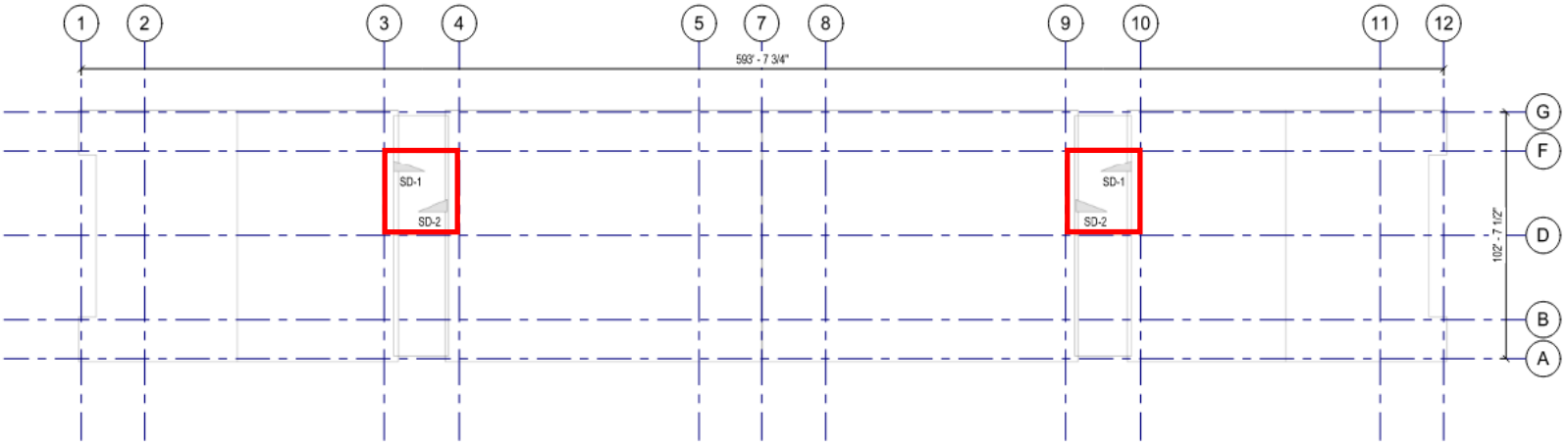
		Zone 1	Zone 2e	Zone 2r	Zone 3	Zone 1
Positive	Eff Area Low	10	10	10	10	
	Eff Area High	100	100	100	100	
	GCp high	0.7	0.7	0.7	0.7	
	GCp low	0.3	0.3	0.3	0.3	
Negative	Eff Area Low	20	10	10	10	10
	Eff Area High	100	200	200	200	100
	GCp high	-1.3	-1.8	-2.4	-1.8	-1.8
	GCp low	-1	-1.1	-1.3	-1.1	-2

Hip Roof 20 - 27 0

		Zone 1	Zone 2e	Zone 2r	Zone 3	Zone 1
Positive	Eff Area Low	10	10	10	10	
	Eff Area High	100	100	100	100	
	GCp high	0.7	0.7	0.7	0.7	
	GCp low	0.3	0.3	0.3	0.3	
Negative	Eff Area Low	10	10	10	10	10
	Eff Area High	100	200	200	200	100
	GCp high	-1.4	-2	-2	-2	-1.9
	GCp low	-0.8	-1	-1	-1	-1.8

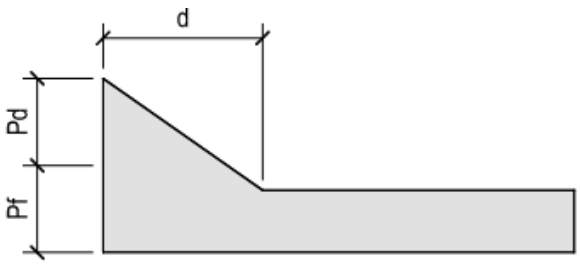
Hip Roof 27 - 45

		Zone 1	Zone 2e	Zone 2r	Zone 3	Zone 1
Positive	Eff Area Low	3	3	3	3	
	Eff Area High	100	100	100	100	
	GCp high	0.9	0.9	0.9	0.9	
	GCp low	0.3	0.3	0.3	0.3	
Negative	Eff Area Low	10	3	7	8.356908	10
	Eff Area High	200	256.1818	100	50	200
	GCp high	-0.713	-0.11916	0.609381	0.735527	-1.51277
	GCp low	-0.15931	-0.8	-1	-1	-0.95931



OVERALL ROOF SNOW DRIFT LOAD PLAN

NTS



Snow Drift Load key			
Mark	**Surcharge Load (P_d)**	**Drift Width (d)**	**Balanced Snow Load (P_f)**
SD-1	33	9	3.9
SD-2	44	12	3.9

Michael Baker International
2004 Jennie Lee Drive
Idaho Falls, Idaho
208-535-8240

JOB TITLE	Holtec IF-657		
	E1/E2 Bay Expansion		
JOB NO.	199643	**SHEET NO.**	
CALCULATED BY	JRH	**DATE**	5/9/25
CHECKED BY	JWB	**DATE**	5/9/25

Snow Loads - from adjacent building or roof:

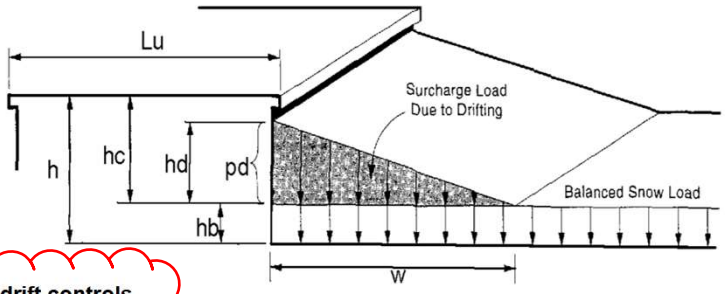
ASCE 7- 16 — Nominal Snow Forces

		Higher Roof	Lower Roof
Roof slope	=	4.8 deg	0.00 / 12 = 0.0 deg
Horiz. eave to ridge dist (W)	=	78.0 ft	25.5 ft
Roof length parallel to ridge (L)	=	101.0 ft	101.0 ft
Projection height (roof step) h	=		8.0 ft
Building separation s	=		0.0 ft
Type of Roof		Hip and gable w/ trussed systems	Monoslope
Ground Snow Load	Pg =	5.0 psf	5.0 psf
Risk Category	=	III	III
Importance Factor	I =	1.1	1.1
Thermal Factor	Ct =	1.00	1.00
Exposure Factor	Ce =	1.0	1.0
Pf = 0.7*Ce*Ct*I*Pg	=	3.9 psf	3.9 psf
Unobstructed Slippery Surface		no	no
Sloped-roof Factor	Cs =	1.00	1.00
Balanced Snow Load	**Ps =**	**3.9 psf**	**3.9 psf**
Rain on Snow Surcharge Angle		1.56 deg	0.51 deg
Code Maximum Rain Surcharge		5.0 psf	5.0 psf
Rain on Snow Surcharge	=	0.0 psf	5.0 psf
Ps plus rain surcharge	=	3.9 psf	8.9 psf
Minimum Snow Load	Pm =	5.5 psf	5.5 psf
Uniform Roof Design Snow Load	=	**5.5 psf**	**8.9 psf**
Building Official Minimum	=		

NOTE: Alternate spans of continuous beams and other areas shall be loaded with half the design roof snow load so as to produce the greatest possible effect - see code.

Leeward Snow Drifts - from adjacent higher roof

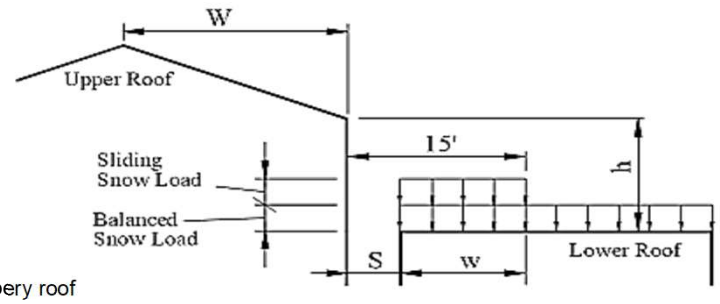
Upper roof length	lu =	78.0 ft
Snow density	γ =	14.7 pcf
Balanced snow height	hb =	0.26 ft
	hc =	7.74 ft
hc/hb >0.2 = 29.4	**Therefore, design for drift**	
Adj structure factor	=	1.00
Drift height (hd)	=	2.22 ft
Drift width	w =	8.88 ft
Surcharge load:	pd = γ*hd =	**32.5 psf**
Balanced Snow load:	=	3.9 psf
		36.4 psf **Leeward drift controls**



SD-1

Windward Snow Drifts - from low roof against high roof

Lower roof length	lu =	25.5 ft
Adj structure factor	=	1.00
Drift height	hd =	0.78 ft
Drift width	w =	3.12 ft
Surcharge load:	pd = γ*hd =	**11.4 psf**
Balanced Snow load:	=	3.9 psf
		15.3 psf



Sliding Snow - onto lower roof

Sliding snow = 0.4 Pf W =	0.0 plf
Distributed over 15 feet =	0.0 psf
hd + hb =	0.26 ft
hd + hb < =h therefore sliding snow =	**0.0 psf**
Balanced snow load =	3.9 psf
Uniform snow load =	3.9 psf

Not required since upper roof slope is 2 in 12 or less and non-slippery roof

Michael Baker International
2004 Jennie Lee Drive
Idaho Falls, Idaho
208-535-8240

JOB TITLE	Holtec IF-657		
	E1/E2 Bay Expansion		
JOB NO.	199643	**SHEET NO.**	
CALCULATED BY	JRH	**DATE**	5/12/25
CHECKED BY	JWB	**DATE**	5/12/25

Snow Loads - from adjacent building or roof:

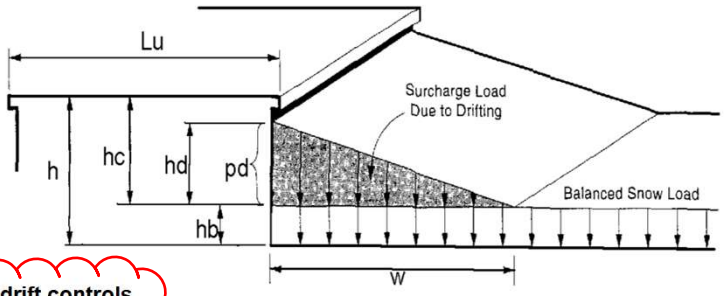
ASCE 7- 16 — Nominal Snow Forces

		Higher Roof	Lower Roof	
Roof slope	=	4.8 deg	0.00 / 12	= 0.0 deg
Horiz. eave to ridge dist (W)	=	137.0 ft	25.5 ft	
Roof length parallel to ridge (L)	=	101.0 ft	101.0 ft	
Projection height (roof step) h	=		8.0 ft	
Building separation s	=		0.0 ft	
Type of Roof		Monoslope	Monoslope	
Ground Snow Load	Pg =	5.0 psf	5.0 psf	
Risk Category	=	III	III	
Importance Factor	I =	1.1	1.1	
Thermal Factor	Ct =	1.00	1.00	
Exposure Factor	Ce =	1.0	1.0	
Pf = 0.7*Ce*Ct*I*Pg	=	3.9 psf	3.9 psf	
Unobstructed Slippery Surface		no	no	
Sloped-roof Factor	Cs =	1.00	1.00	
Balanced Snow Load	**Ps =**	**3.9 psf**	**3.9 psf**	
Rain on Snow Surcharge Angle		2.74 deg	0.51 deg	
Code Maximum Rain Surcharge		5.0 psf	5.0 psf	
Rain on Snow Surcharge	=	0.0 psf	5.0 psf	
Ps plus rain surcharge	=	3.9 psf	8.9 psf	
Minimum Snow Load	Pm =	5.5 psf	5.5 psf	
Uniform Roof Design Snow Load	=	**5.5 psf**	**8.9 psf**	
Building Official Minimum	=			

NOTE: Alternate spans of continuous beams and other areas shall be loaded with half the design roof snow load so as to produce the greatest possible effect - see code.

Leeward Snow Drifts - from adjacent higher roof

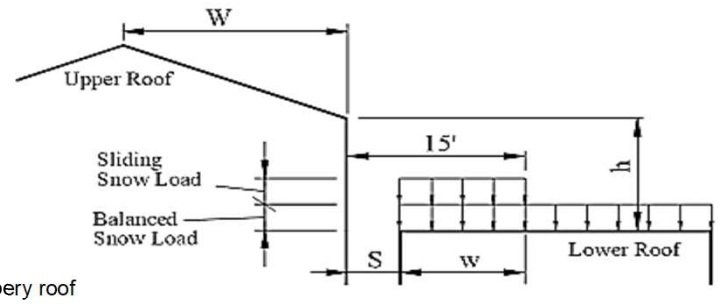
Upper roof length	lu =	137.0 ft
Snow density	γ =	14.7 pcf
Balanced snow height	hb =	0.26 ft
	hc =	7.74 ft
hc/hb >0.2 = 29.4	**Therefore, design for drift**	
Adj structure factor	=	1.00
Drift height (hd)	=	3.00 ft
Drift width	w =	12.01 ft
Surcharge load:	pd = γ*hd =	**44.0 psf**
Balanced Snow load:	=	3.9 psf
		47.8 psf **Leeward drift controls**



SD-2

Windward Snow Drifts - from low roof against high roof

Lower roof length	lu =	25.5 ft
Adj structure factor	=	1.00
Drift height	hd =	0.78 ft
Drift width	w =	3.12 ft
Surcharge load:	pd = γ*hd =	**11.4 psf**
Balanced Snow load:	=	3.9 psf
		15.3 psf



Sliding Snow - onto lower roof

Sliding snow = 0.4 Pf W =	0.0 plf
Distributed over 15 feet =	0.0 psf
hd + hb =	0.26 ft
hd + hb < =h therefore sliding snow =	**0.0 psf**
Balanced snow load =	3.9 psf
Uniform snow load =	3.9 psf

Not required since upper roof slope is 2 in 12 or less and non-slippery roof

Loads Patterns

Load Pattern Definitions

Name	Is Auto Load	Type	Self Weight Multiplier	Auto Load
~LLRF	Yes	Other	0	
Dead	No	Dead	1	
Exx	No	Seismic	0	ASCE 7-16
Exx(1/3)	Yes	Seismic	0	ASCE 7-16
Exx(2/3)	Yes	Seismic	0	ASCE 7-16
Exx(3/3)	Yes	Seismic	0	ASCE 7-16
Eyy	No	Seismic	0	ASCE 7-16
Eyy(1/3)	Yes	Seismic	0	ASCE 7-16
Eyy(2/3)	Yes	Seismic	0	ASCE 7-16
Eyy(3/3)	Yes	Seismic	0	ASCE 7-16
Live	No	Roof Live	0	
LiveM	No	Live	0	
Mass	No	Other	0	
Snow	No	Snow	0	
Snoww	No	Snow	0	
WindX	No	Wind	0	None
WindXX	No	Wind	0	None
WindY	No	Wind	0	None
WindYY	No	Wind	0	None

Load Combinations

Load Combination Definitions

Name	Type	Is Auto	Load Name	SF	Notes
DStlD1	Linear Add	Yes	Dead	1	Dead [Deflections]
DStlD2	Linear Add	Yes	Dead	1	Dead + Live [Deflections]
DStlD2			LiveM	1	
DStlS1	Linear Add	Yes	Dead	1.4	Dead [Strength]
DStlS2	Linear Add	Yes	Dead	1.2	Dead + Live [Strength]
DStlS2			LiveM	1.6	
DStlS2			Snow	0.5	
DStlS2			Snoww	0.5	
DStlS3	Linear Add	Yes	Dead	1.2	Dead + Live + Roof Live [Strength]
DStlS3			Live	0.5	
DStlS3			LiveM	1.6	
DStlS4	Linear Add	Yes	Dead	1.2	Dead + Live + Snow [Strength]
DStlS4			LiveM	1	
DStlS4			Snow	1.6	
DStlS4			Snoww	1.6	
DStlS5	Linear Add	Yes	Dead	1.2	Dead + Live + Roof Live [Strength]
DStlS5			Live	1.6	
DStlS5			LiveM	1	
DStlS6	Linear Add	Yes	Dead	1.2	Dead + Live + Wind + Snow [Strength]
DStlS6			LiveM	1	
DStlS6			Snow	0.5	
DStlS6			Snoww	0.5	
DStlS6			WindX	1	
DStlS7	Linear Add	Yes	Dead	1.2	Dead + Live - Wind + Snow [Strength]
DStlS7			LiveM	1	
DStlS7			Snow	0.5	
DStlS7			Snoww	0.5	
DStlS7			WindX	-1	
DStlS8	Linear Add	Yes	Dead	1.2	Dead + Live + Wind + Snow [Strength]
DStlS8			LiveM	1	
DStlS8			Snow	0.5	
DStlS8			Snoww	0.5	
DStlS8			WindY	1	
DStlS9	Linear Add	Yes	Dead	1.2	Dead + Live - Wind + Snow [Strength]
DStlS9			LiveM	1	
DStlS9			Snow	0.5	
DStlS9			Snoww	0.5	
DStlS9			WindY	-1	
DStlS10	Linear Add	Yes	Dead	1.2	Dead + Live + Wind + Snow [Strength]
DStlS10			LiveM	1	
DStlS10			Snow	0.5	
DStlS10			Snoww	0.5	
DStlS10			WindXX	1	
DStlS11	Linear Add	Yes	Dead	1.2	Dead + Live - Wind + Snow [Strength]
DStlS11			LiveM	1	
DStlS11			Snow	0.5	
DStlS11			Snoww	0.5	
DStlS11			WindXX	-1	
DStlS12	Linear Add	Yes	Dead	1.2	Dead + Live + Wind + Snow [Strength]
DStlS12			LiveM	1	
DStlS12			Snow	0.5	
DStlS12			Snoww	0.5	
DStlS12			WindYY	1	

Name	Type	Is Auto	Load Name	SF	Notes
DStlS13	Linear Add	Yes	Dead	1.2	Dead + Live - Wind + Snow [Strength]
DStlS13			LiveM	1	
DStlS13			Snow	0.5	
DStlS13			Snoww	0.5	
DStlS13			WindYY	-1	
DStlS14	Linear Add	Yes	Dead	1.2	Dead + Live + Roof Live + Wind [Strength]
DStlS14			Live	0.5	
DStlS14			LiveM	1	
DStlS14			WindX	1	
DStlS15	Linear Add	Yes	Dead	1.2	Dead + Live + Roof Live - Wind [Strength]
DStlS15			Live	0.5	
DStlS15			LiveM	1	
DStlS15			WindX	-1	
DStlS16	Linear Add	Yes	Dead	1.2	Dead + Live + Roof Live + Wind [Strength]
DStlS16			Live	0.5	
DStlS16			LiveM	1	
DStlS16			WindY	1	
DStlS17	Linear Add	Yes	Dead	1.2	Dead + Live + Roof Live - Wind [Strength]
DStlS17			Live	0.5	
DStlS17			LiveM	1	
DStlS17			WindY	-1	
DStlS18	Linear Add	Yes	Dead	1.2	Dead + Live + Roof Live + Wind [Strength]
DStlS18			Live	0.5	
DStlS18			LiveM	1	
DStlS18			WindXX	1	
DStlS19	Linear Add	Yes	Dead	1.2	Dead + Live + Roof Live - Wind [Strength]
DStlS19			Live	0.5	
DStlS19			LiveM	1	
DStlS19			WindXX	-1	
DStlS20	Linear Add	Yes	Dead	1.2	Dead + Live + Roof Live + Wind [Strength]
DStlS20			Live	0.5	
DStlS20			LiveM	1	
DStlS20			WindYY	1	
DStlS21	Linear Add	Yes	Dead	1.2	Dead + Live + Roof Live - Wind [Strength]
DStlS21			Live	0.5	
DStlS21			LiveM	1	
DStlS21			WindYY	-1	
DStlS22	Linear Add	Yes	Dead	1.2	Dead + Snow + Wind [Strength]
DStlS22			Snow	1.6	
DStlS22			Snoww	1.6	
DStlS22			WindX	0.5	
DStlS23	Linear Add	Yes	Dead	1.2	Dead + Snow - Wind [Strength]
DStlS23			Snow	1.6	
DStlS23			Snoww	1.6	
DStlS23			WindX	-0.5	
DStlS24	Linear Add	Yes	Dead	1.2	Dead + Snow + Wind [Strength]
DStlS24			Snow	1.6	
DStlS24			Snoww	1.6	
DStlS24			WindY	0.5	
DStlS25	Linear Add	Yes	Dead	1.2	Dead + Snow - Wind [Strength]
DStlS25			Snow	1.6	
DStlS25			Snoww	1.6	
DStlS25			WindY	-0.5	
DStlS26	Linear Add	Yes	Dead	1.2	Dead + Snow + Wind [Strength]
DStlS26			Snow	1.6	

Name	Type	Is Auto	Load Name	SF	Notes
DStlS26			Snoww	1.6	
DStlS26			WindXX	0.5	
DStlS27	Linear Add	Yes	Dead	1.2	Dead + Snow - Wind [Strength]
DStlS27			Snow	1.6	
DStlS27			Snoww	1.6	
DStlS27			WindXX	-0.5	
DStlS28	Linear Add	Yes	Dead	1.2	Dead + Snow + Wind [Strength]
DStlS28			Snow	1.6	
DStlS28			Snoww	1.6	
DStlS28			WindYY	0.5	
DStlS29	Linear Add	Yes	Dead	1.2	Dead + Snow - Wind [Strength]
DStlS29			Snow	1.6	
DStlS29			Snoww	1.6	
DStlS29			WindYY	-0.5	
DStlS30	Linear Add	Yes	Dead	1.2	Dead + Roof Live + Wind [Strength]
DStlS30			Live	1.6	
DStlS30			WindX	0.5	
DStlS31	Linear Add	Yes	Dead	1.2	Dead + Roof Live - Wind [Strength]
DStlS31			Live	1.6	
DStlS31			WindX	-0.5	
DStlS32	Linear Add	Yes	Dead	1.2	Dead + Roof Live + Wind [Strength]
DStlS32			Live	1.6	
DStlS32			WindY	0.5	
DStlS33	Linear Add	Yes	Dead	1.2	Dead + Roof Live - Wind [Strength]
DStlS33			Live	1.6	
DStlS33			WindY	-0.5	
DStlS34	Linear Add	Yes	Dead	1.2	Dead + Roof Live + Wind [Strength]
DStlS34			Live	1.6	
DStlS34			WindXX	0.5	
DStlS35	Linear Add	Yes	Dead	1.2	Dead + Roof Live - Wind [Strength]
DStlS35			Live	1.6	
DStlS35			WindXX	-0.5	
DStlS36	Linear Add	Yes	Dead	1.2	Dead + Roof Live + Wind [Strength]
DStlS36			Live	1.6	
DStlS36			WindYY	0.5	
DStlS37	Linear Add	Yes	Dead	1.2	Dead + Roof Live - Wind [Strength]
DStlS37			Live	1.6	
DStlS37			WindYY	-0.5	
DStlS38	Linear Add	Yes	Dead	0.9	Dead (min) + Wind [Strength]
DStlS38			WindX	1	
DStlS39	Linear Add	Yes	Dead	0.9	Dead (min) - Wind [Strength]
DStlS39			WindX	-1	
DStlS40	Linear Add	Yes	Dead	0.9	Dead (min) + Wind [Strength]
DStlS40			WindY	1	
DStlS41	Linear Add	Yes	Dead	0.9	Dead (min) - Wind [Strength]
DStlS41			WindY	-1	
DStlS42	Linear Add	Yes	Dead	0.9	Dead (min) + Wind [Strength]
DStlS42			WindXX	1	
DStlS43	Linear Add	Yes	Dead	0.9	Dead (min) - Wind [Strength]
DStlS43			WindXX	-1	
DStlS44	Linear Add	Yes	Dead	0.9	Dead (min) + Wind [Strength]
DStlS44			WindYY	1	
DStlS45	Linear Add	Yes	Dead	0.9	Dead (min) - Wind [Strength]
DStlS45			WindYY	-1	
DStlS46	Linear Add	Yes	Dead	1.318	Dead + Live + Static Earthquake [Strength]

Name	Type	Is Auto	Load Name	SF	Notes
DStlS46			LiveM	1	
DStlS46			Snow	0.2	
DStlS46			Snoww	0.2	
DStlS46			Exx	1	
DStlS46-1	Linear Add	No	Dead	1.318	Dead + Live + Static Earthquake [Strength]
DStlS46-1			LiveM	1	
DStlS46-1			Snow	0.2	
DStlS46-1			Snoww	0.2	
DStlS46-1			Exx	2	
DStlS47	Linear Add	Yes	Dead	1.318	Dead + Live - Static Earthquake [Strength]
DStlS47			LiveM	1	
DStlS47			Snow	0.2	
DStlS47			Snoww	0.2	
DStlS47			Exx	-1	
DStlS47-1	Linear Add	No	Dead	1.318	Dead + Live - Static Earthquake [Strength]
DStlS47-1			LiveM	1	
DStlS47-1			Snow	0.2	
DStlS47-1			Snoww	0.2	
DStlS47-1			Exx	-2	
DStlS48	Linear Add	Yes	Dead	1.318	Dead + Live + Static Earthquake [Strength]
DStlS48			LiveM	1	
DStlS48			Snow	0.2	
DStlS48			Snoww	0.2	
DStlS48			Eyy	1	
DStlS48-1	Linear Add	No	Dead	1.318	Dead + Live + Static Earthquake [Strength]
DStlS48-1			LiveM	1	
DStlS48-1			Snow	0.2	
DStlS48-1			Snoww	0.2	
DStlS48-1			Eyy	2	
DStlS49	Linear Add	Yes	Dead	1.318	Dead + Live - Static Earthquake [Strength]
DStlS49			LiveM	1	
DStlS49			Snow	0.2	
DStlS49			Snoww	0.2	
DStlS49			Eyy	-1	
DStlS49-1	Linear Add	No	Dead	1.318	Dead + Live - Static Earthquake [Strength]
DStlS49-1			LiveM	1	
DStlS49-1			Snow	0.2	
DStlS49-1			Snoww	0.2	
DStlS49-1			Eyy	-2	
DStlS50	Linear Add	Yes	Dead	0.782	Dead (min) + Static Earthquake [Strength]
DStlS50			Exx	1	
DStlS50-1	Linear Add	No	Dead	0.782	Dead (min) + Static Earthquake [Strength]
DStlS50-1			Exx	2	
DStlS51	Linear Add	Yes	Dead	0.782	Dead (min) - Static Earthquake [Strength]
DStlS51			Exx	-1	
DStlS51-1	Linear Add	No	Dead	0.782	Dead (min) - Static Earthquake [Strength]
DStlS51-1			Exx	-2	
DStlS52	Linear Add	Yes	Dead	0.782	Dead (min) + Static Earthquake [Strength]
DStlS52			Eyy	1	
DStlS52-1	Linear Add	No	Dead	0.782	Dead (min) + Static Earthquake [Strength]
DStlS52-1			Eyy	2	
DStlS53	Linear Add	Yes	Dead	0.782	Dead (min) - Static Earthquake [Strength]
DStlS53			Eyy	-1	
DStlS53-1	Linear Add	No	Dead	0.782	Dead (min) - Static Earthquake [Strength]
DStlS53-1			Eyy	-2	

Name	Type	Is Auto	Load Name	SF	Notes
DStlS54	Envelope	No	DStlS1	1	Dead (min) - Static Earthquake [Strength]
DStlS54			DStlS2	1	
DStlS54			DStlS3	1	
DStlS54			DStlS4	1	
DStlS54			DStlS5	1	
DStlS54			DStlS6	1	
DStlS54			DStlS7	1	
DStlS54			DStlS8	1	
DStlS54			DStlS9	1	
DStlS54			DStlS10	1	
DStlS54			DStlS11	1	
DStlS54			DStlS12	1	
DStlS54			DStlS13	1	
DStlS54			DStlS14	1	
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DStlS54			DStlS18	1	
DStlS54			DStlS19	1	
DStlS54			DStlS20	1	
DStlS54			DStlS21	1	
DStlS54			DStlS22	1	
DStlS54			DStlS23	1	
DStlS54			DStlS24	1	
DStlS54			DStlS25	1	
DStlS54			DStlS26	1	
DStlS54			DStlS27	1	
DStlS54			DStlS28	1	
DStlS54			DStlS29	1	
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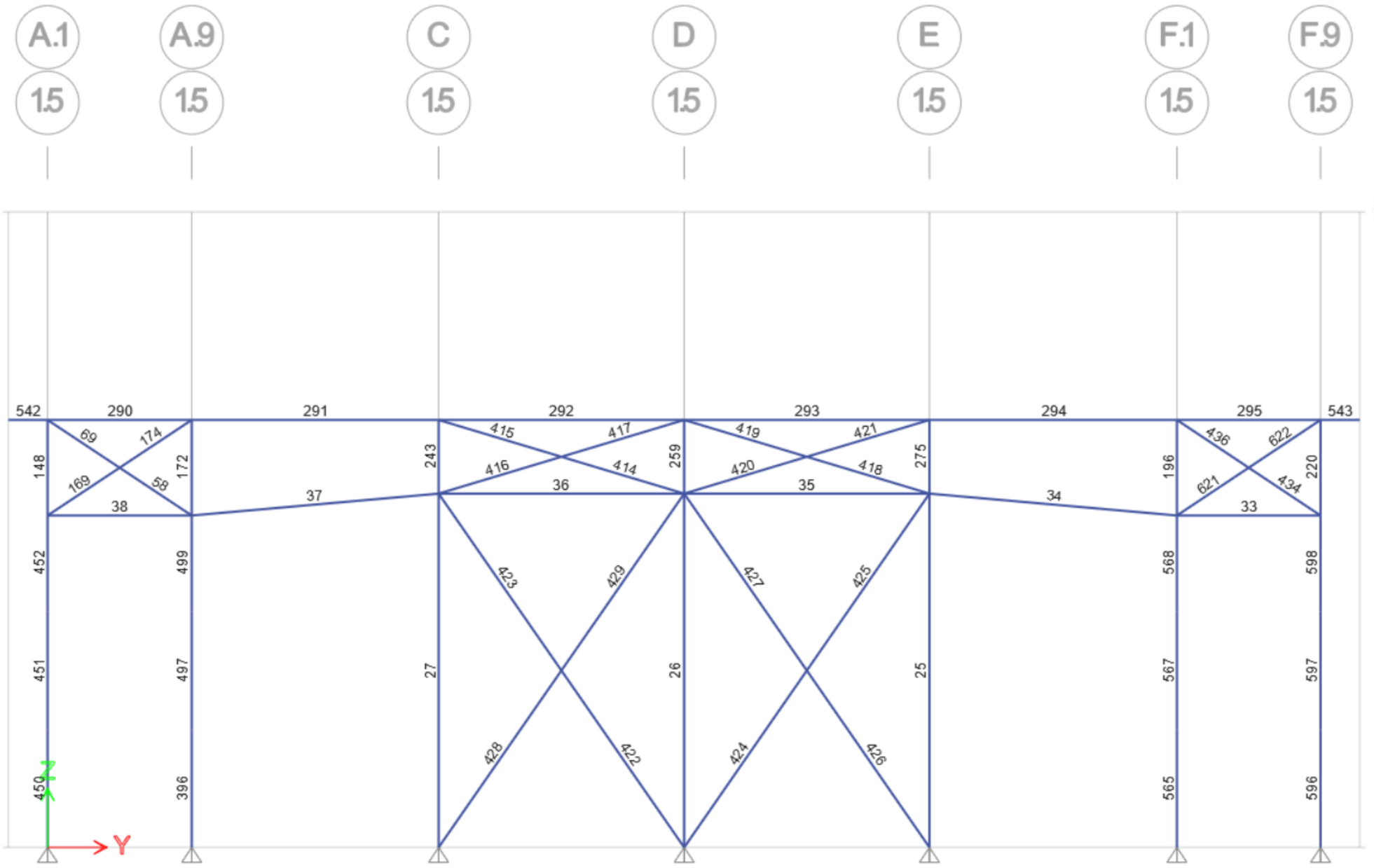
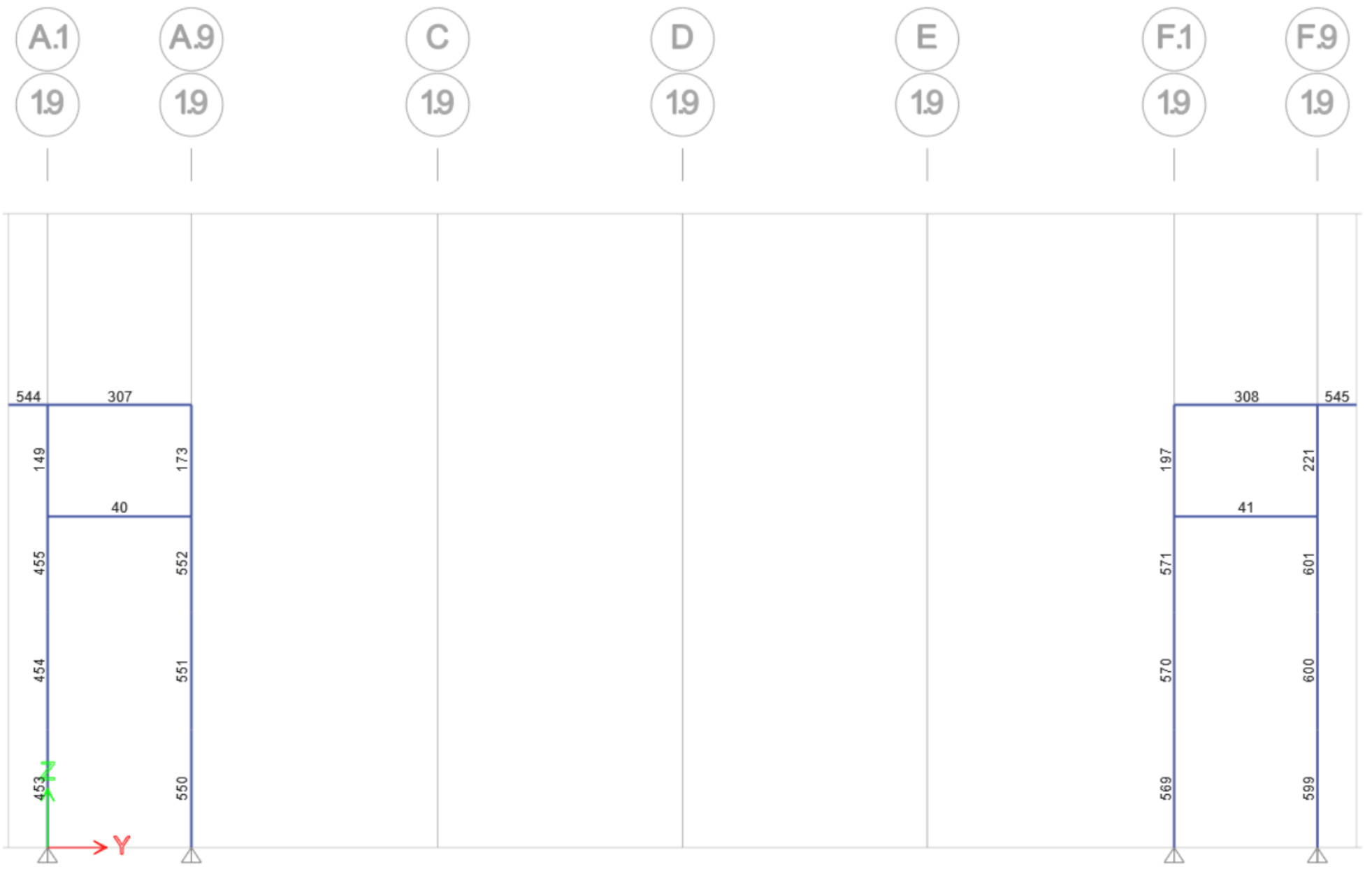
DStlS54			DStlS32	1	
DStlS54			DStlS33	1	
DStlS54			DStlS34	1	
DStlS54			DStlS35	1	
DStlS54			DStlS36	1	
DStlS54			DStlS37	1	
DStlS54			DStlS38	1	
DStlS54			DStlS39	1	
DStlS54			DStlS40	1	
DStlS54			DStlS41	1	
DStlS54			DStlS42	1	
DStlS54			DStlS43	1	
DStlS54			DStlS44	1	
DStlS54			DStlS45	1	
DStlS54			DStlS46-1	1	
DStlS54			DStlS47-1	1	
DStlS54			DStlS48-1	1	
DStlS54			DStlS49-1	1	
DStlS54			DStlS50-1	1	
DStlS54			DStlS51-1	1	
DStlS54			DStlS52-1	1	
DStlS54			DStlS53-1	1	

AOF End - Elevation 1.1

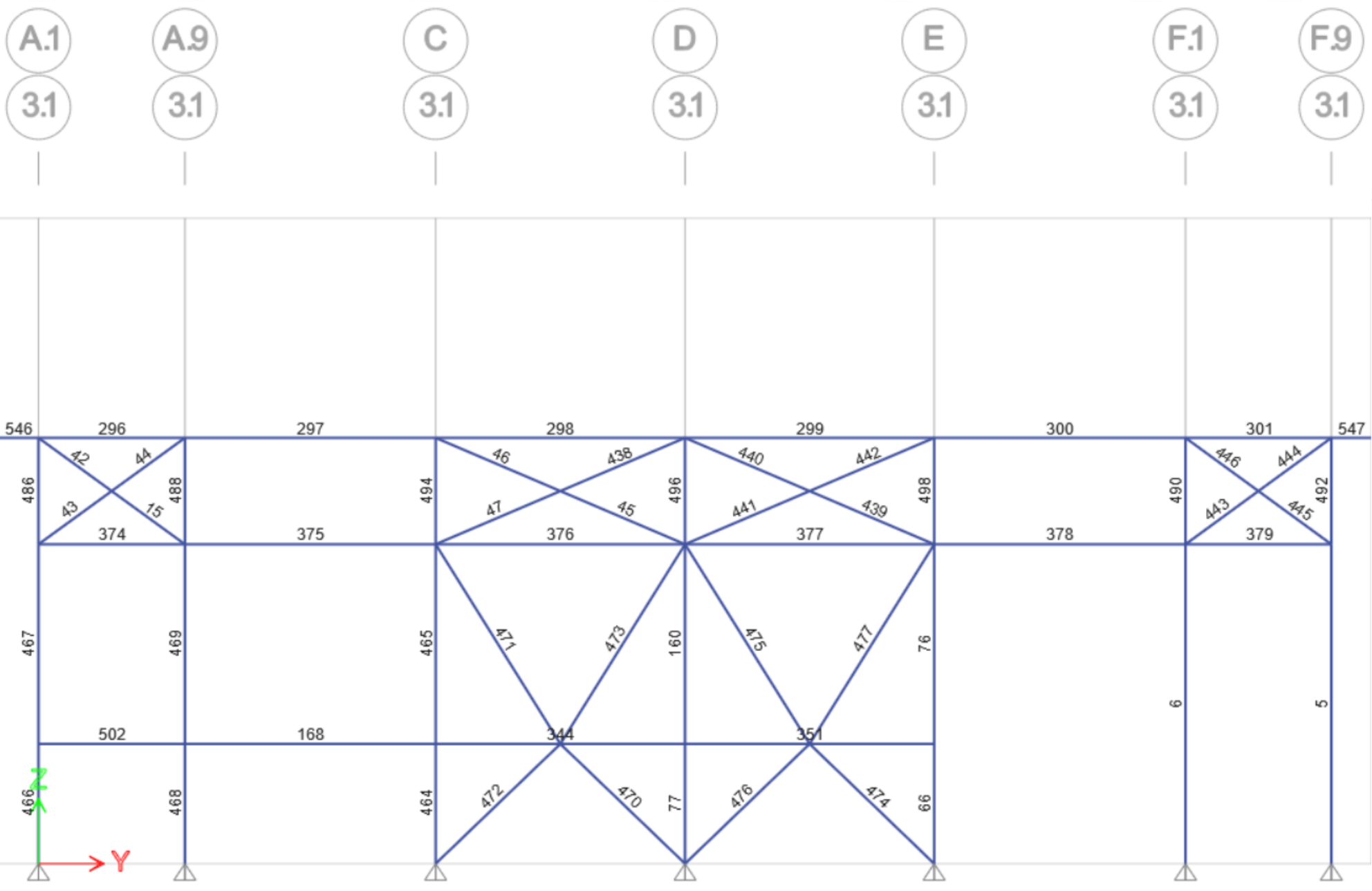
AOF End - Elevation 1.5



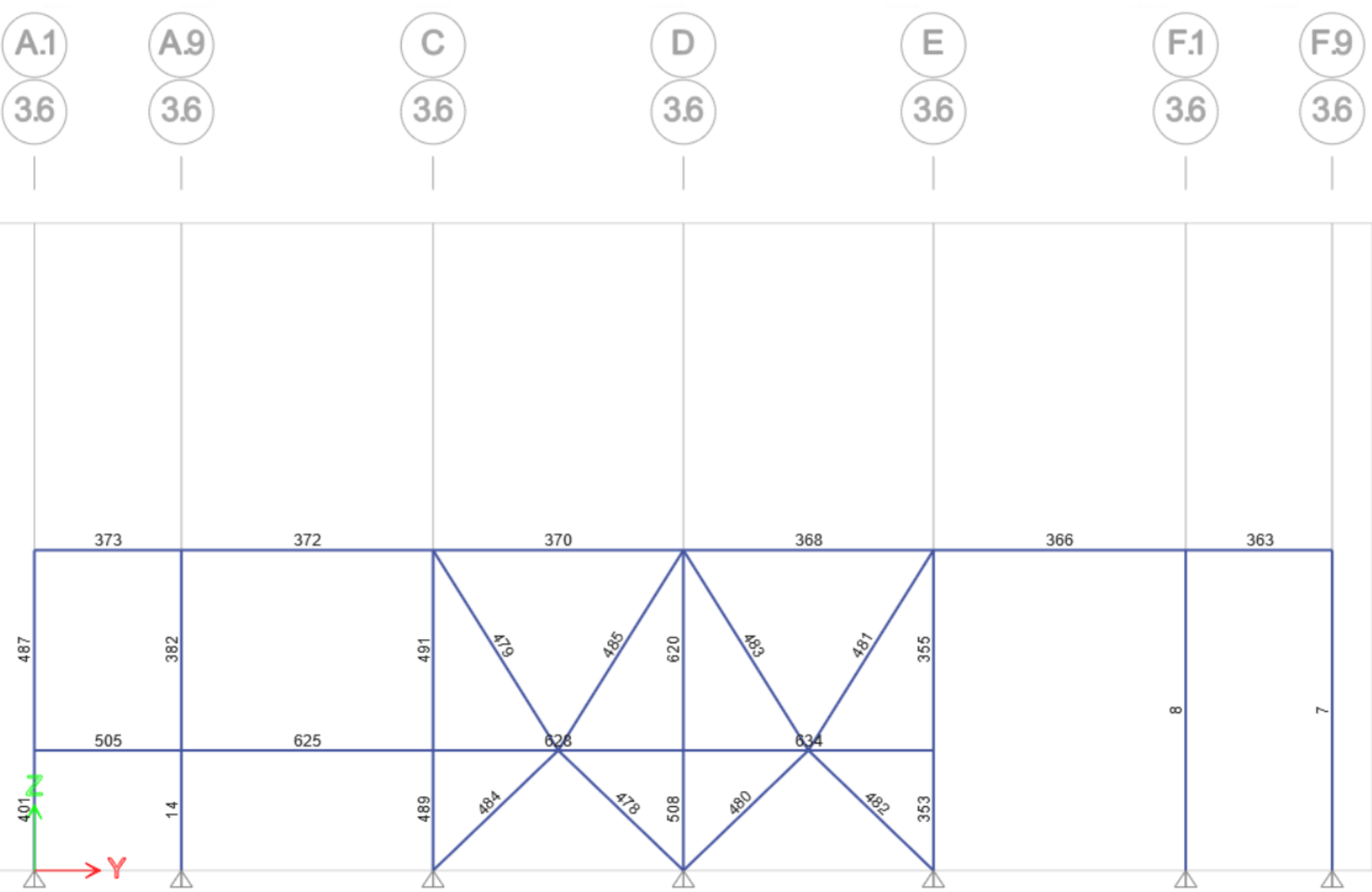
AOF End - Elevation 1.9



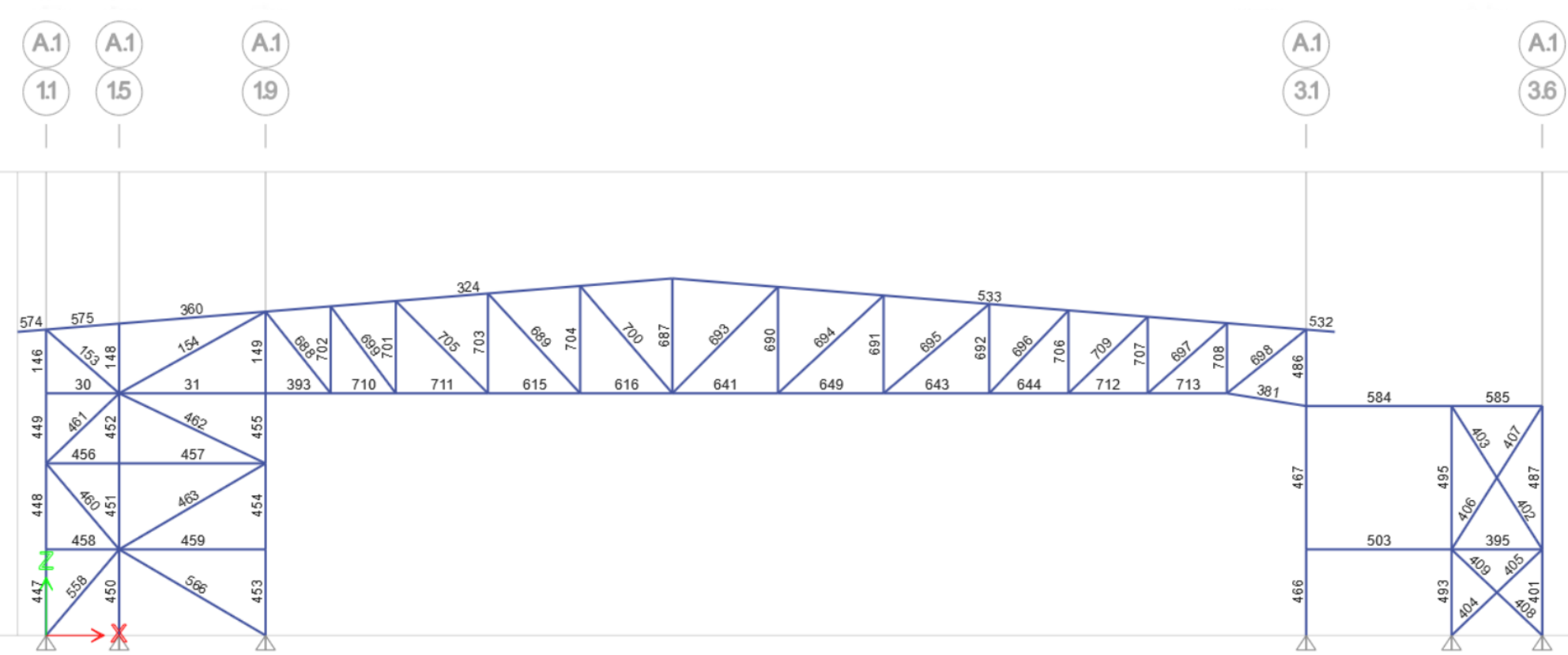
AOF End - Elevation 3.1



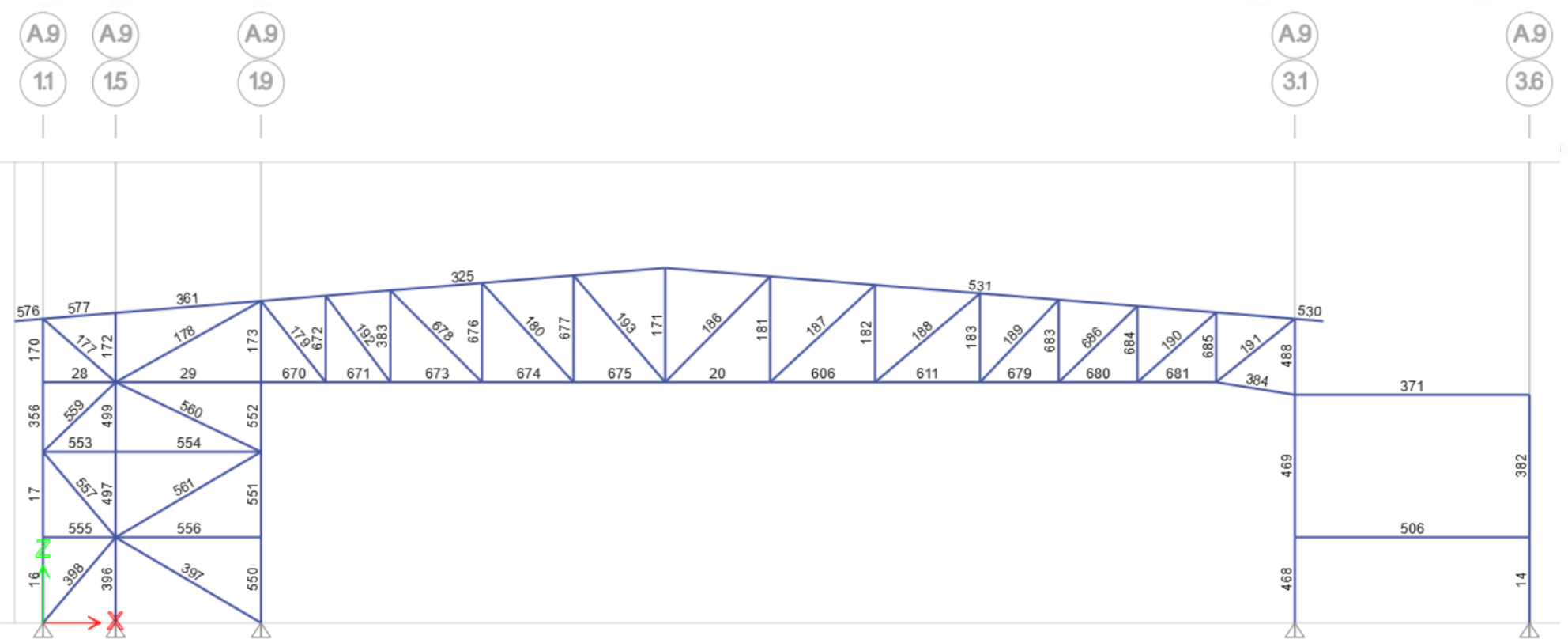
AOF End - Elevation 3.6



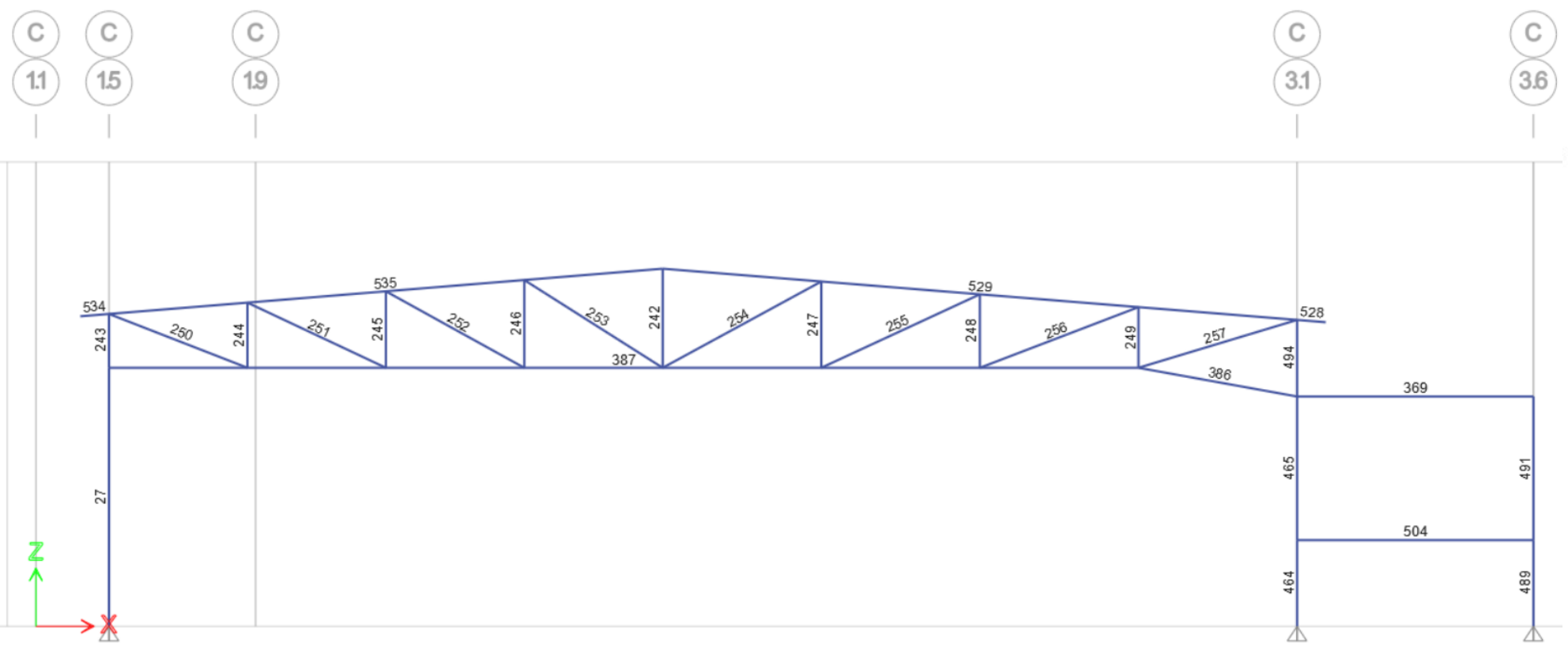
AOF End - Elevation A.1



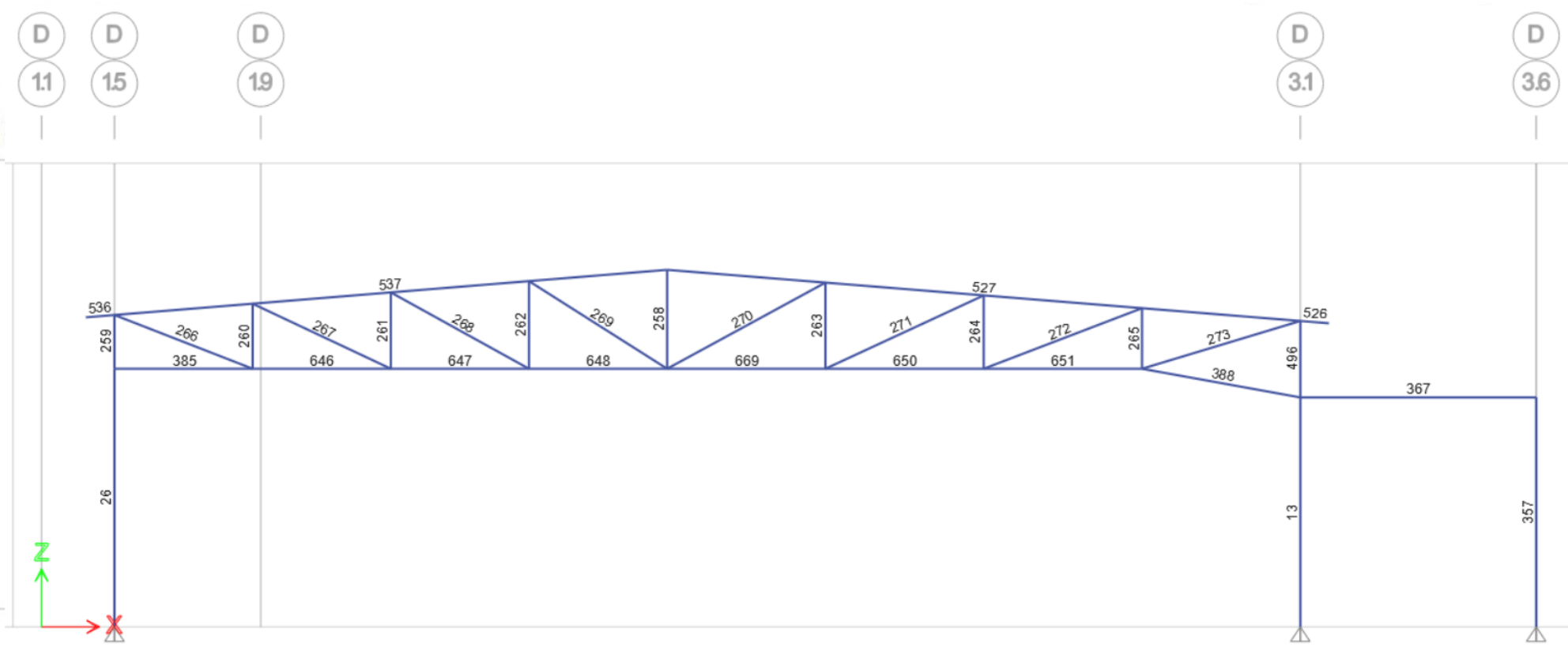
AOF End - Elevation A.9



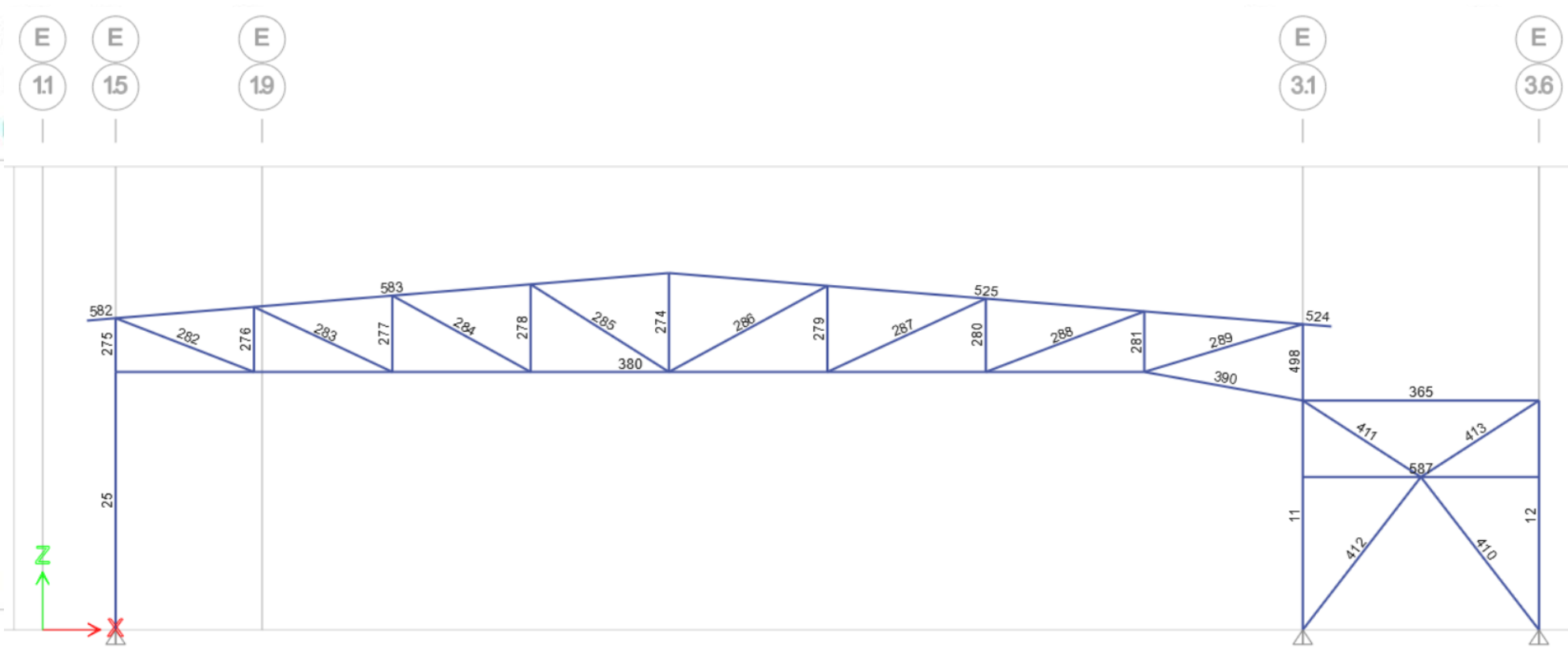
AOF End - Elevation C



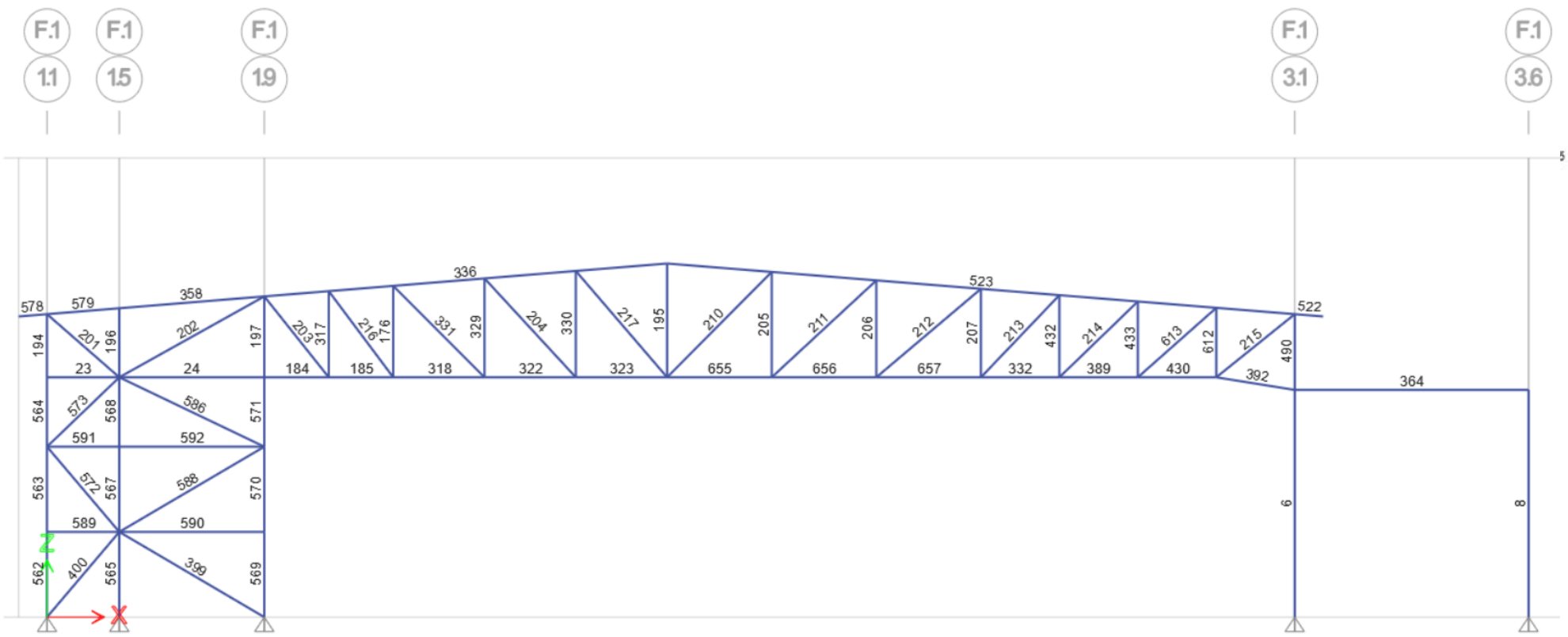
AOF End - Elevation D



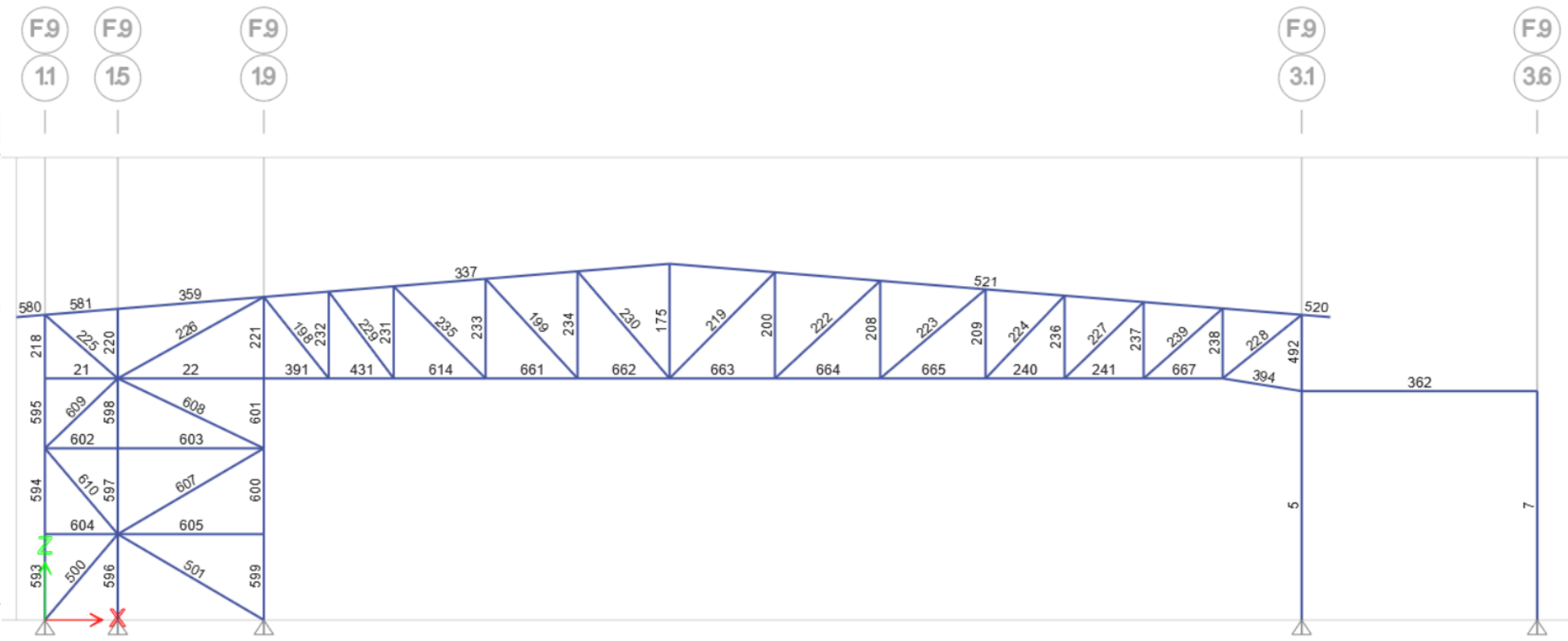
AOF End - Elevation E



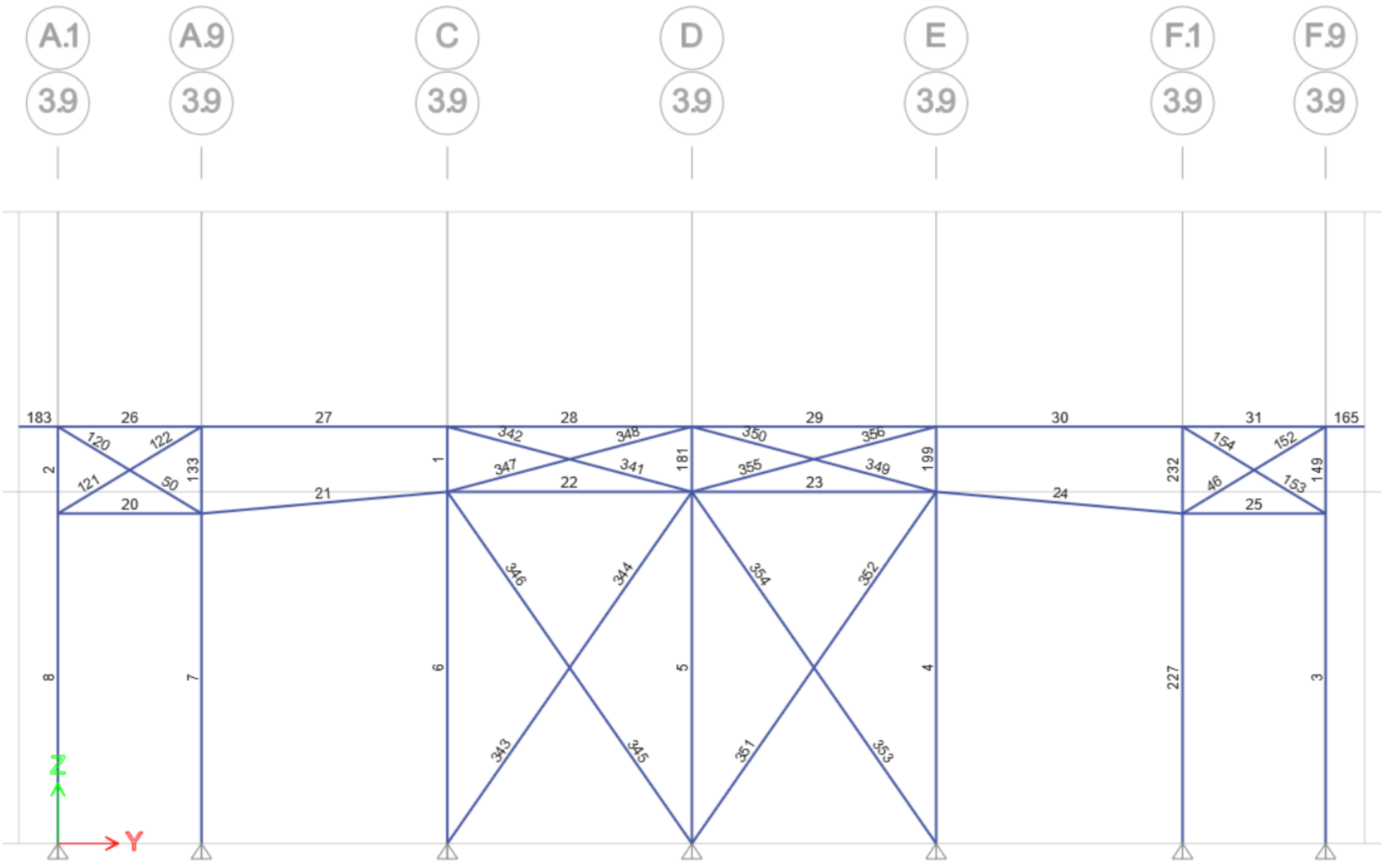
AOF End - Elevation F.1



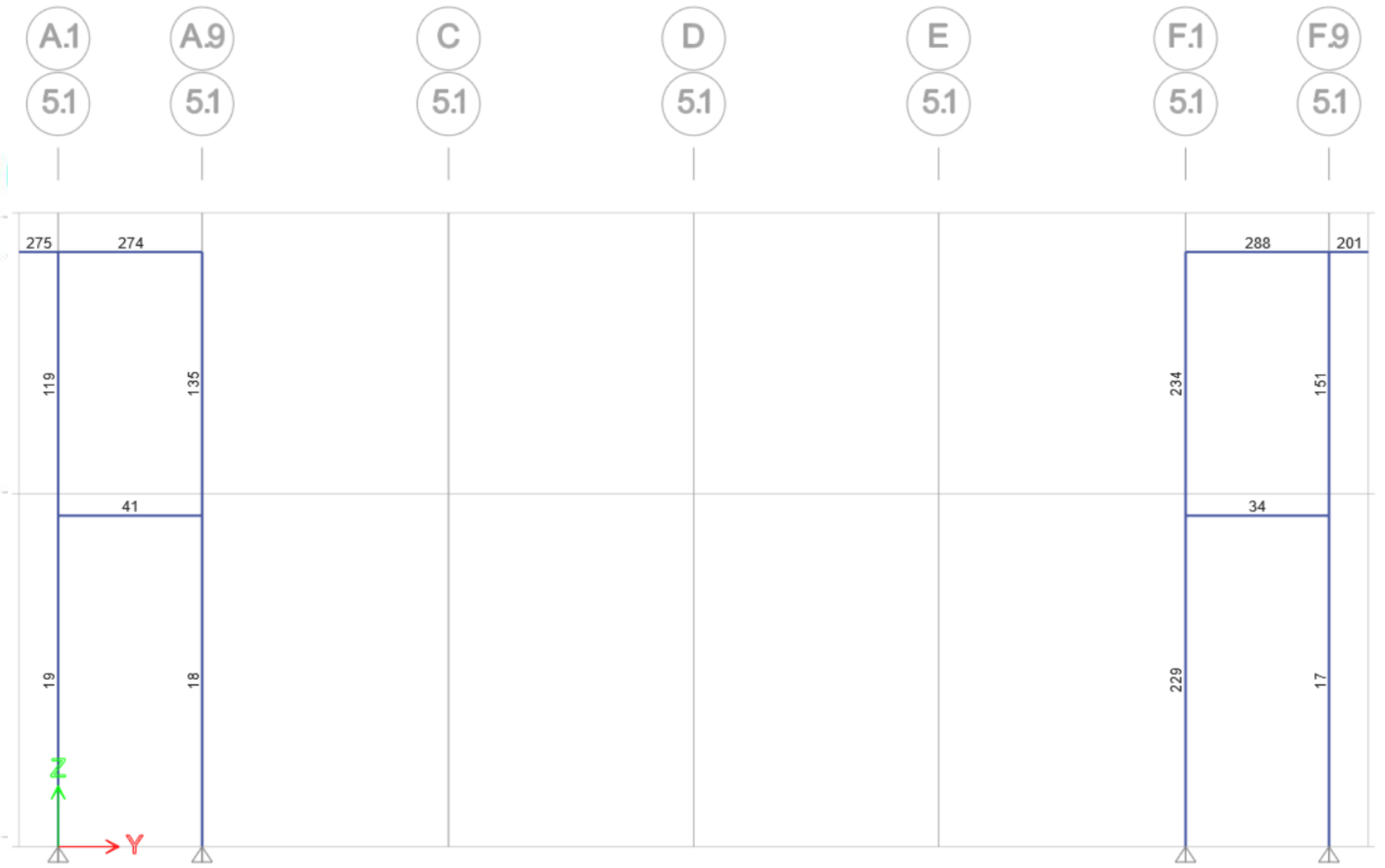
AOF End - Elevation F.9



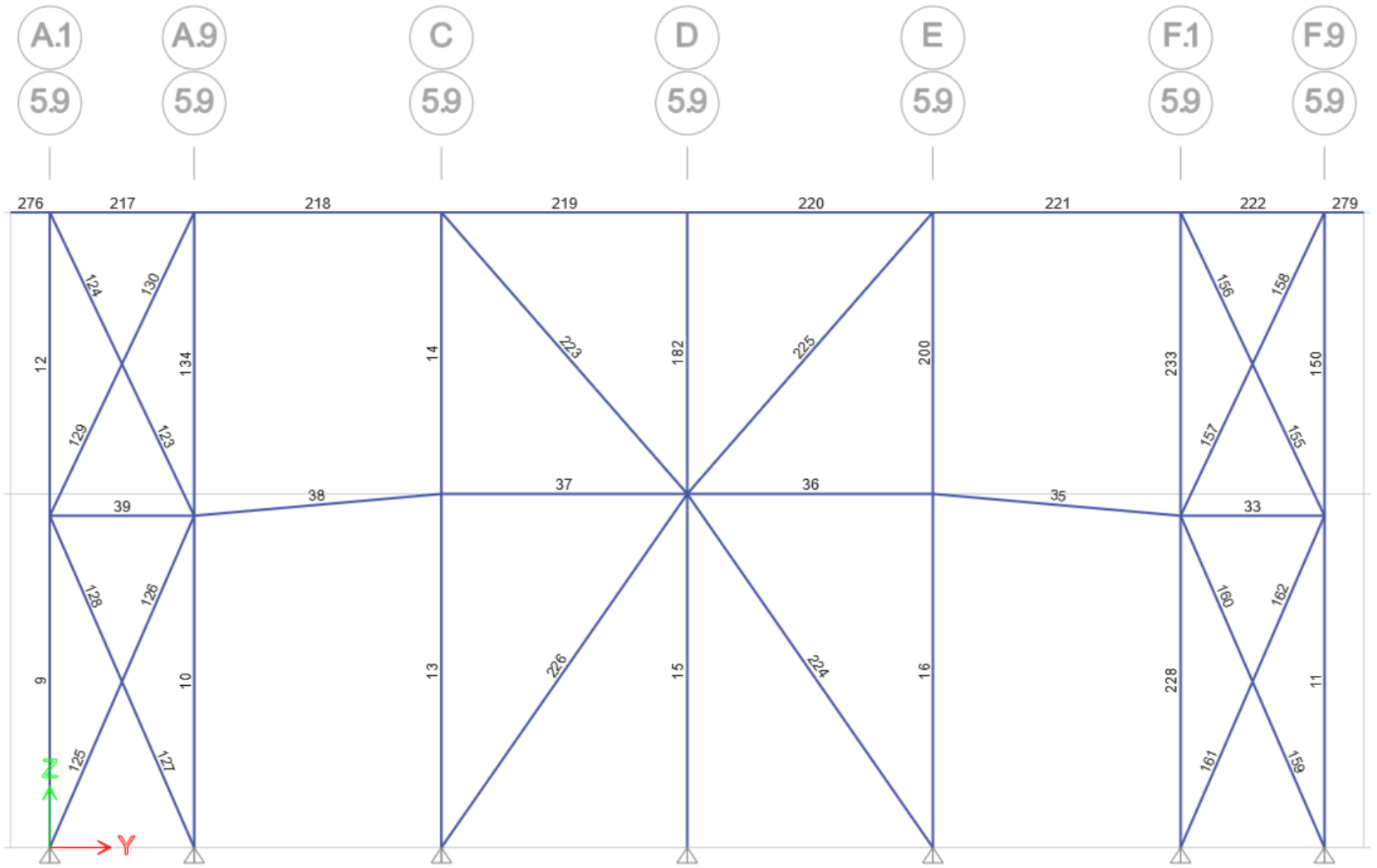
AOF Middle - Elevation 3.9



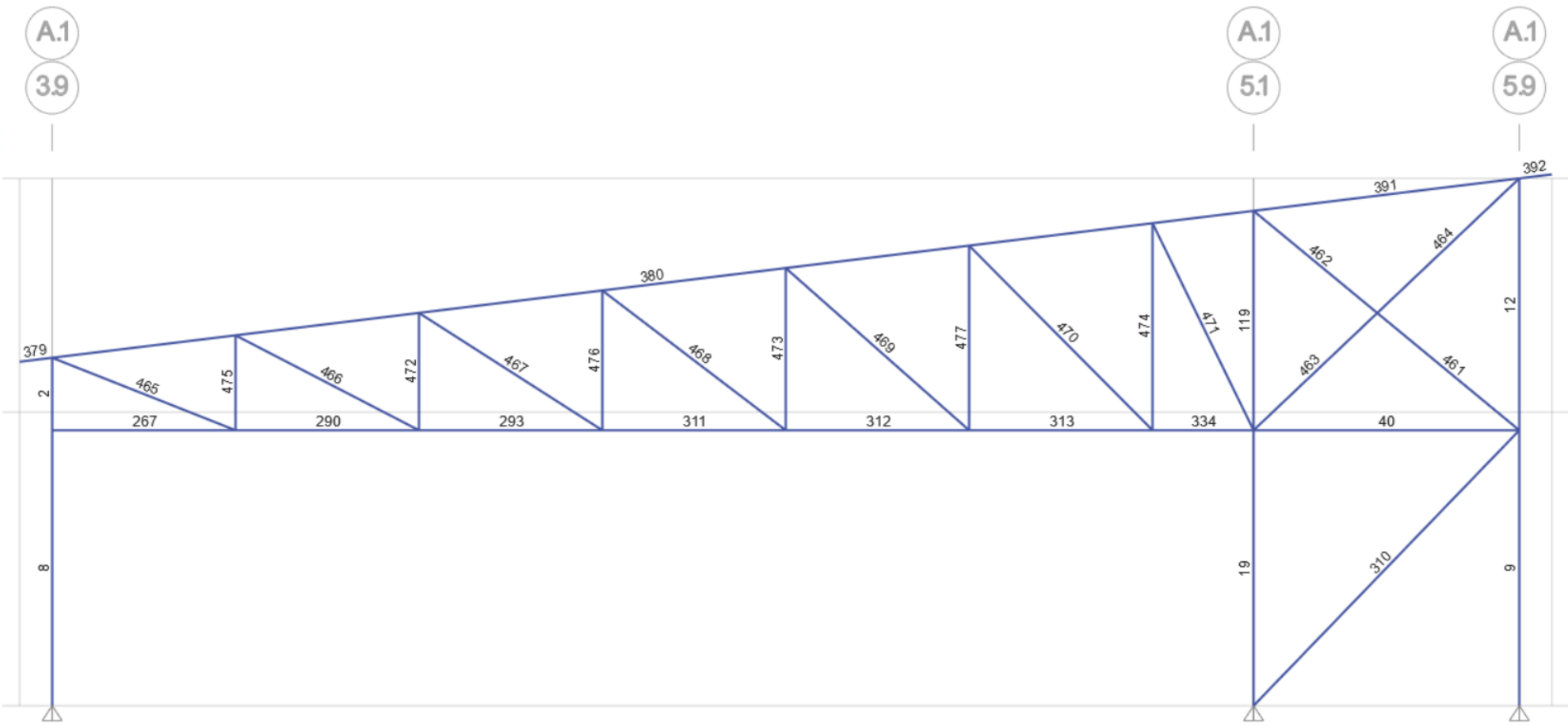
AOF Middle - Elevation 5.1



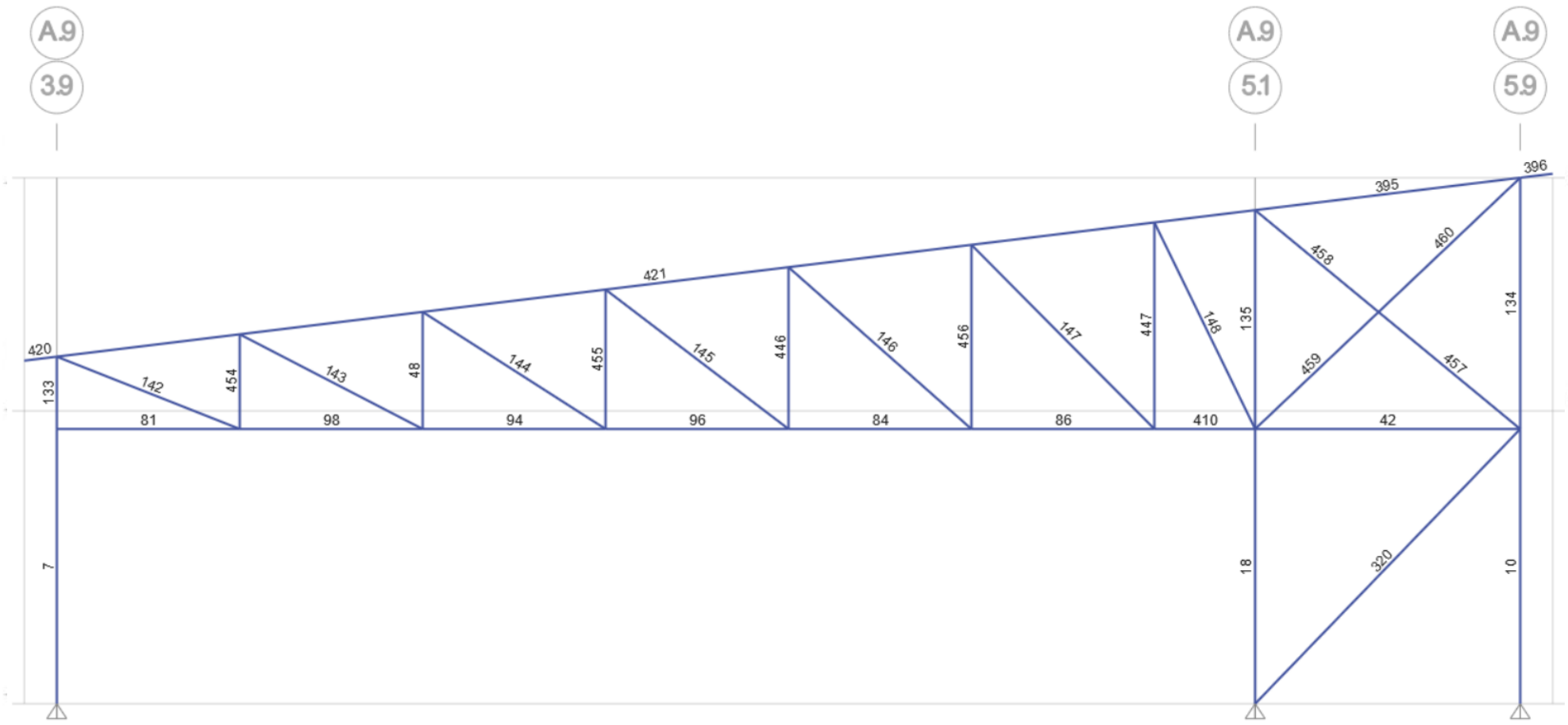
AOF Middle - Elevation 5.9



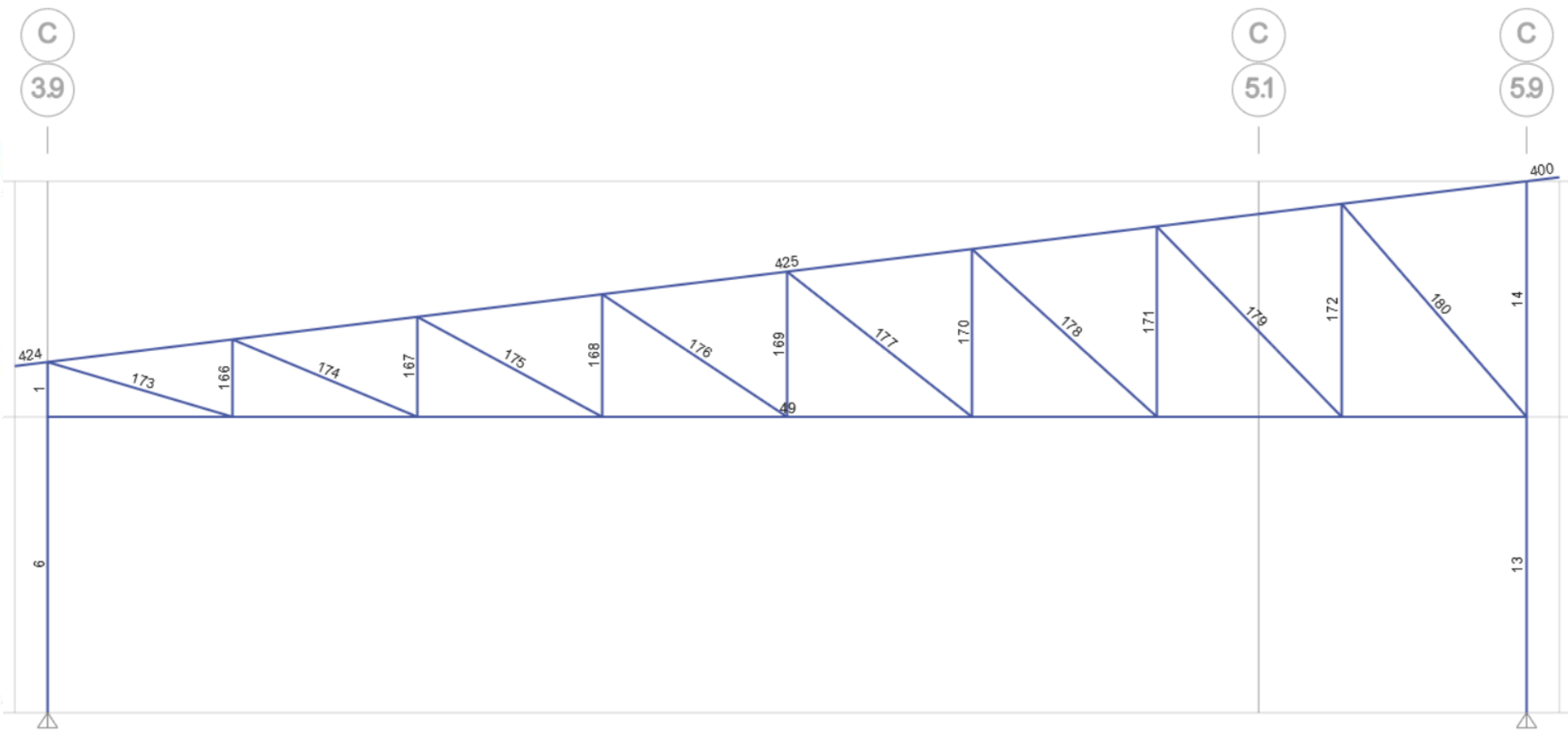
AOF Middle - Elevation A.1



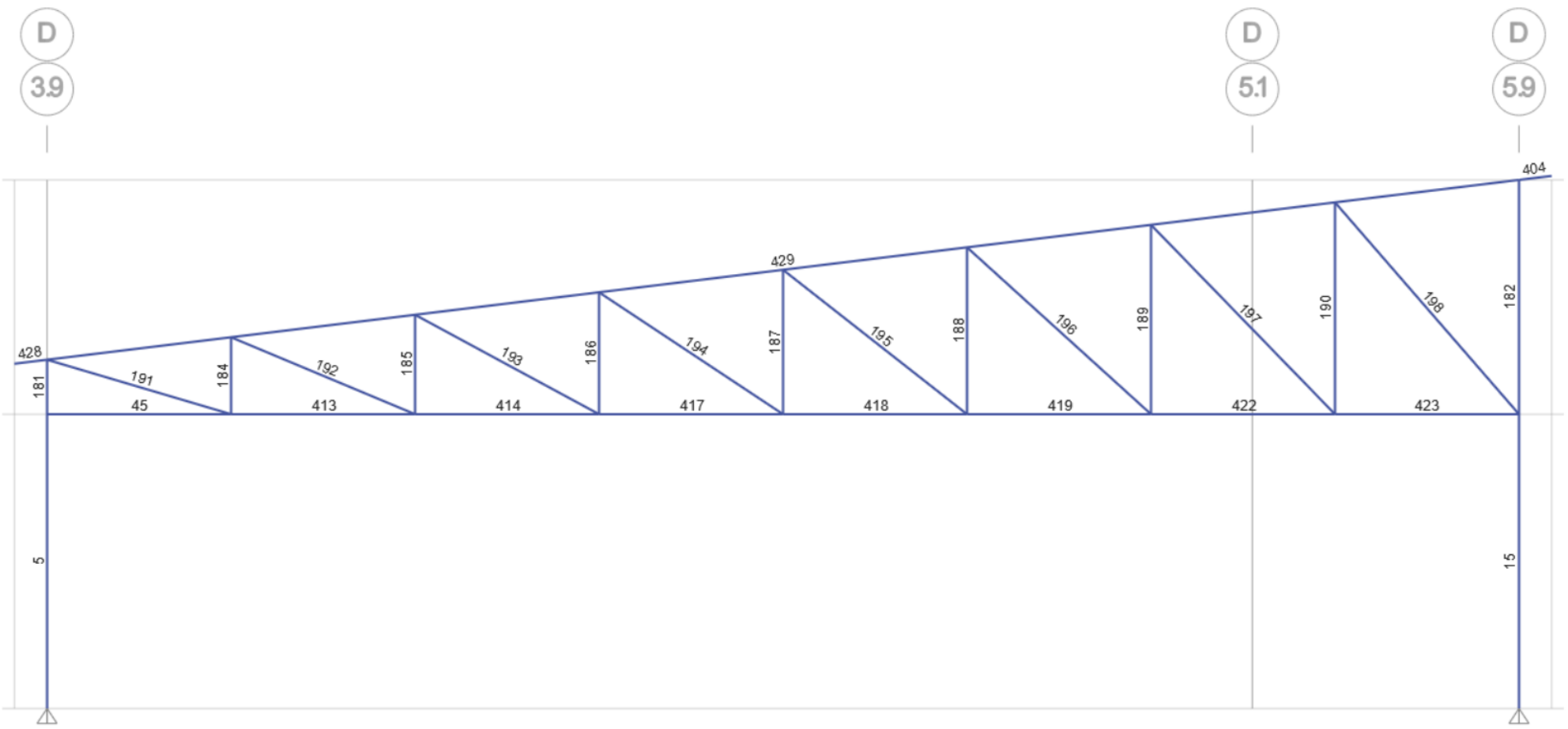
AOF Middle - Elevation A.9



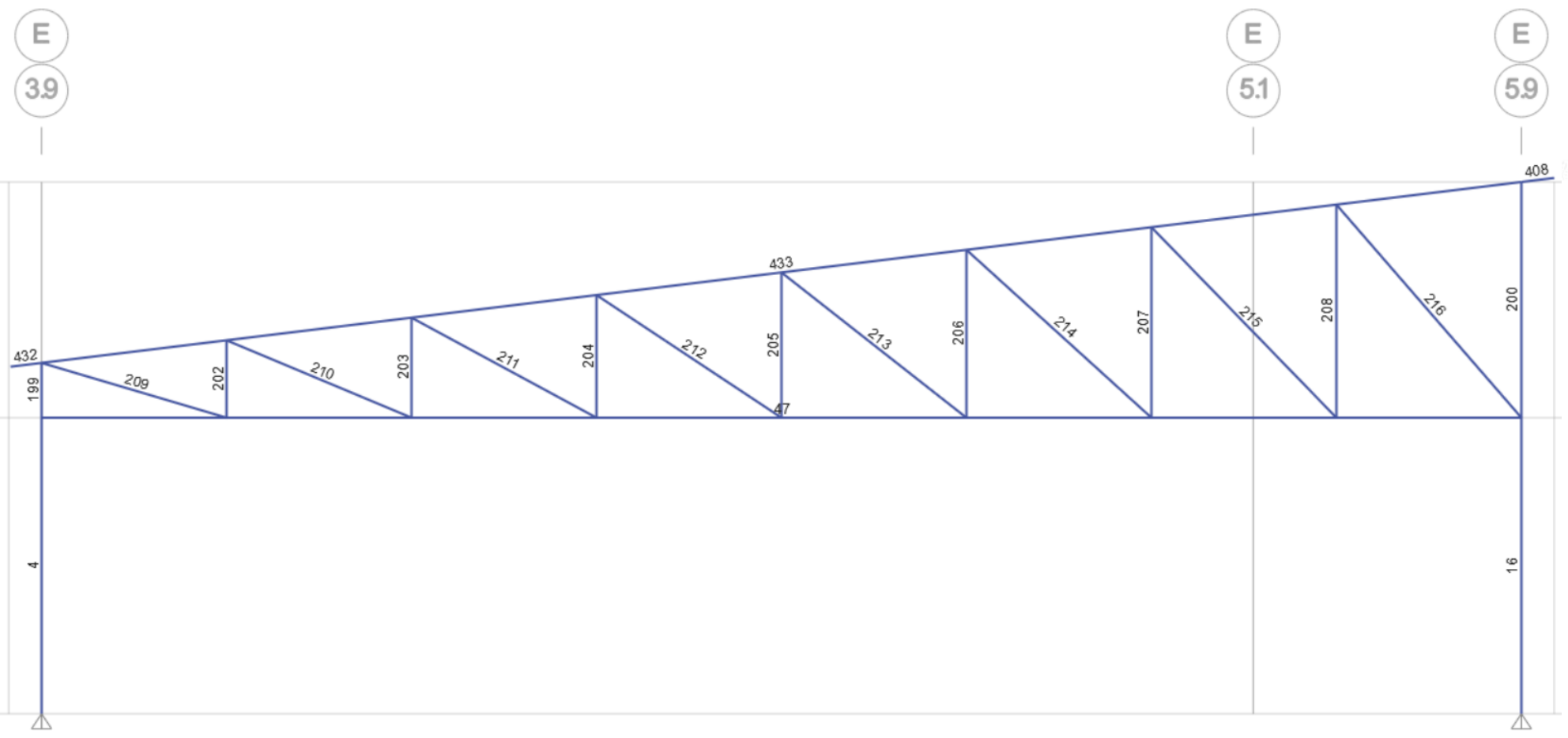
AOF Middle - Elevation C



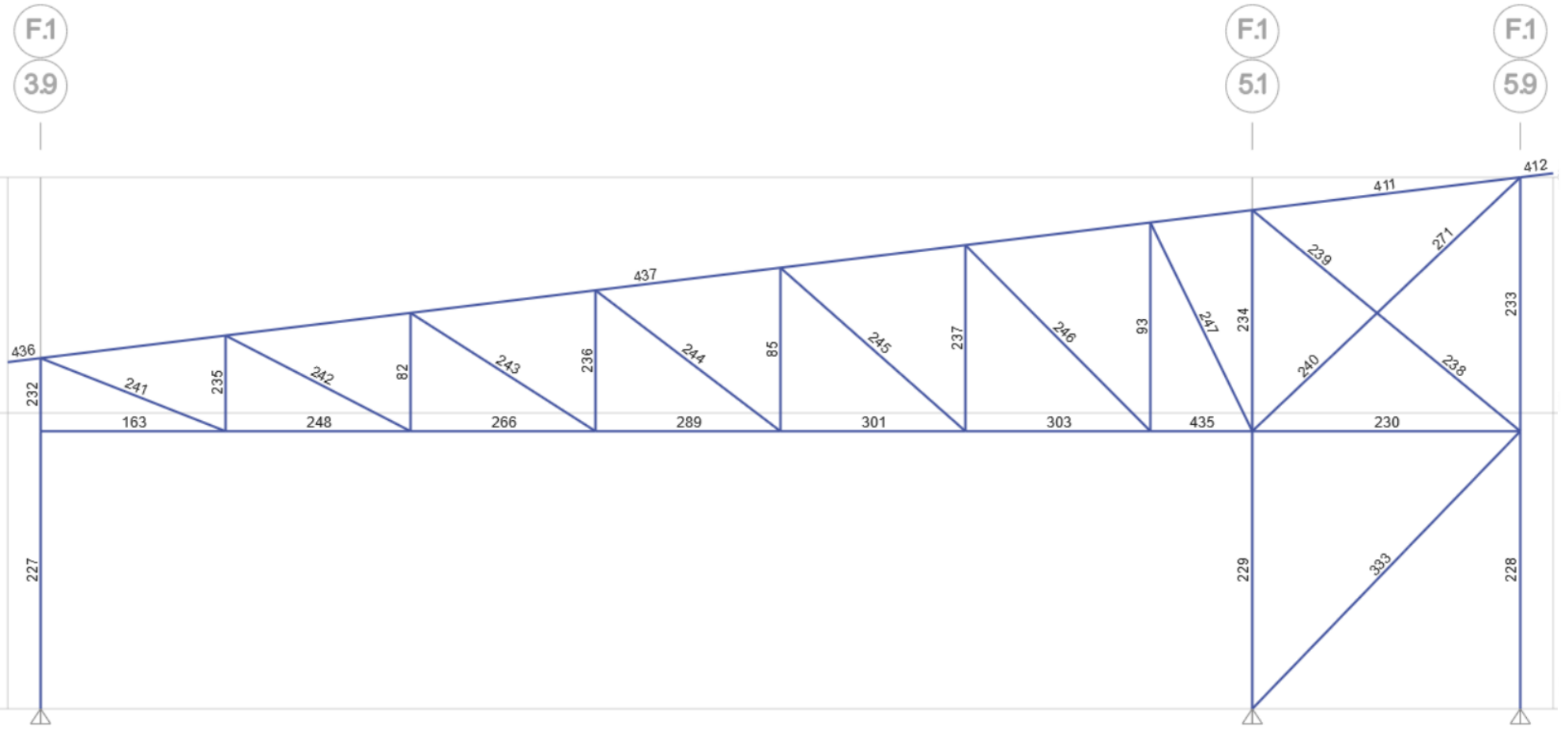
AOF Middle - Elevation D



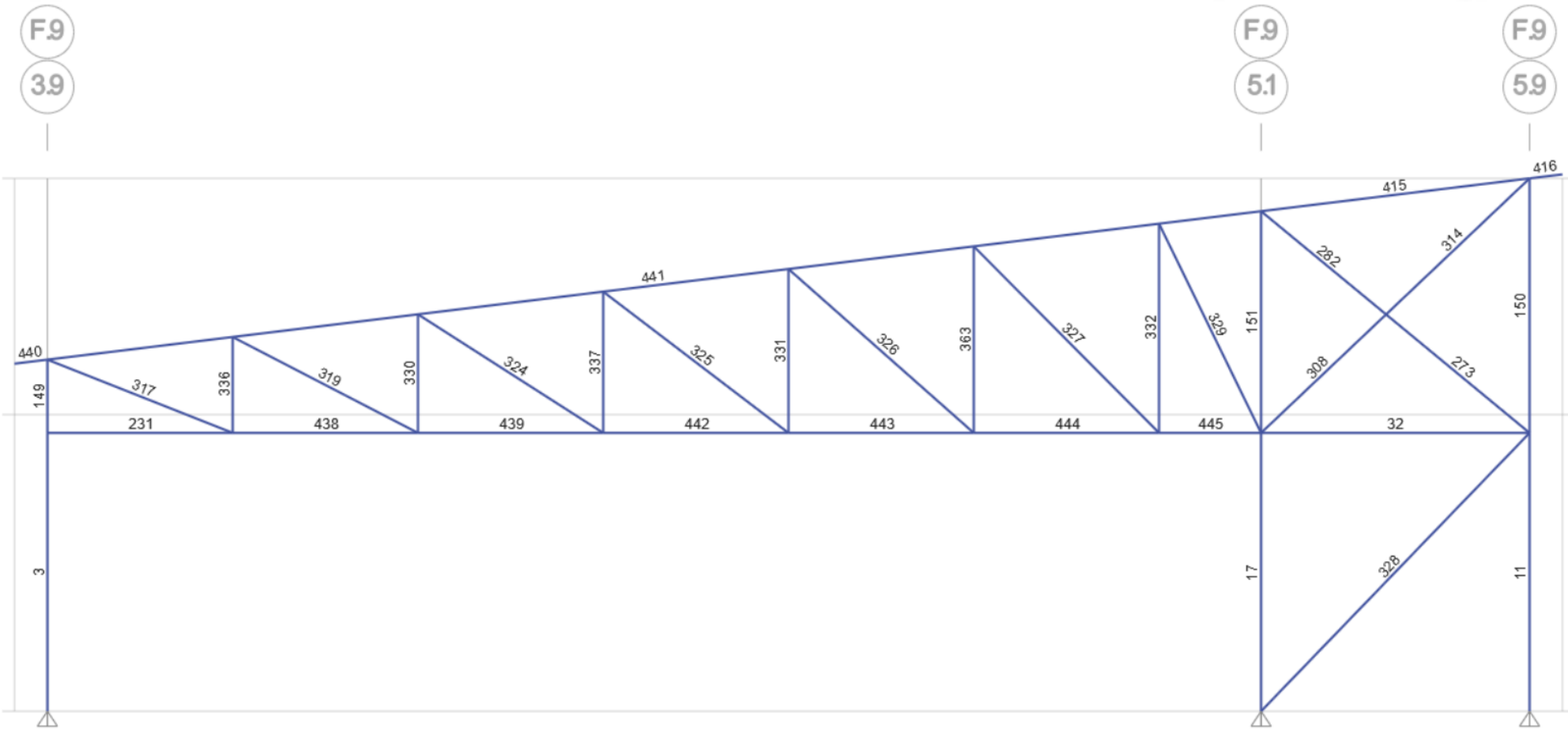
AOF Middle - Elevation E



AOF Middle - Elevation F.1



AOF Middle - Elevation F.9



Michael Baker
INTERNATIONAL

Gravity Framing and Column Calculations

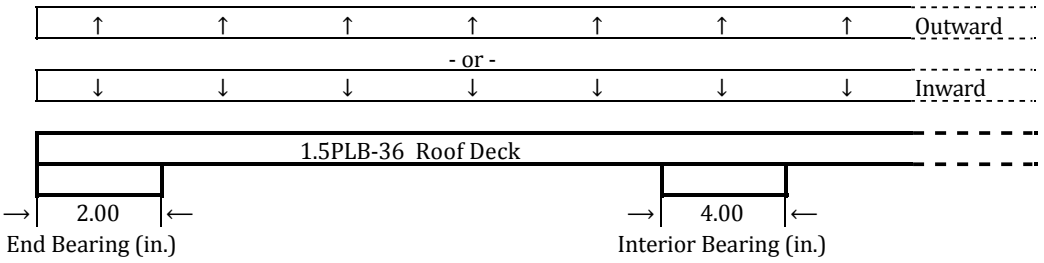
20 Gage 1.5PLB-36 Grade 50

Uniform Design Load Table, LRFD (psf)

For End Lapped Deck

36 / 7/ 4 Connection Pattern to Supports with
Hilti X-HSN24 PAF

Support Member A572 GR50
$0.25 \le t_2$ (in.) ≤ 0.375



Inward Uniform Design Load Table, LRFD (psf)

Span	(ft-in)	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	8'-6"
1	ΦWn	269	222	187	159	137	119	105	93
	L/240	103	78	60	47	38	31	25	21
2	ΦWn	271	224	189	161	139	121	107	95
	L/240	274	206	159	125	100	81	67	56
3	ΦWn	336	279	235	201	173	151	133	118
	L/240	215	161	124	98	78	64	52	44

> High roof: 1.2D + 0.5Lr =1.2*30 + 0.5*20 = 46 psf
> Low roof: 1.2D + 0.5S = 1.2*25 + 0.5*46 = 53 psf

Uplift (Outward) Uniform Design Load Table, LRFD (psf)

Span	(ft-in)	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	8'-6"
1	ΦWn	275	227	191	163	140	122	107	95.0
	ΦRn	386	351	322	297	276	257	241	227
	L/240	114	86	66	52	41	34	28	23
2	ΦWn	176	160	147	136	126	118	104	93
	ΦRn	176	160	147	136	126	118	110	104
	L/240	249	187	144	113	91	74	61	51
3	ΦWn	201	182	167	154	143	134	125	115
	ΦRn	201	182	167	154	143	134	125	118
	L/240	195	147	113	89	71	58	48	40

> 0.9D + W = -0.9*12 + 62 = 50.3 psf

Steel Deck Properties

t in	Fy ksi	wdd psf	Id+ $in.^4/ft$	Id- $in.^4/ft$	Se+ $in.^3/ft$	Se- $in.^3/ft$	ΦMn+ lbs-ft/ft	ΦMn- lbs-ft/ft	ΦVn lbs/ft
0.0358	50	2	0.197	0.217	0.224	0.229	840	859	4874

Where: $W \le \Phi Wn$

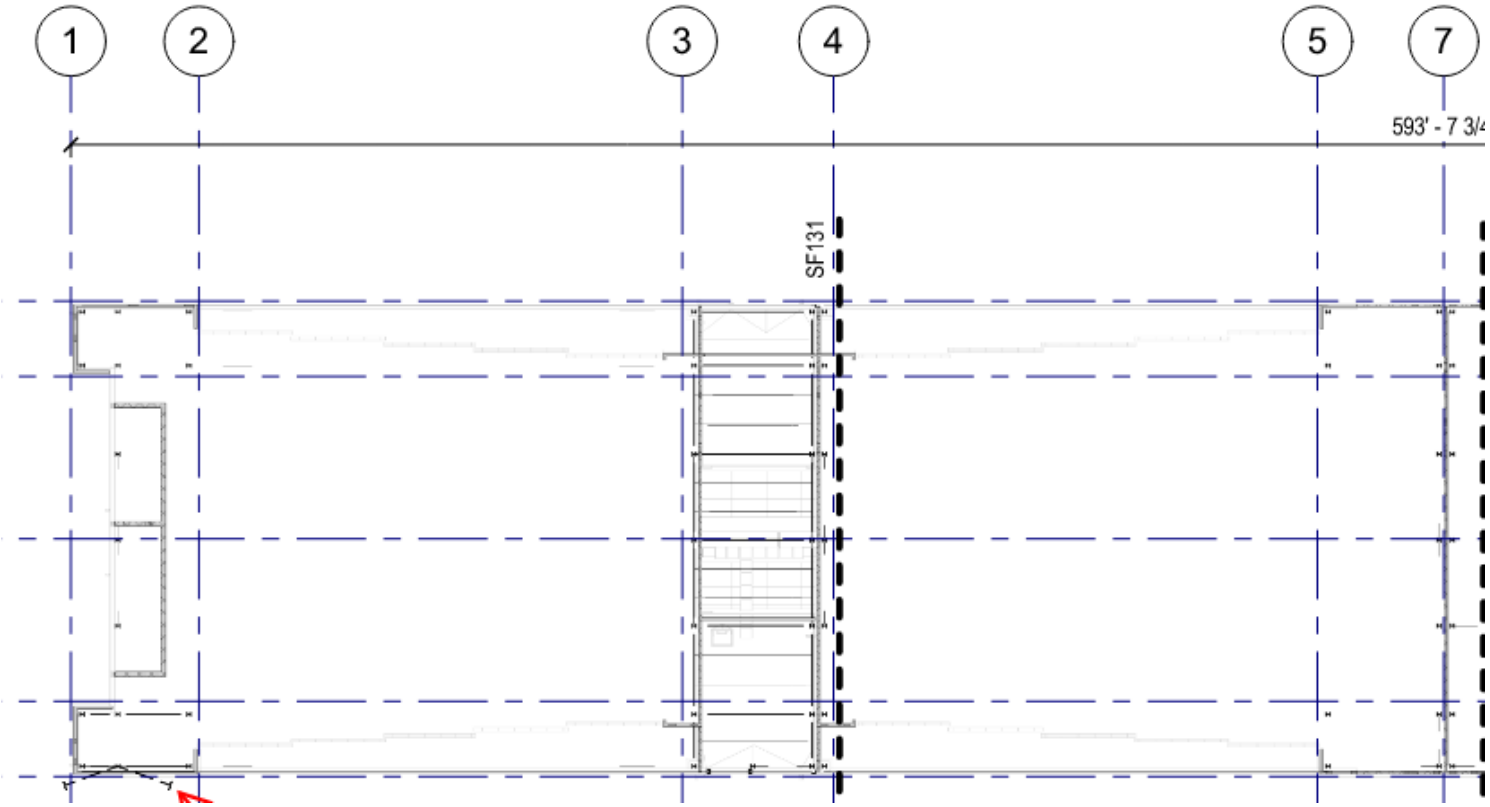
W = Required strength of the governing LRFD load combintaion

ΦWn = Design Strength

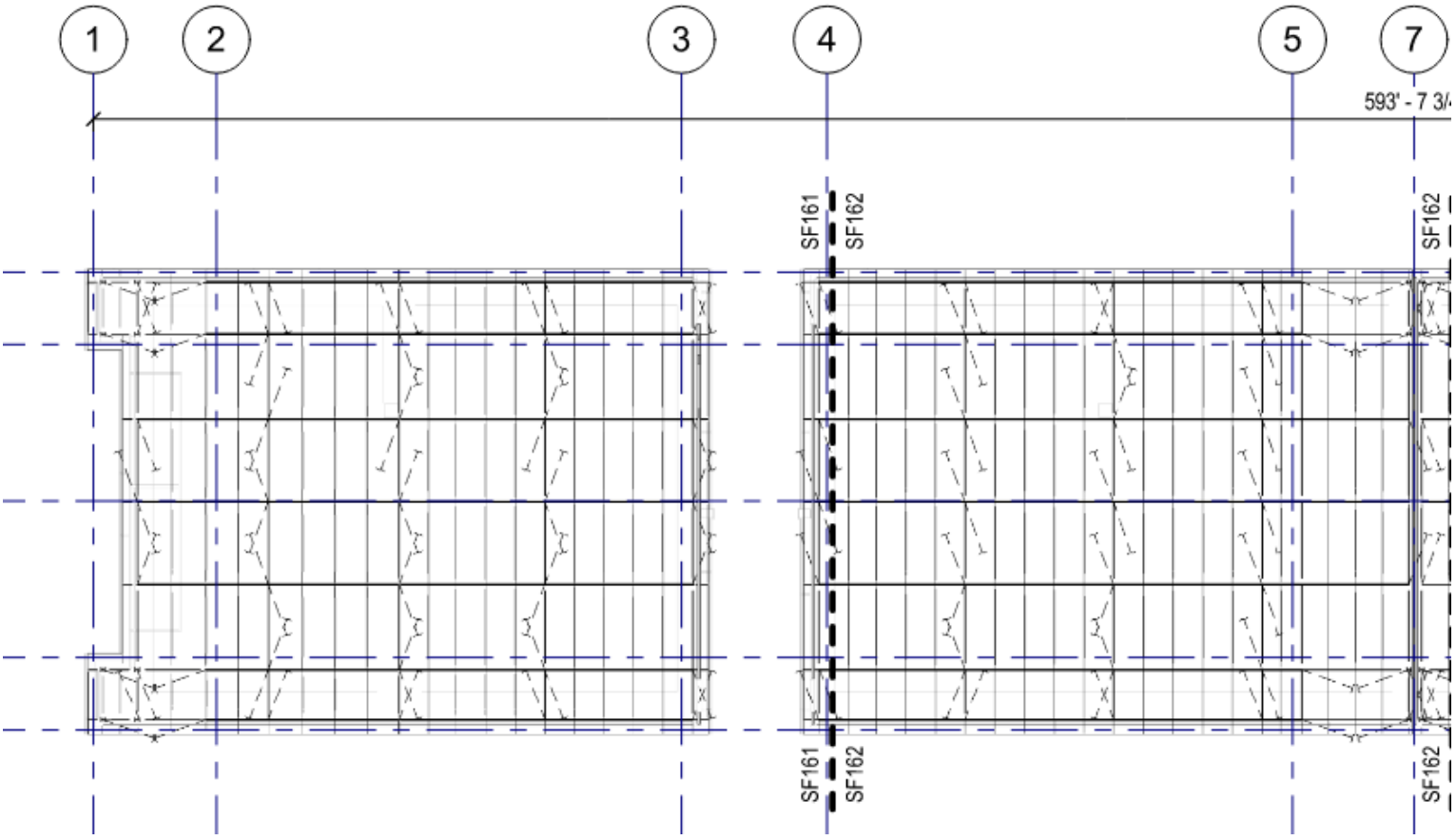
Bare Deck Uniform Load V3.0.2 in accordance with:
AISI S100-16 (2020) w/ S2-20
IAPMO UES ER-0423
IAPMO UES ER-0652
CAN/CSA-S136 (R2021) for Canadian references

Date: 12/4/2024

NOTICE: Design defects that could cause injury or death may result from relying on the information in this document without independent verification by a qualified professional. The information in this document is provided "AS IS". Nucor Corporation and its affiliates expressly disclaim: (i) any and all representations, warranties and conditions and (ii) all liability arising out of or related to this document and the information in it.



Low Roof



High Roof

Low Roof

PROJECT INFO							
Project Number	Project Name	Design Mark	Engineer	Design Method	Load Type	Design Code	Date
-	-	-	-	ASD	Not Reduced	ASCE 7-16	12/04/2024

SPECIFICATIONS							
Designation*	Span (ft)	Tributary Width (ft)	TCXL (ft)	TCXR (ft)	Slope (in/ft)	LL Deflection Limit (L/X)	Min I (in^4)
24K338/150	25	7.5	0	0	0	240	0

UNIFORM LOADS						
All uniform loads are included in designation loading for non-SP joists.						
Dead (psf)	Dead Collateral (psf)	Live (psf)	Live Roof (psf)	Rain (psf)	Snow (psf)	Downward Wind [1.0W] (psf)
25	0	0	20	0	5.5	0

UPLIFT ZONES			
Type	Magnitude (psf)	Start Location (ft)**	Length (ft)
Gross (1.0W)	16	0	25

ESTIMATED PROPERTIES						
All provided properties are accurate for comparison. Contact Vulcraft if exact values are required.						
Self Weight (psf)***	I (in^4)****	LL Deflection (L/X)*****	TC Width (in)	Bridging (T/X/EX/B)	Seat Depth (in)	Max Duct Sizes (Rd | Sq | H x W)******
1.4	173	991 [0.3]	4.00	1/0/0/2	2.50	11" | 9" | 8" x 9"

**Designation loads are unfactored*

***Negative value indicates TCXL location*

****Ensure joist self weight has been included in specified dead load*

*****Minimum moment of inertia should be provided to Vulcraft if required for structural performance*

******Calculated deflections have been increased by 15% to account for shear deformation*

*******Actual duct sizes and locations should be provided to Vulcraft to ensure clearance during final design*

RECORD KEY
pv6XhxqC

Created using the Vulcraft Dynamic Joist Wizard (2024.10.18.3)

High Roof

PROJECT INFO							
Project Number	**Project Name**	**Design Mark**	**Engineer**	**Design Method**	**Load Type**	**Design Code**	**Date**
-	-	-	-	ASD	Not Reduced	ASCE 7-16	12/04/2024

SPECIFICATIONS							
Designation*	**Span (ft)**	**Tributary Width (ft)**	**TCXL (ft)**	**TCXR (ft)**	**Slope (in/ft)**	**LL Deflection Limit (L/X)**	**Min I (in^4)**
16K375/150	19	7.5	0	0	0	240	0

UNIFORM LOADS						
All uniform loads are included in designation loading for non-SP joists.						
Dead (psf)	**Dead Collateral (psf)**	**Live (psf)**	**Live Roof (psf)**	**Rain (psf)**	**Snow (psf)**	**Downward Wind [1.0W] (psf)**
30	0	0	20	0	5.5	0

UPLIFT ZONES			
Type	**Magnitude (psf)**	**Start Location (ft)****	**Length (ft)**
Gross (1.0W)	16	0	19

ESTIMATED PROPERTIES						
All provided properties are accurate for comparison. Contact Vulcraft if exact values are required.						
Self Weight (psf)***	**I (in^4)********	**LL Deflection (L/X)*********	**TC Width (in)**	**Bridging (T/X/EX/B)**	**Seat Depth (in)**	**Max Duct Sizes (Rd | Sq | H x W)**********
1.1	66	859 [0.3]	4.00	1/0/0/2	2.50	8" | 6" | 6" x 7"

**Designation loads are unfactored*

***Negative value indicates TCXL location*

****Ensure joist self weight has been included in specified dead load*

*****Minimum moment of inertia should be provided to Vulcraft if required for structural performance*

******Calculated deflections have been increased by 15% to account for shear deformation*

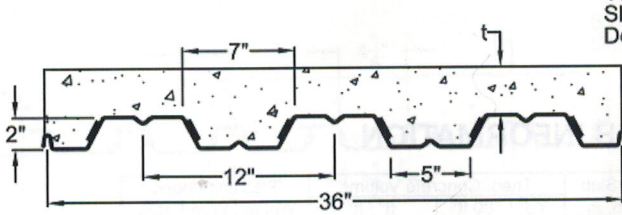
*******Actual duct sizes and locations should be provided to Vulcraft to ensure clearance during final design*

RECORD KEY
pv6XhxqC

Created using the Vulcraft Dynamic Joist Wizard (2024.10.18.3)

2 VLI

Maximum Sheet Length 42'-0
Extra Charge for Lengths Under 6'-0
ICBO Approved (No. 3415)



Interlocking side lap is not drawn to show actual detail.

STEEL SECTION PROPERTIES

Deck Type	Design Thickness in	Deck Weight psf	Section Properties I_p in^4/ft	S_p in^3/ft	I_n in^4/ft	S_n in^3/ft	V_a lbs/ft	F_y ksi
2VLI22	0.0295	1.62	0.324	0.263	0.321	0.266	1832	50
2VLI20	0.0358	1.97	0.409	0.341	0.406	0.346	2698	50
2VLI19	0.0418	2.30	0.492	0.420	0.489	0.426	3190	50
2VLI18	0.0474	2.61	0.559	0.495	0.558	0.504	3608	50
2VLI16	0.0598	3.29	0.704	0.653	0.704	0.653	3618	40

(N=9.35) NORMAL WEIGHT CONCRETE (145 PCF)

TOTAL SLAB DEPTH	DECK TYPE	SDI Max. Unshored Clear Span 1 SPAN	2 SPAN	3 SPAN	Superimposed Live Load, PSF Clear Span (ft.-in.) 5'-6	6'-0	6'-6	7'-0	7'-6	8'-0	8'-6	9'-0	9'-6	10'-0	10'-6	11'-0	11'-6	12'-0
4.00 (t=2.00) 39 PSF	2VLI22	7'-4	9'-6	9'-9	274	239	211	188	145	129	115	104	94	85	78	71	65	59
	2VLI20	8'-7	10'-10	11'-2	310	269	236	210	188	170	155	117	106	96	87	80	73	67
	2VLI19	9'-9	11'-11	12'-4	344	298	261	231	207	186	169	155	142	106	97	88	81	74
	2VLI18	10'-9	12'-9	12'-9	373	324	285	253	228	206	188	172	159	147	137	103	95	87
	2VLI16	11'-1	13'-2	13'-5	400	376	330	292	261	235	214	195	180	166	154	143	109	100
4.50 (t=2.50) 45 PSF	2VLI22	6'-11	9'-0	9'-4	319	278	245	190	168	150	134	121	109	99	90	83	76	69
	2VLI20	8'-2	10'-3	10'-7	361	313	275	244	219	198	152	136	123	112	102	93	85	78
	2VLI19	9'-2	11'-5	11'-9	400	346	303	268	240	216	196	180	136	124	113	103	94	86
	2VLI18	10'-2	12'-4	12'-4	400	376	331	295	264	239	218	200	184	171	130	119	110	102
	2VLI16	10'-5	12'-6	12'-11	400	400	383	339	303	274	248	227	209	193	150	137	126	117
5.00 (t=3.00) 51 PSF	2VLI22	6'-7	8'-7	8'-11	364	317	279	217	192	171	153	138	125	113	103	94	86	79
	2VLI20	7'-9	9'-10	10'-2	400	356	313	278	249	193	173	156	141	128	116	106	97	89
	2VLI19	8'-9	10'-11	11'-3	400	394	345	306	273	247	224	172	156	141	128	117	107	99
	2VLI18	9'-7	11'-10	11'-11	400	400	377	336	301	273	249	228	210	162	148	136	126	116
	2VLI16	9'-11	12'-0	12'-4	400	400	400	386	346	312	283	259	238	187	171	157	144	133
5.50 (t=3.50) 57 PSF	2VLI22	6'-4	8'-0	8'-6	400	355	278	244	216	192	172	155	140	127	116	106	97	89
	2VLI20	7'-5	9'-5	9'-9	400	400	351	312	244	217	194	175	158	143	131	119	109	100
	2VLI19	8'-4	10'-5	10'-9	400	400	388	343	307	277	215	193	175	159	144	132	121	111
	2VLI18	9'-2	11'-4	11'-7	400	400	400	377	338	306	279	256	199	182	167	153	141	130
	2VLI16	9'-5	11'-6	11'-10	400	400	400	400	388	350	318	290	230	210	192	176	162	150
6.00 (t=4.00) 63 PSF	2VLI22	6'-1	7'-5	8'-2	400	394	308	270	239	213	191	172	156	141	129	118	108	99
	2VLI20	7'-1	9'-1	9'-4	400	400	390	346	271	241	215	194	175	159	145	132	121	111
	2VLI19	8'-0	10'-1	10'-5	400	400	400	381	340	307	239	215	194	176	160	146	134	123
	2VLI18	8'-10	10'-11	11'-3	400	400	400	400	375	339	309	243	221	202	185	170	157	145
	2VLI16	9'-1	11'-1	11'-5	400	400	400	400	400	388	352	322	255	233	213	195	180	166
6.50 (t=4.50) 69 PSF	2VLI22	5'-11	6'-11	7'-11	400	390	339	297	263	234	210	189	171	155	141	129	118	108
	2VLI20	6'-11	8'-9	9'-0	400	400	400	337	297	264	237	213	193	175	159	145	133	122
	2VLI19	7'-10	9'-8	10'-0	400	400	400	400	374	293	262	236	213	193	176	161	147	135
	2VLI18	8'-7	10'-6	10'-11	400	400	400	400	400	373	340	268	243	222	203	187	172	159
	2VLI16	8'-10	10'-8	11'-0	400	400	400	400	400	400	387	309	280	256	234	215	198	183

Notes:
1. Minimum exterior bearing length required is 2.00 inches. Minimum interior bearing length required is 4.00 inches. If these minimum lengths are not provided, web crippling must be checked.
2. Always contact Vulcraft when using loads in excess of 200 psf. Such loads often result from concentrated, dynamic, or long term load cases for which reductions due to bond breakage, concrete creep, etc. should be evaluated.
3. All fire rated assemblies are subject to an upper live load limit of 250 psf.

COMPOSITE

AOF End – All beam sections with DC ratios (Gravity Design)

Label	Section	D/C Ratio
1	W8X31	0.078 = 0.011 + 0.06 + 0.007
101	L6X6X5/16	0.158 = 0.061 + 0.077 + 0.021
102	L6X6X5/16	0.07 = 0.038 + 0.015 + 0.016
103	L6X6X5/16	0.161 = 0.088 + 0.053 + 0.021
104	L6X6X5/16	0.128 = 0.079 + 0.03 + 0.019
105	L6X6X5/16	0.124 = 0.076 + 0.029 + 0.019
106	L6X6X5/16	0.16 = 0.082 + 0.053 + 0.025
110	W8X31	0.129 = 0.031 + 0.095 + 0.003
111	W8X31	0.13 = 0.037 + 0.091 + 0.002
112	W8X31	0.13 = 0.037 + 0.091 + 0.002
113	W8X31	0.094 = 0.007 + 0.086 + 0.001
114	W8X31	0.123 = 0.008 + 0.114 + 0.001
115	W8X31	0.15 = 0.015 + 0.135 + 2.992E-04
116	W8X31	0.15 = 0.015 + 0.135 + 2.982E-04
117	W8X31	0.126 = 0.011 + 0.114 + 0.001
118	W8X31	0.092 = 0.022 + 0.068 + 0.002
119	W8X31	0.116 = 0.001 + 0.107 + 0.008
120	W8X31	0.116 = 0.001 + 0.107 + 0.008
121	W8X31	0.092 = 0.022 + 0.068 + 0.002
122	W8X31	0.328 = 0.277 + 0.044 + 0.008
123	W8X31	0.113 = 0.031 + 0.071 + 0.011
124	W8X31	0.113 = 0.032 + 0.07 + 0.011
125	W8X31	0.331 = 0.28 + 0.044 + 0.007
126	W8X31	0.092 = 0.003 + 0.087 + 0.003
127	W8X31	0.093 = 0.01 + 0.08 + 0.003
128	W8X31	0.154 = 0.012 + 0.142 + 0
129	W8X31	0.159 = 0.036 + 0.123 + 0
130	L8X8X1/2	0.301 = 0.21 + 0.046 + 0.045
131	L8X8X1/2	0.207 = 0.112 + 0.048 + 0.046
132	L8X8X1/2	0.315 = 0.224 + 0.046 + 0.045
133	L8X8X1/2	0.205 = 0.11 + 0.048 + 0.046
134	L8X8X1/2	0.12 = 0.01 + 0.056 + 0.054
135	L8X8X1/2	0.164 = 0.069 + 0.048 + 0.046
136	L8X8X1/2	0.121 = 0.01 + 0.057 + 0.054
137	L8X8X1/2	0.164 = 0.07 + 0.048 + 0.046
138	L8X8X1/2	0.198 = 0.092 + 0.055 + 0.051
139	L8X8X1/2	0.167 = 0.061 + 0.055 + 0.051
140	L8X8X1/2	0.187 = 0.081 + 0.055 + 0.051
141	L8X8X1/2	0.159 = 0.035 + 0.064 + 0.06

142	L8X8X5/8	0.161 = 0.061 + 0.05 + 0.05
143	L8X8X5/8	0.446 = 0.349 + 0.049 + 0.049
144	L8X8X5/8	0.118 = 3.092E-04 + 0.059 + 0.058
145	L8X8X5/8	0.86 = 0.762 + 0.049 + 0.049
159	W8X31	0.036 = 0.002 + 0.03 + 0.004
161	W8X31	0.026 = 0 + 0.021 + 0.005
162	W8X31	0.031 = 0 + 0.02 + 0.01
163	L6X6X5/16	0.481 = 0.414 + 0.04 + 0.027
164	L6X6X5/16	0.185 = 0.125 + 0.042 + 0.018
165	L6X6X5/16	0.159 = 0.072 + 0.08 + 0.006
166	L6X6X5/16	0.14 = 0.072 + 0.055 + 0.013
167	L6X6X7/8	0.06 = 0.007 + 0.045 + 0.008
184	W12X50	0.216 = 0.215 + 0.001 + 0
185	W12X50	0.031 = 0.029 + 0.001 + 0
2	W8X31	0.078 = 0.001 + 0.07 + 0.008
20	W12X50	0.246 = 0.243 + 0.003 + 0
21	W12X45	0.008 = 0.006 + 0.001 + 0
22	W12X45	0.084 = 0.078 + 0.006 + 0
23	W12X45	0.012 = 0.01 + 0.001 + 0
24	W12X45	0.252 = 0.246 + 0.006 + 0
240	W12X50	0.075 = 0.073 + 0.002 + 0
241	W12X50	0.065 = 0.063 + 0.002 + 0
257	W8X31	0.312 = 0.302 + 0.01 + 0
273	W8X31	0.415 = 0.405 + 0.01 + 0
28	W12X45	0.012 = 0.011 + 0.001 + 0
289	W8X31	0.305 = 0.295 + 0.01 + 0
29	W12X45	0.256 = 0.25 + 0.006 + 0
290	W8X31	0.007 = 0.003 + 0.004 + 0
291	W8X31	0.03 = 0.016 + 0.015 + 0
292	W8X40	0.03 = 0.017 + 0.013 + 0
293	W8X40	0.03 = 0.017 + 0.013 + 0
294	W8X31	0.031 = 0.016 + 0.015 + 0
295	W8X31	0.008 = 0.004 + 0.004 + 0
296	W8X31	0.009 = 0.005 + 0.004 + 0
297	W8X31	0.026 = 0.011 + 0.015 + 0
298	W8X40	0.025 = 0.012 + 0.013 + 0
299	W8X40	0.026 = 0.013 + 0.013 + 0
3	W8X31	0.051 = 0.019 + 0.024 + 0.008
30	W12X45	0.008 = 0.006 + 0.001 + 0
300	W8X31	0.029 = 0.014 + 0.015 + 0
301	W8X31	0.007 = 0.002 + 0.004 + 0
302	W8X31	0.016 = 4.915E-04 + 0.002 + 0.013

303	W8X31	0.017 = 3.645E-04 + 0.002 + 0.014
307	W8X31	0.059 = 0.003 + 0.029 + 0.026
308	W8X31	0.059 = 0.003 + 0.031 + 0.025
31	W12X45	0.08 = 0.074 + 0.006 + 0
310	W8X31	0.232 = 0.006 + 0.221 + 0.004
311	W8X31	0.214 = 0.006 + 0.207 + 0.001
312	W8X31	0.027 = 0.006 + 0.014 + 0.006
313	W8X31	0.25 = 0.051 + 0.195 + 0.004
314	W8X31	0.253 = 0.053 + 0.197 + 0.004
315	W8X31	0.032 = 0.005 + 0.021 + 0.006
316	W8X31	0.025 = 0.002 + 3.462E-04 + 0.023
318	W12X50	0.031 = 0.028 + 0.002 + 0
319	W8X31	0.032 = 0.001 + 0.001 + 0.03
32	W8X31	0.004 = 0 + 0.004 + 0.001
320	W8X31	0.02 = 0 + 1.947E-04 + 0.02
321	W8X31	0.07 = 0.001 + 0.069 + 0.001
322	W12X50	0.066 = 0.064 + 0.002 + 0
323	W12X50	0.087 = 0.085 + 0.002 + 0
324	W12X50	0.076 = 0.007 + 0.065 + 0.004
325	W12X50	0.238 = 0.052 + 0.072 + 0.114
326	W8X31	0.02 = 0.003 + 0.001 + 0.016
327	W8X31	0.021 = 0.003 + 0.016 + 0.002
328	W8X31	0.02 = 0.001 + 3.603E-04 + 0.019
33	W8X31	0.022 = 0.018 + 0.004 + 0
332	W12X50	0.096 = 0.094 + 0.002 + 0
333	W8X31	0.011 = 0 + 0.001 + 0.01
334	W8X31	0.022 = 0.001 + 0.001 + 0.02
335	W8X31	0.04 = 0.002 + 0.002 + 0.036
336	W12X50	0.234 = 0.053 + 0.071 + 0.11
337	W12X50	0.074 = 0.006 + 0.064 + 0.004
338	W8X31	0.018 = 0.003 + 0.013 + 0.001
339	W8X31	0.02 = 0.001 + 3.191E-04 + 0.019
34	W8X31	0.045 = 0.03 + 0.014 + 0
340	W8X31	0.025 = 0.002 + 2.648E-04 + 0.023
341	W8X31	0.02 = 0.003 + 0.001 + 0.016
345	W8X31	0.027 = 0.001 + 4.56E-04 + 0.026
346	W8X31	0.016 = 1.122E-04 + 0 + 0.015
347	W8X31	0.063 = 0.001 + 0.061 + 0.002
348	W8X31	0.04 = 0.002 + 0.002 + 0.036
349	W8X31	0.013 = 1.282E-04 + 0.001 + 0.011
35	W8X40	0.053 = 0.04 + 0.013 + 0
354	W8X31	0.022 = 0.001 + 0.001 + 0.021

358	W12X45	0.197 = 0.002 + 0.191 + 0.004
359	W12X45	0.121 = 0.024 + 0.096 + 0.001
36	W8X40	0.054 = 0.042 + 0.013 + 0
360	W12X45	0.123 = 0.024 + 0.098 + 0.001
361	W12X45	0.2 = 3.629E-04 + 0.196 + 0.004
362	W8X31	0.042 = 0.006 + 0.036 + 0
363	W8X31	0.088 = 0.002 + 0.086 + 0
364	W8X31	0.061 = 0.029 + 0.031 + 0
365	W8X40	0.098 = 0.07 + 0.028 + 0
366	W8X31	0.312 = 0.007 + 0.304 + 0
367	W8X31	0.112 = 0.081 + 0.031 + 0
368	W8X40	0.23 = 0.019 + 0.212 + 0
369	W8X31	0.052 = 0.021 + 0.031 + 0
37	W8X31	0.047 = 0.033 + 0.014 + 0
370	W8X40	0.236 = 0.026 + 0.21 + 0
371	W8X31	0.06 = 0.029 + 0.031 + 0
372	W8X31	0.318 = 0.024 + 0.294 + 0
373	W8X31	0.094 = 0.007 + 0.086 + 0
374	W8X31	0.093 = 0.006 + 0.086 + 0
375	W8X31	0.306 = 0 + 0.306 + 0
376	W8X40	0.229 = 0.016 + 0.213 + 0
377	W8X40	0.232 = 0.021 + 0.211 + 0
378	W8X31	0.311 = 0.007 + 0.304 + 0
379	W8X31	0.092 = 0.006 + 0.086 + 0
38	W8X31	0.023 = 0.019 + 0.004 + 0
380	W12X50	0.137 = 0.09 + 0.047 + 0.001
381	W12X50	0.012 = 0.01 + 0.002 + 0
384	W12X50	0.037 = 0.035 + 0.002 + 0
385	W12X50	0.007 = 0.001 + 0.006 + 0
386	W12X50	0.116 = 0.054 + 0.061 + 0.001
387	W12X50	0.143 = 0.098 + 0.046 + 3.131E-04
388	W12X50	0.09 = 0.082 + 0.008 + 0
389	W12X50	0.064 = 0.063 + 0.002 + 0
39	W8X31	0.005 = 0 + 0.005 + 0
390	W12X50	0.285 = 0.225 + 0.059 + 0.001
391	W12X50	0.035 = 0.034 + 0.001 + 0
392	W12X50	0.034 = 0.033 + 0.002 + 0
393	W12X50	0.032 = 0.031 + 0.001 + 0
394	W12X50	0.02 = 0.018 + 0.002 + 0
395	W16X31	0.009 = 0.001 + 0.008 + 0
4	W8X31	0.054 = 0.019 + 0.027 + 0.009
40	W8X31	0.053 = 0.029 + 0.023 + 3.06E-04

41	W8X31	0.054 = 0.03 + 0.024 + 1.13E-04
414	HSS3X3X3/8	0.027 = 0.016 + 0.008 + 0.003
415	HSS3X3X3/8	0.033 = 0.018 + 0.01 + 0.005
416	HSS3X3X3/8	0.041 = 0.029 + 0.008 + 0.003
417	HSS3X3X3/8	0.045 = 0.031 + 0.011 + 0.003
418	HSS3X3X3/8	0.045 = 0.033 + 0.008 + 0.003
419	HSS3X3X3/8	0.049 = 0.035 + 0.011 + 0.003
420	HSS3X3X3/8	0.022 = 0.011 + 0.008 + 0.003
421	HSS3X3X3/8	0.028 = 0.013 + 0.01 + 0.005
430	W12X50	0.033 = 0.031 + 0.002 + 0
431	W12X50	0.009 = 0.007 + 0.001 + 0
437	W8X31	0.036 = 0 + 0.026 + 0.01
456	W8X40	0.002 = 0.001 + 0.002 + 0
457	W8X40	0.012 = 0.002 + 0.01 + 0
458	W8X40	0.002 = 2.326E-04 + 0.002 + 0
459	W8X40	0.011 = 0.001 + 0.01 + 0
48	W8X31	0.033 = 0 + 0.027 + 0.006
49	W8X31	0.017 = 0.012 + 0.005 + 0
50	W8X31	0.023 = 0.017 + 0.005 + 0
502	W16X31	0.188 = 2.321E-04 + 0.188 + 0.001
503	W16X31	0.176 = 0 + 0.176 + 0
504	W14X26	0.359 = 0 + 0.359 + 0
505	W16X31	0.175 = 2.092E-04 + 0.174 + 4.038E-04
506	W16X31	0.063 = 0 + 0.063 + 0
507	W16X26	0.371 = 0 + 0.371 + 0
508	W16X31	0.696 = 0 + 0.696 + 0
509	W16X31	0.684 = 0 + 0.684 + 0
51	W8X31	0.151 = 0.037 + 0.111 + 0.003
510	W16X26	0.085 = 0 + 0.085 + 0
511	W16X26	0.085 = 0 + 0.085 + 0
512	W10X12	0.012 = 0 + 0.012 + 0
513	W10X12	0.073 = 1.362E-04 + 0.073 + 0
514	W16X31	0.073 = 1.328E-04 + 0.073 + 1.261E-04
515	W16X31	0.258 = 0 + 0.258 + 0
516	W10X12	0.035 = 0 + 0.035 + 0
517	W10X12	0.013 = 0 + 0.013 + 0
518	W16X31	0.071 = 0 + 0.071 + 1.939E-04
519	W10X12	0.008 = 0 + 0.008 + 4.308E-04
52	W8X31	0.037 = 0.032 + 0.005 + 0
520	WT6X25	0.157 = 0.002 + 0.09 + 0.066
521	W12X50	0.088 = 0.069 + 0.011 + 0.009
522	WT6X25	0.268 = 0.008 + 0.235 + 0.025

523	W12X50	0.282 = 0.24 + 0.038 + 0.004
524	WT6X22.5	0.34 = -0.012 + -0.328 + 0
525	W12X45	0.294 = 0.201 + 0.089 + 0.004
526	WT6X22.5	0.33 = 0.002 + 0.328 + 4.486E-04
527	W12X45	0.361 = 0.277 + 0.084 + 0
528	WT6X22.5	0.34 = -0.012 + -0.327 + 0
529	W12X45	0.228 = 0.077 + 0.151 + 0.001
53	W8X31	0.038 = 0.033 + 0.005 + 0
530	WT6X25	0.27 = 0.009 + 0.235 + 0.026
531	W12X50	0.279 = 0.254 + 0.011 + 0.014
532	WT6X25	0.159 = 0.002 + 0.09 + 0.067
533	W12X50	0.091 = 0.07 + 0.01 + 0.011
534	WT6X22.5	0.349 = -0.019 + 0.327 + 0.041
535	W12X45	0.181 = 0.068 + 0.1 + 0.013
536	WT6X22.5	0.33 = 0.002 + 0.328 + 3.419E-04
537	W12X45	0.439 = 0.365 + 0.073 + 0
538	W8X31	0.018 = 0.002 + 0.001 + 0.015
539	W8X31	0.007 = 0.001 + 0.001 + 0.005
54	W8X31	0.133 = 0.035 + 0.095 + 0.003
540	W8X31	0.007 = 0.001 + 0.001 + 0.005
541	W8X31	0.018 = 0.002 + 0.001 + 0.015
542	W8X31	0.01 = 0.005 + 0.001 + 0.004
543	W8X40	0.01 = 0.004 + 0.001 + 0.005
544	W8X31	0.031 = 0.003 + 0.002 + 0.026
545	W8X31	0.029 = 0.003 + 0.002 + 0.024
546	W8X31	0.09 = 0.007 + 0.004 + 0.079
547	W8X31	0.086 = 0.007 + 0.004 + 0.075
548	W8X31	0.048 = 0.007 + 0.007 + 0.035
549	W8X31	0.051 = 0.006 + 0.009 + 0.036
55	W8X31	0.017 = 0 + 0.013 + 0.004
553	W8X40	0.005 = 0.003 + 0.002 + 0
554	W8X40	0.016 = 0.008 + 0.008 + 0
555	W8X40	0.003 = 4.022E-04 + 0.002 + 0
556	W8X40	0.011 = 0.001 + 0.01 + 0
56	W8X31	0.019 = 0.014 + 0.005 + 0
57	L6X6X7/8	0.195 = 0.118 + 0.064 + 0.013
574	WT6X22.5	0.109 = -0.003 + 0.1 + 0.013
575	W12X45	0.083 = 0.016 + 0.053 + 0.014
576	WT6X22.5	0.273 = 0.002 + 0.26 + 0.011
577	W12X45	0.149 = 0.03 + 0.099 + 0.02
578	WT6X22.5	0.271 = 0.002 + 0.26 + 0.01
579	W12X45	0.144 = 0.028 + 0.097 + 0.019

580	WT6X22.5	0.108 = -0.003 + 0.1 + 0.011
581	W12X45	0.082 = 0.016 + 0.053 + 0.014
582	WT6X22.5	0.351 = -0.018 + 0.327 + 0.042
583	W12X45	0.32 = 0.207 + 0.103 + 0.011
584	W8X31	0.032 = 0.024 + 0.009 + 0
585	W8X40	0.005 = 0.001 + 0.003 + 0
587	W8X40	0.01 = 0.01 + 0 + 0
589	W8X40	0.003 = 3.615E-04 + 0.002 + 0
59	L6X6X5/16	0.163 = 0.064 + 0.077 + 0.022
590	W8X40	0.011 = 0.001 + 0.01 + 0
591	W8X40	0.005 = 0.003 + 0.002 + 0
592	W8X40	0.016 = 0.008 + 0.008 + 0
60	L6X6X5/16	0.063 = 0.033 + 0.016 + 0.014
602	W8X40	0.002 = 0.001 + 0.002 + 0
603	W8X40	0.012 = 0.002 + 0.01 + 0
604	W8X40	0.002 = 2.07E-04 + 0.002 + 0
605	W8X40	0.011 = 0.001 + 0.01 + 0
606	W12X50	0.268 = 0.265 + 0.003 + 0
61	L6X6X5/16	0.165 = 0.091 + 0.053 + 0.021
611	W12X50	0.269 = 0.266 + 0.003 + 0
614	W12X50	0.02 = 0.017 + 0.002 + 0
615	W12X50	0.05 = 0.048 + 0.002 + 0
616	W12X50	0.071 = 0.068 + 0.002 + 0
62	L6X6X5/16	0.149 = 0.095 + 0.046 + 0.007
623	W8X31	0.032 = 0 + 0.026 + 0.006
624	L6X6X5/16	0.131 = 0.055 + 0.064 + 0.013
629	L6X6X5/16	0.115 = 0.055 + 0.051 + 0.009
63	L6X6X5/16	0.129 = 0.07 + 0.052 + 0.007
630	L6X6X5/16	0.26 = 0.195 + 0.05 + 0.015
631	L6X6X5/16	0.105 = 0.057 + 0.027 + 0.022
632	L6X6X5/16	0.197 = 0.13 + 0.055 + 0.012
636	L6X6X5/16	0.099 = 0.051 + 0.04 + 0.008
638	W8X31	0.034 = 0.003 + 0.028 + 0.004
64	L6X6X5/16	0.179 = 0.101 + 0.058 + 0.02
641	W12X50	0.088 = 0.085 + 0.003 + 0
642	L6X6X7/8	0.063 = 0.004 + 0.057 + 0.001
643	W12X50	0.087 = 0.084 + 0.003 + 0
644	W12X50	0.071 = 0.069 + 0.002 + 0
646	W12X50	0.065 = 0.059 + 0.006 + 0
647	W12X50	0.222 = 0.216 + 0.005 + 0
648	W12X50	0.208 = 0.203 + 0.005 + 0
649	W12X50	0.09 = 0.087 + 0.003 + 0

65	L6X6X7/8	0.532 = 0.462 + 0.049 + 0.021
650	W12X50	0.212 = 0.205 + 0.007 + 0
651	W12X50	0.042 = 0.035 + 0.008 + 0
652	L6X6X7/8	0.52 = 0.459 + 0.04 + 0.021
655	W12X50	0.226 = 0.223 + 0.003 + 0
656	W12X50	0.24 = 0.237 + 0.003 + 0
657	W12X50	0.232 = 0.229 + 0.003 + 0
661	W12X50	0.046 = 0.044 + 0.002 + 0
662	W12X50	0.066 = 0.064 + 0.002 + 0
663	W12X50	0.085 = 0.082 + 0.003 + 0
664	W12X50	0.089 = 0.086 + 0.003 + 0
665	W12X50	0.089 = 0.085 + 0.003 + 0
667	W12X50	0.047 = 0.046 + 0.002 + 0
669	W12X50	0.221 = 0.214 + 0.007 + 0
67	L6X6X5/16	0.085 = 0.022 + 0.05 + 0.013
670	W12X50	0.219 = 0.218 + 0.001 + 0
671	W12X50	0.03 = 0.029 + 0.001 + 0
673	W12X50	0.033 = 0.031 + 0.002 + 0
674	W12X50	0.07 = 0.068 + 0.002 + 0
675	W12X50	0.093 = 0.09 + 0.002 + 0
679	W12X50	0.092 = 0.09 + 0.002 + 0
68	L6X6X7/8	0.734 = 0.669 + 0.049 + 0.016
680	W12X50	0.059 = 0.058 + 0.002 + 0
681	W12X50	0.032 = 0.03 + 0.002 + 0
70	L6X6X5/16	0.142 = 0.117 + 0.013 + 0.012
71	L6X6X5/16	0.169 = 0.083 + 0.065 + 0.02
710	W12X50	0.006 = 0.004 + 0.001 + 0
711	W12X50	0.023 = 0.021 + 0.002 + 0
712	W12X50	0.06 = 0.058 + 0.002 + 0
713	W12X50	0.038 = 0.036 + 0.002 + 0
72	L6X6X5/16	0.049 = 0.006 + 0.04 + 0.004
73	L6X6X5/16	0.129 = 0.062 + 0.065 + 0.002
74	L6X6X5/16	0.168 = 0.104 + 0.06 + 0.005
75	L6X6X5/16	0.116 = 0.067 + 0.036 + 0.012
78	L6X6X5/16	0.234 = 0.147 + 0.075 + 0.012
79	W8X31	0.03 = 0 + 0.024 + 0.006
80	W8X31	0.016 = 0.011 + 0.005 + 0
81	W8X31	0.022 = 0.016 + 0.005 + 0
82	W8X31	0.139 = 0.033 + 0.103 + 0.003
83	W8X31	0.035 = 0.03 + 0.005 + 0
84	W8X31	0.036 = 0.031 + 0.005 + 0
85	W8X31	0.12 = 0.034 + 0.086 + 4.425E-04

86	W8X31	0.017 = 0 + 0.014 + 0.003
87	W8X31	0.021 = 0.016 + 0.005 + 0
88	L6X6X7/8	0.73 = 0.665 + 0.053 + 0.012
90	L6X6X5/16	0.144 = 0.118 + 0.011 + 0.015
91	L6X6X5/16	0.162 = 0.079 + 0.061 + 0.021
92	L6X6X5/16	0.045 = 0.005 + 0.026 + 0.014
93	L6X6X5/16	0.13 = 0.07 + 0.04 + 0.021
94	L6X6X5/16	0.145 = 0.085 + 0.039 + 0.021
95	L6X6X5/16	0.112 = 0.072 + 0.02 + 0.02
99	L6X6X7/8	0.21 = 0.136 + 0.065 + 0.009

AOF Middle – All beam sections with DC ratios (Gravity Design)

Label	Section	D/C Ratio
100	W8X31	0.08 = 0.012 + 0.063 + 0.004
101	W8X31	0.066 = 0.018 + 0.042 + 0.005
102	W8X31	0.162 = 0.092 + 0.066 + 0.004
103	W8X31	0.162 = 0.092 + 0.066 + 0.004
104	W8X31	0.069 = 0.013 + 0.055 + 0.002
105	W8X31	0.183 = 0.095 + 0.085 + 0.003
106	W8X31	0.182 = 0.095 + 0.085 + 0.003
107	W8X31	0.081 = 0.012 + 0.064 + 0.004
108	W8X31	0.102 = 0.029 + 0.061 + 0.011
109	W8X31	0.102 = 0.029 + 0.061 + 0.011
110	W8X31	0.067 = 0.018 + 0.043 + 0.005
111	W8X31	0.086 = 0.007 + 0.075 + 0.005
112	W8X31	0.113 = 0.023 + 0.084 + 0.006
113	W8X31	0.113 = 0.023 + 0.084 + 0.006
114	W8X31	0.086 = 0.007 + 0.075 + 0.005
115	W8X31	0.131 = 0.046 + 0.078 + 0.007
116	W8X31	0.392 = 0.324 + 0.063 + 0.004
117	W8X31	0.392 = 0.324 + 0.063 + 0.004
118	W8X31	0.131 = 0.046 + 0.078 + 0.007
131	L6X6X5/16	0.31 = 0.253 + 0.034 + 0.023
136	L6X6X5/16	0.128 = 0.083 + 0.034 + 0.011
138	L6X6X5/16	0.107 = 0.079 + 0.013 + 0.015
140	L6X6X5/16	0.097 = 0.07 + 0.012 + 0.014
163	W12X72	0.017 = 0.005 + 0.011 + 0.001
165	W8X40	0.017 = 0.005 + 0.001 + 0.012
173	W8X31	0.35 = 0.34 + 0.01 + 0
183	W8X31	0.023 = 0.005 + 0.001 + 0.017
191	W8X31	0.421 = 0.412 + 0.008 + 3.162E-04
20	W8X31	0.01 = 0.006 + 0.004 + 0
201	W8X31	0.017 = 0.007 + 0.001 + 0.01
209	W8X31	0.349 = 0.339 + 0.01 + 0
21	W8X31	0.02 = 0.002 + 0.018 + 0
217	W8X40	0.005 = 0 + 0.005 + 0
218	W8X31	0.025 = 0.01 + 0.015 + 0
219	W8X40	0.039 = 0.025 + 0.014 + 0
22	W8X40	0.04 = 0.027 + 0.013 + 0
220	W8X40	0.038 = 0.025 + 0.014 + 0
221	W8X31	0.025 = 0.01 + 0.015 + 0
222	W8X40	0.005 = 4.132E-04 + 0.005 + 0

23	W8X40	0.04 = 0.027 + 0.013 + 0
230	W8X40	0.081 = 0.037 + 0.041 + 0.003
231	W12X72	0.017 = 0.003 + 0.011 + 0.003
24	W8X31	0.02 = 0.002 + 0.018 + 0
248	W12X72	0.065 = 0.049 + 0.011 + 0.005
249	W8X31	0.126 = 0.1 + 0.024 + 0.002
25	W8X31	0.01 = 0.006 + 0.004 + 0
250	W8X31	0.083 = 0.039 + 0.042 + 0.002
251	L8X8X3/4	0.143 = 0.041 + 0.068 + 0.035
252	L8X8X3/4	0.16 = 0.044 + 0.082 + 0.034
253	L8X8X3/4	0.18 = 0.071 + 0.075 + 0.033
255	L8X8X3/4	0.663 = 0.555 + 0.071 + 0.037
256	W8X31	0.087 = 0.062 + 0.025 + 3.531E-04
257	W8X31	0.422 = 0.391 + 0.028 + 0.004
258	W8X31	0.092 = 0.062 + 0.026 + 0.003
259	W8X31	0.413 = 0.384 + 0.029 + 0.001
26	W8X31	0.01 = 0.006 + 0.004 + 0
260	L8X8X3/4	0.172 = 0.071 + 0.067 + 0.035
261	L8X8X3/4	0.663 = 0.557 + 0.069 + 0.036
262	L8X8X3/4	0.151 = 0.095 + 0.049 + 0.007
263	L8X8X3/4	0.158 = 0.044 + 0.078 + 0.036
264	W8X31	0.127 = 0.098 + 0.029 + 3.382E-04
265	W8X31	0.089 = 0.04 + 0.046 + 0.003
266	W12X72	0.099 = 0.079 + 0.011 + 0.008
267	W12X72	0.016 = 0.002 + 0.013 + 0.002
268	W8X31	0.021 = 0.003 + 0.002 + 0.017
269	W8X31	0.046 = 0.003 + 0.027 + 0.017
27	W8X31	0.021 = 0.004 + 0.017 + 0
270	L6X6X5/16	0.153 = 0.115 + 0.028 + 0.011
272	L6X6X5/16	0.299 = 0.268 + 0.023 + 0.008
274	W8X31	0.043 = 0.002 + 0.004 + 0.037
275	W8X31	0.019 = 0.007 + 4.842E-04 + 0.012
276	W8X40	0.013 = 0.002 + 0.001 + 0.01
279	W8X40	0.01 = 0.002 + 4.547E-04 + 0.008
28	W8X40	0.019 = 0.004 + 0.016 + 0
281	L6X6X5/16	0.128 = 0.087 + 0.029 + 0.011
283	L6X6X5/16	0.087 = 0.057 + 0.023 + 0.007
284	W8X31	0.006 = 0 + 0.005 + 0.001
285	W8X31	0.032 = 0.003 + 0.022 + 0.007
286	W8X31	0.021 = 0.001 + 0.002 + 0.018
287	W8X31	0.071 = 0.01 + 0.015 + 0.046
288	W8X31	0.042 = 0.003 + 0.003 + 0.036

289	W12X72	0.089 = 0.071 + 0.011 + 0.007
29	W8X40	0.019 = 0.004 + 0.016 + 0
290	W12X72	0.047 = 0.034 + 0.011 + 0.002
293	W12X72	0.059 = 0.044 + 0.011 + 0.003
295	W8X31	0.072 = 0.013 + 0.014 + 0.044
296	W8X31	0.024 = 0.002 + 0.002 + 0.02
297	W8X31	0.037 = 0.004 + 0.023 + 0.009
298	W8X31	0.006 = 4.985E-04 + 0.006 + 1.958E-04
299	W8X31	0.046 = 0.004 + 0.028 + 0.014
30	W8X31	0.021 = 0.004 + 0.018 + 0
300	W8X31	0.017 = 0.002 + 0.001 + 0.014
301	W12X72	0.076 = 0.057 + 0.011 + 0.008
303	W12X72	0.049 = 0.032 + 0.011 + 0.006
305	W8X31	0.016 = 0 + 0.014 + 0.002
306	W8X31	0.016 = 0 + 0.014 + 0.002
307	W8X31	0.016 = 3.769E-04 + 0.015 + 1.615E-04
309	L6X6X5/16	0.106 = 0.071 + 0.023 + 0.012
31	W8X31	0.01 = 0.006 + 0.004 + 0
311	W12X72	0.057 = 0.044 + 0.011 + 0.002
312	W12X72	0.048 = 0.033 + 0.011 + 0.004
313	W12X72	0.029 = 0.014 + 0.011 + 0.004
315	W8X31	0.016 = 3.263E-04 + 0.015 + 1.683E-04
316	L6X6X5/16	0.115 = 0.078 + 0.025 + 0.012
318	L6X6X5/16	0.061 = 0.019 + 0.03 + 0.012
32	W8X40	0.065 = 0.015 + 0.047 + 0.003
321	W8X31	0.018 = 0 + 0.014 + 0.003
322	W8X31	0.017 = 0 + 0.014 + 0.003
33	W8X40	0.02 = 0.016 + 0.004 + 0
334	W12X72	0.009 = 0.007 + 0.002 + 0
335	L6X6X5/16	0.083 = 0.031 + 0.042 + 0.011
338	W8X31	0.017 = 0 + 0.015 + 0.002
339	W8X31	0.015 = 1.121E-04 + 0.015 + 0
34	W8X31	0.014 = 0.002 + 0.009 + 0.002
340	W8X31	0.015 = 0 + 0.015 + 2.333E-04
341	HSS3X3X3/8	0.015 = 0.003 + 0.011 + 0.001
342	HSS3X3X3/8	0.017 = 0.002 + 0.013 + 0.002
347	HSS3X3X3/8	0.032 = 0.022 + 0.008 + 0.002
348	HSS3X3X3/8	0.035 = 0.023 + 0.01 + 0.001
349	HSS3X3X3/8	0.033 = 0.022 + 0.008 + 0.002
35	W8X31	0.024 = 0.009 + 0.015 + 0
350	HSS3X3X3/8	0.035 = 0.024 + 0.01 + 0.001
355	HSS3X3X3/8	0.02 = 0.008 + 0.011 + 0.001

356	HSS3X3X3/8	0.016 = 0.001 + 0.013 + 0.002
36	W8X40	0.056 = 0.044 + 0.013 + 0
361	W8X31	0.018 = 0 + 0.015 + 0.003
362	W8X31	0.017 = 0 + 0.015 + 0.003
37	W8X40	0.056 = 0.044 + 0.013 + 0
379	WT6X36	0.085 = -0.003 + 0.079 + 0.009
38	W8X31	0.024 = 0.009 + 0.015 + 0
380	W12X72	0.113 = 0.004 + 0.047 + 0.062
39	W8X40	0.02 = 0.016 + 0.004 + 0
391	W12X45	0.136 = 0.031 + 0.098 + 0.007
392	W12X45	0.028 = 0.001 + 0.006 + 0.021
395	W12X45	0.263 = 0.026 + 0.223 + 0.014
396	W12X45	0.069 = 0 + 0.014 + 0.055
399	W8X31	0.043 = 0.003 + 0.036 + 0.004
40	W8X40	0.065 = 0.015 + 0.047 + 0.003
400	W12X72	0.076 = 0.001 + 0.011 + 0.064
401	W8X31	0.042 = 0.003 + 0.035 + 0.004
402	W8X31	0.046 = 0.011 + 0.032 + 0.003
403	W8X31	0.046 = 0.012 + 0.032 + 0.003
404	W12X72	0.014 = 0.002 + 0.011 + 4.599E-04
405	W8X31	0.067 = 0.031 + 0.018 + 0.018
407	W8X31	0.069 = 0.032 + 0.018 + 0.019
408	W12X72	0.075 = 0.001 + 0.011 + 0.063
41	W8X31	0.015 = 0.003 + 0.01 + 0.003
410	W12X72	0.017 = 0.015 + 0.002 + 0
411	W12X45	0.261 = 0.025 + 0.223 + 0.013
412	W12X45	0.069 = 0 + 0.014 + 0.054
413	W12X45	0.103 = 0.09 + 0.012 + 0
414	W12X45	0.283 = 0.269 + 0.013 + 0.002
415	W12X45	0.137 = 0.034 + 0.097 + 0.007
416	W12X45	0.033 = 0.001 + 0.006 + 0.025
417	W12X45	0.264 = 0.254 + 0.01 + 0
418	W12X45	0.106 = 0.095 + 0.01 + 4.203E-04
419	W12X45	0.214 = 0.204 + 0.01 + 0
42	W8X40	0.081 = 0.036 + 0.041 + 0.003
420	WT6X36	0.245 = -0.002 + 0.2 + 0.047
421	W12X72	0.22 = 0.026 + 0.064 + 0.13
422	W12X45	0.059 = 0.045 + 0.014 + 0
423	W12X45	0.082 = 0.069 + 0.012 + 0
424	WT6X25	0.33 = -0.001 + 0.296 + 0.035
425	W12X72	0.183 = 0.033 + 0.15 + 0.001
428	WT6X25	0.297 = -0.001 + -0.297 + 0

429	W12X72	0.206 = 0.039 + 0.167 + 0
43	W8X31	0.011 = 0.003 + 0.003 + 0.006
432	WT6X25	0.296 = -2.208E-04 + 0.259 + 0.037
433	W12X72	0.183 = 0.033 + 0.149 + 0.001
435	W12X72	0.017 = 0.015 + 0.002 + 0
436	WT6X36	0.244 = -0.002 + 0.2 + 0.045
437	W12X72	0.209 = 0.025 + 0.064 + 0.12
438	W12X72	0.047 = 0.033 + 0.011 + 0.002
439	W12X72	0.059 = 0.044 + 0.011 + 0.003
44	W8X31	0.011 = 0.003 + 0.003 + 0.006
440	WT6X36	0.093 = -0.003 + 0.079 + 0.017
441	W12X72	0.114 = 0.018 + 0.019 + 0.077
442	W12X72	0.057 = 0.044 + 0.011 + 0.002
443	W12X72	0.048 = 0.033 + 0.011 + 0.004
444	W12X72	0.029 = 0.014 + 0.011 + 0.004
445	W12X72	0.009 = 0.007 + 0.002 + 0
45	W12X45	0.059 = 0.059 + 0 + 0.001
47	W12X72	0.119 = 0.095 + 0.023 + 0.001
49	W12X72	0.119 = 0.095 + 0.023 + 0.001
51	W8X31	0.012 = 0.007 + 0.005 + 0
52	W8X31	0.071 = 0.024 + 0.045 + 0.002
53	W8X31	0.027 = 0.022 + 0.005 + 0
54	W8X31	0.075 = 0.027 + 0.045 + 0.002
55	W8X31	0.017 = 0.012 + 0.005 + 0
56	W8X31	0.018 = 0.006 + 0.011 + 0.001
57	W8X31	0.013 = 0.007 + 0.005 + 0
58	W8X31	0.069 = 0.024 + 0.043 + 0.002
59	W8X31	0.027 = 0.022 + 0.005 + 0
60	W8X31	0.073 = 0.027 + 0.044 + 0.002
61	W8X31	0.017 = 0.012 + 0.005 + 0
62	W8X31	0.017 = 0.006 + 0.01 + 0.001
63	L6X6X5/16	0.331 = 0.273 + 0.042 + 0.016
64	L6X6X5/16	0.127 = 0.084 + 0.032 + 0.012
65	L6X6X5/16	0.102 = 0.077 + 0.019 + 0.006
66	L6X6X5/16	0.095 = 0.072 + 0.016 + 0.007
67	L6X6X5/16	0.148 = 0.112 + 0.023 + 0.012
68	L6X6X5/16	0.292 = 0.261 + 0.01 + 0.021
69	L6X6X5/16	0.143 = 0.05 + 0.077 + 0.017
70	L6X6X5/16	0.454 = 0.398 + 0.05 + 0.006
71	L6X6X5/16	0.125 = 0.054 + 0.058 + 0.013
72	L6X6X5/16	0.485 = 0.428 + 0.045 + 0.012
73	L6X6X5/16	0.131 = 0.06 + 0.061 + 0.01

74	L6X6X5/16	0.294 = 0.273 + 0.011 + 0.01
75	L6X6X5/16	0.122 = 0.087 + 0.022 + 0.013
76	L6X6X5/16	0.076 = 0.048 + 0.007 + 0.021
77	L6X6X5/16	0.095 = 0.067 + 0.019 + 0.009
78	L6X6X5/16	0.104 = 0.077 + 0.019 + 0.009
79	L6X6X5/16	0.066 = 0.018 + 0.038 + 0.01
80	L6X6X5/16	0.088 = 0.033 + 0.04 + 0.015
81	W12X72	0.017 = 0.005 + 0.011 + 0.002
83	W8X31	0.017 = 0 + 0.014 + 0.002
84	W12X72	0.076 = 0.056 + 0.011 + 0.008
86	W12X72	0.049 = 0.032 + 0.011 + 0.006
87	L6X6X5/16	0.142 = 0.05 + 0.072 + 0.02
88	L6X6X5/16	0.454 = 0.396 + 0.043 + 0.014
89	L6X6X5/16	0.128 = 0.053 + 0.064 + 0.011
90	L6X6X5/16	0.482 = 0.428 + 0.046 + 0.009
91	L6X6X5/16	0.131 = 0.059 + 0.058 + 0.014
92	L6X6X5/16	0.294 = 0.272 + 0.012 + 0.01
94	W12X72	0.098 = 0.079 + 0.011 + 0.008
96	W12X72	0.089 = 0.071 + 0.011 + 0.007
98	W12X72	0.065 = 0.049 + 0.011 + 0.005
99	W8X31	0.068 = 0.012 + 0.054 + 0.002

AOF End - Beam 375

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story5	B665	375	113.25	DStlS5	Special Concentrically Braced Frame	W8X31	Non-Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
226.5000	0.944	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.012	0.025	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
9.13	0.54	110	37.1	6.96	2.28

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
27.5	9.28	30.4	14.1	3.4711	2.0158	531.09

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	216.4	3.4711	62.344	200	62.344	300
Minor (2-2)	1	216.4	2.0158	107.351	200	107.351	300

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
113.25	-5.649	30.8684	0	-3.883E-04	-0.001	-0.0009

Axial Force & Biaxial Moment Design Factors (H1.3b,H1-2,M)

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	0.955	1	1	1	1	1

	L Factor	K_1	K_2	B_1	B_2	C_m
Minor Bending	0.955	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
0.955	1	1.143

Demand/Capacity (D/C) Ratio Eqn.(H1.3b,H1-2,M)

D/C Ratio =	$(M_{r33} / C_b M_{c33})$
0.306 =	0.306

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
5.649	176.904	410.85

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	30.8684	100.7351	113.8774	88.1634
Minor Bending	0	52.7913		

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	3.883E-04	68.4	5.677E-06
Minor Shear	0.001	187.92	5.962E-06

End Reaction Major Shear Forces

Left End Reaction (kip)	Load Combo	Right End Reaction (kip)	Load Combo
6.847	DStlS5	6.847	DStlS5

AOF End - Beam 387

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story5	B66	387	1004.9844	DStlS5	Special Concentrically Braced Frame	W12X50	Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
1292.6190	1	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
-0.176	-0.045	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
14.6	1.71	391	56.3	10.34	4.51

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
64.1	13.94	71.9	21.3	5.175	1.9637	1879.83

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	199.132	5.175	38.479	200	38.479	300
Minor (2-2)	1	398.2622	1.9637	202.811	200	202.811	300

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
1004.9844	128.211	8.8209	0.025	0.064	-0.006	0.001

Axial Force & Biaxial Moment Design Factors (H1.2,H1-1b)

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	0.154	1	1	1	1	1

	L Factor	K_1	K_2	B_1	B_2	C_m
Minor Bending	0.308	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
0.308	1	1.707

Demand/Capacity (D/C) Ratio Eqn.(H1.2,H1-1b)

D/C Ratio =	$(P_r /2P_c) + (M_{r33} /M_{c33}) + (M_{r22} /M_{c22})$
0.143 =	0.098 + 0.046 + 3.131E-04

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
128.211	80.188	657

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	8.8209	193.5009	269.625	113.3293
Minor Bending	0.025	79.875		

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	0.064	135.42	4.758E-04
Minor Shear	0.006	279.245	2.005E-05

End Reaction Major Shear Forces

Left End Reaction (kip)	Load Combo	Right End Reaction (kip)	Load Combo
0.943	DStlS5	1.212	DStlS5

AOF End - Beam 537

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story5	B728	537	348.7804	DStlS5	Special Concentrically Braced Frame	W12X45	Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
697.5343	1	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.184	0.256	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
13.1	1.26	348	50	9.26	4.05

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
57.52	12.42	64.2	19	5.1541	1.9537	1660.07

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	174.3902	5.1541	33.835	200	33.835	300
Minor (2-2)	1	174.3836	1.9537	89.26	200	89.26	300

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
348.7804	-120.32	-17.1528	0.0012	-9.359	0.001	-0.0001

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	0.25	1	1	1	1	1

	L Factor	K_1	K_2	B_1	B_2	C_m
Minor Bending	0.25	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
0.25	1	1.057

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.439 =	0.365 + 0.073 + 1.491E-05

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
120.32	329.22	589.5

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	17.1528	208.0233	240.75	196.8055
Minor Bending	0.0012	71.25		

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	9.359	121.605	0.077
Minor Shear	0.001	249.953	0

End Reaction Major Shear Forces

Left End Reaction (kip)	Load Combo	Right End Reaction (kip)	Load Combo
10.315	DStlS5	9.62	DStlS5

AOF Middle - Beam 47

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story1	B81	47	518.0612	DStlS2	Special Concentrically Braced Frame	W12X72	Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
1621.7580	1	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
-0.17	-0.529	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
21.1	2.93	597	195	16.08	5.29

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
97.07	32.5	108	49.2	5.3192	3.04	6524.79

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	1611.358	5.3192	302.933	200	302.933	300
Minor (2-2)	1	405.44	3.04	133.368	200	133.368	300

Stress Check Message - l/r > 300

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
518.0612	179.721	8.4642	-0.1549	-0.077	-0.002	0.0024

Axial Force & Biaxial Moment Design Factors (H1.2,H1-1b)

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	0.994	1	1	1	1	1
Minor Bending	0.25	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
0.25	1	1.334

Demand/Capacity (D/C) Ratio Eqn.(H1.2,H1-1b)

D/C Ratio =	$(P_r /2P_c) + (M_{r33} /M_{c33}) + (M_{r22} /M_{c22})$
0.119 =	0.095 + 0.023 + 0.001

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
179.721	51.943	949.5

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	8.4642	367.4604	405	275.5437
Minor Bending	0.1549	184.5		

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	0.077	158.67	4.869E-04
Minor Shear	0.002	434.16	0

End Reaction Major Shear Forces

Left End Reaction (kip)	Load Combo	Right End Reaction (kip)	Load Combo
1.508	DStlS2	0.93	DStlS2

AOF Middle - Beam 437

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story5	B193	437	1146.7412	DStlS2	Special Concentrically Braced Frame	W12X72	Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
1337.8649	1	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.033	0.026	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
21.1	2.93	597	195	16.08	5.29

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
97.07	32.5	108	49.2	5.3192	3.04	6524.79

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	204.2253	5.3192	38.394	200	38.394	300
Minor (2-2)	1	204.2253	3.04	67.179	200	67.179	300

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
1146.7412	-34.366	26.0564	22.1099	1.235	7.061	-0.0108

Axial Force & Biaxial Moment Design Factors (H1-1b)

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	0.153	1	1	1	1	1

	L Factor	K_1	K_2	B_1	B_2	C_m
Minor Bending	0.153	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
0.153	1	1.128

Demand/Capacity (D/C) Ratio Eqn.(H1-1b)

D/C Ratio =	$(P_r /2P_c) + (M_{r33} /M_{c33}) + (M_{r22} /M_{c22})$
0.209 =	0.025 + 0.064 + 0.12

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
34.366	682.632	949.5

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	26.0564	405	405	369.7229
Minor Bending	22.1099	184.5		

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	1.235	158.67	0.008
Minor Shear	7.061	434.16	0.016

End Reaction Major Shear Forces

Left End Reaction (kip)	Load Combo	Right End Reaction (kip)	Load Combo
10.332	DStlS2	8.013	DStlS2

AOF End – All column sections with DC ratios (Gravity Design)

Label	Section	D/C Ratio
11	W10X68	0.059 = 0.046 + 0.013 + 0
12	W10X68	0.069 = 0.062 + 0.006 + 1.637E-04
13	W10X68	0.092 = 0.092 + 4.343E-04 + 0
14	W10X60	0.072 = 0.04 + 0.003 + 0.029
146	W10X68	0.061 = 0.012 + 0.047 + 0.002
148	W10X68	0.061 = 0.002 + 0.05 + 0.01
149	W10X68	0.142 = 0.038 + 0.07 + 0.034
16	W10X68	0.015 = 0.01 + 0.004 + 0.001
17	W10X68	0.015 = 0.008 + 0.005 + 0.001
170	W10X68	0.101 = 0.02 + 0.08 + 0.002
171	W8X31	0.006 = 0.006 + 0 + 0
172	W10X68	0.107 = 0.013 + 0.086 + 0.008
173	W10X68	0.227 = 0.099 + 0.095 + 0.033
175	W8X31	0.004 = 0.004 + 0 + 0
176	W8X31	0.267 = 0.267 + 0 + 0
181	W8X31	0.015 = 0.015 + 0 + 0
182	W8X31	0.003 = 0.003 + 0 + 0
183	W8X31	0.025 = 0.025 + 0 + 0
194	W10X68	0.098 = 0.019 + 0.078 + 0.002
195	W8X31	0.005 = 0.005 + 0 + 0
196	W10X68	0.105 = 0.013 + 0.084 + 0.008
197	W10X68	0.224 = 0.096 + 0.094 + 0.033
200	W8X31	0.01 = 0.01 + 0 + 0
205	W8X31	0.012 = 0.012 + 0 + 0
206	W8X31	0.007 = 0.007 + 0 + 0
207	W8X31	0.122 = 0.032 + 0.04 + 0.05
208	W8X31	0.002 = 0.002 + 0 + 0
209	W8X31	0.008 = 0.008 + 0 + 0
218	W10X68	0.06 = 0.012 + 0.047 + 0.002
220	W10X68	0.06 = 0.002 + 0.049 + 0.009
221	W10X68	0.143 = 0.037 + 0.071 + 0.035
231	W8X31	0.051 = 0.051 + 0 + 0
232	W8X31	0.056 = 0.056 + 0 + 0
233	W8X31	0.04 = 0.04 + 0 + 0
234	W8X31	0.029 = 0.029 + 0 + 0
236	W8X31	0.017 = 0.017 + 0 + 0
237	W8X31	0.026 = 0.026 + 0 + 0
238	W8X31	0.033 = 0.033 + 0 + 0
242	W8X31	0.014 = 0.014 + 0 + 0

243	W10X68	0.098 = 0.029 + 0.067 + 0.001
244	W8X31	0.038 = 0.038 + 0 + 0
245	W8X31	0.028 = 0.028 + 0 + 0
246	W8X31	0.027 = 0.027 + 0 + 0
247	W8X31	0.003 = 0.003 + 0 + 0
248	W8X31	0.021 = 0.021 + 0 + 0
249	W8X31	0.055 = 0.055 + 0 + 0
25	W10X68	0.135 = 0.078 + 0.052 + 0.005
258	W8X31	0.03 = 0.03 + 0 + 0
259	W10X68	0.138 = 0.051 + 0.087 + 2.228E-04
26	W10X68	0.174 = 0.092 + 0.082 + 2.152E-04
260	W8X31	0.072 = 0.072 + 0 + 0
261	W8X31	0.044 = 0.044 + 0 + 0
262	W8X31	0.01 = 0.01 + 0 + 0
263	W8X31	0.01 = 0.01 + 0 + 0
264	W8X31	0.049 = 0.049 + 0 + 0
265	W8X31	0.084 = 0.084 + 0 + 0
27	W10X68	0.142 = 0.085 + 0.053 + 0.005
274	W8X31	0.014 = 0.014 + 0 + 0
275	W10X68	0.097 = 0.029 + 0.067 + 0.001
276	W8X31	0.038 = 0.038 + 0 + 0
277	W8X31	0.027 = 0.027 + 0 + 0
278	W8X31	0.026 = 0.026 + 0 + 0
279	W8X31	0.001 = 0.001 + 0 + 0
280	W8X31	0.027 = 0.027 + 0 + 0
281	W8X31	0.063 = 0.063 + 0 + 0
317	W8X31	0.336 = 0.336 + 0 + 0
329	W8X31	0.089 = 0.089 + 0 + 0
330	W8X31	0.066 = 0.066 + 0 + 0
356	W10X68	0.089 = 0.019 + 0.068 + 0.002
357	W10X68	0.016 = 0.016 + 0 + 0
382	W10X60	0.025 = 0.008 + 0.005 + 0.013
383	W8X31	0.275 = 0.275 + 0 + 0
396	W10X68	0.046 = 0.038 + 0.006 + 0.003
401	W10X68	0.082 = 0.056 + 0.007 + 0.019
432	W8X31	0.057 = 0.057 + 0 + 0
433	W8X31	0.076 = 0.076 + 0 + 0
447	W10X68	0.011 = 0.009 + 0.002 + 0.001
448	W10X68	0.013 = 0.008 + 0.004 + 0.002
449	W10X68	0.054 = 0.012 + 0.04 + 0.002
450	W10X68	0.007 = 0.003 + 0.002 + 0.002
451	W10X68	0.021 = 0.009 + 0.005 + 0.007

452	W10X68	0.06 = 0.007 + 0.043 + 0.01
453	W10X68	0.072 = 0.059 + 0.005 + 0.007
454	W10X68	0.093 = 0.058 + 0.021 + 0.014
455	W10X68	0.162 = 0.088 + 0.057 + 0.017
464	W10X68	0.101 = 0.05 + 0.005 + 0.046
465	W10X68	0.075 = 0.056 + 0.004 + 0.016
466	W10X60	0.063 = 0.043 + 0.016 + 0.003
467	W10X60	0.072 = 0.046 + 0.013 + 0.013
468	W10X60	0.108 = 0.083 + 0.013 + 0.012
469	W10X60	0.105 = 0.072 + 0.014 + 0.018
486	W10X60	0.044 = 0.027 + 0.016 + 0.002
487	W10X68	0.039 = 0.026 + 0.009 + 0.004
488	W10X60	0.074 = 0.048 + 0.025 + 0.001
489	W10X68	0.057 = 0.023 + 0.005 + 0.029
490	W10X60	0.075 = 0.048 + 0.026 + 0.001
491	W10X68	0.045 = 0.012 + 0.003 + 0.03
492	W10X60	0.044 = 0.027 + 0.015 + 0.002
493	W10X68	0.048 = 0.04 + 0.006 + 0.003
494	W10X68	0.11 = 0.037 + 0.072 + 0
495	W10X68	0.029 = 0.015 + 0.01 + 0.003
496	W10X68	0.123 = 0.048 + 0.074 + 0
497	W10X68	0.075 = 0.06 + 0.009 + 0.006
498	W10X68	0.114 = 0.039 + 0.075 + 2.21E-04
499	W10X68	0.141 = 0.059 + 0.074 + 0.008
5	W10X60	0.075 = 0.075 + 0 + 0
550	W10X68	0.397 = 0.38 + 0.01 + 0.006
551	W10X68	0.417 = 0.377 + 0.029 + 0.011
552	W10X68	0.542 = 0.463 + 0.068 + 0.011
562	W10X68	0.02 = 0.016 + 0.004 + 3.627E-04
563	W10X68	0.02 = 0.014 + 0.005 + 0.001
564	W10X68	0.086 = 0.019 + 0.067 + 0.001
565	W10X68	0.044 = 0.037 + 0.005 + 0.003
567	W10X68	0.074 = 0.06 + 0.008 + 0.006
568	W10X68	0.139 = 0.059 + 0.072 + 0.008
569	W10X68	0.378 = 0.362 + 0.01 + 0.006
570	W10X68	0.398 = 0.359 + 0.029 + 0.01
571	W10X68	0.528 = 0.45 + 0.067 + 0.011
593	W10X68	0.016 = 0.014 + 0.001 + 0.001
594	W10X68	0.018 = 0.013 + 0.004 + 0.001
595	W10X68	0.053 = 0.011 + 0.04 + 0.001
596	W10X68	0.006 = 0.001 + 0.002 + 0.003
597	W10X68	0.02 = 0.008 + 0.005 + 0.007

598	W10X68	0.058 = 0.006 + 0.042 + 0.009
599	W10X68	0.065 = 0.054 + 0.005 + 0.007
6	W10X60	0.256 = 0.256 + 0 + 0
600	W10X68	0.087 = 0.052 + 0.022 + 0.013
601	W10X68	0.16 = 0.086 + 0.058 + 0.017
612	W8X31	0.09 = 0.09 + 0 + 0
672	W8X31	0.346 = 0.346 + 0 + 0
676	W8X31	0.092 = 0.092 + 0 + 0
677	W8X31	0.069 = 0.069 + 0 + 0
683	W8X31	0.058 = 0.058 + 0 + 0
684	W8X31	0.078 = 0.078 + 0 + 0
685	W8X31	0.092 = 0.092 + 0 + 0
687	W8X31	0.003 = 0.003 + 0 + 0
690	W8X31	0.01 = 0.01 + 0 + 0
691	W8X31	0.002 = 0.002 + 0 + 0
692	W8X31	0.008 = 0.008 + 0 + 0
7	W10X60	0.02 = 0.007 + 0.001 + 0.012
701	W8X31	0.052 = 0.052 + 0 + 0
702	W8X31	0.056 = 0.056 + 0 + 0
703	W8X31	0.041 = 0.041 + 0 + 0
704	W8X31	0.03 = 0.03 + 0 + 0
706	W8X31	0.018 = 0.018 + 0 + 0
707	W8X31	0.026 = 0.026 + 0 + 0
708	W8X31	0.033 = 0.033 + 0 + 0
8	W10X60	0.028 = 0.018 + 0.001 + 0.009

AOF Middle – All column sections with DC ratios (Gravity Design)

Label	Section	D/C Ratio
1	W10X68	0.175 = 0.044 + 0.13 + 0.001
10	W10X68	0.018 = 0.013 + 0.001 + 0.004
11	W10X68	0.028 = 0.021 + 0.002 + 0.004
119	W10X68	0.056 = 0.04 + 0.016 + 0.001
12	W10X68	0.042 = 0.017 + 0.025 + 1.443E-04
13	W10X68	0.115 = 0.093 + 0.021 + 0.002
133	W10X60	0.137 = 0.049 + 0.087 + 0.001
134	W10X68	0.054 = 0.007 + 0.047 + 0
135	W10X68	0.081 = 0.049 + 0.03 + 0.002
14	W10X68	0.038 = 0.015 + 0.021 + 0.002
149	W10X60	0.068 = 0.023 + 0.045 + 0
15	W10X68	0.26 = 0.227 + 0.033 + 0
150	W10X68	0.041 = 0.018 + 0.023 + 0
151	W10X68	0.055 = 0.039 + 0.016 + 0
16	W10X68	0.115 = 0.092 + 0.02 + 0.002
166	W8X31	0.054 = 0.054 + 0 + 0
167	W8X31	0.022 = 0.022 + 0 + 0
168	W8X31	0.005 = 0.005 + 0 + 0
169	W8X31	0.02 = 0.02 + 0 + 0
17	W10X68	0.36 = 0.342 + 0.009 + 0.008
170	W8X31	0.039 = 0.039 + 0 + 0
171	W8X31	0.014 = 0.014 + 0 + 0
172	W8X31	0.023 = 0.023 + 0 + 0
18	W10X68	0.708 = 0.685 + 0.017 + 0.006
181	W10X68	0.189 = 0.053 + 0.137 + 0
182	W10X68	0.054 = 0.018 + 0.036 + 0
184	W8X31	0.063 = 0.063 + 0 + 0
185	W8X31	0.032 = 0.032 + 0 + 0
186	W8X31	0.008 = 0.008 + 0 + 0
187	W8X31	0.031 = 0.031 + 0 + 0
188	W8X31	0.057 = 0.057 + 0 + 0
189	W8X31	0.077 = 0.077 + 0 + 0
19	W10X68	0.357 = 0.34 + 0.009 + 0.008
190	W8X31	0.099 = 0.099 + 0 + 0
199	W10X68	0.176 = 0.043 + 0.131 + 0.001
2	W10X60	0.073 = 0.024 + 0.049 + 2.249E-04
200	W10X68	0.038 = 0.015 + 0.021 + 0.002
202	W8X31	0.054 = 0.054 + 0 + 0
203	W8X31	0.022 = 0.022 + 0 + 0

204	W8X31	0.005 = 0.005 + 0 + 0
205	W8X31	0.02 = 0.02 + 0 + 0
206	W8X31	0.039 = 0.039 + 0 + 0
207	W8X31	0.013 = 0.013 + 0 + 0
208	W8X31	0.022 = 0.022 + 0 + 0
227	W10X60	0.277 = 0.25 + 0.023 + 0.004
228	W10X68	0.018 = 0.013 + 0.001 + 0.004
229	W10X68	0.707 = 0.685 + 0.017 + 0.006
232	W10X60	0.138 = 0.049 + 0.088 + 0.001
233	W10X68	0.054 = 0.007 + 0.048 + 0
234	W10X68	0.081 = 0.049 + 0.03 + 0.002
235	W8X31	0.063 = 0.063 + 0 + 0
236	W8X31	0.016 = 0.016 + 0 + 0
237	W8X31	0.076 = 0.076 + 0 + 0
3	W10X60	0.088 = 0.061 + 0.023 + 0.004
330	W8X31	0.011 = 0.011 + 0 + 0
331	W8X31	0.018 = 0.018 + 0 + 0
332	W8X31	0.038 = 0.038 + 0 + 0
336	W8X31	0.028 = 0.028 + 0 + 0
337	W8X31	0.006 = 0.006 + 0 + 0
363	W8X31	0.029 = 0.029 + 0 + 0
4	W10X68	0.251 = 0.217 + 0.03 + 0.004
446	W8X31	0.044 = 0.044 + 0 + 0
447	W8X31	0.226 = 0.226 + 0 + 0
454	W8X31	0.063 = 0.063 + 0 + 0
455	W8X31	0.017 = 0.017 + 0 + 0
456	W8X31	0.076 = 0.076 + 0 + 0
472	W8X31	0.012 = 0.012 + 0 + 0
473	W8X31	0.018 = 0.018 + 0 + 0
474	W8X31	0.038 = 0.038 + 0 + 0
475	W8X31	0.029 = 0.029 + 0 + 0
476	W8X31	0.006 = 0.006 + 0 + 0
477	W8X31	0.028 = 0.028 + 0 + 0
48	W8X31	0.019 = 0.019 + 0 + 0
5	W10X68	0.227 = 0.201 + 0.026 + 0
6	W10X68	0.253 = 0.219 + 0.03 + 0.004
7	W10X60	0.275 = 0.247 + 0.024 + 0.003
8	W10X60	0.089 = 0.062 + 0.022 + 0.004
82	W8X31	0.019 = 0.019 + 0 + 0
85	W8X31	0.044 = 0.044 + 0 + 0
9	W10X68	0.027 = 0.021 + 0.002 + 0.004
93	W8X31	0.227 = 0.227 + 0 + 0

AOF End - Column 6

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story5	C158	6	0	DStlS5	Special Concentrically Braced Frame	W10X60	Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
288.0000	0.508	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.098	0.2	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
17.7	2.48	341	116	13.74	4.28

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
66.86	22.97	74.6	35	4.3893	2.56	2645.67

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	276.4036	4.3893	62.973	200	62.973	300
Minor (2-2)	1	276.4036	2.56	107.97	200	107.97	300

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
0	-86.903	0	0	-0.06	-0.005	0

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K_1	K_2	B_1	B_2	C_m

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	0.96	1	1	1	1	1
Minor Bending	0.96	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
0.96	1	1

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.256 =	0.256 + 0 + 0

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
86.903	339.634	796.5

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	0	226.7516	279.75	226.7516
Minor Bending	0	131.25		

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	0.06	128.52	4.67E-04
Minor Shear	0.005	370.872	1.426E-05

AOF End - Column 571

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story5	C63	571	75.76	DStlS5	Special Concentrically Braced Frame	W10X68	Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
87.9600	0.5	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.161	0.355	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
19.9	3.56	394	134	15.55	4.89

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
75.77	26.53	85.3	40.1	4.4496	2.5949	3065.46

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	75.76	4.4496	17.026	200	17.026	300
Minor (2-2)	1	291.76	2.5949	112.435	200	112.435	300

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
75.76	-159.819	24.1173	-1.8554	-5.509	0.051	-0.005

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K_1	K_2	B_1	B_2	C_m

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	0.861	1	1	1	1	0.413
Minor Bending	3.317	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
3.317	1	1.894

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r / P_c) + (8/9)(M_{r33} / M_{c33}) + (8/9)(M_{r22} / M_{c22})$
0.528 =	0.45 + 0.067 + 0.011

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
159.819	355.337	895.5

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	24.1173	319.875	319.875	261.3327
Minor Bending	1.8554	150.375		

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	5.509	146.64	0.038
Minor Shear	0.051	419.958	1.222E-04

AOF Middle - Column 15

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story1	C33	15	311.9	DStlS2	Special Concentrically Braced Frame	W10X68	Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
324.0000	0.479	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.071	0.179	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
19.9	3.56	394	134	15.55	4.89

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
75.77	26.53	85.3	40.1	4.4496	2.5949	3065.46

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	311.9	4.4496	70.096	200	70.096	300
Minor (2-2)	1	311.9	2.5949	120.196	200	120.196	300

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
311.9	-70.518	-11.9975	-0.0036	0.413	1.348E-04	0

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	0.963	1	1	1	1	0.6

	L Factor	K_1	K_2	B_1	B_2	C_m
Minor Bending	0.963	1	1	1	1	0.6

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
0.963	1	1.61

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.26 =	0.227 + 0.033 + 2.144E-05

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
70.518	311.182	895.5

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	11.9975	319.875	319.875	254.8463
Minor Bending	0.0036	150.375		

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	0.413	146.64	0.003
Minor Shear	1.348E-04	419.958	0

AOF Middle - Column 229

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story1	C6	229	291.66	DStlS2	Special Concentrically Braced Frame	W10X68	Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
303.9600	0.79	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.245	0.54	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
19.9	3.56	394	134	15.55	4.89

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
75.77	26.53	85.3	40.1	4.4496	2.5949	3065.46

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	291.66	4.4496	65.547	200	65.547	300
Minor (2-2)	1	291.66	2.5949	112.396	200	112.396	300

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
291.66	-243.449	-5.972	-1.0212	0.228	0.02	-0.0016

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	0.96	1	1	1	1	0.6

	L Factor	K_1	K_2	B_1	B_2	C_m
Minor Bending	0.96	1	1	1	1	0.599

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
0.96	1	1.492

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.707 =	0.685 + 0.017 + 0.006

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
243.449	355.563	895.5

Moments and Capacities

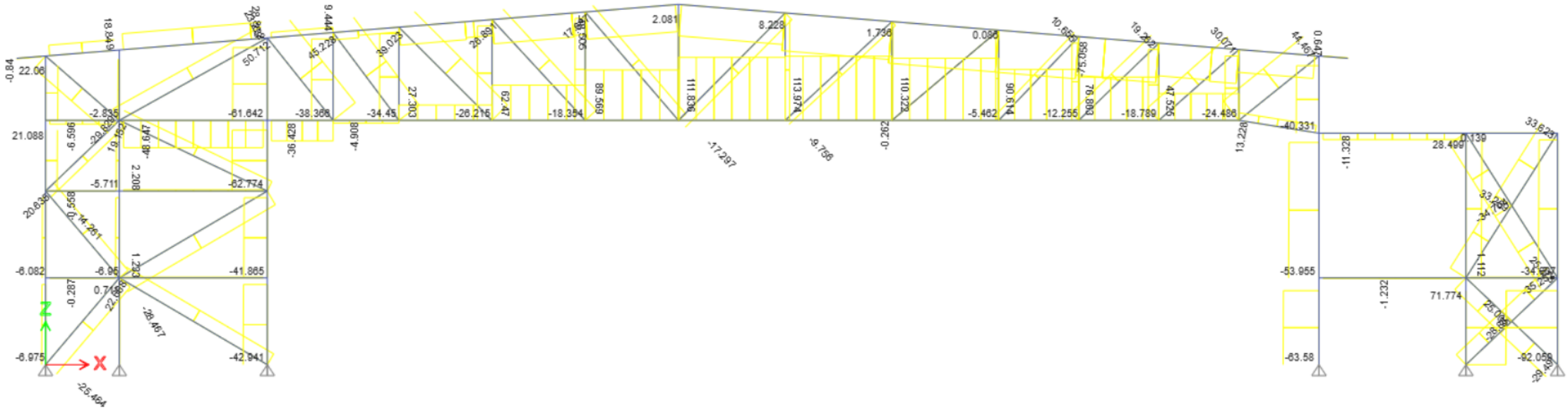
	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	5.972	319.875	319.875	261.3649
Minor Bending	1.0212	150.375		

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	0.228	146.64	0.002
Minor Shear	0.02	419.958	4.688E-05

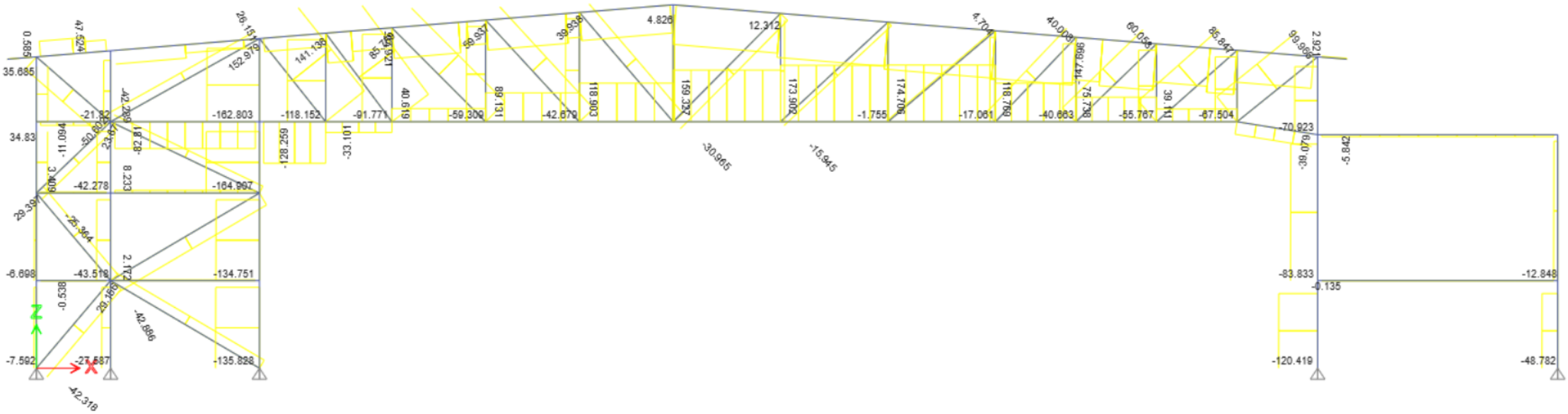
AOF End - Axial Load Distribution (1.2DL+1.6LL)

Elevation A.1



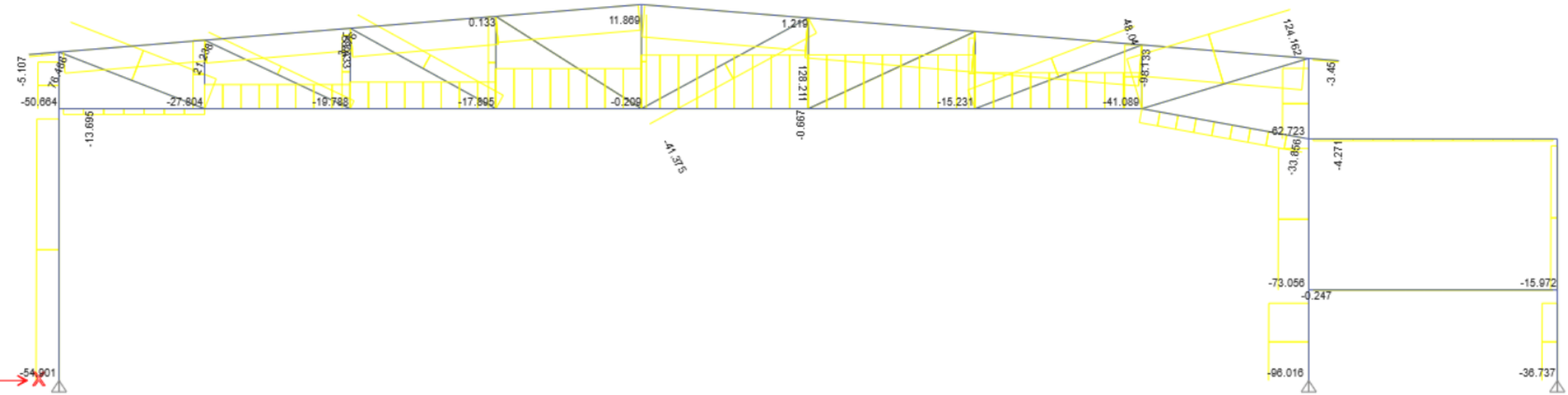
AOF End - Axial Load Distribution (1.2DL+1.6LL)

Elevation A.9



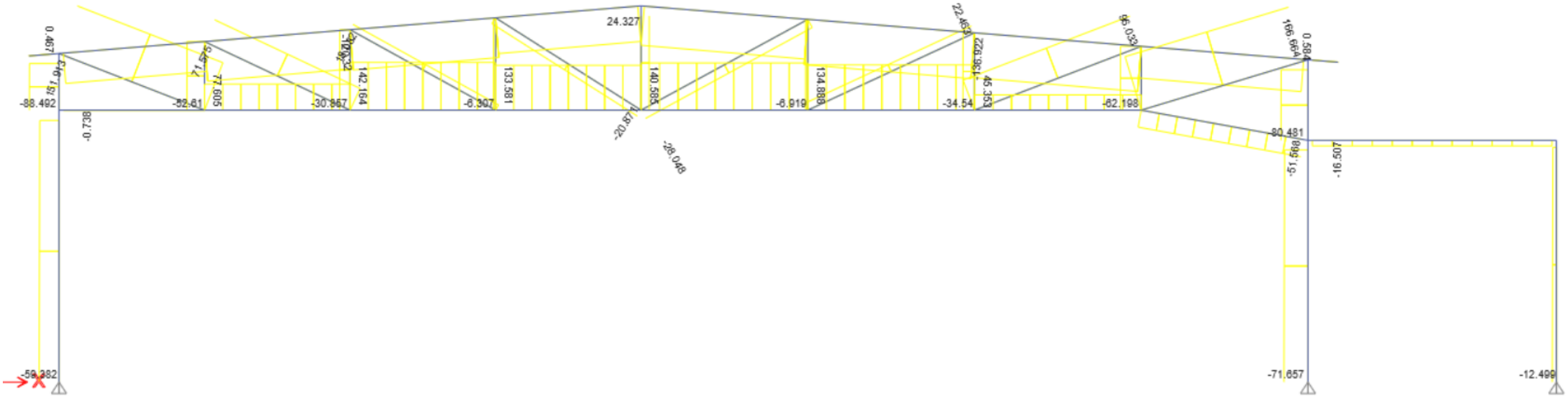
AOF End - Axial Load Distribution (1.2DL+1.6LL)

Elevation C



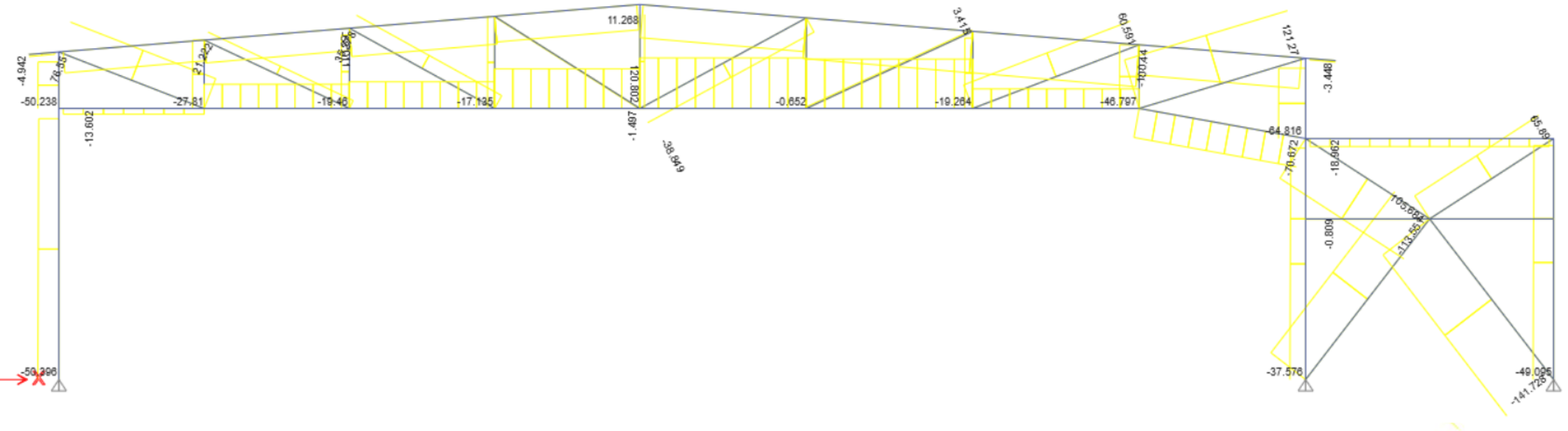
AOF End - Axial Load Distribution (1.2DL+1.6LL)

Elevation D



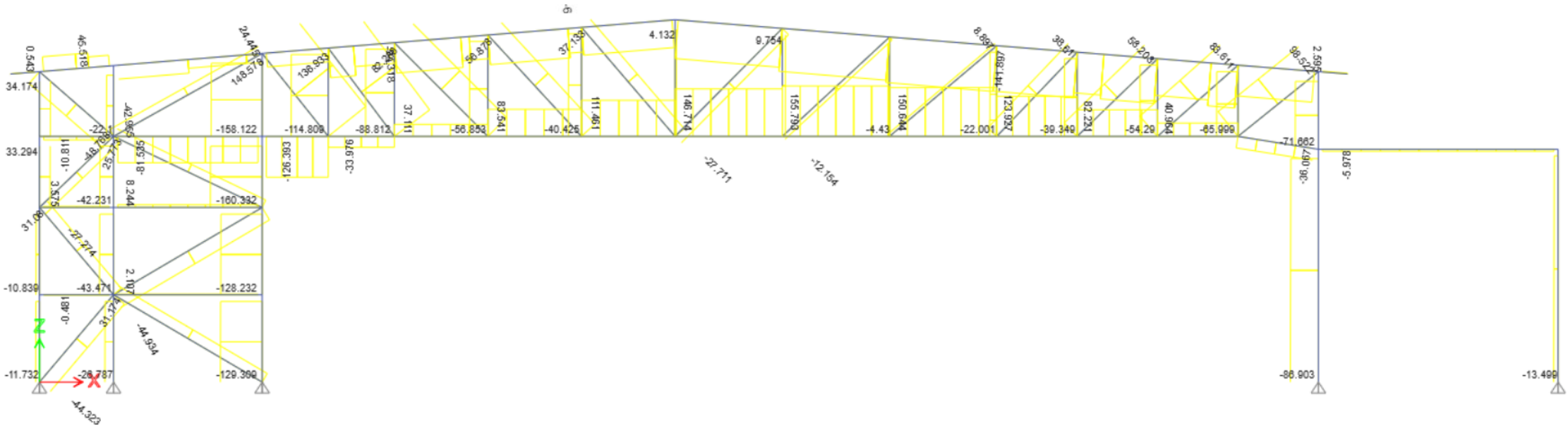
AOF End - Axial Load Distribution (1.2DL+1.6LL)

Elevation E



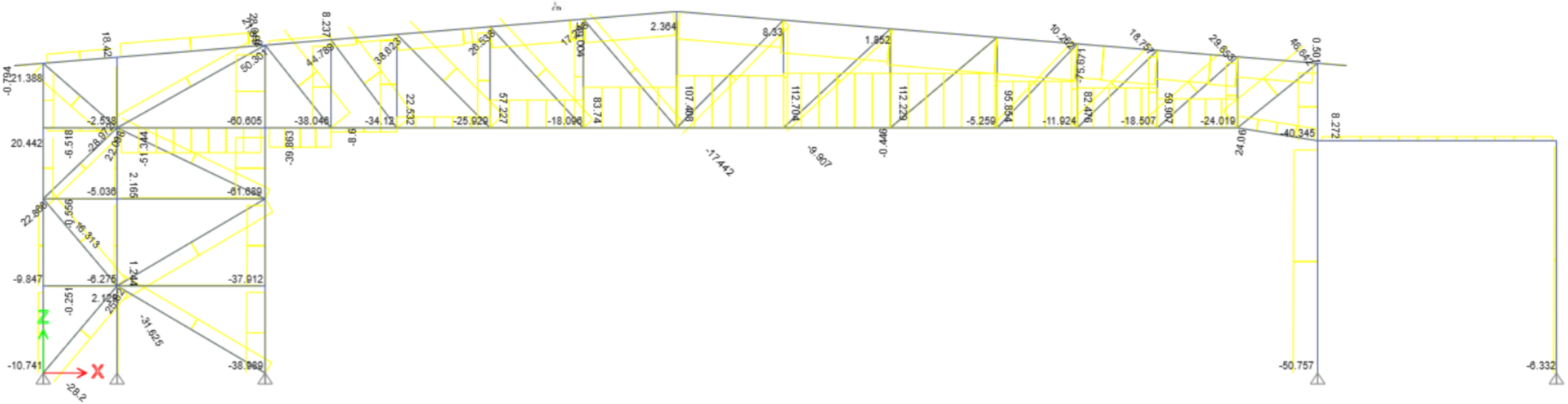
AOF End - Axial Load Distribution (1.2DL+1.6LL)

Elevation F.1

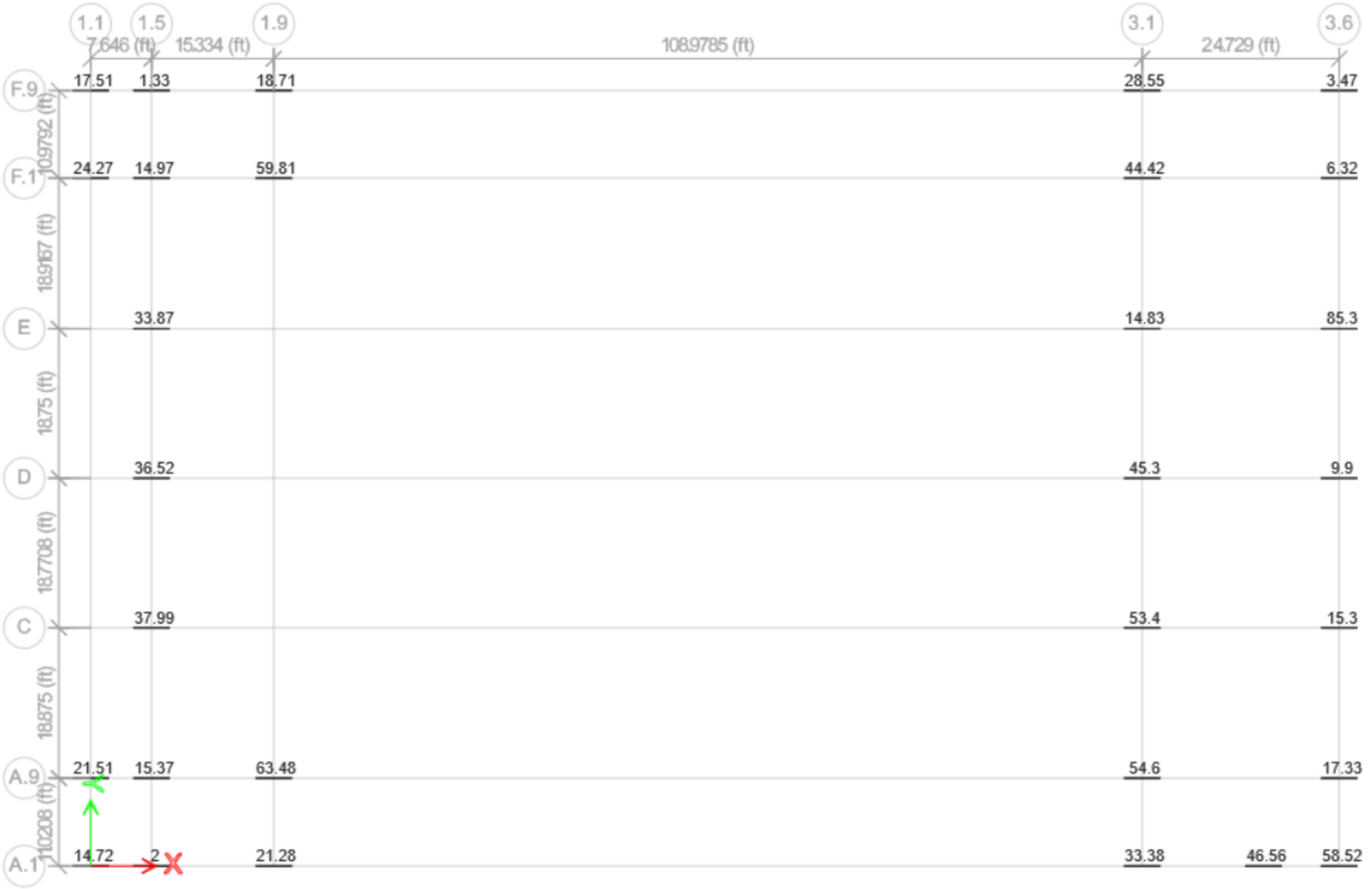


AOF End - Axial Load Distribution (1.2DL+1.6LL)

Elevation F.9



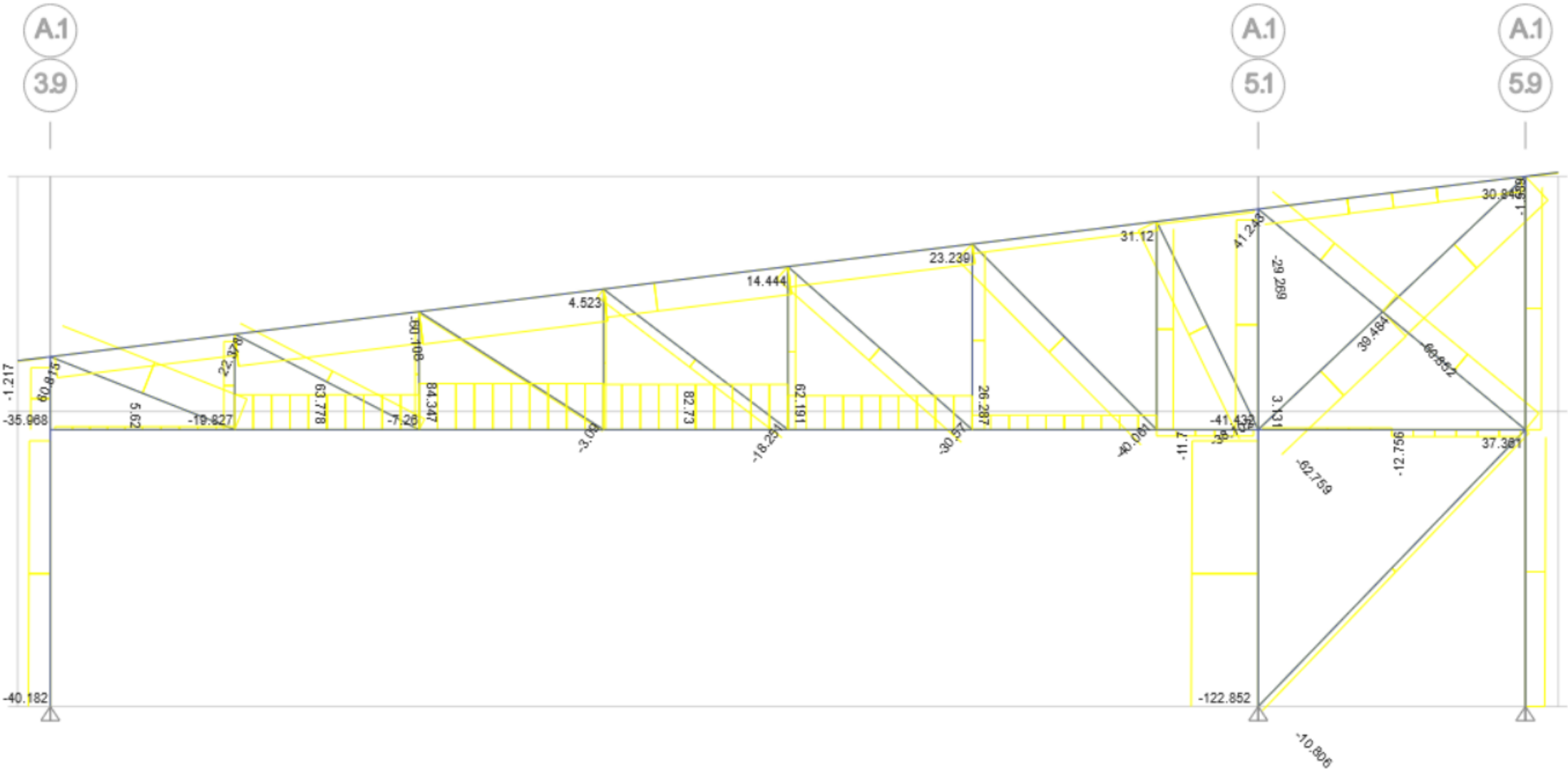
AOF End - Base Reactions (Dead)



AOF End - Base Reactions (Live)

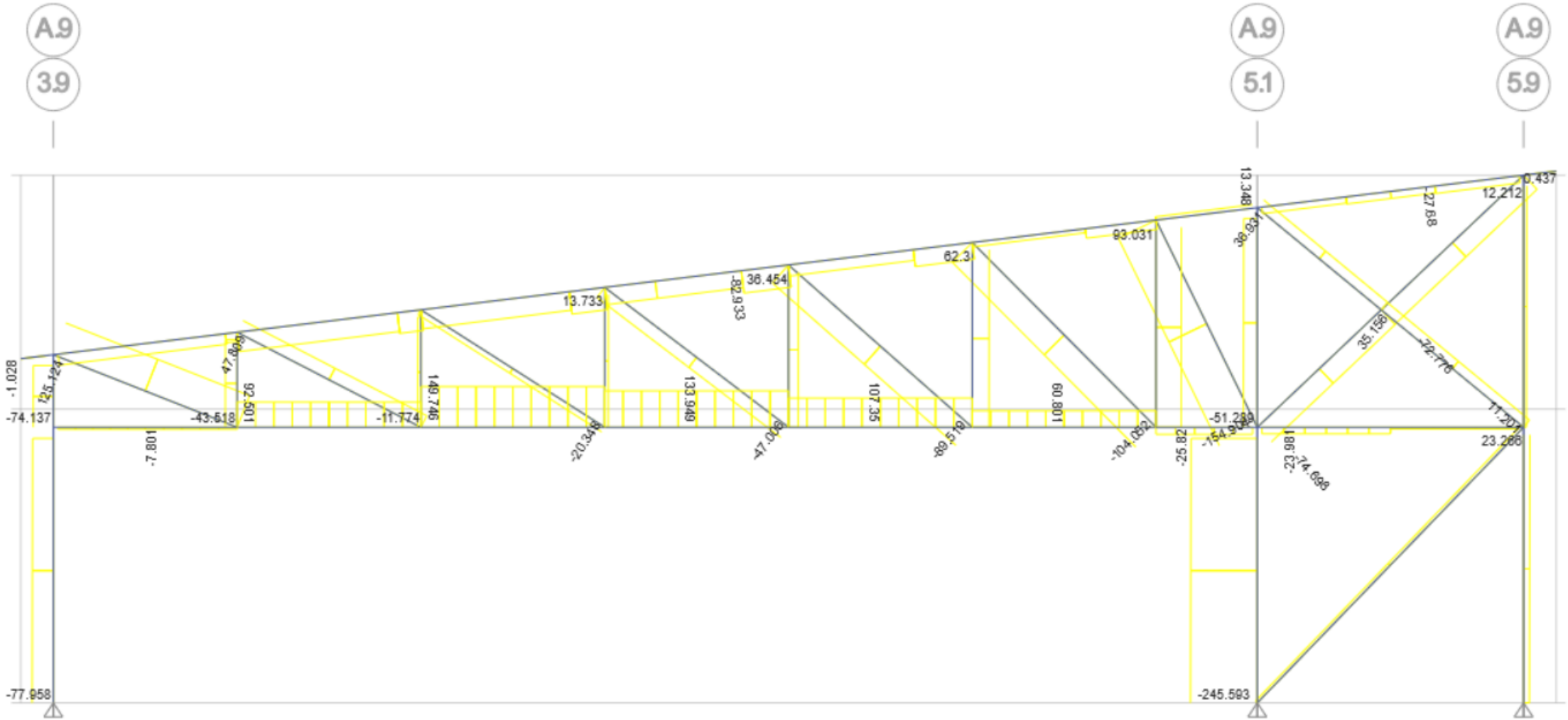
AOF Middle - Axial Load Distribution (1.2DL+1.6LL)

Elevation A.1



AOF Middle - Axial Load Distribution (1.2DL+1.6LL)

Elevation A.9

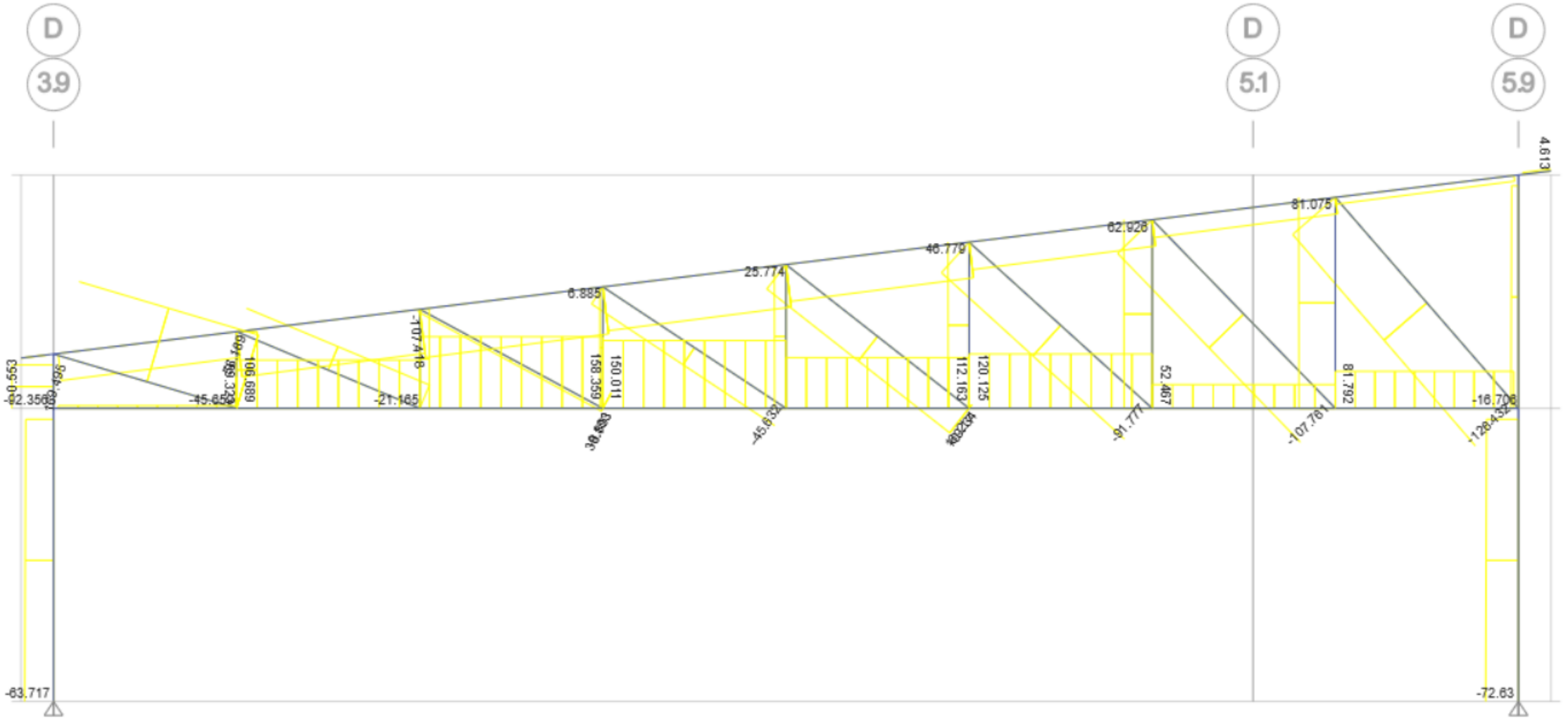


AOF Middle - Axial Load Distribution (1.2DL+1.6LL)

Elevation C

AOF Middle - Axial Load Distribution (1.2DL+1.6LL)

Elevation D

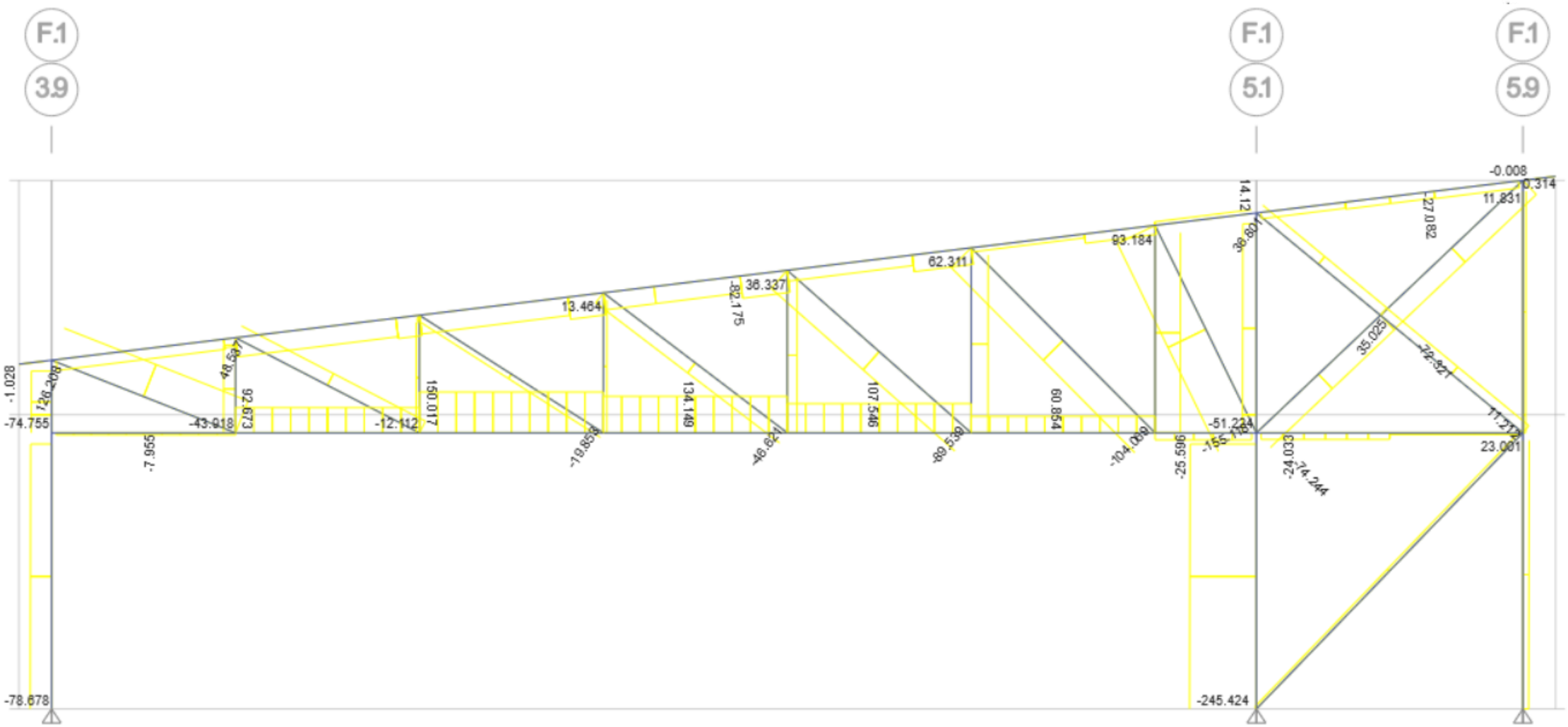


AOF Middle - Axial Load Distribution (1.2DL+1.6LL)

Elevation E

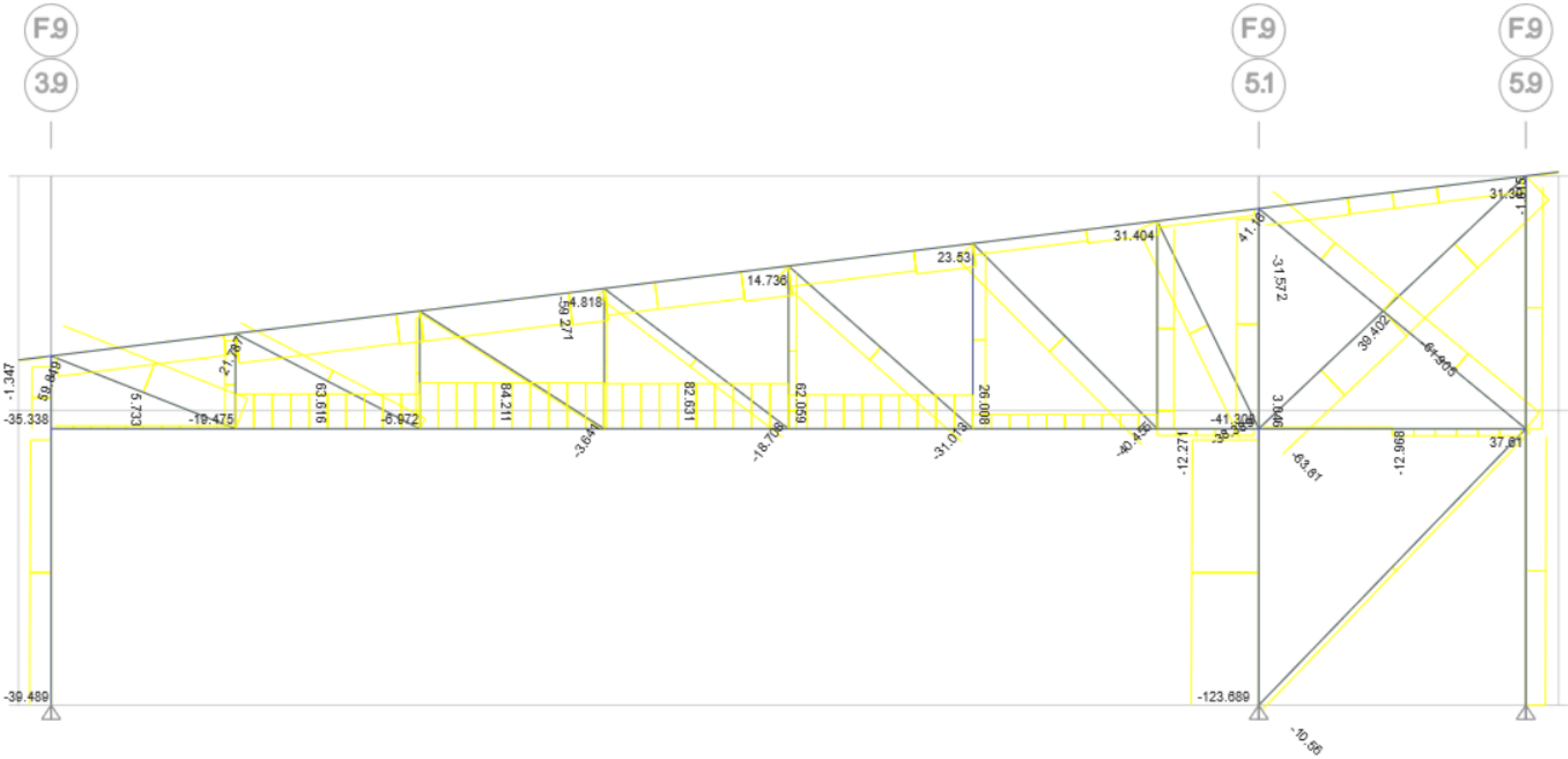
AOF Middle - Axial Load Distribution (1.2DL+1.6LL)

Elevation F.1

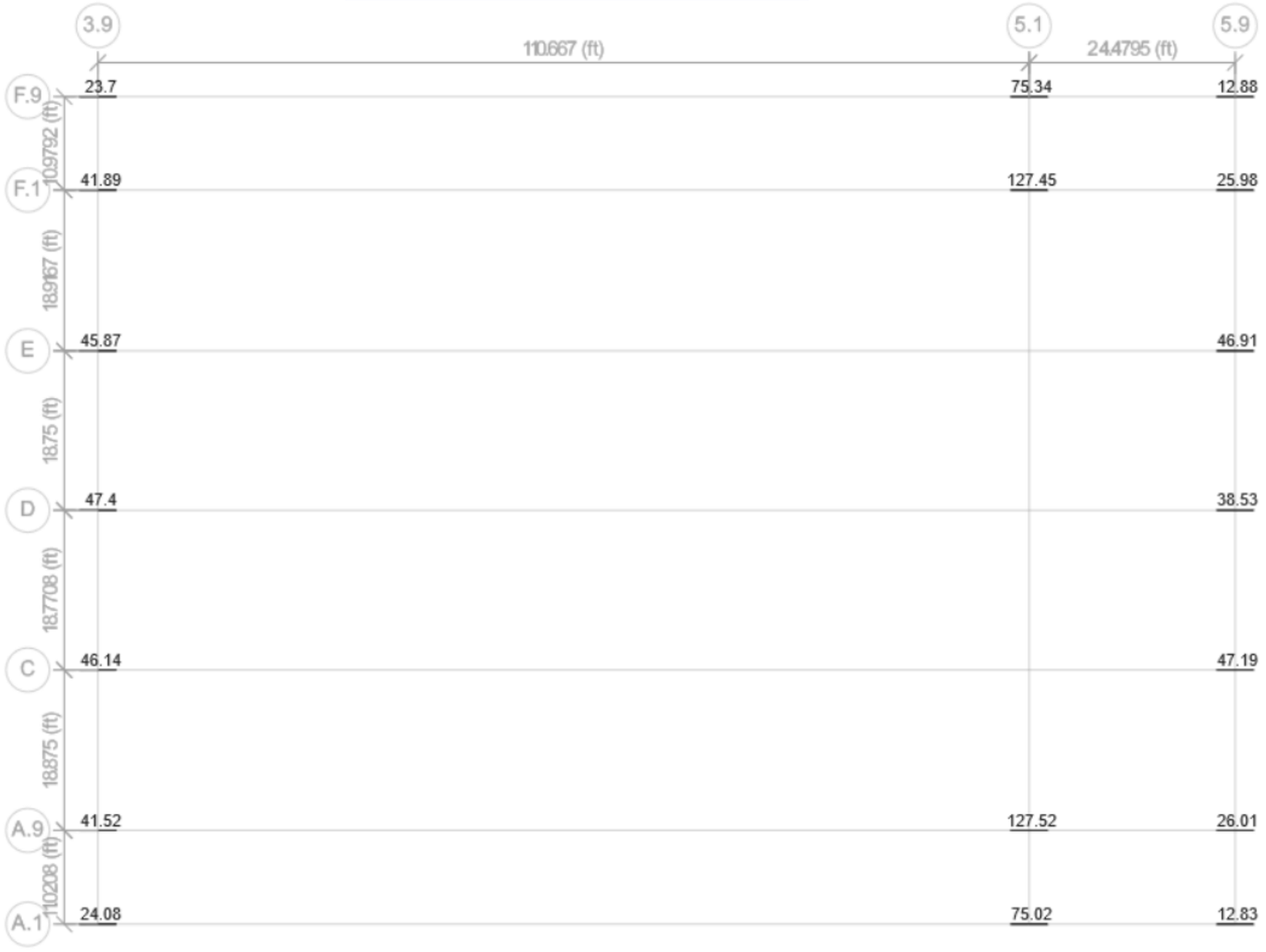


AOF Middle - Axial Load Distribution (1.2DL+1.6LL)

Elevation F.9



AOF Middle - Base Reactions (Dead)



AOF Middle - Base Reactions (Live)

Project Title:
Engineer:
Project ID:
Project Descr:

Masonry Slender Wall

Project File: AOF.ec6

LIC# : KW-06019202, Build:20.24.10.03 Michael Baker International (c) ENERCALC, LLC 1982-2025

DESCRIPTION: Exterior Masonry Walls (MW8)

Code References

Calculations per TMS 402-16, IBC 2021, ASCE 7-16
Load Combinations Used : ASCE 7-22 / IBC 2024 (L<=100psf)

General Information

Calculations per TMS 402-16, IBC 2021, ASCE 7-16

Construction Type : Grouted Hollow Concrete Masonry

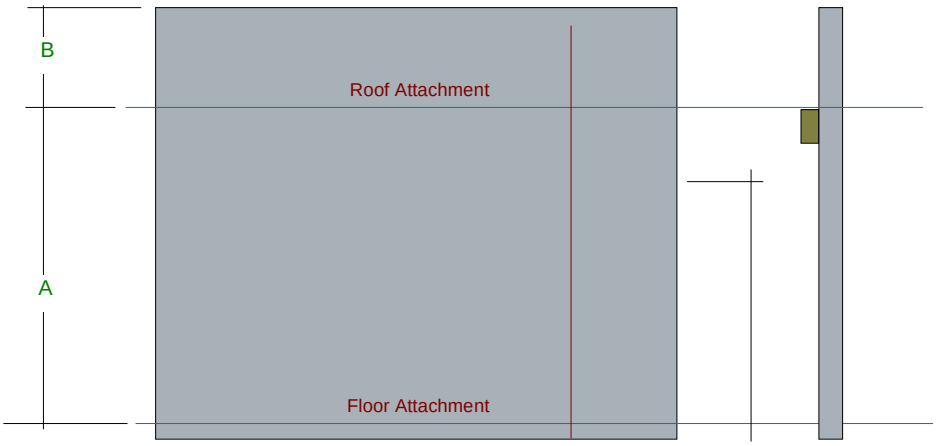
F'm	=	2.0 ksi	Nom. Wall Thickness	8	in	Temp Diff across thickness	=	deg F
Fy - Yield	=	60.0 ksi	Actual Thickness	7.625	in	Min Allow Out-of-plane Defl Ra	=	0.0
Fr - Rupture	=	61.0 psi	Rebar "d" distance	3.8125	in			
Em = f'm *	=	900.0	Lower Level Rebar . . .			Minimum Vertical Steel %	=	0.0020
Max % of ρ bal.	=	0.009223	Bar Size	# 4				
Grout Density	=	140 pcf	Bar Spacing	24	in			
Block Weight		Medium Weight						
Wall Weight	=	49.0 psf						

Wall is grouted at rebar cells only

One-Story Wall Dimensions

A Clear Height = 24.0 ft
B Parapet height = ft

Wall Support Condition Top & Bottom Pinned



Vertical Loads

Vertical Uniform Loads . . . (Applied per foot of Strip Width)			DL : Dead	Lr : Roof Live	Lf : Floor Live	S : Snow	W : Wind
Ledger Load	Eccentricity	in	1.0	1.0			k/ft
Concentric Load							k/ft

Lateral Loads

Wind Loads :
Full area WIND load 16.0 psf

Seismic Loads :
Wall Weight Seismic Load Input Method : ASCE seismic factors entered

SDS Value per ASCE 12.11.1 S_{DS} * I = 0.740
Fp = Wall Wt. * 0.2960 = 14.504 psf

Project Title:
Engineer:
Project ID:
Project Descr:

Masonry Slender Wall

Project File: AOF.ec6

LIC# : KW-06019202, Build:20.24.10.03 Michael Baker International (c) ENERCALC, LLC 1982-2025

DESCRIPTION: Exterior Masonry Walls (MW8)

DESIGN SUMMARY

Results reported for "Strip Width" of 12.0 in

	Governing Load Combination . . .	Actual Values . . .		Allowable Values . . .	
PASS	Moment Capacity Check	Maximum Bending Stress Rat	**0.8698**		
	+1.20D+0.50Lr+W	Max Mu	1.844 k-ft	Phi * Mn	2.120 k-ft
PASS	Service Deflection Check	Actual Defl. Ratio L/	107	Allowable Defl. Ratio	100.0
	W Only	Max. Deflection	2.683 in		
PASS	Axial Load Check	Max Pu / Ag	47.754 psi	Max. Allow. Defl.	2.880 in
	+1.20D+0.50Lr+W	Location	11.60 ft	0.05 * f'm	100.0 psi
	Reinforcing Limit Check	Actual As/bd	0.002186	Max Allow As/bd	0.009223

Maximum Reactions *for Load Combination...*

Top Horizontal	W Only	0.1920 k
Base Horizontal	W Only	0.1920 k
Vertical Reaction	+D+Lr	3.176 k

Design Maximum Combinations - Moments

Results reported for "Strip Width" = 12 in.

Load Combination	Axial Load Pu k	0.05*f'm*b*t k	Moment Values Mcr k-ft	Mu k-ft	Phi	Phi Mn k-ft	As in^2	As Ratio	0.6 * rho bal	Bar 'd'
	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.0000	0.0000	0.00
	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.0000	0.0000	0.00
	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.0000	0.0000	0.00
	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.0000	0.0000	0.00
+1.20D+1.60Lr+0.50W at 11.20 to 12	3.553	5.136	0.47	0.78	0.90	2.41	0.100	0.0022	0.0082	0.00
+1.20D+1.60Lr-0.50W at 11.20 to 12.	3.553	5.136	0.47	0.78	0.90	2.41	0.100	0.0022	0.0082	0.00
+1.20D+0.50W at 11.20 to 12.00	1.953	5.136	0.47	0.65	0.90	2.00	0.100	0.0022	0.0088	0.00
+1.20D-0.50W at 11.20 to 12.00	1.953	5.136	0.47	0.65	0.90	2.00	0.100	0.0022	0.0088	0.00
+1.20D+0.50Lr+W at 11.20 to 12.00	2.453	5.136	0.47	1.85	0.90	2.13	0.100	0.0022	0.0086	0.00
+1.20D+0.50Lr-W at 11.20 to 12.00	2.453	5.136	0.47	1.85	0.90	2.13	0.100	0.0022	0.0086	0.00
+1.20D+W at 11.20 to 12.00	1.953	5.136	0.47	1.65	0.90	2.00	0.100	0.0022	0.0088	0.00
+1.20D-W at 11.20 to 12.00	1.953	5.136	0.47	1.65	0.90	2.00	0.100	0.0022	0.0088	0.00
+0.90D+W at 11.20 to 12.00	1.464	5.136	0.47	1.50	0.90	1.88	0.100	0.0022	0.0090	0.00
+0.90D-W at 11.20 to 12.00	1.464	5.136	0.47	1.50	0.90	1.88	0.100	0.0022	0.0090	0.00
+1.318D+E at 11.20 to 12.00	2.145	5.136	0.47	1.53	0.90	2.05	0.100	0.0022	0.0087	0.00
+1.318D-E at 11.20 to 12.00	2.145	5.136	0.47	1.53	0.90	2.05	0.100	0.0022	0.0087	0.00
+0.7820D+E at 11.20 to 12.00	1.272	5.136	0.47	1.29	0.90	1.83	0.100	0.0022	0.0091	0.00
+0.7820D-E at 11.20 to 12.00	1.272	5.136	0.47	1.29	0.90	1.83	0.100	0.0022	0.0091	0.00

Design Maximum Combinations - Deflections

Results reported for "Strip Width" = 12 in.

Load Combination	Axial Load Pu k	Moment Values Mcr k-ft	Mactual k-ft	Stiffness I gross in^4	I cracked in^4	I effective in^4	Deflections Deflection in	Defl. Ratio
	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.0
	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.0
	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.0
+D+0.60W at 11.20 to 12.00	1.627	0.47	0.85	353.60	20.20	21.232	1.199	240.1
+D-0.60W at 11.20 to 12.00	1.627	0.47	0.85	353.60	20.20	21.232	1.199	240.1
+D+0.750Lr+0.450W at 11.20 to 12.00	2.377	0.47	0.58	353.60	21.79	28.083	0.298	965.3
+D+0.750Lr-0.450W at 11.20 to 12.00	2.377	0.47	0.58	353.60	21.79	28.083	0.298	965.3
+D+0.450W at 11.20 to 12.00	1.627	0.47	0.55	353.60	20.20	28.005	0.245	1,175.5
+D-0.450W at 11.20 to 12.00	1.627	0.47	0.55	353.60	20.20	28.005	0.245	1,175.5

Masonry Slender Wall

LIC# : KW-06019202, Build:20.24.10.03 Michael Baker International (c) ENERCALC, LLC 1982-2025

DESCRIPTION: Exterior Masonry Walls (MW8)

+0.60D+0.60W at 11.20 to 12.00	0.976	0.47	0.77	353.60	18.78	20.182	1.018	282.9
+0.60D-0.60W at 11.20 to 12.00	0.976	0.47	0.77	353.60	18.78	20.182	1.018	282.9
+D+0.70E at 11.20 to 12.00	1.627	0.47	0.92	353.60	20.20	20.968	1.431	201.3
+D-0.70E at 11.20 to 12.00	1.627	0.47	0.92	353.60	20.20	20.968	1.431	201.3

Design Maximum Combinations - Deflections

Results reported for "Strip Width" = 12 in.

Load Combination	Axial Load Pu k	Moment Values Mcr k-ft	Mactual k-ft	Stiffness I gross in^4	I cracked in^4	I effective in^4	Deflections Deflection in	Defl. Ratio
+D+0.5250E at 11.20 to 12.00	1.627	0.47	0.60	353.60	20.20	24.883	0.389	740.1
+D-0.5250E at 11.20 to 12.00	1.627	0.47	0.60	353.60	20.20	24.883	0.389	740.1
+0.60D+0.70E at 11.20 to 12.00	0.976	0.47	0.83	353.60	18.78	19.850	1.215	237.0
+0.60D-0.70E at 11.20 to 12.00	0.976	0.47	0.83	353.60	18.78	19.850	1.215	237.0
	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.0
W Only at 12.00 to 12.80	0.000	0.47	1.15	353.60	16.58	16.874	2.683	107.3
-W at 12.00 to 12.80	0.000	0.47	1.15	353.60	16.58	16.874	2.683	107.3
E Only at 12.00 to 12.80	0.000	0.47	1.04	353.60	16.58	16.991	2.258	127.5
E Only * -1.0 at 12.00 to 12.80	0.000	0.47	1.04	353.60	16.58	16.991	2.258	127.5

Reactions - Vertical & Horizontal

Load Combination	Base Horizontal	Top Horizontal	Vertical @ Wall Base
D Only	0.0 k	0.00 k	2.176 k
+D+Lr	0.0 k	0.00 k	3.176 k
+D+0.750Lr	0.0 k	0.00 k	2.926 k
+D+0.60W	0.1 k	0.12 k	2.176 k
+D-0.60W	0.1 k	0.12 k	2.176 k
+D+0.750Lr+0.450W	0.1 k	0.09 k	2.926 k
+D+0.750Lr-0.450W	0.1 k	0.09 k	2.926 k
+D+0.450W	0.1 k	0.09 k	2.176 k
+D-0.450W	0.1 k	0.09 k	2.176 k
+0.60D+0.60W	0.1 k	0.12 k	1.306 k
+0.60D-0.60W	0.1 k	0.12 k	1.306 k
+D+0.70E	0.1 k	0.13 k	2.176 k
+D-0.70E	0.1 k	0.13 k	2.176 k
+D+0.5250E	0.1 k	0.09 k	2.176 k
+D-0.5250E	0.1 k	0.09 k	2.176 k
+0.60D+0.70E	0.1 k	0.12 k	1.306 k
+0.60D-0.70E	0.1 k	0.12 k	1.306 k
Lr Only	0.0 k	0.00 k	1.000 k
W Only	0.2 k	0.19 k	0.000 k
-W	0.2 k	0.19 k	0.000 k
E Only	0.2 k	0.17 k	0.000 k
E Only * -1.0	0.2 k	0.17 k	0.000 k

Project Title:
Engineer:
Project ID:
Project Descr:

Masonry Slender Wall

Project File: AOF.ec6

LIC# : KW-06019202, Build:20.24.10.03 Michael Baker International (c) ENERCALC, LLC 1982-2025

DESCRIPTION: Wall Elec, FR rooms (MW12)

Code References

Calculations per TMS 402-16, IBC 2021, ASCE 7-16
Load Combinations Used : ASCE 7-22 / IBC 2024 (L<=100psf)

General Information

Calculations per TMS 402-16, IBC 2021, ASCE 7-16

Construction Type : Grouted Hollow Concrete Masonry

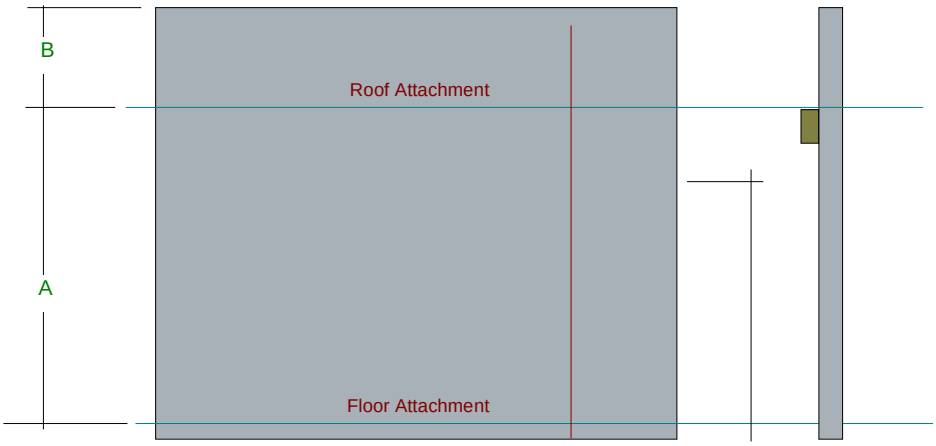
F'm	=	2.0 ksi	Nom. Wall Thickness	12	in	Temp Diff across thickness	=	deg F
Fy - Yield	=	60.0 ksi	Actual Thickness	11.625	in	Min Allow Out-of-plane Defl Ra	=	0.0
Fr - Rupture	=	61.0 psi	Rebar "d" distance	5.8125	in			
Em = f'm *	=	900.0	Lower Level Rebar . . .			Minimum Vertical Steel %	=	0.0020
Max % of ρ bal.	=	0.009320	Bar Size	# 5				
Grout Density	=	140 pcf	Bar Spacing	24	in			
Block Weight		Medium Weight						
Wall Weight	=	70.0 psf						

Wall is grouted at rebar cells only

One-Story Wall Dimensions

A	Clear Height	=	27.0 ft
B	Parapet height	=	ft

Wall Support Condition Top & Bottom Pinned



Vertical Loads

Vertical Uniform Loads . . . (Applied per foot of Strip Width)			DL : Dead	Lr : Roof Live	Lf : Floor Live	S : Snow	W : Wind
Ledger Load	Eccentricity	6.750 in	1.0	1.0			k/ft
Concentric Load							k/ft

Lateral Loads

Wind Loads :
Full area WIND load 16.0 psf

Seismic Loads :
Wall Weight Seismic Load Input Method : ASCE seismic factors entered

SDS Value per ASCE 12.11.1 S_{DS} * I = 0.740
Fp = Wall Wt. * 0.2960 = 20.720 psf

Project Title:
Engineer:
Project ID:
Project Descr:

Masonry Slender Wall

Project File: AOF.ec6

LIC# : KW-06019202, Build:20.24.10.03 Michael Baker International (c) ENERCALC, LLC 1982-2025

DESCRIPTION: Wall Elec, FR rooms (MW12)

DESIGN SUMMARY

Results reported for "Strip Width" of 12.0 in

	Governing Load Combination . . .	Actual Values . . .		Allowable Values . . .	
PASS	Moment Capacity Check	Maximum Bending Stress Rat	0.5834		
	+1.318D+E	Max Mu	2.633 k-ft	Phi * Mn	4.514 k-ft
PASS	Service Deflection Check	Actual Defl. Ratio L/	243	Allowable Defl. Ratio	150.0
	E Only	Max. Deflection	1.334 in		
PASS	Axial Load Check	Max Pu / Ag	37.610 psi	Max. Allow. Defl.	2.160 in
	+1.318D+E	Location	13.950 ft	0.2 * f'm	400.0 psi
	Reinforcing Limit Check	Actual As/bd	0.002222	Max Allow As/bd	0.009320

Maximum Reactions *for Load Combination...*

Top Horizontal	E Only	0.2797 k
Base Horizontal	E Only	0.2797 k
Vertical Reaction	+D+Lr	3.890 k

Design Maximum Combinations - Moments

Results reported for "Strip Width" = 12 in.

Load Combination	Axial Load Pu k	0.2*f'm*b*t k	Moment Values Mcr k-ft	Mu k-ft	Phi	Phi Mn k-ft	As in^2	As Ratio	0.6 * rho bal	Bar 'd'
+1.40D at 26.10 to 27.00	1.488	27.264	0.93	0.79	0.90	4.12	0.155	0.0022	0.0092	0.00
+1.20D+0.50Lr at 26.10 to 27.00	1.776	27.264	0.93	0.96	0.90	4.23	0.155	0.0022	0.0091	0.00
+1.20D at 26.10 to 27.00	1.276	27.264	0.93	0.68	0.90	4.03	0.155	0.0022	0.0092	0.00
+1.20D+1.60Lr at 26.10 to 27.00	2.876	27.264	0.93	1.57	0.90	4.67	0.155	0.0022	0.0088	0.00
+1.20D+1.60Lr+0.50W at 18.00 to 18	3.556	27.264	0.93	1.99	0.90	4.94	0.155	0.0022	0.0087	0.00
+1.20D+1.60Lr-0.50W at 26.10 to 27.	2.876	27.264	0.93	1.57	0.90	4.67	0.155	0.0022	0.0088	0.00
+1.20D+0.50W at 16.20 to 17.10	2.107	27.264	0.93	1.15	0.90	4.37	0.155	0.0022	0.0090	0.00
+1.20D-0.50W at 26.10 to 27.00	1.276	27.264	0.93	0.68	0.90	4.03	0.155	0.0022	0.0092	0.00
+1.20D+0.50Lr+W at 14.40 to 15.30	2.758	27.264	0.93	2.29	0.90	4.62	0.155	0.0022	0.0089	0.00
+1.20D+0.50Lr-W at 10.80 to 11.70	3.061	27.264	0.93	1.05	0.90	4.74	0.155	0.0022	0.0088	0.00
+1.20D+W at 14.40 to 15.30	2.258	27.264	0.93	2.03	0.90	4.43	0.155	0.0022	0.0090	0.00
+1.20D-W at 11.70 to 12.60	2.485	27.264	0.93	1.19	0.90	4.52	0.155	0.0022	0.0089	0.00
+0.90D+W at 14.40 to 15.30	1.694	27.264	0.93	1.86	0.90	4.20	0.155	0.0022	0.0091	0.00
+0.90D-W at 11.70 to 12.60	1.864	27.264	0.93	1.26	0.90	4.27	0.155	0.0022	0.0091	0.00
+1.318D+E at 13.50 to 14.40	2.564	27.264	0.93	2.63	0.90	4.55	0.155	0.0022	0.0089	0.00
+1.318D-E at 11.70 to 12.60	2.730	27.264	0.93	1.69	0.90	4.61	0.155	0.0022	0.0089	0.00
+0.7820D+E at 13.50 to 14.40	1.521	27.264	0.93	2.30	0.90	4.13	0.155	0.0022	0.0092	0.00
+0.7820D-E at 12.60 to 13.50	1.570	27.264	0.93	1.78	0.90	4.15	0.155	0.0022	0.0091	0.00

Design Maximum Combinations - Deflections

Results reported for "Strip Width" = 12 in.

Load Combination	Axial Load Pu k	Moment Values Mcr k-ft	Mactual k-ft	Stiffness I gross in^4	I cracked in^4	I effective in^4	Deflections Deflection in	Defl. Ratio
D Only at 15.30 to 16.20	1.819	0.93	0.33	1,064.50	69.01	1064.500	0.024	13,542.1
+D+Lr at 16.20 to 17.10	2.756	0.93	0.71	1,064.50	73.70	1064.500	0.057	5,704.3
+D+0.750Lr at 15.30 to 16.20	2.569	0.93	0.58	1,064.50	72.77	1064.500	0.042	7,647.4
+D+0.60W at 14.40 to 15.30	1.882	0.93	1.23	1,064.50	69.33	82.160	0.381	849.7
+D-0.60W at 11.70 to 12.60	2.071	0.93	0.62	1,064.50	70.28	1064.500	0.037	8,650.9
+D+0.750Lr+0.450W at 15.30 to 16.20	2.569	0.93	1.31	1,064.50	72.77	82.769	0.481	673.5
+D+0.750Lr-0.450W at 8.10 to 9.00	3.073	0.93	0.26	1,064.50	75.26	1064.500	0.007	45,850.9
+D+0.450W at 14.40 to 15.30	1.882	0.93	0.97	1,064.50	69.33	145.347	0.096	3,381.2
+D-0.450W at 11.70 to 12.60	2.071	0.93	0.40	1,064.50	70.28	1064.500	0.023	14,396.7

Masonry Slender Wall

LIC# : KW-06019202, Build:20.24.10.03 Michael Baker International (c) ENERCALC, LLC 1982-2025

DESCRIPTION: Wall Elec, FR rooms (MW12)

+0.60D+0.60W at 13.50 to 14.40	1.167	0.93	1.06	1,064.50	65.68	94.656	0.184	1,760.1
+0.60D-0.60W at 12.60 to 13.50	1.205	0.93	0.71	1,064.50	65.87	1064.500	0.046	6,983.4
+D+0.70E at 13.50 to 14.40	1.945	0.93	1.78	1,064.50	69.64	72.492	1.066	303.8
+D-0.70E at 11.70 to 12.60	2.071	0.93	1.08	1,064.50	70.28	97.733	0.166	1,949.7

Design Maximum Combinations - Deflections

Results reported for "Strip Width" = 12 in.

Load Combination	Axial Load	Moment Values		Stiffness			Deflections	
	Pu	Mcr	Mactual	I gross	I cracked	I effective	Deflection	Defl. Ratio
	k	k-ft	k-ft	in^4	in^4	in^4	in	
+D+0.5250E at 14.40 to 15.30	1.882	0.93	1.38	1,064.50	69.33	77.092	0.557	581.3
+D-0.5250E at 12.60 to 13.50	2.008	0.93	0.72	1,064.50	69.96	1064.500	0.045	7,132.5
+0.60D+0.70E at 13.50 to 14.40	1.167	0.93	1.57	1,064.50	65.68	69.956	0.835	387.9
+0.60D-0.70E at 12.60 to 13.50	1.205	0.93	1.18	1,064.50	65.87	80.891	0.295	1,097.1
Lr Only at 15.30 to 16.20	1.000	0.93	0.33	1,064.50	64.82	1064.500	0.024	13,602.5
W Only at 13.50 to 14.40	0.000	0.93	1.45	1,064.50	59.57	64.900	0.719	450.6
-W at 13.50 to 14.40	0.000	0.93	1.45	1,064.50	59.57	64.900	0.719	450.6
E Only at 13.50 to 14.40	0.000	0.93	1.88	1,064.50	59.57	61.566	1.334	242.9
E Only * -1.0 at 13.50 to 14.40	0.000	0.93	1.88	1,064.50	59.57	61.566	1.334	242.9

Reactions - Vertical & Horizontal

Load Combination	Base Horizontal	Top Horizontal	Vertical @ Wall Base
D Only	0.0 k	0.02 k	2.890 k
+D+Lr	0.0 k	0.04 k	3.890 k
+D+0.750Lr	0.0 k	0.04 k	3.640 k
+D+0.60W	0.1 k	0.11 k	2.890 k
+D-0.60W	0.1 k	0.15 k	2.890 k
+D+0.750Lr+0.450W	0.1 k	0.06 k	3.640 k
+D+0.750Lr-0.450W	0.1 k	0.13 k	3.640 k
+D+0.450W	0.1 k	0.08 k	2.890 k
+D-0.450W	0.1 k	0.12 k	2.890 k
+0.60D+0.60W	0.1 k	0.12 k	1.734 k
+0.60D-0.60W	0.1 k	0.14 k	1.734 k
+D+0.70E	0.2 k	0.18 k	2.890 k
+D-0.70E	0.2 k	0.22 k	2.890 k
+D+0.5250E	0.2 k	0.13 k	2.890 k
+D-0.5250E	0.1 k	0.17 k	2.890 k
+0.60D+0.70E	0.2 k	0.19 k	1.734 k
+0.60D-0.70E	0.2 k	0.21 k	1.734 k
Lr Only	0.0 k	0.02 k	1.000 k
W Only	0.2 k	0.22 k	0.000 k
-W	0.2 k	0.22 k	0.000 k
E Only	0.3 k	0.28 k	0.000 k
E Only * -1.0	0.3 k	0.28 k	0.000 k

DESIGN MODULE - MASONRY WALL OPENING

Michael Baker INTERNATIONAL

AOF CREECH

LOADS FROM ROOF/FLOOR

	ROOF	FLOOR
DEAD:	30.0 psf	0.0 psf
LIVE:	20.0 psf	0.0 psf
SNOW/Lr:	0.0 psf	0.0 psf

WALL DESIGN INFORMATION

f'm:	2000 psi
Fy:	60 ksi
Solid Opening:	Y
Interior Wall:	N

OUT OF PLANE LOADS

Wall Type	*Wall Weight (Finishes Only)*
1	45 psf
2	0 psf
3	0 psf
4	0 psf

W:	16 psf
S_{DS}:	0.59

LINTEL ID	WALL TYPE	WALL HEIGHT	WALL THICKNESS	ROOF DECK HEIGHT	ROOF TRIB	FLOOR TRIB	VERTICAL LOADING			# MATS HOR REINF
							DEAD	LIVE	SNOW/Lr	
ML1	1	10.0 ft	8" CMU	10.0 ft	6.0 ft	0.0 ft	180 plf	120 plf	0 plf	1
ML2	1	10.0 ft	8" CMU	10.0 ft	6.0 ft	0.0 ft	180 plf	120 plf	0 plf	1

MASONRY WALL DESIGN

LINTEL ID	WALL GROUT SPACING	OPENING		LINTEL				JAMB COLUMN			STATUS
		HEIGHT	WIDTH	BAR SIZE	DEPTH	BARS/ COURSE	# OF COURSES	BAR SIZE	WIDTH	BARS/ CELL	
ML1	24 o.c.	8.00 ft	3.50 ft	#5	16 in	2	1	#5	16 in	1	OK
ML2	24 o.c.	8.00 ft	10.00 ft	#5	24 in	2	1	#5	24 in	1	OK

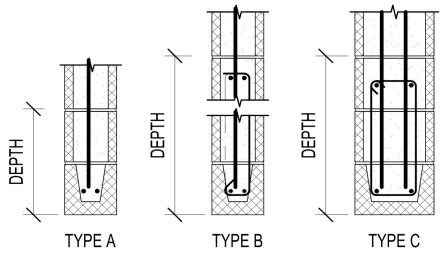
DESIGN MODULE - MASONRY WALL OPENING

AOF CREECH

Michael Baker INTERNATIONAL

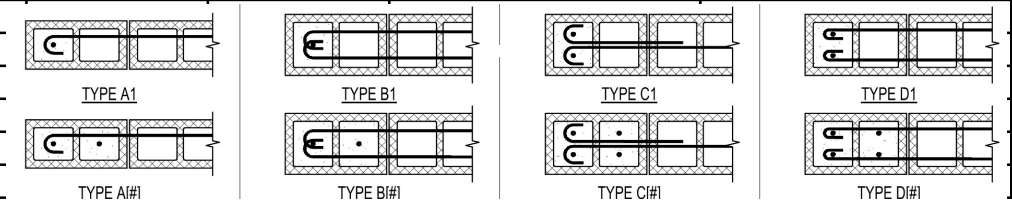
MASONRY LINTEL SCHEDULE

MARK	DEPTH	TYPE	LINTEL REINFORCING		SUPPORT COLUMN	COMMENTS
			HORIZONTAL	STIRRUPS		
ML1	16 "	TYPE A	(2) #5	--	ML1 C	
ML2	24 "	TYPE A	(2) #5	--	ML2 C	



MASONRY JAMB COLUMN SCHEDULE

MARK	SIZE	TYPE	COLUMN REINFORCING		COMMENTS
			VERTICAL	TIES	
ML1 C	8x16	TYPE A2	(3) #5	--	
ML2 C	8x24	TYPE A3	(2) #5	--	



MASONRY WALL OPENING

AOF CREECH: LINTEL DESIGN FOR ML1

Michael Baker INTERNATIONAL

General Design Input

Total Wall Height:	10.00 ft	Lintel Depth:	16.00 in	Vert DL:	180 plf
Block Thickness:	8" CMU	No. of Long Bars:	(2)	Vert LL:	120 plf
Opening Height:	8.00 ft	Bar Size:	#5	Vert SL:	0 plf
Opening Width:	3.50 ft	No. of Courses:	1	Horz Wind:	16 psf
Roof Deck Height:	10.00 ft			Horz Quake:	25 psf
Cells Grouted @:	24 o.c.	Column Width:	16.00 in	Solid Opening:	Y
Masonry f'm:	2000 psi	Depth to Bar(s):	3.81 in		
		No. of Bars:	(3)		
		Bar Size:	#5		

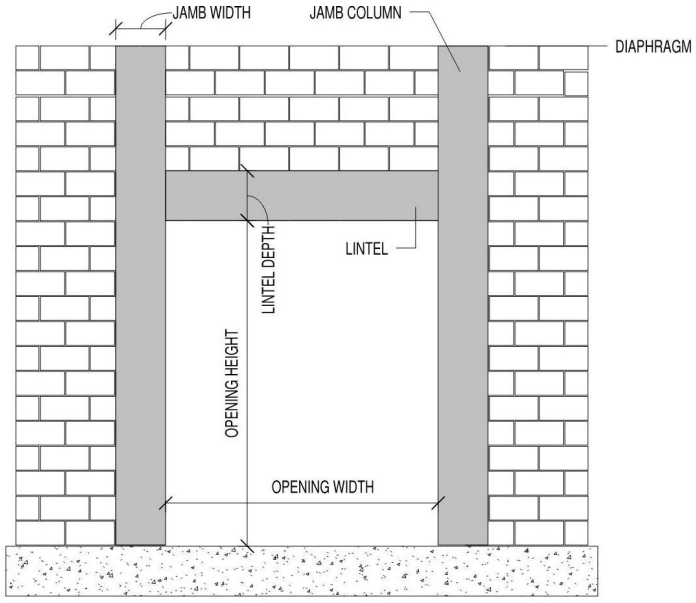
Analysis and Calculations

Masonry Lintel:

Arching action:	No
Effective Span, le:	4.83 ft
Depth to Reinf, d:	12.0 in

Demand		Capacity	
Mu:	1.73 k-ft	fMn:	31.45 k-ft
Vu:	1.43 k	fVn:	10.54 k

Min. Capacity:	5.42 k-ft
Deflection:	l/8269852



Masonry Column:

Demand		Capacity	
Mu+:	1.2 k-ft	fMn:	9.5 k-ft
Mu-:	0.0 k-ft	fMn:	9.5 k-ft
Vu:	0.5 k	fVn:	25.3 k
Pu:	2.4 k	fPn:	152.4 k

Design Summary

Masonry Lintel

No. Grouted Courses:	2	
Flexural Reinforcing:	(2) #5	
Shear Reinforcing (Not Req'd):	1-Leg	2-Legs
#3 @	-	-
#4 @	-	-
#5 @	-	-

Masonry Column

No. of Grouted Cells:	2
Long. Reinforcing:	(3) #5
Depth to bar(s):	3.81 in

Overall Status: **OK**

MASONRY WALL OPENING

AOF CREECH: LINTEL DESIGN FOR ML2

Michael Baker INTERNATIONAL

General Design Input

Total Wall Height:	10.00 ft	Lintel Depth:	24.00 in	Vert DL:	180 plf
Block Thickness:	8" CMU	No. of Long Bars:	(2)	Vert LL:	120 plf
Opening Height:	8.00 ft	Bar Size:	#5	Vert SL:	0 plf
Opening Width:	10.00 ft	No. of Courses:	1	Horz Wind:	16 psf
Roof Deck Height:	10.00 ft			Horz Quake:	25 psf
Cells Grouted @:	24 o.c.	Column Width:	24.00 in	Solid Opening:	Y
Masonry f'm:	2000 psi	Depth to Bar(s):	3.81 in		
		No. of Bars:	(2)		
		Bar Size:	#5		

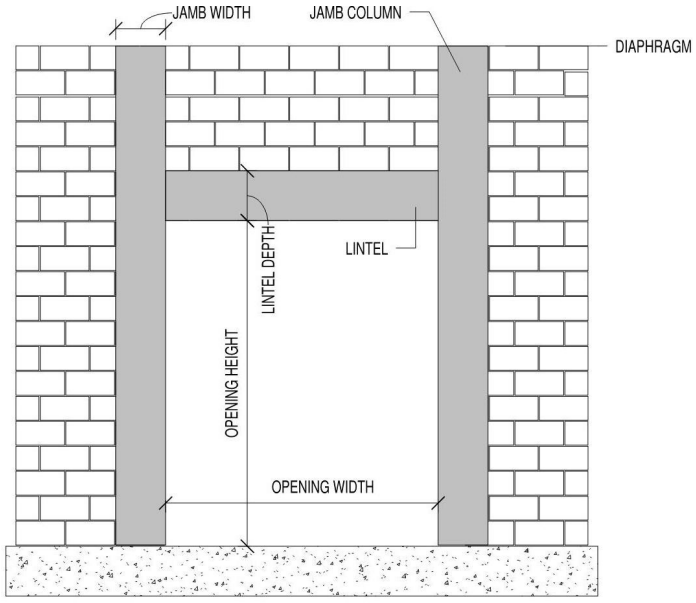
Analysis and Calculations

Masonry Lintel:

Arching action:	No
Effective Span, le:	12.00 ft
Depth to Reinf, d:	20.0 in

Demand		Capacity	
Mu:	10.97 k-ft	fMn:	54.45 k-ft
Vu:	3.66 k	fVn:	14.73 k

Min. Capacity:	12.20 k-ft
Deflection:	l/52646



Masonry Column:

Demand		Capacity	
Mu+:	2.4 k-ft	fMn:	8.3 k-ft
Mu-:	0.0 k-ft	fMn:	8.3 k-ft
Vu:	1.0 k	fVn:	37.9 k
Pu:	5.1 k	fPn:	201.0 k

Design Summary

Masonry Lintel

No. Grouted Courses:	3	
Flexural Reinforcing:	(2) #5	
hear Reinforcing (Not Req'd):	1-Leg	2-Legs
#3 @	-	-
#4 @	-	-
#5 @	-	-

Masonry Column

No. of Grouted Cells:	3
Long. Reinforcing:	(2) #5
Depth to bar(s):	3.81 in

Overall Status: **OK**

DESIGN MODULE - MASONRY WALL OPENING

Michael Baker INTERNATIONAL

AOF CREECH

LOADS FROM ROOF/FLOOR

	ROOF	FLOOR
DEAD:	30.0 psf	0.0 psf
LIVE:	20.0 psf	0.0 psf
SNOW/Lr:	0.0 psf	0.0 psf

WALL DESIGN INFORMATION

f'm:	2000 psi
Fy:	60 ksi
Solid Opening:	Y
Interior Wall:	N

OUT OF PLANE LOADS

Wall Type	*Wall Weight (Finishes Only)*
1	45 psf
2	0 psf
3	0 psf
4	0 psf

W:	16 psf
S_{DS}:	0.59

LINTEL ID	WALL TYPE	WALL HEIGHT	WALL THICKNESS	ROOF DECK HEIGHT	ROOF TRIB	FLOOR TRIB	VERTICAL LOADING			# MATS HOR REINF
							DEAD	LIVE	SNOW/Lr	
ML3	1	27.0 ft	12" CMU	27.0 ft	6.0 ft	0.0 ft	180 plf	120 plf	0 plf	1

MASONRY WALL DESIGN

LINTEL ID	WALL GROUT SPACING	OPENING		LINTEL				JAMB COLUMN			STATUS
		HEIGHT	WIDTH	BAR SIZE	DEPTH	BARS/ COURSE	# OF COURSES	BAR SIZE	WIDTH	BARS/ CELL	
ML3	24 o.c.	8.00 ft	3.50 ft	#5	18 in	2	1	#5	16 in	2	OK

DESIGN MODULE - MASONRY WALL OPENING

AOF CREECH

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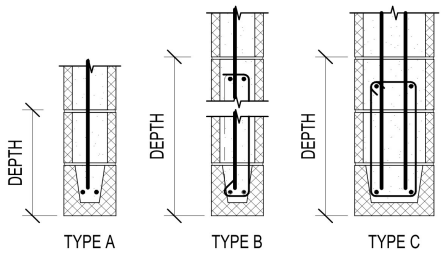
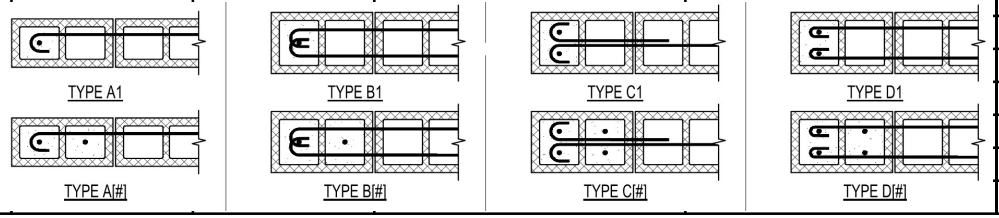
MASONRY LINTEL SCHEDULE

MARK	DEPTH	TYPE	LINTEL REINFORCING		SUPPORT COLUMN	COMMENTS
			HORIZONTAL	STIRRUPS		
ML3	18 "	TYPE A	(2) #5	--	ML3 C	



MASONRY JAMB COLUMN SCHEDULE

MARK	SIZE	TYPE	COLUMN REINFORCING		COMMENTS
			VERTICAL	TIES	
ML3 C	12x16	TYPE C2	(6) #5	--	



MASONRY WALL OPENING

AOF CREECH: LINTEL DESIGN FOR ML3

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General Design Input

Total Wall Height:	27.00 ft	Lintel Depth:	18.00 in	Vert DL:	180 plf
Block Thickness:	12" CMU	No. of Long Bars:	(2)	Vert LL:	120 plf
Opening Height:	8.00 ft	Bar Size:	#5	Vert SL:	0 plf
Opening Width:	3.50 ft	No. of Courses:	1	Horz Wind:	16 psf
Roof Deck Height:	27.00 ft			Horz Quake:	33 psf
Cells Grouted @:	24 o.c.	Column Width:	16.00 in	Solid Opening:	Y
Masonry f'm:	2000 psi	Depth to Bar(s):	9.31 in		
		No. of Bars:	(3)		
		Bar Size:	#5		

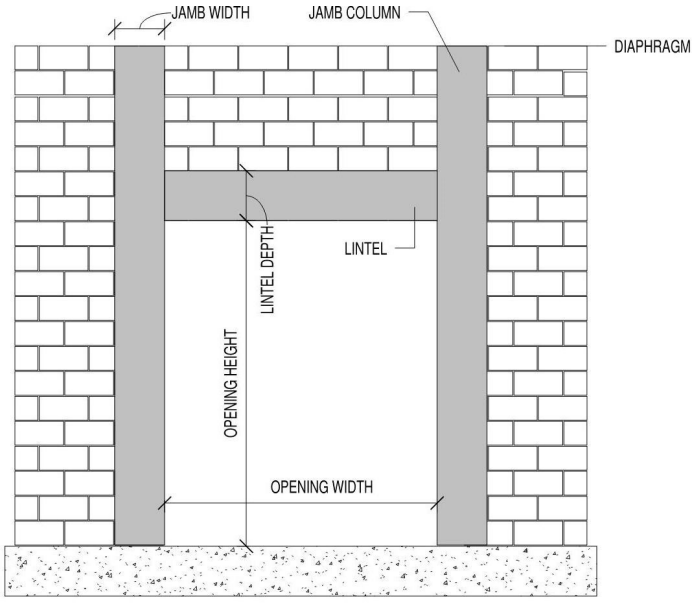
Analysis and Calculations

Masonry Lintel:

Arching action:	Yes
Effective Span, le:	4.83 ft
Depth to Reinf, d:	14.0 in

Demand		Capacity	
Mu:	1.22 k-ft	fMn:	37.26 k-ft
Vu:	1.01 k	fVn:	19.39 k

Min. Capacity:	10.46 k-ft
Deflection:	I/421745633



Masonry Column:

Demand		Capacity	
Mu+:	11.2 k-ft	fMn:	30.4 k-ft
Mu-:	0.0 k-ft	fMn:	30.4 k-ft
Vu:	1.7 k	fVn:	34.1 k
Pu:	10.3 k	fPn:	132.9 k

Design Summary

Masonry Lintel

No. Grouted Courses:	2	
Flexural Reinforcing:	(2) #5	
hear Reinforcing (Not Req'd):	1-Leg	2-Legs
#3 @	-	-
#4 @	-	-
#5 @	-	-

Masonry Column

No. of Grouted Cells:	2
Long. Reinforcing:	(6) #5
Depth to bar(s):	9.31 in

Overall Status: **OK**

Michael Baker
INTERNATIONAL

Lateral System Calculations

AOF End

Auto Seismic Loading

Load Pattern Definitions - Auto Seismic - ASCE 7-16 (Part 1 of 3)

Name	Period Used sec	Coeff Used	Weight Used kip	Base Shear kip	Is Auto Load	X Dir?	X Dir Plus Ecc?	X Dir Minus Ecc?	Y Dir?	Y Dir Plus Ecc?	Y Dir Minus Ecc?	Ecc Ratio
Exx					No	Yes	Yes	Yes	No	No	No	0.05
Exx(1/3)	0.368	0.1224	685.003	83.844	Yes	Yes	No	No	No	No	No	0.05
Exx(2/3)	0.368	0.1224	685.003	83.844	Yes	No	Yes	No	No	No	No	0.05
Exx(3/3)	0.368	0.1224	685.003	83.844	Yes	No	No	Yes	No	No	No	0.05
Eyy					No	No	No	No	Yes	Yes	Yes	0.05
Eyy(1/3)	0.368	0.1224	685.003	83.844	Yes	No	No	No	Yes	No	No	0.05
Eyy(2/3)	0.368	0.1224	685.003	83.844	Yes	No	No	No	No	Yes	No	0.05
Eyy(3/3)	0.368	0.1224	685.003	83.844	Yes	No	No	No	No	No	Yes	0.05

Load Pattern Definitions - Auto Seismic - ASCE 7-16 (Part 2 of 3)

Name	Period Used sec	Coeff Used	Weight Used kip	Base Shear kip	Top Story	Bottom Story	Period Type	Ct and X	Ss	S1	TL sec
Exx					Story5	Base	Approximate	0.02; 0.75	0.72	0.23	6
Exx(1/3)	0.368	0.1224	685.003	83.844	Story5	Base	Approximate	0.02; 0.75	0.72	0.23	6
Exx(2/3)	0.368	0.1224	685.003	83.844	Story5	Base	Approximate	0.02; 0.75	0.72	0.23	6
Exx(3/3)	0.368	0.1224	685.003	83.844	Story5	Base	Approximate	0.02; 0.75	0.72	0.23	6
Eyy					Story5	Base	Approximate	0.02; 0.75	0.72	0.23	6
Eyy(1/3)	0.368	0.1224	685.003	83.844	Story5	Base	Approximate	0.02; 0.75	0.72	0.23	6
Eyy(2/3)	0.368	0.1224	685.003	83.844	Story5	Base	Approximate	0.02; 0.75	0.72	0.23	6
Eyy(3/3)	0.368	0.1224	685.003	83.844	Story5	Base	Approximate	0.02; 0.75	0.72	0.23	6

Load Pattern Definitions - Auto Seismic - ASCE 7-16 (Part 3 of 3)

Name	Period Used sec	Coeff Used	Weight Used kip	Base Shear kip	Site Class	Fa	Fv	SDS	SD1	R	Omega	Cd	I
Exx					D	1.224	2.14	0.58752	0.328133	6	2	5	1.25
Exx(1/3)	0.368	0.1224	685.003	83.844	D	1.224	2.14	0.58752	0.328133	6	2	5	1.25
Exx(2/3)	0.368	0.1224	685.003	83.844	D	1.224	2.14	0.58752	0.328133	6	2	5	1.25
Exx(3/3)	0.368	0.1224	685.003	83.844	D	1.224	2.14	0.58752	0.328133	6	2	5	1.25
Eyy					D	1.224	2.14	0.58752	0.328133	6	2	5	1.25
Eyy(1/3)	0.368	0.1224	685.003	83.844	D	1.224	2.14	0.58752	0.328133	6	2	5	1.25
Eyy(2/3)	0.368	0.1224	685.003	83.844	D	1.224	2.14	0.58752	0.328133	6	2	5	1.25
Eyy(3/3)	0.368	0.1224	685.003	83.844	D	1.224	2.14	0.58752	0.328133	6	2	5	1.25

AOF End

ASCE 7-16 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern Exx according to ASCE 7-16, as calculated by ETABS.

Direction and Eccentricity

Direction = Multiple

Eccentricity Ratio = 5% for all diaphragms

Structural Period

Period Calculation Method = Approximate

Coefficient, C_t [ASCE Table 12.8-2]		
Coefficient, x [ASCE Table 12.8-2]		$C_{t=0.02ft}$
Structure Height Above Base, h_n		
Approximate Fundamental Period, T_a [ASCE 12.8.2.1 Eq. 12.8-7]	Ta=<Ct><hn>^{x}	$T_{a=0.368}$ sec
Long-Period Transition Period, T_L [ASCE 11.4.5]		$T_{L=6}$ sec

Factors and Coefficients

Response Modification Factor, R [ASCE Table 12.2-1]	
System Overstrength Factor, Ω_0 [ASCE Table 12.2-1]	R=6
Deflection Amplification Factor, C_d [ASCE Table 12.2-1]	
Importance Factor, I [ASCE Table 1.5-2]	

Ss and S1 Source = 0.75

Mapped MCE Spectral Response Acceleration, S_s [ASCE 11.4.2]	
Mapped MCE Spectral Response Acceleration, S_1 [ASCE 11.4.2]	
Site Class [ASCE Table 20.3-1] = D - Stiff Soil	$S_{s=0.72g}$
Site Coefficient, F_a [ASCE Table 11.4-1]	
Site Coefficient, F_v [ASCE Table 11.4-2]	

Seismic Response

MCE Spectral Response Acceleration, S_{MS} [ASCE 11.4.4, Eq. 11.4-1]	SMS=<Fa><$S_{S>}$	$S_{MS=0.88128g}$
MCE Spectral Response Acceleration, S_{M1} [ASCE 11.4.4, Eq. 11.4-2]	SM1=<Fv><$S_{1>}$	$S_{M1=0.4922g}$

Design Spectral Response Acceleration, S_{DS} [ASCE 11.4.5, Eq. 11.4-3]	SDS=<<2>/<3>><S_{MS>}	$S_{DS=0.58752g}$
Design Spectral Response Acceleration, S_{D1} [ASCE 11.4.5, Eq. 11.4-4]	SD1=<<2>/<3>><S_{M1>}	$S_{D1=0.328133g}$

Equivalent Lateral Forces

Seismic Response Coefficient, C_S [ASCE 12.8.1.1, Eq. 12.8-2]	CS=<S_{DS>/<(<R>/<I>)>}
[ASCE 12.8.1.1, Eq. 12.8-3]	C<S,max>=<S_{D1>/<T(<R>/<I>)>}
[ASCE 12.8.1.1, Eq. 12.8-5]	C<S,min>=max(0.044<S<sub>DS>I,0.01)=0.032314
[ASCE 12.8.1.1, Eq. 12.8-6]	C<S,min>=0.5<S<sub>1>/<(<R>/<I>)><for <S_{1>>=0.6g>}
	C<S,min>≤<Cs>≤C_{<S,max>}

Calculated Base Shear

Direction	Period Used (sec)	C_s	W (kip)	V (kip)
X	0.368	0.1224	685.003	83.8444
X + Ecc. Y	0.368	0.1224	685.003	83.8444
X - Ecc. Y	0.368	0.1224	685.003	83.8444

Applied Story Forces

Story	Elevation	X-Dir	Y-Dir
	ft	kip	kip
Story5	48.5	83.844	0
Base	0	0	0

AOF End

ASCE 7-16 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern Eyy according to ASCE 7-16, as calculated by ETABS.

Direction and Eccentricity

Direction = Multiple

Eccentricity Ratio = 5% for all diaphragms

Structural Period

Period Calculation Method = Approximate

Coefficient, C_t [ASCE Table 12.8-2]		
Coefficient, x [ASCE Table 12.8-2]		$C_{t=0.02ft}$
Structure Height Above Base, h_n		
Approximate Fundamental Period, T_a [ASCE 12.8.2.1 Eq. 12.8-7]	Ta=<Ct><hn>^{x}	$T_{a=0.368}$ sec
Long-Period Transition Period, T_L [ASCE 11.4.5]		$T_{L=6}$ sec

Factors and Coefficients

Response Modification Factor, R [ASCE Table 12.2-1]	
System Overstrength Factor, Ω_0 [ASCE Table 12.2-1]	R=6
Deflection Amplification Factor, C_d [ASCE Table 12.2-1]	
Importance Factor, I [ASCE Table 1.5-2]	

Ss and S1 Source = 0.75

Mapped MCE Spectral Response Acceleration, S_s [ASCE 11.4.2]	
Mapped MCE Spectral Response Acceleration, S_1 [ASCE 11.4.2]	
Site Class [ASCE Table 20.3-1] = D - Stiff Soil	$S_{s=0.72g}$
Site Coefficient, F_a [ASCE Table 11.4-1]	
Site Coefficient, F_v [ASCE Table 11.4-2]	

Seismic Response

MCE Spectral Response Acceleration, S_{MS} [ASCE 11.4.4, Eq. 11.4-1]	SMS=<Fa><$S_{S>}$	$S_{MS=0.88128g}$
MCE Spectral Response Acceleration, S_{M1} [ASCE 11.4.4, Eq. 11.4-2]	SM1=<Fv><$S_{1>}$	$S_{M1=0.4922g}$

Design Spectral Response Acceleration, S_{DS} [ASCE 11.4.5, Eq. 11.4-3]	SDS=<<2>/<3>><S_{MS}>	$S_{DS=0.58752g}$
Design Spectral Response Acceleration, S_{D1} [ASCE 11.4.5, Eq. 11.4-4]	SD1=<<2>/<3>><S_{M1}>	$S_{D1=0.328133g}$

Equivalent Lateral Forces

Seismic Response Coefficient, C_S [ASCE 12.8.1.1, Eq. 12.8-2]	CS=<S_{DS}>/<(<R>/<I>)>
[ASCE 12.8.1.1, Eq. 12.8-3]	C<S,max>=<S_{D1}>/<T(<R>/<I>)>
[ASCE 12.8.1.1, Eq. 12.8-5]	C<S,min>=max(0.044<S_{DS}>I,0.01)=0.032314
[ASCE 12.8.1.1, Eq. 12.8-6]	C<S,min>=0.5<S_{1}>/<(<R>/<I>)><for <S_{1}>=0.6g>
	C<S,min>≤<Cs>≤$C_{<S,max>}$

Calculated Base Shear

Direction	Period Used (sec)	C_s	W (kip)	V (kip)
Y	0.368	0.1224	685.003	83.8444
Y + Ecc. X	0.368	0.1224	685.003	83.8444
Y - Ecc. X	0.368	0.1224	685.003	83.8444

AOF End - Wind

Structure Results

Base Reactions

Output Case	Case Type	FX kip	FY kip	FZ kip	MX kip-ft	MY kip-ft	MZ kip-ft	X ft	Y ft	Z ft
WindX	LinStatic	-89.884	1.824	-157.009	-7663.4874	9240.1425	4614.4316	0	0	0
WindY	LinStatic	0.766	-171.881	-186.437	-5386.2403	14894.8174	-12545.839	0	0	0
WindXX	LinStatic	-11.264	0	0	0.0094	-180.5075	548.0639	0	0	0
WindYY	LinStatic	0	0	0	0.0079	-0.0369	1.158E-05	0	0	0

AOF End

Applied Loads

Point Loads

Joint Loads Assignments - Force

Story	Label	UniqueName	Load Pattern	FX kip	FY kip	FZ kip	MX kip-ft	MY kip-ft	MZ kip-ft	X Dimension in	Y Dimension in
Story5	576	159	Dead	0	0	-0.3	0	0	0	0	0

Line Loads

Frame Loads Assignments - Distributed (Part 1 of 2)

UniqueName	Load Pattern	Story	Label	Load Type	Direction	Distance Type	Relative Distance A	Relative Distance B	Absolute Distance A ft	Absolute Distance B ft
324	Dead	Story5	B616	Force	Gravity	Relative	0	1	0	42.7429
325	Dead	Story5	B617	Force	Gravity	Relative	0	1	0	42.7429
336	Dead	Story5	B628	Force	Gravity	Relative	0	1	0	42.7429
337	Dead	Story5	B629	Force	Gravity	Relative	0	1	0	42.7429
358	Dead	Story5	B648	Force	Gravity	Relative	0	1	0	15.3849
359	Dead	Story5	B649	Force	Gravity	Relative	0	1	0	15.3849
360	Dead	Story5	B650	Force	Gravity	Relative	0	1	0	15.3849
361	Dead	Story5	B651	Force	Gravity	Relative	0	1	0	15.3849
520	Dead	Story5	B711	Force	Gravity	Relative	0	1	0	3.0097
521	Dead	Story5	B712	Force	Gravity	Relative	0	1	0	66.5924
522	Dead	Story5	B713	Force	Gravity	Relative	0	1	0	3.0097
523	Dead	Story5	B714	Force	Gravity	Relative	0	1	0	66.5924
524	Dead	Story5	B715	Force	Gravity	Relative	0	1	0	3.0097
525	Dead	Story5	B716	Force	Gravity	Relative	0	1	0	66.5924
526	Dead	Story5	B717	Force	Gravity	Relative	0	1	0	3.0097
527	Dead	Story5	B718	Force	Gravity	Relative	0	1	0	66.5924
528	Dead	Story5	B719	Force	Gravity	Relative	0	1	0	3.0097
529	Dead	Story5	B720	Force	Gravity	Relative	0	1	0	66.5924
530	Dead	Story5	B721	Force	Gravity	Relative	0	1	0	3.0097
531	Dead	Story5	B722	Force	Gravity	Relative	0	1	0	66.5924
532	Dead	Story5	B723	Force	Gravity	Relative	0	1	0	3.0097
533	Dead	Story5	B724	Force	Gravity	Relative	0	1	0	66.5924
534	Dead	Story5	B725	Force	Gravity	Relative	0	1	0	3.01
535	Dead	Story5	B726	Force	Gravity	Relative	0	1	0	58.1279
536	Dead	Story5	B727	Force	Gravity	Relative	0	1	0	3.01
537	Dead	Story5	B728	Force	Gravity	Relative	0	1	0	58.1279
574	Dead	Story5	B741	Force	Gravity	Relative	0	1	0	3.01
575	Dead	Story5	B742	Force	Gravity	Relative	0	1	0	7.6714
576	Dead	Story5	B743	Force	Gravity	Relative	0	1	0	3.01
577	Dead	Story5	B744	Force	Gravity	Relative	0	0.0718	0	0.5505
577	Dead	Story5	B744	Force	Gravity	Relative	0.0718	0.5359	0.5505	4.1109
577	Dead	Story5	B744	Force	Gravity	Relative	0.5359	1	4.1109	7.6714
578	Dead	Story5	B745	Force	Gravity	Relative	0	1	0	3.01
579	Dead	Story5	B746	Force	Gravity	Relative	0	0.0718	0	0.5505
579	Dead	Story5	B746	Force	Gravity	Relative	0.0718	0.5359	0.5505	4.1109
579	Dead	Story5	B746	Force	Gravity	Relative	0.5359	1	4.1109	7.6714
580	Dead	Story5	B747	Force	Gravity	Relative	0	1	0	3.01
581	Dead	Story5	B748	Force	Gravity	Relative	0	1	0	7.6714
582	Dead	Story5	B749	Force	Gravity	Relative	0	1	0	3.0104
583	Dead	Story5	B750	Force	Gravity	Relative	0	1	0	58.1279
324	Live	Story5	B616	Force	Gravity	Relative	0	1	0	42.7429

UniqueName	Load Pattern	Story	Label	Load Type	Direction	Distance Type	Relative Distance A	Relative Distance B	Absolute Distance A ft	Absolute Distance B ft
325	Live	Story5	B617	Force	Gravity	Relative	0	1	0	42.7429
336	Live	Story5	B628	Force	Gravity	Relative	0	1	0	42.7429
337	Live	Story5	B629	Force	Gravity	Relative	0	1	0	42.7429
358	Live	Story5	B648	Force	Gravity	Relative	0	0.5	0	7.6925
358	Live	Story5	B648	Force	Gravity	Relative	0.5	1	7.6925	15.3849
359	Live	Story5	B649	Force	Gravity	Relative	0	0.5	0	7.6925
359	Live	Story5	B649	Force	Gravity	Relative	0.5	1	7.6925	15.3849
360	Live	Story5	B650	Force	Gravity	Relative	0	0.5	0	7.6925
360	Live	Story5	B650	Force	Gravity	Relative	0.5	1	7.6925	15.3849
361	Live	Story5	B651	Force	Gravity	Relative	0	0.5	0	7.6925
361	Live	Story5	B651	Force	Gravity	Relative	0.5	1	7.6925	15.3849
520	Live	Story5	B711	Force	Gravity	Relative	0	1	0	3.0097
521	Live	Story5	B712	Force	Gravity	Relative	0	1	0	66.5924
522	Live	Story5	B713	Force	Gravity	Relative	0	1	0	3.0097
523	Live	Story5	B714	Force	Gravity	Relative	0	1	0	66.5924
524	Live	Story5	B715	Force	Gravity	Relative	0	1	0	3.0097
525	Live	Story5	B716	Force	Gravity	Relative	0	1	0	66.5924
526	Live	Story5	B717	Force	Gravity	Relative	0	1	0	3.0097
527	Live	Story5	B718	Force	Gravity	Relative	0	1	0	66.5924
528	Live	Story5	B719	Force	Gravity	Relative	0	1	0	3.0097
529	Live	Story5	B720	Force	Gravity	Relative	0	1	0	66.5924
530	Live	Story5	B721	Force	Gravity	Relative	0	1	0	3.0097
531	Live	Story5	B722	Force	Gravity	Relative	0	1	0	66.5924
532	Live	Story5	B723	Force	Gravity	Relative	0	1	0	3.0097
533	Live	Story5	B724	Force	Gravity	Relative	0	1	0	66.5924
534	Live	Story5	B725	Force	Gravity	Relative	0	1	0	3.01
535	Live	Story5	B726	Force	Gravity	Relative	0	1	0	58.1279
536	Live	Story5	B727	Force	Gravity	Relative	0	1	0	3.01
537	Live	Story5	B728	Force	Gravity	Relative	0	1	0	58.1279
574	Live	Story5	B741	Force	Gravity	Relative	0	1	0	3.01
575	Live	Story5	B742	Force	Gravity	Relative	0	1	0	7.6714
576	Live	Story5	B743	Force	Gravity	Relative	0	1	0	3.01
577	Live	Story5	B744	Force	Gravity	Relative	0	0.0718	0	0.5505
577	Live	Story5	B744	Force	Gravity	Relative	0.0718	0.5359	0.5505	4.1109
577	Live	Story5	B744	Force	Gravity	Relative	0.5359	1	4.1109	7.6714
578	Live	Story5	B745	Force	Gravity	Relative	0	1	0	3.01
579	Live	Story5	B746	Force	Gravity	Relative	0	0.0718	0	0.5505
579	Live	Story5	B746	Force	Gravity	Relative	0.0718	0.5359	0.5505	4.1109
579	Live	Story5	B746	Force	Gravity	Relative	0.5359	1	4.1109	7.6714
580	Live	Story5	B747	Force	Gravity	Relative	0	1	0	3.01
581	Live	Story5	B748	Force	Gravity	Relative	0	1	0	7.6714
582	Live	Story5	B749	Force	Gravity	Relative	0	1	0	3.0104
583	Live	Story5	B750	Force	Gravity	Relative	0	1	0	58.1279
324	Mass	Story5	B616	Force	Gravity	Relative	0	1	0	42.7429
325	Mass	Story5	B617	Force	Gravity	Relative	0	1	0	42.7429
336	Mass	Story5	B628	Force	Gravity	Relative	0	1	0	42.7429
337	Mass	Story5	B629	Force	Gravity	Relative	0	1	0	42.7429
358	Mass	Story5	B648	Force	Gravity	Relative	0	1	0	15.3849
359	Mass	Story5	B649	Force	Gravity	Relative	0	1	0	15.3849
360	Mass	Story5	B650	Force	Gravity	Relative	0	1	0	15.3849
361	Mass	Story5	B651	Force	Gravity	Relative	0	1	0	15.3849
520	Mass	Story5	B711	Force	Gravity	Relative	0	1	0	3.0097
521	Mass	Story5	B712	Force	Gravity	Relative	0	1	0	66.5924
522	Mass	Story5	B713	Force	Gravity	Relative	0	1	0	3.0097

UniqueName	Load Pattern	Story	Label	Load Type	Direction	Distance Type	Relative Distance A	Relative Distance B	Absolute Distance A ft	Absolute Distance B ft
523	Mass	Story5	B714	Force	Gravity	Relative	0	1	0	66.5924
524	Mass	Story5	B715	Force	Gravity	Relative	0	1	0	3.0097
525	Mass	Story5	B716	Force	Gravity	Relative	0	1	0	66.5924
526	Mass	Story5	B717	Force	Gravity	Relative	0	1	0	3.0097
527	Mass	Story5	B718	Force	Gravity	Relative	0	1	0	66.5924
528	Mass	Story5	B719	Force	Gravity	Relative	0	1	0	3.0097
529	Mass	Story5	B720	Force	Gravity	Relative	0	1	0	66.5924
530	Mass	Story5	B721	Force	Gravity	Relative	0	1	0	3.0097
531	Mass	Story5	B722	Force	Gravity	Relative	0	1	0	66.5924
532	Mass	Story5	B723	Force	Gravity	Relative	0	1	0	3.0097
533	Mass	Story5	B724	Force	Gravity	Relative	0	1	0	66.5924
534	Mass	Story5	B725	Force	Gravity	Relative	0	1	0	3.01
535	Mass	Story5	B726	Force	Gravity	Relative	0	1	0	58.1279
536	Mass	Story5	B727	Force	Gravity	Relative	0	1	0	3.01
537	Mass	Story5	B728	Force	Gravity	Relative	0	1	0	58.1279
574	Mass	Story5	B741	Force	Gravity	Relative	0	1	0	3.01
575	Mass	Story5	B742	Force	Gravity	Relative	0	1	0	7.6714
576	Mass	Story5	B743	Force	Gravity	Relative	0	1	0	3.01
577	Mass	Story5	B744	Force	Gravity	Relative	0	0.0718	0	0.5505
577	Mass	Story5	B744	Force	Gravity	Relative	0.0718	0.5359	0.5505	4.1109
577	Mass	Story5	B744	Force	Gravity	Relative	0.5359	1	4.1109	7.6714
578	Mass	Story5	B745	Force	Gravity	Relative	0	1	0	3.01
579	Mass	Story5	B746	Force	Gravity	Relative	0	0.0718	0	0.5505
579	Mass	Story5	B746	Force	Gravity	Relative	0.0718	0.5359	0.5505	4.1109
579	Mass	Story5	B746	Force	Gravity	Relative	0.5359	1	4.1109	7.6714
580	Mass	Story5	B747	Force	Gravity	Relative	0	1	0	3.01
581	Mass	Story5	B748	Force	Gravity	Relative	0	1	0	7.6714
582	Mass	Story5	B749	Force	Gravity	Relative	0	1	0	3.0104
583	Mass	Story5	B750	Force	Gravity	Relative	0	1	0	58.1279
324	WindX	Story5	B616	Force	Local-2	Relative	0	1	0	42.7429
325	WindX	Story5	B617	Force	Local-2	Relative	0	1	0	42.7429
336	WindX	Story5	B628	Force	Local-2	Relative	0	1	0	42.7429
337	WindX	Story5	B629	Force	Local-2	Relative	0	1	0	42.7429
358	WindX	Story5	B648	Force	Local-2	Relative	0	1	0	15.3849
359	WindX	Story5	B649	Force	Local-2	Relative	0	1	0	15.3849
360	WindX	Story5	B650	Force	Local-2	Relative	0	1	0	15.3849
361	WindX	Story5	B651	Force	Local-2	Relative	0	1	0	15.3849
362	WindX	Story5	B652	Force	Global-Y	Relative	0	1	0	24.729
520	WindX	Story5	B711	Force	Local-2	Relative	0	1	0	3.0097
521	WindX	Story5	B712	Force	Local-2	Relative	0	1	0	66.5924
522	WindX	Story5	B713	Force	Local-2	Relative	0	1	0	3.0097
523	WindX	Story5	B714	Force	Local-2	Relative	0	1	0	66.5924
524	WindX	Story5	B715	Force	Local-2	Relative	0	1	0	3.0097
525	WindX	Story5	B716	Force	Local-2	Relative	0	1	0	66.5924
526	WindX	Story5	B717	Force	Local-2	Relative	0	1	0	3.0097
527	WindX	Story5	B718	Force	Local-2	Relative	0	1	0	66.5924
528	WindX	Story5	B719	Force	Local-2	Relative	0	1	0	3.0097
529	WindX	Story5	B720	Force	Local-2	Relative	0	1	0	66.5924
530	WindX	Story5	B721	Force	Local-2	Relative	0	1	0	3.0097
531	WindX	Story5	B722	Force	Local-2	Relative	0	1	0	66.5924
532	WindX	Story5	B723	Force	Local-2	Relative	0	1	0	3.0097
533	WindX	Story5	B724	Force	Local-2	Relative	0	1	0	66.5924
534	WindX	Story5	B725	Force	Local-2	Relative	0	1	0	3.01
535	WindX	Story5	B726	Force	Local-2	Relative	0	1	0	58.1279

UniqueName	Load Pattern	Story	Label	Load Type	Direction	Distance Type	Relative Distance A	Relative Distance B	Absolute Distance A ft	Absolute Distance B ft
536	WindX	Story5	B727	Force	Local-2	Relative	0	1	0	3.01
537	WindX	Story5	B728	Force	Local-2	Relative	0	1	0	58.1279
574	WindX	Story5	B741	Force	Local-2	Relative	0	1	0	3.01
575	WindX	Story5	B742	Force	Local-2	Relative	0	1	0	7.6714
576	WindX	Story5	B743	Force	Local-2	Relative	0	1	0	3.01
577	WindX	Story5	B744	Force	Local-2	Relative	0	1	0	7.6714
578	WindX	Story5	B745	Force	Local-2	Relative	0	1	0	3.01
579	WindX	Story5	B746	Force	Local-2	Relative	0	1	0	7.6714
580	WindX	Story5	B747	Force	Local-2	Relative	0	1	0	3.01
581	WindX	Story5	B748	Force	Local-2	Relative	0	1	0	7.6714
582	WindX	Story5	B749	Force	Local-2	Relative	0	1	0	3.0104
583	WindX	Story5	B750	Force	Local-2	Relative	0	1	0	58.1279
584	WindX	Story5	B751	Force	Global-Y	Relative	0	1	0	15.229
585	WindX	Story5	B752	Force	Global-Y	Relative	0	1	0	9.5
30	WindX	Story5	B1	Force	Global-Y	Relative	0	1	0	7.646
31	WindX	Story5	B2	Force	Global-Y	Relative	0	1	0	15.334
641	WindX	Story5	B7	Force	Global-Y	Relative	0	1	0	11.0629
649	WindX	Story5	B8	Force	Global-Y	Relative	0	1	0	11.0628
643	WindX	Story5	B91	Force	Global-Y	Relative	0	1	0	11.0628
393	WindX	Story5	B46	Force	Global-Y	Relative	0	1	0	6.8174
616	WindX	Story5	B85	Force	Global-Y	Relative	0	1	0	9.6555
615	WindX	Story5	B96	Force	Global-Y	Relative	0	1	0	9.6555
710	WindX	Story5	B97	Force	Global-Y	Relative	0	1	0	6.8174
711	WindX	Story5	B98	Force	Global-Y	Relative	0	1	0	9.6555
644	WindX	Story5	B99	Force	Global-Y	Relative	0	1	0	8.2971
381	WindX	Story5	B119	Force	Global-Y	Relative	0	1	0	8.4031
712	WindX	Story5	B120	Force	Global-Y	Relative	0	1	0	8.2972
713	WindX	Story5	B122	Force	Global-Y	Relative	0	1	0	8.2971
21	WindX	Story5	B54	Force	Global-Y	Relative	0	1	0	7.646
22	WindX	Story5	B55	Force	Global-Y	Relative	0	1	0	15.334
663	WindX	Story5	B60	Force	Global-Y	Relative	0	1	0	11.0629
664	WindX	Story5	B61	Force	Global-Y	Relative	0	1	0	11.0628
665	WindX	Story5	B62	Force	Global-Y	Relative	0	1	0	11.0628
394	WindX	Story5	B118	Force	Global-Y	Relative	0	1	0	8.4031
667	WindX	Story5	B127	Force	Global-Y	Relative	0	1	0	8.2971
240	WindX	Story5	B140	Force	Global-Y	Relative	0	1	0	8.2971
241	WindX	Story5	B141	Force	Global-Y	Relative	0	1	0	8.2972
662	WindX	Story5	B144	Force	Global-Y	Relative	0	1	0	9.6555
661	WindX	Story5	B154	Force	Global-Y	Relative	0	1	0	9.6555
391	WindX	Story5	B159	Force	Global-Y	Relative	0	1	0	6.8174
431	WindX	Story5	B165	Force	Global-Y	Relative	0	1	0	6.8174
614	WindX	Story5	B166	Force	Global-Y	Relative	0	1	0	9.6555
5	WindX	Story5	C157	Force	Global-Y	Relative	0	1	0	24
7	WindX	Story5	C159	Force	Global-Y	Relative	0	1	0	24
8	WindX	Story5	C160	Force	Global-X	Relative	0	1	0	24
12	WindX	Story5	C164	Force	Global-X	Relative	0	1	0	24
25	WindX	Story5	C172	Force	Global-X	Relative	0	1	0	27
26	WindX	Story5	C173	Force	Global-X	Relative	0	1	0	27
27	WindX	Story5	C174	Force	Global-X	Relative	0	1	0	27
243	WindX	Story5	C245	Force	Global-X	Relative	0	1	0	5.6237
259	WindX	Story5	C253	Force	Global-X	Relative	0	1	0	5.6237
275	WindX	Story5	C261	Force	Global-X	Relative	0	1	0	5.6237
357	WindX	Story5	C269	Force	Global-X	Relative	0	1	0	24
486	WindX	Story5	C272	Force	Global-Y	Relative	0	1	0	8

UniqueName	Load Pattern	Story	Label	Load Type	Direction	Distance Type	Relative Distance A	Relative Distance B	Absolute Distance A ft	Absolute Distance B ft
492	WindX	Story5	C1	Force	Global-Y	Relative	0	1	0	8
488	WindX	Story5	C2	Force	Global-X	Relative	0	1	0	8
490	WindX	Story5	C3	Force	Global-X	Relative	0	1	0	8
494	WindX	Story5	C4	Force	Global-X	Relative	0	1	0	8
496	WindX	Story5	C5	Force	Global-X	Relative	0	1	0	8
498	WindX	Story5	C6	Force	Global-X	Relative	0	1	0	8
447	WindX	Story5	C7	Force	Global-Y	Relative	0	1	0	9
448	WindX	Story5	C8	Force	Global-Y	Relative	0	1	0	9
450	WindX	Story5	C10	Force	Global-Y	Relative	0	1	0	9
451	WindX	Story5	C11	Force	Global-Y	Relative	0	1	0	9
453	WindX	Story5	C13	Force	Global-Y	Relative	0	1	0	9
454	WindX	Story5	C14	Force	Global-Y	Relative	0	1	0	9
466	WindX	Story5	C18	Force	Global-Y	Relative	0	1	0	9
467	WindX	Story5	C19	Force	Global-Y	Relative	0	1	0	15
14	WindX	Story5	C22	Force	Global-X	Relative	0	1	0	9
382	WindX	Story5	C23	Force	Global-X	Relative	0	1	0	15
401	WindX	Story5	C24	Force	Global-Y	Relative	0	1	0	9
487	WindX	Story5	C25	Force	Global-Y	Relative	0	1	0	15
489	WindX	Story5	C26	Force	Global-X	Relative	0	1	0	9
491	WindX	Story5	C27	Force	Global-X	Relative	0	1	0	15
493	WindX	Story5	C28	Force	Global-Y	Relative	0	1	0	9
495	WindX	Story5	C29	Force	Global-Y	Relative	0	1	0	15
16	WindX	Story5	C30	Force	Global-X	Relative	0	1	0	9
17	WindX	Story5	C31	Force	Global-X	Relative	0	1	0	9
396	WindX	Story5	C33	Force	Global-X	Relative	0	1	0	9
497	WindX	Story5	C34	Force	Global-X	Relative	0	1	0	9
562	WindX	Story5	C39	Force	Global-X	Relative	0	1	0	9
563	WindX	Story5	C40	Force	Global-X	Relative	0	1	0	9
565	WindX	Story5	C42	Force	Global-X	Relative	0	1	0	9
567	WindX	Story5	C43	Force	Global-X	Relative	0	1	0	9
593	WindX	Story5	C48	Force	Global-Y	Relative	0	1	0	9
594	WindX	Story5	C49	Force	Global-Y	Relative	0	1	0	9
596	WindX	Story5	C51	Force	Global-Y	Relative	0	1	0	9
597	WindX	Story5	C52	Force	Global-Y	Relative	0	1	0	9
599	WindX	Story5	C54	Force	Global-Y	Relative	0	1	0	9
600	WindX	Story5	C55	Force	Global-Y	Relative	0	1	0	9
449	WindX	Story5	C57	Force	Global-Y	Relative	0	1	0	7.33
452	WindX	Story5	C58	Force	Global-Y	Relative	0	1	0	7.33
455	WindX	Story5	C59	Force	Global-Y	Relative	0	1	0	7.33
149	WindX	Story5	C60	Force	Global-Y	Relative	0	1	0	8.5447
148	WindX	Story5	C61	Force	Global-Y	Relative	0	1	0	7.2937
146	WindX	Story5	C62	Force	Global-Y	Relative	0	1	0	6.67
356	WindX	Story5	C72	Force	Global-X	Relative	0	1	0	7.33
499	WindX	Story5	C73	Force	Global-X	Relative	0	1	0	7.33
170	WindX	Story5	C75	Force	Global-X	Relative	0	1	0	6.67
172	WindX	Story5	C76	Force	Global-X	Relative	0	1	0	7.2937
564	WindX	Story5	C9	Force	Global-X	Relative	0	1	0	7.33
194	WindX	Story5	C15	Force	Global-X	Relative	0	1	0	6.67
568	WindX	Story5	C35	Force	Global-X	Relative	0	1	0	7.33
196	WindX	Story5	C38	Force	Global-X	Relative	0	1	0	7.2937
595	WindX	Story5	C41	Force	Global-Y	Relative	0	1	0	7.33
218	WindX	Story5	C44	Force	Global-Y	Relative	0	1	0	6.67
598	WindX	Story5	C47	Force	Global-Y	Relative	0	1	0	7.33
220	WindX	Story5	C66	Force	Global-Y	Relative	0	1	0	7.2937

UniqueName	Load Pattern	Story	Label	Load Type	Direction	Distance Type	Relative Distance A	Relative Distance B	Absolute Distance A ft	Absolute Distance B ft
601	WindX	Story5	C70	Force	Global-Y	Relative	0	1	0	7.33
221	WindX	Story5	C78	Force	Global-Y	Relative	0	1	0	8.5447
324	WindY	Story5	B616	Force	Local-2	Relative	0	1	0	42.7429
325	WindY	Story5	B617	Force	Local-2	Relative	0	1	0	42.7429
336	WindY	Story5	B628	Force	Local-2	Relative	0	1	0	42.7429
337	WindY	Story5	B629	Force	Local-2	Relative	0	1	0	42.7429
358	WindY	Story5	B648	Force	Local-2	Relative	0	1	0	15.3849
359	WindY	Story5	B649	Force	Local-2	Relative	0	1	0	15.3849
360	WindY	Story5	B650	Force	Local-2	Relative	0	1	0	15.3849
361	WindY	Story5	B651	Force	Local-2	Relative	0	1	0	15.3849
362	WindY	Story5	B652	Force	Global-Y	Relative	0	1	0	24.729
520	WindY	Story5	B711	Force	Local-2	Relative	0	1	0	3.0097
521	WindY	Story5	B712	Force	Local-2	Relative	0	1	0	66.5924
522	WindY	Story5	B713	Force	Local-2	Relative	0	1	0	3.0097
523	WindY	Story5	B714	Force	Local-2	Relative	0	1	0	66.5924
524	WindY	Story5	B715	Force	Local-2	Relative	0	1	0	3.0097
525	WindY	Story5	B716	Force	Local-2	Relative	0	1	0	66.5924
526	WindY	Story5	B717	Force	Local-2	Relative	0	1	0	3.0097
527	WindY	Story5	B718	Force	Local-2	Relative	0	1	0	66.5924
528	WindY	Story5	B719	Force	Local-2	Relative	0	1	0	3.0097
529	WindY	Story5	B720	Force	Local-2	Relative	0	1	0	66.5924
530	WindY	Story5	B721	Force	Local-2	Relative	0	1	0	3.0097
531	WindY	Story5	B722	Force	Local-2	Relative	0	1	0	66.5924
532	WindY	Story5	B723	Force	Local-2	Relative	0	1	0	3.0097
533	WindY	Story5	B724	Force	Local-2	Relative	0	1	0	66.5924
534	WindY	Story5	B725	Force	Local-2	Relative	0	1	0	3.01
535	WindY	Story5	B726	Force	Local-2	Relative	0	1	0	58.1279
536	WindY	Story5	B727	Force	Local-2	Relative	0	1	0	3.01
537	WindY	Story5	B728	Force	Local-2	Relative	0	1	0	58.1279
574	WindY	Story5	B741	Force	Local-2	Relative	0	1	0	3.01
575	WindY	Story5	B742	Force	Local-2	Relative	0	1	0	7.6714
576	WindY	Story5	B743	Force	Local-2	Relative	0	1	0	3.01
577	WindY	Story5	B744	Force	Local-2	Relative	0	1	0	7.6714
578	WindY	Story5	B745	Force	Local-2	Relative	0	1	0	3.01
579	WindY	Story5	B746	Force	Local-2	Relative	0	1	0	7.6714
580	WindY	Story5	B747	Force	Local-2	Relative	0	1	0	3.01
581	WindY	Story5	B748	Force	Local-2	Relative	0	1	0	7.6714
582	WindY	Story5	B749	Force	Local-2	Relative	0	1	0	3.0104
583	WindY	Story5	B750	Force	Local-2	Relative	0	1	0	58.1279
584	WindY	Story5	B751	Force	Global-Y	Relative	0	1	0	15.229
585	WindY	Story5	B752	Force	Global-Y	Relative	0	1	0	9.5
30	WindY	Story5	B1	Force	Global-Y	Relative	0	1	0	7.646
31	WindY	Story5	B2	Force	Global-Y	Relative	0	1	0	15.334
641	WindY	Story5	B7	Force	Global-Y	Relative	0	1	0	11.0629
649	WindY	Story5	B8	Force	Global-Y	Relative	0	1	0	11.0628
643	WindY	Story5	B91	Force	Global-Y	Relative	0	1	0	11.0628
393	WindY	Story5	B46	Force	Global-Y	Relative	0	1	0	6.8174
616	WindY	Story5	B85	Force	Global-Y	Relative	0	1	0	9.6555
615	WindY	Story5	B96	Force	Global-Y	Relative	0	1	0	9.6555
710	WindY	Story5	B97	Force	Global-Y	Relative	0	1	0	6.8174
711	WindY	Story5	B98	Force	Global-Y	Relative	0	1	0	9.6555
644	WindY	Story5	B99	Force	Global-Y	Relative	0	1	0	8.2971
381	WindY	Story5	B119	Force	Global-Y	Relative	0	1	0	8.4031
712	WindY	Story5	B120	Force	Global-Y	Relative	0	1	0	8.2972

UniqueName	Load Pattern	Story	Label	Load Type	Direction	Distance Type	Relative Distance A	Relative Distance B	Absolute Distance A ft	Absolute Distance B ft
713	WindY	Story5	B122	Force	Global-Y	Relative	0	1	0	8.2971
21	WindY	Story5	B54	Force	Global-Y	Relative	0	1	0	7.646
22	WindY	Story5	B55	Force	Global-Y	Relative	0	1	0	15.334
663	WindY	Story5	B60	Force	Global-Y	Relative	0	1	0	11.0629
664	WindY	Story5	B61	Force	Global-Y	Relative	0	1	0	11.0628
665	WindY	Story5	B62	Force	Global-Y	Relative	0	1	0	11.0628
394	WindY	Story5	B118	Force	Global-Y	Relative	0	1	0	8.4031
667	WindY	Story5	B127	Force	Global-Y	Relative	0	1	0	8.2971
240	WindY	Story5	B140	Force	Global-Y	Relative	0	1	0	8.2971
241	WindY	Story5	B141	Force	Global-Y	Relative	0	1	0	8.2972
662	WindY	Story5	B144	Force	Global-Y	Relative	0	1	0	9.6555
661	WindY	Story5	B154	Force	Global-Y	Relative	0	1	0	9.6555
391	WindY	Story5	B159	Force	Global-Y	Relative	0	1	0	6.8174
431	WindY	Story5	B165	Force	Global-Y	Relative	0	1	0	6.8174
614	WindY	Story5	B166	Force	Global-Y	Relative	0	1	0	9.6555
5	WindY	Story5	C157	Force	Global-Y	Relative	0	1	0	24
7	WindY	Story5	C159	Force	Global-Y	Relative	0	1	0	24
8	WindY	Story5	C160	Force	Global-X	Relative	0	1	0	24
12	WindY	Story5	C164	Force	Global-X	Relative	0	1	0	24
25	WindY	Story5	C172	Force	Global-X	Relative	0	1	0	27
26	WindY	Story5	C173	Force	Global-X	Relative	0	1	0	27
27	WindY	Story5	C174	Force	Global-X	Relative	0	1	0	27
243	WindY	Story5	C245	Force	Global-X	Relative	0	1	0	5.6237
259	WindY	Story5	C253	Force	Global-X	Relative	0	1	0	5.6237
275	WindY	Story5	C261	Force	Global-X	Relative	0	1	0	5.6237
357	WindY	Story5	C269	Force	Global-X	Relative	0	1	0	24
486	WindY	Story5	C272	Force	Global-Y	Relative	0	1	0	8
492	WindY	Story5	C1	Force	Global-Y	Relative	0	1	0	8
488	WindY	Story5	C2	Force	Global-X	Relative	0	1	0	8
490	WindY	Story5	C3	Force	Global-X	Relative	0	1	0	8
494	WindY	Story5	C4	Force	Global-X	Relative	0	1	0	8
496	WindY	Story5	C5	Force	Global-X	Relative	0	1	0	8
498	WindY	Story5	C6	Force	Global-X	Relative	0	1	0	8
447	WindY	Story5	C7	Force	Global-Y	Relative	0	1	0	9
448	WindY	Story5	C8	Force	Global-Y	Relative	0	1	0	9
450	WindY	Story5	C10	Force	Global-Y	Relative	0	1	0	9
451	WindY	Story5	C11	Force	Global-Y	Relative	0	1	0	9
453	WindY	Story5	C13	Force	Global-Y	Relative	0	1	0	9
454	WindY	Story5	C14	Force	Global-Y	Relative	0	1	0	9
466	WindY	Story5	C18	Force	Global-Y	Relative	0	1	0	9
467	WindY	Story5	C19	Force	Global-Y	Relative	0	1	0	15
14	WindY	Story5	C22	Force	Global-X	Relative	0	1	0	9
382	WindY	Story5	C23	Force	Global-X	Relative	0	1	0	15
401	WindY	Story5	C24	Force	Global-Y	Relative	0	1	0	9
487	WindY	Story5	C25	Force	Global-Y	Relative	0	1	0	15
489	WindY	Story5	C26	Force	Global-X	Relative	0	1	0	9
491	WindY	Story5	C27	Force	Global-X	Relative	0	1	0	15
493	WindY	Story5	C28	Force	Global-Y	Relative	0	1	0	9
495	WindY	Story5	C29	Force	Global-Y	Relative	0	1	0	15
16	WindY	Story5	C30	Force	Global-X	Relative	0	1	0	9
17	WindY	Story5	C31	Force	Global-X	Relative	0	1	0	9
396	WindY	Story5	C33	Force	Global-X	Relative	0	1	0	9
497	WindY	Story5	C34	Force	Global-X	Relative	0	1	0	9
562	WindY	Story5	C39	Force	Global-X	Relative	0	1	0	9

UniqueName	Load Pattern	Story	Label	Load Type	Direction	Distance Type	Relative Distance A	Relative Distance B	Absolute Distance A ft	Absolute Distance B ft
563	WindY	Story5	C40	Force	Global-X	Relative	0	1	0	9
565	WindY	Story5	C42	Force	Global-X	Relative	0	1	0	9
567	WindY	Story5	C43	Force	Global-X	Relative	0	1	0	9
593	WindY	Story5	C48	Force	Global-Y	Relative	0	1	0	9
594	WindY	Story5	C49	Force	Global-Y	Relative	0	1	0	9
596	WindY	Story5	C51	Force	Global-Y	Relative	0	1	0	9
597	WindY	Story5	C52	Force	Global-Y	Relative	0	1	0	9
599	WindY	Story5	C54	Force	Global-Y	Relative	0	1	0	9
600	WindY	Story5	C55	Force	Global-Y	Relative	0	1	0	9
449	WindY	Story5	C57	Force	Global-Y	Relative	0	1	0	7.33
452	WindY	Story5	C58	Force	Global-Y	Relative	0	1	0	7.33
455	WindY	Story5	C59	Force	Global-Y	Relative	0	1	0	7.33
149	WindY	Story5	C60	Force	Global-Y	Relative	0	1	0	8.5447
148	WindY	Story5	C61	Force	Global-Y	Relative	0	1	0	7.2937
146	WindY	Story5	C62	Force	Global-Y	Relative	0	1	0	6.67
356	WindY	Story5	C72	Force	Global-X	Relative	0	1	0	7.33
499	WindY	Story5	C73	Force	Global-X	Relative	0	1	0	7.33
170	WindY	Story5	C75	Force	Global-X	Relative	0	1	0	6.67
172	WindY	Story5	C76	Force	Global-X	Relative	0	1	0	7.2937
564	WindY	Story5	C9	Force	Global-X	Relative	0	1	0	7.33
194	WindY	Story5	C15	Force	Global-X	Relative	0	1	0	6.67
568	WindY	Story5	C35	Force	Global-X	Relative	0	1	0	7.33
196	WindY	Story5	C38	Force	Global-X	Relative	0	1	0	7.2937
595	WindY	Story5	C41	Force	Global-Y	Relative	0	1	0	7.33
218	WindY	Story5	C44	Force	Global-Y	Relative	0	1	0	6.67
598	WindY	Story5	C47	Force	Global-Y	Relative	0	1	0	7.33
220	WindY	Story5	C66	Force	Global-Y	Relative	0	1	0	7.2937
601	WindY	Story5	C70	Force	Global-Y	Relative	0	1	0	7.33
221	WindY	Story5	C78	Force	Global-Y	Relative	0	1	0	8.5447
7	WindXX	Story5	C159	Force	Global-X	Relative	0	1	0	24
486	WindXX	Story5	C272	Force	Global-X	Relative	0	1	0	8
492	WindXX	Story5	C1	Force	Global-X	Relative	0	1	0	8
447	WindXX	Story5	C7	Force	Global-X	Relative	0	1	0	9
448	WindXX	Story5	C8	Force	Global-X	Relative	0	1	0	9
401	WindXX	Story5	C24	Force	Global-X	Relative	0	1	0	9
487	WindXX	Story5	C25	Force	Global-X	Relative	0	1	0	15
593	WindXX	Story5	C48	Force	Global-X	Relative	0	1	0	9
594	WindXX	Story5	C49	Force	Global-X	Relative	0	1	0	9
449	WindXX	Story5	C57	Force	Global-X	Relative	0	1	0	7.33
146	WindXX	Story5	C62	Force	Global-X	Relative	0	1	0	6.67
595	WindXX	Story5	C41	Force	Global-X	Relative	0	1	0	7.33
218	WindXX	Story5	C44	Force	Global-X	Relative	0	1	0	6.67
7	WindYY	Story5	C159	Force	Global-X	Relative	0	1	0	24
486	WindYY	Story5	C272	Force	Global-X	Relative	0	1	0	8
492	WindYY	Story5	C1	Force	Global-X	Relative	0	1	0	8
447	WindYY	Story5	C7	Force	Global-X	Relative	0	1	0	9
448	WindYY	Story5	C8	Force	Global-X	Relative	0	1	0	9
401	WindYY	Story5	C24	Force	Global-X	Relative	0	1	0	9
487	WindYY	Story5	C25	Force	Global-X	Relative	0	1	0	15
593	WindYY	Story5	C48	Force	Global-X	Relative	0	1	0	9
594	WindYY	Story5	C49	Force	Global-X	Relative	0	1	0	9
449	WindYY	Story5	C57	Force	Global-X	Relative	0	1	0	7.33
146	WindYY	Story5	C62	Force	Global-X	Relative	0	1	0	6.67
595	WindYY	Story5	C41	Force	Global-X	Relative	0	1	0	7.33

UniqueName	Load Pattern	Story	Label	Load Type	Direction	Distance Type	Relative Distance A	Relative Distance B	Absolute Distance A ft	Absolute Distance B ft
218	WindYY	Story5	C44	Force	Global-X	Relative	0	1	0	6.67

Frame Loads Assignments - Distributed (Part 2 of 2)

UniqueName	Load Pattern	Force A kip/ft	Force B kip/ft
324	Dead	0.149	0.149
325	Dead	0.405	0.405
336	Dead	0.405	0.405
337	Dead	0.149	0.149
358	Dead	0.405	0.405
359	Dead	0.149	0.149
360	Dead	0.149	0.149
361	Dead	0.405	0.405
520	Dead	0.149	0.149
521	Dead	0.149	0.149
522	Dead	0.405	0.405
523	Dead	0.405	0.405
524	Dead	0.513	0.513
525	Dead	0.513	0.513
526	Dead	0.513	0.513
527	Dead	0.513	0.513
528	Dead	0.513	0.513
529	Dead	0.513	0.513
530	Dead	0.405	0.405
531	Dead	0.405	0.405
532	Dead	0.149	0.149
533	Dead	0.149	0.149
534	Dead	0.513	0.513
535	Dead	0.513	0.513
536	Dead	0.513	0.513
537	Dead	0.513	0.513
574	Dead	0.149	0.149
575	Dead	0.149	0.149
576	Dead	0.405	0.405
577	Dead	0.405	0.405
577	Dead	0.405	0.405
577	Dead	0.405	0.405
578	Dead	0.405	0.405
579	Dead	0.405	0.405
579	Dead	0.405	0.405
579	Dead	0.405	0.405
580	Dead	0.149	0.149
581	Dead	0.149	0.149
582	Dead	0.513	0.513
583	Dead	0.513	0.513
324	Live	0.11	0.11
325	Live	0.3	0.3
336	Live	0.3	0.3
337	Live	0.11	0.11
358	Live	0.3	0.3
358	Live	0.3	0.3
359	Live	0.11	0.11

UniqueName	Load Pattern	Force A kip/ft	Force B kip/ft
359	Live	0.11	0.11
360	Live	0.11	0.11
360	Live	0.11	0.11
361	Live	0.3	0.3
361	Live	0.3	0.3
520	Live	0.11	0.11
521	Live	0.11	0.11
522	Live	0.3	0.3
523	Live	0.3	0.3
524	Live	0.38	0.38
525	Live	0.38	0.38
526	Live	0.38	0.38
527	Live	0.38	0.38
528	Live	0.38	0.38
529	Live	0.38	0.38
530	Live	0.3	0.3
531	Live	0.3	0.3
532	Live	0.11	0.11
533	Live	0.11	0.11
534	Live	0.38	0.38
535	Live	0.38	0.38
536	Live	0.38	0.38
537	Live	0.38	0.38
574	Live	0.11	0.11
575	Live	0.11	0.11
576	Live	0.3	0.3
577	Live	0.3	0.3
577	Live	0.3	0.3
577	Live	0.3	0.3
578	Live	0.3	0.3
579	Live	0.3	0.3
579	Live	0.3	0.3
579	Live	0.3	0.3
580	Live	0.11	0.11
581	Live	0.11	0.11
582	Live	0.38	0.38
583	Live	0.38	0.38
324	Mass	0.255	0.255
325	Mass	0.695	0.695
336	Mass	0.695	0.695
337	Mass	0.255	0.255
358	Mass	0.695	0.695
359	Mass	0.255	0.255
360	Mass	0.255	0.255
361	Mass	0.695	0.695
520	Mass	0.255	0.255
521	Mass	0.255	0.255
522	Mass	0.695	0.695
523	Mass	0.695	0.695
524	Mass	0.88	0.88
525	Mass	0.88	0.88
526	Mass	0.88	0.88
527	Mass	0.88	0.88
528	Mass	0.88	0.88
529	Mass	0.88	0.88

UniqueName	Load Pattern	Force A kip/ft	Force B kip/ft
530	Mass	0.695	0.695
531	Mass	0.695	0.695
532	Mass	0.255	0.255
533	Mass	0.255	0.255
534	Mass	0.88	0.88
535	Mass	0.88	0.88
536	Mass	0.88	0.88
537	Mass	0.88	0.88
574	Mass	0.255	0.255
575	Mass	0.255	0.255
576	Mass	0.695	0.695
577	Mass	0.695	0.695
577	Mass	0.695	0.695
577	Mass	0.695	0.695
578	Mass	0.695	0.695
579	Mass	0.695	0.695
579	Mass	0.695	0.695
579	Mass	0.695	0.695
580	Mass	0.255	0.255
581	Mass	0.255	0.255
582	Mass	0.88	0.88
583	Mass	0.88	0.88
324	WindX	0.066	0.066
325	WindX	0.18	0.18
336	WindX	0.18	0.18
337	WindX	0.066	0.066
358	WindX	0.18	0.18
359	WindX	0.066	0.066
360	WindX	0.066	0.066
361	WindX	0.18	0.18
362	WindX	0.192	0.192
520	WindX	0.066	0.066
521	WindX	0.066	0.066
522	WindX	0.18	0.18
523	WindX	0.18	0.18
524	WindX	0.228	0.228
525	WindX	0.228	0.228
526	WindX	0.228	0.228
527	WindX	0.228	0.228
528	WindX	0.228	0.228
529	WindX	0.228	0.228
530	WindX	0.18	0.18
531	WindX	0.18	0.18
532	WindX	0.066	0.066
533	WindX	0.066	0.066
534	WindX	0.228	0.228
535	WindX	0.228	0.228
536	WindX	0.228	0.228
537	WindX	0.228	0.228
574	WindX	0.066	0.066
575	WindX	0.066	0.066
576	WindX	0.18	0.18
577	WindX	0.18	0.18
578	WindX	0.18	0.18
579	WindX	0.18	0.18

UniqueName	Load Pattern	Force A kip/ft	Force B kip/ft
580	WindX	0.066	0.066
581	WindX	0.066	0.066
582	WindX	0.228	0.228
583	WindX	0.228	0.228
584	WindX	-0.192	-0.192
585	WindX	-0.192	-0.192
30	WindX	-0.344	-0.344
31	WindX	-0.344	-0.344
641	WindX	-0.344	-0.344
649	WindX	-0.344	-0.344
643	WindX	-0.344	-0.344
393	WindX	-0.344	-0.344
616	WindX	-0.344	-0.344
615	WindX	-0.344	-0.344
710	WindX	-0.344	-0.344
711	WindX	-0.344	-0.344
644	WindX	-0.344	-0.344
381	WindX	-0.344	-0.344
712	WindX	-0.344	-0.344
713	WindX	-0.344	-0.344
21	WindX	0.344	0.344
22	WindX	0.344	0.344
663	WindX	0.344	0.344
664	WindX	0.344	0.344
665	WindX	0.344	0.344
394	WindX	0.344	0.344
667	WindX	0.344	0.344
240	WindX	0.344	0.344
241	WindX	0.344	0.344
662	WindX	0.344	0.344
661	WindX	0.344	0.344
391	WindX	0.344	0.344
431	WindX	0.344	0.344
614	WindX	0.344	0.344
5	WindX	0.28	0.28
7	WindX	0.2	0.2
8	WindX	0.24	0.24
12	WindX	0.3	0.3
25	WindX	0.304	0.304
26	WindX	0.304	0.304
27	WindX	0.304	0.304
243	WindX	0.304	0.304
259	WindX	0.304	0.304
275	WindX	0.304	0.304
357	WindX	0.3	0.3
486	WindX	-0.28	-0.28
492	WindX	0.28	0.28
488	WindX	0.24	0.24
490	WindX	0.24	0.24
494	WindX	0.3	0.3
496	WindX	0.3	0.3
498	WindX	0.3	0.3
447	WindX	-0.064	-0.064
448	WindX	-0.064	-0.064
450	WindX	-0.192	-0.192

UniqueName	Load Pattern	Force A kip/ft	Force B kip/ft
451	WindX	-0.192	-0.192
453	WindX	-0.28	-0.28
454	WindX	-0.28	-0.28
466	WindX	-0.28	-0.28
467	WindX	-0.28	-0.28
14	WindX	0.24	0.24
382	WindX	0.24	0.24
401	WindX	-0.076	-0.076
487	WindX	-0.076	-0.076
489	WindX	0.3	0.3
491	WindX	0.3	0.3
493	WindX	-0.2	-0.2
495	WindX	-0.2	-0.2
16	WindX	0.088	0.088
17	WindX	0.088	0.088
396	WindX	0.152	0.152
497	WindX	0.152	0.152
562	WindX	0.088	0.088
563	WindX	0.088	0.088
565	WindX	0.152	0.152
567	WindX	0.152	0.152
593	WindX	0.064	0.064
594	WindX	0.064	0.064
596	WindX	0.192	0.192
597	WindX	0.192	0.192
599	WindX	0.28	0.28
600	WindX	0.28	0.28
449	WindX	-0.064	-0.064
452	WindX	-0.192	-0.192
455	WindX	-0.28	-0.28
149	WindX	-0.28	-0.28
148	WindX	-0.192	-0.192
146	WindX	-0.064	-0.064
356	WindX	0.088	0.088
499	WindX	0.152	0.152
170	WindX	0.088	0.088
172	WindX	0.152	0.152
564	WindX	0.088	0.088
194	WindX	0.088	0.088
568	WindX	0.152	0.152
196	WindX	0.152	0.152
595	WindX	0.064	0.064
218	WindX	0.064	0.064
598	WindX	0.192	0.192
220	WindX	0.192	0.192
601	WindX	0.28	0.28
221	WindX	0.28	0.28
324	WindY	0.066	0.066
325	WindY	0.18	0.18
336	WindY	0.18	0.18
337	WindY	0.066	0.066
358	WindY	0.18	0.18
359	WindY	0.066	0.066
360	WindY	0.066	0.066
361	WindY	0.18	0.18

UniqueName	Load Pattern	Force A kip/ft	Force B kip/ft
362	WindY	0.192	0.192
520	WindY	0.066	0.066
521	WindY	0.066	0.066
522	WindY	0.18	0.18
523	WindY	0.18	0.18
524	WindY	0.228	0.228
525	WindY	0.228	0.228
526	WindY	0.228	0.228
527	WindY	0.228	0.228
528	WindY	0.228	0.228
529	WindY	0.228	0.228
530	WindY	0.18	0.18
531	WindY	0.18	0.18
532	WindY	0.066	0.066
533	WindY	0.066	0.066
534	WindY	0.228	0.228
535	WindY	0.228	0.228
536	WindY	0.228	0.228
537	WindY	0.228	0.228
574	WindY	0.066	0.066
575	WindY	0.066	0.066
576	WindY	0.18	0.18
577	WindY	0.18	0.18
578	WindY	0.18	0.18
579	WindY	0.18	0.18
580	WindY	0.066	0.066
581	WindY	0.066	0.066
582	WindY	0.228	0.228
583	WindY	0.228	0.228
584	WindY	0.192	0.192
585	WindY	0.192	0.192
30	WindY	0.344	0.344
31	WindY	0.344	0.344
641	WindY	0.344	0.344
649	WindY	0.344	0.344
643	WindY	0.344	0.344
393	WindY	0.344	0.344
616	WindY	0.344	0.344
615	WindY	0.344	0.344
710	WindY	0.344	0.344
711	WindY	0.344	0.344
644	WindY	0.344	0.344
381	WindY	0.344	0.344
712	WindY	0.344	0.344
713	WindY	0.344	0.344
21	WindY	0.344	0.344
22	WindY	0.344	0.344
663	WindY	0.344	0.344
664	WindY	0.344	0.344
665	WindY	0.344	0.344
394	WindY	0.344	0.344
667	WindY	0.344	0.344
240	WindY	0.344	0.344
241	WindY	0.344	0.344
662	WindY	0.344	0.344

UniqueName	Load Pattern	Force A kip/ft	Force B kip/ft
661	WindY	0.344	0.344
391	WindY	0.344	0.344
431	WindY	0.344	0.344
614	WindY	0.344	0.344
5	WindY	0.33	0.33
7	WindY	0.2	0.2
8	WindY	0.24	0.24
12	WindY	0.3	0.3
25	WindY	-0.304	-0.304
26	WindY	-0.304	-0.304
27	WindY	-0.304	-0.304
243	WindY	-0.304	-0.304
259	WindY	-0.304	-0.304
275	WindY	-0.304	-0.304
357	WindY	0.3	0.3
486	WindY	0.33	0.33
492	WindY	0.33	0.33
488	WindY	0.24	0.24
490	WindY	0.24	0.24
494	WindY	0.3	0.3
496	WindY	0.3	0.3
498	WindY	0.3	0.3
447	WindY	0.064	0.064
448	WindY	0.064	0.064
450	WindY	0.192	0.192
451	WindY	0.192	0.192
453	WindY	0.33	0.33
454	WindY	0.33	0.33
466	WindY	0.33	0.33
467	WindY	0.33	0.33
14	WindY	0.24	0.24
382	WindY	0.24	0.24
401	WindY	0.076	0.076
487	WindY	0.076	0.076
489	WindY	0.3	0.3
491	WindY	0.3	0.3
493	WindY	0.2	0.2
495	WindY	0.2	0.2
16	WindY	-0.088	-0.088
17	WindY	-0.088	-0.088
396	WindY	-0.152	-0.152
497	WindY	-0.152	-0.152
562	WindY	-0.088	-0.088
563	WindY	-0.088	-0.088
565	WindY	-0.152	-0.152
567	WindY	-0.152	-0.152
593	WindY	0.064	0.064
594	WindY	0.064	0.064
596	WindY	0.192	0.192
597	WindY	0.192	0.192
599	WindY	0.33	0.33
600	WindY	0.33	0.33
449	WindY	0.064	0.064
452	WindY	0.192	0.192
455	WindY	0.33	0.33

UniqueName	Load Pattern	Force A kip/ft	Force B kip/ft
149	WindY	0.33	0.33
148	WindY	0.192	0.192
146	WindY	0.064	0.064
356	WindY	-0.088	-0.088
499	WindY	-0.152	-0.152
170	WindY	-0.088	-0.088
172	WindY	-0.152	-0.152
564	WindY	-0.088	-0.088
194	WindY	-0.088	-0.088
568	WindY	-0.152	-0.152
196	WindY	-0.152	-0.152
595	WindY	0.064	0.064
218	WindY	0.064	0.064
598	WindY	0.192	0.192
220	WindY	0.192	0.192
601	WindY	0.33	0.33
221	WindY	0.33	0.33
7	WindXX	0.088	0.088
486	WindXX	0.088	0.088
492	WindXX	0.088	0.088
447	WindXX	0.088	0.088
448	WindXX	0.088	0.088
401	WindXX	0.088	0.088
487	WindXX	0.088	0.088
593	WindXX	0.088	0.088
594	WindXX	0.088	0.088
449	WindXX	0.088	0.088
146	WindXX	0.088	0.088
595	WindXX	0.088	0.088
218	WindXX	0.088	0.088
7	WindYY	0.088	0.088
486	WindYY	0.088	0.088
492	WindYY	0.088	0.088
447	WindYY	-0.088	-0.088
448	WindYY	-0.088	-0.088
401	WindYY	0.088	0.088
487	WindYY	0.088	0.088
593	WindYY	-0.088	-0.088
594	WindYY	-0.088	-0.088
449	WindYY	-0.088	-0.088
146	WindYY	-0.088	-0.088
595	WindYY	-0.088	-0.088
218	WindYY	-0.088	-0.088

Area Loads

Area Load Assignments - Uniform

Story	Label	UniqueName	Load Pattern	Direction	Load lb/ft2
Story5	F32	13	Dead	Gravity	22
Story5	F33	14	Dead	Gravity	22
Story5	F34	15	Dead	Gravity	22
Story5	F36	16	Dead	Gravity	22
Story5	F37	17	Dead	Gravity	22

Story	Label	UniqueName	Load Pattern	Direction	Load lb/ft2
Story5	F38	18	Dead	Gravity	22
Story5	F39	19	Dead	Gravity	53
Story5	F42	21	Dead	Gravity	53
Story5	F32	13	Live	Gravity	20
Story5	F33	14	Live	Gravity	20
Story5	F34	15	Live	Gravity	20
Story5	F36	16	Live	Gravity	20
Story5	F37	17	Live	Gravity	20
Story5	F38	18	Live	Gravity	20
Story5	F32	13	WindY	Gravity	-12
Story5	F33	14	WindY	Gravity	-12
Story5	F34	15	WindY	Gravity	-12
Story5	F36	16	WindY	Gravity	-12
Story5	F37	17	WindY	Gravity	-12
Story5	F38	18	WindY	Gravity	-12
Story5	F4	41	WindY	Local-3	12
Story5	F39	19	LiveM	Gravity	125
Story5	F42	21	LiveM	Gravity	125

Area Load Assignments - Non-uniform

Story	Label	UniqueName	Load Pattern	Direction	A lb/ft3	B lb/ft3	C lb/ft3	D lb/ft2	Restrictions
Story5	F32	13	Snow	Gravity	-4	0	0	574	Use All Values
Story5	F33	14	Snow	Gravity	-4	0	0	574	Use All Values
Story5	F34	15	Snow	Gravity	-4	0	0	574	Use All Values
Story5	F36	16	Snow	Gravity	-4	0	0	574	Use All Values
Story5	F37	17	Snow	Gravity	-4	0	0	574	Use All Values
Story5	F38	18	Snow	Gravity	-4	0	0	574	Use All Values
Story5	F32	13	Snoww	Gravity	4	0	0	-582	Use All Values
Story5	F33	14	Snoww	Gravity	4	0	0	-582	Use All Values
Story5	F34	15	Snoww	Gravity	4	0	0	-582	Use All Values
Story5	F36	16	Snoww	Gravity	4	0	0	-582	Use All Values
Story5	F37	17	Snoww	Gravity	4	0	0	-582	Use All Values
Story5	F38	18	Snoww	Gravity	4	0	0	-582	Use All Values

AOF Middle

Auto Seismic Loading

Load Pattern Definitions - Auto Seismic - ASCE 7-16 (Part 1 of 3)

Name	Period Used sec	Coeff Used	Weight Used kip	Base Shear kip	Is Auto Load	X Dir?	X Dir Plus Ecc?	X Dir Minus Ecc?	Y Dir?	Y Dir Plus Ecc?	Y Dir Minus Ecc?	Ecc Ratio
Exx					No	Yes	Yes	Yes	No	No	No	0.05
Exx(1/3)	0.368	0.1224	645.4156	78.999	Yes	Yes	No	No	No	No	No	0.05
Exx(2/3)	0.368	0.1224	645.4156	78.999	Yes	No	Yes	No	No	No	No	0.05
Exx(3/3)	0.368	0.1224	645.4156	78.999	Yes	No	No	Yes	No	No	No	0.05
Eyy					No	No	No	No	Yes	Yes	Yes	0.05
Eyy(1/3)	0.368	0.1224	645.4156	78.999	Yes	No	No	No	Yes	No	No	0.05
Eyy(2/3)	0.368	0.1224	645.4156	78.999	Yes	No	No	No	No	Yes	No	0.05
Eyy(3/3)	0.368	0.1224	645.4156	78.999	Yes	No	No	No	No	No	Yes	0.05

Load Pattern Definitions - Auto Seismic - ASCE 7-16 (Part 2 of 3)

Name	Period Used sec	Coeff Used	Weight Used kip	Base Shear kip	Top Story	Bottom Story	Period Type	Ct and X	Ss	S1	TL sec
Exx					Story5	Base	Approximate	0.02; 0.75	0.72	0.23	6
Exx(1/3)	0.368	0.1224	645.4156	78.999	Story5	Base	Approximate	0.02; 0.75	0.72	0.23	6
Exx(2/3)	0.368	0.1224	645.4156	78.999	Story5	Base	Approximate	0.02; 0.75	0.72	0.23	6
Exx(3/3)	0.368	0.1224	645.4156	78.999	Story5	Base	Approximate	0.02; 0.75	0.72	0.23	6
Eyy					Story5	Base	Approximate	0.02; 0.75	0.72	0.23	6
Eyy(1/3)	0.368	0.1224	645.4156	78.999	Story5	Base	Approximate	0.02; 0.75	0.72	0.23	6
Eyy(2/3)	0.368	0.1224	645.4156	78.999	Story5	Base	Approximate	0.02; 0.75	0.72	0.23	6
Eyy(3/3)	0.368	0.1224	645.4156	78.999	Story5	Base	Approximate	0.02; 0.75	0.72	0.23	6

Load Pattern Definitions - Auto Seismic - ASCE 7-16 (Part 3 of 3)

Name	Period Used sec	Coeff Used	Weight Used kip	Base Shear kip	Site Class	Fa	Fv	SDS	SD1	R	Omega	Cd	I
Exx					D	1.224	2.14	0.58752	0.328133	6	2	5	1.25
Exx(1/3)	0.368	0.1224	645.4156	78.999	D	1.224	2.14	0.58752	0.328133	6	2	5	1.25
Exx(2/3)	0.368	0.1224	645.4156	78.999	D	1.224	2.14	0.58752	0.328133	6	2	5	1.25
Exx(3/3)	0.368	0.1224	645.4156	78.999	D	1.224	2.14	0.58752	0.328133	6	2	5	1.25
Eyy					D	1.224	2.14	0.58752	0.328133	6	2	5	1.25
Eyy(1/3)	0.368	0.1224	645.4156	78.999	D	1.224	2.14	0.58752	0.328133	6	2	5	1.25
Eyy(2/3)	0.368	0.1224	645.4156	78.999	D	1.224	2.14	0.58752	0.328133	6	2	5	1.25
Eyy(3/3)	0.368	0.1224	645.4156	78.999	D	1.224	2.14	0.58752	0.328133	6	2	5	1.25

ASCE 7-16 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern Exx according to ASCE 7-16, as calculated by ETABS.

Direction and Eccentricity

Direction = Multiple

Eccentricity Ratio = 5% for all diaphragms

Structural Period

Period Calculation Method = Approximate

Coefficient, C_t [ASCE Table 12.8-2]		
Coefficient, x [ASCE Table 12.8-2]		$C_{t=0.02ft}$
Structure Height Above Base, h_n		
Approximate Fundamental Period, T_a [ASCE 12.8.2.1 Eq. 12.8-7]	Ta=<Ct><hn>^{x}	$T_{a=0.368}$ sec
Long-Period Transition Period, T_L [ASCE 11.4.5]		$T_{L=6}$ sec

Factors and Coefficients

Response Modification Factor, R [ASCE Table 12.2-1]	
System Overstrength Factor, Ω_0 [ASCE Table 12.2-1]	R=6
Deflection Amplification Factor, C_d [ASCE Table 12.2-1]	
Importance Factor, I [ASCE Table 1.5-2]	

Ss and S1 Source = 0.75

Mapped MCE Spectral Response Acceleration, S_s [ASCE 11.4.2]	
Mapped MCE Spectral Response Acceleration, S_1 [ASCE 11.4.2]	
Site Class [ASCE Table 20.3-1] = D - Stiff Soil	$S_{s=0.72g}$
Site Coefficient, F_a [ASCE Table 11.4-1]	
Site Coefficient, F_v [ASCE Table 11.4-2]	

Seismic Response

MCE Spectral Response Acceleration, S_{MS} [ASCE 11.4.4, Eq. 11.4-1]	SMS=<Fa><$S_{S>}$	$S_{MS=0.88128g}$
MCE Spectral Response Acceleration, S_{M1} [ASCE 11.4.4, Eq. 11.4-2]	SM1=<Fv><$S_{1>}$	$S_{M1=0.4922g}$

Design Spectral Response Acceleration, S_{DS} [ASCE 11.4.5, Eq. 11.4-3]	SDS=<<2>/<3>><S_{MS}>	$S_{DS=0.58752g}$
Design Spectral Response Acceleration, S_{D1} [ASCE 11.4.5, Eq. 11.4-4]	SD1=<<2>/<3>><S_{M1}>	$S_{D1=0.328133g}$

Equivalent Lateral Forces

Seismic Response Coefficient, C_S [ASCE 12.8.1.1, Eq. 12.8-2]	CS=<S_{DS}>/<(<R>/<I>)>
[ASCE 12.8.1.1, Eq. 12.8-3]	C<S,max>=<S_{D1}>/<T(<R>/<I>)>
[ASCE 12.8.1.1, Eq. 12.8-5]	C<S,min>=max(0.044<S_{DS}>I,0.01)=0.032314
[ASCE 12.8.1.1, Eq. 12.8-6]	C<S,min>=0.5<S_{1}>/<(<R>/<I>)><for <S_{1}>=0.6g>
	C<S,min>≤<Cs>≤$C_{<S,max>}$

Calculated Base Shear

Direction	Period Used (sec)	C_s	W (kip)	V (kip)
X	0.368	0.1224	645.4156	78.9989
X + Ecc. Y	0.368	0.1224	645.4156	78.9989
X - Ecc. Y	0.368	0.1224	645.4156	78.9989

ASCE 7-16 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern Eyy according to ASCE 7-16, as calculated by ETABS.

Direction and Eccentricity

Direction = Multiple

Eccentricity Ratio = 5% for all diaphragms

Structural Period

Period Calculation Method = Approximate

Coefficient, C_t [ASCE Table 12.8-2]		
Coefficient, x [ASCE Table 12.8-2]		$C_{t=0.02ft}$
Structure Height Above Base, h_n		
Approximate Fundamental Period, T_a [ASCE 12.8.2.1 Eq. 12.8-7]	Ta=<Ct><hn>^{x}	$T_{a=0.368}$ sec
Long-Period Transition Period, T_L [ASCE 11.4.5]		$T_{L=6}$ sec

Factors and Coefficients

Response Modification Factor, R [ASCE Table 12.2-1]	
System Overstrength Factor, Ω_0 [ASCE Table 12.2-1]	R=6
Deflection Amplification Factor, C_d [ASCE Table 12.2-1]	
Importance Factor, I [ASCE Table 1.5-2]	

Ss and S1 Source = 0.75

Mapped MCE Spectral Response Acceleration, S_s [ASCE 11.4.2]	
Mapped MCE Spectral Response Acceleration, S_1 [ASCE 11.4.2]	
Site Class [ASCE Table 20.3-1] = D - Stiff Soil	$S_{s=0.72g}$
Site Coefficient, F_a [ASCE Table 11.4-1]	
Site Coefficient, F_v [ASCE Table 11.4-2]	

Seismic Response

MCE Spectral Response Acceleration, S_{MS} [ASCE 11.4.4, Eq. 11.4-1]	SMS=<Fa><$S_{S>}$	$S_{MS=0.88128g}$
MCE Spectral Response Acceleration, S_{M1} [ASCE 11.4.4, Eq. 11.4-2]	SM1=<Fv><$S_{1>}$	$S_{M1=0.4922g}$

Design Spectral Response Acceleration, S_{DS} [ASCE 11.4.5, Eq. 11.4-3]	SDS=<<2>/<3>><S_{MS}>	$S_{DS=0.58752g}$
Design Spectral Response Acceleration, S_{D1} [ASCE 11.4.5, Eq. 11.4-4]	SD1=<<2>/<3>><S_{M1}>	$S_{D1=0.328133g}$

Equivalent Lateral Forces

Seismic Response Coefficient, C_S [ASCE 12.8.1.1, Eq. 12.8-2]	CS=<S_{DS}>/<(<R>/<I>)>
[ASCE 12.8.1.1, Eq. 12.8-3]	C<S,max>=<S_{D1}>/<T(<R>/<I>)>
[ASCE 12.8.1.1, Eq. 12.8-5]	C<S,min>=max(0.044<S_{DS}>I,0.01)=0.032314
[ASCE 12.8.1.1, Eq. 12.8-6]	C<S,min>=0.5<S_{1}>/<(<R>/<I>)><for <S_{1}>=0.6g>
	C<S,min>≤<Cs>≤$C_{<S,max>}$

Calculated Base Shear

Direction	Period Used (sec)	C_s	W (kip)	V (kip)
Y	0.368	0.1224	645.4156	78.9989
Y + Ecc. X	0.368	0.1224	645.4156	78.9989
Y - Ecc. X	0.368	0.1224	645.4156	78.9989

AOF Middle

Structure Results

Base Reactions

Output Case	Case Type	Step Type	FX kip	FY kip	FZ kip	MX kip-ft	MY kip-ft	MZ kip-ft	X ft	Y ft	Z ft
Dead	LinStatic		0	0	730.873	35565.4183	-167227.0694	-0.0055	0	0	0
Live	LinStatic		0	0	278.638	13558.5785	-62652.7811	-0.0025	0	0	0
Exx	LinStatic	Max	-78.999	0	0	0.0024	-3186.6678	3844.1088	0	0	0
Exx	LinStatic	Min	-78.999	0	0	0.0024	-3186.6678	3844.1088	0	0	0
Eyy	LinStatic	Max	0	-78.999	0	3186.711	-0.0001	-17763.656	0	0	0
Eyy	LinStatic	Min	0	-78.999	0	3186.711	-0.0001	-17763.656	0	0	0
Wind X	LinStatic		-105.44	0	-165.95	-8075.1846	35415.2389	5131.2646	0	0	0
Wind Y	LinStatic		-2.707	-187.137	-165.95	-3636.5858	37205.8912	-43558.4965	0	0	0
Mass	LinStatic		0	0	645.416	31406.0979	-145124.3049	-0.0058	0	0	0
Wind XX	LinStatic		-14.168	0	0	0.0018	-297.8519	689.3614	0	0	0
Wind YY	LinStatic		-2.904	0	0	0.0017	-116.9878	141.2978	0	0	0

Story Results

Story Forces

Story	Output Case	Case Type	Step Type	Location	P kip	VX kip	VY kip	T kip-ft	MX kip-ft	MY kip-ft
Story5	Dead	LinStatic		Top	3.563	0	0	-0.0001	173.3369	-1041.8235
Story5	Dead	LinStatic		Bottom	192.466	-48.06	-4.802	1135.3739	9355.857	-41804.2153
Story5	Live	LinStatic		Top	0	0	0	-4.96E-05	2.922E-05	0
Story5	Live	LinStatic		Bottom	111.571	-23.31	-2.35	548.5217	5423.2767	-24140.7837
Story5	Exx	LinStatic	Max	Top	0	-25.705	0	1250.8266	0.0002	0
Story5	Exx	LinStatic	Max	Bottom	2.98	-17.832	-0.13	844.1095	145.2062	-987.0341
Story5	Exx	LinStatic	Min	Top	0	-25.705	0	1250.8266	0.0002	0
Story5	Exx	LinStatic	Min	Bottom	2.98	-17.832	-0.13	844.1095	145.2062	-987.0341
Story5	Eyy	LinStatic	Max	Top	0	0	-25.705	-7516.54	0.0094	0
Story5	Eyy	LinStatic	Max	Bottom	-0.115	0.14	-54.741	-12414.0477	466.9908	26.2466
Story5	Eyy	LinStatic	Min	Top	0	0	-25.705	-7516.54	0.0094	0
Story5	Eyy	LinStatic	Min	Bottom	-0.115	0.14	-54.741	-12414.0477	466.9908	26.2466
Story5	Wind X	LinStatic		Top	0	0	0	0.0002	0.0011	0
Story5	Wind X	LinStatic		Bottom	-64.671	15.047	-1.259	-967.3211	-3143.5539	14298.2535
Story5	Wind Y	LinStatic		Top	0	0	0	-0.0028	0.0258	0
Story5	Wind Y	LinStatic		Bottom	-70.45	17.425	-30.91	-7897.0875	-3038.4798	15268.7558
Story5	Mass	LinStatic		Top	0	0	0	-0.0001	0.0001	0
Story5	Mass	LinStatic		Bottom	258.385	-53.978	-5.441	1270.1191	12559.5904	-55906.6463
Story5	Wind XX	LinStatic		Top	0	0	0	-1.366E-05	1.329E-05	0
Story5	Wind XX	LinStatic		Bottom	-0.149	-0.811	0.033	46.7112	-7.3219	18.0319
Story5	Wind YY	LinStatic		Top	0	0	0	-1.631E-05	-3.239E-06	0
Story5	Wind YY	LinStatic		Bottom	-0.105	-0.26	-0.034	5.1114	-5.1435	20.6052
Story1	Dead	LinStatic		Top	243.316	-49.183	0.087	2398.0951	11829.5419	-54365.5607
Story1	Dead	LinStatic		Bottom	730.873	0	0	-0.0055	35565.4183	-167227.0694
Story1	Live	LinStatic		Top	114.567	-24.782	0.038	1210.2642	5569.1073	-25360.6711
Story1	Live	LinStatic		Bottom	278.638	0	0	-0.0025	13558.5785	-62652.7811
Story1	Exx	LinStatic	Max	Top	3.983	-19.62	0.002	952.6653	194.0489	-1182.7769
Story1	Exx	LinStatic	Max	Bottom	0	-78.999	0	3844.1088	0.0024	-3186.6678
Story1	Exx	LinStatic	Min	Top	3.983	-19.62	0.002	952.6653	194.0489	-1182.7769
Story1	Exx	LinStatic	Min	Bottom	0	-78.999	0	3844.1088	0.0024	-3186.6678
Story1	Eyy	LinStatic	Max	Top	-0.051	0.007	-54.518	-12336.7375	470.3165	11.2728
Story1	Eyy	LinStatic	Max	Bottom	0	0	-78.999	-17763.656	3186.711	-0.0001
Story1	Eyy	LinStatic	Min	Top	-0.051	0.007	-54.518	-12336.7375	470.3165	11.2728
Story1	Eyy	LinStatic	Min	Bottom	0	0	-78.999	-17763.656	3186.711	-0.0001
Story1	Wind X	LinStatic		Top	-68.791	18.779	-0.023	-918.0836	-3344.1521	15486.8016

Story	Output Case	Case Type	Step Type	Location	P kip	VX kip	VY kip	T kip-ft	MX kip-ft	MY kip-ft
Story1	Wind X	LinStatic		Bottom	-165.95	-105.44	0	5131.2646	-8075.1846	35415.2389
Story1	Wind Y	LinStatic		Top	-71.024	12.343	-34.819	-8377.0291	-3066.9395	15744.3867
Story1	Wind Y	LinStatic		Bottom	-165.95	-2.707	-187.137	-43558.4965	-3636.5858	37205.8912
Story1	Mass	LinStatic		Top	265.321	-57.387	0.088	2802.5778	12897.2839	-58731.5818
Story1	Mass	LinStatic		Bottom	645.416	0	0	-0.0058	31406.0979	-145124.3049
Story1	Wind XX	LinStatic		Top	-0.119	-0.84	-0.0002792	40.9229	-5.823	12.537
Story1	Wind XX	LinStatic		Bottom	0	-14.168	0	689.3614	0.0018	-297.8519
Story1	Wind YY	LinStatic		Top	-0.093	-0.292	-7.207E-05	14.0141	-4.57	18.1856
Story1	Wind YY	LinStatic		Bottom	0	-2.904	0	141.2978	0.0017	-116.9878

AOF Middle

Applied Loads

Line Loads

Frame Loads Assignments - Distributed (Part 1 of 2)

UniqueName	Load Pattern	Story	Label	Load Type	Direction	Distance Type	Relative Distance A	Relative Distance B	Absolute Distance A ft	Absolute Distance B ft
391	Dead	Story5	B296	Force	Gravity	Relative	0	1	0	24.6613
395	Dead	Story5	B298	Force	Gravity	Relative	0	1	0	24.6613
411	Dead	Story5	B307	Force	Gravity	Relative	0	1	0	24.6613
415	Dead	Story5	B310	Force	Gravity	Relative	0	1	0	24.6613
392	Dead	Story5	B47	Force	Gravity	Relative	0	1	0	3.0223
396	Dead	Story5	B50	Force	Gravity	Relative	0	1	0	3.0223
400	Dead	Story5	B53	Force	Gravity	Relative	0	1	0	3.0223
404	Dead	Story5	B56	Force	Gravity	Relative	0	1	0	3.0223
408	Dead	Story5	B59	Force	Gravity	Relative	0	1	0	3.0223
412	Dead	Story5	B62	Force	Gravity	Relative	0	1	0	3.0223
416	Dead	Story5	B65	Force	Gravity	Relative	0	1	0	3.0223
379	Dead	Story5	B180	Force	Gravity	Relative	0	1	0	3.0223
380	Dead	Story5	B181	Force	Gravity	Relative	0	1	0	111.4887
420	Dead	Story5	B182	Force	Gravity	Relative	0	1	0	3.0223
421	Dead	Story5	B183	Force	Gravity	Relative	0	1	0	111.4887
424	Dead	Story5	B184	Force	Gravity	Relative	0	1	0	3.0223
425	Dead	Story5	B185	Force	Gravity	Relative	0	1	0	136.15
428	Dead	Story5	B186	Force	Gravity	Relative	0	1	0	3.0223
429	Dead	Story5	B187	Force	Gravity	Relative	0	1	0	136.15
432	Dead	Story5	B188	Force	Gravity	Relative	0	1	0	2.8544
433	Dead	Story5	B191	Force	Gravity	Relative	0	1	0	136.15
436	Dead	Story5	B192	Force	Gravity	Relative	0	1	0	3.0223
437	Dead	Story5	B193	Force	Gravity	Relative	0	1	0	111.4887
440	Dead	Story5	B194	Force	Gravity	Relative	0	1	0	3.0223
441	Dead	Story5	B208	Force	Gravity	Relative	0	1	0	111.4887
391	Live	Story5	B296	Force	Gravity	Relative	0	1	0	24.6613
395	Live	Story5	B298	Force	Gravity	Relative	0	1	0	24.6613
411	Live	Story5	B307	Force	Gravity	Relative	0	1	0	24.6613
415	Live	Story5	B310	Force	Gravity	Relative	0	1	0	24.6613
392	Live	Story5	B47	Force	Gravity	Relative	0	1	0	3.0223
396	Live	Story5	B50	Force	Gravity	Relative	0	1	0	3.0223
400	Live	Story5	B53	Force	Gravity	Relative	0	1	0	3.0223
404	Live	Story5	B56	Force	Gravity	Relative	0	1	0	3.0223
408	Live	Story5	B59	Force	Gravity	Relative	0	1	0	3.0223
412	Live	Story5	B62	Force	Gravity	Relative	0	1	0	3.0223
416	Live	Story5	B65	Force	Gravity	Relative	0	1	0	3.0223
379	Live	Story5	B180	Force	Gravity	Relative	0	1	0	3.0223
380	Live	Story5	B181	Force	Gravity	Relative	0	1	0	111.4887
420	Live	Story5	B182	Force	Gravity	Relative	0	1	0	3.0223
421	Live	Story5	B183	Force	Gravity	Relative	0	1	0	111.4887
424	Live	Story5	B184	Force	Gravity	Relative	0	1	0	3.0223
425	Live	Story5	B185	Force	Gravity	Relative	0	1	0	136.15
428	Live	Story5	B186	Force	Gravity	Relative	0	1	0	3.0223
429	Live	Story5	B187	Force	Gravity	Relative	0	1	0	136.15
432	Live	Story5	B188	Force	Gravity	Relative	0	1	0	2.8544
433	Live	Story5	B191	Force	Gravity	Relative	0	1	0	136.15
436	Live	Story5	B192	Force	Gravity	Relative	0	1	0	3.0223
437	Live	Story5	B193	Force	Gravity	Relative	0	1	0	111.4887
440	Live	Story5	B194	Force	Gravity	Relative	0	1	0	3.0223

UniqueName	Load Pattern	Story	Label	Load Type	Direction	Distance Type	Relative Distance A	Relative Distance B	Absolute Distance A ft	Absolute Distance B ft
441	Live	Story5	B208	Force	Gravity	Relative	0	1	0	111.4887
391	Wind X	Story5	B296	Force	Local-2	Relative	0	1	0	24.6613
395	Wind X	Story5	B298	Force	Local-2	Relative	0	1	0	24.6613
411	Wind X	Story5	B307	Force	Local-2	Relative	0	1	0	24.6613
415	Wind X	Story5	B310	Force	Local-2	Relative	0	1	0	24.6613
392	Wind X	Story5	B47	Force	Local-2	Relative	0	1	0	3.0223
396	Wind X	Story5	B50	Force	Local-2	Relative	0	1	0	3.0223
400	Wind X	Story5	B53	Force	Local-2	Relative	0	1	0	3.0223
404	Wind X	Story5	B56	Force	Local-2	Relative	0	1	0	3.0223
408	Wind X	Story5	B59	Force	Local-2	Relative	0	1	0	3.0223
412	Wind X	Story5	B62	Force	Local-2	Relative	0	1	0	3.0223
416	Wind X	Story5	B65	Force	Local-2	Relative	0	1	0	3.0223
379	Wind X	Story5	B180	Force	Local-2	Relative	0	1	0	3.0223
380	Wind X	Story5	B181	Force	Local-2	Relative	0	1	0	111.4887
420	Wind X	Story5	B182	Force	Local-2	Relative	0	1	0	3.0223
421	Wind X	Story5	B183	Force	Local-2	Relative	0	1	0	111.4887
424	Wind X	Story5	B184	Force	Local-2	Relative	0	1	0	3.0223
425	Wind X	Story5	B185	Force	Local-2	Relative	0	1	0	136.15
428	Wind X	Story5	B186	Force	Local-2	Relative	0	1	0	3.0223
429	Wind X	Story5	B187	Force	Local-2	Relative	0	1	0	136.15
432	Wind X	Story5	B188	Force	Local-2	Relative	0	1	0	2.8544
433	Wind X	Story5	B191	Force	Local-2	Relative	0	1	0	136.15
436	Wind X	Story5	B192	Force	Local-2	Relative	0	1	0	3.0223
437	Wind X	Story5	B193	Force	Local-2	Relative	0	1	0	111.4887
440	Wind X	Story5	B194	Force	Local-2	Relative	0	1	0	3.0223
441	Wind X	Story5	B208	Force	Local-2	Relative	0	1	0	111.4887
14	Wind X	Story5	C32	Force	Global-X	Relative	0	1	0	21.5
182	Wind X	Story5	C33	Force	Global-X	Relative	0	1	0	21.5
200	Wind X	Story5	C35	Force	Global-X	Relative	0	1	0	21.5
1	Wind X	Story5	C66	Force	Global-X	Relative	0	1	0	5
181	Wind X	Story5	C107	Force	Global-X	Relative	0	1	0	5
199	Wind X	Story5	C115	Force	Global-X	Relative	0	1	0	5
134	Wind X	Story5	C3	Force	Global-X	Relative	0	1	0	23.17
133	Wind X	Story5	C29	Force	Global-X	Relative	0	1	0	6.67
2	Wind X	Story5	C31	Force	Global-Y	Relative	0	1	0	6.67
119	Wind X	Story5	C36	Force	Global-Y	Relative	0	1	0	20.1813
12	Wind X	Story5	C38	Force	Global-Y	Relative	0	1	0	23.17
233	Wind X	Story5	C13	Force	Global-X	Relative	0	1	0	23.17
232	Wind X	Story5	C18	Force	Global-X	Relative	0	1	0	6.67
149	Wind X	Story5	C56	Force	Global-Y	Relative	0	1	0	6.67
151	Wind X	Story5	C58	Force	Global-Y	Relative	0	1	0	20.1813
150	Wind X	Story5	C60	Force	Global-Y	Relative	0	1	0	23.17
22	Wind X	Story1	B134	Force	Global-X	Relative	0	1	0	18.7708
23	Wind X	Story1	B135	Force	Global-X	Relative	0	1	0	18.75
36	Wind X	Story1	B221	Force	Global-X	Relative	0	1	0	18.75
37	Wind X	Story1	B222	Force	Global-X	Relative	0	1	0	18.7708
40	Wind X	Story1	B117	Force	Global-Y	Relative	0	1	0	24.4795
267	Wind X	Story1	B126	Force	Global-Y	Relative	0	1	0	16.8933
290	Wind X	Story1	B128	Force	Global-Y	Relative	0	1	0	16.8933
293	Wind X	Story1	B130	Force	Global-Y	Relative	0	1	0	16.8933
311	Wind X	Story1	B136	Force	Global-Y	Relative	0	1	0	16.8933
312	Wind X	Story1	B138	Force	Global-Y	Relative	0	1	0	16.8933
334	Wind X	Story1	B139	Force	Global-Y	Relative	0	1	0	9.3071
313	Wind X	Story1	B140	Force	Global-Y	Relative	0	1	0	16.8933

UniqueName	Load Pattern	Story	Label	Load Type	Direction	Distance Type	Relative Distance A	Relative Distance B	Absolute Distance A ft	Absolute Distance B ft
20	Wind X	Story1	B20	Force	Global-X	Relative	0	1	0	11.0208
39	Wind X	Story1	B248	Force	Global-X	Relative	0	1	0	11.0208
21	Wind X	Story1	B295	Force	Global-X	Relative	0	1	0	18.9487
38	Wind X	Story1	B297	Force	Global-X	Relative	0	1	0	18.9487
32	Wind X	Story1	B109	Force	Global-Y	Relative	0	1	0	24.4795
445	Wind X	Story1	B127	Force	Global-Y	Relative	0	1	0	9.3071
444	Wind X	Story1	B131	Force	Global-Y	Relative	0	1	0	16.8933
443	Wind X	Story1	B133	Force	Global-Y	Relative	0	1	0	16.8933
442	Wind X	Story1	B142	Force	Global-Y	Relative	0	1	0	16.8933
439	Wind X	Story1	B144	Force	Global-Y	Relative	0	1	0	16.8933
438	Wind X	Story1	B146	Force	Global-Y	Relative	0	1	0	16.8933
231	Wind X	Story1	B156	Force	Global-Y	Relative	0	1	0	16.8933
24	Wind X	Story1	B24	Force	Global-X	Relative	0	1	0	18.9902
25	Wind X	Story1	B29	Force	Global-X	Relative	0	1	0	10.9792
33	Wind X	Story1	B203	Force	Global-X	Relative	0	1	0	10.9792
35	Wind X	Story1	B26	Force	Global-X	Relative	0	1	0	18.9902
4	Wind X	Story1	C10	Force	Global-X	Relative	0	1	0	27
5	Wind X	Story1	C11	Force	Global-X	Relative	0	1	0	27
6	Wind X	Story1	C12	Force	Global-X	Relative	0	1	0	27
13	Wind X	Story1	C32	Force	Global-X	Relative	0	1	0	27
15	Wind X	Story1	C33	Force	Global-X	Relative	0	1	0	27
16	Wind X	Story1	C35	Force	Global-X	Relative	0	1	0	27
10	Wind X	Story1	C2	Force	Global-X	Relative	0	1	0	25.33
7	Wind X	Story1	C28	Force	Global-X	Relative	0	1	0	25.33
8	Wind X	Story1	C30	Force	Global-Y	Relative	0	1	0	25.33
19	Wind X	Story1	C34	Force	Global-Y	Relative	0	1	0	25.33
9	Wind X	Story1	C37	Force	Global-Y	Relative	0	1	0	25.33
227	Wind X	Story1	C5	Force	Global-X	Relative	0	1	0	25.33
228	Wind X	Story1	C7	Force	Global-X	Relative	0	1	0	25.33
3	Wind X	Story1	C55	Force	Global-Y	Relative	0	1	0	25.33
17	Wind X	Story1	C57	Force	Global-Y	Relative	0	1	0	25.33
11	Wind X	Story1	C59	Force	Global-Y	Relative	0	1	0	25.33
391	Wind Y	Story5	B296	Force	Local-2	Relative	0	1	0	24.6613
395	Wind Y	Story5	B298	Force	Local-2	Relative	0	1	0	24.6613
411	Wind Y	Story5	B307	Force	Local-2	Relative	0	1	0	24.6613
415	Wind Y	Story5	B310	Force	Local-2	Relative	0	1	0	24.6613
392	Wind Y	Story5	B47	Force	Local-2	Relative	0	1	0	3.0223
396	Wind Y	Story5	B50	Force	Local-2	Relative	0	1	0	3.0223
400	Wind Y	Story5	B53	Force	Local-2	Relative	0	1	0	3.0223
404	Wind Y	Story5	B56	Force	Local-2	Relative	0	1	0	3.0223
408	Wind Y	Story5	B59	Force	Local-2	Relative	0	1	0	3.0223
412	Wind Y	Story5	B62	Force	Local-2	Relative	0	1	0	3.0223
416	Wind Y	Story5	B65	Force	Local-2	Relative	0	1	0	3.0223
379	Wind Y	Story5	B180	Force	Local-2	Relative	0	1	0	3.0223
380	Wind Y	Story5	B181	Force	Local-2	Relative	0	1	0	111.4887
420	Wind Y	Story5	B182	Force	Local-2	Relative	0	1	0	3.0223
421	Wind Y	Story5	B183	Force	Local-2	Relative	0	1	0	111.4887
424	Wind Y	Story5	B184	Force	Local-2	Relative	0	1	0	3.0223
425	Wind Y	Story5	B185	Force	Local-2	Relative	0	1	0	136.15
428	Wind Y	Story5	B186	Force	Local-2	Relative	0	1	0	3.0223
429	Wind Y	Story5	B187	Force	Local-2	Relative	0	1	0	136.15
432	Wind Y	Story5	B188	Force	Local-2	Relative	0	1	0	2.8544
433	Wind Y	Story5	B191	Force	Local-2	Relative	0	1	0	136.15
436	Wind Y	Story5	B192	Force	Local-2	Relative	0	1	0	3.0223

UniqueName	Load Pattern	Story	Label	Load Type	Direction	Distance Type	Relative Distance A	Relative Distance B	Absolute Distance A ft	Absolute Distance B ft
437	Wind Y	Story5	B193	Force	Local-2	Relative	0	1	0	111.4887
440	Wind Y	Story5	B194	Force	Local-2	Relative	0	1	0	3.0223
441	Wind Y	Story5	B208	Force	Local-2	Relative	0	1	0	111.4887
14	Wind Y	Story5	C32	Force	Global-X	Relative	0	1	0	21.5
182	Wind Y	Story5	C33	Force	Global-X	Relative	0	1	0	21.5
200	Wind Y	Story5	C35	Force	Global-X	Relative	0	1	0	21.5
1	Wind Y	Story5	C66	Force	Global-X	Relative	0	1	0	5
181	Wind Y	Story5	C107	Force	Global-X	Relative	0	1	0	5
199	Wind Y	Story5	C115	Force	Global-X	Relative	0	1	0	5
134	Wind Y	Story5	C3	Force	Global-X	Relative	0	1	0	23.17
133	Wind Y	Story5	C29	Force	Global-X	Relative	0	1	0	6.67
2	Wind Y	Story5	C31	Force	Global-Y	Relative	0	1	0	6.67
119	Wind Y	Story5	C36	Force	Global-Y	Relative	0	1	0	20.1813
12	Wind Y	Story5	C38	Force	Global-Y	Relative	0	1	0	23.17
233	Wind Y	Story5	C13	Force	Global-X	Relative	0	1	0	23.17
232	Wind Y	Story5	C18	Force	Global-X	Relative	0	1	0	6.67
149	Wind Y	Story5	C56	Force	Global-Y	Relative	0	1	0	6.67
151	Wind Y	Story5	C58	Force	Global-Y	Relative	0	1	0	20.1813
150	Wind Y	Story5	C60	Force	Global-Y	Relative	0	1	0	23.17
22	Wind Y	Story1	B134	Force	Global-X	Relative	0	1	0	18.7708
23	Wind Y	Story1	B135	Force	Global-X	Relative	0	1	0	18.75
36	Wind Y	Story1	B221	Force	Global-X	Relative	0	1	0	18.75
37	Wind Y	Story1	B222	Force	Global-X	Relative	0	1	0	18.7708
40	Wind Y	Story1	B117	Force	Global-Y	Relative	0	1	0	24.4795
267	Wind Y	Story1	B126	Force	Global-Y	Relative	0	1	0	16.8933
290	Wind Y	Story1	B128	Force	Global-Y	Relative	0	1	0	16.8933
293	Wind Y	Story1	B130	Force	Global-Y	Relative	0	1	0	16.8933
311	Wind Y	Story1	B136	Force	Global-Y	Relative	0	1	0	16.8933
312	Wind Y	Story1	B138	Force	Global-Y	Relative	0	1	0	16.8933
334	Wind Y	Story1	B139	Force	Global-Y	Relative	0	1	0	9.3071
313	Wind Y	Story1	B140	Force	Global-Y	Relative	0	1	0	16.8933
20	Wind Y	Story1	B20	Force	Global-X	Relative	0	1	0	11.0208
39	Wind Y	Story1	B248	Force	Global-X	Relative	0	1	0	11.0208
21	Wind Y	Story1	B295	Force	Global-X	Relative	0	1	0	18.9487
38	Wind Y	Story1	B297	Force	Global-X	Relative	0	1	0	18.9487
32	Wind Y	Story1	B109	Force	Global-Y	Relative	0	1	0	24.4795
445	Wind Y	Story1	B127	Force	Global-Y	Relative	0	1	0	9.3071
444	Wind Y	Story1	B131	Force	Global-Y	Relative	0	1	0	16.8933
443	Wind Y	Story1	B133	Force	Global-Y	Relative	0	1	0	16.8933
442	Wind Y	Story1	B142	Force	Global-Y	Relative	0	1	0	16.8933
439	Wind Y	Story1	B144	Force	Global-Y	Relative	0	1	0	16.8933
438	Wind Y	Story1	B146	Force	Global-Y	Relative	0	1	0	16.8933
231	Wind Y	Story1	B156	Force	Global-Y	Relative	0	1	0	16.8933
24	Wind Y	Story1	B24	Force	Global-X	Relative	0	1	0	18.9902
25	Wind Y	Story1	B29	Force	Global-X	Relative	0	1	0	10.9792
33	Wind Y	Story1	B203	Force	Global-X	Relative	0	1	0	10.9792
35	Wind Y	Story1	B26	Force	Global-X	Relative	0	1	0	18.9902
4	Wind Y	Story1	C10	Force	Global-X	Relative	0	1	0	27
5	Wind Y	Story1	C11	Force	Global-X	Relative	0	1	0	27
6	Wind Y	Story1	C12	Force	Global-X	Relative	0	1	0	27
13	Wind Y	Story1	C32	Force	Global-X	Relative	0	1	0	27
15	Wind Y	Story1	C33	Force	Global-X	Relative	0	1	0	27
16	Wind Y	Story1	C35	Force	Global-X	Relative	0	1	0	27
10	Wind Y	Story1	C2	Force	Global-X	Relative	0	1	0	25.33

UniqueName	Load Pattern	Story	Label	Load Type	Direction	Distance Type	Relative Distance A	Relative Distance B	Absolute Distance A ft	Absolute Distance B ft
7	Wind Y	Story1	C28	Force	Global-X	Relative	0	1	0	25.33
8	Wind Y	Story1	C30	Force	Global-Y	Relative	0	1	0	25.33
19	Wind Y	Story1	C34	Force	Global-Y	Relative	0	1	0	25.33
9	Wind Y	Story1	C37	Force	Global-Y	Relative	0	1	0	25.33
227	Wind Y	Story1	C5	Force	Global-X	Relative	0	1	0	25.33
228	Wind Y	Story1	C7	Force	Global-X	Relative	0	1	0	25.33
3	Wind Y	Story1	C55	Force	Global-Y	Relative	0	1	0	25.33
17	Wind Y	Story1	C57	Force	Global-Y	Relative	0	1	0	25.33
11	Wind Y	Story1	C59	Force	Global-Y	Relative	0	1	0	25.33
391	Mass	Story5	B296	Force	Gravity	Relative	0	1	0	24.6613
395	Mass	Story5	B298	Force	Gravity	Relative	0	1	0	24.6613
411	Mass	Story5	B307	Force	Gravity	Relative	0	1	0	24.6613
415	Mass	Story5	B310	Force	Gravity	Relative	0	1	0	24.6613
392	Mass	Story5	B47	Force	Gravity	Relative	0	1	0	3.0223
396	Mass	Story5	B50	Force	Gravity	Relative	0	1	0	3.0223
400	Mass	Story5	B53	Force	Gravity	Relative	0	1	0	3.0223
404	Mass	Story5	B56	Force	Gravity	Relative	0	1	0	3.0223
408	Mass	Story5	B59	Force	Gravity	Relative	0	1	0	3.0223
412	Mass	Story5	B62	Force	Gravity	Relative	0	1	0	3.0223
416	Mass	Story5	B65	Force	Gravity	Relative	0	1	0	3.0223
379	Mass	Story5	B180	Force	Gravity	Relative	0	1	0	3.0223
380	Mass	Story5	B181	Force	Gravity	Relative	0	1	0	111.4887
420	Mass	Story5	B182	Force	Gravity	Relative	0	1	0	3.0223
421	Mass	Story5	B183	Force	Gravity	Relative	0	1	0	111.4887
424	Mass	Story5	B184	Force	Gravity	Relative	0	1	0	3.0223
425	Mass	Story5	B185	Force	Gravity	Relative	0	1	0	136.15
428	Mass	Story5	B186	Force	Gravity	Relative	0	1	0	3.0223
429	Mass	Story5	B187	Force	Gravity	Relative	0	1	0	136.15
432	Mass	Story5	B188	Force	Gravity	Relative	0	1	0	2.8544
433	Mass	Story5	B191	Force	Gravity	Relative	0	1	0	136.15
436	Mass	Story5	B192	Force	Gravity	Relative	0	1	0	3.0223
437	Mass	Story5	B193	Force	Gravity	Relative	0	1	0	111.4887
440	Mass	Story5	B194	Force	Gravity	Relative	0	1	0	3.0223
441	Mass	Story5	B208	Force	Gravity	Relative	0	1	0	111.4887
2	Wind XX	Story5	C31	Force	Global-X	Relative	0	1	0	6.67
12	Wind XX	Story5	C38	Force	Global-X	Relative	0	1	0	23.17
149	Wind XX	Story5	C56	Force	Global-X	Relative	0	1	0	6.67
150	Wind XX	Story5	C60	Force	Global-X	Relative	0	1	0	23.17
8	Wind XX	Story1	C30	Force	Global-X	Relative	0	1	0	25.33
9	Wind XX	Story1	C37	Force	Global-X	Relative	0	1	0	25.33
3	Wind XX	Story1	C55	Force	Global-X	Relative	0	1	0	25.33
11	Wind XX	Story1	C59	Force	Global-X	Relative	0	1	0	25.33
2	Wind YY	Story5	C31	Force	Global-X	Relative	0	1	0	6.67
12	Wind YY	Story5	C38	Force	Global-X	Relative	0	1	0	23.17
149	Wind YY	Story5	C56	Force	Global-X	Relative	0	1	0	6.67
150	Wind YY	Story5	C60	Force	Global-X	Relative	0	1	0	23.17
8	Wind YY	Story1	C30	Force	Global-X	Relative	0	1	0	25.33
9	Wind YY	Story1	C37	Force	Global-X	Relative	0	1	0	25.33
3	Wind YY	Story1	C55	Force	Global-X	Relative	0	1	0	25.33
11	Wind YY	Story1	C59	Force	Global-X	Relative	0	1	0	25.33

AOF Middle

Frame Loads Assignments - Distributed (Part 2 of 2)

UniqueName	Load Pattern	Force A kip/ft	Force B kip/ft
391	Dead	0.149	0.149
395	Dead	0.405	0.405
411	Dead	0.405	0.405
415	Dead	0.149	0.149
392	Dead	0.149	0.149
396	Dead	0.405	0.405
400	Dead	0.513	0.513
404	Dead	0.513	0.513
408	Dead	0.513	0.513
412	Dead	0.405	0.405
416	Dead	0.149	0.149
379	Dead	0.149	0.149
380	Dead	0.149	0.149
420	Dead	0.405	0.405
421	Dead	0.405	0.405
424	Dead	0.513	0.513
425	Dead	0.513	0.513
428	Dead	0.513	0.513
429	Dead	0.513	0.513
432	Dead	0.513	0.513
433	Dead	0.513	0.513
436	Dead	0.405	0.405
437	Dead	0.405	0.405
440	Dead	0.149	0.149
441	Dead	0.149	0.149
391	Live	0.11	0.11
395	Live	0.3	0.3
411	Live	0.3	0.3
415	Live	0.11	0.11
392	Live	0.11	0.11
396	Live	0.3	0.3
400	Live	0.38	0.38
404	Live	0.38	0.38
408	Live	0.38	0.38
412	Live	0.3	0.3
416	Live	0.11	0.11
379	Live	0.11	0.11
380	Live	0.11	0.11
420	Live	0.3	0.3
421	Live	0.3	0.3
424	Live	0.38	0.38
425	Live	0.38	0.38
428	Live	0.38	0.38
429	Live	0.38	0.38
432	Live	0.38	0.38
433	Live	0.38	0.38
436	Live	0.3	0.3
437	Live	0.3	0.3
440	Live	0.11	0.11
441	Live	0.11	0.11
391	Wind X	0.066	0.066
395	Wind X	0.18	0.18
411	Wind X	0.18	0.18
415	Wind X	0.066	0.066

UniqueName	Load Pattern	Force A kip/ft	Force B kip/ft
392	Wind X	0.066	0.066
396	Wind X	0.18	0.18
400	Wind X	0.228	0.228
404	Wind X	0.228	0.228
408	Wind X	0.228	0.228
412	Wind X	0.18	0.18
416	Wind X	0.066	0.066
379	Wind X	0.066	0.066
380	Wind X	0.066	0.066
420	Wind X	0.18	0.18
421	Wind X	0.18	0.18
424	Wind X	0.228	0.228
425	Wind X	0.228	0.228
428	Wind X	0.228	0.228
429	Wind X	0.228	0.228
432	Wind X	0.228	0.228
433	Wind X	0.228	0.228
436	Wind X	0.18	0.18
437	Wind X	0.18	0.18
440	Wind X	0.066	0.066
441	Wind X	0.066	0.066
14	Wind X	0.304	0.304
182	Wind X	0.304	0.304
200	Wind X	0.304	0.304
1	Wind X	0.304	0.304
181	Wind X	0.304	0.304
199	Wind X	0.304	0.304
134	Wind X	0.24	0.24
133	Wind X	0.24	0.24
2	Wind X	-0.32	-0.32
119	Wind X	-0.43	-0.43
12	Wind X	-0.2	-0.2
233	Wind X	0.24	0.24
232	Wind X	0.24	0.24
149	Wind X	0.32	0.32
151	Wind X	0.43	0.43
150	Wind X	0.2	0.2
22	Wind X	0.07	0.07
23	Wind X	0.07	0.07
36	Wind X	0.07	0.07
37	Wind X	0.07	0.07
40	Wind X	-0.4	-0.4
267	Wind X	-0.4	-0.4
290	Wind X	-0.4	-0.4
293	Wind X	-0.4	-0.4
311	Wind X	-0.4	-0.4
312	Wind X	-0.4	-0.4
334	Wind X	-0.4	-0.4
313	Wind X	-0.4	-0.4
20	Wind X	0.07	0.07
39	Wind X	0.07	0.07
21	Wind X	0.07	0.07
38	Wind X	0.07	0.07
32	Wind X	0.4	0.4
445	Wind X	0.4	0.4

UniqueName	Load Pattern	Force A kip/ft	Force B kip/ft
444	Wind X	0.4	0.4
443	Wind X	0.4	0.4
442	Wind X	0.4	0.4
439	Wind X	0.4	0.4
438	Wind X	0.4	0.4
231	Wind X	0.4	0.4
24	Wind X	0.07	0.07
25	Wind X	0.07	0.07
33	Wind X	0.07	0.07
35	Wind X	0.07	0.07
4	Wind X	0.304	0.304
5	Wind X	0.304	0.304
6	Wind X	0.304	0.304
13	Wind X	0.304	0.304
15	Wind X	0.304	0.304
16	Wind X	0.304	0.304
10	Wind X	0.24	0.24
7	Wind X	0.24	0.24
8	Wind X	-0.32	-0.32
19	Wind X	-0.43	-0.43
9	Wind X	-0.2	-0.2
227	Wind X	0.24	0.24
228	Wind X	0.24	0.24
3	Wind X	0.32	0.32
17	Wind X	0.43	0.43
11	Wind X	0.2	0.2
391	Wind Y	0.066	0.066
395	Wind Y	0.18	0.18
411	Wind Y	0.18	0.18
415	Wind Y	0.066	0.066
392	Wind Y	0.066	0.066
396	Wind Y	0.18	0.18
400	Wind Y	0.228	0.228
404	Wind Y	0.228	0.228
408	Wind Y	0.228	0.228
412	Wind Y	0.18	0.18
416	Wind Y	0.066	0.066
379	Wind Y	0.066	0.066
380	Wind Y	0.066	0.066
420	Wind Y	0.18	0.18
421	Wind Y	0.18	0.18
424	Wind Y	0.228	0.228
425	Wind Y	0.228	0.228
428	Wind Y	0.228	0.228
429	Wind Y	0.228	0.228
432	Wind Y	0.228	0.228
433	Wind Y	0.228	0.228
436	Wind Y	0.18	0.18
437	Wind Y	0.18	0.18
440	Wind Y	0.066	0.066
441	Wind Y	0.066	0.066
14	Wind Y	0.304	0.304
182	Wind Y	0.304	0.304
200	Wind Y	0.304	0.304
1	Wind Y	-0.304	-0.304

UniqueName	Load Pattern	Force A kip/ft	Force B kip/ft
181	Wind Y	-0.304	-0.304
199	Wind Y	-0.304	-0.304
134	Wind Y	0.24	0.24
133	Wind Y	-0.24	-0.24
2	Wind Y	0.32	0.32
119	Wind Y	0.43	0.43
12	Wind Y	0.2	0.2
233	Wind Y	0.24	0.24
232	Wind Y	-0.24	-0.24
149	Wind Y	0.32	0.32
151	Wind Y	0.43	0.43
150	Wind Y	0.2	0.2
22	Wind Y	-0.07	-0.07
23	Wind Y	-0.07	-0.07
36	Wind Y	0.07	0.07
37	Wind Y	0.07	0.07
40	Wind Y	0.4	0.4
267	Wind Y	0.4	0.4
290	Wind Y	0.4	0.4
293	Wind Y	0.4	0.4
311	Wind Y	0.4	0.4
312	Wind Y	0.4	0.4
334	Wind Y	0.4	0.4
313	Wind Y	0.4	0.4
20	Wind Y	-0.07	-0.07
39	Wind Y	0.07	0.07
21	Wind Y	-0.07	-0.07
38	Wind Y	0.07	0.07
32	Wind Y	0.4	0.4
445	Wind Y	0.4	0.4
444	Wind Y	0.4	0.4
443	Wind Y	0.4	0.4
442	Wind Y	0.4	0.4
439	Wind Y	0.4	0.4
438	Wind Y	0.4	0.4
231	Wind Y	0.4	0.4
24	Wind Y	-0.07	-0.07
25	Wind Y	-0.07	-0.07
33	Wind Y	0.07	0.07
35	Wind Y	0.07	0.07
4	Wind Y	-0.304	-0.304
5	Wind Y	-0.304	-0.304
6	Wind Y	-0.304	-0.304
13	Wind Y	0.304	0.304
15	Wind Y	0.304	0.304
16	Wind Y	0.304	0.304
10	Wind Y	0.24	0.24
7	Wind Y	-0.24	-0.24
8	Wind Y	0.32	0.32
19	Wind Y	0.43	0.43
9	Wind Y	0.2	0.2
227	Wind Y	-0.24	-0.24
228	Wind Y	0.24	0.24
3	Wind Y	0.32	0.32
17	Wind Y	0.43	0.43

UniqueName	Load Pattern	Force A kip/ft	Force B kip/ft
11	Wind Y	0.2	0.2
391	Mass	0.255	0.255
395	Mass	0.695	0.695
411	Mass	0.695	0.695
415	Mass	0.255	0.255
392	Mass	0.255	0.255
396	Mass	0.695	0.695
400	Mass	0.88	0.88
404	Mass	0.88	0.88
408	Mass	0.88	0.88
412	Mass	0.695	0.695
416	Mass	0.255	0.255
379	Mass	0.255	0.255
380	Mass	0.255	0.255
420	Mass	0.695	0.695
421	Mass	0.695	0.695
424	Mass	0.88	0.88
425	Mass	0.88	0.88
428	Mass	0.88	0.88
429	Mass	0.88	0.88
432	Mass	0.88	0.88
433	Mass	0.88	0.88
436	Mass	0.695	0.695
437	Mass	0.695	0.695
440	Mass	0.255	0.255
441	Mass	0.255	0.255
2	Wind XX	0.088	0.088
12	Wind XX	0.088	0.088
149	Wind XX	0.088	0.088
150	Wind XX	0.088	0.088
8	Wind XX	0.088	0.088
9	Wind XX	0.088	0.088
3	Wind XX	0.088	0.088
11	Wind XX	0.088	0.088
2	Wind YY	-0.088	-0.088
12	Wind YY	0.088	0.088
149	Wind YY	-0.088	-0.088
150	Wind YY	0.088	0.088
8	Wind YY	-0.088	-0.088
9	Wind YY	0.088	0.088
3	Wind YY	-0.088	-0.088
11	Wind YY	0.088	0.088

AOF End - Base Labels
1.1
1.5
1.9
3.1
3.6
7.646 (ft)
15.334 (ft)
108.9785 (ft)
24.729 (ft)
F.9
F.1
E
D
C
A.9
A.1
10.9792 (ft)
18.9167 (ft)
18.75 (ft)
18.7708 (ft)
18.875 (ft)
11.0208 (ft)
5
6
19
16
203
7
15
204
17
201
1
31
39
2
34
38
3
35
200
20
21
210
37
198
22
38
211
40
229
199
Y
X

Point Results

Joint Reactions

Story	Label	Unique Name	Output Case	Case Type	Step Type	FX kip	FY kip	FZ kip
Base	5	1	Exx	LinStatic	Max	-5.006	0.001	-15.723
Base	5	1	Exx	LinStatic	Min	-5.044	0.001	-15.864
Base	5	1	Eyy	LinStatic	Max	-0.298	-0.014	-1.068
Base	5	1	Eyy	LinStatic	Min	-0.308	-0.014	-1.104
Base	5	1	WindX	LinStatic		-5.73	-0.649	-16.07
Base	5	1	WindY	LinStatic		-2.911	-0.666	-8.555
Base	5	1	WindXX	LinStatic		-1.211	-2.264E-05	-1.695
Base	5	1	WindYY	LinStatic		0.813	-4.372E-05	0.393
Base	6	2	Exx	LinStatic	Max	0.04	0.004	3.427
Base	6	2	Exx	LinStatic	Min	0.04	0.004	3.395
Base	6	2	Eyy	LinStatic	Max	0.005	-0.012	2.07
Base	6	2	Eyy	LinStatic	Min	0.005	-0.012	2.061
Base	6	2	WindX	LinStatic		0.025	-1.984	0.797
Base	6	2	WindY	LinStatic		0.01	-2.019	-0.803
Base	6	2	WindXX	LinStatic		-0.003	-0.000169	0.411
Base	6	2	WindYY	LinStatic		0.007	0.0002348	-0.157
Base	7	3	Exx	LinStatic	Max	-5.751	0.001	-18.182
Base	7	3	Exx	LinStatic	Min	-5.783	0.001	-18.296
Base	7	3	Eyy	LinStatic	Max	-0.609	-0.012	-2.549
Base	7	3	Eyy	LinStatic	Min	-0.617	-0.012	-2.578
Base	7	3	WindX	LinStatic		-9.739	-0.058	-17.092
Base	7	3	WindY	LinStatic		-3.311	-0.072	-6.296
Base	7	3	WindXX	LinStatic		-0.416	-9.234E-06	-1.264
Base	7	3	WindYY	LinStatic		0.002	-4.59E-05	-0.059
Base	15	4	Exx	LinStatic	Max	0.046	0.003	2.706
Base	15	4	Exx	LinStatic	Min	0.045	0.003	2.692
Base	15	4	Eyy	LinStatic	Max	0.01	-0.005	-1.509
Base	15	4	Eyy	LinStatic	Min	0.009	-0.005	-1.513
Base	15	4	WindX	LinStatic		-0.559	-0.008	0.873
Base	15	4	WindY	LinStatic		0.53	-0.031	-1.983
Base	15	4	WindXX	LinStatic		0.003	-0.000132	0.246
Base	15	4	WindYY	LinStatic		0.0003177	0.0001884	-0.024
Base	16	5	Exx	LinStatic	Max	0.007	0.0003923	-0.106
Base	16	5	Exx	LinStatic	Min	0.007	0.0003192	-0.172
Base	16	5	Eyy	LinStatic	Max	0.002	0.005	3.899
Base	16	5	Eyy	LinStatic	Min	0.002	0.005	3.882
Base	16	5	WindX	LinStatic		0.001	-3.223	-7.714
Base	16	5	WindY	LinStatic		0.002	-3.791	-6.715
Base	16	5	WindXX	LinStatic		0.001	3.377E-05	-0.08
Base	16	5	WindYY	LinStatic		0.0002317	2.088E-05	-0.08
Base	17	6	Exx	LinStatic	Max	0.011	0.001	1.266
Base	17	6	Exx	LinStatic	Min	0.011	0.001	1.251
Base	17	6	Eyy	LinStatic	Max	0.003	0.009	-2.524
Base	17	6	Eyy	LinStatic	Min	0.003	0.009	-2.528
Base	17	6	WindX	LinStatic		-0.002	0.002	-8.688
Base	17	6	WindY	LinStatic		-0.003	0.015	-12.445
Base	17	6	WindXX	LinStatic		0.001	6.185E-05	-0.018
Base	17	6	WindYY	LinStatic		0.0003106	3.894E-05	-0.01
Base	20	7	Exx	LinStatic	Max	-5.759	-0.001	-18.397
Base	20	7	Exx	LinStatic	Min	-5.779	-0.001	-18.473
Base	20	7	Eyy	LinStatic	Max	0.578	-0.013	2.483
Base	20	7	Eyy	LinStatic	Min	0.573	-0.013	2.464
Base	20	7	WindX	LinStatic		-9.528	0.058	-16.343
Base	20	7	WindY	LinStatic		-0.141	-0.074	0.076

Story	Label	Unique Name	Output Case	Case Type	Step Type	FX kip	FY kip	FZ kip
Base	20	7	WindXX	LinStatic		-0.394	-6.048E-05	-1.197
Base	20	7	WindYY	LinStatic		0.02	-1.601E-05	0.003
Base	21	8	Exx	LinStatic	Max	0.047	-0.003	2.769
Base	21	8	Exx	LinStatic	Min	0.047	-0.003	2.762
Base	21	8	Eyy	LinStatic	Max	-0.009	-0.005	1.53
Base	21	8	Eyy	LinStatic	Min	-0.009	-0.005	1.528
Base	21	8	WindX	LinStatic		-0.562	0.007	0.766
Base	21	8	WindY	LinStatic		0.518	-0.04	-5.867
Base	21	8	WindXX	LinStatic		0.003	9.701E-05	0.241
Base	21	8	WindYY	LinStatic		0.0001222	-0.0002309	-0.031
Base	22	9	Exx	LinStatic	Max	-5.029	-0.001	-15.796
Base	22	9	Exx	LinStatic	Min	-5.055	-0.001	-15.894
Base	22	9	Eyy	LinStatic	Max	0.262	-0.015	0.921
Base	22	9	Eyy	LinStatic	Min	0.256	-0.015	0.896
Base	22	9	WindX	LinStatic		-5.448	0.653	-15.09
Base	22	9	WindY	LinStatic		-0.932	-0.674	2.836
Base	22	9	WindXX	LinStatic		-1.184	-5.982E-05	-1.6
Base	22	9	WindYY	LinStatic		0.835	-3.2E-05	0.473
Base	30	10	Exx	LinStatic	Max	0.04	-0.003	3.403
Base	30	10	Exx	LinStatic	Min	0.04	-0.003	3.378
Base	30	10	Eyy	LinStatic	Max	-0.004	-0.012	-2.032
Base	30	10	Eyy	LinStatic	Min	-0.005	-0.012	-2.038
Base	30	10	WindX	LinStatic		0.022	1.982	0.583
Base	30	10	WindY	LinStatic		-0.026	-2.033	1.839
Base	30	10	WindXX	LinStatic		-0.003	0.0001076	0.387
Base	30	10	WindYY	LinStatic		0.006	-0.0003012	-0.175
Base	31	11	Exx	LinStatic	Max	-11.62	0.155	-20.112
Base	31	11	Exx	LinStatic	Min	-11.714	0.066	-20.176
Base	31	11	Eyy	LinStatic	Max	-0.318	-8.023	20.149
Base	31	11	Eyy	LinStatic	Min	-0.342	-8.045	20.132
Base	31	11	WindX	LinStatic		1.238	1.634	-6.119
Base	31	11	WindY	LinStatic		5.189	-10.797	28.724
Base	31	11	WindXX	LinStatic		-0.754	0.003	-1.287
Base	31	11	WindYY	LinStatic		-0.187	-0.002	-0.299
Base	34	13	Exx	LinStatic	Max	0.01	-1.031	-1.579
Base	34	13	Exx	LinStatic	Min	0.01	-1.197	-1.589
Base	34	13	Eyy	LinStatic	Max	2.154E-05	-12.85	-0.434
Base	34	13	Eyy	LinStatic	Min	2.077E-05	-12.892	-0.437
Base	34	13	WindX	LinStatic		0.004	0.588	-12.6
Base	34	13	WindY	LinStatic		0.005	-21.563	-14.142
Base	34	13	WindXX	LinStatic		0.001	-0.075	-0.096
Base	34	13	WindYY	LinStatic		0.0001048	-0.02	-0.024
Base	35	14	Exx	LinStatic	Max	0.016	0.105	0.572
Base	35	14	Exx	LinStatic	Min	0.015	0.018	0.359
Base	35	14	Eyy	LinStatic	Max	-0.003	-8.041	-21.938
Base	35	14	Eyy	LinStatic	Min	-0.003	-8.063	-21.992
Base	35	14	WindX	LinStatic		-1.179	-0.883	-10.097
Base	35	14	WindY	LinStatic		-1.893	-16.028	-48.553
Base	35	14	WindXX	LinStatic		0.001	0.007	0.024
Base	35	14	WindYY	LinStatic		0.0002258	0.004	0.014
Base	37	15	Exx	LinStatic	Max	0.076	-0.013	1.107
Base	37	15	Exx	LinStatic	Min	0.075	-0.014	1.094
Base	37	15	Eyy	LinStatic	Max	-0.023	0.018	2.449
Base	37	15	Eyy	LinStatic	Min	-0.023	0.017	2.446
Base	37	15	WindX	LinStatic		-0.429	0.497	-8.651
Base	37	15	WindY	LinStatic		-0.695	-0.841	-12.896
Base	37	15	WindXX	LinStatic		0.000253	0.0001707	-0.015

Story	Label	Unique Name	Output Case	Case Type	Step Type	FX kip	FY kip	FZ kip
Base	37	15	WindYY	LinStatic		-0.004	0.001	-0.001
Base	40	16	Exx	LinStatic	Max	0.097	-0.015	0.651
Base	40	16	Exx	LinStatic	Min	0.095	-0.015	0.604
Base	40	16	Eyy	LinStatic	Max	-0.028	0.016	-4.075
Base	40	16	Eyy	LinStatic	Min	-0.029	0.016	-4.086
Base	40	16	WindX	LinStatic		-0.018	1.223	-7.618
Base	40	16	WindY	LinStatic		-0.141	-1.731	-5.76
Base	40	16	WindXX	LinStatic		-0.0002274	0.0001937	-0.003
Base	40	16	WindYY	LinStatic		-0.006	0.001	-0.045
Base	1	17	Exx	LinStatic	Max	-0.016	0.203	-0.775
Base	1	17	Exx	LinStatic	Min	-0.016	0.1	-1.066
Base	1	17	Eyy	LinStatic	Max	-0.013	-10.379	29.336
Base	1	17	Eyy	LinStatic	Min	-0.013	-10.405	29.262
Base	1	17	WindX	LinStatic		-3.37	1.221	-6.091
Base	1	17	WindY	LinStatic		3.189	-17.594	45.619
Base	1	17	WindXX	LinStatic		-0.001	-0.022	0.066
Base	1	17	WindYY	LinStatic		0.0002971	-0.024	0.061
Base	2	18	Exx	LinStatic	Max	-0.028	0.225	0.417
Base	2	18	Exx	LinStatic	Min	-0.028	0.054	0.416
Base	2	18	Eyy	LinStatic	Max	-0.0002699	-16.858	-0.014
Base	2	18	Eyy	LinStatic	Min	-0.0002793	-16.901	-0.014
Base	2	18	WindX	LinStatic		-3.508	-0.346	-9.115
Base	2	18	WindY	LinStatic		3.187	-32.265	-10.408
Base	2	18	WindXX	LinStatic		-0.002	-0.038	-0.02
Base	2	18	WindYY	LinStatic		-2.458E-05	-0.04	0.044
Base	3	19	Exx	LinStatic	Max	-0.012	0.071	-0.242
Base	3	19	Exx	LinStatic	Min	-0.013	-0.032	-0.533
Base	3	19	Eyy	LinStatic	Max	0.013	-10.394	-29.273
Base	3	19	Eyy	LinStatic	Min	0.013	-10.42	-29.347
Base	3	19	WindX	LinStatic		-3.367	-1.644	-7.29
Base	3	19	WindY	LinStatic		3.183	-20.91	-65.886
Base	3	19	WindXX	LinStatic		-0.001	-0.024	-0.062
Base	3	19	WindYY	LinStatic		0.0003528	-0.024	-0.074
Base	199	74	Exx	LinStatic	Max	-4.529	0.019	22.995
Base	199	74	Exx	LinStatic	Min	-4.651	0.018	22.389
Base	199	74	Eyy	LinStatic	Max	1.443	0.001	-6.949
Base	199	74	Eyy	LinStatic	Min	1.412	0.001	-7.103
Base	199	74	WindX	LinStatic		-1.409	0.961	3.284
Base	199	74	WindY	LinStatic		4.936	-0.575	-27.149
Base	199	74	WindXX	LinStatic		-1.04	-0.001	2.532
Base	199	74	WindYY	LinStatic		-0.788	-0.002	1.287
Base	198	75	Exx	LinStatic	Max	0.054	0.012	0.0004967
Base	198	75	Exx	LinStatic	Min	0.054	0.012	0.000491
Base	198	75	Eyy	LinStatic	Max	-0.014	-0.005	-0.0004828
Base	198	75	Eyy	LinStatic	Min	-0.015	-0.005	-0.0004843
Base	198	75	WindX	LinStatic		-0.937	0.802	-0.0002957
Base	198	75	WindY	LinStatic		-1.166	-0.572	-2.218
Base	198	75	WindXX	LinStatic		-0.001	-0.0004053	4.719E-05
Base	198	75	WindYY	LinStatic		-0.004	-0.001	1.93E-05
Base	200	76	Exx	LinStatic	Max	-0.006	-0.098	0.029
Base	200	76	Exx	LinStatic	Min	-0.006	-0.285	-0.42
Base	200	76	Eyy	LinStatic	Max	-0.004	-4.595	-10.968
Base	200	76	Eyy	LinStatic	Min	-0.004	-4.643	-11.082
Base	200	76	WindX	LinStatic		-1.833	1.278	0.837
Base	200	76	WindY	LinStatic		-2.44	-8.407	-21.128
Base	200	76	WindXX	LinStatic		-0.0004575	0.014	0.001
Base	200	76	WindYY	LinStatic		-3.627E-05	0.021	0.017

Story	Label	Unique Name	Output Case	Case Type	Step Type	FX kip	FY kip	FZ kip
Base	38	77	Exx	LinStatic	Max	0.001	1.2	1.184
Base	38	77	Exx	LinStatic	Min	0.001	0.854	1.16
Base	38	77	Eyy	LinStatic	Max	-1.739E-05	-7.913	0.087
Base	38	77	Eyy	LinStatic	Min	-1.951E-05	-8.001	0.08
Base	38	77	WindX	LinStatic		-3.635	0.304	-0.405
Base	38	77	WindY	LinStatic		-3.642	-13.711	-2.484
Base	38	77	WindXX	LinStatic		0.0001169	0.12	0.189
Base	38	77	WindYY	LinStatic		4.355E-05	0.063	0.102
Base	39	78	Exx	LinStatic	Max	-12.962	-0.115	23.133
Base	39	78	Exx	LinStatic	Min	-13.051	-0.302	22.838
Base	39	78	Eyy	LinStatic	Max	-2.252	-4.57	13.495
Base	39	78	Eyy	LinStatic	Min	-2.275	-4.618	13.421
Base	39	78	WindX	LinStatic		0.919	0.337	-6.009
Base	39	78	WindY	LinStatic		2.458	-6.991	4.351
Base	39	78	WindXX	LinStatic		-0.821	0.015	1.339
Base	39	78	WindYY	LinStatic		-0.194	0.022	0.25
Base	201	79	Exx	LinStatic	Max	0.002	-1.024E-05	8.113E-05
Base	201	79	Exx	LinStatic	Min	0.002	-4.569E-05	7.602E-05
Base	201	79	Eyy	LinStatic	Max	0.000361	0.001	0.0002265
Base	201	79	Eyy	LinStatic	Min	0.0003538	0.001	0.0002252
Base	201	79	WindX	LinStatic		-2.88	-3.529E-05	0.0004463
Base	201	79	WindY	LinStatic		-2.88	0.011	-2.217
Base	201	79	WindXX	LinStatic		-1.723E-05	-2.302E-05	0
Base	201	79	WindYY	LinStatic		-9.986E-05	-1.729E-05	0
Base	203	80	Exx	LinStatic	Max	0.001	0	0
Base	203	80	Exx	LinStatic	Min	0.001	-2.063E-05	0
Base	203	80	Eyy	LinStatic	Max	0.0002385	0.0003172	9.195E-05
Base	203	80	Eyy	LinStatic	Min	0.0002328	0.000313	9.163E-05
Base	203	80	WindX	LinStatic		-0.0002942	-2.399	-0.0002578
Base	203	80	WindY	LinStatic		-0.0002448	-2.385	-0.815
Base	203	80	WindXX	LinStatic		-1.056	-1.144E-05	-9.687E-05
Base	203	80	WindYY	LinStatic		-1.056	-8.812E-06	-9.817E-05
Base	19	81	Exx	LinStatic	Max	-6.816	0.002	13.056
Base	19	81	Exx	LinStatic	Min	-6.869	0.002	12.92
Base	19	81	Eyy	LinStatic	Max	-0.889	-0.005	3.095
Base	19	81	Eyy	LinStatic	Min	-0.902	-0.005	3.06
Base	19	81	WindX	LinStatic		-7.005	-2.764	4.85
Base	19	81	WindY	LinStatic		-3.244	-3.284	-0.824
Base	19	81	WindXX	LinStatic		-1.161	0.0001442	1.251
Base	19	81	WindYY	LinStatic		0.623	-9.451E-05	-0.164
Base	204	82	Exx	LinStatic	Max	-7.504	0.001	12.566
Base	204	82	Exx	LinStatic	Min	-7.545	0.001	12.442
Base	204	82	Eyy	LinStatic	Max	-0.326	0.01	2.327
Base	204	82	Eyy	LinStatic	Min	-0.337	0.01	2.295
Base	204	82	WindX	LinStatic		-11.361	0.019	-6.903
Base	204	82	WindY	LinStatic		-3.789	0.023	-13.413
Base	204	82	WindXX	LinStatic		-0.557	7.184E-05	1.042
Base	204	82	WindYY	LinStatic		0.009	-4.4E-05	0.043
Base	210	84	Exx	LinStatic	Max	-7.53	-0.0003543	12.969
Base	210	84	Exx	LinStatic	Min	-7.555	-0.0003999	12.877
Base	210	84	Eyy	LinStatic	Max	0.286	0.011	-2.215
Base	210	84	Eyy	LinStatic	Min	0.28	0.011	-2.238
Base	210	84	WindX	LinStatic		-11.082	-0.019	-7.774
Base	210	84	WindY	LinStatic		0.968	0.009	-20.919
Base	210	84	WindXX	LinStatic		-0.529	-2.463E-05	0.984
Base	210	84	WindYY	LinStatic		0.032	6.111E-05	-0.019
Base	211	83	Exx	LinStatic	Max	-6.839	-0.001	13.026

Story	Label	Unique Name	Output Case	Case Type	Step Type	FX kip	FY kip	FZ kip
Base	211	83	Exx	LinStatic	Min	-6.876	-0.001	12.926
Base	211	83	Eyy	LinStatic	Max	0.841	-0.004	-2.894
Base	211	83	Eyy	LinStatic	Min	0.831	-0.004	-2.919
Base	211	83	WindX	LinStatic		-6.615	2.757	3.954
Base	211	83	WindY	LinStatic		-1.586	-3.306	-4.741
Base	211	83	WindXX	LinStatic		-1.123	-0.0001444	1.157
Base	211	83	WindYY	LinStatic		0.654	5.327E-05	-0.239
Base	229	85	Exx	LinStatic	Max	-4.535	0.0003146	-22.39
Base	229	85	Exx	LinStatic	Min	-4.656	-3.699E-05	-22.996
Base	229	85	Eyy	LinStatic	Max	1.438	-0.009	7.103
Base	229	85	Eyy	LinStatic	Min	1.407	-0.009	6.949
Base	229	85	WindX	LinStatic		-1.898	1.477	-3.283
Base	229	85	WindY	LinStatic		5.392	-1.58	26.333
Base	229	85	WindXX	LinStatic		-1.016	0.002	-2.533
Base	229	85	WindYY	LinStatic		-0.764	0.002	-1.287

AOF Middle - Base Labels
3.9
5.1
5.9
110.667 (ft)
24.4795 (ft)
F.9
F.1
E
D
C
A.9
A.1
10.9792 (ft)
18.9167 (ft)
18.75 (ft)
18.7708 (ft)
18.875 (ft)
11.0208 (ft)
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Point Results

Joint Reactions

Story	Label	Unique Name	Output Case	Case Type	Step Type	FX kip	FY kip	FZ kip
Base	8	7	Exx	LinStatic	Max	-0.047	0.0001292	-1.127
Base	8	7	Exx	LinStatic	Min	-0.047	0.0001292	-1.127
Base	8	7	Eyy	LinStatic	Max	-0.003	0.001	4.233
Base	8	7	Eyy	LinStatic	Min	-0.003	0.001	4.233
Base	8	7	Wind X	LinStatic		-0.067	-3.186	-9.248
Base	8	7	Wind Y	LinStatic		0.001	-3.2	-8.479
Base	8	7	Wind XX	LinStatic		-0.891	-0.0002444	0.012
Base	8	7	Wind YY	LinStatic		0.885	0.0002673	-0.047
Base	9	8	Exx	LinStatic	Max	-0.04	-4.477E-05	-1.048
Base	9	8	Exx	LinStatic	Min	-0.04	-4.477E-05	-1.048
Base	9	8	Eyy	LinStatic	Max	0.001	0.01	-3.882
Base	9	8	Eyy	LinStatic	Min	0.001	0.01	-3.882
Base	9	8	Wind X	LinStatic		-2.493	-0.007	-7.344
Base	9	8	Wind Y	LinStatic		2.377	-0.006	-9.089
Base	9	8	Wind XX	LinStatic		-0.006	-0.0001392	0.083
Base	9	8	Wind YY	LinStatic		0.0004649	0.0001787	-0.162
Base	10	9	Exx	LinStatic	Max	-0.038	0.023	-0.419
Base	10	9	Exx	LinStatic	Min	-0.038	0.023	-0.419
Base	10	9	Eyy	LinStatic	Max	-0.006	-10.866	31.078
Base	10	9	Eyy	LinStatic	Min	-0.006	-10.866	31.078
Base	10	9	Wind X	LinStatic		-3.314	1.371	-9.075
Base	10	9	Wind Y	LinStatic		3.186	-17.431	41.885
Base	10	9	Wind XX	LinStatic		-0.005	0.005	-0.037
Base	10	9	Wind YY	LinStatic		-0.0003488	0.003	-0.041
Base	11	10	Exx	LinStatic	Max	-0.046	0.003	0.267
Base	11	10	Exx	LinStatic	Min	-0.046	0.003	0.267
Base	11	10	Eyy	LinStatic	Max	-2.416E-05	-17.218	-0.005
Base	11	10	Eyy	LinStatic	Min	-2.416E-05	-17.218	-0.005
Base	11	10	Wind X	LinStatic		-3.443	0.005	-11.244
Base	11	10	Wind Y	LinStatic		3.218	-32.643	-12.85
Base	11	10	Wind XX	LinStatic		-0.005	3.567E-05	-0.096
Base	11	10	Wind YY	LinStatic		-0.001	1.469E-05	0.022
Base	12	11	Exx	LinStatic	Max	-0.038	-0.018	-0.41
Base	12	11	Exx	LinStatic	Min	-0.038	-0.018	-0.41
Base	12	11	Eyy	LinStatic	Max	0.006	-10.881	-31.101
Base	12	11	Eyy	LinStatic	Min	0.006	-10.881	-31.101
Base	12	11	Wind X	LinStatic		-3.313	-1.381	-9.155
Base	12	11	Wind Y	LinStatic		3.166	-20.898	-66.672
Base	12	11	Wind XX	LinStatic		-0.005	-0.005	-0.035
Base	12	11	Wind YY	LinStatic		-0.0003443	-0.003	-0.04
Base	13	12	Exx	LinStatic	Max	-0.04	1.428E-05	-1.068
Base	13	12	Exx	LinStatic	Min	-0.04	1.428E-05	-1.068
Base	13	12	Eyy	LinStatic	Max	-0.001	0.01	3.918
Base	13	12	Eyy	LinStatic	Min	-0.001	0.01	3.918
Base	13	12	Wind X	LinStatic		-2.494	0.007	-7.289
Base	13	12	Wind Y	LinStatic		2.382	-0.01	-11.997
Base	13	12	Wind XX	LinStatic		-0.006	0.0001392	0.082
Base	13	12	Wind YY	LinStatic		0.0004841	-0.0001827	-0.165
Base	14	13	Exx	LinStatic	Max	-0.046	-0.0001546	-1.097
Base	14	13	Exx	LinStatic	Min	-0.046	-0.0001546	-1.097
Base	14	13	Eyy	LinStatic	Max	0.003	0.001	-4.247
Base	14	13	Eyy	LinStatic	Min	0.003	0.001	-4.247
Base	14	13	Wind X	LinStatic		-0.066	3.186	-9.293
Base	14	13	Wind Y	LinStatic		-0.045	-3.205	-0.494

Story	Label	Unique Name	Output Case	Case Type	Step Type	FX kip	FY kip	FZ kip
Base	14	13	Wind XX	LinStatic		-0.891	0.000243	0.01
Base	14	13	Wind YY	LinStatic		0.885	-0.0002713	-0.043
Base	23	14	Exx	LinStatic	Max	-0.013	4.499	27.376
Base	23	14	Exx	LinStatic	Min	-0.013	4.499	27.376
Base	23	14	Eyy	LinStatic	Max	0.005	-4.252	-21.158
Base	23	14	Eyy	LinStatic	Min	0.005	-4.252	-21.158
Base	23	14	Wind X	LinStatic		-0.034	8.056	34.922
Base	23	14	Wind Y	LinStatic		0.049	-14.944	-40.736
Base	23	14	Wind XX	LinStatic		-0.875	0.445	3.093
Base	23	14	Wind YY	LinStatic		-0.874	0.049	0.609
Base	24	15	Exx	LinStatic	Max	-0.025	-3.067	24.568
Base	24	15	Exx	LinStatic	Min	-0.025	-3.067	24.568
Base	24	15	Eyy	LinStatic	Max	0.001	-4.01	20.038
Base	24	15	Eyy	LinStatic	Min	0.001	-4.01	20.038
Base	24	15	Wind X	LinStatic		-2.401	-2.001	23.377
Base	24	15	Wind Y	LinStatic		-2.426	-14.342	50.311
Base	24	15	Wind XX	LinStatic		-0.001	-0.449	3.017
Base	24	15	Wind YY	LinStatic		0.001	-0.148	0.712
Base	25	16	Exx	LinStatic	Max	-0.025	3.06	24.541
Base	25	16	Exx	LinStatic	Min	-0.025	3.06	24.541
Base	25	16	Eyy	LinStatic	Max	-0.001	-3.992	-19.985
Base	25	16	Eyy	LinStatic	Min	-0.001	-3.992	-19.985
Base	25	16	Wind X	LinStatic		-2.401	2.005	23.331
Base	25	16	Wind Y	LinStatic		-2.374	-10.322	-34.408
Base	25	16	Wind XX	LinStatic		-0.001	0.448	3.02
Base	25	16	Wind YY	LinStatic		0.001	0.148	0.712
Base	26	18	Exx	LinStatic	Max	-0.013	-4.487	27.397
Base	26	18	Exx	LinStatic	Min	-0.013	-4.487	27.397
Base	26	18	Eyy	LinStatic	Max	-0.005	-4.231	21.101
Base	26	18	Eyy	LinStatic	Min	-0.005	-4.231	21.101
Base	26	18	Wind X	LinStatic		-0.033	-8.035	34.967
Base	26	18	Wind Y	LinStatic		-0.035	-14.43	49.453
Base	26	18	Wind XX	LinStatic		-0.876	-0.445	3.094
Base	26	18	Wind YY	LinStatic		-0.874	-0.049	0.609
Base	27	19	Exx	LinStatic	Max	-0.016	0.184	1.684
Base	27	19	Exx	LinStatic	Min	-0.016	0.184	1.684
Base	27	19	Eyy	LinStatic	Max	-0.002	-11.836	-27.15
Base	27	19	Eyy	LinStatic	Min	-0.002	-11.836	-27.15
Base	27	19	Wind X	LinStatic		-3.25	-2.708	-9.97
Base	27	19	Wind Y	LinStatic		-3.231	-26.469	-57.108
Base	27	19	Wind XX	LinStatic		-0.002	0.004	0.008
Base	27	19	Wind YY	LinStatic		-0.000293	0.001	-0.006
Base	28	20	Exx	LinStatic	Max	-0.021	5.655E-06	0.727
Base	28	20	Exx	LinStatic	Min	-0.021	5.655E-06	0.727
Base	28	20	Eyy	LinStatic	Max	1.548E-05	0.009	-0.001
Base	28	20	Eyy	LinStatic	Min	1.548E-05	0.009	-0.001
Base	28	20	Wind X	LinStatic		-3.227	2.051E-05	-10.334
Base	28	20	Wind Y	LinStatic		-3.207	0.008	-9.862
Base	28	20	Wind XX	LinStatic		-0.002	0	0.015
Base	28	20	Wind YY	LinStatic		-0.0003215	0	0.004
Base	29	21	Exx	LinStatic	Max	-0.016	-0.196	1.714
Base	29	21	Exx	LinStatic	Min	-0.016	-0.196	1.714
Base	29	21	Eyy	LinStatic	Max	0.003	-11.822	27.131
Base	29	21	Eyy	LinStatic	Min	0.003	-11.822	27.131
Base	29	21	Wind X	LinStatic		-3.25	2.687	-9.856
Base	29	21	Wind Y	LinStatic		-3.24	-21.291	32.825
Base	29	21	Wind XX	LinStatic		-0.002	-0.004	0.006

Story	Label	Unique Name	Output Case	Case Type	Step Type	FX kip	FY kip	FZ kip
Base	29	21	Wind YY	LinStatic		-0.0002945	-0.001	-0.007
Base	44	22	Exx	LinStatic	Max	-18.62	-3.26E-05	-24.927
Base	44	22	Exx	LinStatic	Min	-18.62	-3.26E-05	-24.927
Base	44	22	Eyy	LinStatic	Max	1.901	0.012	6.576
Base	44	22	Eyy	LinStatic	Min	1.901	0.012	6.576
Base	44	22	Wind X	LinStatic		-19.803	-4.083	-40.209
Base	44	22	Wind Y	LinStatic		-1.809	-4.07	-9.889
Base	44	22	Wind XX	LinStatic		-2.884	1.473E-05	-3.232
Base	44	22	Wind YY	LinStatic		-1.031	7.016E-05	-0.665
Base	45	73	Exx	LinStatic	Max	-20.671	-0.001	-26.619
Base	45	73	Exx	LinStatic	Min	-20.671	-0.001	-26.619
Base	45	73	Eyy	LinStatic	Max	-3.45	0.028	-4.04
Base	45	73	Eyy	LinStatic	Min	-3.45	0.028	-4.04
Base	45	73	Wind X	LinStatic		-18.017	0.046	-54.687
Base	45	73	Wind Y	LinStatic		-4.155	0.101	-38.381
Base	45	73	Wind XX	LinStatic		-2.415	0.0001499	-2.906
Base	45	73	Wind YY	LinStatic		-0.432	0.0002427	-0.413
Base	46	24	Exx	LinStatic	Max	-20.671	0.001	-26.634
Base	46	24	Exx	LinStatic	Min	-20.671	0.001	-26.634
Base	46	24	Eyy	LinStatic	Max	3.455	0.028	4.02
Base	46	24	Eyy	LinStatic	Min	3.455	0.028	4.02
Base	46	24	Wind X	LinStatic		-18.016	-0.046	-54.731
Base	46	24	Wind Y	LinStatic		3.065	0.098	-22.313
Base	46	24	Wind XX	LinStatic		-2.416	-0.0001442	-2.904
Base	46	24	Wind YY	LinStatic		-0.432	-0.0002372	-0.413
Base	47	25	Exx	LinStatic	Max	-18.612	3.577E-05	-24.924
Base	47	25	Exx	LinStatic	Min	-18.612	3.577E-05	-24.924
Base	47	25	Eyy	LinStatic	Max	-1.906	0.012	-6.526
Base	47	25	Eyy	LinStatic	Min	-1.906	0.012	-6.526
Base	47	25	Wind X	LinStatic		-19.819	4.083	-40.112
Base	47	25	Wind Y	LinStatic		0.373	-4.082	-18.147
Base	47	25	Wind XX	LinStatic		-2.885	-1.508E-05	-3.23
Base	47	25	Wind YY	LinStatic		-1.031	-6.882E-05	-0.667

AOF End – All beam sections with DC ratios (Lateral Design)

Label	Section	D/C Ratio
1	W8X31	0.086
101	L6X6X5/16	0.163
102	L6X6X5/16	0.077
103	L6X6X5/16	0.177
104	L6X6X5/16	0.136
105	L6X6X5/16	0.127
106	L6X6X5/16	0.167
110	W8X31	0.155
111	W8X31	0.152
112	W8X31	0.152
113	W8X31	0.104
114	W8X31	0.13
115	W8X31	0.176
116	W8X31	0.176
117	W8X31	0.136
118	W8X31	0.099
119	W8X31	0.142
120	W8X31	0.142
121	W8X31	0.098
122	W8X31	0.352
123	W8X31	0.117
124	W8X31	0.121
125	W8X31	0.361
126	W8X31	0.092
127	W8X31	0.093
128	W8X31	0.154
129	W8X31	0.159
130	L8X8X1/2	0.354
131	L8X8X1/2	0.226
132	L8X8X1/2	0.446
133	L8X8X1/2	0.21
134	L8X8X1/2	0.12
135	L8X8X1/2	0.173
136	L8X8X1/2	0.121
137	L8X8X1/2	0.165
138	L8X8X1/2	0.201
139	L8X8X1/2	0.17
140	L8X8X1/2	0.198
141	L8X8X1/2	0.164
142	L8X8X5/8	0.168

143	L8X8X5/8	0.552
144	L8X8X5/8	0.243
145	L8X8X5/8	0.916
159	W8X31	0.042
161	W8X31	0.029
162	W8X31	0.034
163	L6X6X5/16	0.641
164	L6X6X5/16	0.215
165	L6X6X5/16	0.19
166	L6X6X5/16	0.164
167	L6X6X7/8	0.075
184	W12X50	0.233
185	W12X50	0.032
2	W8X31	0.087
20	W12X50	0.262
21	W12X45	0.035
22	W12X45	0.21
23	W12X45	0.013
24	W12X45	0.272
240	W12X50	0.101
241	W12X50	0.091
257	W8X31	0.334
273	W8X31	0.445
28	W12X45	0.013
289	W8X31	0.326
29	W12X45	0.273
290	W8X31	0.009
291	W8X31	0.033
292	W8X40	0.032
293	W8X40	0.03
294	W8X31	0.031
295	W8X31	0.009
296	W8X31	0.011
297	W8X31	0.028
298	W8X40	0.027
299	W8X40	0.027
3	W8X31	0.056
30	W12X45	0.035
300	W8X31	0.029
301	W8X31	0.009
302	W8X31	0.05
303	W8X31	0.051
307	W8X31	0.068

308	W8X31	0.064
31	W12X45	0.206
310	W8X31	0.253
311	W8X31	0.238
312	W8X31	0.032
313	W8X31	0.274
314	W8X31	0.277
315	W8X31	0.038
316	W8X31	0.027
318	W12X50	0.032
319	W8X31	0.035
32	W8X31	0.059
320	W8X31	0.022
321	W8X31	0.077
322	W12X50	0.07
323	W12X50	0.093
324	W12X50	0.082
325	W12X50	0.238
326	W8X31	0.022
327	W8X31	0.024
328	W8X31	0.022
33	W8X31	0.026
332	W12X50	0.204
333	W8X31	0.013
334	W8X31	0.024
335	W8X31	0.044
336	W12X50	0.234
337	W12X50	0.078
338	W8X31	0.023
339	W8X31	0.022
34	W8X31	0.052
340	W8X31	0.028
341	W8X31	0.021
345	W8X31	0.031
346	W8X31	0.017
347	W8X31	0.072
348	W8X31	0.044
349	W8X31	0.014
35	W8X40	0.057
354	W8X31	0.025
358	W12X45	0.212
359	W12X45	0.129
36	W8X40	0.064

360	W12X45	0.133
361	W12X45	0.215
362	W8X31	0.299
363	W8X31	0.095
364	W8X31	0.068
365	W8X40	0.101
366	W8X31	0.341
367	W8X31	0.123
368	W8X40	0.251
369	W8X31	0.057
37	W8X31	0.062
370	W8X40	0.258
371	W8X31	0.069
372	W8X31	0.349
373	W8X31	0.104
374	W8X31	0.105
375	W8X31	0.336
376	W8X40	0.253
377	W8X40	0.251
378	W8X31	0.339
379	W8X31	0.097
38	W8X31	0.031
380	W12X50	0.251
381	W12X50	0.045
384	W12X50	0.04
385	W12X50	0.019
386	W12X50	0.14
387	W12X50	0.311
388	W12X50	0.099
389	W12X50	0.069
39	W8X31	0.06
390	W12X50	0.307
391	W12X50	0.058
392	W12X50	0.04
393	W12X50	0.056
394	W12X50	0.05
395	W16X31	0.022
4	W8X31	0.058
40	W8X31	0.135
41	W8X31	0.123
414	HSS3X3X3/8	0.254
415	HSS3X3X3/8	0.236
416	HSS3X3X3/8	0.047

417	HSS3X3X3/8	0.05
418	HSS3X3X3/8	0.049
419	HSS3X3X3/8	0.055
420	HSS3X3X3/8	0.289
421	HSS3X3X3/8	0.27
430	W12X50	0.035
431	W12X50	0.037
437	W8X31	0.039
456	W8X40	0.003
457	W8X40	0.012
458	W8X40	0.003
459	W8X40	0.011
48	W8X31	0.033
49	W8X31	0.018
50	W8X31	0.024
502	W16X31	0.188
503	W16X31	0.176
504	W14X26	0.359
505	W16X31	0.175
506	W16X31	0.069
507	W16X26	0.71
508	W16X31	0.696
509	W16X31	0.684
51	W8X31	0.171
510	W16X26	0.085
511	W16X26	0.085
512	W10X12	0.012
513	W10X12	0.073
514	W16X31	0.073
515	W16X31	0.258
516	W10X12	0.035
517	W10X12	0.013
518	W16X31	0.071
519	W10X12	0.013
52	W8X31	0.04
520	WT6X25	0.171
521	W12X50	0.092
522	WT6X25	0.293
523	W12X50	0.304
524	WT6X22.5	0.371
525	W12X45	0.317
526	WT6X22.5	0.361
527	W12X45	0.39

528	WT6X22.5	0.317
529	W12X45	0.32
53	W8X31	0.042
530	WT6X25	0.295
531	W12X50	0.297
532	WT6X25	0.173
533	W12X50	0.094
534	WT6X22.5	0.383
535	W12X45	0.197
536	WT6X22.5	0.362
537	W12X45	0.474
538	W8X31	0.02
539	W8X31	0.01
54	W8X31	0.152
540	W8X31	0.009
541	W8X31	0.018
542	W8X31	0.015
543	W8X40	0.015
544	W8X31	0.035
545	W8X31	0.03
546	W8X31	0.098
547	W8X31	0.094
548	W8X31	0.055
549	W8X31	0.058
55	W8X31	0.017
553	W8X40	0.006
554	W8X40	0.017
555	W8X40	0.003
556	W8X40	0.011
56	W8X31	0.021
57	L6X6X7/8	0.308
574	WT6X22.5	0.122
575	W12X45	0.092
576	WT6X22.5	0.301
577	W12X45	0.167
578	WT6X22.5	0.291
579	W12X45	0.162
580	WT6X22.5	0.114
581	W12X45	0.091
582	WT6X22.5	0.381
583	W12X45	0.344
584	W8X31	0.128
585	W8X40	0.03

587	W8X40	0.027
589	W8X40	0.003
59	L6X6X5/16	0.182
590	W8X40	0.011
591	W8X40	0.006
592	W8X40	0.017
60	L6X6X5/16	0.075
602	W8X40	0.003
603	W8X40	0.012
604	W8X40	0.003
605	W8X40	0.011
606	W12X50	0.287
61	L6X6X5/16	0.18
611	W12X50	0.29
614	W12X50	0.065
615	W12X50	0.098
616	W12X50	0.116
62	L6X6X5/16	0.16
623	W8X31	0.036
624	L6X6X5/16	0.143
629	L6X6X5/16	0.122
63	L6X6X5/16	0.136
630	L6X6X5/16	0.339
631	L6X6X5/16	0.109
632	L6X6X5/16	0.223
636	L6X6X5/16	0.105
638	W8X31	0.039
64	L6X6X5/16	0.203
641	W12X50	0.149
642	L6X6X7/8	0.081
643	W12X50	0.146
644	W12X50	0.1
646	W12X50	0.072
647	W12X50	0.242
648	W12X50	0.225
649	W12X50	0.151
65	L6X6X7/8	0.636
650	W12X50	0.228
651	W12X50	0.045
652	L6X6X7/8	0.623
655	W12X50	0.242
656	W12X50	0.258
657	W12X50	0.249

661	W12X50	0.087
662	W12X50	0.106
663	W12X50	0.141
664	W12X50	0.143
665	W12X50	0.145
667	W12X50	0.076
669	W12X50	0.238
67	L6X6X5/16	0.089
670	W12X50	0.237
671	W12X50	0.034
673	W12X50	0.037
674	W12X50	0.075
675	W12X50	0.099
679	W12X50	0.099
68	L6X6X7/8	0.808
680	W12X50	0.064
681	W12X50	0.034
70	L6X6X5/16	0.158
71	L6X6X5/16	0.181
710	W12X50	0.035
711	W12X50	0.072
712	W12X50	0.091
713	W12X50	0.07
72	L6X6X5/16	0.129
73	L6X6X5/16	0.141
74	L6X6X5/16	0.183
75	L6X6X5/16	0.127
78	L6X6X5/16	0.256
79	W8X31	0.03
80	W8X31	0.017
81	W8X31	0.023
82	W8X31	0.16
83	W8X31	0.038
84	W8X31	0.039
85	W8X31	0.141
86	W8X31	0.017
87	W8X31	0.023
88	L6X6X7/8	0.77
90	L6X6X5/16	0.147
91	L6X6X5/16	0.172
92	L6X6X5/16	0.121
93	L6X6X5/16	0.135
94	L6X6X5/16	0.15

95	L6X6X5/16	0.122
99	L6X6X7/8	0.353

AOF Middle – All beam sections with DC ratios (Lateral Design)

Label	Section	D/C Ratio
100	W8X31	0.112
101	W8X31	0.109
102	W8X31	0.294
103	W8X31	0.294
104	W8X31	0.102
105	W8X31	0.312
106	W8X31	0.312
107	W8X31	0.113
108	W8X31	0.12
109	W8X31	0.12
110	W8X31	0.109
111	W8X31	0.086
112	W8X31	0.116
113	W8X31	0.119
114	W8X31	0.086
115	W8X31	0.137
116	W8X31	0.423
117	W8X31	0.474
118	W8X31	0.141
131	L6X6X5/16	0.51
136	L6X6X5/16	0.147
138	L6X6X5/16	0.116
140	L6X6X5/16	0.115
163	W12X72	0.025
165	W8X40	0.019
173	W8X31	0.377
183	W8X31	0.026
191	W8X31	0.454
20	W8X31	0.038
201	W8X31	0.019
209	W8X31	0.378
21	W8X31	0.11
217	W8X40	0.006
218	W8X31	0.029
219	W8X40	0.044
22	W8X40	0.089
220	W8X40	0.043
221	W8X31	0.03
222	W8X40	0.006
23	W8X40	0.082

230	W8X40	0.087
231	W12X72	0.047
24	W8X31	0.105
248	W12X72	0.074
249	W8X31	0.309
25	W8X31	0.036
250	W8X31	0.093
251	L8X8X3/4	0.145
252	L8X8X3/4	0.164
253	L8X8X3/4	0.183
255	L8X8X3/4	0.911
256	W8X31	0.098
257	W8X31	0.49
258	W8X31	0.095
259	W8X31	0.554
26	W8X31	0.011
260	L8X8X3/4	0.184
261	L8X8X3/4	0.818
262	L8X8X3/4	0.166
263	L8X8X3/4	0.17
264	W8X31	0.38
265	W8X31	0.094
266	W12X72	0.109
267	W12X72	0.047
268	W8X31	0.023
269	W8X31	0.052
27	W8X31	0.021
270	L6X6X5/16	0.174
272	L6X6X5/16	0.478
274	W8X31	0.099
275	W8X31	0.02
276	W8X40	0.014
279	W8X40	0.012
28	W8X40	0.02
281	L6X6X5/16	0.153
283	L6X6X5/16	0.269
284	W8X31	0.006
285	W8X31	0.037
286	W8X31	0.023
287	W8X31	0.078
288	W8X31	0.097
289	W12X72	0.099
29	W8X40	0.019

290	W12X72	0.06
293	W12X72	0.073
295	W8X31	0.075
296	W8X31	0.026
297	W8X31	0.043
298	W8X31	0.006
299	W8X31	0.054
30	W8X31	0.021
300	W8X31	0.019
301	W12X72	0.084
303	W12X72	0.054
305	W8X31	0.029
306	W8X31	0.023
307	W8X31	0.021
309	L6X6X5/16	0.121
31	W8X31	0.011
311	W12X72	0.071
312	W12X72	0.063
313	W12X72	0.047
315	W8X31	0.021
316	L6X6X5/16	0.138
318	L6X6X5/16	0.208
32	W8X40	0.165
321	W8X31	0.024
322	W8X31	0.022
33	W8X40	0.044
334	W12X72	0.032
335	L6X6X5/16	0.275
338	W8X31	0.023
339	W8X31	0.02
34	W8X31	0.111
340	W8X31	0.021
341	HSS3X3X3/8	0.431
342	HSS3X3X3/8	0.404
347	HSS3X3X3/8	0.101
348	HSS3X3X3/8	0.091
349	HSS3X3X3/8	0.098
35	W8X31	0.087
350	HSS3X3X3/8	0.088
355	HSS3X3X3/8	0.44
356	HSS3X3X3/8	0.409
36	W8X40	0.094
361	W8X31	0.024

362	W8X31	0.024
37	W8X40	0.105
379	WT6X36	0.092
38	W8X31	0.087
380	W12X72	0.124
39	W8X40	0.044
391	W12X45	0.148
392	W12X45	0.031
395	W12X45	0.284
396	W12X45	0.075
399	W8X31	0.05
40	W8X40	0.165
400	W12X72	0.082
401	W8X31	0.047
402	W8X31	0.05
403	W8X31	0.049
404	W12X72	0.015
405	W8X31	0.07
407	W8X31	0.074
408	W12X72	0.082
41	W8X31	0.11
410	W12X72	0.02
411	W12X45	0.282
412	W12X45	0.075
413	W12X45	0.211
414	W12X45	0.307
415	W12X45	0.149
416	W12X45	0.035
417	W12X45	0.284
418	W12X45	0.214
419	W12X45	0.226
42	W8X40	0.09
420	WT6X36	0.266
421	W12X72	0.22
422	W12X45	0.06
423	W12X45	0.082
424	WT6X25	0.359
425	W12X72	0.197
428	WT6X25	0.325
429	W12X72	0.222
43	W8X31	0.017
432	WT6X25	0.324
433	W12X72	0.196

435	W12X72	0.019
436	WT6X36	0.265
437	W12X72	0.209
438	W12X72	0.059
439	W12X72	0.067
44	W8X31	0.014
440	WT6X36	0.101
441	W12X72	0.122
442	W12X72	0.068
443	W12X72	0.061
444	W12X72	0.045
445	W12X72	0.034
45	W12X45	0.065
47	W12X72	0.31
49	W12X72	0.348
51	W8X31	0.014
52	W8X31	0.087
53	W8X31	0.029
54	W8X31	0.089
55	W8X31	0.019
56	W8X31	0.034
57	W8X31	0.014
58	W8X31	0.085
59	W8X31	0.029
60	W8X31	0.088
61	W8X31	0.019
62	W8X31	0.034
63	L6X6X5/16	0.456
64	L6X6X5/16	0.154
65	L6X6X5/16	0.117
66	L6X6X5/16	0.119
67	L6X6X5/16	0.171
68	L6X6X5/16	0.405
69	L6X6X5/16	0.172
70	L6X6X5/16	0.486
71	L6X6X5/16	0.22
72	L6X6X5/16	0.592
73	L6X6X5/16	0.146
74	L6X6X5/16	0.48
75	L6X6X5/16	0.141
76	L6X6X5/16	0.293
77	L6X6X5/16	0.104
78	L6X6X5/16	0.121

79	L6X6X5/16	0.232
80	L6X6X5/16	0.267
81	W12X72	0.023
83	W8X31	0.029
84	W12X72	0.083
86	W12X72	0.054
87	L6X6X5/16	0.169
88	L6X6X5/16	0.536
89	L6X6X5/16	0.26
90	L6X6X5/16	0.691
91	L6X6X5/16	0.154
92	L6X6X5/16	0.479
94	W12X72	0.109
96	W12X72	0.098
98	W12X72	0.074
99	W8X31	0.101

AOF End - Beam 387

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story5	B66	387	173.8062	DStlS17	Special Concentrically Braced Frame	W12X50	Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
1292.6190	1	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.031	0.221	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
14.6	1.71	391	56.3	10.34	4.51

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
64.1	13.94	71.9	21.3	5.175	1.9637	1879.83

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	199.132	5.175	38.479	200	38.479	300
Minor (2-2)	1	398.2622	1.9637	202.811	200	202.811	300

Stress Check Message - kl/r > 200

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
173.8062	-22.408	6.8041	-0.1065	-0.028	0.007	-0.0126

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	0.154	1	1	1	1	1
Minor Bending	0.308	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
0.308	1	1.782

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r / P_c) + (8/9)(M_{r33} / M_{c33}) + (8/9)(M_{r22} / M_{c22})$
0.311 =	0.279 + 0.03 + 0.001

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
22.408	80.188	657

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	6.8041	201.9665	269.625	113.3293
Minor Bending	0.1065	79.875		

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	0.028	135.42	2.052E-04
Minor Shear	0.007	279.245	2.481E-05

End Reaction Major Shear Forces

Left End Reaction (kip)	Load Combo	Right End Reaction (kip)	Load Combo
0.992	DStlS33	1.275	DStlS33

AOF End - Beam 537

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story5	B728	537	348.7804	DStlS33	Special Concentrically Braced Frame	W12X45	Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
697.5343	1	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.198	0.275	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
13.1	1.26	348	50	9.26	4.05

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
57.52	12.42	64.2	19	5.1541	1.9537	1660.07

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	174.3902	5.1541	33.835	200	33.835	300
Minor (2-2)	1	174.3836	1.9537	89.26	200	89.26	300

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
348.7804	-129.435	-18.7699	0.0059	-10.194	0.001	0.0001

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K_1	K_2	B_1	B_2	C_m

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	0.25	1	1	1	1	1
Minor Bending	0.25	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
0.25	1	1.055

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.474 =	0.393 + 0.08 + 7.389E-05

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
129.435	329.22	589.5

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	18.7699	207.6111	240.75	196.8055
Minor Bending	0.0059	71.25		

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	10.194	121.605	0.084
Minor Shear	0.001	249.953	0

End Reaction Major Shear Forces

Left End Reaction (kip)	Load Combo	Right End Reaction (kip)	Load Combo
11.252	DStlS31	10.479	DStlS31

AOF Middle - Beam 49

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story1	B63	49	1616.558	DStlS42	Special Concentrically Braced Frame	W12X72	Seismic MD

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
1621.7580	1	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
-0.006	-0.02	1	0.8	0.8

Seismic Parameters

Ignore Seismic Code?	Ignore Special EQ Load?	Plug Welded?	SDC	I	Rho	S_{DS}	R	Ω_0	C_d
No	No	Yes	D	1.25	1	0.59	6	2	5

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
21.1	2.93	597	195	16.08	5.29

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
97.07	32.5	108	49.2	5.3192	3.04	6524.79

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	1611.358	5.3192	302.933	200	302.933	300
Minor (2-2)	1	405.44	3.04	133.368	200	133.368	300

Stress Check Message - Section is not seismically compact for highly ductile members (AISC 341-16 F2.5a, D1.1, Table D1.1)

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
1616.558	6.736	0	0	0.504	-0.005	0.0067

Axial Force & Biaxial Moment Design Factors (H1.2,H1-1b)

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	0.994	1	1	1	1	1
Minor Bending	0.25	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
0.25	1	1.469

Demand/Capacity (D/C) Ratio Eqn.(H1.2,H1-1b)

D/C Ratio =	$(P_r /2P_c) + (M_{r33} /M_{c33}) + (M_{r22} /M_{c22})$
0.004 =	0.004 + 0 + 0

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
6.736	51.943	949.5

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	0	404.7787	405	275.5437
Minor Bending	0	184.5		

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	0.504	158.67	0.003
Minor Shear	0.005	434.16	1.148E-05

End Reaction Major Shear Forces

Left End Reaction (kip)	Load Combo	Right End Reaction (kip)	Load Combo
1.579	DStlS22	0.944	DStlS22

AOF Middle - Beam 429

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story5	B187	429	1628.7518	DStlS42	Special Concentrically Braced Frame	W12X72	Seismic MD

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
1633.8002	1	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.005	0.003	1	0.8	0.8

Seismic Parameters

Ignore Seismic Code?	Ignore Special EQ Load?	Plug Welded?	SDC	I	Rho	S_{DS}	R	Ω_0	C_d
No	No	Yes	D	1.25	1	0.59	6	2	5

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
21.1	2.93	597	195	16.08	5.29

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
97.07	32.5	108	49.2	5.3192	3.04	6524.79

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	204.2253	5.3192	38.394	200	38.394	300
Minor (2-2)	1	163.38	3.04	53.743	200	53.743	300

Stress Check Message - Section is not seismically compact for highly ductile members (AISC 341-16 F2.5a, D1.1, Table D1.1)

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
1628.7518	-5.395	-8.1656	-0.0504	3.504	0.001	3.884E-05

Axial Force & Biaxial Moment Design Factors (H1.3a,H1-1b)

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	0.125	1	1	1	1	1
Minor Bending	0.1	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
0.1	1	1.032

Demand/Capacity (D/C) Ratio Eqn.(H1.3a,H1-1b)

D/C Ratio =	$(P_r /2P_c) + (M_{r33} /M_{c33}) + (M_{r22} /M_{c22})$
0.024 =	0.004 + 0.02 + 2.733E-04

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
5.395	768.737	949.5

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	8.1656	401.4149	405	388.8406
Minor Bending	0.0504	184.5		

Shear Design

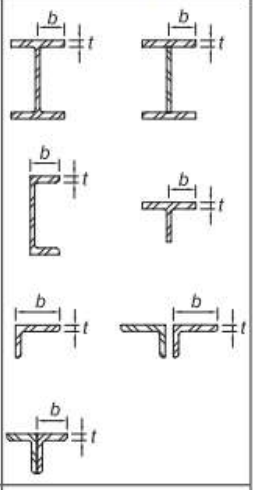
	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	3.504	158.67	0.022
Minor Shear	0.001	434.16	0

End Reaction Major Shear Forces

Left End Reaction (kip)	Load Combo	Right End Reaction (kip)	Load Combo
15.507	DStlS20	10.988	DStlS20

Highly Ductile Requirement and Unbraced Lengths from AISC 341 for SCBF Beams:

TABLE D1.1
Limiting Width-to-Thickness Ratios for Compression Elements for Moderately Ductile and Highly Ductile Members

	Description of Element	Width-to-Thickness Ratio	Limiting Width-to-Thickness Ratio: λ_{hd} Highly Ductile Members	Limiting Width-to-Thickness Ratio: λ_{md} Moderately Ductile Members	Example
Unstiffened Elements	Flanges of rolled or built-up I-shaped sections, channels and tees; legs of single angles or double-angle members with separators; outstanding legs of pairs of angles in continuous contact	b/t	$0.32\sqrt{\frac{E}{R_y F_y}}$	$0.40\sqrt{\frac{E}{R_y F_y}}$	

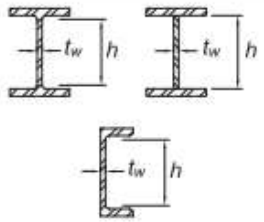
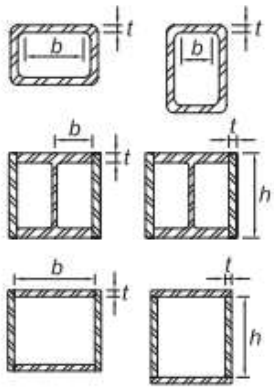
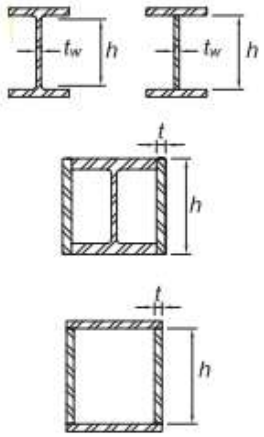
W8x40: b/t (=7.2) ≤ 0.32 $\sqrt{\frac{29000}{1.1\times50}}$ = 7.35

W12x45: b/t (=7) ≤ 0.32 $\sqrt{\frac{29000}{1.1\times50}}$ = 7.35

W16x31: b/t (=6.3) ≤ 0.32 $\sqrt{\frac{29000}{1.1\times50}}$ = 7.35

W14x132: b/t (=7.1) ≤ 0.32 $\sqrt{\frac{29000}{1.1\times50}}$ = 7.35

TABLE D1.1 (continued)
Limiting Width-to-Thickness Ratios for Compression Elements for Moderately Ductile and Highly Ductile Members

	Description of Element	Width-to-Thickness Ratio	Limiting Width-to-Thickness Ratio: λ_{hd} Highly Ductile Members	Limiting Width-to-Thickness Ratio: λ_{md} Moderately Ductile Members	Example
Stiffened Elements	Webs of rolled or built-up I shaped sections and channels used as diagonal braces	h/t_w	$1.57\sqrt{\frac{E}{R_yF_y}}$	$1.57\sqrt{\frac{E}{R_yF_y}}$	
	Where used in beams or columns as flanges in uniform compression due to axial, flexure, or combined axial and flexure: 1) Walls of rectangular HSS 2) Flanges and side plates of boxed I-shaped sections, webs and flanges of built-up box shapes	b/t h/t	$0.65\sqrt{\frac{E}{R_yF_y}}$	$1.18\sqrt{\frac{E}{R_yF_y}}$	
	Where used in beams, columns, or links, as webs in flexure, or combined axial and flexure: 1) Webs of rolled or built-up I-shaped sections or channels [b] 2) Side plates of boxed I-shaped sections 3) Webs of built-up box sections	h/t_w h/t h/t	For $C_a \le 0.114$: $2.57\sqrt{\frac{E}{R_yF_y}}(1-1.04C_a)$ For $C_a > 0.114$: $0.88\sqrt{\frac{E}{R_yF_y}}(2.68-C_a) \ge 1.57\sqrt{\frac{E}{R_yF_y}}$ where $C_a = \frac{P_u}{\phi_c P_y}$ (LRFD), $C_a = \frac{\Omega_c P_a}{P_y}$ (ASD), $P_y = R_yF_yA_g$	For $C_a \le 0.114$: $3.96\sqrt{\frac{E}{R_yF_y}}(1-3.04C_a)$ For $C_a > 0.114$: $1.29\sqrt{\frac{E}{R_yF_y}}(2.12-C_a) \ge 1.57\sqrt{\frac{E}{R_yF_y}}$ where $C_a = \frac{P_u}{\phi_c P_y}$ (LRFD), $C_a = \frac{\Omega_c P_a}{P_y}$ (ASD), $P_y = R_yF_yA_g$	

W8x40: $C_a = \frac{40}{0.9\times1.1\times50\times11.7} = 0.07 \le 0.114$

h/t_w (=23) $\le 2.57\sqrt{\frac{29000}{1.1\times50}}(1\text{-}1.04\times0.07) = 55$

W12x45: $C_a = \frac{40}{0.9\times1.1\times50\times13.1} = 0.06 \le 0.114$

h/t_w (=36) $\le 2.57\sqrt{\frac{29000}{1.1\times50}}(1\text{-}1.04\times0.06) = 55$

W16x31: $C_a = \frac{40}{0.9\times1.1\times50\times9.13} = 0.088 \le 0.114$

h/t_w (=23) $\le 2.57\sqrt{\frac{29000}{1.1\times50}}(1\text{-}1.04\times0.088) = 54$

W14x132: $C_a = \frac{40}{0.9\times1.1\times50\times38.8} = 0.02 \le 0.114$

h/t_w (=57) $\le 2.57\sqrt{\frac{29000}{1.1\times50}}(1\text{-}1.04\times0.02) = 58$

Highly Ductile Members

In addition to the requirements of Sections D1.2a.1(a) and (b), and D1.2a.2(a) and (b), the bracing of highly ductile beam members shall have a maximum spacing of $L_b = 0.095 r_y E/(R_y F_y)$. For concrete-encased composite beams, the material properties of the steel section shall be used and the calculation for r_y in the plane of buckling shall be based on the elastic transformed section.

W8x40: $L_b = 0.095 \times 2.04 \times \frac{29000}{1.1 \times 50} = 8.5'$

W12x45: $L_b = 0.095 \times 1.95 \times \frac{29000}{1.1 \times 50} = 8.1'$

W16x31: $L_b = 0.095 \times 1.17 \times \frac{29000}{1.1 \times 50} = 4.9'$

W14x132: $L_b = 0.095 \times 3.76 \times \frac{29000}{1.1 \times 50} = 15.7'$

AOF End

SCBF Beam Section	Frame	Label	Actual Length (ft)	Calculated L_b Length (ft)	Bracing Required (brace size /spacing of brace)	P_{br} (kips)	$\phi_c P_n$ (kips)	β_{br} (K/in)	K_{brace} (K/in)
W14x132	A.1	459	15.3	15.7	-	-	-	-	-
W14x132	A.1	457	15.3	15.7	-	-	-	-	-
W12x45	A.1	31	15.3	8.1	W8x31 / 7.65’	6.5	283	45	1838
W12x45	A.1	360	15.3	8.1	W8x31 / 7.65’	6.5	283	45	1838
W8x40	A.1	458	7.7	8.5	-	-	-	-	-
W8x40	A.1	456	7.7	8.5	-	-	-	-	-
W12x45	A.1	30	7.7	8.1	-	-	-	-	-
W12x45	A.1	575	7.7	8.1	-	-	-	-	-
W16x31	A.1	395	12.75	4.9	-	-	-	-	-
W8x40	A.1	585	12.75	8.5	L4x4x1/4 / 6.4	6	38	50	777
W14x132	A.9	556	15.3	15.7	-	-	-	-	-
W14x132	A.9	554	15.3	15.7	-	-	-	-	-
W12x45	A.9	29	15.3	8.1	W8x31 / 7.65’	6.5	283	45	1838
W12x45	A.9	361	15.3	8.1	W8x31 / 7.65’	6.5	283	45	1838
W8x40	A.9	555	7.7	8.5	-	-	-	-	-
W8x40	A.9	553	7.7	8.5	-	-	-	-	-
W12x45	A.9	28	7.7	8.1	-	-	-	-	-
W12x45	A.9	577	7.7	8.1	-	-	-	-	-
W14x132	F.1	590	15.3	15.7	-	-	-	-	-
W14x132	F.1	592	15.3	15.7	-	-	-	-	-
W12x45	F.1	24	15.3	8.1	W8x31 / 7.65’	6.5	283	45	1838
W12x45	F.1	358	15.3	8.1	W8x31 / 7.65’	6.5	283	45	1838
W8x40	F.1	589	7.7	8.5	-	-	-	-	-
W8x40	F.1	591	7.7	8.5	-	-	-	-	-
W12x45	F.1	23	7.7	8.1	-	-	-	-	-

W12x45	F.1	579	7.7	8.1	-	-	-	-	-
W14x132	F.9	605	15.3	15.7	-	-	-	-	-
W14x132	F.9	603	15.3	15.7	-	-	-	-	-
W12x45	F.9	22	15.3	8.1	W8x31 / 7.65’	6.5	283	45	1838
W12x45	F.9	359	15.3	8.1	W8x31 / 7.65’	6.5	283	45	1838
W8x40	F.9	604	7.7	8.5	-	-	-	-	-
W8x40	F.9	602	7.7	8.5	-	-	-	-	-
W12x45	F.9	21	7.7	8.1	-	-	-	-	-
W12x45	F.9	581	7.7	8.1	-	-	-	-	-
W8x40	E	365	25.4	8.5	L4x4x1/4 / 8.4’	6	32.8	38	717
W8x40	E	587	25.4	8.5	L4x4x1/4 / 8.4’	6	12.9	38	388
W8x40	1.5	35	18.5	8.5	L4x4x1/4 / 6.2’	6	18.6	51	466
W8x40	1.5	36	18.5	8.5	L4x4x1/4 / 6.2’	6	18.6	51	466
W8x40	1.5	292	18.5	8.5	L4x4x1/4 / 6.2’	6	27.7	51	583
W8x40	1.5	293	18.5	8.5	L4x4x1/4 / 6.2’	6	27.7	51	583
W8x40	3.1	376	18.5	8.5	L2x2x1/4 / 6.2’	6	13.6	51	570
W8x40	3.1	377	18.5	8.5	L2x2x1/4 / 6.2’	6	13.6	51	570
W8x40	3.1	298	18.5	8.5	L4x4x1/4 / 6.2’	6	32.8	51	666
W8x40	3.1	299	18.5	8.5	L4x4x1/4 / 6.2’	6	32.8	51	666
W16x31	3.1	344	18.5	4.9	Brace to the CMU wall	-	-	-	-
W16x31	3.1	351	18.5	4.9	Brace to the CMU wall	-	-	-	-
W8x40	3.6	370	18.5	8.5	L2x2x1/4 / 6.2’	6	13.6	51	570
W8x40	3.6	368	18.5	8.5	L2x2x1/4 / 6.2’	6	13.6	51	570
W16x31	3.6	628	18.5	4.9	Brace to the CMU wall	-	-	-	-

W16x31	3.6	634	18.5	4.9	Brace to the CMU wall	-	-	-	-

AOF Middle

SCBF Beam Section	Frame	Label	Actual Length (ft)	Calculated L_b Length (ft)	Bracing Required (brace size/spacing of brace)	P_{br} (kips)	$\phi_c P_n$ (kips)	β_{br} (K/in)	K_{brace} (K/in)
W8x40	A.1	40	23.8	8.5	L8x8x1/2 / 7.9’	6	46	27	728
W12x45	A.1	391	24	8.1	W8x31 / 6’	6.5	283	57	1838
W8x40	A.9	42	23.8	8.5	L8x8x1/2 / 7.9’	6	46	27	728
W12x45	A.9	395	24	8.1	W8x31 / 6’	6.5	283	57	1838
W8x40	F.1	230	23.8	8.5	L8x8x1/2 / 7.9’	6	46	27	728
W12x45	F.1	411	24	8.1	W8x31 / 6’	6.5	283	57	1838
W8x40	F.9	32	23.8	8.5	L8x8x1/2 / 7.9’	6	46	27	728
W12x45	F.9	415	24	8.1	W8x31 / 6’	6.5	283	57	1838
W8x40	3.9	22	18.5	8.5	L4x4x1/4 / 6.2’	6	12.9	51	388
W8x40	3.9	23	18.5	8.5	L4x4x1/4 / 6.2’	6	12.9	51	388
W8x40	3.9	28	18.5	8.5	L4x4x1/4 / 6.2’	6	32.8	51	666
W8x40	3.9	29	18.5	8.5	L4x4x1/4 / 6.2’	6	32.8	51	666
W8x40	5.9	37	18.5	8.5	L8x8x1/2 / 6.2’	6	46	51	728
W8x40	5.9	36	18.5	8.5	L8x8x1/2 / 6.2’	6	46	51	728
W8x40	5.9	219	18.5	8.5	L4x4x1/4 / 6.2’	6	32.8	51	666
W8x40	5.9	220	18.5	8.5	L4x4x1/4 / 6.2’	6	32.8	51	666
W8x40	5.9	39	11.6	8.5	L8x8x1/2 / 5.8’	6	46	55	728
W8x40	5.9	217	11.6	8.5	L4x4x1/4 / 5.8’	6	32.8	51	666
W8x40	5.9	33	11.6	8.5	L8x8x1/2 / 5.8’	6	46	55	728
W8x40	5.9	222	11.6	8.5	L4x4x1/4 / 5.8’	6	32.8	51	666

Project item BCB Shear Conn

Design

Name	BCB Shear Conn
Description	
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC 360-22 (LRFD) / ACI 318-19

Members

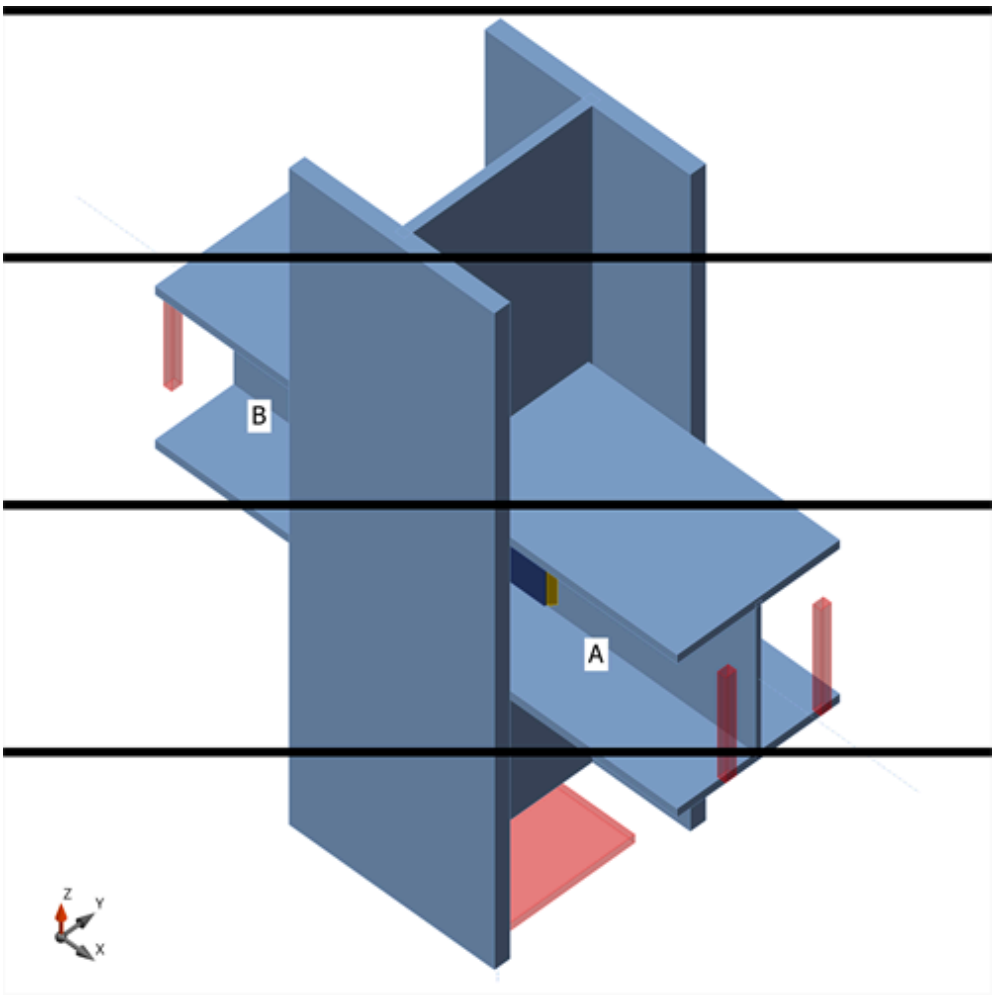
Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
C	3 - W10X68	0.0	90.0	90.0	0"	0"	0"
B	1 - W8X31	180.0	0.0	0.0	0"	0"	0"
A	1 - W8X31	0.0	0.0	0.0	0"	0"	0"

Supports and forces

Name	Support	Forces in	X [in]
C / begin	N-Vy-Vz-Mx-My-Mz	Node	0"
C / end		Node	0"
B / end	Vy-Mx-Mz	Bolts	0"
A / end	Vy-Mx-Mz	Bolts	0"

Project:
Project no:
Author:

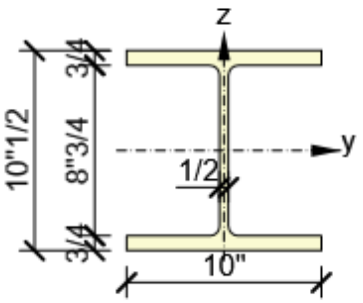
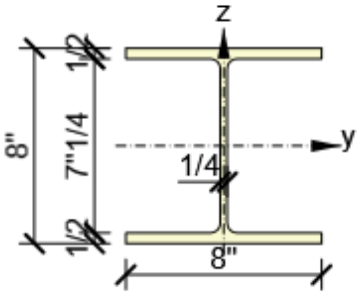


Cross-sections

Name	Material
3 - W10X68	A992
1 - W8X31	A992

Project:
Project no:
Author:

Cross-sections

Name	Material	Drawing
3 - W10X68	A992	
1 - W8X31	A992	

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
LE1	C / End	0.0	0.0	0.0	0.0	0.0	0.0
	A / End	36.4	0.0	-9.0	0.0	0.0	0.0
	B / End	36.4	0.0	-9.0	0.0	0.0	0.0
	C / Begin	0.0	0.0	0.0	0.0	0.0	0.0
LE2	C / End	0.0	0.0	0.0	0.0	0.0	0.0
	A / End	-61.7	0.0	-9.0	0.0	0.0	0.0
	B / End	-61.7	0.0	-9.0	0.0	0.0	0.0
	C / Begin	0.0	0.0	0.0	0.0	0.0	0.0

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
LE1	0.0	0.0	-18.0	0.0	0.0	0.0
LE2	0.0	0.0	-18.0	0.0	0.0	0.0

Project:
Project no:
Author:

Michael Baker INTERNATIONAL

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.3 < 5.0%	OK
Welds	92.3 < 100%	OK
Buckling	20.38	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
C-bfl 1	A992	3/4	LE1	1.0	0.0	0.0	OK
C-tfl 1	A992	3/4	LE2	1.2	0.0	0.0	OK
C-w 1	A992	1/2	LE1	5.2	0.0	0.0	OK
B-bfl 1	A992	1/2	LE1	23.1	0.0	0.0	OK
B-tfl 1	A992	1/2	LE2	34.0	0.0	0.0	OK
B-w 1	A992	1/4	LE2	45.1	0.2	0.0	OK
A-bfl 1	A992	1/2	LE1	23.1	0.0	0.0	OK
A-tfl 1	A992	1/2	LE2	34.0	0.0	0.0	OK
A-w 1	A992	1/4	LE2	45.1	0.2	0.0	OK
SHP1	A572 Gr.50	1/4	LE2	45.1	0.3	0.0	OK
SHP2	A572 Gr.50	1/2	LE2	45.1	0.3	0.0	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for C-bfl 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y =$ 50.0 ksi – characteristic yield strength

$\phi =$ 0.90 – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for C-tfl 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y =$ 50.0 ksi – characteristic yield strength

$\phi =$ 0.90 – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for C-w 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y =$ 50.0 ksi – characteristic yield strength

$\phi =$ 0.90 – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for B-bfl 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y =$ 50.0 ksi – characteristic yield strength

$\phi =$ 0.90 – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for B-tfl 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y =$ 50.0 ksi – characteristic yield strength

$\phi =$ 0.90 – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for B-w 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y =$ 50.0 ksi – characteristic yield strength

$\phi =$ 0.90 – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for A-bfl 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y =$ 50.0 ksi – characteristic yield strength

$\phi =$ 0.90 – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for A-tfl 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y =$ 50.0 ksi – characteristic yield strength

$\phi =$ 0.90 – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for A-w 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y =$ 50.0 ksi – characteristic yield strength

$\phi =$ 0.90 – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for SHP1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y =$ 50.0 ksi – characteristic yield strength

$\phi =$ 0.90 – resistance factor for steel material AISC 360-22 – B3.1

Detailed result for SHP2

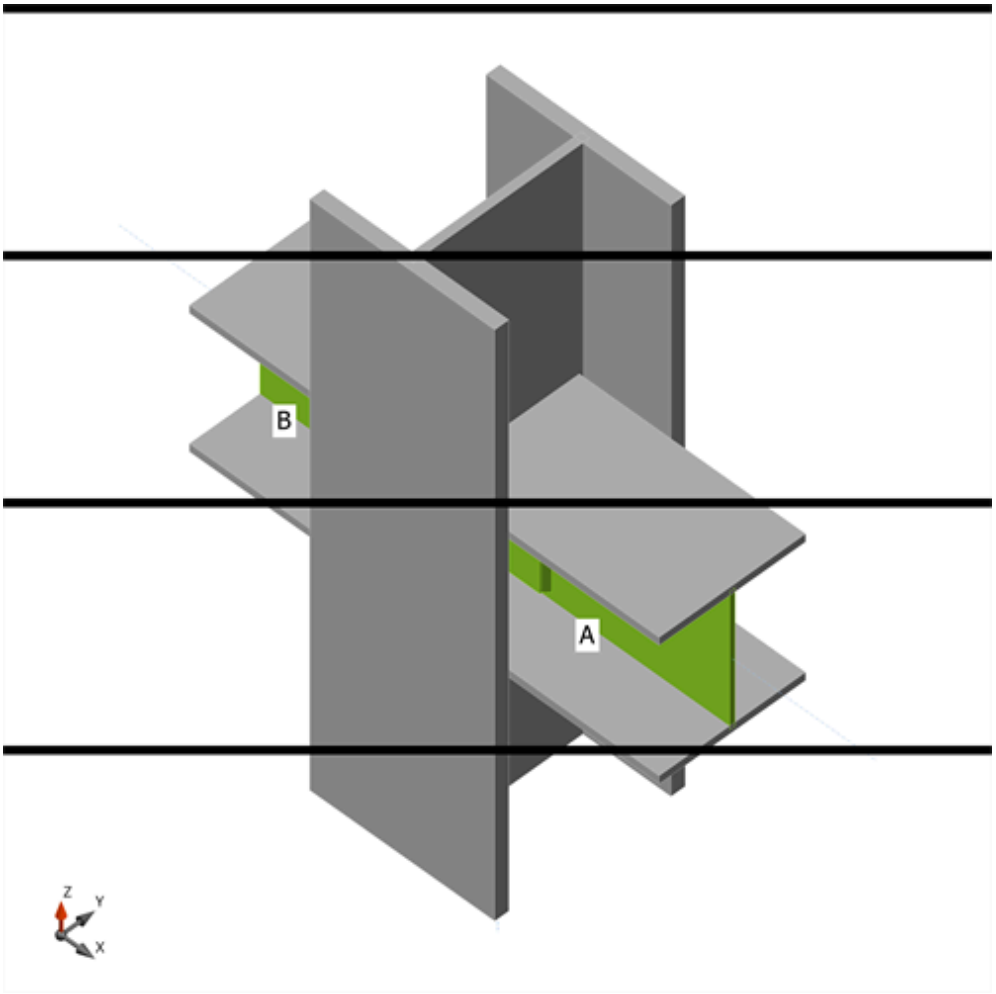
Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

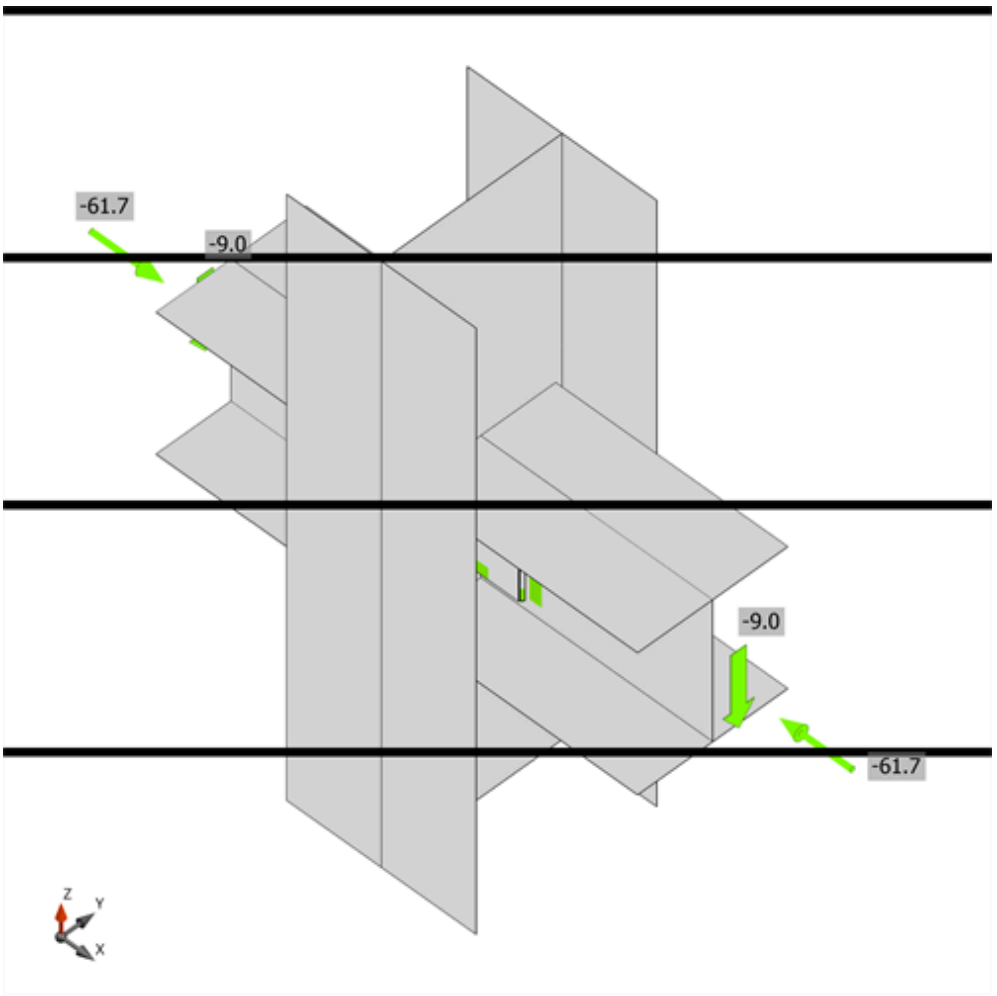
$F_y =$ 50.0 ksi – characteristic yield strength

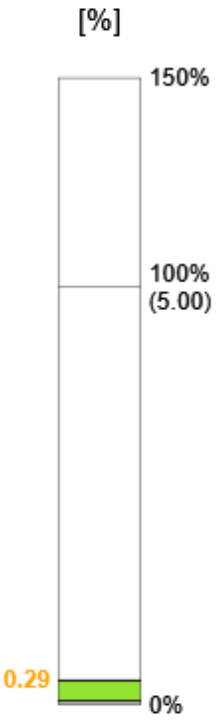
$\phi =$ 0.90 – resistance factor for steel material AISC 360-22 – B3.1



Overall check, LE2

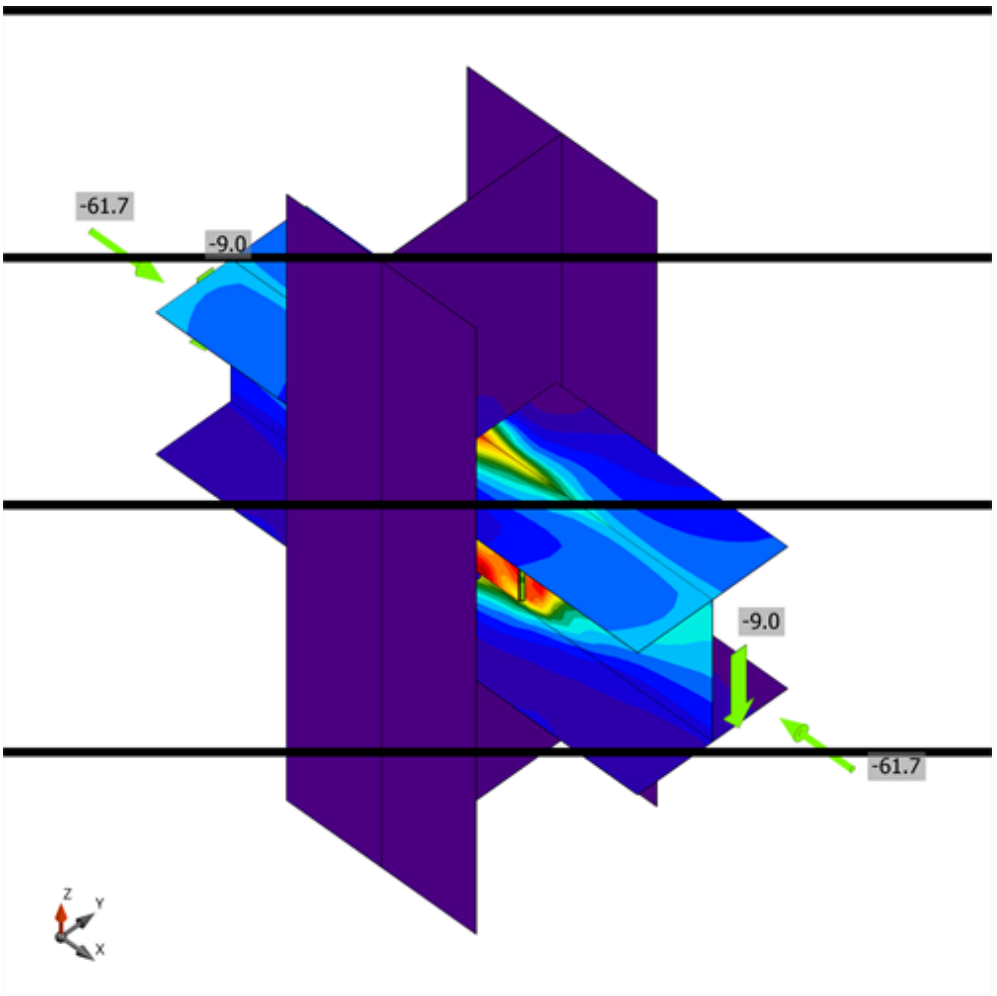
Project:
Project no:
Author:

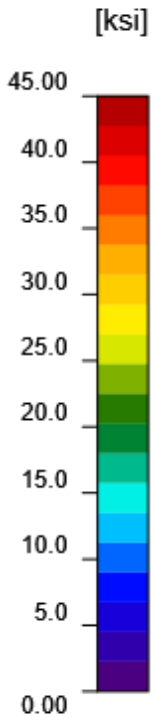




Strain check, LE2

Project:
Project no:
Author:





Equivalent stress, LE2

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
C-w 1	SHP1	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	6"1/4	1/4	LE2	2.1	2.8	75.6	58.1	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	6"1/4	1/4	LE2	2.1	2.7	77.6	64.2	OK	OK
A-w 1	SHP1	E70xx	◢ 1/4	◢ 1/4	2"1/4	1/4	LE2	1.7	2.1	79.1	68.9	OK	OK
A-w 1	SHP1	E70xx	◢ 1/4	◢ 1/4	2"1/4	1/4	LE2	1.7	1.9	92.3	92.3	OK	OK
A-w 1	SHP1	E70xx	◢ 1/4	◢ 1/4	6"1/4	1/4	LE2	2.3	2.7	83.5	80.0	OK	OK
B-w 1	SHP2	E70xx	◢ 1/4	◢ 1/4	2"1/4	1/4	LE2	1.7	2.1	79.2	68.9	OK	OK
C-w 1	SHP2	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	6"1/4	1/4	LE2	2.1	2.7	77.6	64.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	6"1/4	1/4	LE2	2.1	2.8	75.6	58.1	OK	OK
B-w 1	SHP2	E70xx	◢ 1/4	◢ 1/4	2"1/4	1/4	LE2	1.7	1.9	92.2	92.2	OK	OK
B-w 1	SHP2	E70xx	◢ 1/4	◢ 1/4	6"1/4	1/4	LE2	2.3	2.7	83.5	80.0	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Project:
Project no:
Author:

Michael Baker INTERNATIONAL

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-22 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Detailed result for C-w 1 / SHP1 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 2.8 kip ≥ $F_n =$ 2.1 kip

Where:

$F_{nw} =$ 63.0 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 89.0° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.06 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for C-w 1 / SHP1 - 2

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 2.7 kip ≥ $F_n =$ 2.1 kip

Where:

$F_{nw} =$ 62.7 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 81.7° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.06 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for A-w 1 / SHP1 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 2.1 kip ≥ $F_n =$ 1.7 kip

Where:

$F_{nw} =$ 51.9 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 37.3° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.05 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for A-w 1 / SHP1 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 1.9 kip ≥ $F_n =$ 1.7 kip

Where:

$F_{nw} =$ 45.3 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 17.0° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.05 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for A-w 1 / SHP1 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 2.7 kip ≥ $F_n =$ 2.3 kip

Where:

$F_{nw} =$ 61.2 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 70.6° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.06 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for B-w 1 / SHP2 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 2.1 kip ≥ $F_n =$ 1.7 kip

Where:

$F_{nw} =$ 51.9 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 37.3° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.05 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for C-w 1 / SHP2 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 2.7 kip ≥ $F_n =$ 2.1 kip

Where:

$F_{nw} =$ 62.7 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 81.6° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.06 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for C-w 1 / SHP2 - 2

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 2.8 kip ≥ $F_n =$ 2.1 kip

Where:

$F_{nw} =$ 63.0 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 89.0° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.06 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for B-w 1 / SHP2 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 1.9 kip ≥ $F_n =$ 1.7 kip

Where:

$F_{nw} =$ 45.4 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 17.1° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.05 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Detailed result for B-w 1 / SHP2 - 1

Weld resistance check (AISC 360-22 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 2.7 kip ≥ $F_n =$ 2.3 kip

Where:

$F_{nw} =$ 61.2 ksi – nominal stress of weld material:

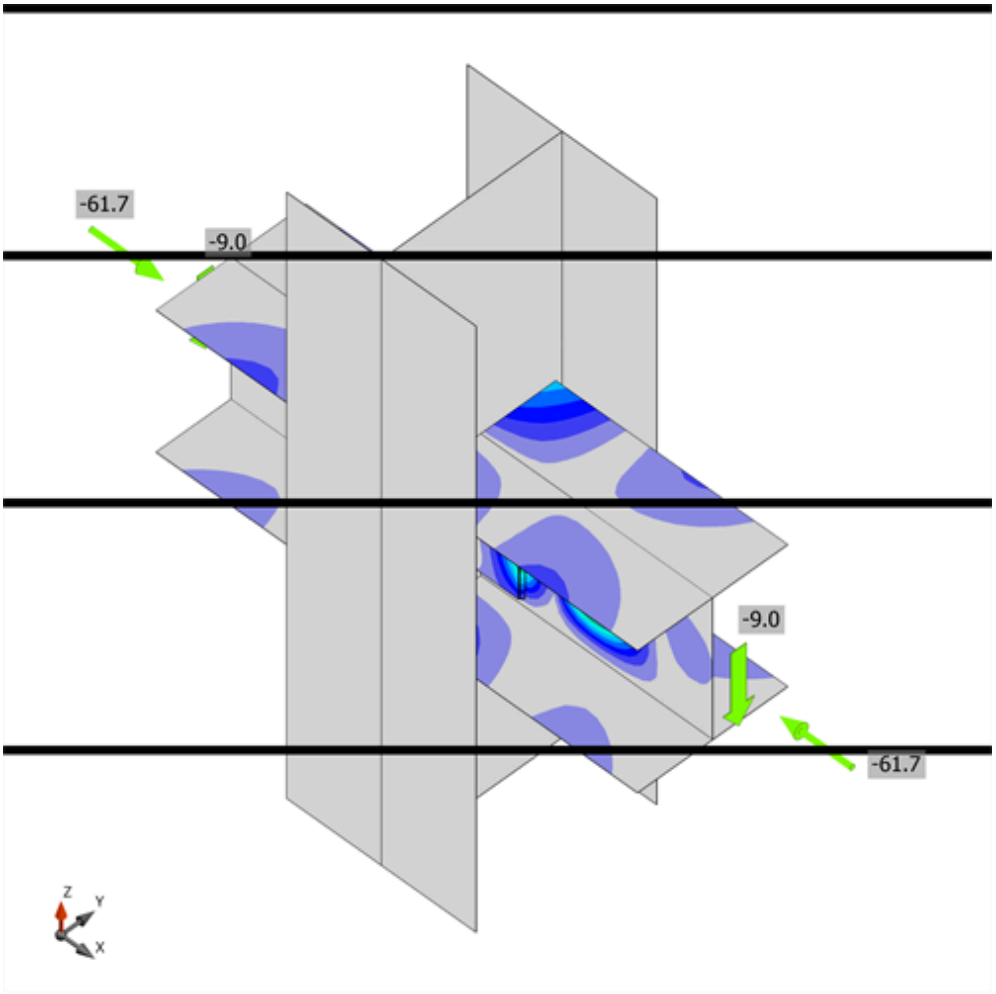
- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 70.6° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.06 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Buckling

Loads	Shape	Factor [-]
LE1	1	131.66
	2	131.86
	3	164.28
	4	164.55
	5	252.25
	6	299.55
LE2	1	20.38
	2	21.24
	3	25.14
	4	25.98
	5	27.50
	6	28.64



First buckling mode shape, LE2

Code settings

Item	Value	Unit	Reference
Friction coefficient - concrete	0.40	-	ACI 349-01 – B.6.1.4
Friction coefficient in slip-resistance	0.30	-	AISC 360-22 – J3.9
Limit plastic strain	0.05	-	
Detailing	Yes		
Distance between bolts [d]	2.66	-	AISC 360-22 – J3.4
Concrete breakout resistance check	Both		
Base metal capacity check at weld fusion face	No		AISC 360-22 – J2-2
Deformation at bolt hole at service load is design consideration	Yes		AISC 360-22 – J3.11
Cracked concrete	Yes		ACI 318-19 – 17
Local deformation check	Yes		
Local deformation limit	0.03	-	CIDECT DG 1, 3 – 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints

AOF End – All brace sections with DC ratios (Lateral Design)

Label	Section	D/C Ratio
10	HSS5X5X1/2	0.075
100	HSS5X5X1/2	0.061
107	HSS5X5X1/2	0.06
108	HSS5X5X1/2	0.35
109	HSS5X5X1/2	0.343
147	HSS5X5X1/2	0.06
15	HSS3X3X3/8	0.038
150	HSS5X5X1/2	0.059
151	HSS5X5X1/2	0.358
152	HSS5X5X1/2	0.351
153	HSS3X3X3/8	0.575
154	HSS3X3X3/8	0.122
155	HSS5X5X1/2	0.024
156	HSS5X5X1/2	0.026
157	HSS5X5X1/2	0.266
158	HSS5X5X1/2	0.257
169	HSS3X3X3/8	0.049
174	HSS3X3X3/8	0.061
177	HSS3X3X3/8	0.956
178	HSS3X3X3/8	0.129
179	W8X31	0.405
18	HSS5X5X1/2	0.614
180	W8X31	0.084
186	W8X31	0.084
187	W8X31	0.045
188	W8X31	0.013
189	W8X31	0.056
19	HSS5X5X1/2	0.603
190	W8X31	0.228
191	W8X31	0.264
192	W8X31	0.084
193	W8X31	0.058
198	W8X31	0.068
199	W8X31	0.04
201	HSS3X3X3/8	0.924
202	HSS3X3X3/8	0.123
203	W8X31	0.394
204	W8X31	0.08
210	W8X31	0.076
211	W8X31	0.036

212	W8X31	0.018
213	W8X31	0.055
214	W8X31	0.08
215	W8X31	0.26
216	W8X31	0.364
217	W8X31	0.055
219	W8X31	0.049
222	W8X31	0.029
223	W8X31	0.008
224	W8X31	0.017
225	HSS3X3X3/8	0.536
226	HSS3X3X3/8	0.112
227	W8X31	0.028
228	W8X31	0.063
229	W8X31	0.061
230	W8X31	0.028
235	W8X31	0.055
239	W8X31	0.042
250	W8X31	0.214
251	W8X31	0.039
252	W8X31	0.058
253	W8X31	0.013
254	W8X31	0.283
255	W8X31	0.02
256	W8X31	0.076
266	W8X31	0.408
267	W8X31	0.104
268	W8X31	0.034
269	W8X31	0.07
270	W8X31	0.106
271	W8X31	0.042
272	W8X31	0.262
282	W8X31	0.209
283	W8X31	0.037
284	W8X31	0.056
285	W8X31	0.015
286	W8X31	0.269
287	W8X31	0.018
288	W8X31	0.09
331	W8X31	0.221
397	HSS5X5X1/2	0.072
398	HSS5X5X1/2	0.223
399	HSS5X5X1/2	0.075

400	HSS5X5X1/2	0.233
402	HSS6X6X1/2	0.097
403	HSS6X6X1/2	0.096
404	HSS6X6X1/2	0.051
405	HSS6X6X1/2	0.05
406	HSS6X6X1/2	0.055
407	HSS6X6X1/2	0.057
408	HSS6X6X1/2	0.05
409	HSS6X6X1/2	0.056
410	HSS8X8X1/2	0.39
411	HSS8X8X1/2	0.255
412	HSS8X8X1/2	0.102
413	HSS8X8X1/2	0.067
42	HSS3X3X3/8	0.043
422	HSS6X6X1/2	0.442
423	HSS6X6X1/2	0.436
424	HSS6X6X1/2	0.513
425	HSS6X6X1/2	0.508
426	HSS6X6X1/2	0.629
427	HSS6X6X1/2	0.625
428	HSS6X6X1/2	0.763
429	HSS6X6X1/2	0.762
43	HSS3X3X3/8	0.535
434	HSS3X3X3/8	0.046
435	HSS5X5X1/2	0.023
436	HSS3X3X3/8	0.055
438	HSS4X4X3/8	0.047
439	HSS4X4X3/8	0.09
44	HSS3X3X3/8	0.536
440	HSS4X4X3/8	0.083
441	HSS4X4X3/8	0.049
442	HSS4X4X3/8	0.048
443	HSS3X3X3/8	0.028
444	HSS3X3X3/8	0.037
445	HSS3X3X3/8	0.457
446	HSS3X3X3/8	0.453
45	HSS4X4X3/8	0.099
46	HSS4X4X3/8	0.097
460	HSS5X5X1/2	0.041
461	HSS5X5X1/2	0.041
462	HSS5X5X1/2	0.053
463	HSS5X5X1/2	0.275
47	HSS4X4X3/8	0.051

470	HSS6X6X1/2	0.369
471	HSS6X6X1/2	0.365
472	HSS6X6X1/2	0.513
473	HSS6X6X1/2	0.511
474	HSS6X6X1/2	0.401
475	HSS6X6X1/2	0.399
476	HSS6X6X1/2	0.307
477	HSS6X6X1/2	0.3
478	HSS6X6X1/2	0.083
479	HSS6X6X1/2	0.081
480	HSS6X6X1/2	0.209
481	HSS6X6X1/2	0.119
482	HSS6X6X1/2	0.106
483	HSS6X6X1/2	0.104
484	HSS6X6X1/2	0.097
485	HSS6X6X1/2	0.096
500	HSS5X5X1/2	0.079
501	HSS5X5X1/2	0.064
557	HSS5X5X1/2	0.056
558	HSS5X5X1/2	0.072
559	HSS5X5X1/2	0.065
560	HSS5X5X1/2	0.061
561	HSS5X5X1/2	0.403
566	HSS5X5X1/2	0.059
572	HSS5X5X1/2	0.059
573	HSS5X5X1/2	0.069
58	HSS3X3X3/8	0.278
586	HSS5X5X1/2	0.064
588	HSS5X5X1/2	0.421
607	HSS5X5X1/2	0.302
608	HSS5X5X1/2	0.058
609	HSS5X5X1/2	0.046
610	HSS5X5X1/2	0.044
613	W8X31	0.222
617	HSS5X5X1/2	0.026
618	HSS5X5X1/2	0.106
619	HSS5X5X1/2	0.102
621	HSS3X3X3/8	0.268
622	HSS3X3X3/8	0.257
678	W8X31	0.23
686	W8X31	0.065
688	W8X31	0.068
689	W8X31	0.061

69	HSS3X3X3/8	0.269
693	W8X31	0.049
694	W8X31	0.029
695	W8X31	0.008
696	W8X31	0.018
697	W8X31	0.042
698	W8X31	0.061
699	W8X31	0.061
700	W8X31	0.029
705	W8X31	0.056
709	W8X31	0.029
89	HSS5X5X1/2	0.603
9	HSS5X5X1/2	0.073
96	HSS5X5X1/2	0.592
97	HSS5X5X1/2	0.069
98	HSS5X5X1/2	0.073

AOF Middle – All brace sections with DC ratios (Lateral Design)

Label	Section	D/C Ratio
120	HSS3X3X3/8	0.071
121	HSS3X3X3/8	0.217
122	HSS3X3X3/8	0.211
123	HSS6X6X1/2	0.03
124	HSS6X6X1/2	0.03
125	HSS8X8X1/2	0.08
126	HSS8X8X1/2	0.079
127	HSS8X8X1/2	0.06
128	HSS8X8X1/2	0.06
129	HSS6X6X1/2	0.031
130	HSS6X6X1/2	0.031
142	W8X31	0.337
143	W8X31	0.075
144	W8X31	0.09
145	W8X31	0.405
146	W8X35	0.744
147	W8X48	0.682
148	W8X58	0.639
152	HSS3X3X3/8	0.073
153	HSS3X3X3/8	0.213
154	HSS3X3X3/8	0.108
155	HSS6X6X1/2	0.028
156	HSS6X6X1/2	0.029
157	HSS6X6X1/2	0.029
158	HSS6X6X1/2	0.03
159	HSS8X8X1/2	0.075
160	HSS8X8X1/2	0.075
161	HSS8X8X1/2	0.05
162	HSS8X8X1/2	0.05
174	W8X31	0.067
175	W8X31	0.03
176	W8X31	0.322
177	W8X31	0.448
178	W8X31	0.713
179	W8X31	0.286
180	W8X31	0.643
192	W8X31	0.086
193	W8X31	0.053
194	W8X31	0.363
195	W8X31	0.606

196	W8X35	0.782
197	W8X48	0.725
198	W8X58	0.776
210	W8X31	0.068
211	W8X31	0.031
212	W8X31	0.321
213	W8X31	0.434
214	W8X31	0.7
215	W8X31	0.267
216	W8X31	0.623
223	HSS8X8X1/2	0.071
224	HSS8X8X1/2	0.367
225	HSS8X8X1/2	0.072
226	HSS8X8X1/2	0.417
238	HSS8X8X5/8	0.042
239	HSS8X8X5/8	0.041
240	HSS8X8X5/8	0.404
241	W8X31	0.343
242	W8X31	0.077
243	W8X31	0.089
244	W8X31	0.402
245	W8X35	0.748
246	W8X48	0.685
247	W8X58	0.64
271	HSS8X8X5/8	0.399
273	HSS8X8X5/8	0.046
282	HSS8X8X5/8	0.047
308	HSS8X8X5/8	0.349
310	HSS8X8X5/8	0.14
314	HSS8X8X5/8	0.338
317	W8X31	0.09
319	W8X31	0.042
320	HSS8X8X5/8	0.11
324	W8X31	0.031
325	W8X31	0.09
326	W8X31	0.297
327	W8X31	0.433
328	HSS8X8X5/8	0.139
329	W8X31	0.316
333	HSS8X8X5/8	0.109
343	HSS6X6X1/2	0.753
344	HSS6X6X1/2	0.752
345	HSS6X6X1/2	0.552

346	HSS6X6X1/2	0.547
351	HSS6X6X1/2	0.614
352	HSS6X6X1/2	0.609
353	HSS6X6X1/2	0.668
354	HSS6X6X1/2	0.664
364	HSS5X5X1/2	0.026
365	HSS5X5X1/2	0.028
366	HSS5X5X1/2	0.235
367	HSS5X5X1/2	0.228
368	HSS5X5X1/2	0.042
377	HSS5X5X1/2	0.041
382	HSS5X5X1/2	0.091
383	HSS5X5X1/2	0.082
384	HSS5X5X1/2	0.233
385	HSS5X5X1/2	0.226
386	HSS5X5X1/2	0.026
387	HSS5X5X1/2	0.029
389	HSS5X5X1/2	0.087
393	HSS5X5X1/2	0.078
397	HSS5X5X1/2	0.043
406	HSS5X5X1/2	0.042
409	HSS5X5X1/2	0.101
426	HSS5X5X1/2	0.103
427	HSS5X5X1/2	0.485
430	HSS5X5X1/2	0.469
431	HSS5X5X1/2	0.48
434	HSS5X5X1/2	0.463
448	HSS5X5X1/2	0.103
449	HSS5X5X1/2	0.106
457	HSS8X8X5/8	0.042
458	HSS8X8X5/8	0.041
459	HSS8X8X5/8	0.4
46	HSS3X3X3/8	0.071
460	HSS8X8X5/8	0.394
461	HSS8X8X5/8	0.05
462	HSS8X8X5/8	0.047
463	HSS8X8X5/8	0.344
464	HSS8X8X5/8	0.34
465	W8X31	0.091
466	W8X31	0.042
467	W8X31	0.029
468	W8X31	0.089
469	W8X31	0.293

470	W8X31	0.428
471	W8X31	0.313
50	HSS3X3X3/8	0.07

AOF End - Brace 153

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story5	D44	153	60.8786	DStlS33	Special Concentrically Braced Frame	HSS3X3X3/8	Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
121.7573	1	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.192	0.446	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
3.39	6.64	3.78	3.78	1.36	1.36

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
2.52	2.52	3.25	3.25	1.056	1.056	Not required

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	121.7573	1.056	115.305	200	115.305	300
Minor (2-2)	1	121.7573	1.056	115.305	200	115.305	300

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
60.8786	-32.553	0.1342	0	-0.01	-0.004	0.021

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K_1	K_2	B_1	B_2	C_m

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	1	1	1	1	1	1
Minor Bending	1	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
1	1	1.316

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r / P_c) + (8/9)(M_{r33} / M_{c33}) + (8/9)(M_{r22} / M_{c22})$
0.575 =	0.565 + 0.01 + 0

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
32.553	57.603	152.55

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	0.1342	12.1875	12.1875	12.1875
Minor Bending	0	12.1875		

Torsion Moment and Capacities

T_u Moment (kip-ft)	T_n Capacity (kip-ft)	ϕT_n Capacity (kip-ft)
0.021	11.853	10.6677

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	0.01	36.806	2.807E-04
Minor Shear	0.004	36.806	1.077E-04

End Reaction Axial Forces

Left End Reaction (kip)	Load Combo	Right End Reaction (kip)	Load Combo
-32.599	DStlS33	-32.599	DStlS33

AOF End - Brace 177

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story5	D83	177	60.8786	DStlS31	Special Concentrically Braced Frame	HSS3X3X3/8	Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
121.7573	1	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.322	0.747	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
3.39	6.64	3.78	3.78	1.36	1.36

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
2.52	2.52	3.25	3.25	1.056	1.056	Not required

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	121.7573	1.056	115.305	200	115.305	300
Minor (2-2)	1	121.7573	1.056	115.305	200	115.305	300

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
60.8786	-54.513	0.1342	0	-0.037	-0.007	-0.0509

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K_1	K_2	B_1	B_2	C_m

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	1	1	1	1	1	1
Minor Bending	1	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
1	1	1.316

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.956 =	0.946 + 0.01 + 0

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
54.513	57.603	152.55

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	0.1342	12.1875	12.1875	12.1875
Minor Bending	0	12.1875		

Torsion Moment and Capacities

T_u Moment (kip-ft)	T_n Capacity (kip-ft)	ϕT_n Capacity (kip-ft)
-0.0509	11.853	10.6677

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	0.037	36.806	0.001
Minor Shear	0.007	36.806	1.924E-04

End Reaction Axial Forces

Left End Reaction (kip)	Load Combo	Right End Reaction (kip)	Load Combo
-54.559	DStlS31	-54.559	DStlS31

AOF Middle - Brace 343

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story1	D41	343	98.6513	DStlS14	Special Concentrically Braced Frame	HSS6X6X1/2	Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
197.3027	1	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.108	0.59	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
9.74	81.1	48.3	48.3	4.28	4.28

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
16.1	16.1	19.8	19.8	2.2269	2.2269	Not required

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	197.3027	2.2269	88.601	200	88.601	300
Minor (2-2)	1	394.6054	2.2269	177.202	200	177.202	300

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
98.6513	-52.362	0.464	0.0119	0.035	0.006	-0.0176

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K_1	K_2	B_1	B_2	C_m

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	1	1	1	1	1	1
Minor Bending	2	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
2	1	1.784

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.753 =	0.747 + 0.006 + 1.429E-04

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
52.362	70.075	438.3

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	0.464	74.25	74.25	74.25
Minor Bending	0.0119	74.25		

Torsion Moment and Capacities

T_u Moment (kip-ft)	T_n Capacity (kip-ft)	ϕT_n Capacity (kip-ft)
-0.0176	70.2583	63.2324

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	0.035	115.632	3.031E-04
Minor Shear	0.006	115.632	5.204E-05

End Reaction Axial Forces

Left End Reaction (kip)	Load Combo	Right End Reaction (kip)	Load Combo
-53.079	DStlS14	-53.079	DStlS14

AOF Middle - Brace 354

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story1	D48	354	0	DStlS13	Special Concentrically Braced Frame	HSS6X6X1/2	Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
197.2315	1	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.094	0.513	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
9.74	81.1	48.3	48.3	4.28	4.28

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
16.1	16.1	19.8	19.8	2.2269	2.2269	Not required

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	197.2315	2.2269	88.569	200	88.569	300
Minor (2-2)	1	394.4629	2.2269	177.138	200	177.138	300

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
0	-45.61	-0.8621	-0.242	-0.242	-0.022	-0.3816

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K_1	K_2	B_1	B_2	C_m

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	1	1	1	1	1	1
Minor Bending	2	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
2	1	2.257

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.664 =	0.65 + 0.01 + 0.003

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
45.61	70.125	438.3

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	0.8621	74.25	74.25	74.25
Minor Bending	0.242	74.25		

Torsion Moment and Capacities

T_u Moment (kip-ft)	T_n Capacity (kip-ft)	ϕT_n Capacity (kip-ft)
-0.3816	70.2583	63.2324

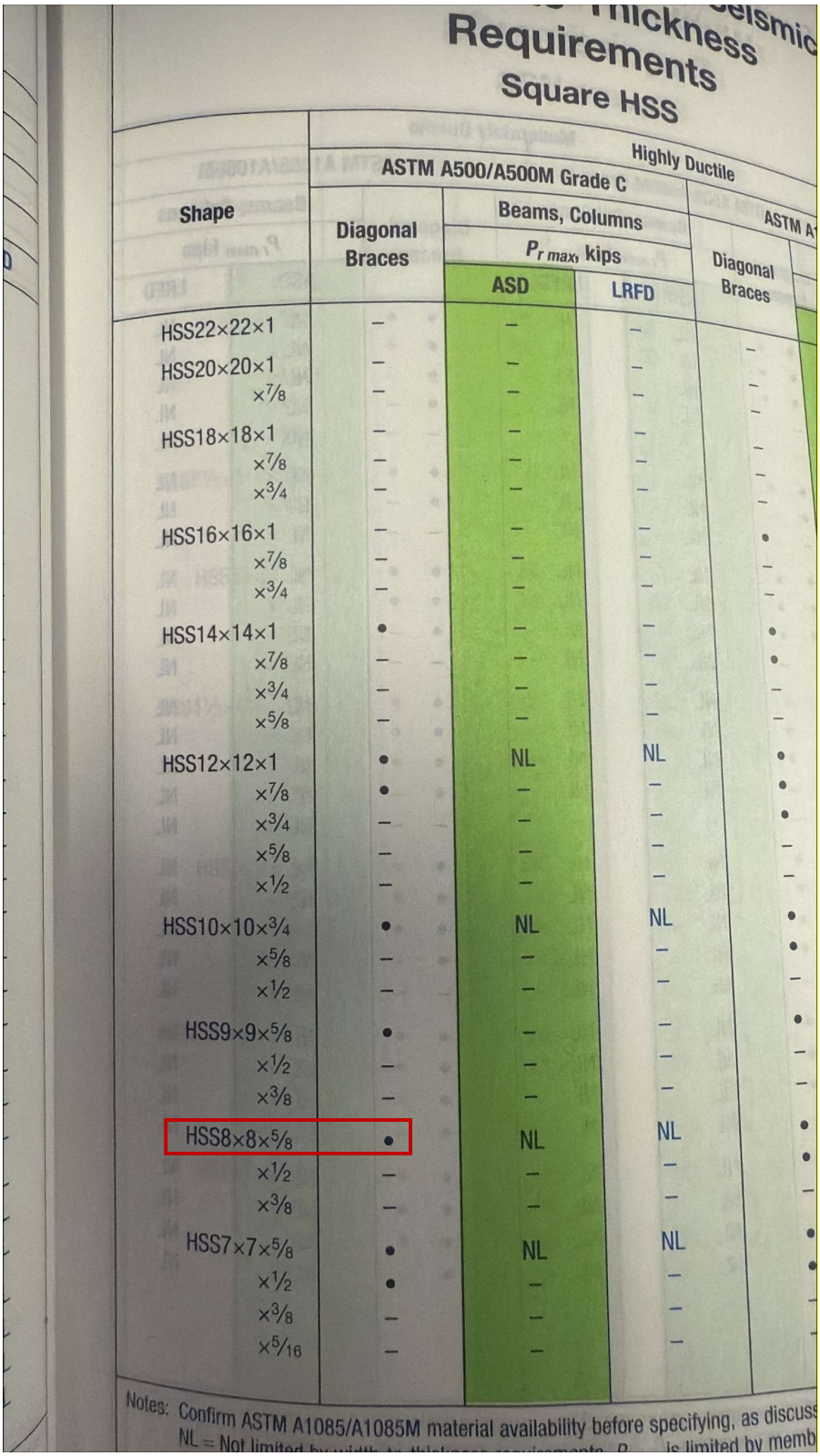
Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	0.242	115.632	0.002
Minor Shear	0.022	115.632	1.929E-04

End Reaction Axial Forces

Left End Reaction (kip)	Load Combo	Right End Reaction (kip)	Load Combo
-52	DStlS13	-52.000	DStlS13

Highly Ductile Requirement and Unbraced Lengths from AISC 341 for SCBF Braces:



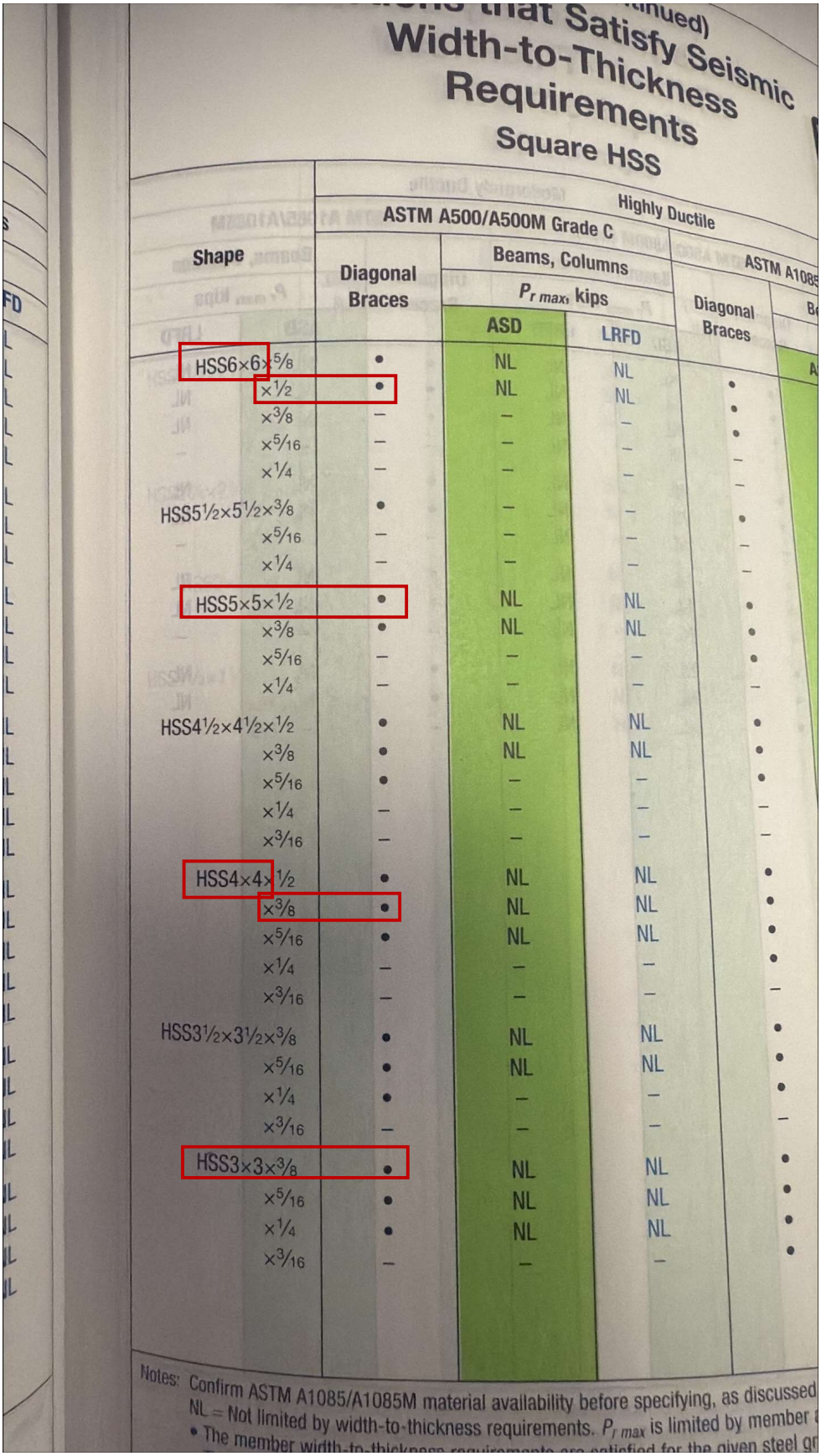
Thickness Requirements

Square HSS

Shape	Highly Ductile			
	ASTM A500/A500M Grade C			ASTM A
	Diagonal Braces	Beams, Columns $P_{r\,max}$, kips		Diagonal Braces
		ASD	LRFD	
HSS22×22×1	–	–	–	–
HSS20×20×1	–	–	–	–
×7/8	–	–	–	–
HSS18×18×1	–	–	–	–
×7/8	–	–	–	–
×3/4	–	–	–	–
HSS16×16×1	–	–	–	•
×7/8	–	–	–	–
×3/4	–	–	–	–
HSS14×14×1	•	–	–	•
×7/8	–	–	–	•
×3/4	–	–	–	–
×5/8	–	–	–	–
HSS12×12×1	•	NL	NL	•
×7/8	•	–	–	•
×3/4	–	–	–	•
×5/8	–	–	–	–
×1/2	–	–	–	–
HSS10×10×3/4	•	NL	NL	•
×5/8	–	–	–	•
×1/2	–	–	–	–
HSS9×9×5/8	•	–	–	•
×1/2	–	–	–	–
×3/8	–	–	–	–
HSS8×8×5/8	•	NL	NL	•
×1/2	–	–	–	•
×3/8	–	–	–	–
HSS7×7×5/8	•	NL	NL	•
×1/2	•	–	–	•
×3/8	–	–	–	–
×5/16	–	–	–	–

Notes: Confirm ASTM A1085/A1085M material availability before specifying, as discuss

NL = Not limited by width-to-thickness requirements. $P_{r\,max}$ is limited by memb



Width-to-Thickness Requirements

Square HSS

Shape	Highly Ductile: ASTM A500/A500M Grade C, Diagonal Braces	Highly Ductile: ASTM A500/A500M Grade C, Beams, Columns, $P_{r\,max}$, kips: ASD	Highly Ductile: ASTM A500/A500M Grade C, Beams, Columns, $P_{r\,max}$, kips: LRFD	Highly Ductile: ASTM A1085, Diagonal Braces	Highly Ductile: ASTM A1085, Beams, Columns
HSS6×6×5/8	•	NL	NL	•	
×1/2	•	NL	NL	•	
×3/8	–	–	–	•	
×5/16	–	–	–	•	
×1/4	–	–	–	–	
HSS5 1/2×5 1/2×3/8	•	–	–	•	
×5/16	–	–	–	–	
×1/4	–	–	–	–	
HSS5×5×1/2	•	NL	NL	•	
×3/8	•	NL	NL	•	
×5/16	–	–	–	•	
×1/4	–	–	–	–	
HSS4 1/2×4 1/2×1/2	•	NL	NL	•	
×3/8	•	NL	NL	•	
×5/16	•	–	–	•	
×1/4	–	–	–	–	
×3/16	–	–	–	–	
HSS4×4×1/2	•	NL	NL	•	
×3/8	•	NL	NL	•	
×5/16	•	NL	NL	•	
×1/4	–	–	–	•	
×3/16	–	–	–	–	
HSS3 1/2×3 1/2×3/8	•	NL	NL	•	
×5/16	•	NL	NL	•	
×1/4	•	–	–	•	
×3/16	–	–	–	–	
HSS3×3×3/8	•	NL	NL	•	
×5/16	•	NL	NL	•	
×1/4	•	NL	NL	•	
×3/16	–	–	–	•	

Notes: Confirm ASTM A1085/A1085M material availability before specifying, as discussed
NL = Not limited by width-to-thickness requirements. $P_{r\,max}$ is limited by member
• The member width-to-thickness requirements are satisfied for the given steel gr

AOF End – All column sections with DC ratios (Lateral Design)

Label	Section	D/C Ratio
11	W10X68	0.064
12	W10X68	0.081
13	W10X68	0.099
14	W10X60	0.105
146	W10X68	0.071
148	W10X68	0.137
149	W10X68	0.203
16	W10X68	0.042
17	W10X68	0.04
170	W10X68	0.125
171	W8X31	0.007
172	W10X68	0.118
173	W10X68	0.345
175	W8X31	0.004
176	W8X31	0.287
181	W8X31	0.016
182	W8X31	0.004
183	W8X31	0.028
194	W10X68	0.123
195	W8X31	0.007
196	W10X68	0.112
197	W10X68	0.321
200	W8X31	0.011
205	W8X31	0.013
206	W8X31	0.007
207	W8X31	0.154
208	W8X31	0.003
209	W8X31	0.009
218	W10X68	0.071
220	W10X68	0.135
221	W10X68	0.208
231	W8X31	0.054
232	W8X31	0.059
233	W8X31	0.043
234	W8X31	0.031
236	W8X31	0.019
237	W8X31	0.028
238	W8X31	0.035
242	W8X31	0.016
243	W10X68	0.148

244	W8X31	0.042
245	W8X31	0.031
246	W8X31	0.029
247	W8X31	0.004
248	W8X31	0.024
249	W8X31	0.06
25	W10X68	0.203
258	W8X31	0.032
259	W10X68	0.187
26	W10X68	0.218
260	W8X31	0.078
261	W8X31	0.048
262	W8X31	0.011
263	W8X31	0.012
264	W8X31	0.053
265	W8X31	0.091
27	W10X68	0.333
274	W8X31	0.015
275	W10X68	0.14
276	W8X31	0.041
277	W8X31	0.029
278	W8X31	0.028
279	W8X31	0.003
280	W8X31	0.028
281	W8X31	0.067
317	W8X31	0.364
329	W8X31	0.096
330	W8X31	0.071
356	W10X68	0.101
357	W10X68	0.078
382	W10X60	0.074
383	W8X31	0.296
396	W10X68	0.053
401	W10X68	0.111
432	W8X31	0.061
433	W8X31	0.082
447	W10X68	0.043
448	W10X68	0.043
449	W10X68	0.063
450	W10X68	0.074
451	W10X68	0.079
452	W10X68	0.116
453	W10X68	0.182

454	W10X68	0.185
455	W10X68	0.249
464	W10X68	0.168
465	W10X68	0.211
466	W10X60	0.095
467	W10X60	0.119
468	W10X60	0.181
469	W10X60	0.153
486	W10X60	0.054
487	W10X68	0.079
488	W10X60	0.08
489	W10X68	0.105
490	W10X60	0.08
491	W10X68	0.117
492	W10X60	0.053
493	W10X68	0.074
494	W10X68	0.119
495	W10X68	0.069
496	W10X68	0.132
497	W10X68	0.082
498	W10X68	0.122
499	W10X68	0.153
5	W10X60	0.246
550	W10X68	0.427
551	W10X68	0.451
552	W10X68	0.584
562	W10X68	0.045
563	W10X68	0.043
564	W10X68	0.099
565	W10X68	0.046
567	W10X68	0.078
568	W10X68	0.148
569	W10X68	0.399
570	W10X68	0.421
571	W10X68	0.569
593	W10X68	0.048
594	W10X68	0.048
595	W10X68	0.062
596	W10X68	0.072
597	W10X68	0.076
598	W10X68	0.114
599	W10X68	0.162
6	W10X60	0.274

600	W10X68	0.165
601	W10X68	0.254
612	W8X31	0.097
672	W8X31	0.374
676	W8X31	0.1
677	W8X31	0.075
683	W8X31	0.063
684	W8X31	0.084
685	W8X31	0.099
687	W8X31	0.004
690	W8X31	0.011
691	W8X31	0.003
692	W8X31	0.009
7	W10X60	0.121
701	W8X31	0.055
702	W8X31	0.059
703	W8X31	0.044
704	W8X31	0.032
706	W8X31	0.019
707	W8X31	0.028
708	W8X31	0.035
8	W10X60	0.082

AOF Middle – All column sections with DC ratios (Lateral Design)

Label	Section	D/C Ratio
1	W10X68	0.194
10	W10X68	0.071
11	W10X68	0.115
119	W10X68	0.201
12	W10X68	0.11
13	W10X68	0.263
133	W10X60	0.148
134	W10X68	0.064
135	W10X68	0.094
14	W10X68	0.115
149	W10X60	0.216
15	W10X68	0.303
150	W10X68	0.11
151	W10X68	0.202
16	W10X68	0.2
166	W8X31	0.059
167	W8X31	0.024
168	W8X31	0.006
169	W8X31	0.022
17	W10X68	0.497
170	W8X31	0.043
171	W8X31	0.016
172	W8X31	0.025
18	W10X68	0.76
181	W10X68	0.21
182	W10X68	0.118
184	W8X31	0.069
185	W8X31	0.035
186	W8X31	0.009
187	W8X31	0.034
188	W8X31	0.061
189	W8X31	0.082
19	W10X68	0.494
190	W8X31	0.212
199	W10X68	0.194
2	W10X60	0.216
200	W10X68	0.099
202	W8X31	0.059
203	W8X31	0.024
204	W8X31	0.006

205	W8X31	0.022
206	W8X31	0.041
207	W8X31	0.016
208	W8X31	0.025
227	W10X60	0.31
228	W10X68	0.067
229	W10X68	0.76
232	W10X60	0.149
233	W10X68	0.065
234	W10X68	0.092
235	W8X31	0.069
236	W8X31	0.018
237	W8X31	0.082
3	W10X60	0.22
330	W8X31	0.012
331	W8X31	0.019
332	W8X31	0.04
336	W8X31	0.03
337	W8X31	0.008
363	W8X31	0.03
4	W10X68	0.289
446	W8X31	0.049
447	W8X31	0.246
454	W8X31	0.067
455	W8X31	0.018
456	W8X31	0.081
472	W8X31	0.013
473	W8X31	0.018
474	W8X31	0.04
475	W8X31	0.031
476	W8X31	0.007
477	W8X31	0.029
48	W8X31	0.022
5	W10X68	0.289
6	W10X68	0.362
7	W10X60	0.318
8	W10X60	0.221
82	W8X31	0.02
85	W8X31	0.049
9	W10X68	0.115
93	W8X31	0.247

AOF End - Column 27

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story5	C174	27	311.8	DStlS17	Special Concentrically Braced Frame	W10X68	Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
324.0000	0.532	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.075	0.188	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
19.9	3.56	394	134	15.55	4.89

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
75.77	26.53	85.3	40.1	4.4496	2.5949	3065.46

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	311.8	4.4496	70.074	200	70.074	300
Minor (2-2)	1	311.8	2.5949	120.157	200	120.157	300

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
311.8	-74.339	32.0538	0.956	-5.164	-0.017	0.0171

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K_1	K_2	B_1	B_2	C_m

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	0.962	1	1	1	1	1
Minor Bending	0.962	1	1	1	1	0.6

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
0.962	1	2.402

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.333 =	0.239 + 0.089 + 0.006

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
74.339	311.381	895.5

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	32.0538	319.875	319.875	254.8785
Minor Bending	0.956	150.375		

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	5.164	146.64	0.035
Minor Shear	0.017	419.958	4.095E-05

AOF End - Column 552

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story5	C74	552	75.76	DStlS31	Special Concentrically Braced Frame	W10X68	Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
87.9600	0.5	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.178	0.393	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
19.9	3.56	394	134	15.55	4.89

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
75.77	26.53	85.3	40.1	4.4496	2.5949	3065.46

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	75.76	4.4496	17.026	200	17.026	300
Minor (2-2)	1	291.76	2.5949	112.435	200	112.435	300

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
75.76	-176.859	26.6109	2.116	-6.053	-0.057	-0.0158

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K_1	K_2	B_1	B_2	C_m

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	0.861	1	1	1	1	0.415
Minor Bending	3.317	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
3.317	1	1.894

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r / P_c) + (8/9)(M_{r33} / M_{c33}) + (8/9)(M_{r22} / M_{c22})$
0.584 =	0.498 + 0.074 + 0.013

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
176.859	355.337	895.5

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	26.6109	319.875	319.875	261.3327
Minor Bending	2.116	150.375		

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	6.053	146.64	0.041
Minor Shear	0.057	419.958	1.357E-04

AOF Middle - Column 17

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story1	C57	17	291.66	DStlS12	Special Concentrically Braced Frame	W10X68	Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
303.9600	0.74	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.115	0.255	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
19.9	3.56	394	134	15.55	4.89

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
75.77	26.53	85.3	40.1	4.4496	2.5949	3065.46

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	291.66	4.4496	65.547	200	65.547	300
Minor (2-2)	1	291.66	2.5949	112.396	200	112.396	300

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
291.66	-114.86	-2.2093	-28.3165	0.118	6.402	0.0858

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K_1	K_2	B_1	B_2	C_m

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	0.96	1	1	1	1	0.6
Minor Bending	0.96	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
0.96	1	1.58

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.497 =	0.323 + 0.006 + 0.167

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
114.86	355.563	895.5

Moments and Capacities

	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	2.2093	319.875	319.875	261.3649
Minor Bending	28.3165	150.375		

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	0.118	146.64	0.001
Minor Shear	6.402	419.958	0.015

AOF Middle - Column 229

ETABS Steel Frame Design

AISC 360-16 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (in)	Combo	Element Type	Section	Classification
Story1	C6	229	291.66	DStlS20	Special Concentrically Braced Frame	W10X68	Compact

LLRF and Demand/Capacity Ratio

L (in)	LLRF	Stress Ratio Limit
303.9600	0.79	0.75

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	Tau-b Fixed

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.263	0.58	1	0.8	0.8

Design Code Parameters

ϕ_b	ϕ_c	ϕ_{TY}	ϕ_{TF}	ϕ_V	$\phi_{V\text{-}RI}$	ϕ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (in^2)	J (in^4)	I_{33} (in^4)	I_{22} (in^4)	A_{v3} (in^2)	A_{v2} (in^2)
19.9	3.56	394	134	15.55	4.89

Design Properties

S_{33} (in^3)	S_{22} (in^3)	Z_{33} (in^3)	Z_{22} (in^3)	r_{33} (in)	r_{22} (in)	C_w (in^6)
75.77	26.53	85.3	40.1	4.4496	2.5949	3065.46

Material Properties

E (lb/in^2)	f_y (lb/in^2)	R_y	C_{pr}	α
29000000	50000	1.1	1.4	NA

Slenderness Check

Buckling Mode	K Factor	L Length (in)	r (in)	KL/r	KL/r Limit	L/r	L/r Limit
Major (3-3)	1	291.66	4.4496	65.547	200	65.547	300
Minor (2-2)	1	291.66	2.5949	112.396	200	112.396	300

Stress Check Forces and Moments

Location (in)	P_u (kip)	M_{u33} (kip-ft)	M_{u22} (kip-ft)	V_{u2} (kip)	V_{u3} (kip)	T_u (kip-ft)
291.66	-261.45	-6.0235	-1.2604	0.249	0.043	-0.0031

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K_1	K_2	B_1	B_2	C_m

	L Factor	K_1	K_2	B_1	B_2	C_m
Major Bending	0.96	1	1	1	1	0.6
Minor Bending	0.96	1	1	1	1	0.599

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
0.96	1	1.492

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.76 =	0.735 + 0.017 + 0.007

Axial Force and Capacities

P_u Force (kip)	ϕP_{nc} Capacity (kip)	ϕP_{nt} Capacity (kip)
261.45	355.563	895.5

Moments and Capacities

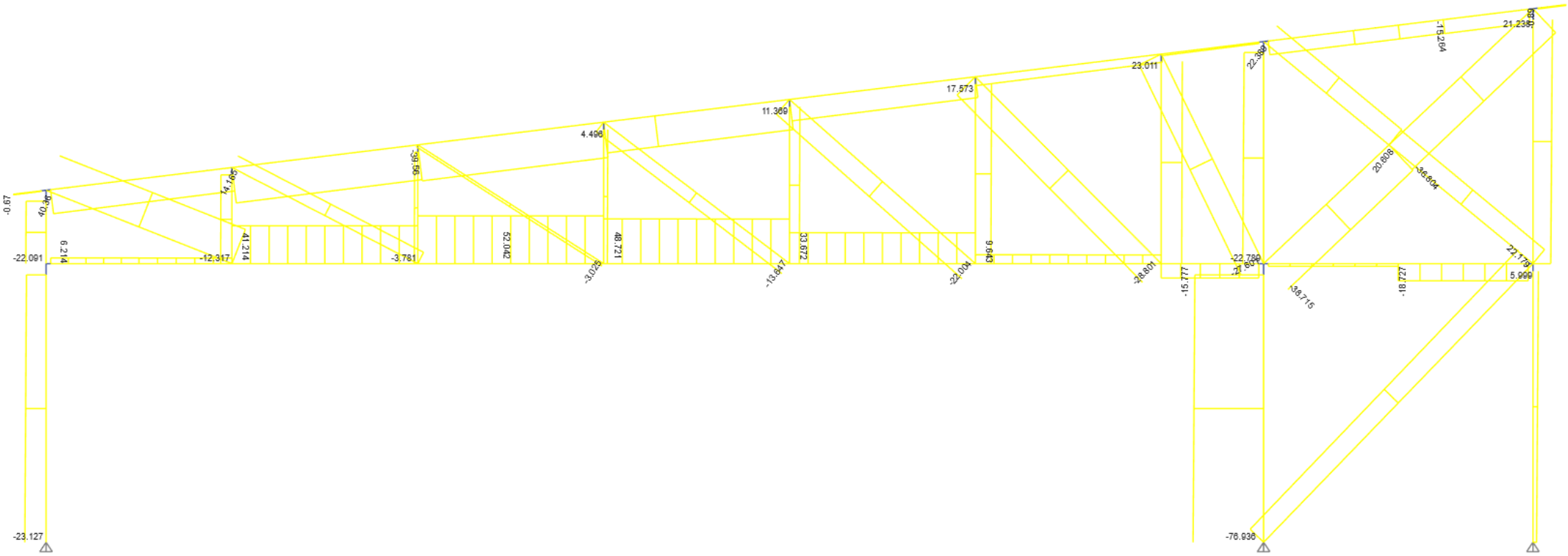
	M_u Moment (kip-ft)	ϕM_n (kip-ft)	ϕM_n No LTB (kip-ft)	ϕM_n Cb=1 (kip-ft)
Major Bending	6.0235	319.875	319.875	261.3649
Minor Bending	1.2604	150.375		

Shear Design

	V_u Force (kip)	ϕV_n Capacity (kip)	Stress Ratio
Major Shear	0.249	146.64	0.002
Minor Shear	0.043	419.958	1.024E-04

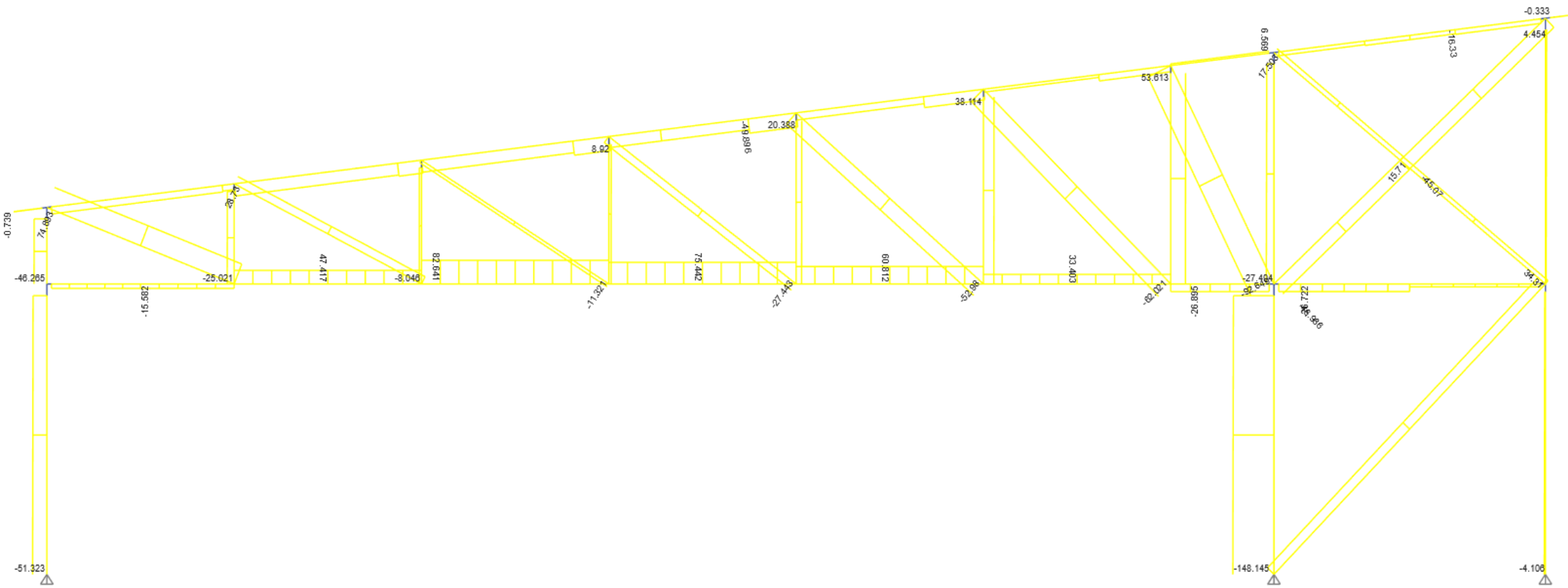
AOF Middle - Axial Load Distribution (1.2DL+0.5LL+Wx)

Elevation A.1



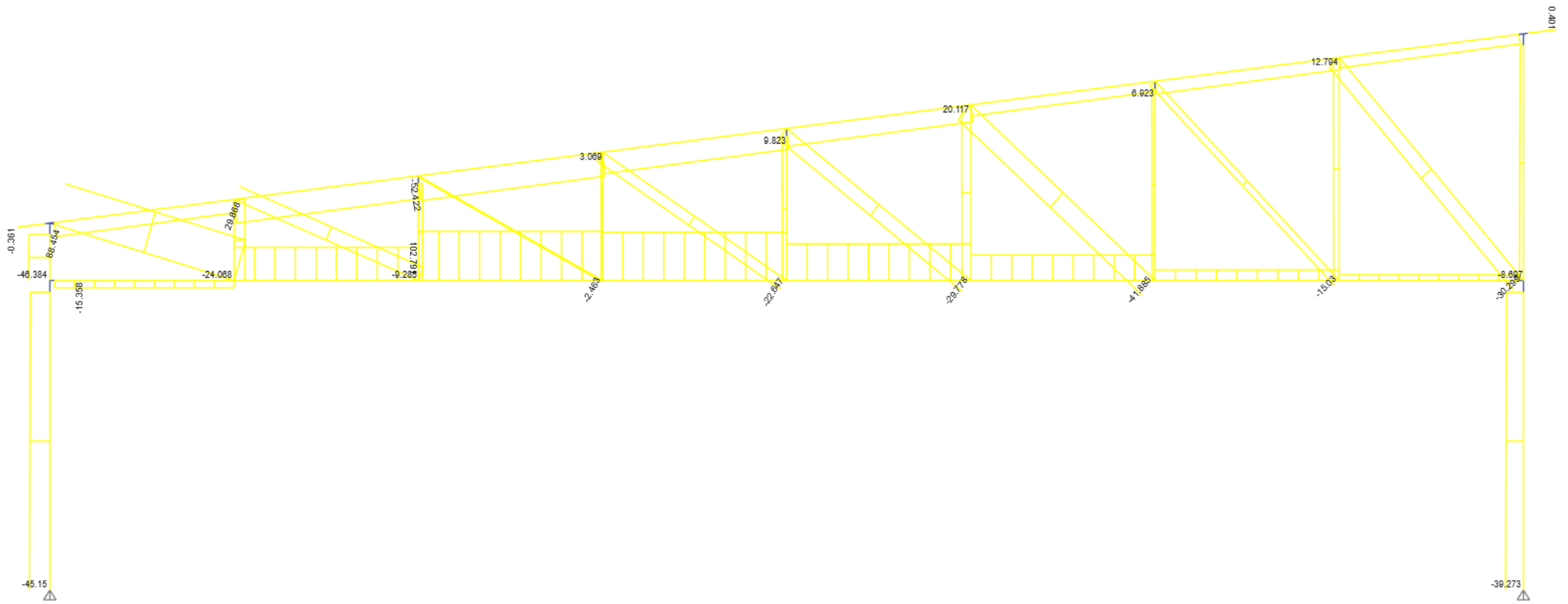
AOF Middle - Axial Load Distribution (1.2DL+0.5LL+Wx)

Elevation A.9



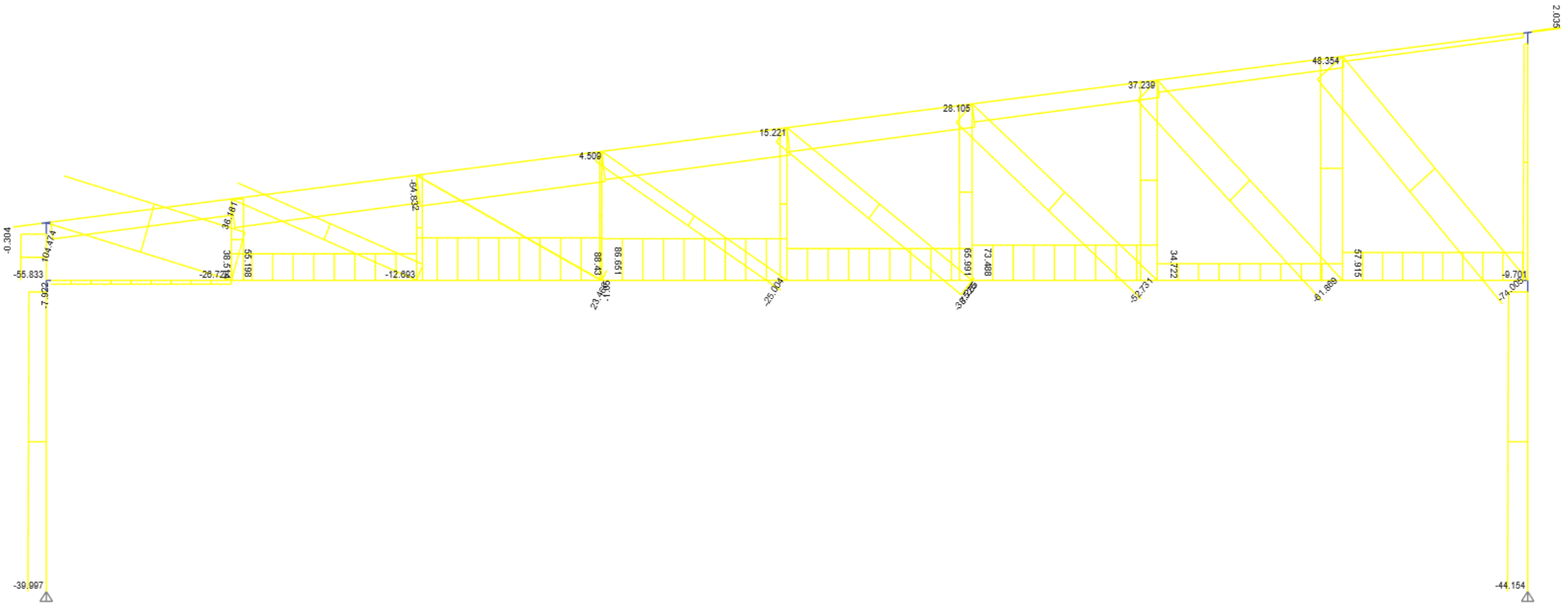
AOF Middle - Axial Load Distribution (1.2DL+0.5LL+Wx)

Elevation C



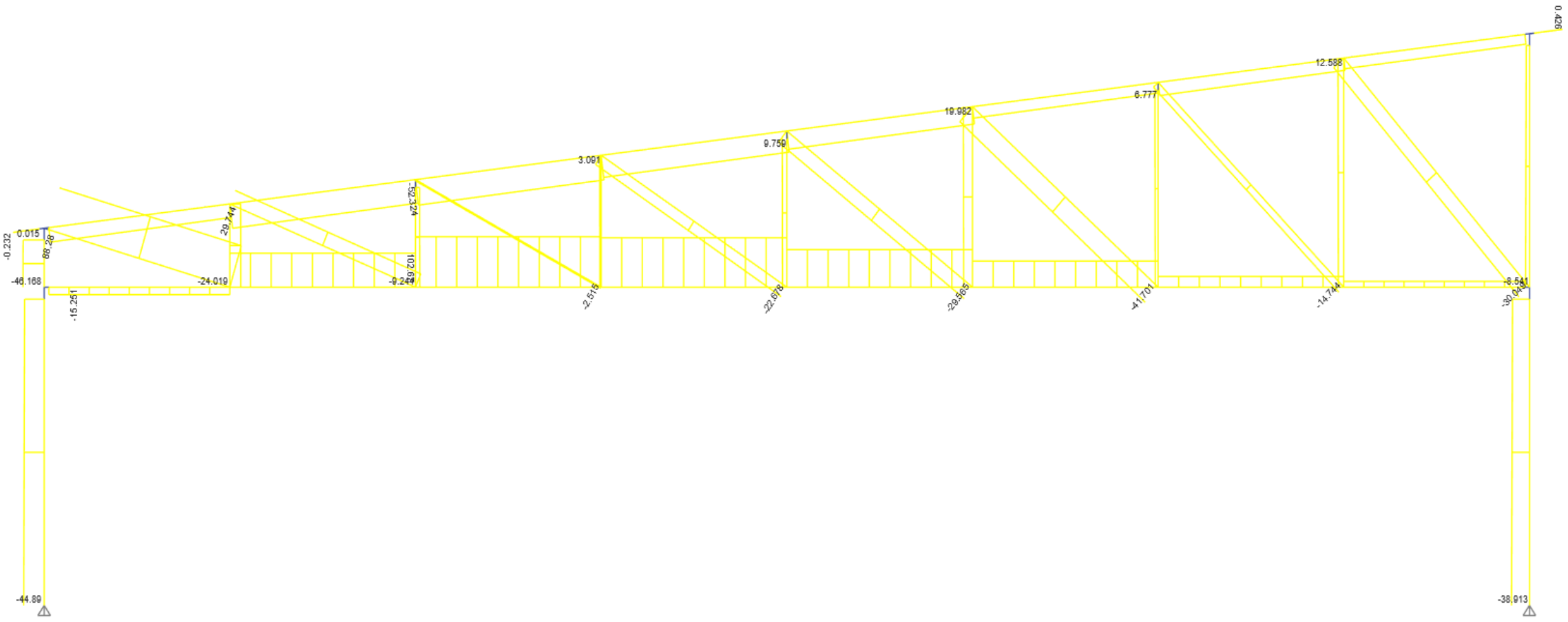
AOF Middle - Axial Load Distribution (1.2DL+0.5LL+Wx)

Elevation D



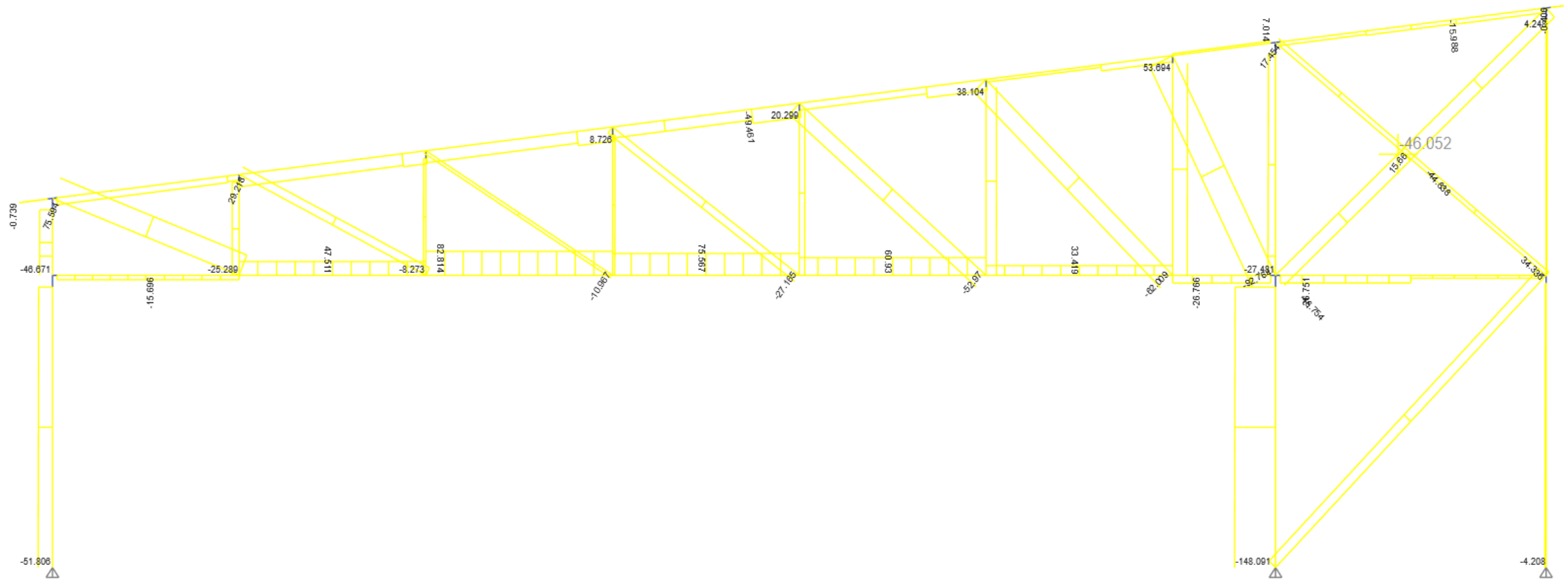
AOF Middle - Axial Load Distribution (1.2DL+0.5LL+Wx)

Elevation E



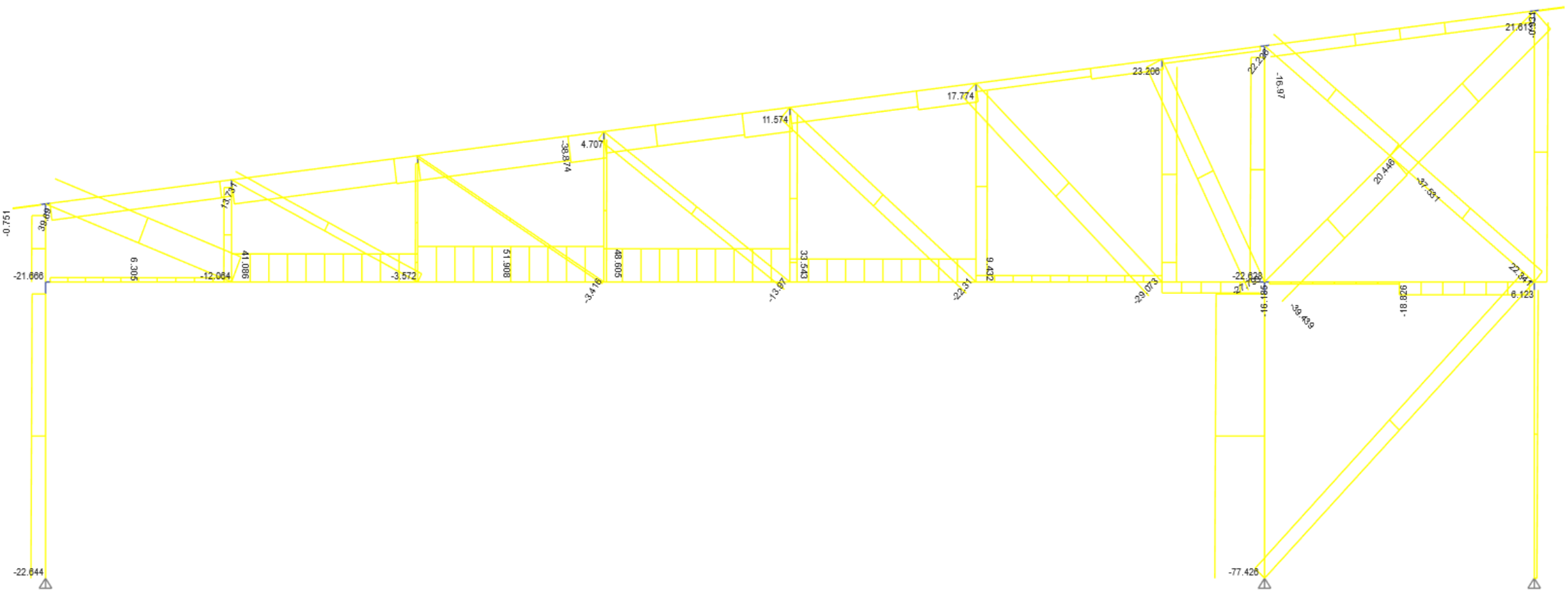
AOF Middle - Axial Load Distribution (1.2DL+0.5LL+Wx)

Elevation F.1



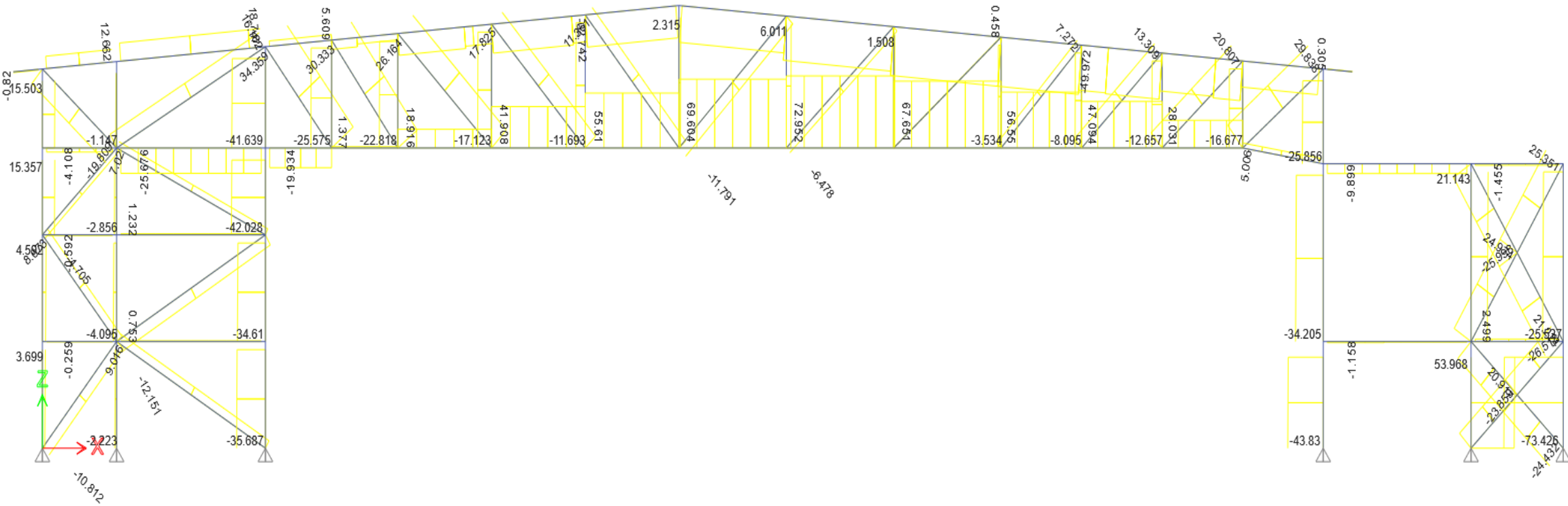
AOF Middle - Axial Load Distribution (1.2DL+0.5LL+Wx)

Elevation F.9



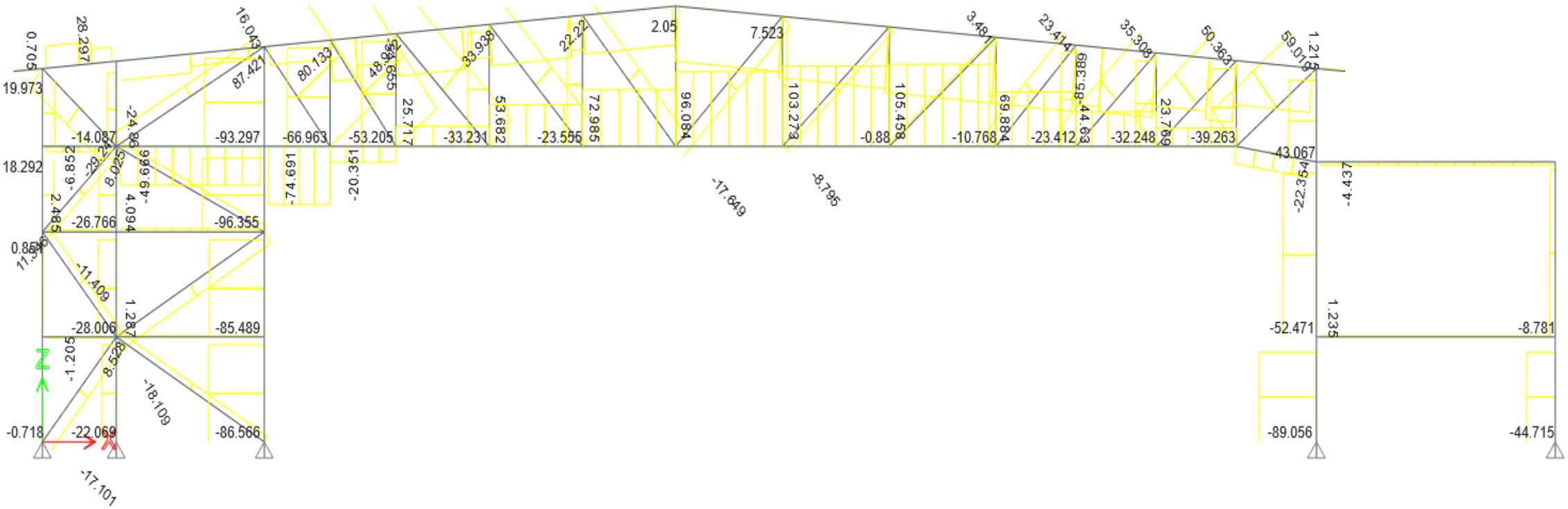
AOF End - Axial Load Distribution (1.2DL+0.5LL+Wx)

Elevation A.1



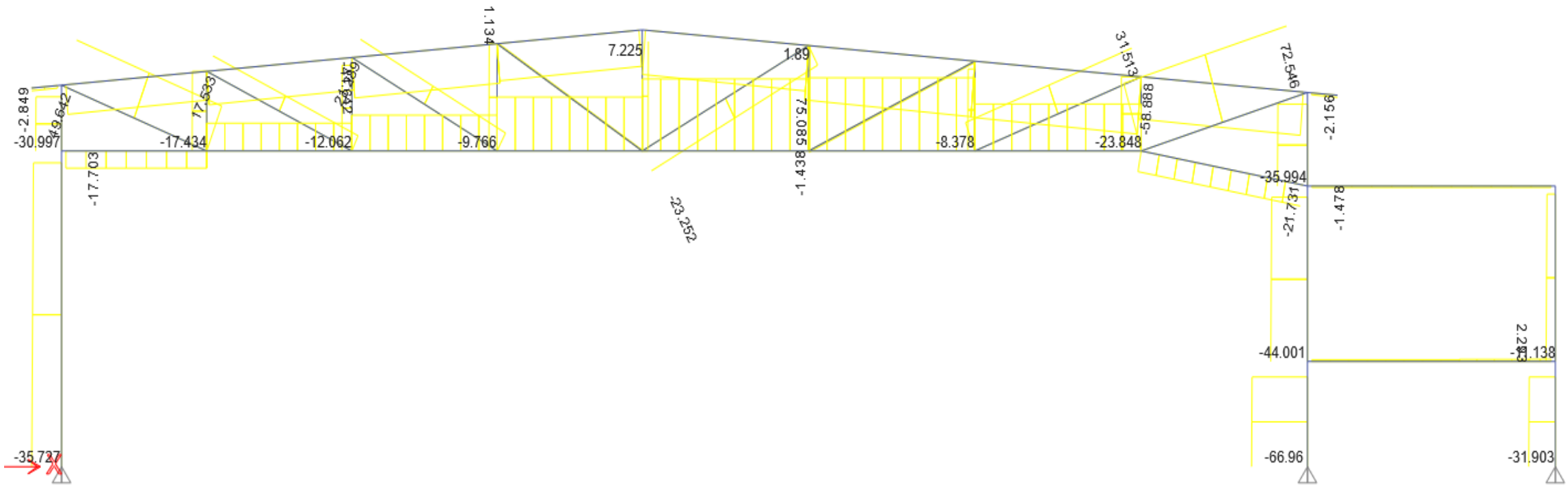
AOF End - Axial Load Distribution
(1.2DL+0.5LL+Wx)

Elevation A.9



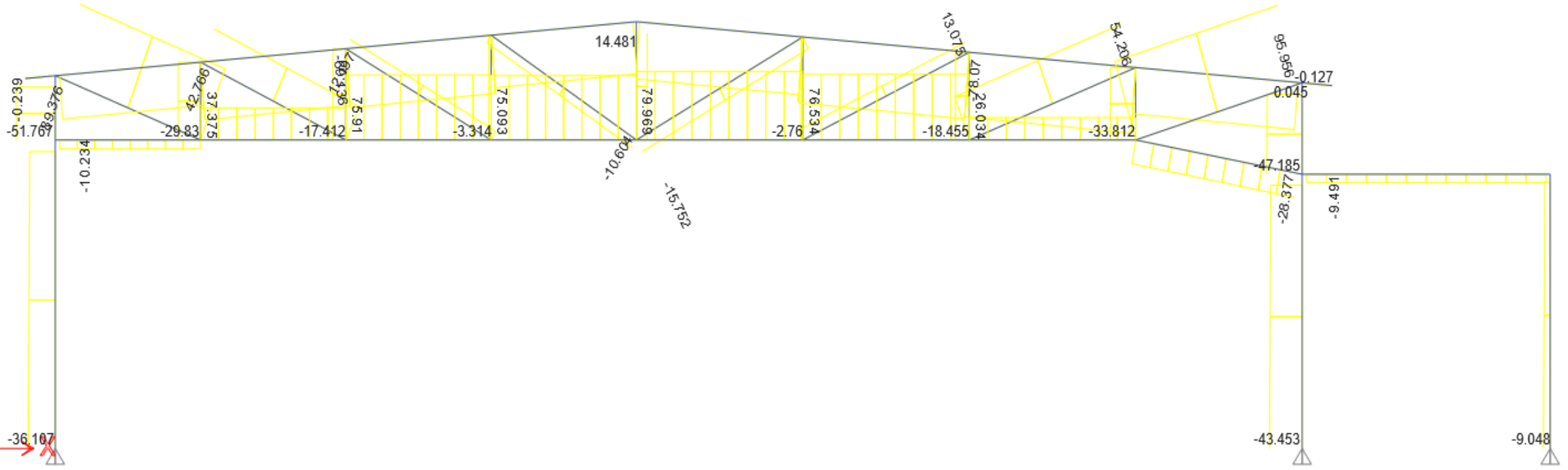
AOF End - Axial Load Distribution (1.2DL+0.5LL+Wx)

Elevation C



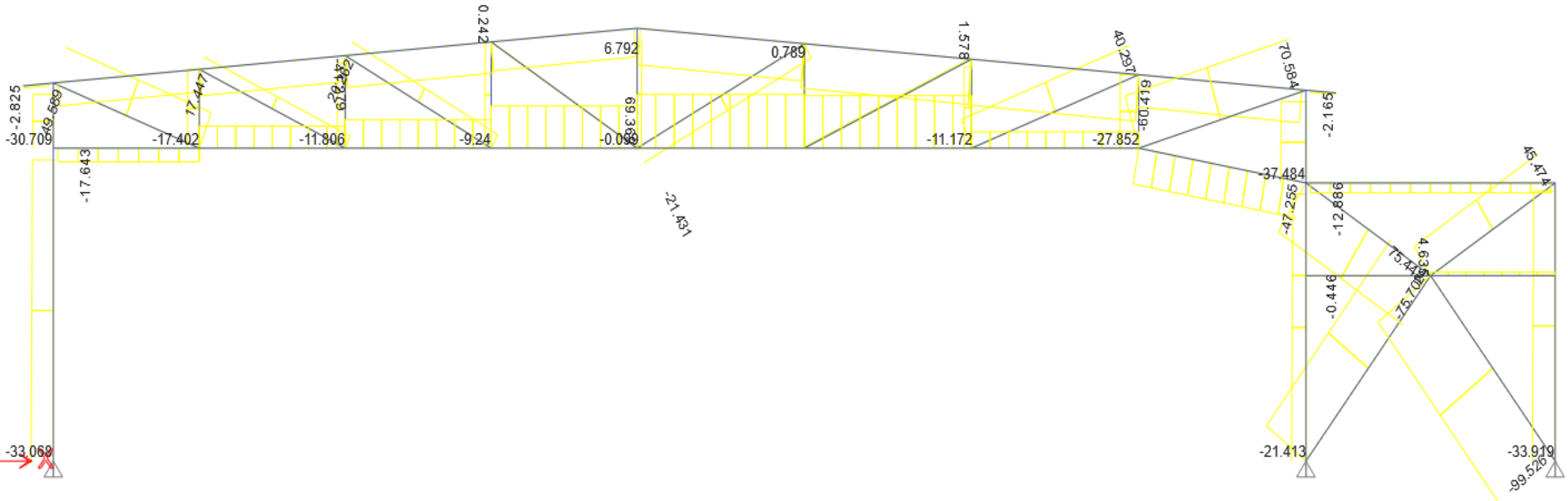
AOF End - Axial Load Distribution (1.2DL+0.5LL+Wx)

Elevation D



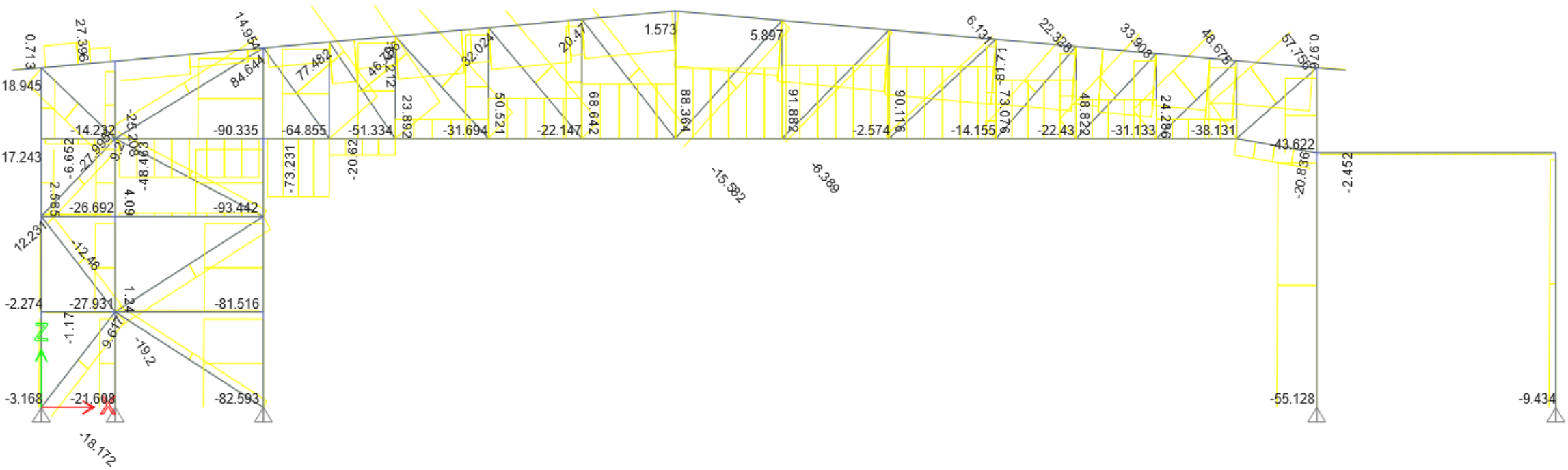
AOF End - Axial Load Distribution (1.2DL+0.5LL+Wx)

Elevation E



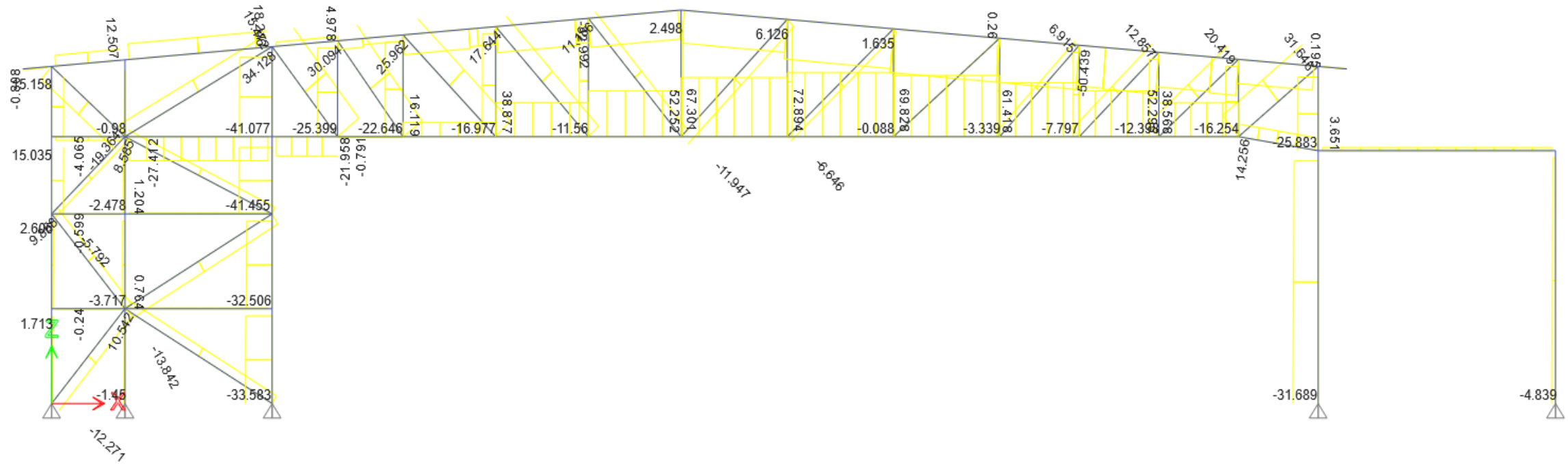
AOF End - Axial Load Distribution
(1.2DL+0.5LL+Wx)

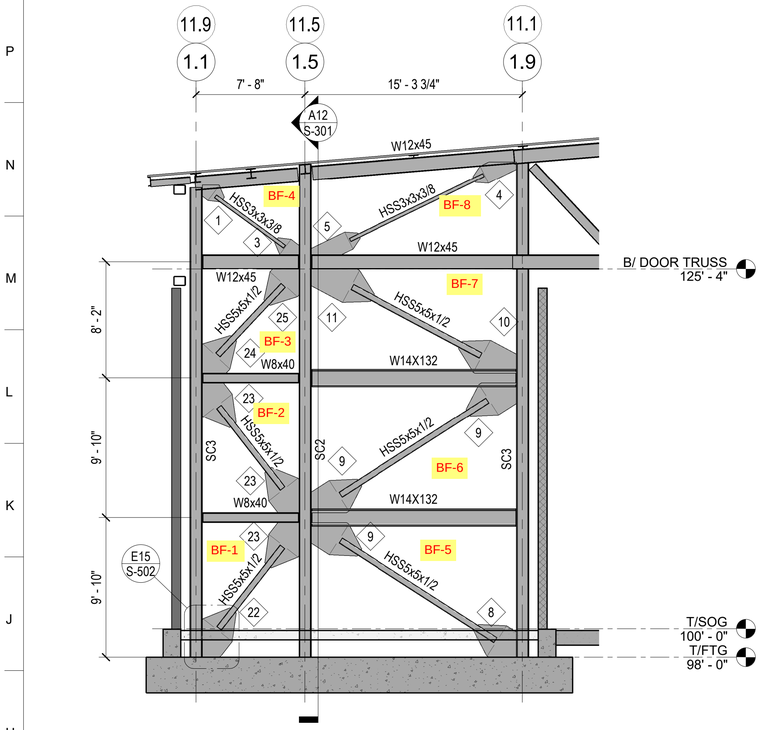
Elevation F.1



AOF End - Axial Load Distribution
(1.2DL+0.5LL+Wx)

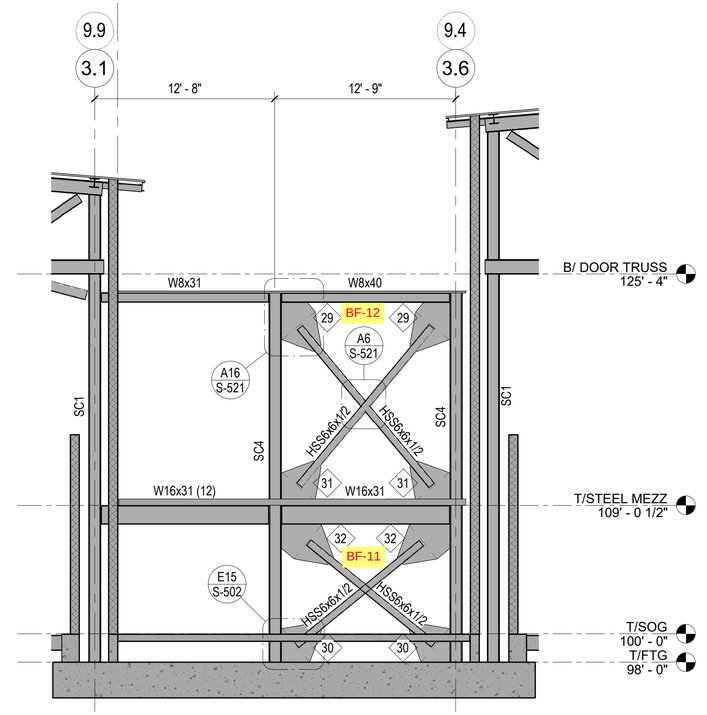
Elevation F.9





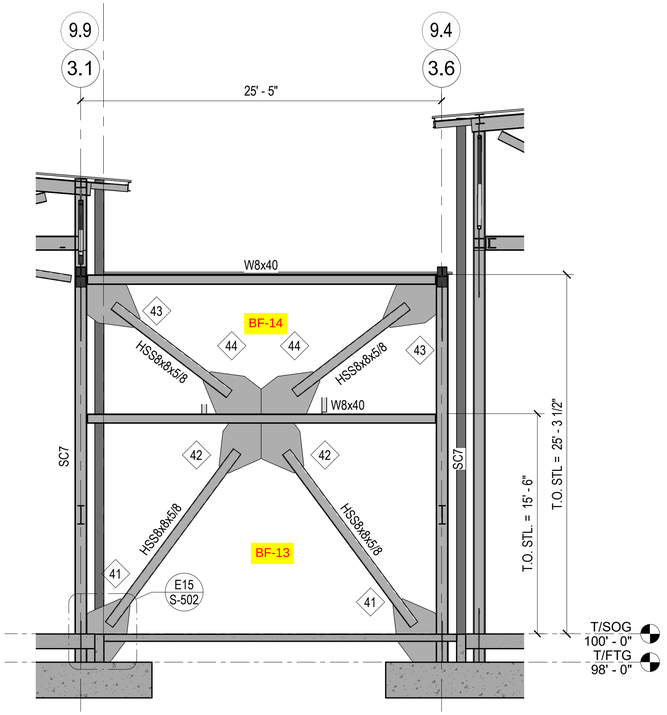
H1 BRACED FRAME ELEV. - GRIDS A.1 A.9 F.1 F.9

3/16" = 1'-0" REF: SB101



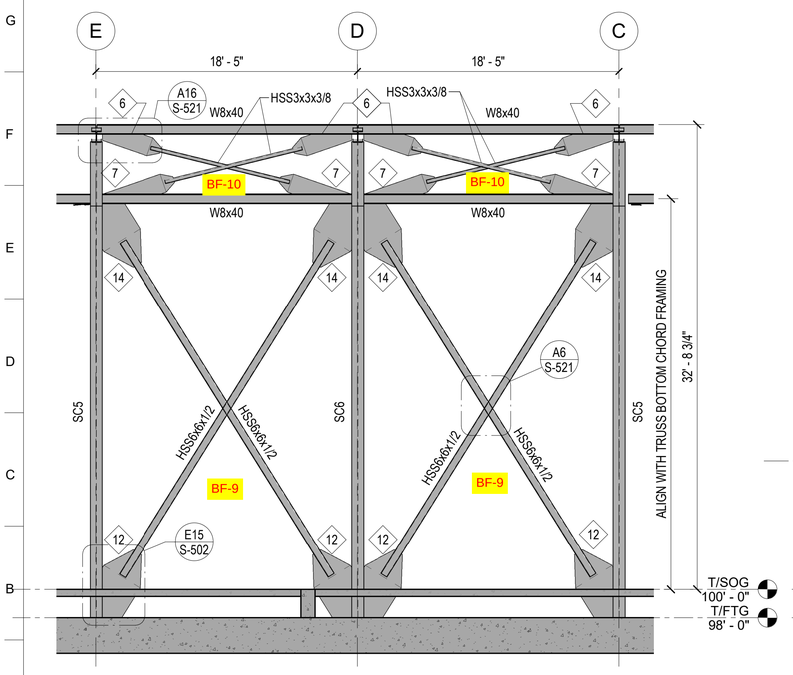
H8 BRACED FRAME ELEVATION - GRID A.1

3/16" = 1'-0" REF: SB101



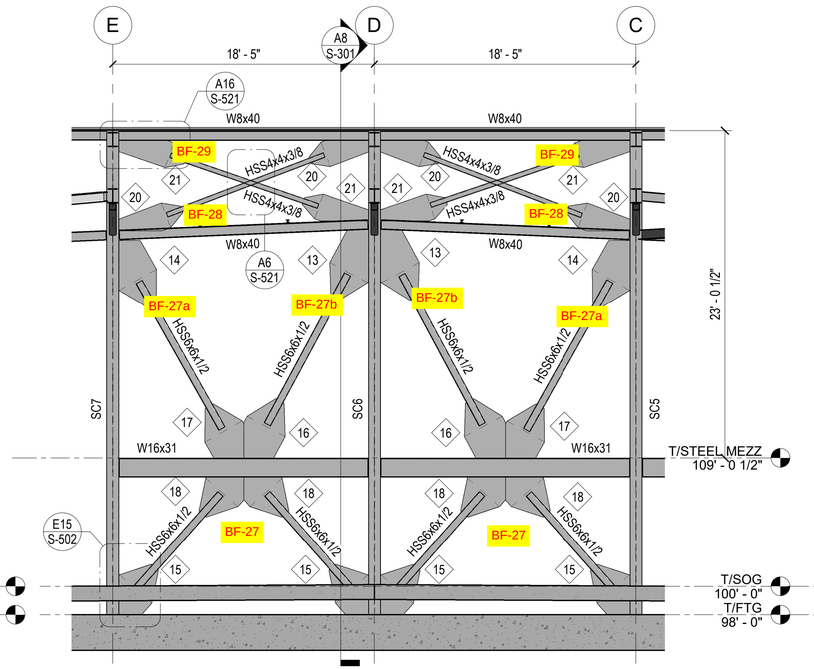
H14 BRACED FRAME ELEVATION - GRID E

3/16" = 1'-0" REF: SB101



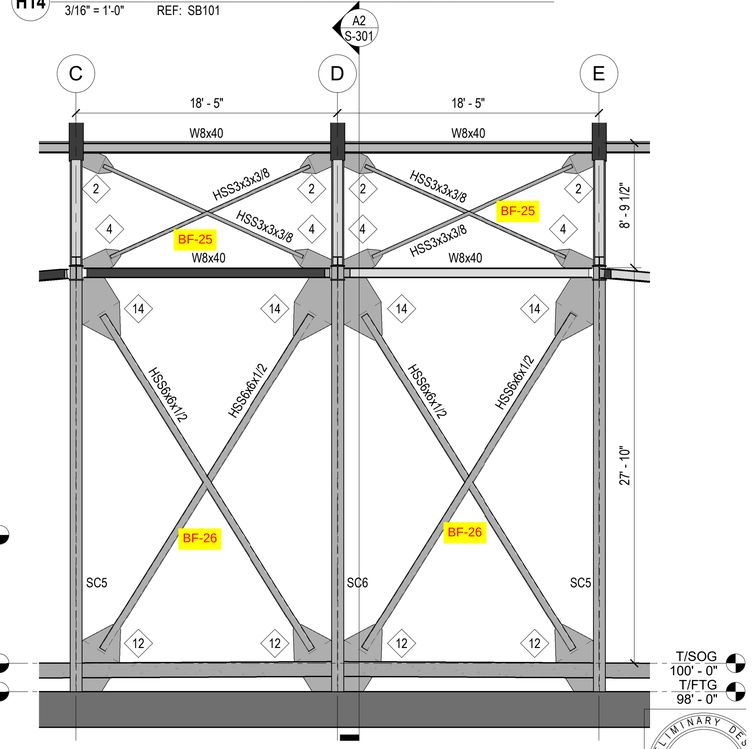
A1 BRACED FRAME ELEV. - GRIDS 1.5 11.5

3/16" = 1'-0" REF: SB101



A8 BRACED FRAME ELEV. - GRIDS 3.1 9.9

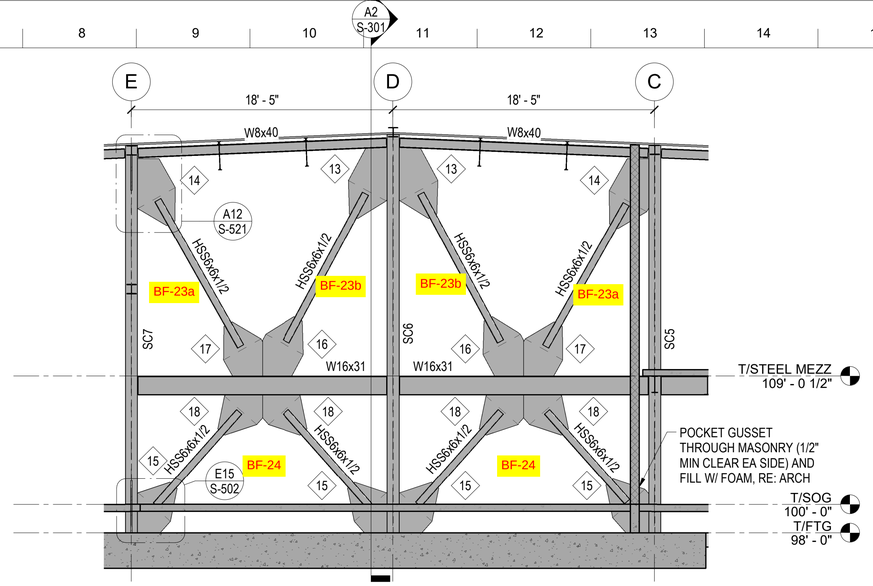
3/16" = 1'-0" REF: SB101



A14 BRACED FRAME ELEV - GRIDS 3.9 9.1

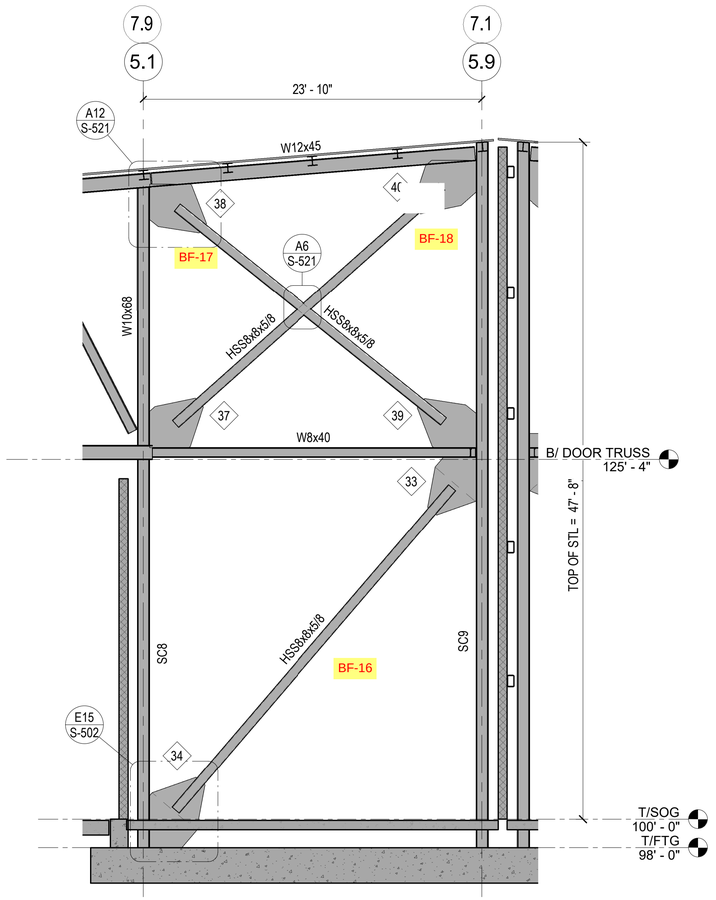
3/16" = 1'-0" REF: SB101

PRELIMINARY DES
NOT FOR CONSTRUCTION



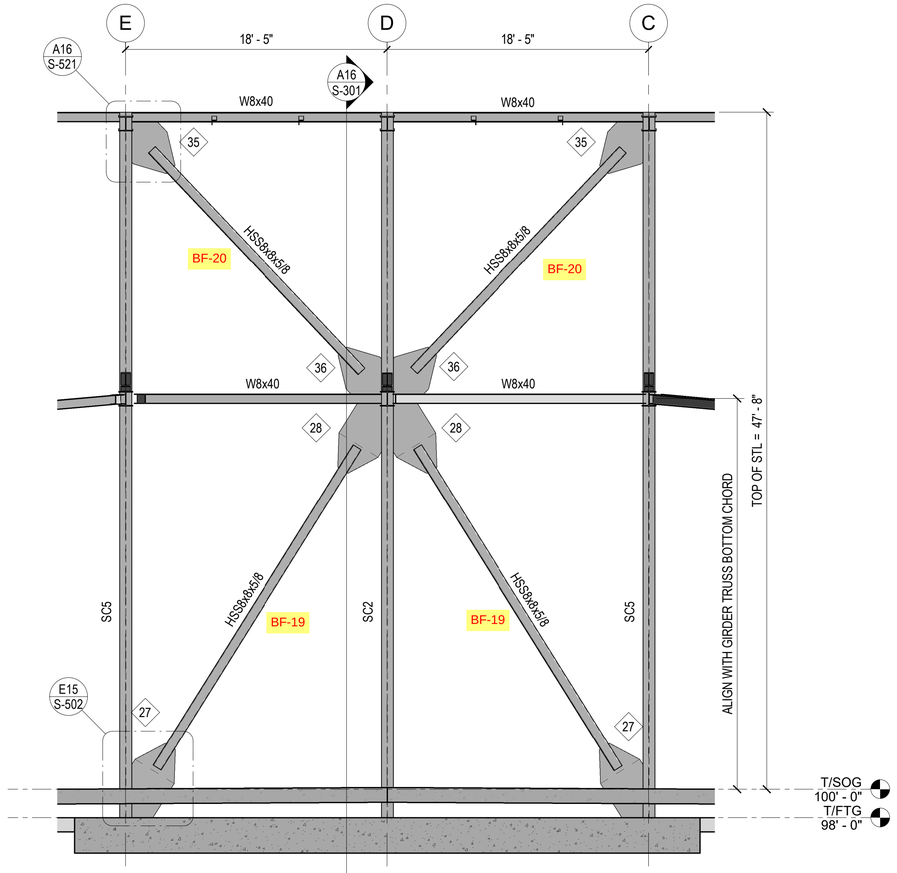
J8 BRACED FRAME ELEV. - GRIDS 3.6 9.4

3/16" = 1'-0" REF: SB101



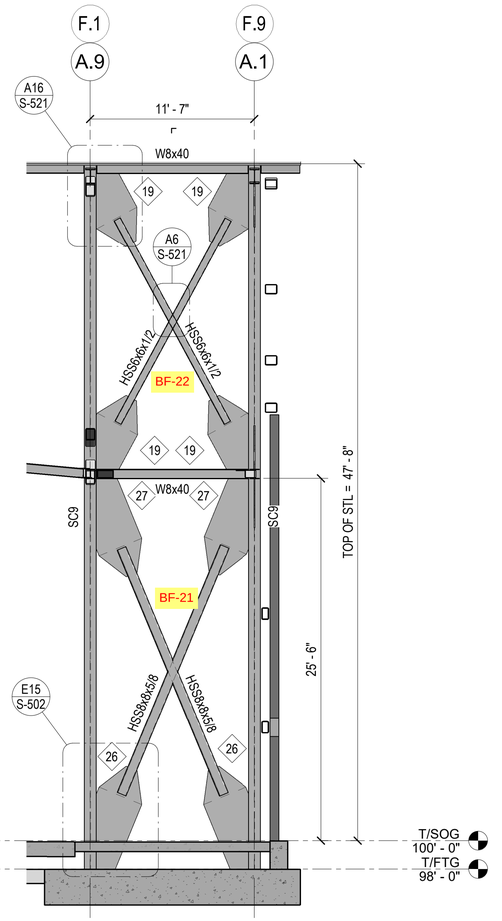
A1 BRACED FRAME ELEVATION - GRID A.1 A.9 F.1 F.9

3/16" = 1'-0" REF: SB102



A8 BRACED FRAME ELEV. - GRIDS 5.9 7.1

3/16" = 1'-0" REF: SB102



B16 BRACED FRAME ELEV. - GRIDS 5.9 7.1

3/16" = 1'-0" REF: SB102

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

DESIGN MODULE - SCBF Gusset Design

Michael Baker INTERNATIONAL

Creech DRP Phase 1 AOF

TYPICAL BRACED FRAME DESIGN INFORMATION

Frame Height:	20.00 ft	Gusset Plate Fy:	50 ksi
Floor Thickness:	0.00 in	Weld Size Brace to Gusset:	5 /16
Gusset Thickness:	0.75 in	Corner Snip:	1.00 in
Measured from Top of Slab:	No		
Beam Size Above:	W10X26		
Beam Size Below:	BasePlate		
Column Size:	W12X106		
Brace Size:	HSS8X8X1/2		
Brace Grade:	A500 Gr C		

BRACED FRAME GUSSET SUMMARY SCHEDULE

FRAME ID	GUSSET MARK	LENGTH	HEIGHT	BEAM		COLUMN	BRACE	STATUS
BF1	1	7.67 ft	9.67 ft	TOP	W8X40	W10X68	HSS5X5X1/2	PASS
	2			BTM	BasePlate			PASS
BF2	3	7.67 ft	9.67 ft	TOP	W8X40	W10X68	HSS5X5X1/2	PASS
	4			BTM	W8X40			PASS
BF3	5	7.67 ft	8.17 ft	TOP	W12X45	W10X68	HSS5X5X1/2	PASS
	6			BTM	W8X40			PASS
BF4	7	7.67 ft	5.50 ft	TOP	W12X45	W10X68	HSS3X3X3/8	PASS
	8			BTM	W12X45			PASS
BF5	9	15.31 ft	9.67 ft	TOP	W14X132	W10X68	HSS5X5X1/2	PASS
	10			BTM	BasePlate			PASS
BF6	11	15.31 ft	9.67 ft	TOP	W14X132	W10X68	HSS5X5X1/2	PASS
	12			BTM	W14X132			PASS
BF7	13	15.31 ft	8.17 ft	TOP	W12X45	W10X68	HSS5X5X1/2	PASS
	14			BTM	W14X132			PASS
BF8	15	15.31 ft	7.50 ft	TOP	W12X45	W10X68	HSS3X3X3/8	PASS
	16			BTM	W12X45			PASS

SCBF GUSSET DESIGN

BF1 Top, Gusset 1

GENERAL CRITERIA

Frame Height:	9.67 ft	Beam Size:	W8X40
Frame Length:	7.67 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS5X5X1/2
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

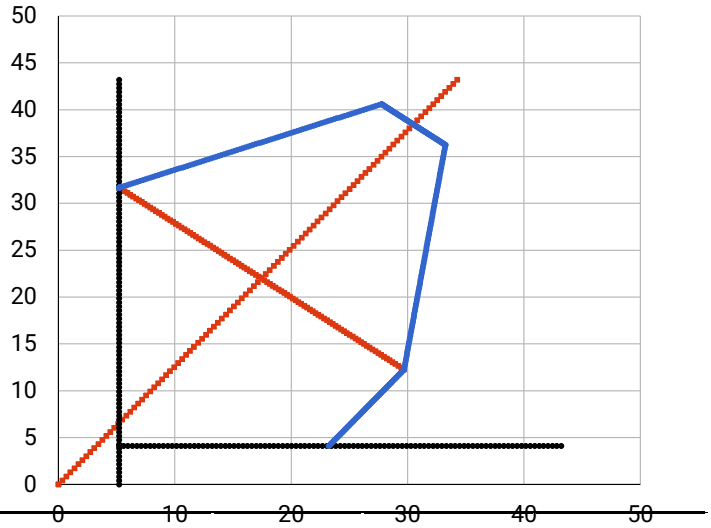
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	9.67 ft
Frame Length:	7.67 ft
Brace Length:	12.34 ft
Angle from Horz:	51.58 deg
Angle from Vert:	38.42 deg

Gusset Plate Geometry

Brace on Gusset:	19.00 in
Length along Beam:	18.01 in
Length along Column:	27.57 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	9.46 in
b:	14.36 in
r:	23.60

Max Brace Force, Pu = **512 kips**

Vub:	0.175 x Pu	= **90 kips**	V= Vertical Force
Hub:	0.401 x Pu	= **206 kips**	H= Horizontal Force
Vuc:	0.609 x Pu	= **312 kips**	b= Beam Side
Huc:	0.220 x Pu	= **113 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	6/16	Weld to Column Size:	5/16
Interaction for Vub:	0.190	Interaction for Vuc:	0.780
Interaction for Hub:	0.652	Interaction for Huc:	0.188
Total Interaction:	**0.841**	Total Interaction:	**0.969**

Gusset Design

Buckling Capacity:	452k OK
Yielding Capacity:	1302k OK
Block Shear Capacity:	1099k OK

SCBF GUSSET DESIGN

BF1 Bottom, Gusset 2

GENERAL CRITERIA

Frame Height:	9.67 ft	Beam Size:	BasePlate
Frame Length:	7.67 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS5X5X1/2
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

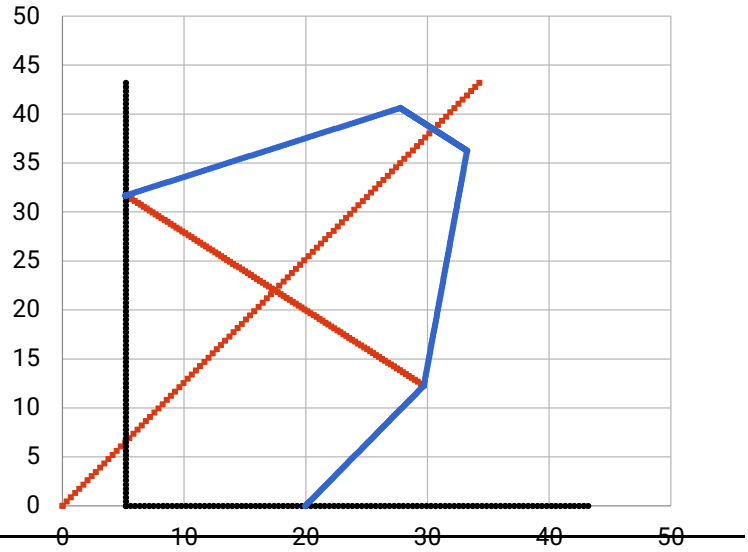
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	9.67 ft
Frame Length:	7.67 ft
Brace Length:	12.34 ft
Angle from Horz:	51.58 deg
Angle from Vert:	38.42 deg

Gusset Plate Geometry

Brace on Gusset:	19.00 in
Length along Beam:	14.74 in
Length along Column:	31.70 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	0.00 in
a:	7.84 in
b:	16.44 in
r:	20.99

Max Brace Force, Pu = **512 kips**

Vub:	0.000 x Pu	= **0 kips**	V= Vertical Force
Hub:	0.374 x Pu	= **192 kips**	H= Horizontal Force
Vuc:	0.783 x Pu	= **402 kips**	b= Beam Side
Huc:	0.248 x Pu	= **127 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	5/16	Weld to Column Size:	6/16
Interaction for Vub:	0.000	Interaction for Vuc:	0.732
Interaction for Hub:	0.879	Interaction for Huc:	0.154
Total Interaction:	**0.879**	Total Interaction:	**0.886**

Gusset Design

Buckling Capacity:	452k OK
Yielding Capacity:	1302k OK
Block Shear Capacity:	1099k OK

SCBF GUSSET DESIGN

BF2 Top, Gusset 3

GENERAL CRITERIA

Frame Height:	9.67 ft	Beam Size:	W8X40
Frame Length:	7.67 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS5X5X1/2
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

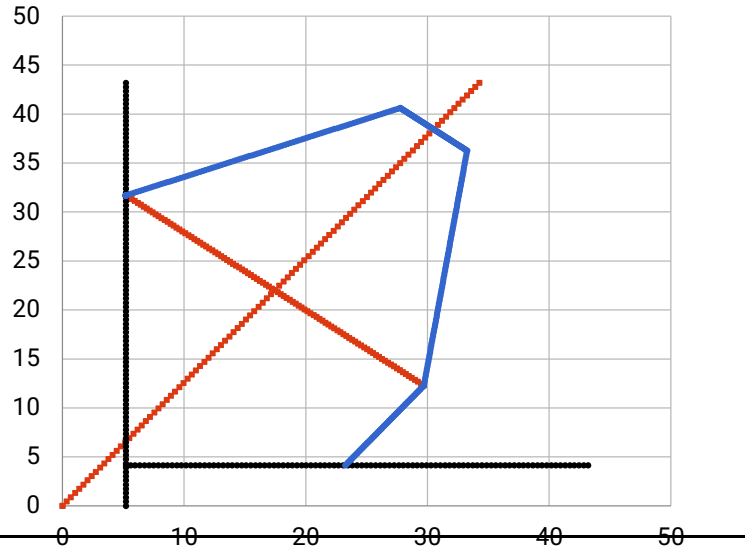
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	9.67 ft
Frame Length:	7.67 ft
Brace Length:	12.34 ft
Angle from Horz:	51.58 deg
Angle from Vert:	38.42 deg

Gusset Plate Geometry

Brace on Gusset:	19.00 in
Length along Beam:	18.01 in
Length along Column:	27.57 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	9.46 in
b:	14.36 in
r:	23.60

Max Brace Force, Pu = **512 kips**

Vub:	0.175 x Pu	= **90 kips**	V= Vertical Force
Hub:	0.401 x Pu	= **206 kips**	H= Horizontal Force
Vuc:	0.609 x Pu	= **312 kips**	b= Beam Side
Huc:	0.220 x Pu	= **113 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	6/16	Weld to Column Size:	5/16
Interaction for Vub:	0.190	Interaction for Vuc:	0.780
Interaction for Hub:	0.652	Interaction for Huc:	0.188
Total Interaction:	**0.841**	Total Interaction:	**0.969**

Gusset Design

Buckling Capacity:	452k OK
Yielding Capacity:	1302k OK
Block Shear Capacity:	1099k OK

SCBF GUSSET DESIGN

BF2 Bottom, Gusset 4

GENERAL CRITERIA

Frame Height:	9.67 ft	Beam Size:	W8X40
Frame Length:	7.67 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS5X5X1/2
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

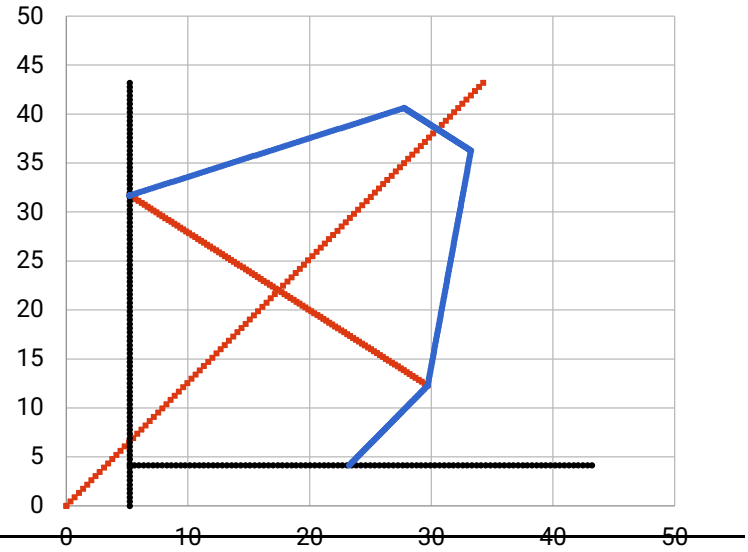
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	9.67 ft
Frame Length:	7.67 ft
Brace Length:	12.34 ft
Angle from Horz:	51.58 deg
Angle from Vert:	38.42 deg

Gusset Plate Geometry

Brace on Gusset:	19.00 in
Length along Beam:	18.01 in
Length along Column:	27.57 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	9.46 in
b:	14.36 in
r:	23.60

Max Brace Force, Pu = **512 kips**

Vub:	0.175 x Pu	= **90 kips**	V= Vertical Force
Hub:	0.401 x Pu	= **206 kips**	H= Horizontal Force
Vuc:	0.609 x Pu	= **312 kips**	b= Beam Side
Huc:	0.220 x Pu	= **113 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	6/16	Weld to Column Size:	5/16
Interaction for Vub:	0.190	Interaction for Vuc:	0.780
Interaction for Hub:	0.652	Interaction for Huc:	0.188
Total Interaction:	**0.841**	Total Interaction:	**0.969**

Gusset Design

Buckling Capacity:	452k OK
Yielding Capacity:	1302k OK
Block Shear Capacity:	1099k OK

SCBF GUSSET DESIGN

BF3 Top, Gusset 5

GENERAL CRITERIA

Frame Height:	8.17 ft	Beam Size:	W12X45
Frame Length:	7.67 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS5X5X1/2
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

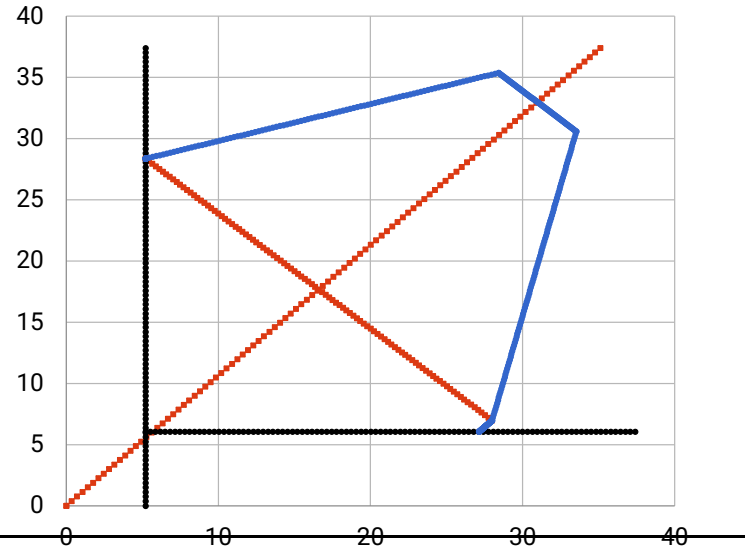
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	8.17 ft
Frame Length:	7.67 ft
Brace Length:	11.20 ft
Angle from Horz:	46.80 deg
Angle from Vert:	43.20 deg

Gusset Plate Geometry

Brace on Gusset:	19.00 in
Length along Beam:	21.92 in
Length along Column:	22.31 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	6.05 in
a:	11.44 in
b:	11.67 in
r:	24.31

Max Brace Force, Pu = **512 kips**

Vub:	0.249 x Pu	= **128 kips**	V= Vertical Force
Hub:	0.471 x Pu	= **242 kips**	H= Horizontal Force
Vuc:	0.480 x Pu	= **246 kips**	b= Beam Side
Huc:	0.214 x Pu	= **110 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	6/16	Weld to Column Size:	5/16
Interaction for Vub:	0.223	Interaction for Vuc:	0.757
Interaction for Hub:	0.633	Interaction for Huc:	0.226
Total Interaction:	**0.856**	Total Interaction:	**0.983**

Gusset Design

Buckling Capacity:	452k OK
Yielding Capacity:	1302k OK
Block Shear Capacity:	1099k OK

SCBF GUSSET DESIGN

BF3 Bottom, Gusset 6

GENERAL CRITERIA

Frame Height:	8.17 ft	Beam Size:	W8X40
Frame Length:	7.67 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS5X5X1/2
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

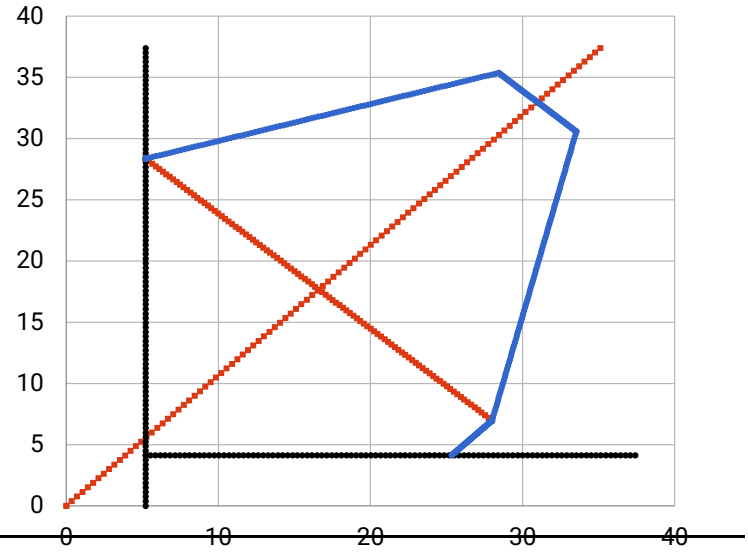
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	8.17 ft
Frame Length:	7.67 ft
Brace Length:	11.20 ft
Angle from Horz:	46.80 deg
Angle from Vert:	43.20 deg

Gusset Plate Geometry

Brace on Gusset:	19.00 in
Length along Beam:	20.11 in
Length along Column:	24.23 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	10.54 in
b:	12.64 in
r:	22.99

Max Brace Force, Pu = **512 kips**

Vub:	0.179 x Pu	= **92 kips**	V= Vertical Force
Hub:	0.458 x Pu	= **235 kips**	H= Horizontal Force
Vuc:	0.550 x Pu	= **282 kips**	b= Beam Side
Huc:	0.226 x Pu	= **116 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	6/16	Weld to Column Size:	6/16
Interaction for Vub:	0.174	Interaction for Vuc:	0.668
Interaction for Hub:	0.667	Interaction for Huc:	0.183
Total Interaction:	**0.842**	Total Interaction:	**0.851**

Gusset Design

Buckling Capacity:	452k OK
Yielding Capacity:	1302k OK
Block Shear Capacity:	1099k OK

SCBF GUSSET DESIGN

BF4 Top, Gusset 7

GENERAL CRITERIA

Frame Height:	5.50 ft	Beam Size:	W12X45
Frame Length:	7.67 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS3X3X3/8
Gusset Thickness:	0.75 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

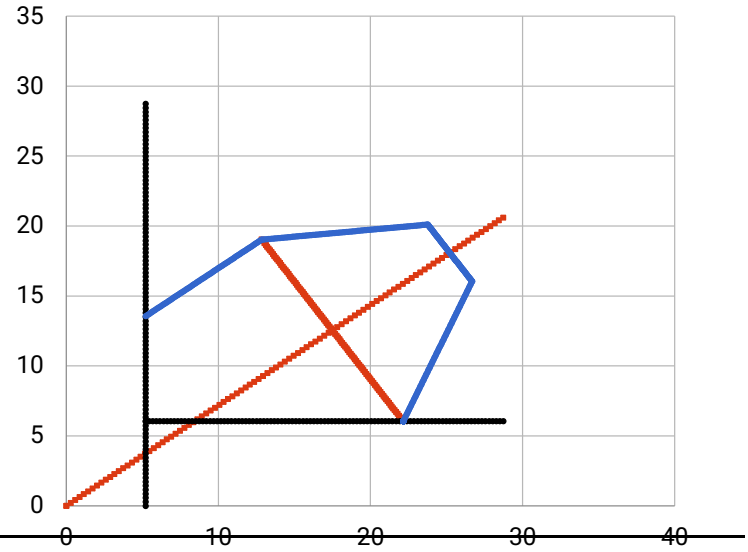
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	5.50 ft
Frame Length:	7.67 ft
Brace Length:	9.44 ft
Angle from Horz:	35.64 deg
Angle from Vert:	54.36 deg

Gusset Plate Geometry

Brace on Gusset:	8.00 in
Length along Beam:	16.94 in
Length along Column:	7.50 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	6.05 in
a:	9.11 in
b:	4.21 in
r:	17.61

Max Brace Force, Pu = **220 kips**

Vub:	0.344 x Pu	= **76 kips**	V= Vertical Force
Hub:	0.517 x Pu	= **114 kips**	H= Horizontal Force
Vuc:	0.239 x Pu	= **53 kips**	b= Beam Side
Huc:	0.295 x Pu	= **66 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	4/16	Weld to Column Size:	5/16
Interaction for Vub:	0.250	Interaction for Vuc:	0.452
Interaction for Hub:	0.562	Interaction for Huc:	0.376
Total Interaction:	**0.812**	Total Interaction:	**0.828**

Gusset Design

Buckling Capacity:	305k	OK
Yielding Capacity:	481k	OK
Block Shear Capacity:	380k	OK

SCBF GUSSET DESIGN

BF4 Bottom, Gusset 8

GENERAL CRITERIA

Frame Height:	5.50 ft	Beam Size:	W12X45
Frame Length:	7.67 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS3X3X3/8
Gusset Thickness:	0.75 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

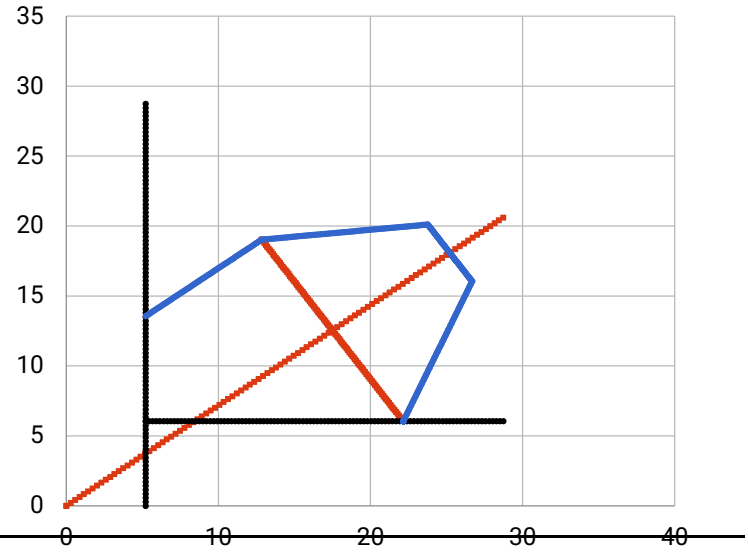
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	5.50 ft
Frame Length:	7.67 ft
Brace Length:	9.44 ft
Angle from Horz:	35.64 deg
Angle from Vert:	54.36 deg

Gusset Plate Geometry

Brace on Gusset:	8.00 in
Length along Beam:	16.94 in
Length along Column:	7.50 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	6.05 in
a:	9.11 in
b:	4.21 in
r:	17.61

Max Brace Force, Pu = **220 kips**

Vub:	0.344 x Pu	= **76 kips**	V= Vertical Force
Hub:	0.517 x Pu	= **114 kips**	H= Horizontal Force
Vuc:	0.239 x Pu	= **53 kips**	b= Beam Side
Huc:	0.295 x Pu	= **66 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	4/16	Weld to Column Size:	5/16
Interaction for Vub:	0.250	Interaction for Vuc:	0.452
Interaction for Hub:	0.562	Interaction for Huc:	0.376
Total Interaction:	**0.812**	Total Interaction:	**0.828**

Gusset Design

Buckling Capacity:	305k	OK
Yielding Capacity:	481k	OK
Block Shear Capacity:	380k	OK

SCBF GUSSET DESIGN

BF5 Top, Gusset 9

GENERAL CRITERIA

Frame Height:	9.67 ft	Beam Size:	W14X132
Frame Length:	15.31 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS5X5X1/2
Gusset Thickness:	0.75 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

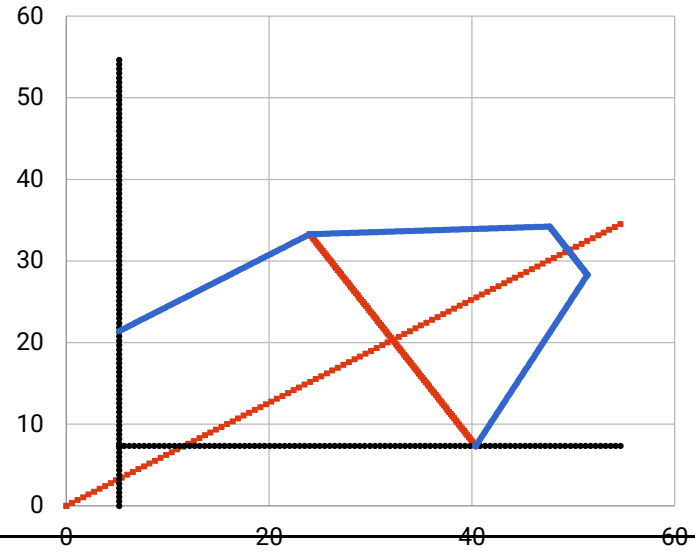
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	9.67 ft
Frame Length:	15.31 ft
Brace Length:	18.11 ft
Angle from Horz:	32.27 deg
Angle from Vert:	57.73 deg

Gusset Plate Geometry

Brace on Gusset:	19.00 in
Length along Beam:	35.16 in
Length along Column:	14.07 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	7.35 in
a:	18.28 in
b:	7.48 in
r:	27.77

Max Brace Force, Pu = **512 kips**

Vub:	0.265 x Pu	= **136 kips**
Hub:	0.658 x Pu	= **338 kips**
Vuc:	0.269 x Pu	= **138 kips**
Huc:	0.187 x Pu	= **96 kips**

V= Vertical Force
H= Horizontal Force
b= Beam Side
c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	5/16	Weld to Column Size:	5/16
Interaction for Vub:	0.178	Interaction for Vuc:	0.663
Interaction for Hub:	0.664	Interaction for Huc:	0.307
Total Interaction:	**0.842**	Total Interaction:	**0.970**

Gusset Design

Buckling Capacity:	191k	OK
Yielding Capacity:	977k	OK
Block Shear Capacity:	824k	OK

SCBF GUSSET DESIGN

BF5 Bottom, Gusset 10

GENERAL CRITERIA

Frame Height:	9.67 ft	Beam Size:	BasePlate
Frame Length:	15.31 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS5X5X1/2
Gusset Thickness:	0.75 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

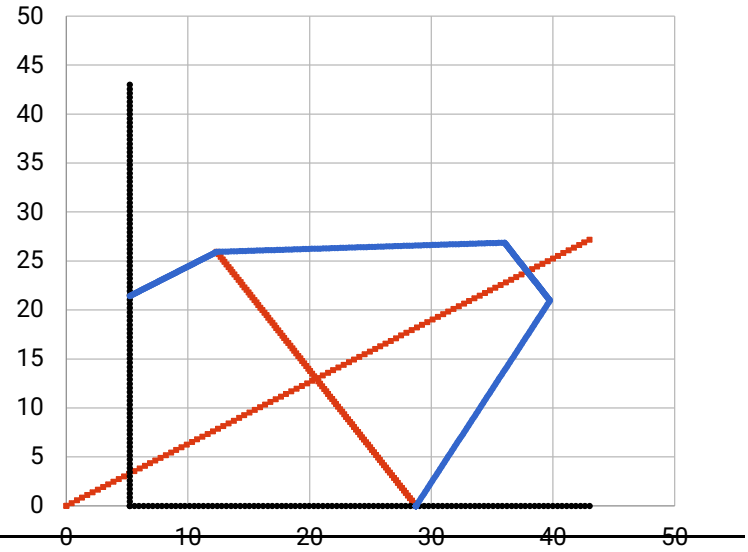
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	9.67 ft
Frame Length:	15.31 ft
Brace Length:	18.11 ft
Angle from Horz:	32.27 deg
Angle from Vert:	57.73 deg

Gusset Plate Geometry

Brace on Gusset:	19.00 in
Length along Beam:	23.52 in
Length along Column:	21.42 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	0.00 in
a:	12.35 in
b:	11.09 in
r:	20.76

Max Brace Force, Pu = **512 kips**

Vub:	0.000 x Pu	= **0 kips**	V= Vertical Force
Hub:	0.595 x Pu	= **305 kips**	H= Horizontal Force
Vuc:	0.534 x Pu	= **274 kips**	b= Beam Side
Huc:	0.250 x Pu	= **129 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	5/16	Weld to Column Size:	6/16
Interaction for Vub:	0.000	Interaction for Vuc:	0.740
Interaction for Hub:	0.887	Interaction for Huc:	0.232
Total Interaction:	**0.887**	Total Interaction:	**0.972**

Gusset Design

Buckling Capacity:	191k	OK
Yielding Capacity:	977k	OK
Block Shear Capacity:	824k	OK

SCBF GUSSET DESIGN

BF6 Top, Gusset 11

GENERAL CRITERIA

Frame Height:	9.67 ft	Beam Size:	W14X132
Frame Length:	15.31 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS5X5X1/2
Gusset Thickness:	0.75 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

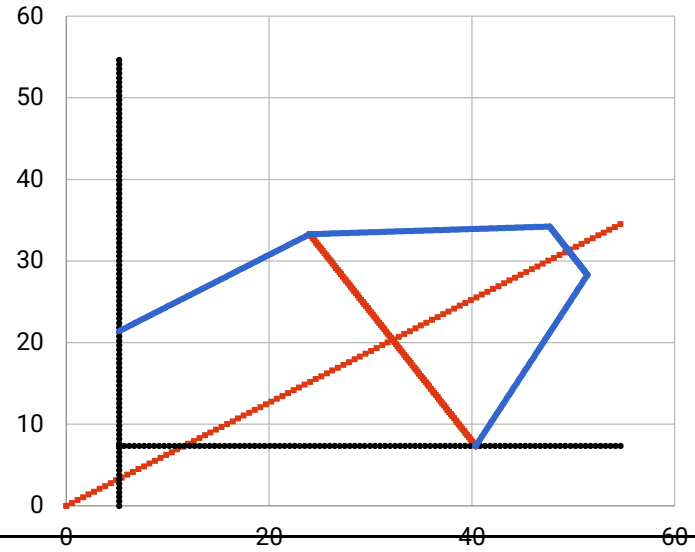
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	9.67 ft
Frame Length:	15.31 ft
Brace Length:	18.11 ft
Angle from Horz:	32.27 deg
Angle from Vert:	57.73 deg

Gusset Plate Geometry

Brace on Gusset:	19.00 in
Length along Beam:	35.16 in
Length along Column:	14.07 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	7.35 in
a:	18.28 in
b:	7.48 in
r:	27.77

Max Brace Force, Pu = **512 kips**

Vub:	0.265 x Pu	= **136 kips**	V= Vertical Force
Hub:	0.658 x Pu	= **338 kips**	H= Horizontal Force
Vuc:	0.269 x Pu	= **138 kips**	b= Beam Side
Huc:	0.187 x Pu	= **96 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	5/16	Weld to Column Size:	5/16
Interaction for Vub:	0.178	Interaction for Vuc:	0.663
Interaction for Hub:	0.664	Interaction for Huc:	0.307
Total Interaction:	**0.842**	Total Interaction:	**0.970**

Gusset Design

Buckling Capacity:	191k	OK
Yielding Capacity:	977k	OK
Block Shear Capacity:	824k	OK

SCBF GUSSET DESIGN

BF6 Bottom, Gusset 12

GENERAL CRITERIA

Frame Height:	9.67 ft	Beam Size:	W14X132
Frame Length:	15.31 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS5X5X1/2
Gusset Thickness:	0.75 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

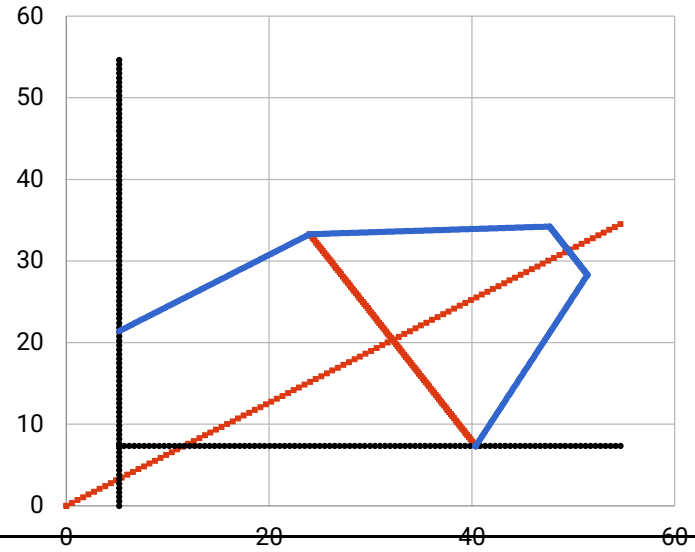
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	9.67 ft
Frame Length:	15.31 ft
Brace Length:	18.11 ft
Angle from Horz:	32.27 deg
Angle from Vert:	57.73 deg

Gusset Plate Geometry

Brace on Gusset:	19.00 in
Length along Beam:	35.16 in
Length along Column:	14.07 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	7.35 in
a:	18.28 in
b:	7.48 in
r:	27.77

Max Brace Force, Pu = **512 kips**

Vub:	0.265 x Pu	= **136 kips**
Hub:	0.658 x Pu	= **338 kips**
Vuc:	0.269 x Pu	= **138 kips**
Huc:	0.187 x Pu	= **96 kips**

V= Vertical Force
H= Horizontal Force
b= Beam Side
c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	5/16	Weld to Column Size:	5/16
Interaction for Vub:	0.178	Interaction for Vuc:	0.663
Interaction for Hub:	0.664	Interaction for Huc:	0.307
Total Interaction:	**0.842**	Total Interaction:	**0.970**

Gusset Design

Buckling Capacity:	191k	OK
Yielding Capacity:	977k	OK
Block Shear Capacity:	824k	OK

SCBF GUSSET DESIGN

BF7 Top, Gusset 13

GENERAL CRITERIA

Frame Height:	8.17 ft	Beam Size:	W12X45
Frame Length:	15.31 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS5X5X1/2
Gusset Thickness:	0.75 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

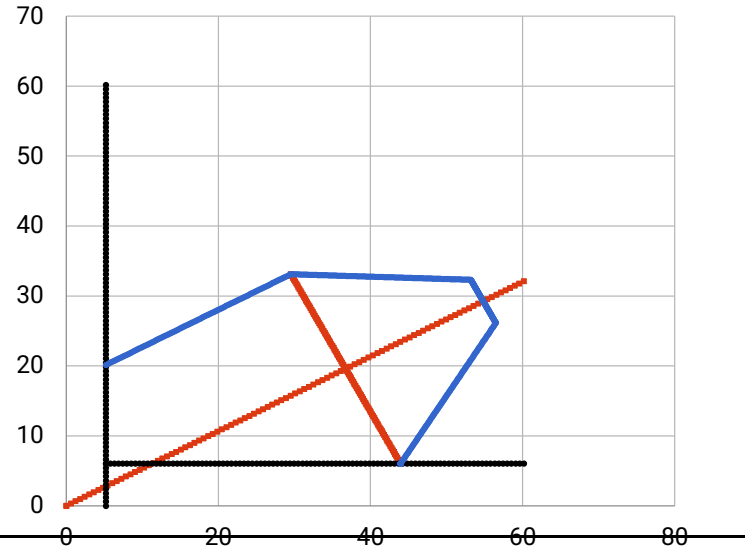
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	8.17 ft
Frame Length:	15.31 ft
Brace Length:	17.35 ft
Angle from Horz:	28.07 deg
Angle from Vert:	61.93 deg

Gusset Plate Geometry

Brace on Gusset:	19.00 in
Length along Beam:	38.73 in
Length along Column:	14.10 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	6.05 in
a:	20.16 in
b:	7.47 in
r:	28.74

Max Brace Force, Pu = **512 kips**

Vub:	0.211 x Pu	= **108 kips**	V= Vertical Force
Hub:	0.701 x Pu	= **360 kips**	H= Horizontal Force
Vuc:	0.260 x Pu	= **134 kips**	b= Beam Side
Huc:	0.181 x Pu	= **93 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	4/16	Weld to Column Size:	5/16
Interaction for Vub:	0.160	Interaction for Vuc:	0.644
Interaction for Hub:	0.802	Interaction for Huc:	0.298
Total Interaction:	**0.962**	Total Interaction:	**0.942**

Gusset Design

Buckling Capacity:	191k	OK
Yielding Capacity:	977k	OK
Block Shear Capacity:	824k	OK

SCBF GUSSET DESIGN

BF7 Bottom, Gusset 14

GENERAL CRITERIA

Frame Height:	8.17 ft	Beam Size:	W14X132
Frame Length:	15.31 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS5X5X1/2
Gusset Thickness:	0.75 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

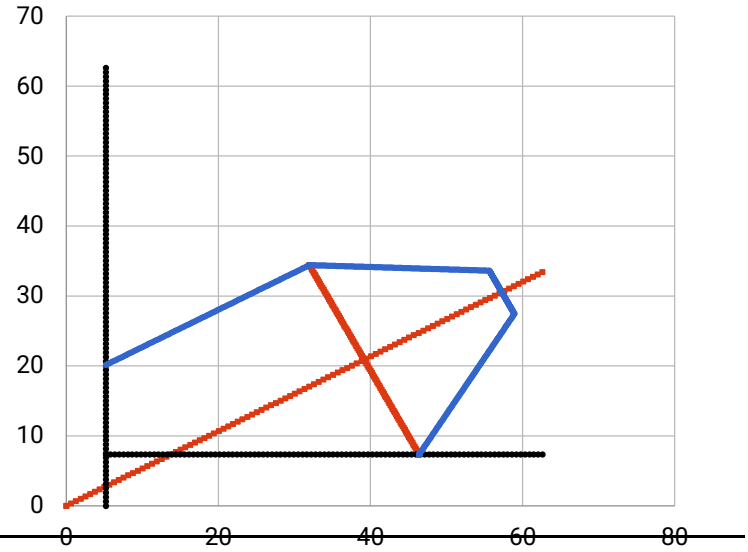
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	8.17 ft
Frame Length:	15.31 ft
Brace Length:	17.35 ft
Angle from Horz:	28.07 deg
Angle from Vert:	61.93 deg

Gusset Plate Geometry

Brace on Gusset:	19.00 in
Length along Beam:	41.17 in
Length along Column:	12.80 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	7.35 in
a:	21.40 in
b:	6.84 in
r:	30.15

Max Brace Force, Pu = **512 kips**

Vub:	0.244 x Pu	= **125 kips**	V= Vertical Force
Hub:	0.710 x Pu	= **364 kips**	H= Horizontal Force
Vuc:	0.227 x Pu	= **117 kips**	b= Beam Side
Huc:	0.172 x Pu	= **89 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	4/16	Weld to Column Size:	5/16
Interaction for Vub:	0.175	Interaction for Vuc:	0.615
Interaction for Hub:	0.764	Interaction for Huc:	0.312
Total Interaction:	**0.938**	Total Interaction:	**0.926**

Gusset Design

Buckling Capacity:	191k	OK
Yielding Capacity:	977k	OK
Block Shear Capacity:	824k	OK

SCBF GUSSET DESIGN

BF8 Top, Gusset 15

GENERAL CRITERIA

Frame Height:	7.50 ft	Beam Size:	W12X45
Frame Length:	15.31 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS3X3X3/8
Gusset Thickness:	0.75 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

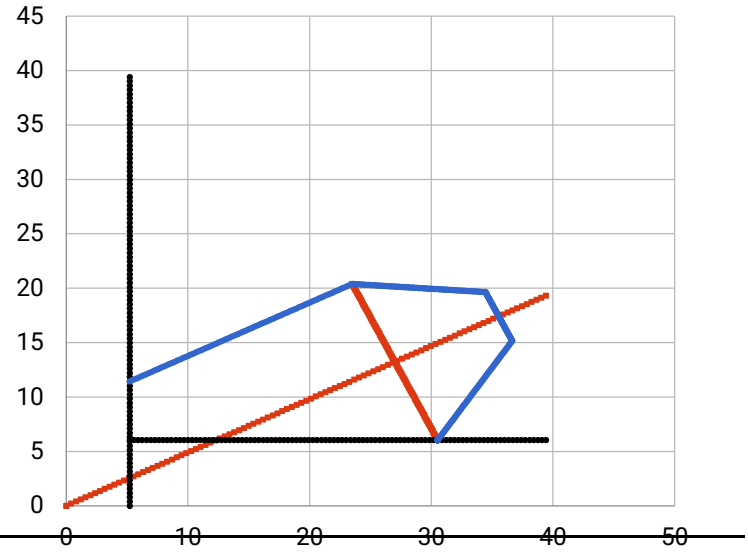
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	7.50 ft
Frame Length:	15.31 ft
Brace Length:	17.05 ft
Angle from Horz:	26.10 deg
Angle from Vert:	63.90 deg

Gusset Plate Geometry

Brace on Gusset:	8.00 in
Length along Beam:	25.30 in
Length along Column:	5.39 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	6.05 in
a:	13.57 in
b:	3.14 in
r:	20.90

Max Brace Force, Pu = **220 kips**

Vub:	0.289 x Pu	= **64 kips**	V= Vertical Force
Hub:	0.649 x Pu	= **144 kips**	H= Horizontal Force
Vuc:	0.150 x Pu	= **34 kips**	b= Beam Side
Huc:	0.249 x Pu	= **55 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	3/16	Weld to Column Size:	5/16
Interaction for Vub:	0.188	Interaction for Vuc:	0.389
Interaction for Hub:	0.635	Interaction for Huc:	0.419
Total Interaction:	**0.824**	Total Interaction:	**0.807**

Gusset Design

Buckling Capacity:	305k	OK
Yielding Capacity:	481k	OK
Block Shear Capacity:	380k	OK

SCBF GUSSET DESIGN

BF8 Bottom, Gusset 16

GENERAL CRITERIA

Frame Height:	7.50 ft	Beam Size:	W12X45
Frame Length:	15.31 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS3X3X3/8
Gusset Thickness:	0.75 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

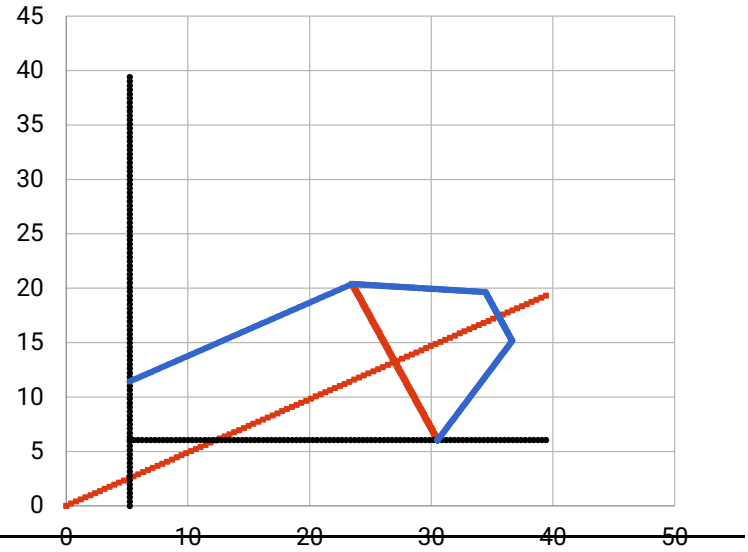
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	7.50 ft
Frame Length:	15.31 ft
Brace Length:	17.05 ft
Angle from Horz:	26.10 deg
Angle from Vert:	63.90 deg

Gusset Plate Geometry

Brace on Gusset:	8.00 in
Length along Beam:	25.30 in
Length along Column:	5.39 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	6.05 in
a:	13.57 in
b:	3.14 in
r:	20.90

Max Brace Force, Pu = **220 kips**

Vub:	0.289 x Pu	= **64 kips**	V= Vertical Force
Hub:	0.649 x Pu	= **144 kips**	H= Horizontal Force
Vuc:	0.150 x Pu	= **34 kips**	b= Beam Side
Huc:	0.249 x Pu	= **55 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	3/16	Weld to Column Size:	5/16
Interaction for Vub:	0.188	Interaction for Vuc:	0.389
Interaction for Hub:	0.635	Interaction for Huc:	0.419
Total Interaction:	**0.824**	Total Interaction:	**0.807**

Gusset Design

Buckling Capacity:	305k	OK
Yielding Capacity:	481k	OK
Block Shear Capacity:	380k	OK

DESIGN MODULE - SCBF Gusset Design

Michael Baker INTERNATIONAL

Creech DRP Phase 1 AOF

TYPICAL BRACED FRAME DESIGN INFORMATION

Frame Height:	20.00 ft	Gusset Plate Fy:	50 ksi
Floor Thickness:	0.00 in	Weld Size Brace to Gusset:	5 /16
Gusset Thickness:	0.75 in	Corner Snip:	1.00 in
Measured from Top of Slab:	No		
Beam Size Above:	W10X26		
Beam Size Below:	BasePlate		
Column Size:	W12X106		
Brace Size:	HSS8X8X1/2		
Brace Grade:	A500 Gr C		

BRACED FRAME GUSSET SUMMARY SCHEDULE

FRAME ID	GUSSET MARK	LENGTH	HEIGHT	BEAM		COLUMN	BRACE	STATUS
BF9	17	18.42 ft	29.50 ft	TOP	W8X40	W10X68	HSS6X6X1/2	PASS
	18			BTM	BasePlate			PASS
BF10	19	18.42 ft	4.83 ft	TOP	W8X40	W10X68	HSS3X3X3/8	PASS
	20			BTM	W8X40			PASS
BF11	21	12.75 ft	10.50 ft	TOP	W16X31	W10X68	HSS6X6X1/2	PASS
	22			BTM	BasePlate			PASS
BF12	23	12.75 ft	15.17 ft	TOP	W8X40	W10X68	HSS6X6X1/2	PASS
	24			BTM	W16X31			PASS
BF13	25	12.71 ft	17.17 ft	TOP	W8X40	W10X68	HSS8X8X5/8	PASS
	26			BTM	BasePlate			PASS
BF14	27	12.71 ft	9.79 ft	TOP	W8X40	W10X68	HSS8X8X5/8	PASS
	28			BTM	W8X40			PASS
BF16	31	23.84 ft	27.75 ft	TOP	W8X40	W10X68	HSS8X8X5/8	PASS
	32			BTM	BasePlate			PASS

SCBF GUSSET DESIGN

BF9 Top, Gusset 1

GENERAL CRITERIA

Frame Height:	29.50 ft	Beam Size:	W8X40
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	0.75 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

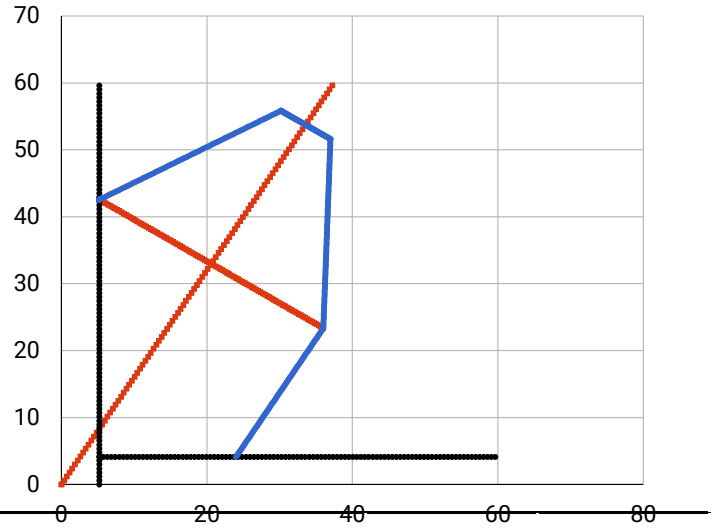
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	29.50 ft
Frame Length:	18.42 ft
Brace Length:	34.78 ft
Angle from Horz:	58.02 deg
Angle from Vert:	31.98 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	18.77 in
Length along Column:	38.46 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in	Max Brace Force, Pu		**= 631 kips**	
eb:	4.13 in	Vub:	0.146 x Pu	**= 92 kips**	V= Vertical Force
a:	9.81 in	Hub:	0.346 x Pu	**= 219 kips**	H= Horizontal Force
b:	19.91 in	Vuc:	0.703 x Pu	**= 444 kips**	b= Beam Side
r:	28.34	Huc:	0.183 x Pu	**= 116 kips**	c= Column Side

Welding of Gusset Connection

				Gusset Design	
Weld to Beam Size:	6/16	Weld to Column Size:	5/16	Buckling Capacity:	160k OK
Interaction for Vub:	0.187	Interaction for Vuc:	0.801	Yielding Capacity:	1166k OK
Interaction for Hub:	0.668	Interaction for Huc:	0.139	Block Shear Capacity:	996k OK
Total Interaction:	**0.855**	Total Interaction:	**0.940**		

SCBF GUSSET DESIGN

BF9 Bottom, Gusset 2

GENERAL CRITERIA

Frame Height:	29.50 ft	Beam Size:	BasePlate
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	0.75 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

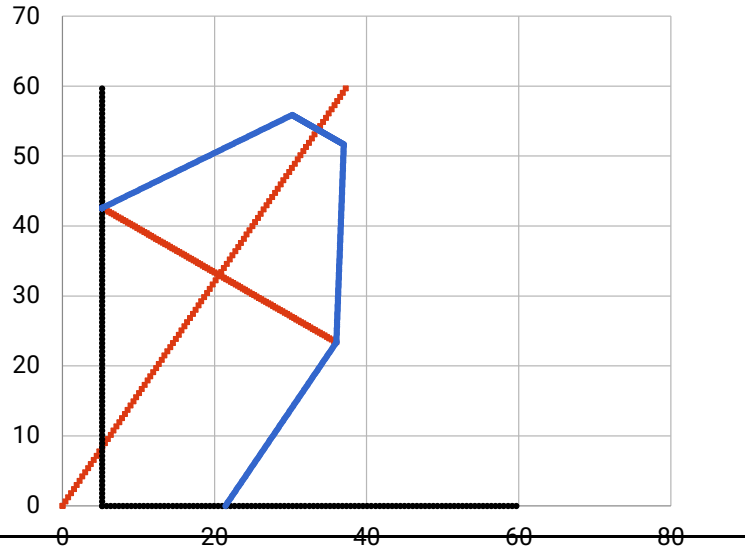
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	29.50 ft
Frame Length:	18.42 ft
Brace Length:	34.78 ft
Angle from Horz:	58.02 deg
Angle from Vert:	31.98 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	16.19 in
Length along Column:	42.59 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	0.00 in
a:	8.54 in
b:	22.01 in
r:	25.95

Max Brace Force, Pu = **631 kips**

Vub:	0.000 x Pu	= **0 kips**	V= Vertical Force
Hub:	0.329 x Pu	= **208 kips**	H= Horizontal Force
Vuc:	0.848 x Pu	= **535 kips**	b= Beam Side
Huc:	0.200 x Pu	= **127 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	5/16	Weld to Column Size:	6/16
Interaction for Vub:	0.000	Interaction for Vuc:	0.728
Interaction for Hub:	0.875	Interaction for Huc:	0.115
Total Interaction:	**0.875**	Total Interaction:	**0.843**

Gusset Design

Buckling Capacity:	160k OK
Yielding Capacity:	1166k OK
Block Shear Capacity:	996k OK

SCBF GUSSET DESIGN

BF10 Top, Gusset 3

GENERAL CRITERIA

Frame Height:	4.83 ft	Beam Size:	W8X40
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS3X3X3/8
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

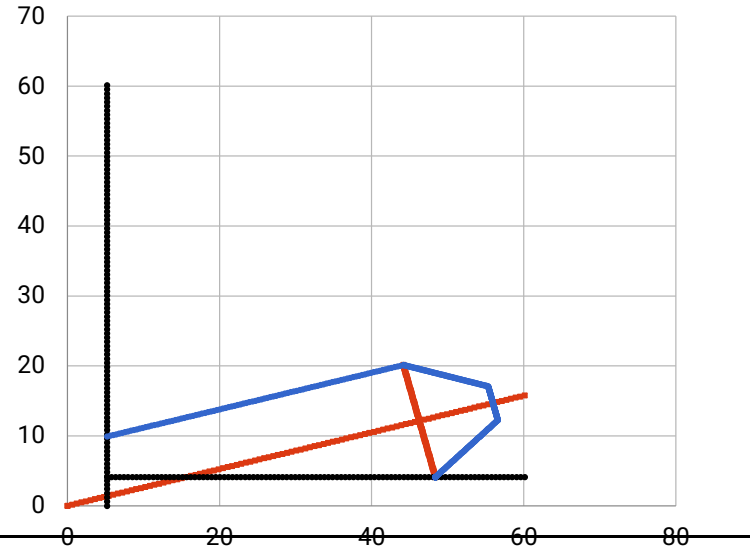
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	4.83 ft
Frame Length:	18.42 ft
Brace Length:	19.04 ft
Angle from Horz:	14.69 deg
Angle from Vert:	75.31 deg

Gusset Plate Geometry

Brace on Gusset:	8.00 in
Length along Beam:	43.15 in
Length along Column:	5.79 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	23.12 in
b:	3.30 in
r:	29.28

Max Brace Force, Pu = **220 kips**

Vub:	0.141 x Pu	= **32 kips**	V= Vertical Force
Hub:	0.790 x Pu	= **175 kips**	H= Horizontal Force
Vuc:	0.113 x Pu	= **25 kips**	b= Beam Side
Huc:	0.178 x Pu	= **40 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	2/16	Weld to Column Size:	3/16
Interaction for Vub:	0.083	Interaction for Vuc:	0.453
Interaction for Hub:	0.680	Interaction for Huc:	0.484
Total Interaction:	**0.763**	Total Interaction:	**0.937**

Gusset Design

Buckling Capacity:	496k	OK
Yielding Capacity:	641k	OK
Block Shear Capacity:	506k	OK

SCBF GUSSET DESIGN

BF10 Bottom, Gusset 4

GENERAL CRITERIA

Frame Height:	4.83 ft	Beam Size:	W8X40
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS3X3X3/8
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

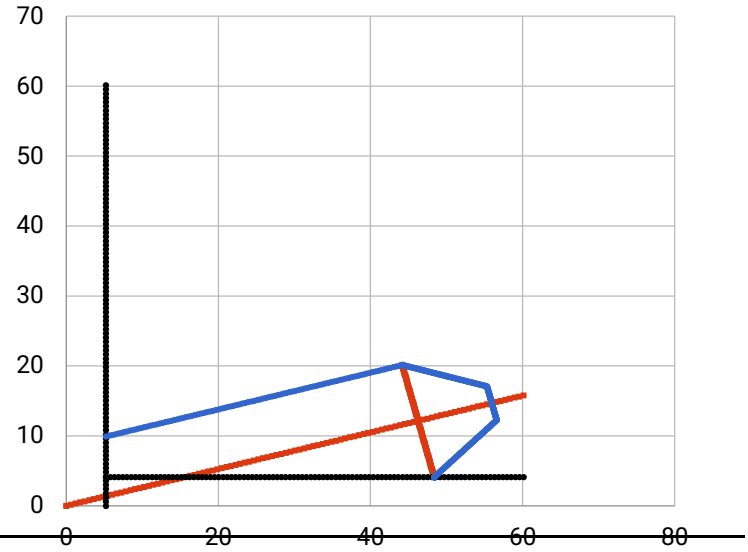
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	4.83 ft
Frame Length:	18.42 ft
Brace Length:	19.04 ft
Angle from Horz:	14.69 deg
Angle from Vert:	75.31 deg

Gusset Plate Geometry

Brace on Gusset:	8.00 in
Length along Beam:	43.15 in
Length along Column:	5.79 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	23.12 in
b:	3.30 in
r:	29.28

Max Brace Force, Pu = **220 kips**

Vub:	0.141 x Pu	= **32 kips**	V= Vertical Force
Hub:	0.790 x Pu	= **175 kips**	H= Horizontal Force
Vuc:	0.113 x Pu	= **25 kips**	b= Beam Side
Huc:	0.178 x Pu	= **40 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	2/16	Weld to Column Size:	3/16
Interaction for Vub:	0.083	Interaction for Vuc:	0.453
Interaction for Hub:	0.680	Interaction for Huc:	0.484
Total Interaction:	**0.763**	Total Interaction:	**0.937**

Gusset Design

Buckling Capacity:	496k	OK
Yielding Capacity:	641k	OK
Block Shear Capacity:	506k	OK

SCBF GUSSET DESIGN

BF11 Top, Gusset 5

GENERAL CRITERIA

Frame Height:	10.50 ft	Beam Size:	W16X31
Frame Length:	12.75 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

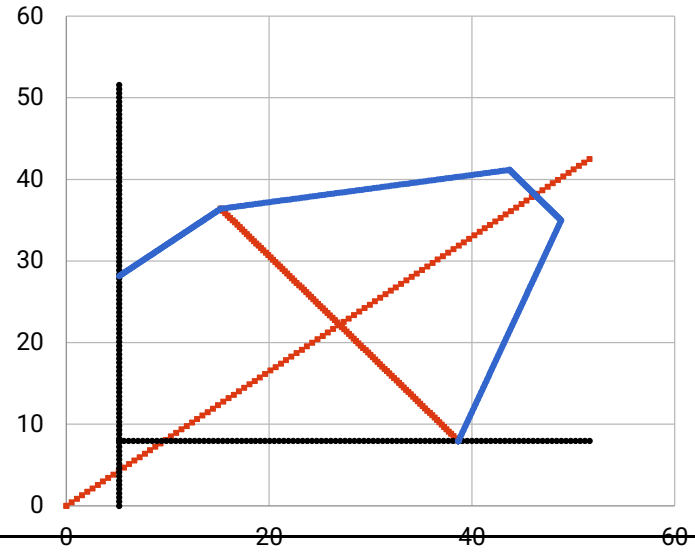
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	10.50 ft
Frame Length:	12.75 ft
Brace Length:	16.52 ft
Angle from Horz:	39.47 deg
Angle from Vert:	50.53 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	33.45 in
Length along Column:	20.21 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	7.95 in
a:	17.29 in
b:	10.57 in
r:	29.14

Max Brace Force, Pu = **631 kips**

Vub:	0.273 x Pu	= **173 kips**	V= Vertical Force
Hub:	0.593 x Pu	= **375 kips**	H= Horizontal Force
Vuc:	0.363 x Pu	= **229 kips**	b= Beam Side
Huc:	0.178 x Pu	= **113 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	6/16	Weld to Column Size:	6/16
Interaction for Vub:	0.200	Interaction for Vuc:	0.648
Interaction for Hub:	0.649	Interaction for Huc:	0.213
Total Interaction:	**0.849**	Total Interaction:	**0.862**

Gusset Design

Buckling Capacity:	378k OK
Yielding Capacity:	1555k OK
Block Shear Capacity:	1328k OK

SCBF GUSSET DESIGN

BF11 Bottom, Gusset 6

GENERAL CRITERIA

Frame Height:	10.50 ft	Beam Size:	BasePlate
Frame Length:	12.75 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

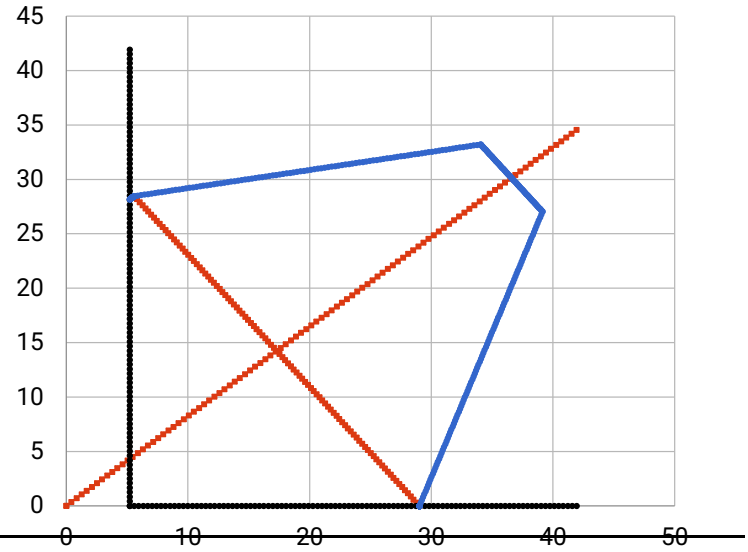
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	10.50 ft
Frame Length:	12.75 ft
Brace Length:	16.52 ft
Angle from Horz:	39.47 deg
Angle from Vert:	50.53 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	23.80 in
Length along Column:	28.16 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in	Max Brace Force, Pu		**= 631 kips**	
eb:	0.00 in	Vub:	0.000 x Pu	**= 0 kips**	V= Vertical Force
a:	12.43 in	Hub:	0.544 x Pu	**= 344 kips**	H= Horizontal Force
b:	14.52 in	Vuc:	0.636 x Pu	**= 401 kips**	b= Beam Side
r:	22.84	Huc:	0.228 x Pu	**= 144 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	6/16	Weld to Column Size:	7/16
Interaction for Vub:	0.000	Interaction for Vuc:	0.709
Interaction for Hub:	0.828	Interaction for Huc:	0.170
Total Interaction:	**0.828**	Total Interaction:	**0.878**

Gusset Design

Buckling Capacity:	378k OK
Yielding Capacity:	1555k OK
Block Shear Capacity:	1328k OK

SCBF GUSSET DESIGN

BF12 Top, Gusset 7

GENERAL CRITERIA

Frame Height:	15.17 ft	Beam Size:	W8X40
Frame Length:	12.75 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

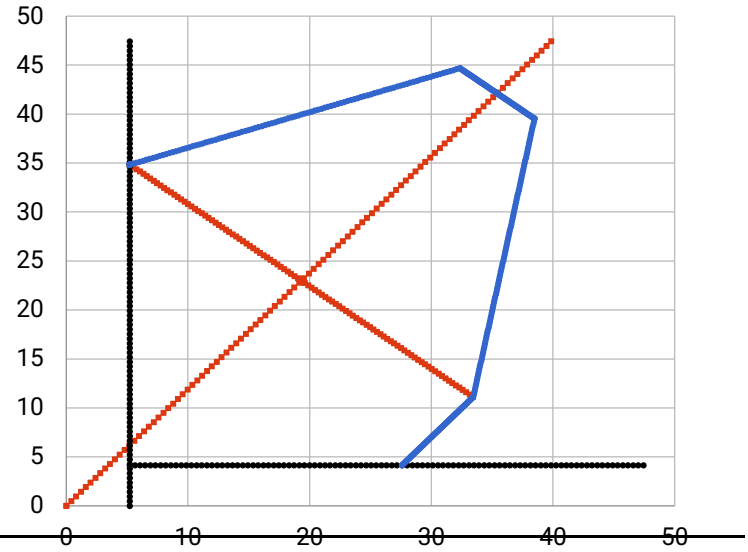
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	15.17 ft
Frame Length:	12.75 ft
Brace Length:	19.81 ft
Angle from Horz:	49.95 deg
Angle from Vert:	40.05 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	22.35 in
Length along Column:	30.71 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	11.64 in
b:	15.91 in
r:	26.17

Max Brace Force, Pu = **631 kips**

Vub:	0.158 x Pu	= **100 kips**	V= Vertical Force
Hub:	0.445 x Pu	= **281 kips**	H= Horizontal Force
Vuc:	0.608 x Pu	= **384 kips**	b= Beam Side
Huc:	0.199 x Pu	= **126 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	6/16	Weld to Column Size:	6/16
Interaction for Vub:	0.171	Interaction for Vuc:	0.723
Interaction for Hub:	0.723	Interaction for Huc:	0.158
Total Interaction:	**0.894**	Total Interaction:	**0.881**

Gusset Design

Buckling Capacity:	378k OK
Yielding Capacity:	1555k OK
Block Shear Capacity:	1328k OK

SCBF GUSSET DESIGN

BF12 Bottom, Gusset 8

GENERAL CRITERIA

Frame Height:	15.17 ft	Beam Size:	W16X31
Frame Length:	12.75 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

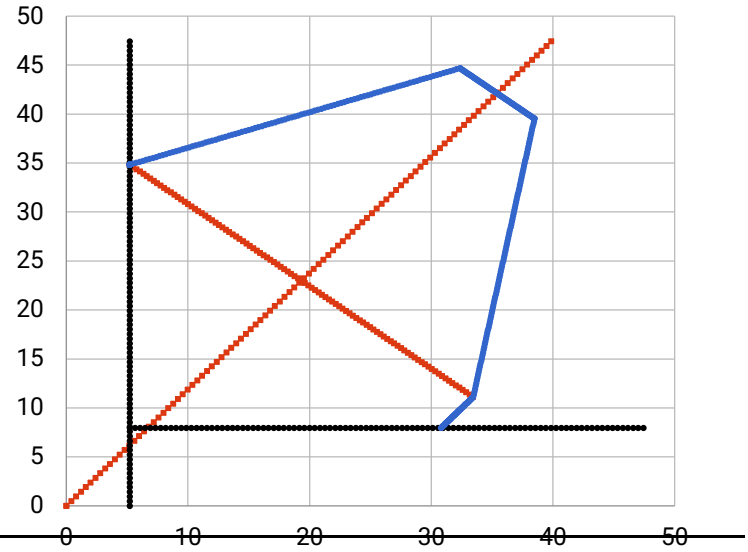
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	15.17 ft
Frame Length:	12.75 ft
Brace Length:	19.81 ft
Angle from Horz:	49.95 deg
Angle from Vert:	40.05 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	25.57 in
Length along Column:	26.88 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	7.95 in
a:	13.24 in
b:	13.98 in
r:	28.65

Max Brace Force, Pu = **631 kips**

Vub:	0.277 x Pu	= **175 kips**	V= Vertical Force
Hub:	0.462 x Pu	= **292 kips**	H= Horizontal Force
Vuc:	0.488 x Pu	= **308 kips**	b= Beam Side
Huc:	0.181 x Pu	= **115 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	6/16	Weld to Column Size:	5/16
Interaction for Vub:	0.264	Interaction for Vuc:	0.791
Interaction for Hub:	0.660	Interaction for Huc:	0.197
Total Interaction:	**0.924**	Total Interaction:	**0.988**

Gusset Design

Buckling Capacity:	378k OK
Yielding Capacity:	1555k OK
Block Shear Capacity:	1328k OK

SCBF GUSSET DESIGN

BF13 Top, Gusset 9

GENERAL CRITERIA

Frame Height:	17.17 ft	Beam Size:	W8X40
Frame Length:	12.71 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS8X8X5/8
Gusset Thickness:	1.38 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	7 /16
		Corner Snip:	1.00 in

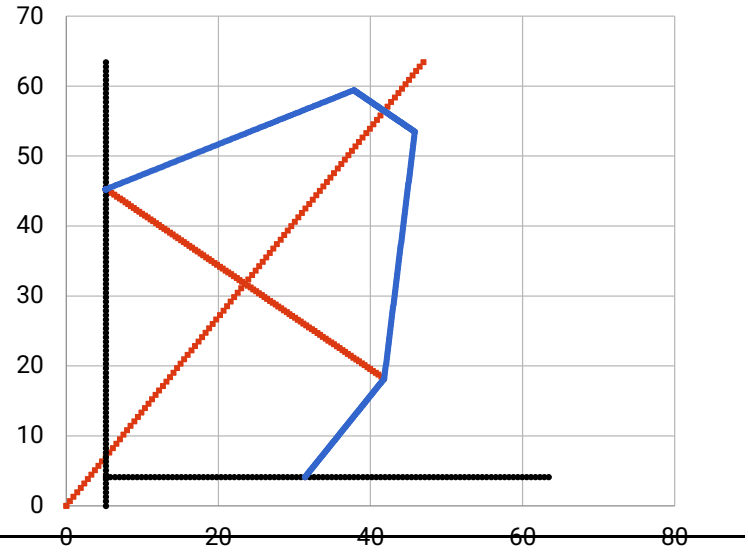
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	17.17 ft
Frame Length:	12.71 ft
Brace Length:	21.36 ft
Angle from Horz:	53.49 deg
Angle from Vert:	36.51 deg

Gusset Plate Geometry

Brace on Gusset:	28.00 in
Length along Beam:	26.16 in
Length along Column:	41.14 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	13.53 in
b:	21.17 in
r:	31.47

Max Brace Force, Pu = **1066 kips**

Vub:	0.131 x Pu	= **140 kips**	V= Vertical Force
Hub:	0.430 x Pu	= **459 kips**	H= Horizontal Force
Vuc:	0.673 x Pu	= **718 kips**	b= Beam Side
Huc:	0.165 x Pu	= **177 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	8/16	Weld to Column Size:	8/16
Interaction for Vub:	0.155	Interaction for Vuc:	0.761
Interaction for Hub:	0.762	Interaction for Huc:	0.125
Total Interaction:	**0.917**	Total Interaction:	**0.887**

Gusset Design

Buckling Capacity:	803k OK
Yielding Capacity:	2619k OK
Block Shear Capacity:	2269k OK

SCBF GUSSET DESIGN

BF13 Bottom, Gusset 10

GENERAL CRITERIA

Frame Height:	17.17 ft	Beam Size:	BasePlate
Frame Length:	12.71 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS8X8X5/8
Gusset Thickness:	1.38 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	7 /16
		Corner Snip:	1.00 in

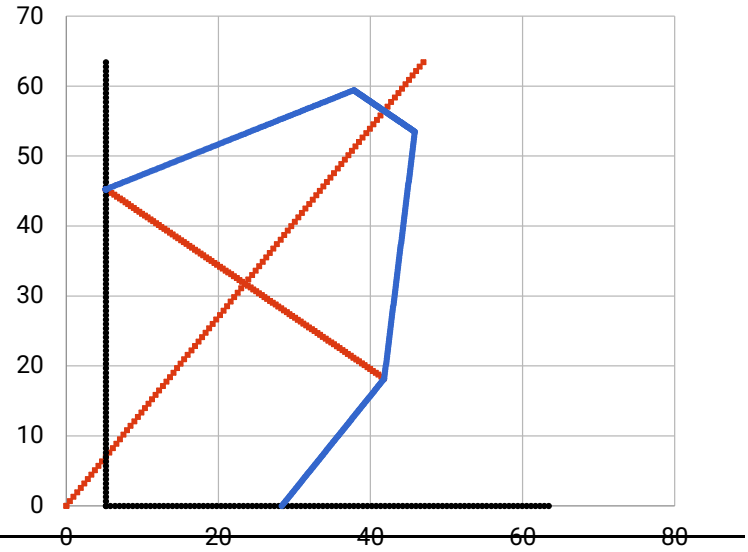
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	17.17 ft
Frame Length:	12.71 ft
Brace Length:	21.36 ft
Angle from Horz:	53.49 deg
Angle from Vert:	36.51 deg

Gusset Plate Geometry

Brace on Gusset:	28.00 in
Length along Beam:	23.11 in
Length along Column:	45.27 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	0.00 in
a:	12.01 in
b:	23.25 in
r:	28.93

Max Brace Force, Pu = **1066 kips**

Vub:	0.000 x Pu	**= 0 kips**	V= Vertical Force
Hub:	0.415 x Pu	**= 443 kips**	H= Horizontal Force
Vuc:	0.804 x Pu	**= 857 kips**	b= Beam Side
Huc:	0.180 x Pu	**= 192 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	7/16	Weld to Column Size:	8/16
Interaction for Vub:	0.000	Interaction for Vuc:	0.828
Interaction for Hub:	0.946	Interaction for Huc:	0.124
Total Interaction:	**0.946**	Total Interaction:	**0.951**

Gusset Design

Buckling Capacity:	803k OK
Yielding Capacity:	2619k OK
Block Shear Capacity:	2269k OK

SCBF GUSSET DESIGN

BF14 Top, Gusset 11

GENERAL CRITERIA

Frame Height:	9.79 ft	Beam Size:	W8X40
Frame Length:	12.71 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS8X8X5/8
Gusset Thickness:	1.50 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	7 /16
		Corner Snip:	1.00 in

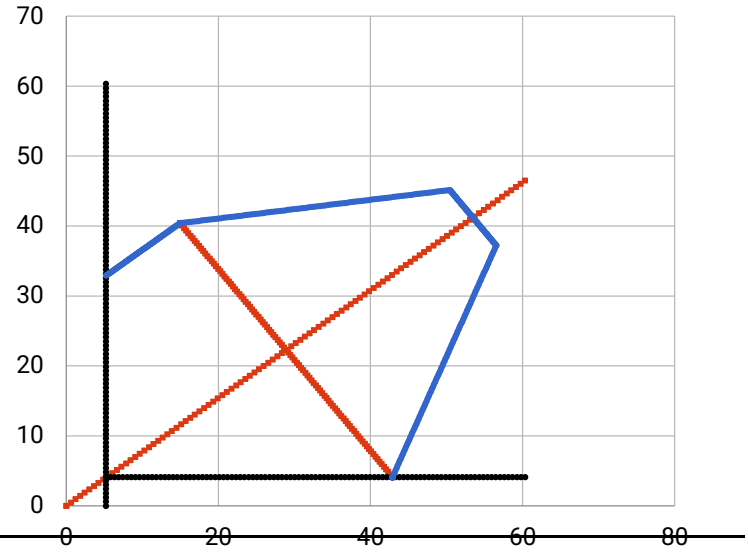
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	9.79 ft
Frame Length:	12.71 ft
Brace Length:	16.04 ft
Angle from Horz:	37.61 deg
Angle from Vert:	52.39 deg

Gusset Plate Geometry

Brace on Gusset:	28.00 in
Length along Beam:	37.67 in
Length along Column:	28.79 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	19.41 in
b:	14.84 in
r:	31.07

Max Brace Force, Pu = **1066 kips**

Vub:	0.133 x Pu	= **142 kips**	V= Vertical Force
Hub:	0.625 x Pu	= **666 kips**	H= Horizontal Force
Vuc:	0.478 x Pu	= **510 kips**	b= Beam Side
Huc:	0.167 x Pu	= **179 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	8/16	Weld to Column Size:	8/16
Interaction for Vub:	0.110	Interaction for Vuc:	0.772
Interaction for Hub:	0.770	Interaction for Huc:	0.181
Total Interaction:	**0.880**	Total Interaction:	**0.952**

Gusset Design

Buckling Capacity:	1042k	OK
Yielding Capacity:	2857k	OK
Block Shear Capacity:	2475k	OK

SCBF GUSSET DESIGN

BF14 Bottom, Gusset 12

GENERAL CRITERIA

Frame Height:	9.79 ft	Beam Size:	W8X40
Frame Length:	12.71 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS8X8X5/8
Gusset Thickness:	1.50 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	7 /16
		Corner Snip:	1.00 in

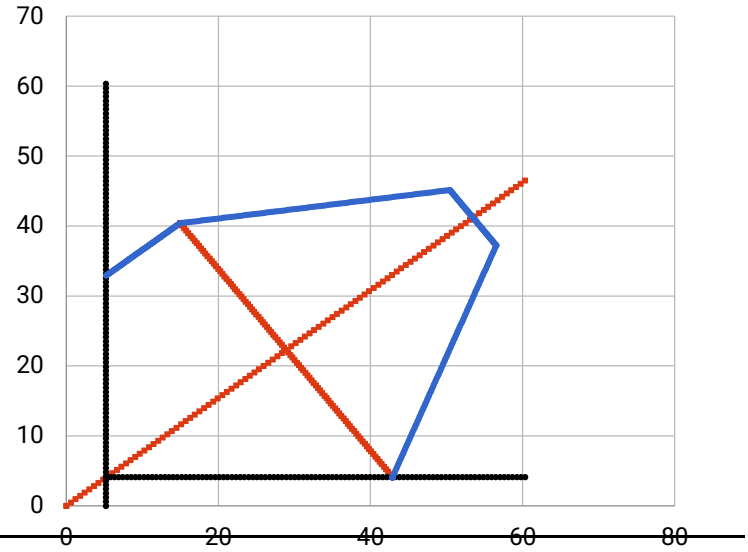
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	9.79 ft
Frame Length:	12.71 ft
Brace Length:	16.04 ft
Angle from Horz:	37.61 deg
Angle from Vert:	52.39 deg

Gusset Plate Geometry

Brace on Gusset:	28.00 in
Length along Beam:	37.67 in
Length along Column:	28.79 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	19.41 in
b:	14.84 in
r:	31.07

Max Brace Force, Pu = **1066 kips**

Vub:	0.133 x Pu	= **142 kips**	V= Vertical Force
Hub:	0.625 x Pu	= **666 kips**	H= Horizontal Force
Vuc:	0.478 x Pu	= **510 kips**	b= Beam Side
Huc:	0.167 x Pu	= **179 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	8/16	Weld to Column Size:	8/16
Interaction for Vub:	0.110	Interaction for Vuc:	0.772
Interaction for Hub:	0.770	Interaction for Huc:	0.181
Total Interaction:	**0.880**	Total Interaction:	**0.952**

Gusset Design

Buckling Capacity:	1042k	OK
Yielding Capacity:	2857k	OK
Block Shear Capacity:	2475k	OK

SCBF GUSSET DESIGN

BF16 Top, Gusset 15

GENERAL CRITERIA

Frame Height:	27.75 ft	Beam Size:	W8X40
Frame Length:	23.84 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS8X8X5/8
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	7 /16
		Corner Snip:	1.00 in

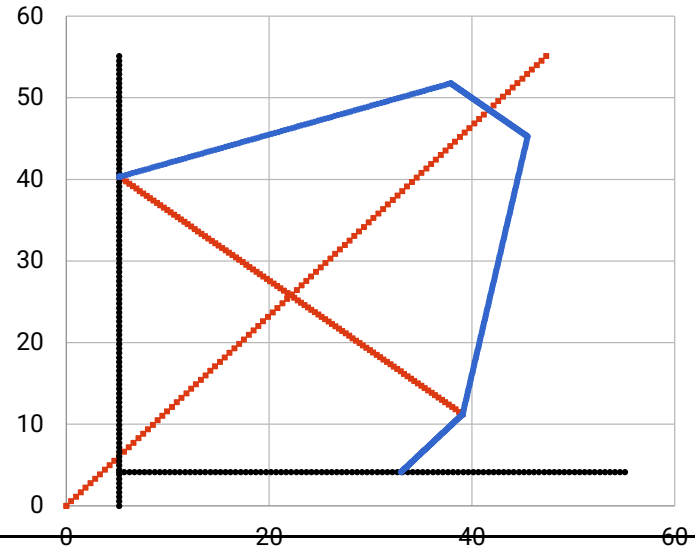
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	27.75 ft
Frame Length:	23.84 ft
Brace Length:	36.58 ft
Angle from Horz:	49.33 deg
Angle from Vert:	40.67 deg

Gusset Plate Geometry

Brace on Gusset:	28.00 in
Length along Beam:	27.77 in
Length along Column:	36.18 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	14.35 in
b:	18.64 in
r:	30.01

Max Brace Force, Pu = **1066 kips**

Vub:	0.137 x Pu	= **147 kips**	V= Vertical Force
Hub:	0.478 x Pu	= **510 kips**	H= Horizontal Force
Vuc:	0.621 x Pu	= **663 kips**	b= Beam Side
Huc:	0.173 x Pu	= **185 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	8/16	Weld to Column Size:	8/16
Interaction for Vub:	0.153	Interaction for Vuc:	0.799
Interaction for Hub:	0.798	Interaction for Huc:	0.149
Total Interaction:	**0.951**	Total Interaction:	**0.947**

Gusset Design

Buckling Capacity:	309k OK
Yielding Capacity:	1905k OK
Block Shear Capacity:	1650k OK

SCBF GUSSET DESIGN

BF16 Bottom, Gusset 16

GENERAL CRITERIA

Frame Height:	27.75 ft	Beam Size:	BasePlate
Frame Length:	23.84 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS8X8X5/8
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	6 /16
		Corner Snip:	1.00 in

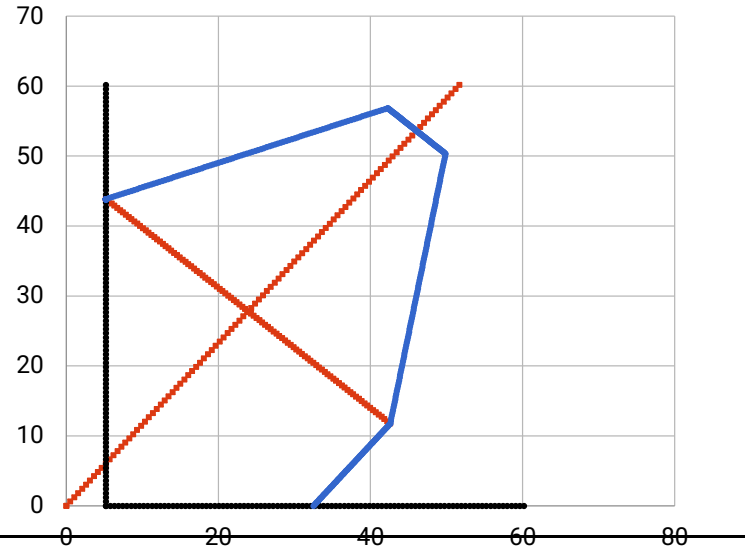
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	27.75 ft
Frame Length:	23.84 ft
Brace Length:	36.58 ft
Angle from Horz:	49.33 deg
Angle from Vert:	40.67 deg

Gusset Plate Geometry

Brace on Gusset:	32.00 in
Length along Beam:	27.27 in
Length along Column:	43.85 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	0.00 in
a:	14.11 in
b:	22.48 in
r:	29.63

Max Brace Force, Pu = **1066 kips**

Vub:	0.000 x Pu	**= 0 kips**	V= Vertical Force
Hub:	0.476 x Pu	**= 508 kips**	H= Horizontal Force
Vuc:	0.759 x Pu	**= 809 kips**	b= Beam Side
Huc:	0.175 x Pu	**= 188 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	7/16	Weld to Column Size:	8/16
Interaction for Vub:	0.000	Interaction for Vuc:	0.808
Interaction for Hub:	0.924	Interaction for Huc:	0.125
Total Interaction:	**0.924**	Total Interaction:	**0.933**

Gusset Design

Buckling Capacity:	278k OK
Yielding Capacity:	2113k OK
Block Shear Capacity:	1830k OK

DESIGN MODULE - SCBF Gusset Design

Michael Baker INTERNATIONAL

Creech DRP Phase 1 AOF

TYPICAL BRACED FRAME DESIGN INFORMATION

Frame Height:	20.00 ft	Gusset Plate Fy:	50 ksi
Floor Thickness:	0.00 in	Weld Size Brace to Gusset:	5 /16
Gusset Thickness:	0.75 in	Corner Snip:	1.00 in
Measured from Top of Slab:	No		
Beam Size Above:	W8X40		
Beam Size Below:	BasePlate		
Column Size:	W12X106		
Brace Size:	HSS8X8X1/2		
Brace Grade:	A500 Gr C		

BRACED FRAME GUSSET SUMMARY SCHEDULE

FRAME ID	GUSSET MARK	LENGTH	HEIGHT	BEAM		COLUMN	BRACE	STATUS
BF17	33	23.83 ft	19.17 ft	TOP	W12X45	W10X68	HSS8X8X5/8	PASS
	34			BTM	W8X40			PASS
BF18	35	23.83 ft	21.00 ft	TOP	W12X45	W10X68	HSS8X8X5/8	PASS
	36			BTM	W8X40			PASS
BF19	37	18.42 ft	29.50 ft	TOP	W8X40	W10X68	HSS8X8X5/8	PASS
	38			BTM	BasePlate			PASS
BF20	39	18.42 ft	19.83 ft	TOP	W8X40	W10X68	HSS8X8X5/8	PASS
	40			BTM	W8X40			PASS
BF21	41	11.58 ft	27.75 ft	TOP	W8X40	W10X68	HSS8X8X5/8	PASS
	42			BTM	BasePlate			PASS
BF22	43	11.58 ft	21.50 ft	TOP	W8X40	W10X68	HSS6X6X1/2	PASS
	44			BTM	W8X40			PASS
BF23a	45	18.42 ft	16.35 ft	TOP	W8X40	W10X68	HSS6X6X1/2	PASS
	46			BTM	W16X31			PASS
BF24	47	18.42 ft	20.44 ft	TOP	W16X31	W10X68	HSS6X6X1/2	PASS
	48			BTM	BasePlate			PASS
BF23b	45	18.42 ft	17.08 ft	TOP	W8X40	W10X69	HSS6X6X1/2	PASS
	46			BTM	W16X31			PASS

SCBF GUSSET DESIGN

BF17 Top, Gusset 1

GENERAL CRITERIA

Frame Height:	19.17 ft	Beam Size:	W12X45
Frame Length:	23.83 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS8X8X5/8
Gusset Thickness:	1.13 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	7 /16
		Corner Snip:	1.00 in

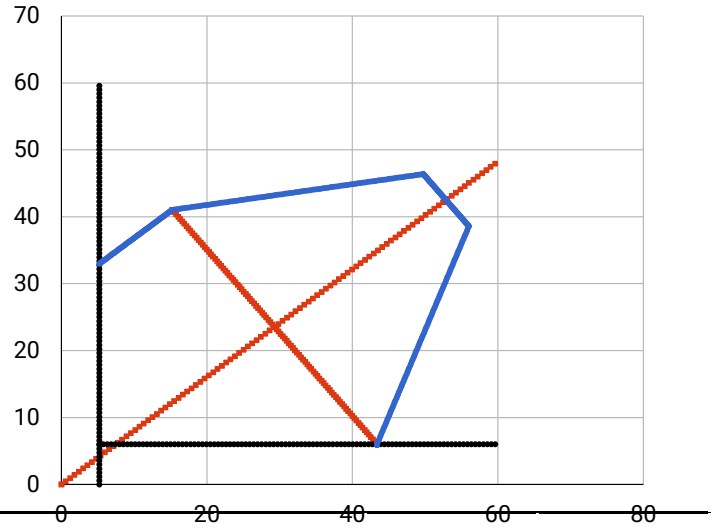
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	19.17 ft
Frame Length:	23.83 ft
Brace Length:	30.58 ft
Angle from Horz:	38.81 deg
Angle from Vert:	51.19 deg

Gusset Plate Geometry

Brace on Gusset:	28.00 in
Length along Beam:	38.17 in
Length along Column:	26.96 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	6.05 in
a:	19.65 in
b:	13.94 in
r:	31.89

Max Brace Force, Pu **= 1066 kips**

Vub:	0.190 x Pu	**= 203 kips**	V= Vertical Force
Hub:	0.616 x Pu	**= 657 kips**	H= Horizontal Force
Vuc:	0.437 x Pu	**= 466 kips**	b= Beam Side
Huc:	0.163 x Pu	**= 174 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	8/16	Weld to Column Size:	8/16
Interaction for Vub:	0.155	Interaction for Vuc:	0.751
Interaction for Hub:	0.751	Interaction for Huc:	0.187
Total Interaction:	**0.905**	Total Interaction:	**0.937**

Gusset Design

Buckling Capacity:	440k OK
Yielding Capacity:	2143k OK
Block Shear Capacity:	1856k OK

SCBF GUSSET DESIGN

BF17 Bottom, Gusset 2

GENERAL CRITERIA

Frame Height:	19.17 ft	Beam Size:	W8X40
Frame Length:	23.83 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS8X8X5/8
Gusset Thickness:	1.13 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	7 /16
		Corner Snip:	1.00 in

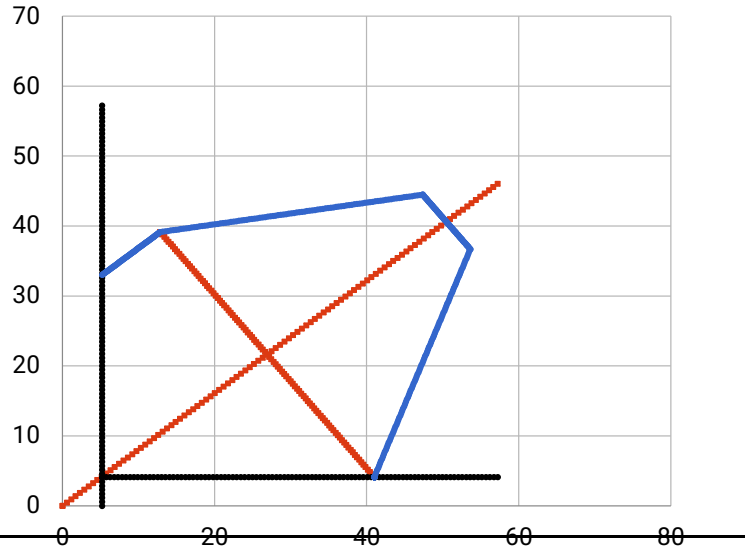
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	19.17 ft
Frame Length:	23.83 ft
Brace Length:	30.58 ft
Angle from Horz:	38.81 deg
Angle from Vert:	51.19 deg

Gusset Plate Geometry

Brace on Gusset:	28.00 in
Length along Beam:	35.77 in
Length along Column:	28.89 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	18.45 in
b:	14.89 in
r:	30.35

Max Brace Force, Pu = **1066 kips**

Vub:	0.136 x Pu	= **145 kips**	V= Vertical Force
Hub:	0.608 x Pu	= **648 kips**	H= Horizontal Force
Vuc:	0.491 x Pu	= **524 kips**	b= Beam Side
Huc:	0.171 x Pu	= **183 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	8/16	Weld to Column Size:	8/16
Interaction for Vub:	0.118	Interaction for Vuc:	0.790
Interaction for Hub:	0.789	Interaction for Huc:	0.184
Total Interaction:	**0.906**	Total Interaction:	**0.974**

Gusset Design

Buckling Capacity:	440k OK
Yielding Capacity:	2143k OK
Block Shear Capacity:	1856k OK

SCBF GUSSET DESIGN

BF18 Top, Gusset 3

GENERAL CRITERIA

Frame Height:	21.00 ft	Beam Size:	W12X45
Frame Length:	23.83 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS8X8X5/8
Gusset Thickness:	1.13 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	7 /16
		Corner Snip:	1.00 in

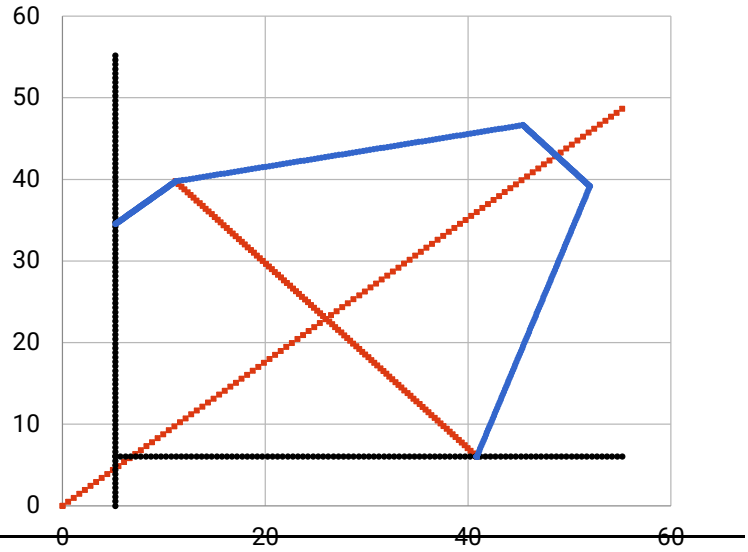
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	21.00 ft
Frame Length:	23.83 ft
Brace Length:	31.76 ft
Angle from Horz:	41.39 deg
Angle from Vert:	48.61 deg

Gusset Plate Geometry

Brace on Gusset:	28.00 in
Length along Beam:	35.64 in
Length along Column:	28.48 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	6.05 in
a:	18.36 in
b:	14.71 in
r:	31.40

Max Brace Force, Pu = **1066 kips**

Vub:	0.193 x Pu	**= 206 kips**	V= Vertical Force
Hub:	0.585 x Pu	**= 624 kips**	H= Horizontal Force
Vuc:	0.468 x Pu	**= 500 kips**	b= Beam Side
Huc:	0.166 x Pu	**= 177 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	8/16	Weld to Column Size:	8/16
Interaction for Vub:	0.168	Interaction for Vuc:	0.763
Interaction for Hub:	0.763	Interaction for Huc:	0.180
Total Interaction:	**0.931**	Total Interaction:	**0.943**

Gusset Design

Buckling Capacity:	440k OK
Yielding Capacity:	2143k OK
Block Shear Capacity:	1856k OK

SCBF GUSSET DESIGN

BF18 Bottom, Gusset 4

GENERAL CRITERIA

Frame Height:	21.00 ft	Beam Size:	W8X40
Frame Length:	23.83 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS8X8X5/8
Gusset Thickness:	1.13 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	7 /16
		Corner Snip:	1.00 in

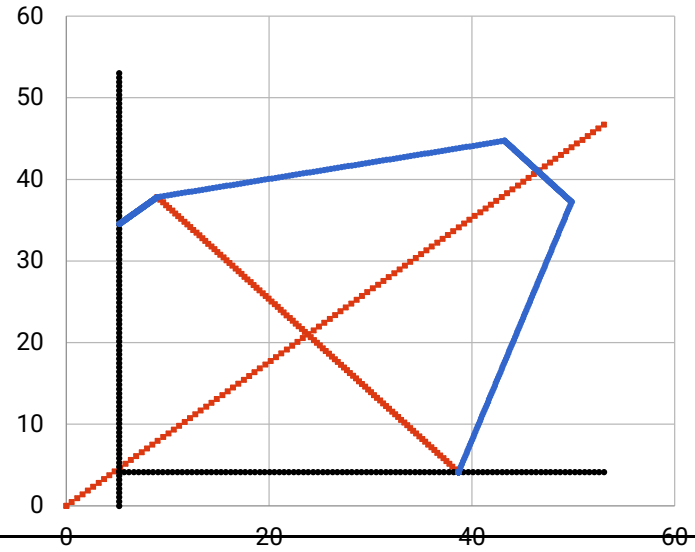
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	21.00 ft
Frame Length:	23.83 ft
Brace Length:	31.76 ft
Angle from Horz:	41.39 deg
Angle from Vert:	48.61 deg

Gusset Plate Geometry

Brace on Gusset:	28.00 in
Length along Beam:	33.46 in
Length along Column:	30.40 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	17.26 in
b:	15.67 in
r:	29.94

Max Brace Force, Pu = **1066 kips**

Vub:	0.138 x Pu	= **147 kips**	V= Vertical Force
Hub:	0.577 x Pu	= **615 kips**	H= Horizontal Force
Vuc:	0.523 x Pu	= **558 kips**	b= Beam Side
Huc:	0.174 x Pu	= **186 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	8/16	Weld to Column Size:	8/16
Interaction for Vub:	0.127	Interaction for Vuc:	0.799
Interaction for Hub:	0.800	Interaction for Huc:	0.178
Total Interaction:	**0.927**	Total Interaction:	**0.977**

Gusset Design

Buckling Capacity:	440k OK
Yielding Capacity:	2143k OK
Block Shear Capacity:	1856k OK

SCBF GUSSET DESIGN

BF19 Top, Gusset 5

GENERAL CRITERIA

Frame Height:	29.50 ft	Beam Size:	W8X40
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS8X8X5/8
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	7 /16
		Corner Snip:	1.00 in

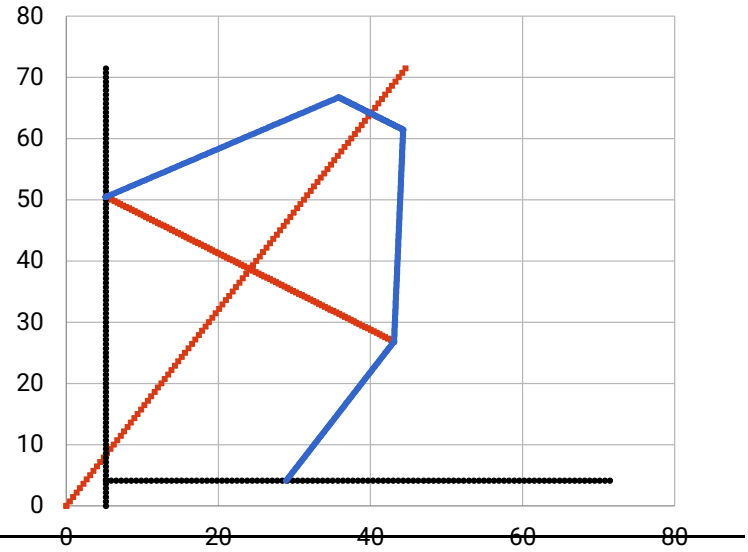
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	29.50 ft
Frame Length:	18.42 ft
Brace Length:	34.78 ft
Angle from Horz:	58.02 deg
Angle from Vert:	31.98 deg

Gusset Plate Geometry

Brace on Gusset:	28.00 in
Length along Beam:	23.69 in
Length along Column:	46.35 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	12.27 in
b:	23.85 in
r:	32.98

Max Brace Force, Pu = **1066 kips**

Vub:	0.125 x Pu	= **134 kips**	V= Vertical Force
Hub:	0.372 x Pu	= **397 kips**	H= Horizontal Force
Vuc:	0.723 x Pu	= **771 kips**	b= Beam Side
Huc:	0.158 x Pu	= **169 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	8/16	Weld to Column Size:	7/16
Interaction for Vub:	0.163	Interaction for Vuc:	0.829
Interaction for Hub:	0.727	Interaction for Huc:	0.121
Total Interaction:	**0.890**	Total Interaction:	**0.951**

Gusset Design

Buckling Capacity:	309k OK
Yielding Capacity:	1905k OK
Block Shear Capacity:	1650k OK

SCBF GUSSET DESIGN

BF19 Bottom, Gusset 6

GENERAL CRITERIA

Frame Height:	29.50 ft	Beam Size:	BasePlate
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS8X8X5/8
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	7 /16
		Corner Snip:	1.00 in

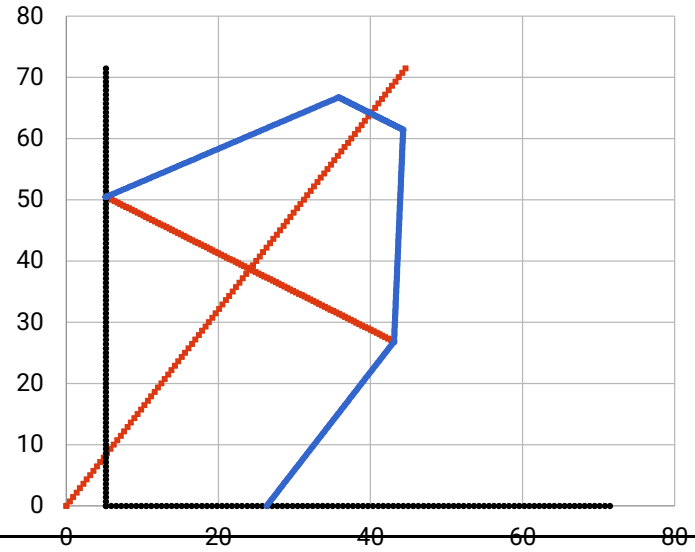
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	29.50 ft
Frame Length:	18.42 ft
Brace Length:	34.78 ft
Angle from Horz:	58.02 deg
Angle from Vert:	31.98 deg

Gusset Plate Geometry

Brace on Gusset:	28.00 in
Length along Beam:	21.11 in
Length along Column:	50.47 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	0.00 in
a:	11.00 in
b:	25.94 in
r:	30.58

Max Brace Force, Pu = **1066 kips**

Vub:	0.000 x Pu	**= 0 kips**	V= Vertical Force
Hub:	0.360 x Pu	**= 384 kips**	H= Horizontal Force
Vuc:	0.848 x Pu	**= 905 kips**	b= Beam Side
Huc:	0.170 x Pu	**= 182 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	7/16	Weld to Column Size:	8/16
Interaction for Vub:	0.000	Interaction for Vuc:	0.783
Interaction for Hub:	0.896	Interaction for Huc:	0.105
Total Interaction:	**0.896**	Total Interaction:	**0.888**

Gusset Design

Buckling Capacity:	309k OK
Yielding Capacity:	1905k OK
Block Shear Capacity:	1650k OK

SCBF GUSSET DESIGN

BF20 Top, Gusset 7

GENERAL CRITERIA

Frame Height:	19.83 ft	Beam Size:	W8X40
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS8X8X5/8
Gusset Thickness:	1.13 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	7 /16
		Corner Snip:	1.00 in

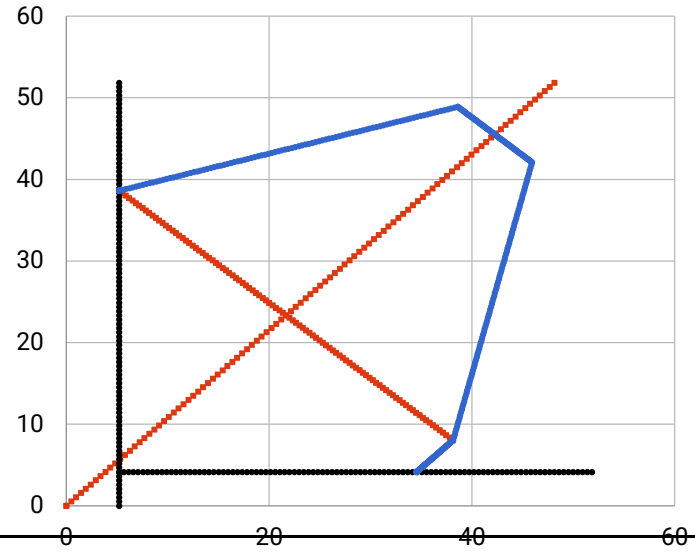
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	19.83 ft
Frame Length:	18.42 ft
Brace Length:	27.07 ft
Angle from Horz:	47.12 deg
Angle from Vert:	42.88 deg

Gusset Plate Geometry

Brace on Gusset:	28.00 in
Length along Beam:	29.29 in
Length along Column:	34.49 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	15.13 in
b:	17.76 in
r:	29.87

Max Brace Force, Pu = **1066 kips**

Vub:	0.138 x Pu	= **148 kips**	V= Vertical Force
Hub:	0.506 x Pu	= **540 kips**	H= Horizontal Force
Vuc:	0.595 x Pu	= **634 kips**	b= Beam Side
Huc:	0.174 x Pu	= **186 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	8/16	Weld to Column Size:	8/16
Interaction for Vub:	0.146	Interaction for Vuc:	0.801
Interaction for Hub:	0.801	Interaction for Huc:	0.157
Total Interaction:	**0.948**	Total Interaction:	**0.958**

Gusset Design

Buckling Capacity:	440k OK
Yielding Capacity:	2143k OK
Block Shear Capacity:	1856k OK

SCBF GUSSET DESIGN

BF20 Bottom, Gusset 8

GENERAL CRITERIA

Frame Height:	19.83 ft	Beam Size:	W8X40
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS8X8X5/8
Gusset Thickness:	1.13 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	7 /16
		Corner Snip:	1.00 in

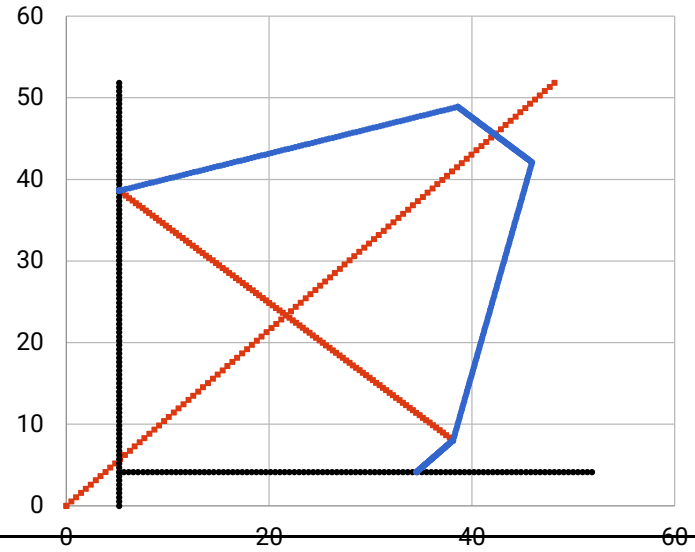
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	19.83 ft
Frame Length:	18.42 ft
Brace Length:	27.07 ft
Angle from Horz:	47.12 deg
Angle from Vert:	42.88 deg

Gusset Plate Geometry

Brace on Gusset:	28.00 in
Length along Beam:	29.29 in
Length along Column:	34.49 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	15.13 in
b:	17.76 in
r:	29.87

Max Brace Force, Pu = **1066 kips**

Vub:	0.138 x Pu	= **148 kips**	V= Vertical Force
Hub:	0.506 x Pu	= **540 kips**	H= Horizontal Force
Vuc:	0.595 x Pu	= **634 kips**	b= Beam Side
Huc:	0.174 x Pu	= **186 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	8/16	Weld to Column Size:	8/16
Interaction for Vub:	0.146	Interaction for Vuc:	0.801
Interaction for Hub:	0.801	Interaction for Huc:	0.157
Total Interaction:	**0.948**	Total Interaction:	**0.958**

Gusset Design

Buckling Capacity:	440k OK
Yielding Capacity:	2143k OK
Block Shear Capacity:	1856k OK

SCBF GUSSET DESIGN

BF21 Top, Gusset 9

GENERAL CRITERIA

Frame Height:	27.75 ft	Beam Size:	W8X40
Frame Length:	11.58 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS8X8X5/8
Gusset Thickness:	1.13 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	7 /16
		Corner Snip:	1.00 in

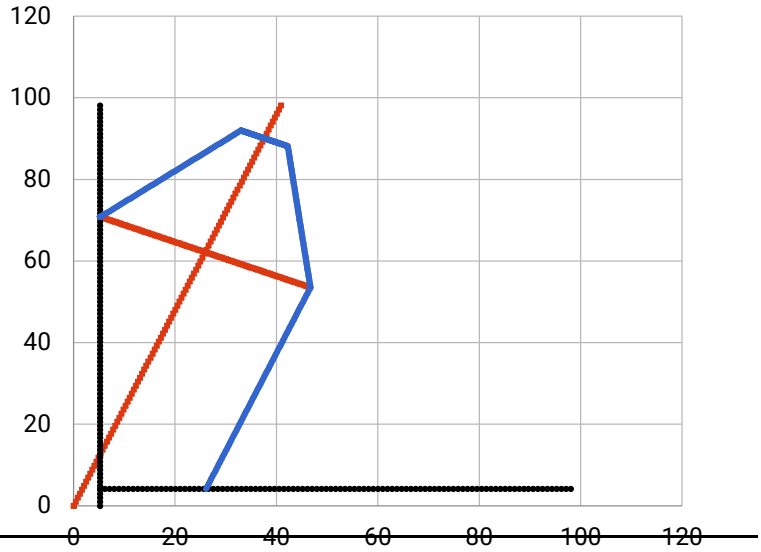
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	27.75 ft
Frame Length:	11.58 ft
Brace Length:	30.07 ft
Angle from Horz:	67.35 deg
Angle from Vert:	22.65 deg

Gusset Plate Geometry

Brace on Gusset:	28.00 in
Length along Beam:	20.86 in
Length along Column:	66.67 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	10.82 in
b:	34.27 in
r:	41.61

Max Brace Force, Pu = **1066 kips**

Vub:	0.099 x Pu	= **106 kips**	V= Vertical Force
Hub:	0.260 x Pu	= **278 kips**	H= Horizontal Force
Vuc:	0.824 x Pu	= **879 kips**	b= Beam Side
Huc:	0.125 x Pu	= **134 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	6/16	Weld to Column Size:	6/16
Interaction for Vub:	0.195	Interaction for Vuc:	0.768
Interaction for Hub:	0.769	Interaction for Huc:	0.078
Total Interaction:	**0.964**	Total Interaction:	**0.846**

Gusset Design

Buckling Capacity:	440k OK
Yielding Capacity:	2143k OK
Block Shear Capacity:	1856k OK

SCBF GUSSET DESIGN

BF21 Bottom, Gusset 10

GENERAL CRITERIA

Frame Height:	27.75 ft	Beam Size:	BasePlate
Frame Length:	11.58 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS8X8X5/8
Gusset Thickness:	1.13 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	7 /16
		Corner Snip:	1.00 in

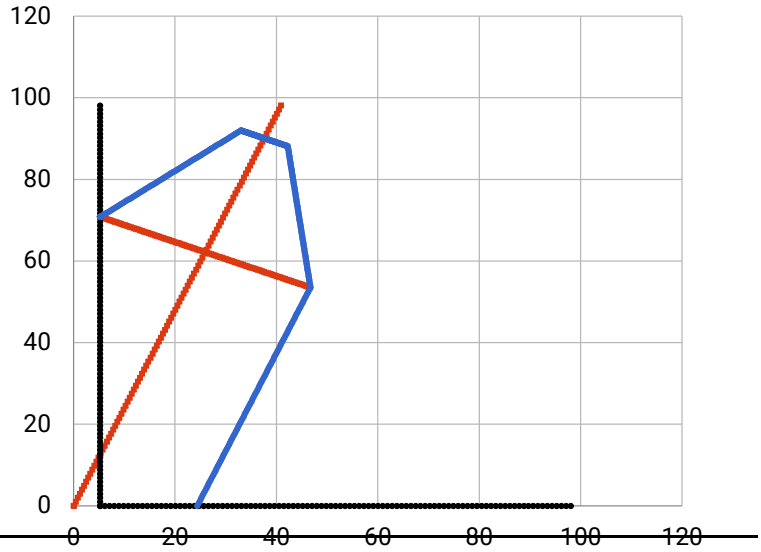
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	27.75 ft
Frame Length:	11.58 ft
Brace Length:	30.07 ft
Angle from Horz:	67.35 deg
Angle from Vert:	22.65 deg

Gusset Plate Geometry

Brace on Gusset:	28.00 in
Length along Beam:	19.14 in
Length along Column:	70.79 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	0.00 in
a:	9.98 in
b:	36.38 in
r:	39.42

Max Brace Force, Pu = **1066 kips**

Vub:	0.000 x Pu	**= 0 kips**	V= Vertical Force
Hub:	0.253 x Pu	**= 270 kips**	H= Horizontal Force
Vuc:	0.923 x Pu	**= 984 kips**	b= Beam Side
Huc:	0.132 x Pu	**= 141 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	5/16	Weld to Column Size:	6/16
Interaction for Vub:	0.000	Interaction for Vuc:	0.810
Interaction for Hub:	0.972	Interaction for Huc:	0.077
Total Interaction:	**0.972**	Total Interaction:	**0.887**

Gusset Design

Buckling Capacity:	440k OK
Yielding Capacity:	2143k OK
Block Shear Capacity:	1856k OK

SCBF GUSSET DESIGN

BF22 Top, Gusset 11

GENERAL CRITERIA

Frame Height:	21.50 ft	Beam Size:	W8X40
Frame Length:	11.58 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	0.88 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

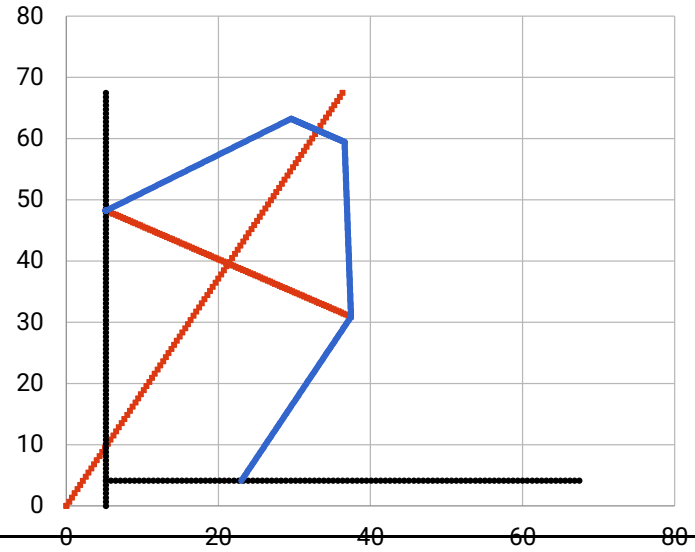
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	21.50 ft
Frame Length:	11.58 ft
Brace Length:	24.42 ft
Angle from Horz:	61.69 deg
Angle from Vert:	28.31 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	17.80 in
Length along Column:	44.10 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	9.31 in
b:	22.82 in
r:	30.60

Max Brace Force, Pu = **631 kips**

Vub:	0.135 x Pu	= **85 kips**	V= Vertical Force
Hub:	0.304 x Pu	= **192 kips**	H= Horizontal Force
Vuc:	0.746 x Pu	= **471 kips**	b= Beam Side
Huc:	0.170 x Pu	= **108 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	5/16	Weld to Column Size:	5/16
Interaction for Vub:	0.219	Interaction for Vuc:	0.742
Interaction for Hub:	0.741	Interaction for Huc:	0.113
Total Interaction:	**0.959**	Total Interaction:	**0.855**

Gusset Design

Buckling Capacity:	253k OK
Yielding Capacity:	1361k OK
Block Shear Capacity:	1162k OK

SCBF GUSSET DESIGN

BF22 Bottom, Gusset 12

GENERAL CRITERIA

Frame Height:	21.50 ft	Beam Size:	W8X40
Frame Length:	11.58 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	0.88 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

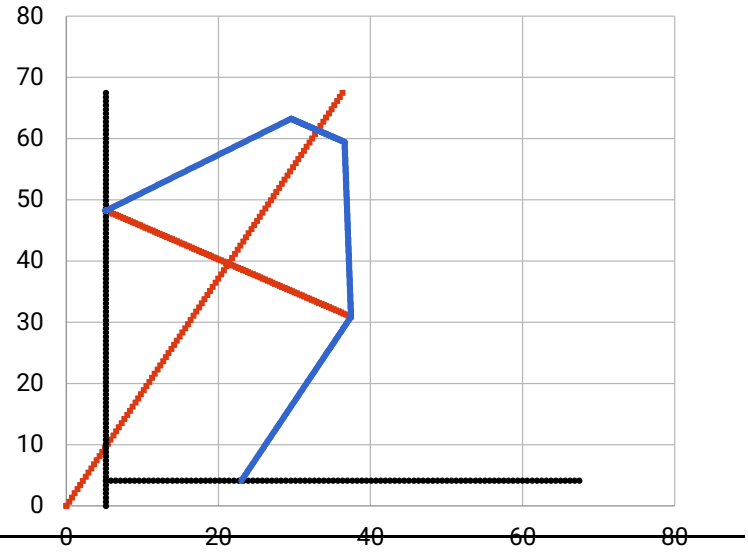
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	21.50 ft
Frame Length:	11.58 ft
Brace Length:	24.42 ft
Angle from Horz:	61.69 deg
Angle from Vert:	28.31 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	17.80 in
Length along Column:	44.10 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	9.31 in
b:	22.82 in
r:	30.60

Max Brace Force, Pu = **631 kips**

Vub:	0.135 x Pu	= **85 kips**	V= Vertical Force
Hub:	0.304 x Pu	= **192 kips**	H= Horizontal Force
Vuc:	0.746 x Pu	= **471 kips**	b= Beam Side
Huc:	0.170 x Pu	= **108 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	5/16	Weld to Column Size:	5/16
Interaction for Vub:	0.219	Interaction for Vuc:	0.742
Interaction for Hub:	0.741	Interaction for Huc:	0.113
Total Interaction:	**0.959**	Total Interaction:	**0.855**

Gusset Design

Buckling Capacity:	253k OK
Yielding Capacity:	1361k OK
Block Shear Capacity:	1162k OK

SCBF GUSSET DESIGN

BF23a Top, Gusset 13

GENERAL CRITERIA

Frame Height:	16.35 ft	Beam Size:	W8X40
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

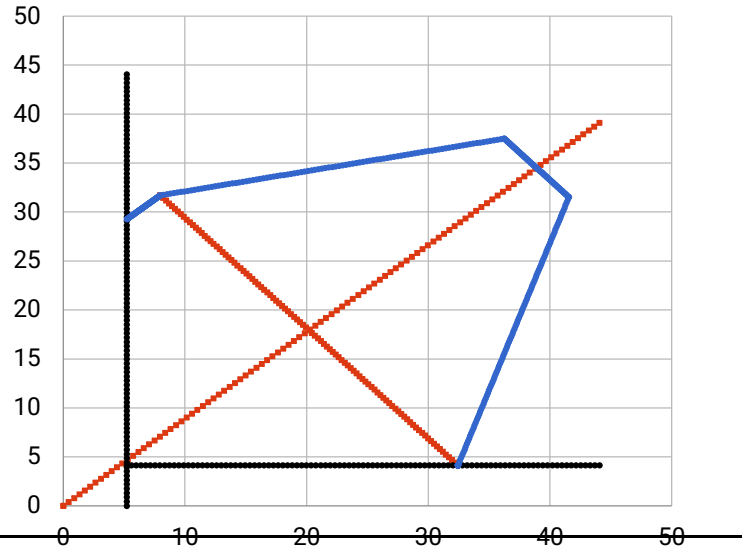
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	16.35 ft
Frame Length:	18.42 ft
Brace Length:	24.63 ft
Angle from Horz:	41.59 deg
Angle from Vert:	48.41 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	27.22 in
Length along Column:	25.14 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	14.14 in
b:	13.04 in
r:	25.86

Max Brace Force, Pu = **631 kips**

Vub:	0.160 x Pu	= **101 kips**	V= Vertical Force
Hub:	0.547 x Pu	= **345 kips**	H= Horizontal Force
Vuc:	0.504 x Pu	= **318 kips**	b= Beam Side
Huc:	0.201 x Pu	= **127 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	6/16	Weld to Column Size:	6/16
Interaction for Vub:	0.143	Interaction for Vuc:	0.730
Interaction for Hub:	0.730	Interaction for Huc:	0.194
Total Interaction:	**0.873**	Total Interaction:	**0.924**

Gusset Design

Buckling Capacity:	378k OK
Yielding Capacity:	1555k OK
Block Shear Capacity:	1328k OK

SCBF GUSSET DESIGN

BF23a Bottom, Gusset 14

GENERAL CRITERIA

Frame Height:	16.35 ft	Beam Size:	W16X31
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

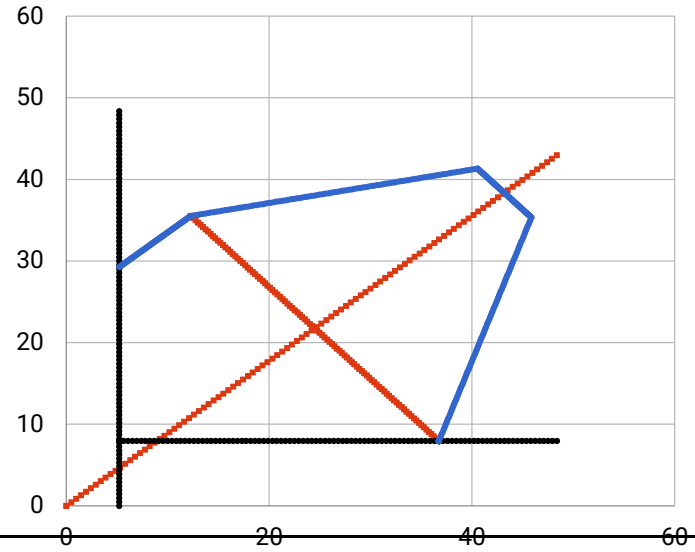
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	16.35 ft
Frame Length:	18.42 ft
Brace Length:	24.63 ft
Angle from Horz:	41.59 deg
Angle from Vert:	48.41 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	31.53 in
Length along Column:	21.31 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	7.95 in
a:	16.30 in
b:	11.14 in
r:	28.75

Max Brace Force, Pu = **631 kips**

Vub:	0.277 x Pu	= **175 kips**	V= Vertical Force
Hub:	0.567 x Pu	= **358 kips**	H= Horizontal Force
Vuc:	0.387 x Pu	= **245 kips**	b= Beam Side
Huc:	0.181 x Pu	= **115 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	6/16	Weld to Column Size:	6/16
Interaction for Vub:	0.214	Interaction for Vuc:	0.659
Interaction for Hub:	0.657	Interaction for Huc:	0.206
Total Interaction:	**0.872**	Total Interaction:	**0.865**

Gusset Design

Buckling Capacity:	378k OK
Yielding Capacity:	1555k OK
Block Shear Capacity:	1328k OK

SCBF GUSSET DESIGN

BF24 Top, Gusset 15

GENERAL CRITERIA

Frame Height:	20.44 ft	Beam Size:	W16X31
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

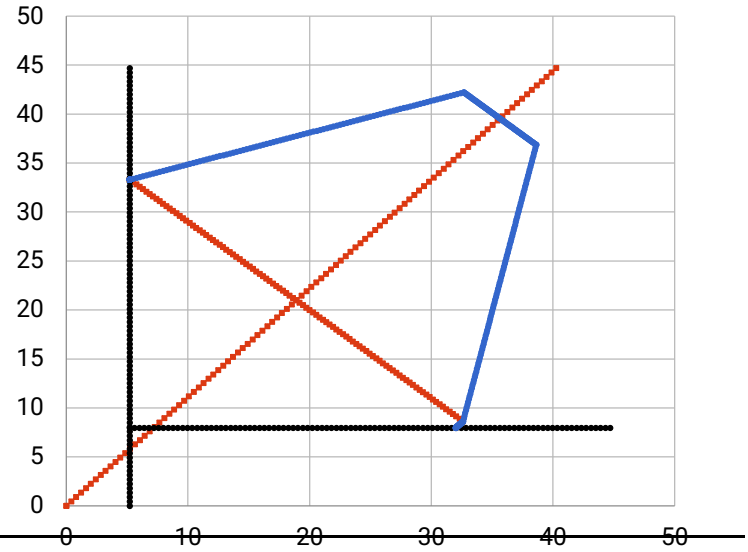
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	20.44 ft
Frame Length:	18.42 ft
Brace Length:	27.52 ft
Angle from Horz:	47.98 deg
Angle from Vert:	42.02 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	26.78 in
Length along Column:	25.36 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	7.95 in
a:	13.86 in
b:	13.20 in
r:	28.47

Max Brace Force, Pu = **631 kips**

Vub:	0.279 x Pu	= **177 kips**	V= Vertical Force
Hub:	0.487 x Pu	= **307 kips**	H= Horizontal Force
Vuc:	0.464 x Pu	= **293 kips**	b= Beam Side
Huc:	0.183 x Pu	= **116 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	6/16	Weld to Column Size:	6/16
Interaction for Vub:	0.255	Interaction for Vuc:	0.664
Interaction for Hub:	0.663	Interaction for Huc:	0.175
Total Interaction:	**0.918**	Total Interaction:	**0.840**

Gusset Design

Buckling Capacity:	378k OK
Yielding Capacity:	1555k OK
Block Shear Capacity:	1328k OK

SCBF GUSSET DESIGN

BF24 Bottom, Gusset 16

GENERAL CRITERIA

Frame Height:	20.44 ft	Beam Size:	BasePlate
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

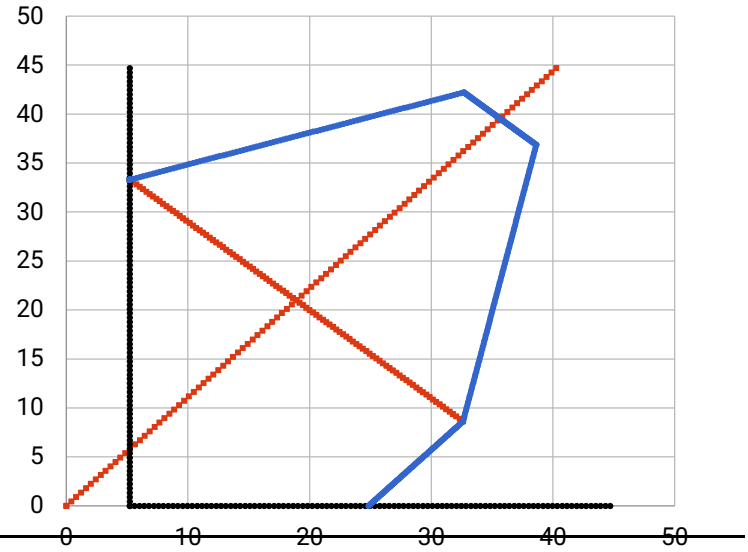
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	20.44 ft
Frame Length:	18.42 ft
Brace Length:	27.52 ft
Angle from Horz:	47.98 deg
Angle from Vert:	42.02 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	19.61 in
Length along Column:	33.31 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	0.00 in
a:	10.29 in
b:	17.19 in
r:	23.14

Max Brace Force, Pu = **631 kips**

Vub:	0.000 x Pu	= **0 kips**	V= Vertical Force
Hub:	0.445 x Pu	= **281 kips**	H= Horizontal Force
Vuc:	0.743 x Pu	= **469 kips**	b= Beam Side
Huc:	0.225 x Pu	= **142 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	5/16	Weld to Column Size:	6/16
Interaction for Vub:	0.000	Interaction for Vuc:	0.817
Interaction for Hub:	0.981	Interaction for Huc:	0.165
Total Interaction:	**0.981**	Total Interaction:	**0.982**

Gusset Design

Buckling Capacity:	378k OK
Yielding Capacity:	1555k OK
Block Shear Capacity:	1328k OK

DESIGN MODULE - SCBF Gusset Design

Michael Baker INTERNATIONAL

Creech DRP Phase 1 AOF

TYPICAL BRACED FRAME DESIGN INFORMATION

Frame Height:	20.00 ft	Gusset Plate Fy:	50 ksi
Floor Thickness:	0.00 in	Weld Size Brace to Gusset:	5 /16
Gusset Thickness:	0.75 in	Corner Snip:	1.00 in
Measured from Top of Slab:	No		
Beam Size Above:	W10X26		
Beam Size Below:	BasePlate		
Column Size:	W12X106		
Brace Size:	HSS8X8X1/2		
Brace Grade:	A500 Gr C		

BRACED FRAME GUSSET SUMMARY SCHEDULE

FRAME ID	GUSSET MARK	LENGTH	HEIGHT	BEAM		COLUMN	BRACE	STATUS
BF25	49	18.42 ft	8.75 ft	TOP	W8X40	W10X68	HSS3X3X3/8	PASS
	50			BTM	W8X40			PASS
BF26	51	18.42 ft	27.50 ft	TOP	W8X40	W10X68	HSS6X6X1/2	PASS
	52			BTM	BasePlate			PASS
BF27	53	18.42 ft	10.40 ft	TOP	W8X40	W10X68	HSS6X6X1/2	PASS
	54			BTM	W16X31			PASS
BF28	55	18.42 ft	7.00 ft	TOP	W8X40	W10X68	HSS4X4X3/8	PASS
	56			BTM	W8X40			PASS
BF29	57	18.42 ft	6.25 ft	TOP	W8X40	W10X68	HSS4X4X3/8	PASS
	58			BTM	W8X40			PASS
BF27a	59	18.42 ft	16.50 ft	TOP	W8X40	W10X68	HSS6X6X1/2	PASS
	60			BTM	W16X31			PASS
BF27b	61	18.42 ft	17.17 ft	TOP	W8X40	W10X68	HSS6X6X1/2	PASS
	62			BTM	W16X31			PASS

SCBF GUSSET DESIGN

BF25 Top, Gusset 1

GENERAL CRITERIA

Frame Height:	8.75 ft	Beam Size:	W8X40
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS3X3X3/8
Gusset Thickness:	0.75 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

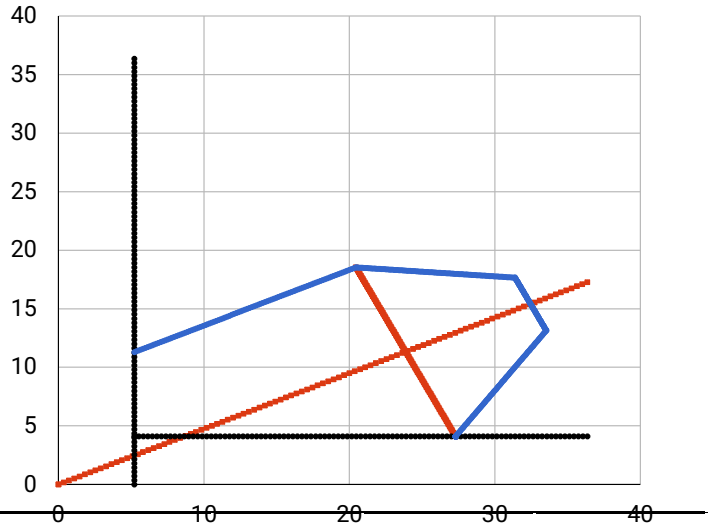
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	8.75 ft
Frame Length:	18.42 ft
Brace Length:	20.39 ft
Angle from Horz:	25.41 deg
Angle from Vert:	64.59 deg

Gusset Plate Geometry

Brace on Gusset:	8.00 in
Length along Beam:	22.09 in
Length along Column:	7.19 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	11.90 in
b:	4.00 in
r:	18.93

Max Brace Force, Pu **= 220 kips**

Vub:	0.218 x Pu	**= 49 kips**	V= Vertical Force
Hub:	0.629 x Pu	**= 139 kips**	H= Horizontal Force
Vuc:	0.211 x Pu	**= 47 kips**	b= Beam Side
Huc:	0.275 x Pu	**= 61 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	3/16	Weld to Column Size:	4/16
Interaction for Vub:	0.164	Interaction for Vuc:	0.528
Interaction for Hub:	0.699	Interaction for Huc:	0.457
Total Interaction:	**0.864**	Total Interaction:	**0.984**

Gusset Design

Buckling Capacity:	305k	OK
Yielding Capacity:	481k	OK
Block Shear Capacity:	380k	OK

SCBF GUSSET DESIGN

BF25 Bottom, Gusset 2

GENERAL CRITERIA

Frame Height:	8.75 ft	Beam Size:	W8X40
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS3X3X3/8
Gusset Thickness:	0.75 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

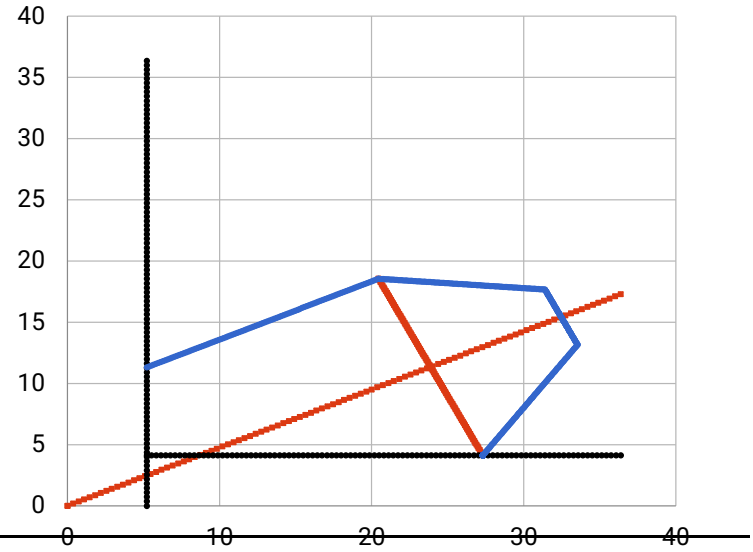
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	8.75 ft
Frame Length:	18.42 ft
Brace Length:	20.39 ft
Angle from Horz:	25.41 deg
Angle from Vert:	64.59 deg

Gusset Plate Geometry

Brace on Gusset:	8.00 in
Length along Beam:	22.09 in
Length along Column:	7.19 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	11.90 in
b:	4.00 in
r:	18.93

Max Brace Force, Pu = **220 kips**

Vub:	0.218 x Pu	= **49 kips**	V= Vertical Force
Hub:	0.629 x Pu	= **139 kips**	H= Horizontal Force
Vuc:	0.211 x Pu	= **47 kips**	b= Beam Side
Huc:	0.275 x Pu	= **61 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	3/16	Weld to Column Size:	4/16
Interaction for Vub:	0.164	Interaction for Vuc:	0.528
Interaction for Hub:	0.699	Interaction for Huc:	0.457
Total Interaction:	**0.864**	Total Interaction:	**0.984**

Gusset Design

Buckling Capacity:	305k	OK
Yielding Capacity:	481k	OK
Block Shear Capacity:	380k	OK

SCBF GUSSET DESIGN

BF26 Top, Gusset 3

GENERAL CRITERIA

Frame Height:	27.50 ft	Beam Size:	W8X40
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	0.75 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

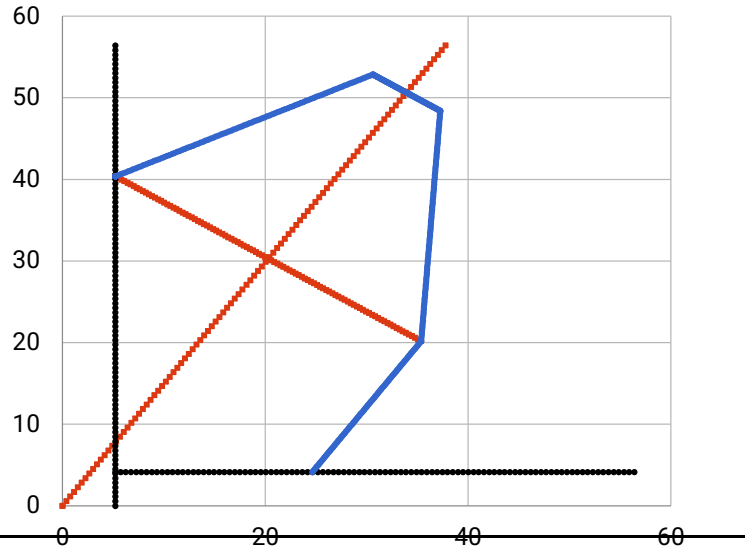
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	27.50 ft
Frame Length:	18.42 ft
Brace Length:	33.10 ft
Angle from Horz:	56.19 deg
Angle from Vert:	33.81 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	19.40 in
Length along Column:	36.24 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	10.14 in
b:	18.77 in
r:	27.56

Max Brace Force, Pu = **631 kips**

Vub:	0.150 x Pu	= **95 kips**	V= Vertical Force
Hub:	0.368 x Pu	= **232 kips**	H= Horizontal Force
Vuc:	0.681 x Pu	= **430 kips**	b= Beam Side
Huc:	0.189 x Pu	= **119 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	6/16	Weld to Column Size:	5/16
Interaction for Vub:	0.187	Interaction for Vuc:	0.823
Interaction for Hub:	0.685	Interaction for Huc:	0.152
Total Interaction:	**0.872**	Total Interaction:	**0.975**

Gusset Design

Buckling Capacity:	160k OK
Yielding Capacity:	1166k OK
Block Shear Capacity:	996k OK

SCBF GUSSET DESIGN

BF26 Bottom, Gusset 4

GENERAL CRITERIA

Frame Height:	27.50 ft	Beam Size:	BasePlate
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	0.75 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

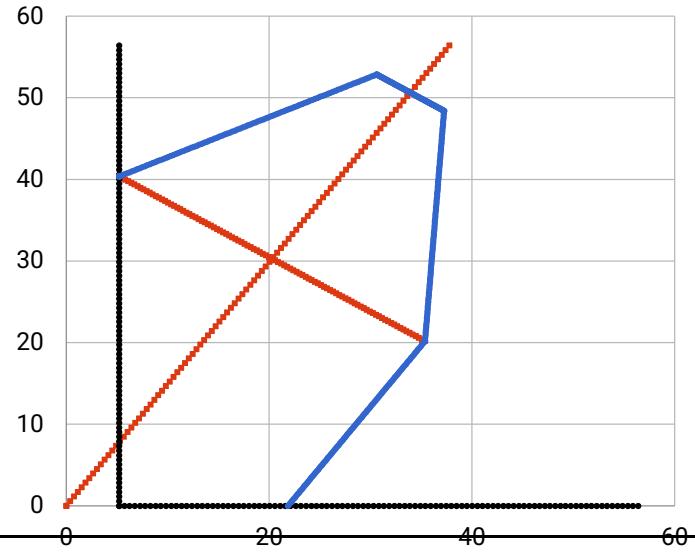
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	27.50 ft
Frame Length:	18.42 ft
Brace Length:	33.10 ft
Angle from Horz:	56.19 deg
Angle from Vert:	33.81 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	16.64 in
Length along Column:	40.37 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	0.00 in
a:	8.77 in
b:	20.86 in
r:	25.11

Max Brace Force, Pu = **631 kips**

Vub:	0.000 x Pu	= **0 kips**	V= Vertical Force
Hub:	0.349 x Pu	= **221 kips**	H= Horizontal Force
Vuc:	0.831 x Pu	= **524 kips**	b= Beam Side
Huc:	0.207 x Pu	= **131 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	5/16	Weld to Column Size:	6/16
Interaction for Vub:	0.000	Interaction for Vuc:	0.752
Interaction for Hub:	0.905	Interaction for Huc:	0.125
Total Interaction:	**0.905**	Total Interaction:	**0.877**

Gusset Design

Buckling Capacity:	160k OK
Yielding Capacity:	1166k OK
Block Shear Capacity:	996k OK

SCBF GUSSET DESIGN

BF27 Top, Gusset 5

GENERAL CRITERIA

Frame Height:	10.40 ft	Beam Size:	W8X40
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	0.88 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

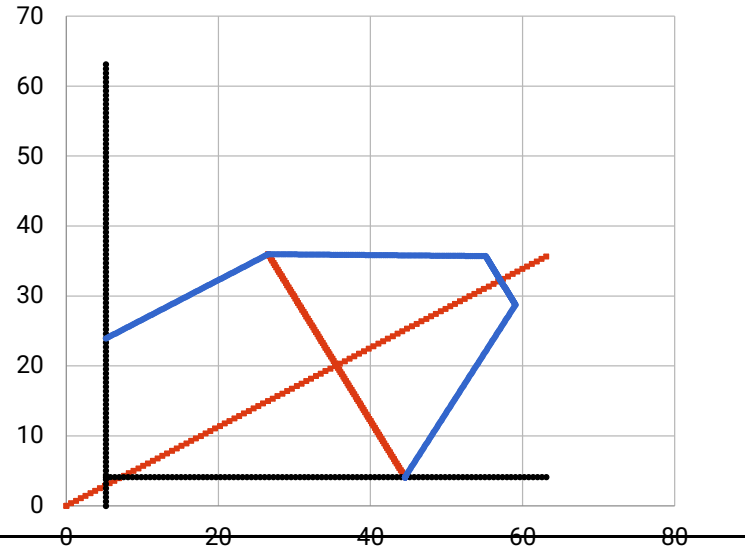
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	10.40 ft
Frame Length:	18.42 ft
Brace Length:	21.15 ft
Angle from Horz:	29.45 deg
Angle from Vert:	60.55 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	39.31 in
Length along Column:	19.81 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	20.36 in
b:	10.31 in
r:	29.36

Max Brace Force, Pu = **631 kips**

Vub:	0.141 x Pu	= **89 kips**	V= Vertical Force
Hub:	0.694 x Pu	= **438 kips**	H= Horizontal Force
Vuc:	0.351 x Pu	= **222 kips**	b= Beam Side
Huc:	0.177 x Pu	= **112 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	5/16	Weld to Column Size:	6/16
Interaction for Vub:	0.105	Interaction for Vuc:	0.645
Interaction for Hub:	0.773	Interaction for Huc:	0.217
Total Interaction:	**0.877**	Total Interaction:	**0.862**

Gusset Design

Buckling Capacity:	253k OK
Yielding Capacity:	1361k OK
Block Shear Capacity:	1162k OK

SCBF GUSSET DESIGN

BF27 Bottom, Gusset 6

GENERAL CRITERIA

Frame Height:	10.40 ft	Beam Size:	W16X31
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	0.88 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

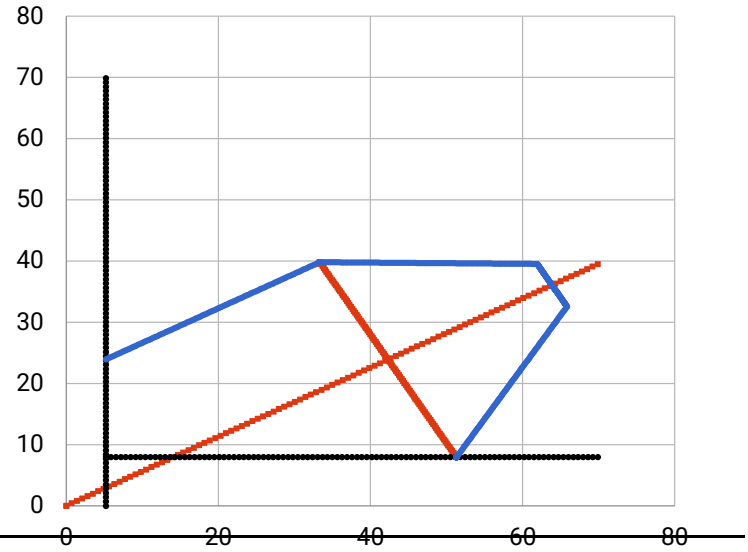
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	10.40 ft
Frame Length:	18.42 ft
Brace Length:	21.15 ft
Angle from Horz:	29.45 deg
Angle from Vert:	60.55 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	46.08 in
Length along Column:	15.99 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	7.95 in
a:	23.81 in
b:	8.43 in
r:	33.32

Max Brace Force, Pu = **631 kips**

Vub:	0.239 x Pu	= **151 kips**	V= Vertical Force
Hub:	0.715 x Pu	= **451 kips**	H= Horizontal Force
Vuc:	0.253 x Pu	= **160 kips**	b= Beam Side
Huc:	0.156 x Pu	= **99 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	5/16	Weld to Column Size:	5/16
Interaction for Vub:	0.152	Interaction for Vuc:	0.682
Interaction for Hub:	0.680	Interaction for Huc:	0.281
Total Interaction:	**0.832**	Total Interaction:	**0.963**

Gusset Design

Buckling Capacity:	253k OK
Yielding Capacity:	1361k OK
Block Shear Capacity:	1162k OK

SCBF GUSSET DESIGN

BF28 Top, Gusset 7

GENERAL CRITERIA

Frame Height:	7.00 ft	Beam Size:	W8X40
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS4X4X3/8
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

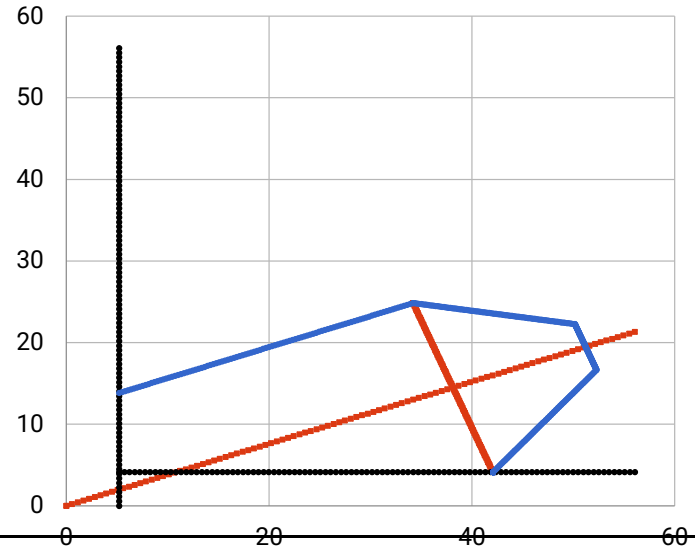
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	7.00 ft
Frame Length:	18.42 ft
Brace Length:	19.71 ft
Angle from Horz:	20.81 deg
Angle from Vert:	69.19 deg

Gusset Plate Geometry

Brace on Gusset:	12.00 in
Length along Beam:	36.85 in
Length along Column:	9.71 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	19.45 in
b:	5.24 in
r:	26.37

Max Brace Force, Pu = **312 kips**

Vub:	0.156 x Pu	= **49 kips**	V= Vertical Force
Hub:	0.738 x Pu	= **231 kips**	H= Horizontal Force
Vuc:	0.199 x Pu	= **63 kips**	b= Beam Side
Huc:	0.197 x Pu	= **62 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	3/16	Weld to Column Size:	4/16
Interaction for Vub:	0.101	Interaction for Vuc:	0.540
Interaction for Hub:	0.711	Interaction for Huc:	0.354
Total Interaction:	**0.812**	Total Interaction:	**0.894**

Gusset Design

Buckling Capacity:	543k	OK
Yielding Capacity:	894k	OK
Block Shear Capacity:	735k	OK

SCBF GUSSET DESIGN

BF28 Bottom, Gusset 8

GENERAL CRITERIA

Frame Height:	7.00 ft	Beam Size:	W8X40
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS4X4X3/8
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

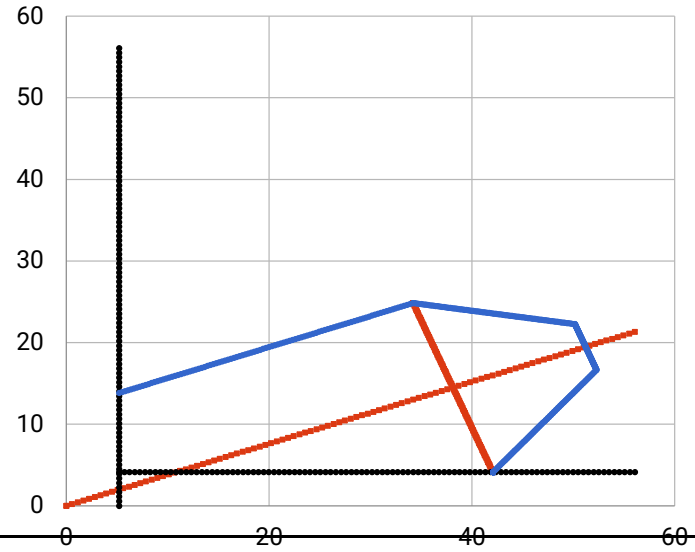
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	7.00 ft
Frame Length:	18.42 ft
Brace Length:	19.71 ft
Angle from Horz:	20.81 deg
Angle from Vert:	69.19 deg

Gusset Plate Geometry

Brace on Gusset:	12.00 in
Length along Beam:	36.85 in
Length along Column:	9.71 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	19.45 in
b:	5.24 in
r:	26.37

Max Brace Force, Pu = **312 kips**

Vub:	0.156 x Pu	= **49 kips**	V= Vertical Force
Hub:	0.738 x Pu	= **231 kips**	H= Horizontal Force
Vuc:	0.199 x Pu	= **63 kips**	b= Beam Side
Huc:	0.197 x Pu	= **62 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	3/16	Weld to Column Size:	4/16
Interaction for Vub:	0.101	Interaction for Vuc:	0.540
Interaction for Hub:	0.711	Interaction for Huc:	0.354
Total Interaction:	**0.812**	Total Interaction:	**0.894**

Gusset Design

Buckling Capacity:	543k	OK
Yielding Capacity:	894k	OK
Block Shear Capacity:	735k	OK

SCBF GUSSET DESIGN

BF29 Top, Gusset 9

GENERAL CRITERIA

Frame Height:	6.25 ft	Beam Size:	W8X40
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS4X4X3/8
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

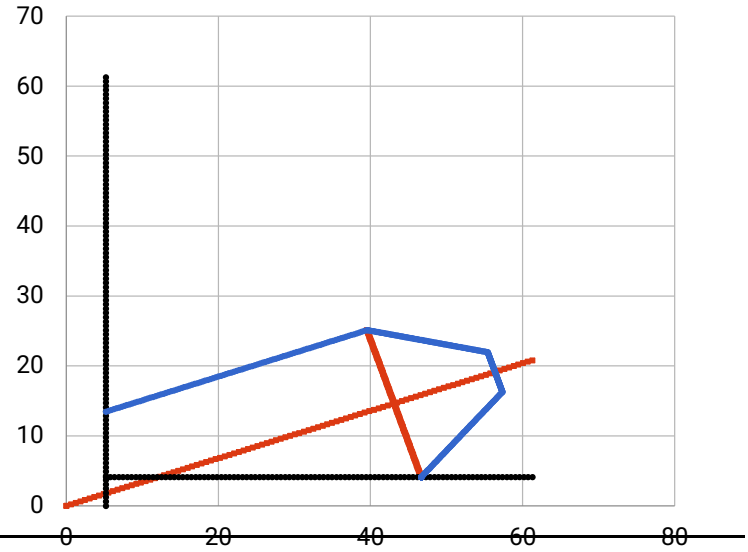
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	6.25 ft
Frame Length:	18.42 ft
Brace Length:	19.45 ft
Angle from Horz:	18.74 deg
Angle from Vert:	71.26 deg

Gusset Plate Geometry

Brace on Gusset:	12.00 in
Length along Beam:	41.45 in
Length along Column:	9.34 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	21.87 in
b:	5.06 in
r:	28.58

Max Brace Force, Pu = **312 kips**

Vub:	0.144 x Pu	= **46 kips**	V= Vertical Force
Hub:	0.765 x Pu	= **239 kips**	H= Horizontal Force
Vuc:	0.177 x Pu	= **56 kips**	b= Beam Side
Huc:	0.182 x Pu	= **57 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	3/16	Weld to Column Size:	4/16
Interaction for Vub:	0.084	Interaction for Vuc:	0.497
Interaction for Hub:	0.654	Interaction for Huc:	0.337
Total Interaction:	**0.738**	Total Interaction:	**0.834**

Gusset Design

Buckling Capacity:	543k	OK
Yielding Capacity:	894k	OK
Block Shear Capacity:	735k	OK

SCBF GUSSET DESIGN

BF29 Bottom, Gusset 10

GENERAL CRITERIA

Frame Height:	6.25 ft	Beam Size:	W8X40
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS4X4X3/8
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

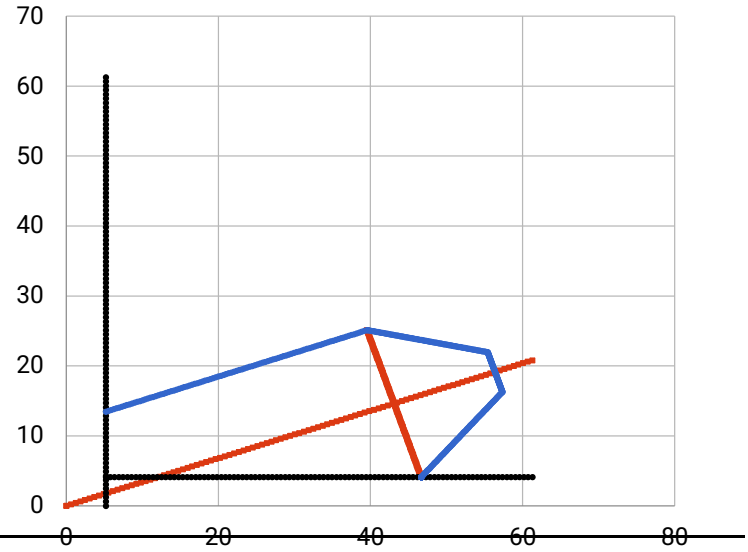
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	6.25 ft
Frame Length:	18.42 ft
Brace Length:	19.45 ft
Angle from Horz:	18.74 deg
Angle from Vert:	71.26 deg

Gusset Plate Geometry

Brace on Gusset:	12.00 in
Length along Beam:	41.45 in
Length along Column:	9.34 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	21.87 in
b:	5.06 in
r:	28.58

Max Brace Force, Pu = **312 kips**

Vub:	0.144 x Pu	= **46 kips**	V= Vertical Force
Hub:	0.765 x Pu	= **239 kips**	H= Horizontal Force
Vuc:	0.177 x Pu	= **56 kips**	b= Beam Side
Huc:	0.182 x Pu	= **57 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	3/16	Weld to Column Size:	4/16
Interaction for Vub:	0.084	Interaction for Vuc:	0.497
Interaction for Hub:	0.654	Interaction for Huc:	0.337
Total Interaction:	**0.738**	Total Interaction:	**0.834**

Gusset Design

Buckling Capacity:	543k	OK
Yielding Capacity:	894k	OK
Block Shear Capacity:	735k	OK

SCBF GUSSET DESIGN

BF29 Bottom, Gusset 10

GENERAL CRITERIA

Frame Height:	16.50 ft	Beam Size:	W8X40
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

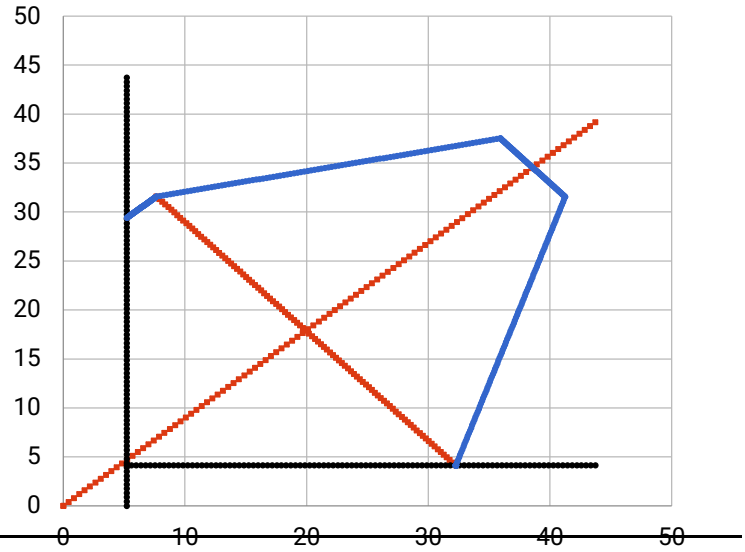
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	16.50 ft
Frame Length:	18.42 ft
Brace Length:	24.73 ft
Angle from Horz:	41.85 deg
Angle from Vert:	48.15 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	27.04 in
Length along Column:	25.28 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	14.05 in
b:	13.11 in
r:	25.84

Max Brace Force, Pu = **631 kips**

Vub:	0.160 x Pu	= **101 kips**	V= Vertical Force
Hub:	0.544 x Pu	= **343 kips**	H= Horizontal Force
Vuc:	0.508 x Pu	= **320 kips**	b= Beam Side
Huc:	0.201 x Pu	= **127 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	6/16	Weld to Column Size:	6/16
Interaction for Vub:	0.144	Interaction for Vuc:	0.731
Interaction for Hub:	0.731	Interaction for Huc:	0.193
Total Interaction:	**0.875**	Total Interaction:	**0.924**

Gusset Design

Buckling Capacity:	378k OK
Yielding Capacity:	1555k OK
Block Shear Capacity:	1328k OK

SCBF GUSSET DESIGN

BF29 Bottom, Gusset 10

GENERAL CRITERIA

Frame Height:	16.50 ft	Beam Size:	W16X31
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

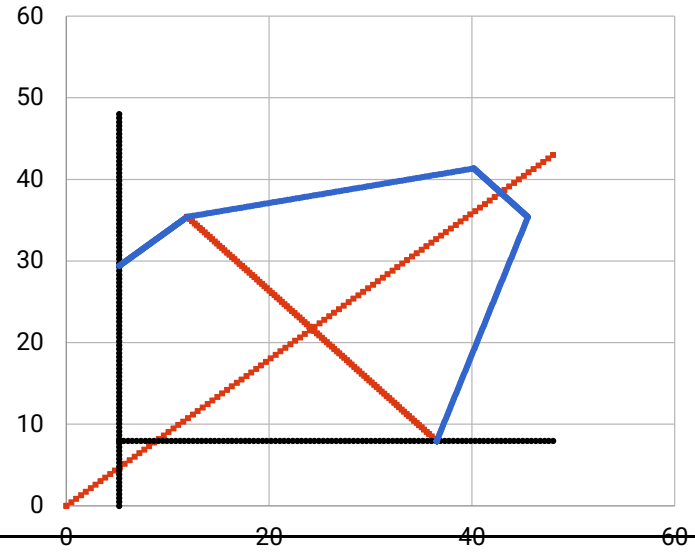
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	16.50 ft
Frame Length:	18.42 ft
Brace Length:	24.73 ft
Angle from Horz:	41.85 deg
Angle from Vert:	48.15 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	31.31 in
Length along Column:	21.45 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	7.95 in
a:	16.19 in
b:	11.21 in
r:	28.71

Max Brace Force, Pu = **631 kips**

Vub:	0.277 x Pu	= **175 kips**	V= Vertical Force
Hub:	0.564 x Pu	= **356 kips**	H= Horizontal Force
Vuc:	0.390 x Pu	= **247 kips**	b= Beam Side
Huc:	0.181 x Pu	= **115 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	6/16	Weld to Column Size:	6/16
Interaction for Vub:	0.216	Interaction for Vuc:	0.660
Interaction for Hub:	0.658	Interaction for Huc:	0.205
Total Interaction:	**0.874**	Total Interaction:	**0.865**

Gusset Design

Buckling Capacity:	378k OK
Yielding Capacity:	1555k OK
Block Shear Capacity:	1328k OK

SCBF GUSSET DESIGN

BF29 Bottom, Gusset 10

GENERAL CRITERIA

Frame Height:	17.17 ft	Beam Size:	W8X40
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

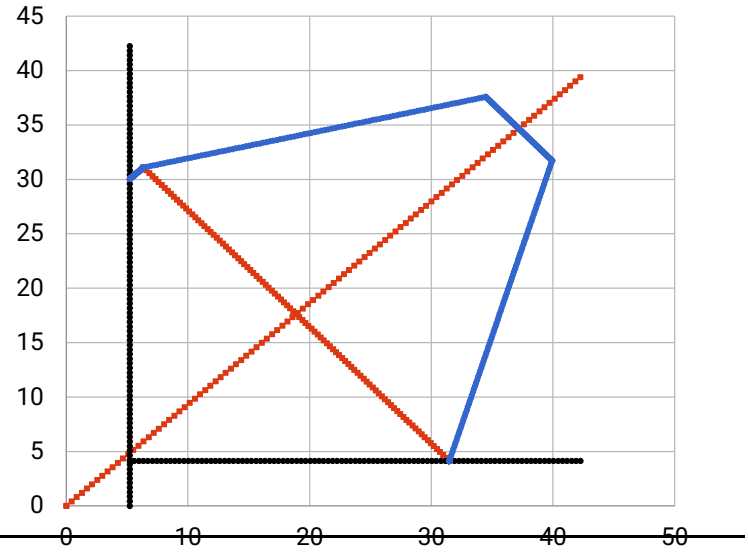
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	17.17 ft
Frame Length:	18.42 ft
Brace Length:	25.18 ft
Angle from Horz:	42.99 deg
Angle from Vert:	47.01 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	26.26 in
Length along Column:	25.92 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	4.13 in
a:	13.65 in
b:	13.44 in
r:	25.77

Max Brace Force, Pu = **631 kips**

Vub:	0.160 x Pu	= **101 kips**	V= Vertical Force
Hub:	0.530 x Pu	= **334 kips**	H= Horizontal Force
Vuc:	0.522 x Pu	= **329 kips**	b= Beam Side
Huc:	0.202 x Pu	= **128 kips**	c= Column Side

Welding of Gusset Connection

Weld to Beam Size:	6/16	Weld to Column Size:	6/16
Interaction for Vub:	0.148	Interaction for Vuc:	0.733
Interaction for Hub:	0.733	Interaction for Huc:	0.190
Total Interaction:	**0.880**	Total Interaction:	**0.923**

Gusset Design

Buckling Capacity:	378k OK
Yielding Capacity:	1555k OK
Block Shear Capacity:	1328k OK

SCBF GUSSET DESIGN

BF29 Bottom, Gusset 10

GENERAL CRITERIA

Frame Height:	17.17 ft	Beam Size:	W16X31
Frame Length:	18.42 ft	Column Size:	W10X68
Floor Thickness:	0.00 in	Brace Size:	HSS6X6X1/2
Gusset Thickness:	1.00 in	Brace Grade:	A500 Gr C
Measured from Top of Slab:	No	Gusset Plate Fy:	50 ksi
		Weld Size Brace to Gusset:	5 /16
		Corner Snip:	1.00 in

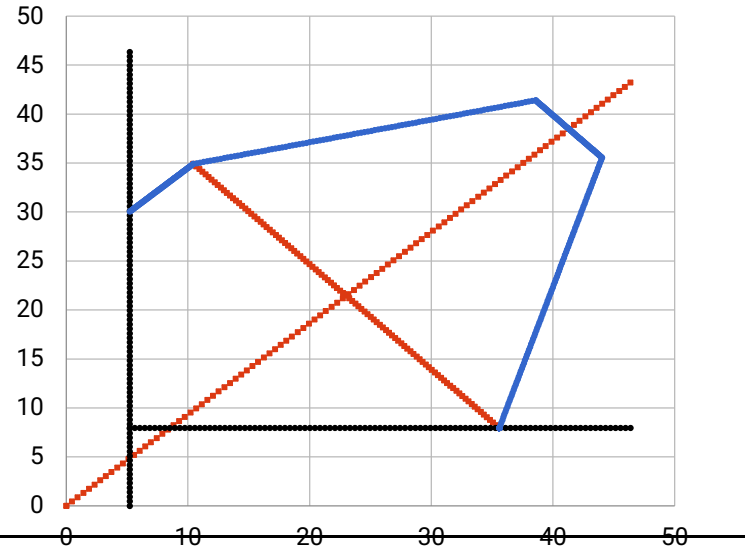
ANALYSIS AND CALCULATIONS

Frame Geometry (Work-Point to Work-Point)

Frame Height:	17.17 ft
Frame Length:	18.42 ft
Brace Length:	25.18 ft
Angle from Horz:	42.99 deg
Angle from Vert:	47.01 deg

Gusset Plate Geometry

Brace on Gusset:	23.00 in
Length along Beam:	30.36 in
Length along Column:	22.10 in



DESIGN OUTPUT

Uniform Force Method

ec:	5.20 in
eb:	7.95 in
a:	15.70 in
b:	11.54 in
r:	28.58

Max Brace Force, Pu = **631 kips**

Vub:	0.278 x Pu	= **176 kips**	V= Vertical Force
Hub:	0.550 x Pu	= **347 kips**	H= Horizontal Force
Vuc:	0.404 x Pu	= **255 kips**	b= Beam Side
Huc:	0.182 x Pu	= **115 kips**	c= Column Side

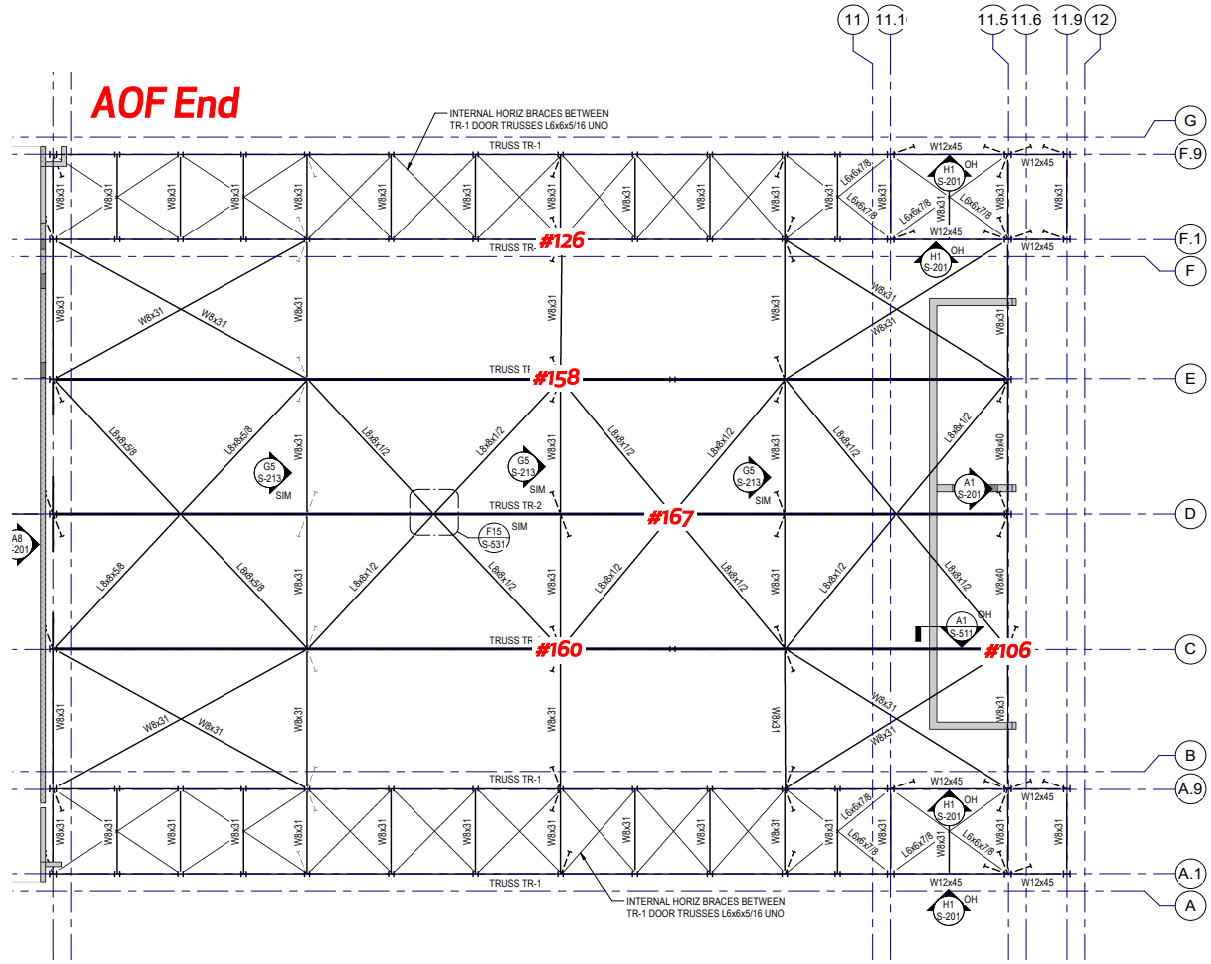
Welding of Gusset Connection

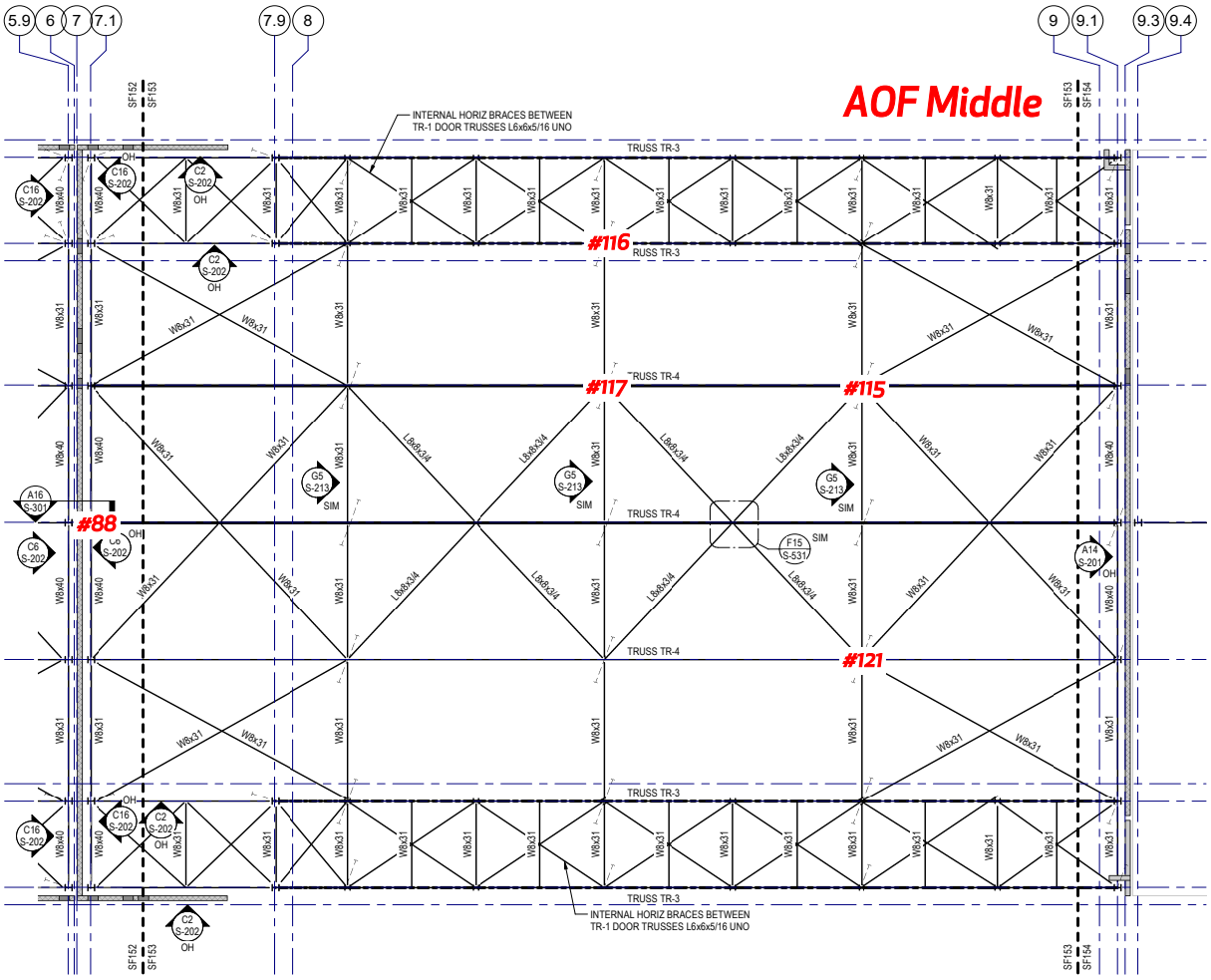
Weld to Beam Size:	6/16	Weld to Column Size:	6/16
Interaction for Vub:	0.224	Interaction for Vuc:	0.662
Interaction for Hub:	0.661	Interaction for Huc:	0.199
Total Interaction:	**0.885**	Total Interaction:	**0.861**

Gusset Design

Buckling Capacity:	378k OK
Yielding Capacity:	1555k OK
Block Shear Capacity:	1328k OK

BRACING CONN PLAN LOCATIONS





Project: AOF Hangar Connection (Model 1)
Project no: 203434
Author: Allison Valencia

Project data

Project name	AOF Hangar Connection (Model 1)
Project number	203434
Author	Allison Valencia
Description	
Date	3/26/2025
Code	AISC/ACI

Material

Steel	A992, A572 Gr.50
Concrete	4000 psi

Project item 106

Design

Name	106
Description	FL 9.9 - GL E
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC - LRFD (2016)

Members

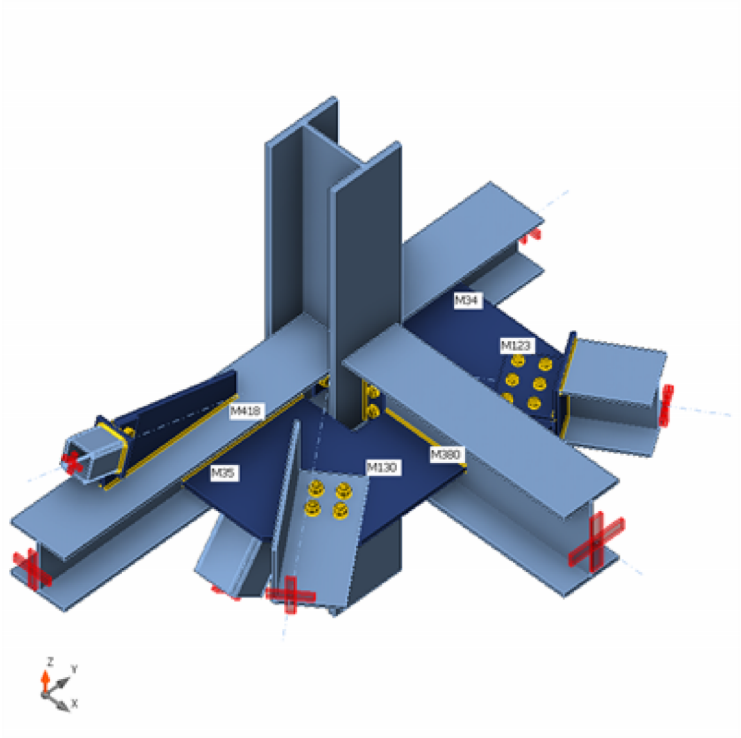
Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M34	22 - W8X31	90.0	0.0	0.0	0.00	0.00	0.00
M25	121 - W10X68	0.0	90.0	-180.0	0.00	0.00	0.00
M35	142 - W8X40	90.0	0.0	0.0	0.00	0.00	0.00
M123	22 - W8X31	33.1	0.0	0.0	0.00	0.00	0.00
M130	495 - L8X8X1/2	-52.3	0.0	0.0	0.00	0.00	0.00
M418	44 - HSS4X4X3/8(HSS4X4X3/8(HSS4X4X3/8(HSS(Imp)4X4X3/8)))	-90.0	16.7	0.0	0.00	0.00	0.00
M425	133 - HSS6X6X1/2(HSS6X6X1/2(HSS6X6X1/2(HSS(Imp)6X6X1/2)))	90.0	55.2	0.0	0.00	0.00	0.00
M380	33 - W12X50	0.0	0.0	0.0	0.00	0.00	0.00

Supports and forces

Name	Support	Forces in	X [in]
M34 / end	Mx-My-Mz	Bolts	1.99
M25 / begin	N-Vy-Vz-Mx-My-Mz	Position	0.00
M25 / end		Position	0.00
M35 / begin	Mx-My-Mz	Bolts	1.98
M123 / end	Mx-My-Mz	Position	21.00
M130 / end	Mx-My-Mz	Bolts	20.37
M418 / end	Mx-My-Mz	Position	33.50
M425 / begin	Mx-My-Mz	Position	16.00
M380 / end	Mx-My-Mz	Bolts	6.70

Project:	**AOF Hangar Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**



Cross-sections

Name	Material
22 - W8X31	A992
121 - W10X68	A992
142 - W8X40	A992
495 - L8X8X1/2	A992
44 - HSS4X4X3/8(HSS4X4X3/8(HSS4X4X3/8(HSS(Imp)4X4X3/8)))	A992
133 - HSS6X6X1/2(HSS6X6X1/2(HSS6X6X1/2(HSS(Imp)6X6X1/2)))	A992
33 - W12X50	A992

Bolts

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
5/8 A325	0.63	92.0	120.0	0.31
3/4 A325	0.75	92.0	120.0	0.44

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS41(1)	M34 / End	-8.48	0.00	-0.25	0.00	0.00	0.00
	M25 / Begin	4.04	0.01	5.39	0.02	32.97	0.07
	M25 / End	-31.85	-0.03	4.76	0.03	-34.37	-0.07
	M35 / Begin	-4.88	0.00	-0.34	0.00	-0.12	0.00
	M123 / End	-0.64	-0.01	-0.58	0.00	0.00	0.00
	M130 / End	-1.18	0.00	-0.26	0.00	0.00	0.00
	M418 / End	7.03	0.00	-0.05	0.00	0.00	0.00
	M425 / Begin	34.05	0.00	-0.10	0.00	0.00	0.00
	M380 / End	-8.91	0.00	-0.66	0.00	0.00	0.00
DStlS16(2)	M34 / End	27.86	-0.01	-0.34	0.00	0.00	0.00
	M25 / Begin	53.14	0.01	-4.46	-0.01	-6.96	-0.61
	M25 / End	-32.86	0.09	-5.08	0.09	9.76	0.58
	M35 / Begin	-29.31	0.00	-0.45	0.00	-0.16	0.00
	M123 / End	17.23	-0.01	-0.76	0.00	0.00	0.00
	M130 / End	-9.43	0.00	-0.36	0.00	0.00	0.00
	M418 / End	2.80	0.00	-0.08	0.00	0.00	0.00
	M425 / Begin	-22.34	-0.02	-0.13	0.00	0.00	0.00
	M380 / End	0.86	0.00	-0.71	0.00	0.00	0.00
DStlS31(4)	M34 / End	13.51	-0.01	-0.34	0.00	0.00	0.00
	M25 / Begin	50.79	0.02	-1.62	0.00	13.69	-0.48
	M25 / End	-59.03	0.06	-2.99	0.13	-11.66	0.46
	M35 / Begin	-29.90	0.00	-0.45	0.00	-0.16	0.00
	M123 / End	17.86	-0.02	-0.81	0.00	0.00	0.00
	M130 / End	-11.03	0.00	-0.34	0.00	0.00	0.00
	M418 / End	8.64	0.00	-0.08	0.00	0.00	0.00
	M425 / Begin	10.82	-0.02	-0.13	0.00	0.00	0.00
	M380 / End	-3.62	0.01	-1.07	0.00	0.00	0.00
DStlS52-1(7)	M34 / End	17.77	0.00	-0.22	0.00	0.00	0.00
	M25 / Begin	47.54	-0.01	0.29	0.00	8.02	-0.14
	M25 / End	-22.77	0.03	-0.06	0.04	-7.53	0.12
	M35 / Begin	-20.24	0.00	-0.29	0.00	-0.10	0.00
	M123 / End	7.30	0.00	-0.47	0.00	0.00	0.00
	M130 / End	-9.72	0.00	-0.23	0.00	0.00	0.00
	M418 / End	-5.80	0.00	-0.05	0.00	0.00	0.00
	M425 / Begin	-25.91	-0.01	-0.08	0.00	0.00	0.00
	M380 / End	-0.42	0.00	-0.46	0.00	0.00	0.00
DStlS1(5)	M34 / End	11.44	-0.01	-0.39	0.00	0.00	0.00
	M25 / Begin	34.29	0.01	0.55	0.01	15.59	-0.32
	M25 / End	-38.45	0.03	-0.14	0.07	-14.69	0.29
	M35 / Begin	-20.19	0.00	-0.52	0.00	-0.19	0.00
	M123 / End	9.66	-0.01	-0.88	0.00	0.00	0.00
	M130 / End	-6.21	0.00	-0.41	0.00	0.00	0.00

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
	M418 / End	5.73	0.00	-0.08	0.00	0.00	0.00
	M425 / Begin	6.97	-0.01	-0.16	0.00	0.00	0.00
	M380 / End	-4.73	0.00	-0.85	0.00	0.00	0.00
DStlS15(9)	M34 / End	4.94	-0.01	-0.34	0.00	0.00	0.00
	M25 / Begin	40.64	0.01	-4.23	-0.01	-0.25	-0.35
	M25 / End	-47.06	0.04	-5.24	0.12	3.20	0.33
	M35 / Begin	-21.11	0.00	-0.45	0.00	-0.16	0.00
	M123 / End	15.88	-0.02	-0.79	0.00	0.00	0.00
	M130 / End	-9.63	0.00	-0.35	0.00	0.00	0.00
	M418 / End	5.77	0.00	-0.07	0.00	0.00	0.00
	M425 / Begin	9.42	-0.02	-0.13	0.00	0.00	0.00
	M380 / End	2.03	0.01	-0.93	0.00	0.00	0.00
DStlS38(10)	M34 / End	14.44	0.00	-0.25	0.00	0.00	0.00
	M25 / Begin	16.55	0.01	5.15	0.01	26.26	-0.19
	M25 / End	-17.64	0.02	4.91	0.00	-27.81	0.17
	M35 / Begin	-13.08	0.00	-0.34	0.00	-0.12	0.00
	M123 / End	0.72	0.00	-0.55	0.00	0.00	0.00
	M130 / End	-0.98	0.00	-0.27	0.00	0.00	0.00
	M418 / End	4.05	0.00	-0.05	0.00	0.00	0.00
	M425 / Begin	2.29	0.00	-0.10	0.00	0.00	0.00
	M380 / End	-10.07	0.00	-0.44	0.00	0.00	0.00
DStlS48-1(8)	M34 / End	22.10	0.00	-0.37	0.00	0.00	0.00
	M25 / Begin	60.59	-0.01	0.50	0.00	13.98	-0.27
	M25 / End	-37.48	0.04	-0.11	0.06	-13.15	0.23
	M35 / Begin	-27.93	0.00	-0.49	0.00	-0.18	0.00
	M123 / End	10.96	-0.01	-0.81	0.00	0.00	0.00
	M130 / End	-12.08	0.00	-0.39	0.00	0.00	0.00
	M418 / End	-3.59	0.00	-0.08	0.00	0.00	0.00
	M425 / Begin	-23.16	-0.01	-0.14	0.00	0.00	0.00
	M380 / End	-2.21	0.01	-0.79	0.00	0.00	0.00
DStlS53-1(6)	M34 / End	-4.99	0.00	-0.22	0.00	0.00	0.00
	M25 / Begin	-9.23	0.02	0.33	0.00	9.39	-0.21
	M25 / End	-20.18	0.01	-0.09	0.04	-8.88	0.21
	M35 / Begin	-2.31	0.00	-0.29	0.00	-0.10	0.00
	M123 / End	3.50	-0.01	-0.51	0.00	0.00	0.00
	M130 / End	2.79	0.00	-0.23	0.00	0.00	0.00
	M418 / End	12.20	0.00	-0.04	0.00	0.00	0.00
	M425 / Begin	33.70	-0.01	-0.09	0.00	0.00	0.00
	M380 / End	-4.87	0.00	-0.49	0.00	0.00	0.00
DStlS49-1(11)	M34 / End	-0.65	-0.01	-0.37	0.00	0.00	0.00
	M25 / Begin	3.82	0.02	0.55	0.00	15.36	-0.33
	M25 / End	-34.90	0.03	-0.15	0.07	-14.51	0.32
	M35 / Begin	-10.00	0.00	-0.49	0.00	-0.18	0.00
	M123 / End	7.16	-0.01	-0.85	0.00	0.00	0.00

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
	M130 / End	0.43	0.00	-0.39	0.00	0.00	0.00
	M418 / End	14.40	0.00	-0.08	0.00	0.00	0.00
	M425 / Begin	36.45	-0.01	-0.15	0.00	0.00	0.00
	M380 / End	-6.66	0.00	-0.82	0.00	0.00	0.00
DStlS17(12)	M34 / End	-3.81	-0.01	-0.34	0.00	0.00	0.00
	M25 / Begin	17.14	0.01	5.60	0.02	38.95	-0.06
	M25 / End	-47.12	-0.01	4.61	0.06	-40.10	0.05
	M35 / Begin	-13.12	0.00	-0.45	0.00	-0.16	0.00
	M123 / End	3.53	-0.02	-0.79	0.00	0.00	0.00
	M130 / End	-3.81	0.00	-0.35	0.00	0.00	0.00
	M418 / End	9.50	0.00	-0.07	0.00	0.00	0.00
	M425 / Begin	36.80	-0.01	-0.14	0.00	0.00	0.00
	M380 / End	-10.87	0.00	-0.93	0.00	0.00	0.00
DStlS40(13)	M34 / End	23.19	0.00	-0.25	0.00	0.00	0.00
	M25 / Begin	40.04	0.00	-4.67	-0.01	-12.93	-0.48
	M25 / End	-17.58	0.08	-4.94	0.06	15.48	0.45
	M35 / Begin	-21.07	0.00	-0.33	0.00	-0.12	0.00
	M123 / End	13.06	0.00	-0.55	0.00	0.00	0.00
	M130 / End	-6.81	0.00	-0.27	0.00	0.00	0.00
	M418 / End	0.33	0.00	-0.06	0.00	0.00	0.00
	M425 / Begin	-25.09	-0.01	-0.10	0.00	0.00	0.00
	M380 / End	2.82	0.00	-0.44	0.00	0.00	0.00
DStlS32(14)	M34 / End	24.97	-0.01	-0.34	0.00	0.00	0.00
	M25 / Begin	57.04	0.01	-1.74	0.00	10.33	-0.61
	M25 / End	-51.92	0.09	-2.92	0.11	-8.38	0.58
	M35 / Begin	-34.00	0.00	-0.45	0.00	-0.16	0.00
	M123 / End	18.54	-0.01	-0.79	0.00	0.00	0.00
	M130 / End	-10.94	0.00	-0.34	0.00	0.00	0.00
	M418 / End	7.15	0.00	-0.08	0.00	0.00	0.00
	M425 / Begin	-5.07	-0.02	-0.13	0.00	0.00	0.00
	M380 / End	-4.21	0.01	-0.96	0.00	0.00	0.00
DStlS33(15)	M34 / End	9.14	-0.01	-0.34	0.00	0.00	0.00
	M25 / Begin	39.04	0.02	3.29	0.01	33.29	-0.33
	M25 / End	-59.05	0.03	1.93	0.09	-33.31	0.32
	M35 / Begin	-25.90	0.00	-0.45	0.00	-0.16	0.00
	M123 / End	11.69	-0.02	-0.81	0.00	0.00	0.00
	M130 / End	-8.12	0.00	-0.34	0.00	0.00	0.00
	M418 / End	10.50	0.00	-0.08	0.00	0.00	0.00
	M425 / Begin	24.51	-0.01	-0.13	0.00	0.00	0.00
	M380 / End	-10.07	0.01	-1.07	0.00	0.00	0.00
DStlS14(16)	M34 / End	19.11	0.00	-0.34	0.00	0.00	0.00
	M25 / Begin	29.65	0.01	5.36	0.02	32.24	-0.32
	M25 / End	-32.92	0.04	4.77	0.03	-33.54	0.30
	M35 / Begin	-21.31	0.00	-0.45	0.00	-0.16	0.00

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
	M123 / End	4.89	-0.01	-0.76	0.00	0.00	0.00
	M130 / End	-3.61	0.00	-0.36	0.00	0.00	0.00
	M418 / End	6.52	0.00	-0.07	0.00	0.00	0.00
	M425 / Begin	5.04	0.00	-0.13	0.00	0.00	0.00
	M380 / End	-12.03	0.00	-0.72	0.00	0.00	0.00
DStlS39(17)	M34 / End	0.27	0.00	-0.25	0.00	0.00	0.00
	M25 / Begin	27.54	0.01	-4.44	-0.01	-6.23	-0.22
	M25 / End	-31.79	0.02	-5.09	0.09	8.92	0.21
	M35 / Begin	-12.88	0.00	-0.34	0.00	-0.12	0.00
	M123 / End	11.70	-0.01	-0.58	0.00	0.00	0.00
	M130 / End	-7.00	0.00	-0.26	0.00	0.00	0.00
	M418 / End	3.31	0.00	-0.05	0.00	0.00	0.00
	M425 / Begin	6.67	-0.02	-0.10	0.00	0.00	0.00
	M380 / End	3.99	0.01	-0.65	0.00	0.00	0.00

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS41(1)	0.00	0.00	-0.02	0.21	2.89	0.03
DStlS16(2)	0.00	0.00	-0.02	0.29	-0.95	0.07
DStlS31(4)	0.00	0.00	-0.02	0.23	0.08	0.10
DStlS52-1(7)	-0.02	0.03	0.05	0.20	0.70	0.03
DStlS1(5)	0.00	0.00	-0.02	0.34	1.29	0.06
DStlS15(9)	0.00	0.00	-0.02	0.26	-0.95	0.09
DStlS38(10)	0.00	0.00	-0.02	0.24	2.89	0.01
DStlS48-1(8)	-0.02	0.03	0.04	0.33	1.19	0.06
DStlS53-1(6)	0.02	-0.03	-0.08	0.18	0.75	0.04
DStlS49-1(11)	0.02	-0.03	-0.08	0.31	1.24	0.06
DStlS17(12)	0.00	0.00	-0.02	0.27	3.17	0.06
DStlS40(13)	0.00	0.00	-0.02	0.23	-1.23	0.05
DStlS32(14)	0.00	0.00	-0.02	0.25	0.08	0.09
DStlS33(15)	0.00	0.00	-0.02	0.24	2.14	0.08
DStlS14(16)	0.00	0.00	-0.02	0.30	3.17	0.04
DStlS39(17)	0.00	0.00	-0.02	0.20	-1.23	0.07

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.2 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Bolts	74.8 < 100%	OK
Welds	81.1 < 100%	OK
Buckling	Not calculated	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M34-bfl 1	A992	7/16	DStlS16(2)	12.4	0.0	0.0	OK
M34-tfl 1	A992	7/16	DStlS16(2)	14.3	0.0	0.0	OK
M34-w 1	A992	5/16	DStlS16(2)	45.0	0.1	3.9	OK
M25-bfl 1	A992	3/4	DStlS16(2)	6.4	0.0	0.0	OK
M25-tfl 1	A992	3/4	DStlS17(12)	9.9	0.0	0.0	OK
M25-w 1	A992	1/2	DStlS16(2)	37.5	0.0	0.0	OK
M35-bfl 1	A992	9/16	DStlS32(14)	8.6	0.0	0.0	OK
M35-tfl 1	A992	9/16	DStlS16(2)	6.5	0.0	0.0	OK
M35-w 1	A992	3/8	DStlS16(2)	29.0	0.0	2.6	OK
M123-bfl 1	A992	7/16	DStlS32(14)	13.1	0.0	0.0	OK
M123-tfl 1	A992	7/16	DStlS16(2)	4.6	0.0	0.0	OK
M123-w 1	A992	5/16	DStlS32(14)	25.3	0.0	0.0	OK
M130-bfl 1	A992	1/2	DStlS48-1(8)	11.4	0.0	1.5	OK
M130-w 1	A992	1/2	DStlS14(16)	2.9	0.0	0.0	OK
M418	A992	3/8	DStlS49-1(11)	11.1	0.0	0.0	OK
M425	A992	1/2	DStlS17(12)	31.1	0.0	0.0	OK
M380-bfl 1	A992	5/8	DStlS16(2)	8.2	0.0	0.0	OK
M380-tfl 1	A992	5/8	DStlS32(14)	1.9	0.0	0.0	OK
M380-w 1	A992	3/8	DStlS16(2)	45.0	0.1	7.1	OK
FP1	A992	5/16	DStlS16(2)	45.0	0.1	8.5	OK
FP2	A992	5/16	DStlS16(2)	45.1	0.2	8.2	OK
FP3	A992	5/16	DStlS16(2)	32.3	0.0	8.4	OK
CPL1a	A572 Gr.50	1/2	DStlS49-1(11)	23.8	0.0	1.3	OK
CPL1b	A572 Gr.50	1/2	DStlS49-1(11)	8.3	0.0	0.0	OK
CPL1c	A572 Gr.50	1/2	DStlS49-1(11)	28.0	0.0	1.8	OK
CPL2a	A572 Gr.50	3/4	DStlS33(15)	23.1	0.0	1.3	OK
CPL2b	A572 Gr.50	1/2	DStlS17(12)	21.4	0.0	0.0	OK
CPL2c	A572 Gr.50	1/2	DStlS17(12)	35.7	0.0	2.6	OK
CPL3a	A572 Gr.50	3/4	DStlS16(2)	26.8	0.0	0.8	OK
CPL3b	A572 Gr.50	1/2	DStlS32(14)	20.3	0.0	0.0	OK
CPL3c	A572 Gr.50	1/2	DStlS32(14)	28.1	0.0	2.5	OK
GUSS1	A572 Gr.50	3/4	DStlS16(2)	32.5	0.0	0.4	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for FP2

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y = 50.0$ ksi – characteristic yield strength

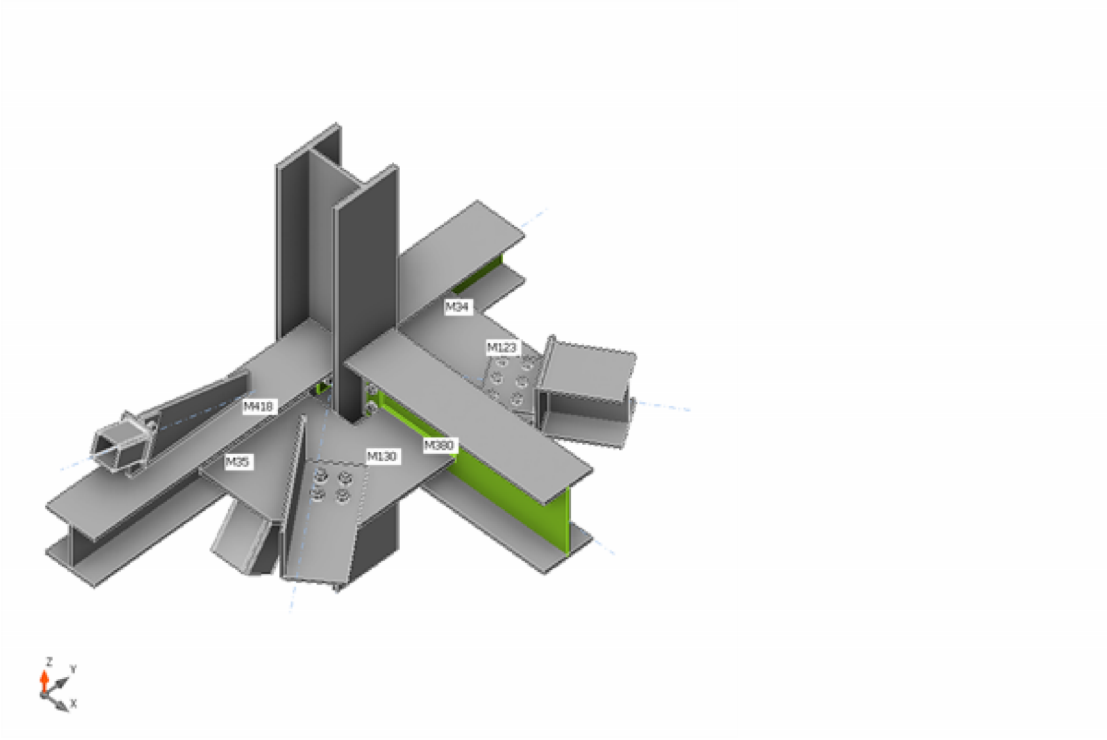
$\phi = 0.90$ – resistance factor for steel material AISC 360-16 – B3.1

Loc. deformation

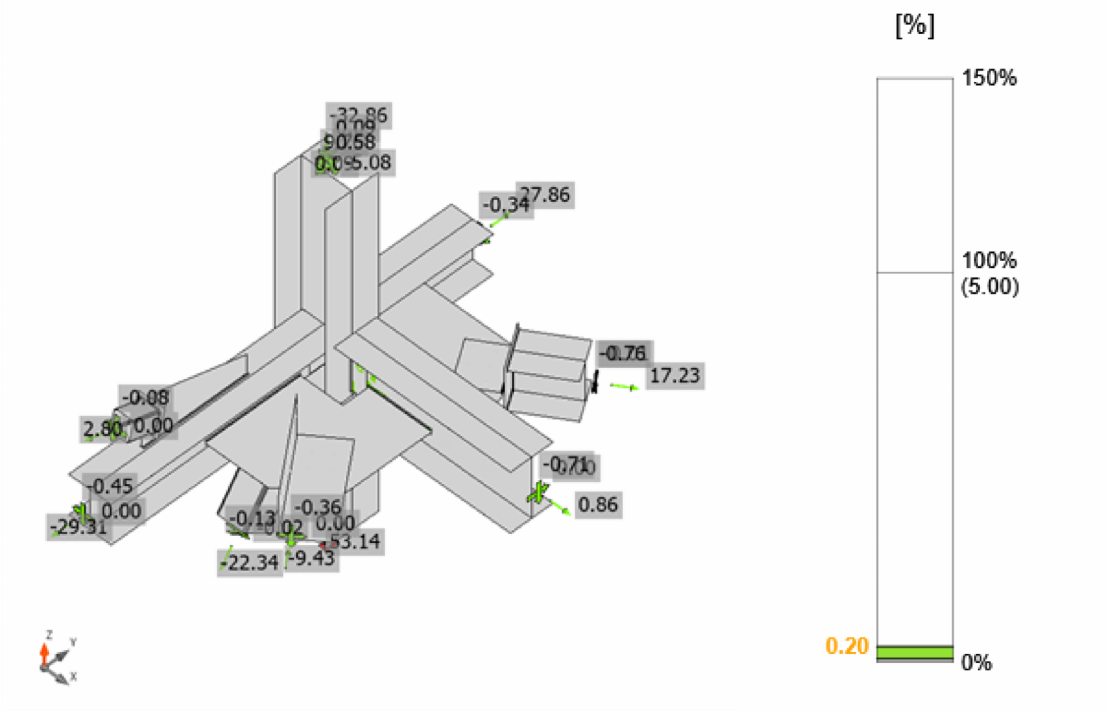
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M418	4.02	DStlS39(17)	0.00	0.12	0.0	OK
M425	5.98	DStlS39(17)	0.00	0.18	0.0	OK

Symbol explanation

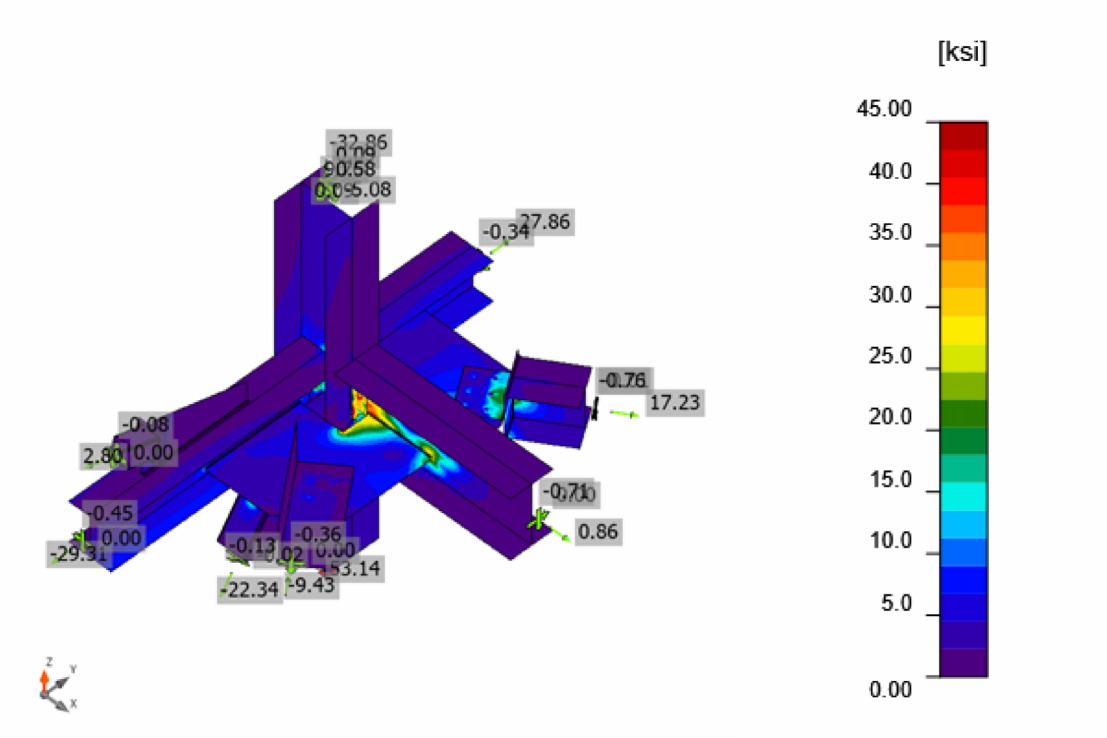
d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation



Overall check, DStlS16(2)

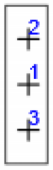
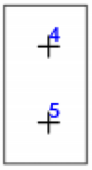
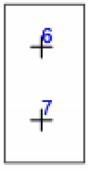
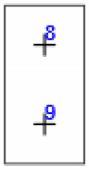
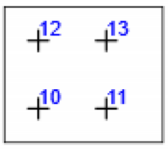
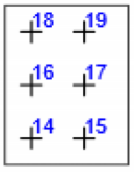
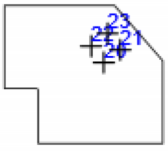


Strain check, DStlS16(2)



Equivalent stress, DStlS16(2)

Bolts

Shape	Item	Grade	Loads	F_t [kip]	V [kip]	$\phi R_{n,bearing}$ [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	B1	5/8 A325 - 1	DStlS16(2)	6.56	1.90	17.67	31.7	15.3	0.0	OK	OK
	B2	5/8 A325 - 1	DStlS17(12)	0.88	3.34	21.24	4.2	26.9	0.0	OK	OK
	B3	5/8 A325 - 1	DStlS14(16)	0.89	1.74	21.65	4.3	14.0	0.0	OK	OK
	B4	3/4 A325 - 2	DStlS16(2)	2.05	10.18	18.28	6.9	57.0	0.0	OK	OK
	B5	3/4 A325 - 2	DStlS16(2)	2.22	11.61	18.26	7.4	65.0	0.0	OK	OK
	B6	3/4 A325 - 2	DStlS16(2)	1.65	8.19	20.58	5.5	45.8	0.0	OK	OK
	B7	3/4 A325 - 2	DStlS16(2)	1.58	5.49	21.54	5.3	30.7	0.0	OK	OK
	B8	5/8 A325 - 1	DStlS49-1(11)	0.86	6.88	29.21	4.2	55.4	0.0	OK	OK
	B9	5/8 A325 - 1	DStlS49-1(11)	0.49	7.52	29.84	2.4	60.6	0.0	OK	OK
	B10	5/8 A325 - 1	DStlS17(12)	0.76	9.17	36.57	3.7	73.9	0.0	OK	OK
	B11	5/8 A325 - 1	DStlS17(12)	1.69	9.15	36.57	8.2	73.7	0.0	OK	OK
	B12	5/8 A325 - 1	DStlS17(12)	0.78	9.28	36.57	3.8	74.8	0.0	OK	OK
	B13	5/8 A325 - 1	DStlS17(12)	2.46	9.20	36.57	11.9	74.1	0.0	OK	OK
	B14	5/8 A325 - 1	DStlS32(14)	1.15	3.54	34.05	5.6	28.5	0.0	OK	OK
	B15	5/8 A325 - 1	DStlS32(14)	0.28	3.50	36.57	1.3	28.2	0.0	OK	OK
	B16	5/8 A325 - 1	DStlS32(14)	0.98	3.07	33.88	4.8	24.7	0.0	OK	OK
	B17	5/8 A325 - 1	DStlS32(14)	0.81	3.15	36.57	3.9	25.4	0.0	OK	OK
	B18	5/8 A325 - 1	DStlS31(4)	0.75	2.69	33.84	3.6	21.7	0.0	OK	OK
	B19	5/8 A325 - 1	DStlS31(4)	0.74	2.75	36.57	3.6	22.1	0.0	OK	OK
	B20	3/4 A325 - 2	DStlS48-1(8)	0.42	4.18	43.88	1.4	23.4	0.0	OK	OK
	B21	3/4 A325 - 2	DStlS48-1(8)	0.42	4.21	43.88	1.4	23.6	0.0	OK	OK
	B22	3/4 A325 - 2	DStlS48-1(8)	0.12	2.20	43.88	0.4	12.3	0.0	OK	OK
	B23	3/4 A325 - 2	DStlS48-1(8)	0.55	2.20	43.88	1.8	12.3	0.0	OK	OK

Design data

Grade	$\phi R_{n,tension}$ [kip]	$\phi R_{n,shear}$ [kip]
5/8 A325 - 1	20.69	12.41
3/4 A325 - 2	29.79	17.88

Project:	**AOF Hangar Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**

Symbol explanation

F_t	Tension force
V	Resultant of bolt shear forces Vy and Vz in shear planes
$\phi R_{n,bearing}$	Bolt bearing resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
$\phi R_{n,tension}$	Bolt tension resistance - AISC 360-16 – J3.6
$\phi R_{n,shear}$	Bolt shear resistance - AISC 360-16 – J3.6

Detailed result for B12

Tension resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 20.69 \quad \text{kip} \quad \geq \quad F_t = \quad 0.78 \quad \text{kip}$$

Where:

$F_{nt} =$ 89.9 ksi – nominal tensile stress AISC 360-16 – Table J3.2

$A_b =$ 0.31 in^2 – gross bolt cross-sectional area

$\phi =$ 0.75 – resistance factor

Shear resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 12.41 \quad \text{kip} \quad \geq \quad V = \quad 9.28 \quad \text{kip}$$

Where:

$F_{nv} =$ 54.0 ksi – nominal shear stress AISC 360-16 – Table J3.2

$A_b =$ 0.31 in^2 – gross bolt cross-sectional area

$\phi =$ 0.75 – resistance factor

Bearing resistance check (AISC 360-16 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = \quad 36.57 \quad \text{kip} \quad \geq \quad V = \quad 9.28 \quad \text{kip}$$

Where:

$l_c =$ 2.31 in – clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material

$t =$ 0.50 in – thickness of the plate

$d =$ 0.63 in – diameter of a bolt

$F_u =$ 65.0 ksi – specified minimum tensile strength of the connected material

$\phi =$ 0.75 – resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-16 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
M25-tfl 1	FP1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	10.41	0.52	DStlS32(14)	2.53	4.58	55.2	27.1	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	10.41	0.52	DStlS16(2)	2.30	4.61	49.9	23.9	OK	OK
M25-w 1	FP2	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.21	0.31	DStlS16(2)	0.98	2.64	37.1	17.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.21	0.31	DStlS16(2)	2.00	2.65	75.3	53.7	OK	OK
M25-w 1	FP3	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.46	0.32	DStlS16(2)	1.33	2.83	46.9	27.9	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.42	0.32	DStlS16(2)	1.43	1.94	73.7	50.8	OK	OK
M35-tfl 1	CPL1a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	19.94	0.69	DStlS49-1(11)	1.57	5.30	29.5	12.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	19.94	0.69	DStlS49-1(11)	1.50	5.34	28.2	10.5	OK	OK
CPL1b	CPL1c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	4.95	0.31	DStlS49-1(11)	0.31	2.41	12.9	5.6	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	4.98	0.31	DStlS49-1(11)	1.29	2.75	46.8	30.2	OK	OK
M35-bfl 1	CPL2a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.71	0.70	DStlS31(4)	4.04	5.36	75.4	41.1	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.71	0.70	DStlS17(12)	2.79	4.33	64.4	33.5	OK	OK
M25-w 1	CPL2a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.96	0.75	DStlS16(2)	4.90	6.31	77.6	50.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.96	0.75	DStlS16(2)	5.00	6.61	75.7	44.3	OK	OK
CPL2b	CPL2c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.97	0.35	DStlS17(12)	2.31	3.05	75.7	54.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.97	0.35	DStlS17(12)	2.42	3.09	78.4	66.6	OK	OK
M380-w 1	CPL3a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	18.16	1.01	DStlS16(2)	3.24	8.62	37.6	20.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	18.12	1.01	DStlS16(2)	6.67	8.87	75.2	44.6	OK	OK
M34-w 1	CPL3a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	12.26	0.68	DStlS16(2)	1.57	5.13	30.6	12.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	12.26	0.68	DStlS16(2)	1.14	4.15	27.5	10.6	OK	OK
CPL3b	CPL3c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.92	0.45	DStlS32(14)	1.45	3.89	37.3	21.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.92	0.45	DStlS32(14)	2.31	3.93	58.8	36.5	OK	OK
CPL3b	M123-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.96	0.44	DStlS32(14)	0.86	3.50	24.6	10.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS16(2)	0.60	2.78	21.5	10.6	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
CPL3b	M123-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS16(2)	0.32	2.70	11.8	0.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.96	0.44	DStlS16(2)	0.30	3.42	8.7	0.0	OK	OK
CPL3b	M123-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS32(14)	2.11	3.90	54.0	29.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS32(14)	2.22	3.91	56.9	31.5	OK	OK
M35-w 1	GUSS1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	18.05	0.69	DStlS14(16)	1.83	5.61	32.7	13.6	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	18.05	0.69	DStlS32(14)	2.33	5.26	44.4	24.3	OK	OK
M380-w 1	GUSS1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	11.98	1.00	DStlS16(2)	6.58	8.12	81.1	70.6	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	11.98	1.00	DStlS16(2)	5.89	7.72	76.3	56.6	OK	OK
CPL1b	M418	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	13.82	0.33	DStlS49-1(11)	0.69	2.87	23.9	11.8	OK	OK
CPL2b	M425	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	20.93	0.35	DStlS17(12)	2.05	3.09	66.6	41.8	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	13.82	0.33	DStlS49-1(11)	0.64	2.87	22.3	10.9	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	20.93	0.35	DStlS17(12)	1.21	3.09	39.2	21.8	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Detailed result for M380-w 1 / GUSS1

Weld resistance check (AISC 360-16 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 8.12 kip ≥ $F_n =$ 6.58 kip

Where:

$F_{nw} =$ 61.3 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 71.2° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.18 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Buckling

Buckling analysis was not calculated.

Project item 158

Design

Name	158
Description	GL C - FL Middle
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC - LRFD (2016)

Members

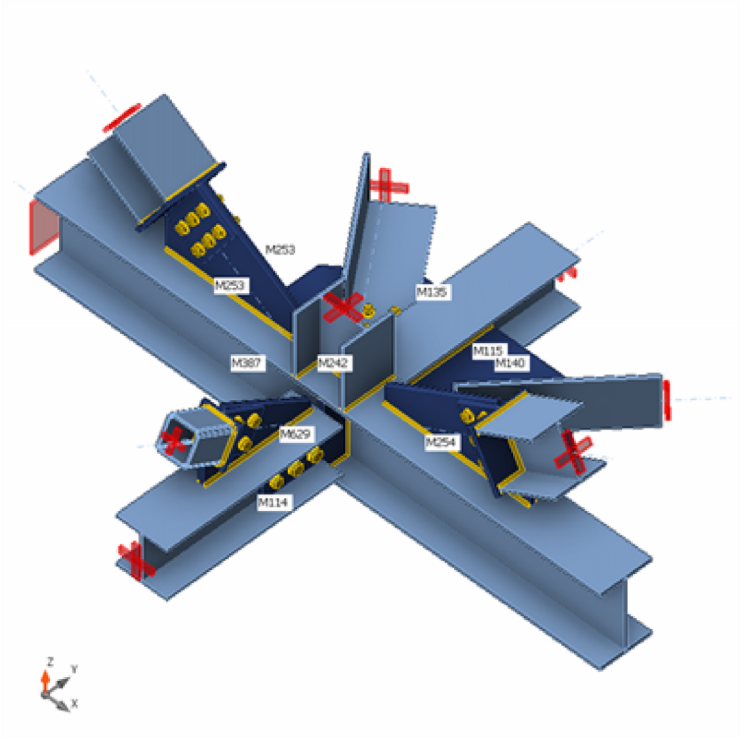
Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M387	33 - W12X50	0.0	0.0	0.0	0.00	0.00	0.00
M114	22 - W8X31	90.0	0.0	0.0	0.00	0.00	0.00
M115	22 - W8X31	90.0	0.0	0.0	0.00	0.00	0.00
M135	495 - L8X8X1/2	-52.3	0.0	0.0	0.00	0.00	0.00
M140	495 - L8X8X1/2	48.5	0.0	0.0	0.00	0.00	0.00
M242	22 - W8X31	0.0	90.0	-180.0	0.00	0.00	0.00
M253	22 - W8X31	-180.0	32.3	0.0	0.00	0.00	0.00
M254	22 - W8X31	0.0	28.5	0.0	0.00	0.00	0.00
M629	345 - HSS5X5X1/2(HSS5X5X1/2(HSS5X5X1/2(HSS(Imp)5X5X1/2)))	-90.0	28.7	0.0	0.00	0.00	0.00

Supports and forces

Name	Support	Forces in	X [in]
M387 / begin	N-Vy-Vz-Mx-My-Mz	Position	0.00
M387 / end		Position	0.00
M114 / begin	Mx-My-Mz	Bolts	8.39
M115 / end	Mx-My-Mz	Bolts	3.44
M135 / begin	Mx-My-Mz	Bolts	16.32
M140 / end	Mx-My-Mz	Bolts	17.13
M242 / end	Mx-My-Mz	Connected member face	6.10
M253 / end	Mx-My-Mz	Position	26.25
M254 / end	Mx-My-Mz	Position	26.00
M629 / end	Mx-My-Mz	Position	19.25

Project:	**AOF Hangar Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**



Cross-sections

Name	Material
33 - W12X50	A992
22 - W8X31	A992
495 - L8X8X1/2	A992
345 - HSS5X5X1/2(HSS5X5X1/2(HSS5X5X1/2(HSS(Imp)5X5X1/2)))	A992

Bolts

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
7/8 A325	0.88	92.0	120.0	0.60
3/4 A325	0.75	92.0	120.0	0.44
5/8 A325	0.63	92.0	120.0	0.31

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS17(1)	M387 / Begin	-103.12	0.00	-0.95	0.00	-2.27	0.03
	M387 / End	135.39	0.01	-1.11	0.01	2.27	0.10
	M114 / Begin	-12.55	0.03	-1.38	0.00	-9.18	-0.20
	M115 / End	-9.13	0.00	-1.41	0.00	9.19	0.07
	M135 / Begin	-27.42	0.00	-0.40	0.00	0.00	0.00
	M140 / End	31.18	0.00	-0.45	0.00	0.00	0.00
	M242 / End	10.86	0.00	0.01	0.00	0.00	0.00
	M253 / End	2.26	0.00	-0.27	0.00	0.00	0.00
	M254 / End	-38.97	-0.01	-0.29	0.00	0.00	0.00
	M629 / End	26.62	0.00	-0.11	0.00	0.00	0.00
DStlS38(3)	M387 / Begin	-36.40	-0.01	-0.48	0.00	-1.03	0.08
	M387 / End	47.60	-0.01	-0.55	0.00	1.03	-0.02
	M114 / Begin	-13.15	0.01	-0.55	0.00	-3.06	-0.09
	M115 / End	3.93	0.00	-0.55	0.00	3.06	0.03
	M135 / Begin	-10.34	0.00	-0.29	0.00	0.00	0.00
	M140 / End	12.97	0.00	-0.31	0.00	0.00	0.00
	M242 / End	3.18	0.00	0.00	0.00	0.00	0.00
	M253 / End	2.60	0.00	-0.20	0.00	0.00	0.00
	M254 / End	-12.82	0.00	-0.22	0.00	0.00	0.00
	M629 / End	9.85	0.00	-0.09	0.00	0.00	0.00
DStlS31(4)	M387 / Begin	-127.77	0.00	-1.12	-0.01	-3.17	0.09
	M387 / End	165.41	0.01	-1.29	0.01	3.16	0.14
	M114 / Begin	1.57	0.03	-1.82	0.00	-12.91	-0.27
	M115 / End	-15.91	0.00	-1.79	0.00	12.92	0.05
	M135 / Begin	-25.36	-0.01	-0.42	0.00	0.00	0.00
	M140 / End	31.87	-0.01	-0.46	0.00	0.00	0.00
	M242 / End	15.43	0.00	0.01	0.00	0.00	0.00
	M253 / End	-0.71	0.00	-0.27	0.00	0.00	0.00
	M254 / End	-49.87	0.00	-0.28	0.00	0.00	0.00
	M629 / End	33.74	0.00	-0.10	0.00	0.00	0.00
DStlS33(5)	M387 / Begin	-126.86	0.00	-1.10	-0.01	-2.88	0.07
	M387 / End	165.48	0.01	-1.28	0.01	2.88	0.11
	M114 / Begin	-9.13	0.03	-1.73	0.00	-12.10	-0.26
	M115 / End	-11.30	0.00	-1.73	0.00	12.11	0.07
	M135 / Begin	-29.88	0.00	-0.41	0.00	0.00	0.00
	M140 / End	35.59	-0.01	-0.46	0.00	0.00	0.00
	M242 / End	13.82	0.00	0.01	0.00	0.00	0.00
	M253 / End	0.96	0.00	-0.27	0.00	0.00	0.00
	M254 / End	-49.04	0.00	-0.28	0.00	0.00	0.00
	M629 / End	34.02	0.00	-0.10	0.00	0.00	0.00
DStlS15(10)	M387 / Begin	-104.93	0.00	-0.99	-0.01	-2.83	0.05
	M387 / End	135.25	0.02	-1.14	0.01	2.83	0.14

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
	M114 / Begin	8.86	0.02	-1.55	0.00	-10.81	-0.22
	M115 / End	-18.33	0.00	-1.53	0.00	10.81	0.03
	M135 / Begin	-18.38	0.00	-0.41	0.00	0.00	0.00
	M140 / End	23.75	-0.01	-0.45	0.00	0.00	0.00
	M242 / End	14.09	0.00	0.01	0.00	0.00	0.00
	M253 / End	-1.07	0.00	-0.27	0.00	0.00	0.00
	M254 / End	-40.63	0.00	-0.29	0.00	0.00	0.00
	M629 / End	26.05	0.00	-0.10	0.00	0.00	0.00
DStlS49-1(9)	M387 / Begin	-79.37	-0.01	-0.90	0.00	-2.60	0.08
	M387 / End	103.62	0.01	-1.02	0.00	2.59	0.11
	M114 / Begin	-2.24	0.02	-1.35	0.00	-9.11	-0.21
	M115 / End	-8.42	0.00	-1.26	0.00	9.12	0.04
	M135 / Begin	-16.96	0.00	-0.44	0.00	0.00	0.00
	M140 / End	22.29	0.00	-0.48	0.00	0.00	0.00
	M242 / End	9.38	0.00	0.01	0.00	0.00	0.00
	M253 / End	1.64	0.00	-0.30	0.00	0.00	0.00
	M254 / End	-30.96	0.01	-0.32	0.00	0.00	0.00
	M629 / End	22.10	0.00	-0.13	0.00	0.00	0.00
DStlS39(14)	M387 / Begin	-72.35	0.00	-0.71	0.00	-2.05	0.03
	M387 / End	92.90	0.02	-0.81	0.00	2.04	0.12
	M114 / Begin	10.05	0.02	-1.09	0.00	-7.58	-0.15
	M115 / End	-15.35	0.00	-1.08	0.00	7.58	0.01
	M135 / Begin	-11.44	0.00	-0.31	0.00	0.00	0.00
	M140 / End	15.11	0.00	-0.34	0.00	0.00	0.00
	M242 / End	10.39	0.00	0.01	0.00	0.00	0.00
	M253 / End	-1.10	0.00	-0.20	0.00	0.00	0.00
	M254 / End	-27.87	0.00	-0.22	0.00	0.00	0.00
	M629 / End	17.17	0.00	-0.07	0.00	0.00	0.00
DStlS6(15)	M387 / Begin	-54.51	-0.01	-0.68	0.00	-1.55	0.10
	M387 / End	71.06	-0.01	-0.78	0.00	1.55	-0.01
	M114 / Begin	-13.66	0.02	-0.82	0.00	-4.82	-0.13
	M115 / End	2.03	0.00	-0.82	0.00	4.83	0.04
	M135 / Begin	-13.98	0.00	-0.39	0.00	0.00	0.00
	M140 / End	17.67	0.00	-0.42	0.00	0.00	0.00
	M242 / End	5.44	0.00	0.00	0.00	0.00	0.00
	M253 / End	2.87	0.00	-0.27	0.00	0.00	0.00
	M254 / End	-19.65	0.00	-0.30	0.00	0.00	0.00
	M629 / End	14.38	0.00	-0.12	0.00	0.00	0.00
DStlS16(16)	M387 / Begin	-70.78	-0.01	-0.81	0.00	-2.38	0.13
	M387 / End	89.79	0.00	-0.91	0.00	2.37	0.05
	M114 / Begin	7.07	0.02	-1.18	0.00	-7.92	-0.18
	M115 / End	-8.26	0.00	-1.12	0.00	7.92	0.01
	M135 / Begin	-8.25	0.00	-0.40	0.00	0.00	0.00
	M140 / End	14.19	0.00	-0.44	0.00	0.00	0.00

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
	M242 / End	10.09	0.00	0.01	0.00	0.00	0.00
	M253 / End	-0.70	0.00	-0.27	0.00	0.00	0.00
	M254 / End	-27.25	0.00	-0.29	0.00	0.00	0.00
	M629 / End	18.15	0.00	-0.11	0.00	0.00	0.00
DStlS1(19)	M387 / Begin	-84.58	0.00	-0.93	0.00	-2.40	0.08
	M387 / End	109.28	0.00	-1.06	0.00	2.39	0.07
	M114 / Begin	-2.41	0.02	-1.28	0.00	-8.27	-0.19
	M115 / End	-8.88	0.00	-1.27	0.00	8.28	0.04
	M135 / Begin	-16.94	0.00	-0.46	0.00	0.00	0.00
	M140 / End	21.84	0.00	-0.51	0.00	0.00	0.00
	M242 / End	10.55	0.00	0.01	0.00	0.00	0.00
	M253 / End	1.17	0.00	-0.31	0.00	0.00	0.00
	M254 / End	-31.64	0.00	-0.34	0.00	0.00	0.00
	M629 / End	21.02	0.00	-0.13	0.00	0.00	0.00
DStlS14(20)	M387 / Begin	-68.97	-0.01	-0.76	0.00	-1.82	0.11
	M387 / End	89.94	-0.01	-0.88	0.00	1.81	0.00
	M114 / Begin	-14.34	0.02	-1.01	0.00	-6.29	-0.16
	M115 / End	0.95	0.00	-1.00	0.00	6.29	0.05
	M135 / Begin	-17.29	0.00	-0.39	0.00	0.00	0.00
	M140 / End	21.62	0.00	-0.43	0.00	0.00	0.00
	M242 / End	6.87	0.00	0.01	0.00	0.00	0.00
	M253 / End	2.63	0.00	-0.27	0.00	0.00	0.00
	M254 / End	-25.59	0.00	-0.30	0.00	0.00	0.00
	M629 / End	18.72	0.00	-0.12	0.00	0.00	0.00

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS17(1)	0.00	0.00	0.00	-0.18	0.13	-0.03
DStlS38(3)	0.00	0.00	0.00	-0.28	0.10	-0.01
DStlS31(4)	0.00	0.00	0.00	-0.03	0.12	-0.02
DStlS33(5)	0.00	0.00	0.00	-0.06	0.12	-0.03
DStlS15(10)	0.00	0.00	0.00	-0.13	0.12	-0.01
DStlS49-1(9)	0.03	0.03	0.00	-0.20	0.13	0.00
DStlS39(14)	0.00	0.00	0.00	-0.12	0.09	-0.01
DStlS6(15)	0.00	0.00	0.00	-0.34	0.13	-0.01
DStlS16(16)	0.00	0.00	0.00	-0.23	0.12	0.00
DStlS1(19)	0.00	0.00	0.00	-0.31	0.15	-0.02
DStlS14(20)	0.00	0.00	0.00	-0.28	0.13	-0.02

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.1 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Bolts	61.0 < 100%	OK
Welds	77.1 < 100%	OK
Buckling	Not calculated	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M387-bfl 1	A992	5/8	DStlS33(5)	20.6	0.0	0.0	OK
M387-tfl 1	A992	5/8	DStlS31(4)	18.1	0.0	0.0	OK
M387-w 1	A992	3/8	DStlS33(5)	45.0	0.1	0.0	OK
M114-bfl 1	A992	7/16	DStlS33(5)	7.2	0.0	0.0	OK
M114-tfl 1	A992	7/16	DStlS33(5)	13.3	0.0	0.0	OK
M114-w 1	A992	5/16	DStlS33(5)	43.5	0.0	4.5	OK
M115-bfl 1	A992	7/16	DStlS15(10)	2.0	0.0	0.0	OK
M115-tfl 1	A992	7/16	DStlS31(4)	3.3	0.0	0.0	OK
M115-w 1	A992	5/16	DStlS33(5)	15.6	0.0	1.2	OK
M135-bfl 1	A992	1/2	DStlS33(5)	22.6	0.0	1.3	OK
M135-w 1	A992	1/2	DStlS33(5)	5.3	0.0	0.0	OK
M140-bfl 1	A992	1/2	DStlS33(5)	25.8	0.0	1.6	OK
M140-w 1	A992	1/2	DStlS33(5)	7.1	0.0	0.0	OK
M242-bfl 1	A992	7/16	DStlS31(4)	10.6	0.0	0.0	OK
M242-tfl 1	A992	7/16	DStlS31(4)	11.9	0.0	0.0	OK
M242-w 1	A992	5/16	DStlS31(4)	12.0	0.0	0.0	OK
M253-bfl 1	A992	7/16	DStlS6(15)	0.9	0.0	0.0	OK
M253-tfl 1	A992	7/16	DStlS6(15)	0.6	0.0	0.0	OK
M253-w 1	A992	5/16	DStlS6(15)	1.0	0.0	0.0	OK
M254-bfl 1	A992	7/16	DStlS31(4)	13.5	0.0	0.0	OK
M254-tfl 1	A992	7/16	DStlS31(4)	11.9	0.0	0.0	OK
M254-w 1	A992	5/16	DStlS31(4)	15.5	0.0	0.0	OK
M629	A992	1/2	DStlS33(5)	21.2	0.0	0.0	OK
FP1	A572 Gr.50	3/4	DStlS33(5)	25.8	0.0	10.1	OK
FP2	A572 Gr.50	1/2	DStlS33(5)	10.0	0.0	1.5	OK
CPL1a	A572 Gr.50	3/4	DStlS31(4)	7.6	0.0	0.0	OK
CPL1b	A572 Gr.50	1/2	DStlS6(15)	0.8	0.0	0.0	OK
CPL1c	A572 Gr.50	1/2	DStlS6(15)	2.3	0.0	0.2	OK
CPL2a	A572 Gr.50	3/4	DStlS31(4)	22.4	0.0	1.7	OK
CPL2b	A572 Gr.50	1/2	DStlS31(4)	12.9	0.0	0.0	OK
CPL2c	A572 Gr.50	1/2	DStlS31(4)	42.3	0.0	2.7	OK
CPL3a	A572 Gr.50	3/4	DStlS33(5)	32.4	0.0	2.4	OK
CPL3b	A992	1/2	DStlS33(5)	14.8	0.0	0.0	OK
CPL3c	A992	1/2	DStlS33(5)	41.0	0.0	5.1	OK
GUSS1	A572 Gr.50	3/4	DStlS33(5)	20.6	0.0	1.6	OK
GUSS2	A572 Gr.50	3/4	DStlS33(5)	19.4	0.0	1.1	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for M387-w 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y = 50.0$ ksi – characteristic yield strength

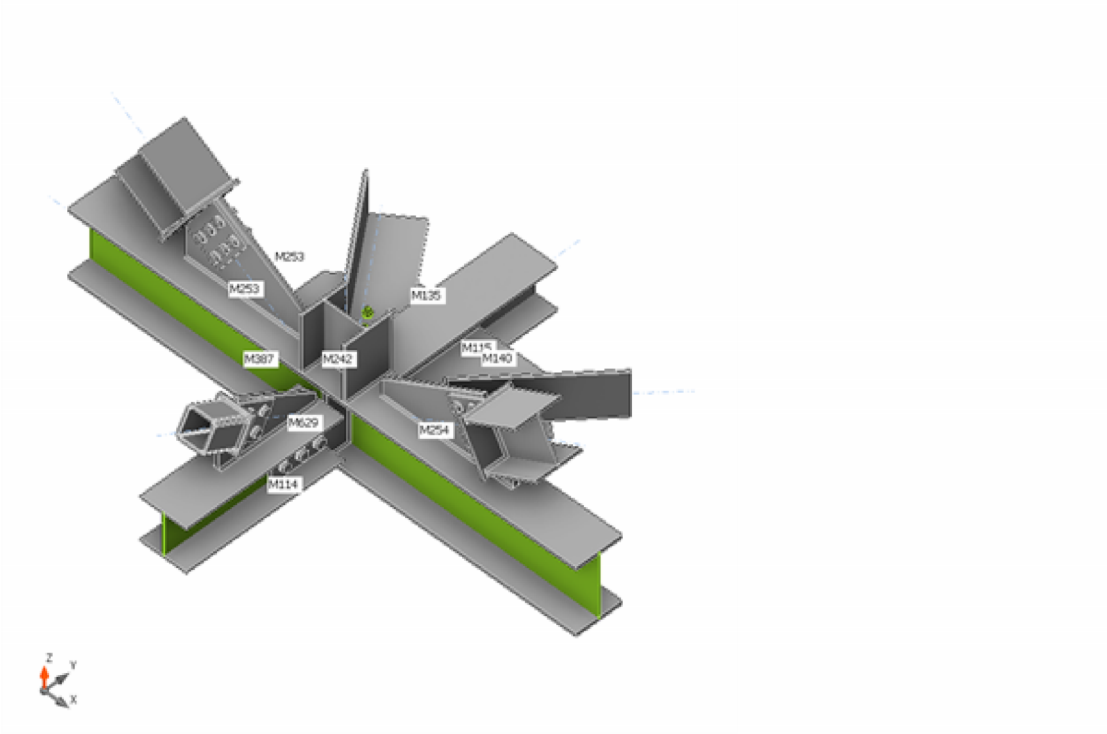
$\phi = 0.90$ – resistance factor for steel material AISC 360-16 – B3.1

Loc. deformation

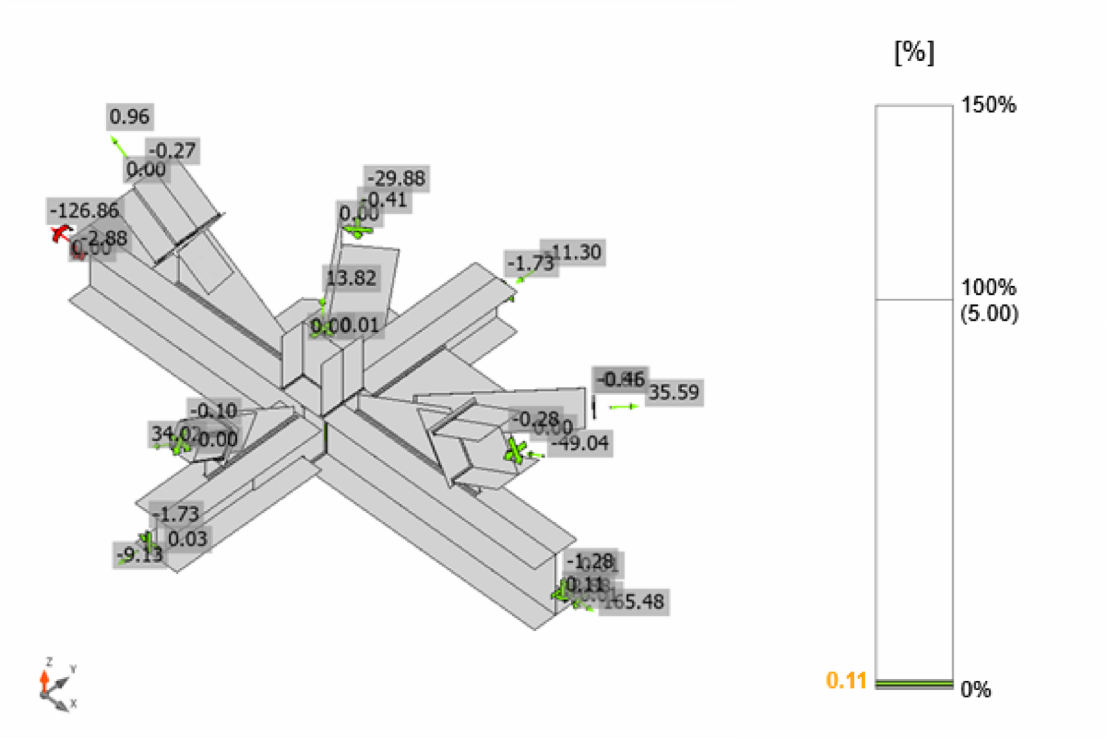
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M629	5.00	DStlS14(20)	0.00	0.15	0.0	OK

Symbol explanation

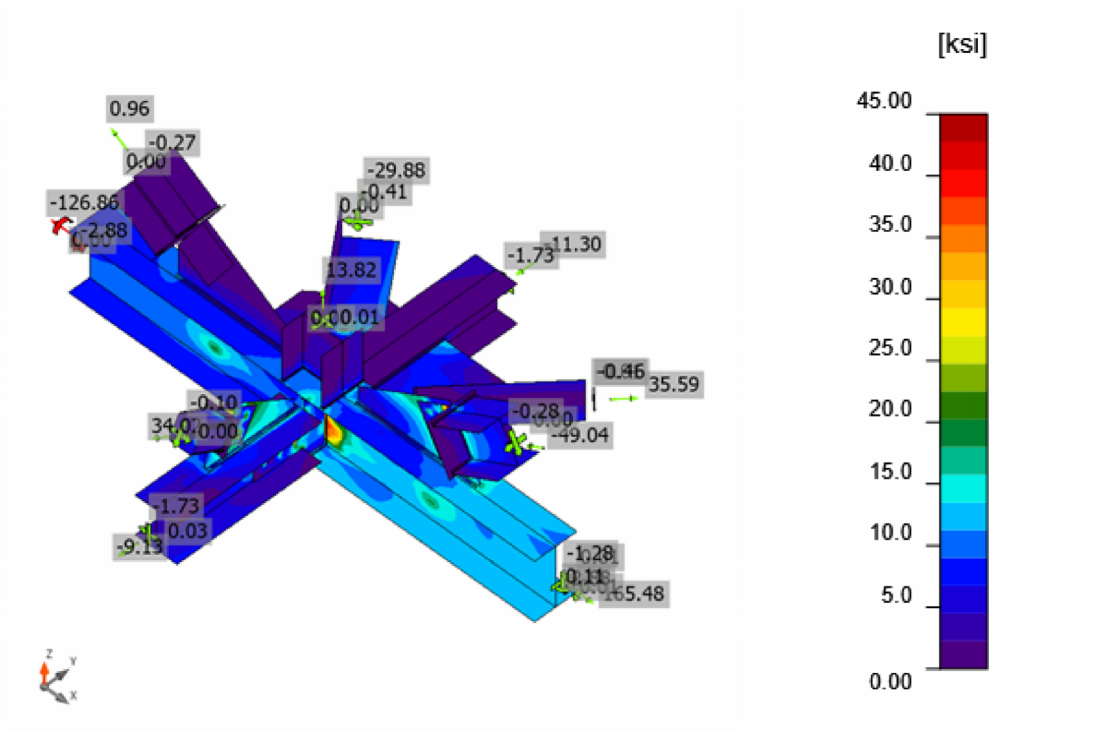
d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation



Overall check, DStlS33(5)

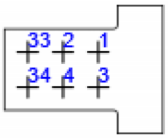
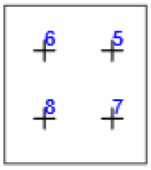
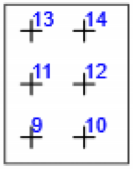
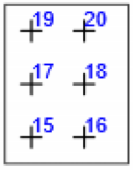
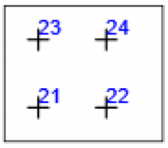
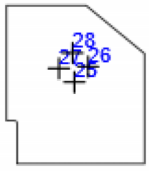
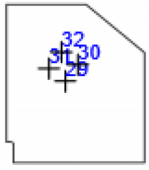


Strain check, DStlS33(5)



Equivalent stress, DStlS33(5)

Bolts

Shape	Item	Grade	Loads	F_t [kip]	V [kip]	$\phi R_{n,bearing}$ [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	B1	7/8 A325 - 1	DStlS33(5)	3.89	10.22	21.88	9.6	46.7	0.0	OK	OK
	B2	7/8 A325 - 1	DStlS33(5)	2.18	8.82	29.18	5.4	36.3	0.0	OK	OK
	B3	7/8 A325 - 1	DStlS33(5)	2.27	7.65	27.38	5.6	31.5	0.0	OK	OK
	B4	7/8 A325 - 1	DStlS33(5)	1.00	5.74	29.18	2.5	23.6	0.0	OK	OK
	B5	3/4 A325 - 2	DStlS14(20)	0.38	2.48	25.01	1.3	13.9	0.0	OK	OK
	B6	3/4 A325 - 2	DStlS33(5)	0.53	2.50	19.74	1.8	14.0	0.0	OK	OK
	B7	3/4 A325 - 2	DStlS33(5)	0.71	2.86	25.01	2.4	16.0	0.0	OK	OK
	B8	3/4 A325 - 2	DStlS33(5)	0.94	2.96	19.46	3.1	16.6	0.0	OK	OK
	B9	3/4 A325 - 2	DStlS6(15)	0.14	0.44	32.18	0.5	2.4	0.0	OK	OK
	B10	3/4 A325 - 2	DStlS6(15)	0.02	0.44	43.88	0.1	2.5	0.0	OK	OK
	B11	3/4 A325 - 2	DStlS6(15)	0.16	0.48	32.16	0.5	2.7	0.0	OK	OK
	B12	3/4 A325 - 2	DStlS6(15)	0.04	0.48	43.88	0.1	2.7	0.0	OK	OK
	B13	3/4 A325 - 2	DStlS6(15)	0.20	0.52	32.07	0.7	2.9	0.0	OK	OK
	B14	3/4 A325 - 2	DStlS6(15)	0.02	0.52	43.88	0.1	2.9	0.0	OK	OK
	B15	3/4 A325 - 2	DStlS31(4)	0.89	9.32	43.88	3.0	52.2	0.0	OK	OK
	B16	3/4 A325 - 2	DStlS31(4)	2.92	9.27	43.88	9.8	51.9	0.0	OK	OK
	B17	3/4 A325 - 2	DStlS31(4)	0.68	8.21	43.88	2.3	45.9	0.0	OK	OK
	B18	3/4 A325 - 2	DStlS31(4)	1.61	8.17	43.88	5.4	45.7	0.0	OK	OK
	B19	3/4 A325 - 2	DStlS31(4)	0.70	7.46	43.88	2.4	41.8	0.0	OK	OK
	B20	3/4 A325 - 2	DStlS31(4)	2.36	7.46	43.88	7.9	41.7	0.0	OK	OK
	B21	3/4 A325 - 2	DStlS33(5)	2.28	7.23	32.31	7.7	40.4	0.0	OK	OK
	B22	3/4 A325 - 2	DStlS33(5)	0.75	7.26	43.88	2.5	40.6	0.0	OK	OK
	B23	3/4 A325 - 2	DStlS33(5)	3.62	9.89	32.27	12.1	55.3	0.0	OK	OK
	B24	3/4 A325 - 2	DStlS33(5)	0.49	9.87	43.88	1.6	55.2	0.0	OK	OK
	B25	3/4 A325 - 2	DStlS33(5)	1.28	9.36	43.88	4.3	52.3	0.0	OK	OK
	B26	3/4 A325 - 2	DStlS33(5)	1.16	9.40	43.88	3.9	52.6	0.0	OK	OK
	B27	3/4 A325 - 2	DStlS33(5)	2.30	8.40	43.88	7.7	47.0	0.0	OK	OK
	B28	3/4 A325 - 2	DStlS33(5)	0.16	8.47	43.88	0.5	47.4	0.0	OK	OK
	B29	5/8 A325 - 3	DStlS33(5)	0.92	7.54	36.57	4.4	60.8	0.0	OK	OK
	B30	5/8 A325 - 3	DStlS33(5)	0.65	7.58	36.57	3.2	61.0	0.0	OK	OK
	B31	5/8 A325 - 3	DStlS33(5)	1.77	7.35	36.57	8.6	59.2	0.0	OK	OK
	B32	5/8 A325 - 3	DStlS33(5)	0.16	7.41	36.57	0.8	59.7	0.0	OK	OK
	B33	3/4 A325 - 2	DStlS33(5)	2.25	7.02	25.01	7.6	39.3	0.0	OK	OK
	B34	3/4 A325 - 2	DStlS33(5)	1.25	4.40	25.01	4.2	24.6	0.0	OK	OK

Design data

Grade	$\phi R_{n,tension}$ [kip]	$\phi R_{n,shear}$ [kip]
7/8 A325 - 1	40.55	24.33
3/4 A325 - 2	29.79	17.88
5/8 A325 - 3	20.69	12.41

Symbol explanation

F_t	Tension force
V	Resultant of bolt shear forces Vy and Vz in shear planes
$\phi R_{n,bearing}$	Bolt bearing resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
$\phi R_{n,tension}$	Bolt tension resistance - AISC 360-16 – J3.6
$\phi R_{n,shear}$	Bolt shear resistance - AISC 360-16 – J3.6

Detailed result for B30

Tension resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 20.69 \quad \text{kip} \quad \geq \quad F_t = \quad 0.65 \quad \text{kip}$$

Where:

$F_{nt} = 89.9$ ksi – nominal tensile stress AISC 360-16 – Table J3.2

$A_b = 0.31$ in^2 – gross bolt cross-sectional area

$\phi = 0.75$ – resistance factor

Shear resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 12.41 \quad \text{kip} \quad \geq \quad V = \quad 7.58 \quad \text{kip}$$

Where:

$F_{nv} = 54.0$ ksi – nominal shear stress AISC 360-16 – Table J3.2

$A_b = 0.31$ in^2 – gross bolt cross-sectional area

$\phi = 0.75$ – resistance factor

Bearing resistance check (AISC 360-16 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = \quad 36.57 \quad \text{kip} \quad \geq \quad V = \quad 7.58 \quad \text{kip}$$

Where:

$l_c = 2.31$ in – clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material

$t = 0.50$ in – thickness of the plate

$d = 0.63$ in – diameter of a bolt

$F_u = 65.0$ ksi – specified minimum tensile strength of the connected material

$\phi = 0.75$ – resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-16 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
M387-w 1	FP1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	10.86	0.68	DStlS33(5)	3.38	5.87	57.5	34.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	10.86	0.68	DStlS33(5)	2.12	5.67	37.3	19.5	OK	OK
M387-w 1	FP2	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.92	0.35	DStlS33(5)	0.55	3.06	18.0	8.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.92	0.35	DStlS33(5)	0.43	3.00	14.3	6.2	OK	OK
M387-tfl 1	CPL1a	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	22.95	1.00	DStlS31(4)	3.29	8.96	36.8	18.8	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	22.95	1.00	DStlS33(5)	3.21	9.20	34.9	14.7	OK	OK
CPL1b	CPL1c	E70xx	-	-	9.00	-	-	-	-	-	-	OK	OK
CPL1b	M253-bfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.93	0.44	DStlS6(15)	0.13	5.20	2.4	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.93	0.44	DStlS6(15)	0.11	5.12	2.1	0.0	OK	OK
CPL1b	M253-tfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.93	0.44	DStlS6(15)	0.07	5.18	1.4	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.93	0.44	DStlS6(15)	0.08	5.20	1.5	0.0	OK	OK
CPL1b	M253-w 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.50	0.44	DStlS6(15)	0.05	5.21	0.9	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.50	0.44	DStlS6(15)	0.06	4.86	1.3	0.0	OK	OK
M387-tfl 1	CPL2a	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	22.95	1.00	DStlS31(4)	4.57	8.56	53.4	27.6	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	22.95	1.00	DStlS31(4)	5.58	10.47	53.3	26.1	OK	OK
CPL2b	CPL2c	E70xx	-	-	9.00	-	-	-	-	-	-	OK	OK
CPL2b	M254-bfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.93	0.44	DStlS31(4)	1.95	5.20	37.5	19.9	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.93	0.44	DStlS31(4)	1.73	5.14	33.7	17.5	OK	OK
CPL2b	M254-tfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.93	0.44	DStlS31(4)	1.32	4.57	28.9	15.1	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.93	0.44	DStlS31(4)	1.68	5.20	32.2	16.8	OK	OK
CPL2b	M254-w 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.50	0.44	DStlS31(4)	0.94	5.06	18.6	9.1	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.50	0.44	DStlS31(4)	0.80	5.21	15.4	6.7	OK	OK
M114-tfl 1	CPL3a	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	16.90	0.65	DStlS33(5)	2.36	5.28	44.6	27.7	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	16.95	0.65	DStlS31(4)	2.18	7.32	29.8	15.1	OK	OK
CPL3b	CPL3c	E70xx	-	-	6.00	-	-	-	-	-	-	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
M387-w 1	GUSS1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	18.46	1.03	DStlS33(5)	8.31	10.78	77.1	45.3	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	18.46	1.03	DStlS33(5)	8.25	10.73	76.9	44.6	OK	OK
M115-w 1	GUSS1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	16.70	0.67	DStlS33(5)	3.37	7.15	47.1	27.1	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	16.70	0.67	DStlS33(5)	3.16	7.17	44.1	24.9	OK	OK
M387-w 1	GUSS2	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	18.96	1.00	DStlS33(5)	7.62	9.99	76.2	43.6	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	18.96	1.00	DStlS33(5)	7.72	10.11	76.3	42.9	OK	OK
M115-w 1	GUSS2	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	19.94	0.66	DStlS31(4)	2.26	7.17	31.5	13.1	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	19.88	0.66	DStlS33(5)	1.77	7.50	23.6	10.8	OK	OK
M387-tfl 1	M242-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS31(4)	1.28	4.75	27.0	12.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS31(4)	1.55	5.51	28.2	12.9	OK	OK
M387-tfl 1	M242-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS31(4)	1.62	5.85	27.7	14.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS31(4)	1.34	4.85	27.6	12.8	OK	OK
M387-tfl 1	M242-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.54	0.69	DStlS31(4)	0.72	4.56	15.8	5.9	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.54	0.69	DStlS33(5)	0.46	5.08	9.1	0.0	OK	OK
M387-bfl 1	FP1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	3.84	0.64	DStlS33(5)	1.09	3.70	29.4	13.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	3.84	0.64	DStlS33(5)	1.17	3.75	31.2	13.9	OK	OK
M387-tfl 1	FP1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	3.84	0.64	DStlS31(4)	1.19	5.32	22.4	10.8	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	3.84	0.64	DStlS33(5)	0.88	4.57	19.3	7.3	OK	OK
CPL3b	M629	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	17.02	0.32	DStlS33(5)	1.81	3.82	47.4	27.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	17.02	0.32	DStlS33(5)	1.72	3.82	45.1	25.7	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Detailed result for M387-w 1 / GUSS1

Weld resistance check (AISC 360-16 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 10.78 kip ≥ $F_n =$ 8.31 kip

Where:

$F_{nw} =$ 56.0 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 49.8° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.26 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Buckling

Buckling analysis was not calculated.

Project item 126

Design

Name	126
Description	GL B - FL Middle
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC - LRFD (2016)

Members

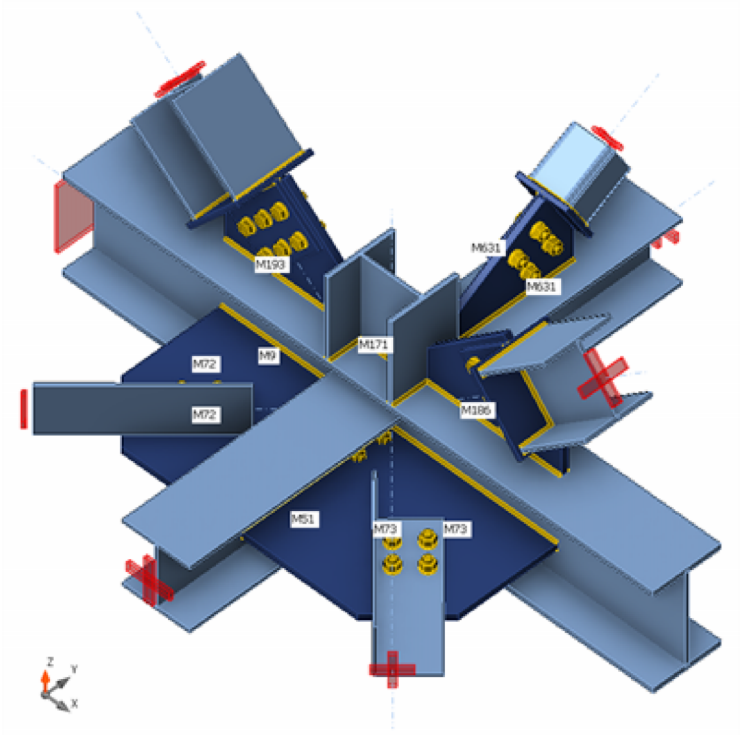
Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M9	33 - W12X50	0.0	0.0	0.0	0.00	0.00	0.00
M72	16 - L6X6X5/16	44.9	0.0	0.0	0.00	0.00	0.00
M51	22 - W8X31	90.0	0.0	0.0	0.00	0.00	0.00
M73	16 - L6X6X5/16	-44.9	0.0	0.0	0.00	0.00	0.00
M114	22 - W8X31	90.0	0.0	0.0	0.00	0.00	0.00
M171	22 - W8X31	0.0	90.0	-180.0	0.00	0.00	0.00
M186	22 - W8X31	0.0	40.5	0.0	0.00	0.00	0.00
M193	22 - W8X31	-180.0	40.5	0.0	0.00	0.00	0.00
M631	345 - HSS5X5X1/2(HSS5X5X1/2(HSS5X5X1/2(HSS(Imp)5X5X1/2)))	90.0	28.7	0.0	0.00	0.00	0.00

Supports and forces

Name	Support	Forces in	X [in]
M9 / begin	N-Vy-Vz-Mx-My-Mz	Position	0.00
M9 / end		Position	0.00
M72 / begin	Mx-My-Mz	Bolts	16.25
M51 / begin	Mx-My-Mz	Bolts	3.37
M73 / end	Mx-My-Mz	Bolts	16.25
M114 / end	Mx-My-Mz	Bolts	8.55
M171 / end		Position	0.00
M186 / end	Mx-My-Mz	Position	18.00
M193 / end	Mx-My-Mz	Position	18.00
M631 / end	Mx-My-Mz	Position	18.00

Project:	**AOF Hangar Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**



Cross-sections

Name	Material
33 - W12X50	A992
16 - L6X6X5/16	A992
22 - W8X31	A992
345 - HSS5X5X1/2(HSS5X5X1/2(HSS5X5X1/2(HSS(Imp)5X5X1/2)))	A992

Bolts

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
3/4 A325	0.75	92.0	120.0	0.44
7/8 A325	0.88	92.0	120.0	0.60

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS15(1)	M9 / Begin	-102.46	0.02	-0.15	-0.02	0.00	0.00
	M9 / End	139.62	0.03	-0.47	-0.03	0.00	0.00
	M72 / Begin	9.55	0.04	-0.10	0.00	0.00	0.00
	M51 / Begin	30.44	-0.02	0.76	0.00	11.76	0.24
	M73 / End	6.89	0.07	-0.10	0.00	0.00	0.00
	M114 / End	-8.86	-0.02	0.85	0.00	-11.83	-0.24
	M171 / End	8.41	0.00	0.01	0.00	0.00	0.00
	M186 / End	-28.98	0.00	-0.18	0.00	0.00	0.00
	M193 / End	35.33	0.00	-0.16	0.00	0.00	0.00
	M631 / End	-26.96	-0.01	-0.10	0.00	0.00	0.00
DStlS38(2)	M9 / Begin	-37.71	-0.02	-0.19	0.00	0.00	0.00
	M9 / End	53.19	0.00	-0.30	-0.01	0.00	0.00
	M72 / Begin	-8.11	0.03	-0.08	0.00	0.00	0.00
	M51 / Begin	-1.33	-0.01	0.03	0.00	2.36	0.12
	M73 / End	7.28	0.04	-0.08	0.00	0.00	0.00
	M114 / End	13.15	-0.01	0.02	0.00	-2.37	-0.12
	M171 / End	1.98	0.00	0.00	0.00	0.00	0.00
	M186 / End	-10.23	0.00	-0.15	0.00	0.00	0.00
	M193 / End	9.41	0.00	-0.14	0.00	0.00	0.00
	M631 / End	-1.17	0.00	-0.09	0.00	0.00	0.00
DStlS33(3)	M9 / Begin	-124.39	-0.01	-0.12	-0.03	0.00	0.00
	M9 / End	172.02	0.03	-0.50	-0.04	0.00	0.00
	M72 / Begin	-0.94	0.04	-0.09	0.00	0.00	0.00
	M51 / Begin	22.58	-0.03	0.93	0.00	13.97	0.33
	M73 / End	13.88	0.08	-0.09	0.00	0.00	0.00
	M114 / End	9.13	-0.03	1.03	0.00	-14.04	-0.33
	M171 / End	8.10	0.00	0.01	0.00	0.00	0.00
	M186 / End	-35.25	0.00	-0.18	0.00	0.00	0.00
	M193 / End	39.62	-0.01	-0.15	0.00	0.00	0.00
	M631 / End	-24.42	-0.01	-0.11	0.00	0.00	0.00
DStlS1(7)	M9 / Begin	-84.14	0.00	-0.24	-0.01	0.00	0.00
	M9 / End	115.74	0.02	-0.50	-0.02	0.00	0.00
	M72 / Begin	0.64	0.05	-0.12	0.00	0.00	0.00
	M51 / Begin	17.40	-0.02	0.42	0.00	8.07	0.22
	M73 / End	8.52	0.07	-0.12	0.00	0.00	0.00
	M114 / End	2.41	-0.02	0.46	0.00	-8.11	-0.22
	M171 / End	6.42	0.00	0.01	0.00	0.00	0.00
	M186 / End	-23.54	0.00	-0.22	0.00	0.00	0.00
	M193 / End	26.66	0.00	-0.20	0.00	0.00	0.00
	M631 / End	-16.43	0.00	-0.13	0.00	0.00	0.00
DStlS31(5)	M9 / Begin	-124.94	0.01	-0.12	-0.03	0.00	0.00
	M9 / End	171.18	0.03	-0.50	-0.04	0.00	0.00

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
	M72 / Begin	6.36	0.04	-0.09	0.00	0.00	0.00
	M51 / Begin	30.79	-0.02	1.00	0.00	14.77	0.31
	M73 / End	10.78	0.08	-0.09	0.00	0.00	0.00
	M114 / End	-1.57	-0.03	1.12	0.00	-14.85	-0.31
	M171 / End	9.08	0.00	0.01	0.00	0.00	0.00
	M186 / End	-35.12	0.00	-0.18	0.00	0.00	0.00
	M193 / End	41.83	0.00	-0.15	0.00	0.00	0.00
	M631 / End	-29.97	-0.01	-0.11	0.00	0.00	0.00
DStlS39(14)	M9 / Begin	-70.46	0.02	-0.13	-0.02	0.00	0.00
	M9 / End	95.62	0.02	-0.34	-0.02	0.00	0.00
	M72 / Begin	8.93	0.03	-0.07	0.00	0.00	0.00
	M51 / Begin	23.70	-0.01	0.50	0.00	8.02	0.16
	M73 / End	3.68	0.05	-0.07	0.00	0.00	0.00
	M114 / End	-10.05	-0.02	0.56	0.00	-8.06	-0.16
	M171 / End	6.28	0.00	0.01	0.00	0.00	0.00
	M186 / End	-20.04	0.00	-0.14	0.00	0.00	0.00
	M193 / End	24.87	0.00	-0.12	0.00	0.00	0.00
	M631 / End	-19.95	0.00	-0.08	0.00	0.00	0.00
DStlS14(15)	M9 / Begin	-69.72	-0.02	-0.21	-0.01	0.00	0.00
	M9 / End	97.19	0.01	-0.43	-0.02	0.00	0.00
	M72 / Begin	-7.48	0.04	-0.10	0.00	0.00	0.00
	M51 / Begin	5.40	-0.02	0.29	0.00	6.10	0.21
	M73 / End	10.49	0.06	-0.11	0.00	0.00	0.00
	M114 / End	14.34	-0.02	0.31	0.00	-6.14	-0.20
	M171 / End	4.12	0.00	0.01	0.00	0.00	0.00
	M186 / End	-19.17	0.00	-0.19	0.00	0.00	0.00
	M193 / End	19.87	-0.01	-0.17	0.00	0.00	0.00
	M631 / End	-8.18	0.00	-0.11	0.00	0.00	0.00
DStlS49-1(19)	M9 / Begin	-86.05	0.00	-0.22	-0.02	0.00	0.00
	M9 / End	116.68	0.02	-0.48	-0.02	0.00	0.00
	M72 / Begin	0.72	0.05	-0.11	0.00	0.00	0.00
	M51 / Begin	18.38	-0.02	0.52	0.00	9.02	0.23
	M73 / End	7.81	0.07	-0.11	0.00	0.00	0.00
	M114 / End	2.24	-0.02	0.58	0.00	-9.07	-0.23
	M171 / End	4.50	0.00	0.01	0.00	0.00	0.00
	M186 / End	-20.76	0.01	-0.21	0.00	0.00	0.00
	M193 / End	27.56	0.01	-0.19	0.00	0.00	0.00
	M631 / End	-18.01	-0.01	-0.13	0.00	0.00	0.00

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS15(1)	0.00	0.00	0.00	0.42	0.04	0.02
DStlS38(2)	0.00	0.00	0.00	0.03	0.02	-0.01
DStlS33(3)	0.00	0.00	0.00	0.49	0.05	0.01
DStlS1(7)	0.00	0.00	0.00	0.25	0.04	0.01
DStlS31(5)	0.00	0.00	0.00	0.54	0.05	0.02
DStlS39(14)	0.00	0.00	0.00	0.29	0.03	0.02
DStlS14(15)	0.00	0.00	0.00	0.16	0.03	0.00
DStlS49-1(19)	0.01	-0.01	0.01	0.29	0.04	0.02

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Bolts	48.6 < 100%	OK
Welds	77.5 < 100%	OK
Buckling	Not calculated	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M9-bfl 1	A992	5/8	DStlS33(3)	12.2	0.0	0.0	OK
M9-tfl 1	A992	5/8	DStlS31(5)	21.5	0.0	0.0	OK
M9-w 1	A992	3/8	DStlS15(1)	41.2	0.0	0.0	OK
M72-bfl 1	A992	5/16	DStlS15(1)	11.2	0.0	1.2	OK
M72-w 1	A992	5/16	DStlS15(1)	3.4	0.0	0.0	OK
M51-bfl 1	A992	7/16	DStlS31(5)	6.5	0.0	0.0	OK
M51-tfl 1	A992	7/16	DStlS15(1)	1.5	0.0	0.0	OK
M51-w 1	A992	5/16	DStlS33(3)	13.4	0.0	0.4	OK
M73-bfl 1	A992	5/16	DStlS33(3)	17.2	0.0	2.3	OK
M73-w 1	A992	5/16	DStlS33(3)	4.7	0.0	0.0	OK
M114-bfl 1	A992	7/16	DStlS15(1)	5.6	0.0	0.0	OK
M114-tfl 1	A992	7/16	DStlS31(5)	11.4	0.0	0.0	OK
M114-w 1	A992	5/16	DStlS31(5)	40.9	0.0	4.7	OK
M171-bfl 1	A992	7/16	DStlS31(5)	9.8	0.0	0.0	OK
M171-tfl 1	A992	7/16	DStlS33(3)	7.6	0.0	0.0	OK
M171-w 1	A992	5/16	DStlS31(5)	10.6	0.0	0.0	OK
M186-bfl 1	A992	7/16	DStlS31(5)	9.1	0.0	0.0	OK
M186-tfl 1	A992	7/16	DStlS31(5)	8.4	0.0	0.0	OK
M186-w 1	A992	5/16	DStlS31(5)	10.8	0.0	0.0	OK
M193-bfl 1	A992	7/16	DStlS31(5)	10.7	0.0	0.0	OK
M193-tfl 1	A992	7/16	DStlS31(5)	10.1	0.0	0.0	OK
M193-w 1	A992	5/16	DStlS31(5)	12.6	0.0	0.0	OK
M631	A992	1/2	DStlS31(5)	19.6	0.0	0.0	OK
CPL1a	A572 Gr.50	3/4	DStlS33(3)	18.5	0.0	0.9	OK
CPL1b	A572 Gr.50	1/2	DStlS31(5)	8.7	0.0	0.0	OK
CPL1c	A572 Gr.50	1/2	DStlS31(5)	29.0	0.0	2.3	OK
CPL2a	A572 Gr.50	3/4	DStlS31(5)	28.0	0.0	2.1	OK
CPL2b	A572 Gr.50	1/2	DStlS31(5)	10.4	0.0	0.0	OK
CPL2c	A572 Gr.50	1/2	DStlS31(5)	37.3	0.0	2.6	OK
FP1	A572 Gr.50	3/4	DStlS15(1)	18.6	0.0	4.9	OK
FP2	A572 Gr.50	3/8	DStlS15(1)	14.3	0.0	0.7	OK
CPL3a	A572 Gr.50	3/4	DStlS31(5)	21.3	0.0	1.2	OK
CPL3b	A572 Gr.50	1/2	DStlS31(5)	13.1	0.0	0.0	OK
CPL3c	A572 Gr.50	1/2	DStlS31(5)	33.4	0.0	3.1	OK
GUSS1	A572 Gr.50	3/4	DStlS31(5)	15.5	0.0	1.8	OK
GUSS2	A572 Gr.50	3/4	DStlS31(5)	15.8	0.0	0.8	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for M114-w 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y = 50.0$ ksi – characteristic yield strength

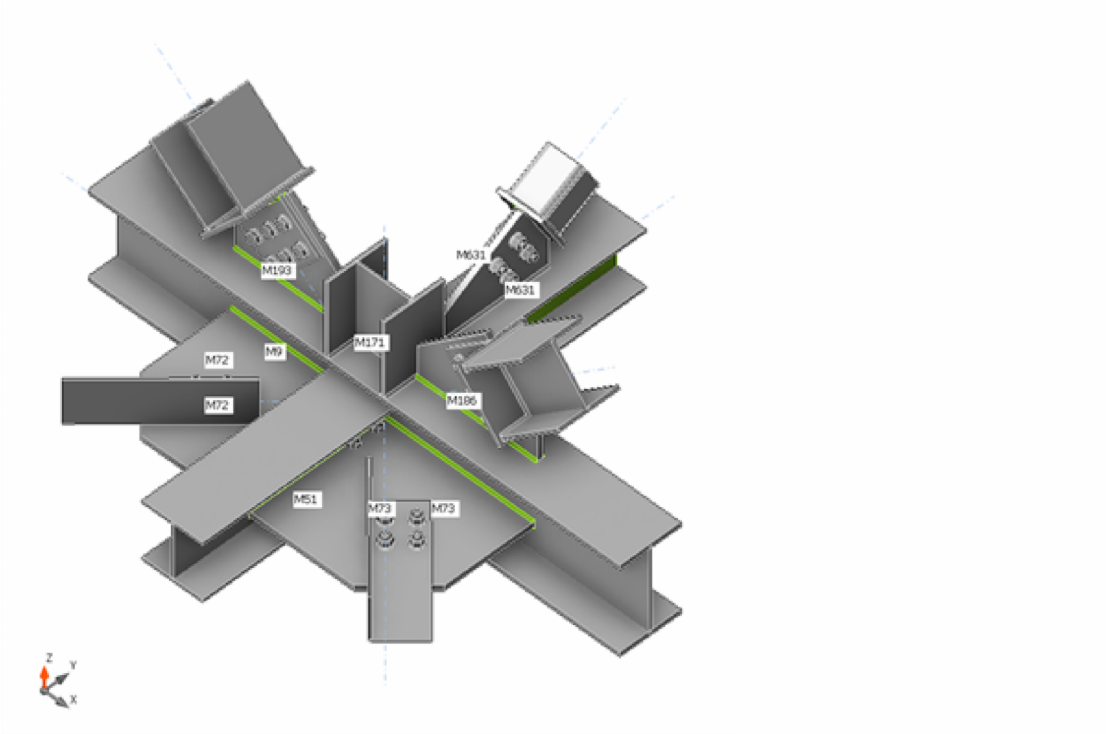
$\phi = 0.90$ – resistance factor for steel material AISC 360-16 – B3.1

Loc. deformation

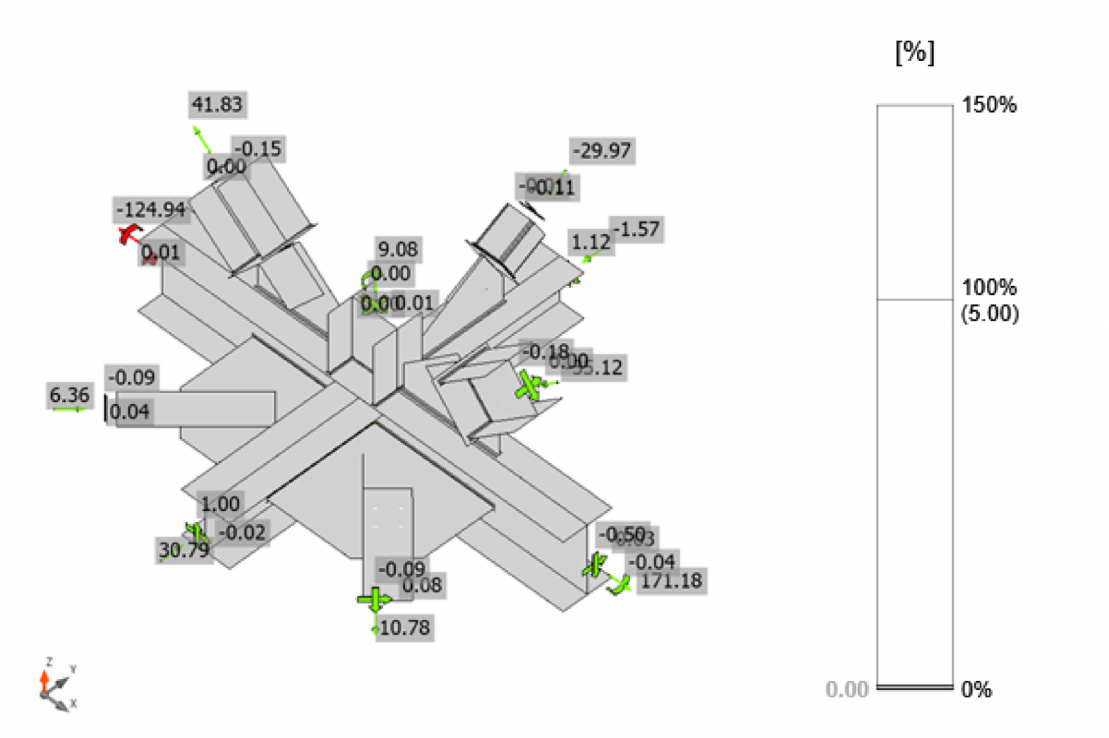
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M631	5.00	DStlS49-1(19)	0.00	0.15	0.0	OK

Symbol explanation

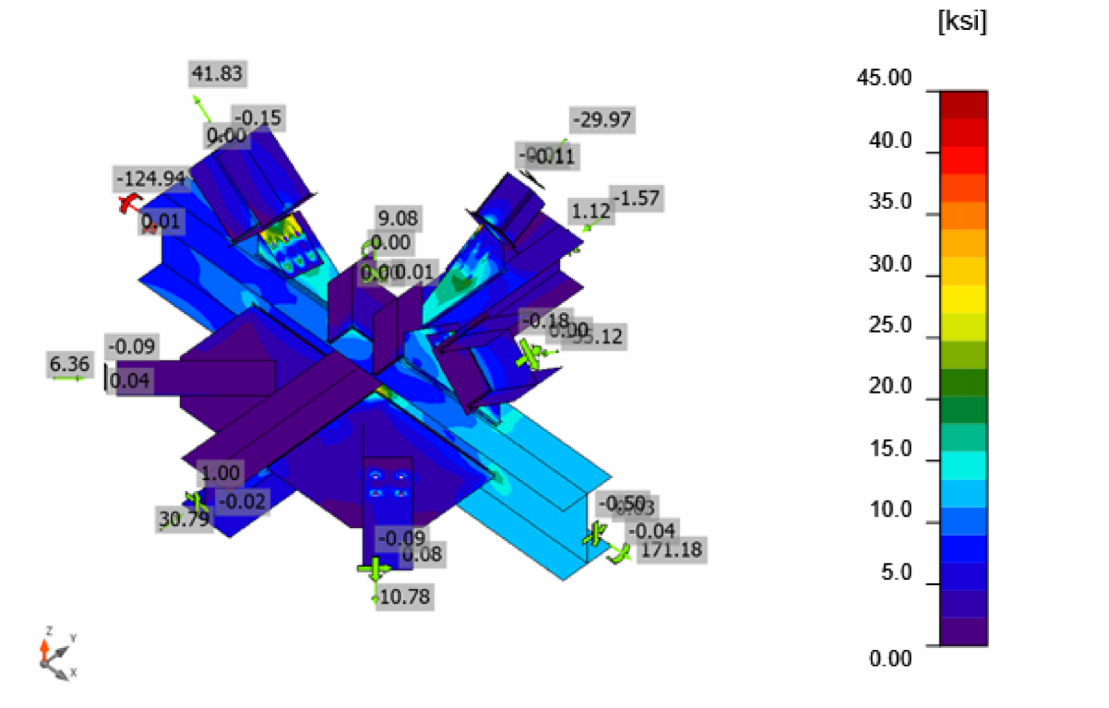
d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation



Overall check, DStlS31(5)

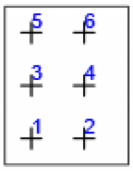
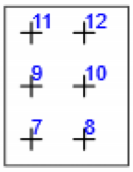
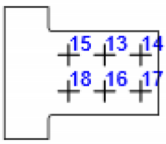
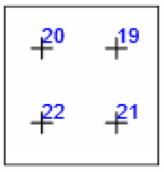
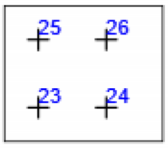
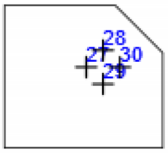
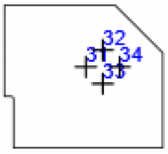


Strain check, DStlS31(5)



Equivalent stress, DStlS31(5)

Bolts

Shape	Item	Grade	Loads	F_t [kip]	V [kip]	$\phi R_{n,bearing}$ [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	B1	3/4 A325 - 1	DStlS33(3)	0.69	6.51	43.88	2.3	36.4	0.0	OK	OK
	B2	3/4 A325 - 1	DStlS33(3)	1.76	6.38	43.88	5.9	35.7	0.0	OK	OK
	B3	3/4 A325 - 1	DStlS33(3)	0.50	5.82	43.88	1.7	32.5	0.0	OK	OK
	B4	3/4 A325 - 1	DStlS33(3)	1.05	5.72	43.88	3.5	32.0	0.0	OK	OK
	B5	3/4 A325 - 1	DStlS33(3)	0.53	5.46	43.88	1.8	30.5	0.0	OK	OK
	B6	3/4 A325 - 1	DStlS33(3)	1.54	5.38	43.88	5.2	30.1	0.0	OK	OK
	B7	3/4 A325 - 1	DStlS31(5)	2.03	6.49	31.99	6.8	36.3	0.0	OK	OK
	B8	3/4 A325 - 1	DStlS31(5)	1.12	6.61	43.88	3.8	37.0	0.0	OK	OK
	B9	3/4 A325 - 1	DStlS31(5)	2.29	6.89	31.99	7.7	38.6	0.0	OK	OK
	B10	3/4 A325 - 1	DStlS31(5)	1.20	6.95	43.88	4.0	38.9	0.0	OK	OK
	B11	3/4 A325 - 1	DStlS31(5)	2.88	7.45	32.01	9.7	41.7	0.0	OK	OK
	B12	3/4 A325 - 1	DStlS31(5)	0.37	7.44	43.88	1.3	41.6	0.0	OK	OK
	B13	7/8 A325 - 2	DStlS15(1)	2.08	6.97	29.18	5.1	28.6	0.0	OK	OK
	B14	7/8 A325 - 2	DStlS15(1)	1.34	6.70	29.18	3.3	27.5	0.0	OK	OK
	B15	7/8 A325 - 2	DStlS31(5)	4.52	8.58	29.18	11.1	35.2	0.0	OK	OK
	B16	7/8 A325 - 2	DStlS15(1)	0.99	4.45	29.18	2.4	18.3	0.0	OK	OK
	B17	7/8 A325 - 2	DStlS15(1)	0.96	4.06	29.18	2.4	16.7	0.0	OK	OK
	B18	7/8 A325 - 2	DStlS31(5)	1.21	6.36	29.18	3.0	26.1	0.0	OK	OK
	B19	3/4 A325 - 1	DStlS15(1)	0.35	1.70	25.01	1.2	9.5	0.0	OK	OK
	B20	3/4 A325 - 1	DStlS15(1)	0.14	1.73	25.01	0.5	9.7	0.0	OK	OK
	B21	3/4 A325 - 1	DStlS15(1)	0.28	1.69	25.01	1.0	9.4	0.0	OK	OK
	B22	3/4 A325 - 1	DStlS15(1)	0.20	1.85	25.01	0.7	10.3	0.0	OK	OK
	B23	3/4 A325 - 1	DStlS31(5)	0.65	6.48	43.88	2.2	36.2	0.0	OK	OK
	B24	3/4 A325 - 1	DStlS31(5)	1.80	6.37	43.88	6.0	35.6	0.0	OK	OK
	B25	3/4 A325 - 1	DStlS31(5)	0.88	8.68	43.88	3.0	48.6	0.0	OK	OK
	B26	3/4 A325 - 1	DStlS31(5)	1.73	8.56	43.88	5.8	47.9	0.0	OK	OK
	B27	3/4 A325 - 1	DStlS33(3)	1.39	3.94	27.47	4.7	22.0	0.0	OK	OK
	B28	3/4 A325 - 1	DStlS33(3)	0.61	3.95	27.47	2.0	22.1	0.0	OK	OK
	B29	3/4 A325 - 1	DStlS33(3)	1.22	3.04	27.47	4.1	17.0	0.0	OK	OK
	B30	3/4 A325 - 1	DStlS33(3)	0.52	3.08	27.47	1.7	17.2	0.0	OK	OK
	B31	3/4 A325 - 1	DStlS15(1)	0.66	2.47	27.47	2.2	13.8	0.0	OK	OK
	B32	3/4 A325 - 1	DStlS15(1)	0.55	2.54	27.47	1.8	14.2	0.0	OK	OK
	B33	3/4 A325 - 1	DStlS15(1)	0.37	2.24	27.47	1.2	12.5	0.0	OK	OK
	B34	3/4 A325 - 1	DStlS15(1)	0.73	2.31	27.47	2.5	12.9	0.0	OK	OK

Project:	**AOF Hangar Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**

Design data

Grade	$\phi R_{n,tension}$ [kip]	$\phi R_{n,shear}$ [kip]
3/4 A325 - 1	29.79	17.88
7/8 A325 - 2	40.55	24.33

Symbol explanation

F_t	Tension force
V	Resultant of bolt shear forces Vy and Vz in shear planes
$\phi R_{n,bearing}$	Bolt bearing resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
$\phi R_{n,tension}$	Bolt tension resistance - AISC 360-16 – J3.6
$\phi R_{n,shear}$	Bolt shear resistance - AISC 360-16 – J3.6

Detailed result for B25

Tension resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = 29.79 \text{ kip} \geq F_t = 0.88 \text{ kip}$$

Where:

$F_{nt} = 89.9$ ksi – nominal tensile stress AISC 360-16 – Table J3.2

$A_b = 0.44$ in^2 – gross bolt cross-sectional area

$\phi = 0.75$ – resistance factor

Shear resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = 17.88 \text{ kip} \geq V = 8.68 \text{ kip}$$

Where:

$F_{nv} = 54.0$ ksi – nominal shear stress AISC 360-16 – Table J3.2

$A_b = 0.44$ in^2 – gross bolt cross-sectional area

$\phi = 0.75$ – resistance factor

Bearing resistance check (AISC 360-16 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \leq 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = 43.88 \text{ kip} \geq V = 8.68 \text{ kip}$$

Where:

$l_c = 2.19$ in – clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material

$t = 0.50$ in – thickness of the plate

$d = 0.75$ in – diameter of a bolt

$F_u = 65.0$ ksi – specified minimum tensile strength of the connected material

$\phi = 0.75$ – resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-16 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
M9-tfl 1	M171-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS31(5)	1.52	4.62	33.0	15.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS31(5)	1.96	4.73	41.5	21.1	OK	OK
M9-tfl 1	M171-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS33(3)	1.10	4.45	24.8	11.6	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS33(3)	0.57	5.14	11.1	0.0	OK	OK
M51-w 1	GUSS1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.76	0.66	DStlS31(5)	3.20	4.23	75.7	53.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.76	0.66	DStlS31(5)	3.68	4.90	75.2	50.6	OK	OK
M9-tfl 1	M171-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.54	0.69	DStlS31(5)	0.55	4.52	12.2	0.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.54	0.69	DStlS33(3)	0.80	4.64	17.2	6.1	OK	OK
M9-tfl 1	CPL1a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	15.96	0.80	DStlS33(3)	3.21	5.13	62.4	35.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	15.96	0.80	DStlS33(3)	4.24	6.16	68.9	36.7	OK	OK
CPL1b	CPL1c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.92	0.45	DStlS33(3)	1.19	3.95	30.0	15.6	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.92	0.45	DStlS31(5)	1.99	3.94	50.6	33.9	OK	OK
CPL1b	M186-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS31(5)	1.33	3.90	34.1	17.8	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS31(5)	1.10	3.85	28.6	14.5	OK	OK
CPL1b	M186-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS33(3)	0.98	3.85	25.4	12.9	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS33(3)	1.19	3.90	30.5	15.6	OK	OK
CPL1b	M186-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS31(5)	0.66	3.80	17.5	8.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS33(3)	0.57	3.91	14.6	6.5	OK	OK
M9-tfl 1	CPL2a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	15.96	0.80	DStlS31(5)	4.69	6.12	76.6	56.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	15.96	0.80	DStlS31(5)	4.82	6.28	76.7	51.5	OK	OK
CPL2b	CPL2c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.92	0.45	DStlS31(5)	1.21	3.94	30.7	15.9	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.92	0.45	DStlS31(5)	2.59	3.95	65.6	46.4	OK	OK
CPL2b	M193-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS31(5)	1.58	3.90	40.6	21.6	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS31(5)	1.30	3.87	33.6	17.8	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
CPL2b	M193-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS31(5)	1.16	3.84	30.2	15.9	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS31(5)	1.40	3.90	36.0	18.8	OK	OK
CPL2b	M193-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS31(5)	0.69	3.89	17.7	8.4	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS31(5)	0.75	3.73	20.1	10.0	OK	OK
M9-w 1	FP1	E70xx	◢ 1/8 ◣	◢ 3/16 ◣	10.85	0.64	DStlS15(1)	2.99	3.99	75.0	49.2	OK	OK
		E70xx	◢ 1/8 ◣	◢ 3/16 ◣	10.85	0.64	DStlS15(1)	2.86	3.81	75.0	48.5	OK	OK
M9-w 1	FP2	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.34	0.32	DStlS31(5)	0.82	2.63	31.2	16.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.34	0.32	DStlS31(5)	0.77	2.72	28.4	13.7	OK	OK
M114-tfl 1	CPL3a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	15.91	0.66	DStlS31(5)	2.26	4.10	55.0	36.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	15.95	0.66	DStlS31(5)	1.74	5.72	30.3	16.0	OK	OK
CPL3b	CPL3c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.93	0.31	DStlS31(5)	1.58	2.76	57.3	32.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.93	0.31	DStlS31(5)	1.95	2.76	70.5	48.0	OK	OK
M9-w 1	GUSS1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	19.96	1.00	DStlS15(1)	6.73	8.69	77.5	55.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	19.96	1.00	DStlS15(1)	6.78	8.79	77.1	54.8	OK	OK
M9-w 1	GUSS2	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	18.78	0.99	DStlS15(1)	6.35	8.32	76.3	44.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	18.78	0.99	DStlS15(1)	6.34	8.31	76.3	44.8	OK	OK
M51-w 1	GUSS2	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	11.47	0.67	DStlS31(5)	2.85	5.97	47.6	27.9	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	11.47	0.67	DStlS31(5)	3.09	5.97	51.7	31.7	OK	OK
M9-bfl 1	FP1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	3.65	0.61	DStlS15(1)	1.10	3.91	28.1	13.1	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	3.65	0.61	DStlS31(5)	1.27	4.44	28.6	12.5	OK	OK
M9-tfl 1	FP1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	3.65	0.61	DStlS31(5)	0.91	5.30	17.1	7.6	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	3.65	0.61	DStlS31(5)	1.37	5.31	25.7	12.9	OK	OK
CPL3b	M631	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.02	0.32	DStlS31(5)	1.60	2.86	55.9	33.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.04	0.32	DStlS31(5)	1.44	2.86	50.4	29.5	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Detailed result for M9-w 1 / GUSS1

Weld resistance check (AISC 360-16 – J2-4)

$$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} = \quad 8.69 \quad \text{kip} \quad \geq \quad F_n = \quad 6.73 \quad \text{kip}$$

Where:

$F_{nw} = 61.9$ ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 74.6° – angle of loading measured from the weld longitudinal axis

$A_{we} = 0.19$ in^2 – effective area of weld critical element

$\phi = 0.75$ – resistance factor for welded connections

Buckling

Buckling analysis was not calculated.

Project item 160

Design

Name	160
Description	GL E - FL Middle
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC - LRFD (2016)

Members

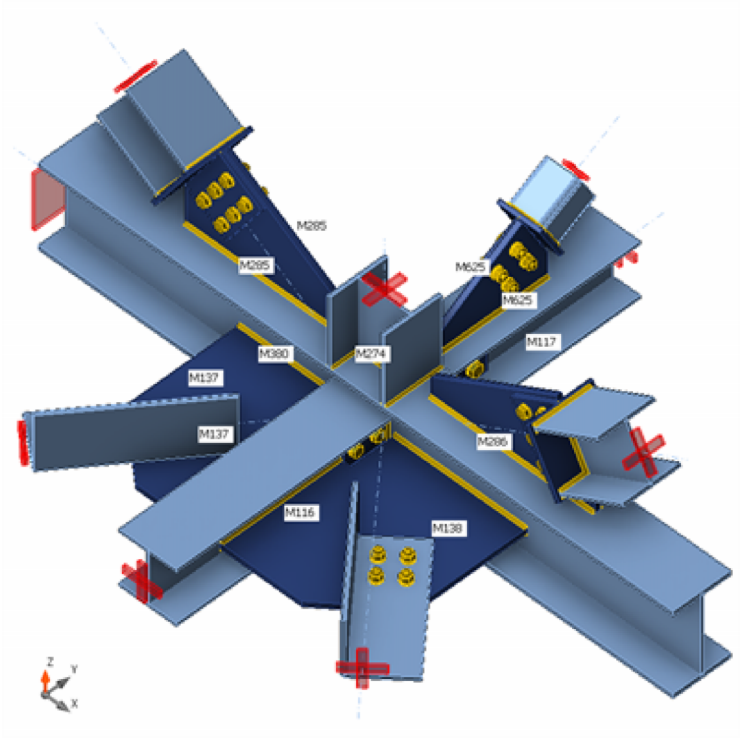
Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M380	33 - W12X50	0.0	0.0	0.0	0.00	0.00	0.00
M117	22 - W8X31	90.0	0.0	0.0	0.00	0.00	0.00
M116	22 - W8X31	90.0	0.0	0.0	0.00	0.00	0.00
M137	495 - L8X8X1/2	52.3	0.0	0.0	0.00	0.00	0.00
M138	495 - L8X8X1/2	-48.5	0.0	0.0	0.00	0.00	0.00
M274	22 - W8X31	0.0	90.0	-180.0	0.00	0.00	0.00
M285	22 - W8X31	-180.0	32.3	0.0	0.00	0.00	0.00
M286	22 - W8X31	0.0	28.5	0.0	0.00	0.00	0.00
M625	345 - HSS5X5X1/2(HSS5X5X1/2(HSS5X5X1/2(HSS(Imp)5X5X1/2)))	90.0	28.7	0.0	0.00	0.00	0.00

Supports and forces

Name	Support	Forces in	X [in]
M380 / begin	N-Vy-Vz-Mx-My-Mz	Position	0.00
M380 / end		Position	0.00
M117 / end	Mx-My-Mz	Bolts	8.44
M116 / begin	Mx-My-Mz	Bolts	3.44
M137 / begin	Mx-My-Mz	Bolts	19.34
M138 / end	Mx-My-Mz	Bolts	20.59
M274 / end	Mx-My-Mz	Connected member face	6.10
M285 / end	Mx-My-Mz	Position	26.00
M286 / end	Mx-My-Mz	Position	26.00
M625 / end	Mx-My-Mz	Position	19.00

Project:	**AOF Hangar Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**



Cross-sections

Name	Material
33 - W12X50	A992
22 - W8X31	A992
495 - L8X8X1/2	A992
345 - HSS5X5X1/2(HSS5X5X1/2(HSS5X5X1/2(HSS(Imp)5X5X1/2)))	A992

Bolts

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
7/8 A325	0.88	92.0	120.0	0.60
3/4 A325	0.75	92.0	120.0	0.44
5/8 A325	0.63	92.0	120.0	0.31

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS14(1)	M380 / Begin	-68.26	0.00	-0.75	0.00	-1.66	-0.04
	M380 / End	84.06	-0.02	-0.85	0.00	1.65	-0.20
	M117 / End	15.66	0.02	-1.00	0.00	6.60	0.23
	M116 / Begin	-0.95	0.00	-1.01	0.00	-6.61	0.00
	M137 / Begin	-17.15	0.00	-0.40	0.00	0.00	0.00
	M138 / End	23.55	0.00	-0.44	0.00	0.00	0.00
	M274 / End	6.05	0.00	0.00	0.00	0.00	0.00
	M285 / End	1.35	0.00	-0.27	0.00	0.00	0.00
	M286 / End	-22.48	0.00	-0.30	0.00	0.00	0.00
	M625 / End	18.75	0.00	-0.12	0.00	0.00	0.00
DStlS39(2)	M380 / Begin	-71.79	0.00	-0.70	0.00	-1.93	-0.11
	M380 / End	88.02	0.01	-0.79	0.00	1.92	0.05
	M117 / End	-9.06	0.01	-1.09	0.00	7.84	0.12
	M116 / Begin	15.35	0.00	-1.09	0.00	-7.85	-0.06
	M137 / Begin	-11.10	0.00	-0.31	0.00	0.00	0.00
	M138 / End	16.93	0.00	-0.34	0.00	0.00	0.00
	M274 / End	9.77	0.00	0.00	0.00	0.00	0.00
	M285 / End	-2.08	0.00	-0.20	0.00	0.00	0.00
	M286 / End	-25.51	0.00	-0.22	0.00	0.00	0.00
	M625 / End	17.24	0.00	-0.07	0.00	0.00	0.00
DStlS31(3)	M380 / Begin	-126.61	0.01	-1.10	0.01	-2.93	-0.14
	M380 / End	155.82	0.00	-1.24	-0.01	2.92	-0.07
	M117 / End	0.41	0.03	-1.82	0.00	13.43	0.28
	M116 / Begin	15.90	0.01	-1.82	0.00	-13.44	-0.07
	M137 / Begin	-24.79	0.01	-0.42	0.00	0.00	0.00
	M138 / End	35.35	0.01	-0.48	0.00	0.00	0.00
	M274 / End	14.18	0.00	0.01	0.00	0.00	0.00
	M285 / End	-2.66	0.00	-0.27	0.00	0.00	0.00
	M286 / End	-45.18	0.00	-0.29	0.00	0.00	0.00
	M625 / End	33.87	0.00	-0.10	0.00	0.00	0.00
DStlS38(4)	M380 / Begin	-35.95	0.00	-0.47	0.00	-0.94	-0.01
	M380 / End	44.30	-0.02	-0.53	0.00	0.93	-0.16
	M117 / End	13.93	0.02	-0.54	0.00	3.22	0.16
	M116 / Begin	-3.93	0.00	-0.56	0.00	-3.23	0.01
	M137 / Begin	-10.37	0.00	-0.29	0.00	0.00	0.00
	M138 / End	13.99	0.00	-0.32	0.00	0.00	0.00
	M274 / End	2.69	0.00	0.00	0.00	0.00	0.00
	M285 / End	1.86	0.00	-0.20	0.00	0.00	0.00
	M286 / End	-11.03	0.00	-0.23	0.00	0.00	0.00
	M625 / End	9.87	0.00	-0.09	0.00	0.00	0.00
DStlS40(6)	M380 / Begin	-43.84	0.00	-0.49	0.00	-0.92	0.01
	M380 / End	53.08	0.00	-0.55	0.00	0.92	-0.01

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
	M117 / End	9.98	0.01	-0.50	0.00	2.90	0.05
	M116 / Begin	5.26	0.00	-0.58	0.00	-2.90	-0.05
	M137 / Begin	-13.66	0.00	-0.29	0.00	0.00	0.00
	M138 / End	15.01	0.00	-0.32	0.00	0.00	0.00
	M274 / End	3.23	0.00	0.00	0.00	0.00	0.00
	M285 / End	2.13	0.00	-0.20	0.00	0.00	0.00
	M286 / End	-10.28	0.00	-0.23	0.00	0.00	0.00
	M625 / End	7.71	0.00	-0.08	0.00	0.00	0.00
DStlS33(18)	M380 / Begin	-122.66	0.01	-1.10	0.01	-2.94	-0.15
	M380 / End	151.43	-0.01	-1.23	-0.01	2.92	-0.14
	M117 / End	2.38	0.04	-1.84	0.00	13.59	0.33
	M116 / Begin	11.31	0.00	-1.81	0.00	-13.60	-0.04
	M137 / Begin	-23.14	0.00	-0.42	0.00	0.00	0.00
	M138 / End	34.84	0.01	-0.48	0.00	0.00	0.00
	M274 / End	13.91	0.00	0.01	0.00	0.00	0.00
	M285 / End	-2.79	0.00	-0.27	0.00	0.00	0.00
	M286 / End	-45.55	0.00	-0.29	0.00	0.00	0.00
	M625 / End	34.95	0.00	-0.11	0.00	0.00	0.00
DStlS30(8)	M380 / Begin	-108.69	0.00	-0.99	0.00	-2.44	-0.09
	M380 / End	133.96	-0.02	-1.12	-0.01	2.42	-0.18
	M117 / End	11.91	0.03	-1.54	0.00	11.12	0.29
	M116 / Begin	6.27	0.00	-1.55	0.00	-11.13	-0.04
	M137 / Begin	-24.42	0.00	-0.41	0.00	0.00	0.00
	M138 / End	33.88	0.01	-0.47	0.00	0.00	0.00
	M274 / End	10.64	0.00	0.01	0.00	0.00	0.00
	M285 / End	-0.69	0.00	-0.27	0.00	0.00	0.00
	M286 / End	-37.94	0.00	-0.29	0.00	0.00	0.00
	M625 / End	30.18	0.00	-0.11	0.00	0.00	0.00
DStlS15(11)	M380 / Begin	-104.10	0.01	-0.98	0.00	-2.65	-0.14
	M380 / End	127.79	0.01	-1.10	-0.01	2.64	0.02
	M117 / End	-7.34	0.02	-1.55	0.00	11.22	0.19
	M116 / Begin	18.33	0.01	-1.55	0.00	-11.23	-0.08
	M137 / Begin	-17.87	0.00	-0.41	0.00	0.00	0.00
	M138 / End	26.48	0.01	-0.46	0.00	0.00	0.00
	M274 / End	13.12	0.00	0.01	0.00	0.00	0.00
	M285 / End	-2.60	0.00	-0.27	0.00	0.00	0.00
	M286 / End	-36.96	0.00	-0.29	0.00	0.00	0.00
	M625 / End	26.12	0.00	-0.10	0.00	0.00	0.00
DStlS48-1(23)	M380 / Begin	-78.51	0.01	-0.89	0.00	-2.43	-0.09
	M380 / End	97.24	-0.01	-0.99	0.00	2.42	-0.12
	M117 / End	3.68	0.03	-1.34	0.00	9.40	0.23
	M116 / Begin	8.28	0.00	-1.27	0.00	-9.40	-0.04
	M137 / Begin	-16.69	0.00	-0.44	0.00	0.00	0.00
	M138 / End	24.31	0.00	-0.49	0.00	0.00	0.00

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
	M274 / End	8.54	0.00	0.00	0.00	0.00	0.00
	M285 / End	0.29	0.00	-0.30	0.00	0.00	0.00
	M286 / End	-27.77	-0.01	-0.33	0.00	0.00	0.00
	M625 / End	22.14	0.00	-0.13	0.00	0.00	0.00
DStlS17(9)	M380 / Begin	-96.21	0.01	-0.97	0.00	-2.67	-0.17
	M380 / End	119.00	-0.01	-1.08	-0.01	2.65	-0.13
	M117 / End	-3.39	0.03	-1.59	0.00	11.54	0.30
	M116 / Begin	9.14	0.00	-1.53	0.00	-11.55	-0.01
	M137 / Begin	-14.58	0.00	-0.41	0.00	0.00	0.00
	M138 / End	25.47	0.01	-0.47	0.00	0.00	0.00
	M274 / End	12.59	0.00	0.01	0.00	0.00	0.00
	M285 / End	-2.86	0.00	-0.27	0.00	0.00	0.00
	M286 / End	-37.71	-0.01	-0.29	0.00	0.00	0.00
	M625 / End	28.28	0.00	-0.11	0.00	0.00	0.00
DStlS32(14)	M380 / Begin	-112.64	0.00	-0.99	0.00	-2.43	-0.08
	M380 / End	138.35	0.00	-1.12	-0.01	2.42	-0.10
	M117 / End	9.94	0.03	-1.52	0.00	10.96	0.24
	M116 / Begin	10.86	0.01	-1.56	0.00	-10.97	-0.07
	M137 / Begin	-26.07	0.00	-0.41	0.00	0.00	0.00
	M138 / End	34.39	0.01	-0.46	0.00	0.00	0.00
	M274 / End	10.91	0.00	0.01	0.00	0.00	0.00
	M285 / End	-0.55	0.00	-0.27	0.00	0.00	0.00
	M286 / End	-37.56	0.00	-0.29	0.00	0.00	0.00
	M625 / End	29.10	0.00	-0.11	0.00	0.00	0.00
DStlS1(22)	M380 / Begin	-83.80	0.01	-0.92	0.00	-2.23	-0.09
	M380 / End	102.91	-0.01	-1.03	0.00	2.22	-0.09
	M117 / End	3.78	0.02	-1.27	0.00	8.61	0.21
	M116 / Begin	8.88	0.00	-1.28	0.00	-8.61	-0.04
	M137 / Begin	-16.70	0.00	-0.47	0.00	0.00	0.00
	M138 / End	24.05	0.00	-0.51	0.00	0.00	0.00
	M274 / End	9.69	0.00	0.01	0.00	0.00	0.00
	M285 / End	-0.17	0.00	-0.32	0.00	0.00	0.00
	M286 / End	-28.41	0.00	-0.35	0.00	0.00	0.00
	M625 / End	21.09	0.00	-0.13	0.00	0.00	0.00

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS14(1)	0.00	0.00	0.00	0.47	0.15	0.01
DStlS39(2)	0.00	0.00	0.00	0.27	0.12	0.01
DStlS31(3)	0.00	0.00	0.00	0.24	0.16	0.01
DStlS38(4)	0.00	0.00	0.00	0.41	0.12	0.01
DStlS40(6)	0.00	0.00	0.00	0.45	0.13	0.01
DStlS33(18)	0.00	0.00	0.00	0.22	0.15	0.01
DStlS30(8)	0.00	0.00	0.00	0.31	0.15	0.02
DStlS15(11)	0.00	0.00	0.00	0.33	0.16	0.01
DStlS48-1(23)	-0.03	0.03	0.00	0.42	0.17	0.00
DStlS17(9)	0.00	0.00	0.00	0.29	0.15	0.01
DStlS32(14)	0.00	0.00	0.00	0.33	0.16	0.02
DStlS1(22)	0.00	0.00	0.00	0.53	0.18	0.01

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.1 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Bolts	56.9 < 100%	OK
Welds	76.9 < 100%	OK
Buckling	Not calculated	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M380-bfl 1	A992	5/8	DStlS30(8)	18.9	0.0	0.0	OK
M380-tfl 1	A992	5/8	DStlS33(18)	19.4	0.0	0.0	OK
M380-w 1	A992	3/8	DStlS30(8)	45.0	0.1	0.0	OK
M117-bfl 1	A992	7/16	DStlS30(8)	6.0	0.0	0.0	OK
M117-tfl 1	A992	7/16	DStlS30(8)	15.4	0.0	0.0	OK
M117-w 1	A992	5/16	DStlS33(18)	43.7	0.0	4.7	OK
M116-bfl 1	A992	7/16	DStlS15(11)	2.1	0.0	0.0	OK
M116-tfl 1	A992	7/16	DStlS15(11)	2.8	0.0	0.0	OK
M116-w 1	A992	5/16	DStlS30(8)	15.3	0.0	1.2	OK
M137-bfl 1	A992	1/2	DStlS32(14)	22.6	0.0	1.8	OK
M137-w 1	A992	1/2	DStlS32(14)	7.1	0.0	0.0	OK
M138-bfl 1	A992	1/2	DStlS31(3)	31.3	0.0	3.2	OK
M138-w 1	A992	1/2	DStlS33(18)	11.4	0.0	0.0	OK
M274-bfl 1	A992	7/16	DStlS31(3)	10.1	0.0	0.0	OK
M274-tfl 1	A992	7/16	DStlS31(3)	10.9	0.0	0.0	OK
M274-w 1	A992	5/16	DStlS31(3)	12.7	0.0	0.0	OK
M285-bfl 1	A992	7/16	DStlS40(6)	0.7	0.0	0.0	OK
M285-tfl 1	A992	7/16	DStlS17(9)	0.9	0.0	0.0	OK
M285-w 1	A992	5/16	DStlS17(9)	1.0	0.0	0.0	OK
M286-bfl 1	A992	7/16	DStlS33(18)	12.5	0.0	0.0	OK
M286-tfl 1	A992	7/16	DStlS33(18)	10.9	0.0	0.0	OK
M286-w 1	A992	5/16	DStlS33(18)	14.5	0.0	0.0	OK
M625	A992	1/2	DStlS33(18)	21.7	0.0	0.0	OK
FP1	A572 Gr.50	3/4	DStlS30(8)	23.0	0.0	4.8	OK
FP2	A572 Gr.50	1/2	DStlS30(8)	9.6	0.0	1.3	OK
CPL1a	A572 Gr.50	3/4	DStlS31(3)	7.6	0.0	0.1	OK
CPL1b	A572 Gr.50	1/2	DStlS17(9)	0.9	0.0	0.0	OK
CPL1c	A572 Gr.50	1/2	DStlS38(4)	3.0	0.0	0.5	OK
CPL2a	A572 Gr.50	3/4	DStlS33(18)	20.4	0.0	1.6	OK
CPL2b	A572 Gr.50	1/2	DStlS33(18)	12.1	0.0	0.0	OK
CPL2c	A572 Gr.50	1/2	DStlS33(18)	39.9	0.0	2.5	OK
CPL3a	A572 Gr.50	3/4	DStlS33(18)	34.5	0.0	2.6	OK
CPL3b	A572 Gr.50	1/2	DStlS33(18)	15.2	0.0	0.0	OK
CPL3c	A572 Gr.50	1/2	DStlS33(18)	38.3	0.0	2.8	OK
GUSS1	A572 Gr.50	3/4	DStlS31(3)	19.9	0.0	1.5	OK
GUSS2	A572 Gr.50	3/4	DStlS32(14)	16.0	0.0	0.9	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for M380-w 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y = 50.0$ ksi – characteristic yield strength

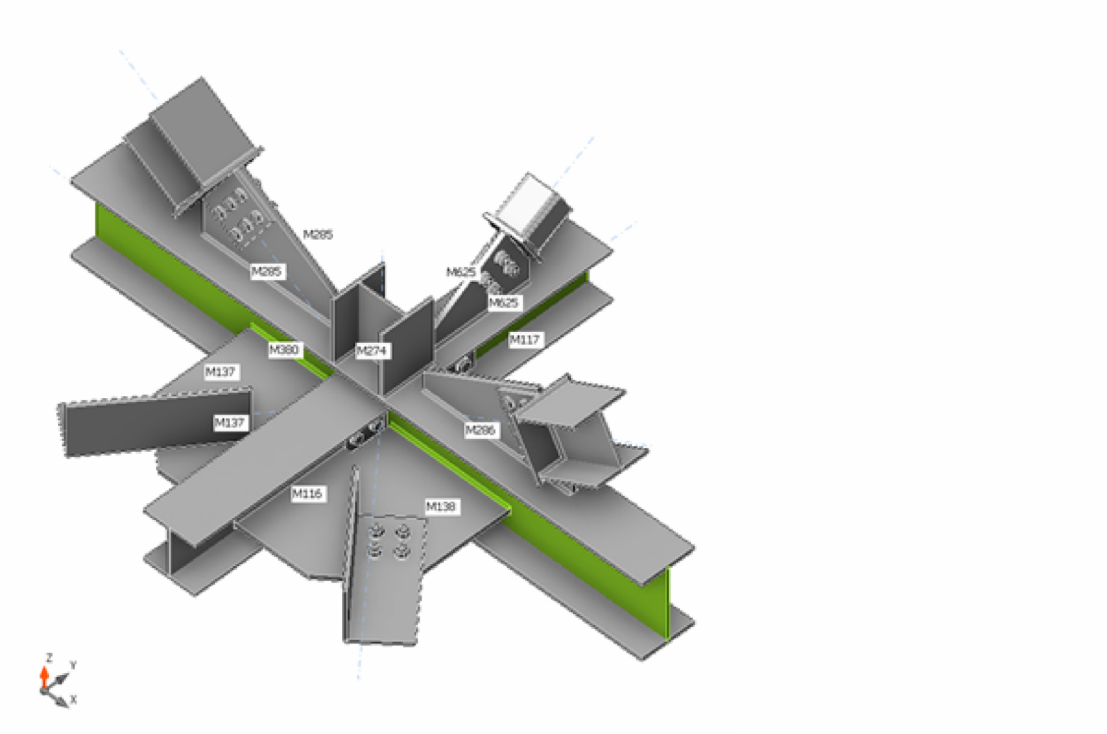
$\phi = 0.90$ – resistance factor for steel material AISC 360-16 – B3.1

Loc. deformation

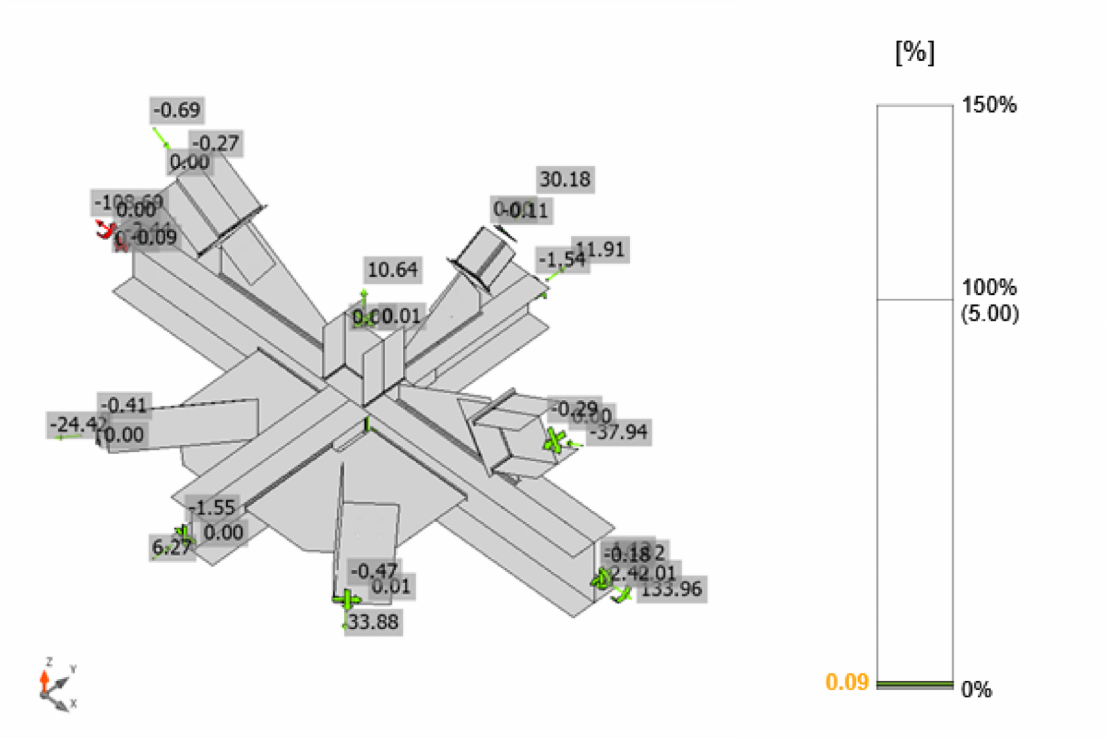
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M625	5.00	DStlS1(22)	0.00	0.15	0.0	OK

Symbol explanation

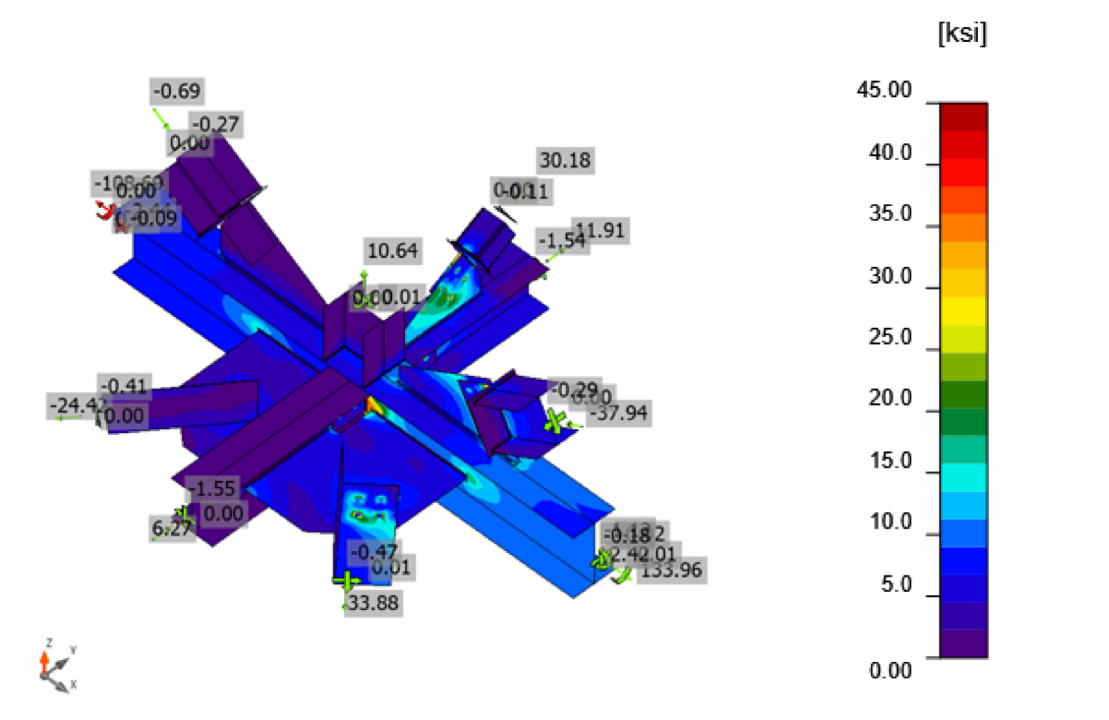
d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation



Overall check, DStlS30(8)

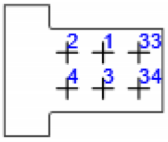
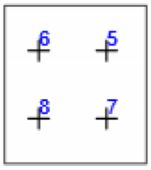
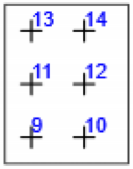
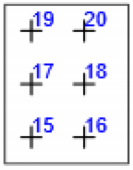
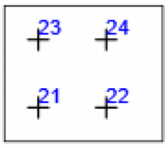
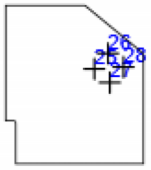
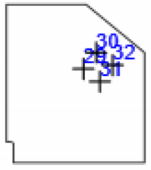


Strain check, DStlS30(8)



Equivalent stress, DStlS30(8)

Bolts

Shape	Item	Grade	Loads	F_t [kip]	V [kip]	$\phi R_{n,bearing}$ [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	B1	7/8 A325 - 1	DStlS30(8)	1.43	7.95	29.18	3.5	32.7	0.0	OK	OK
	B2	7/8 A325 - 1	DStlS30(8)	2.47	9.08	18.46	6.1	49.2	0.0	OK	OK
	B3	7/8 A325 - 1	DStlS30(8)	1.11	5.47	29.18	2.7	22.5	0.0	OK	OK
	B4	7/8 A325 - 1	DStlS30(8)	1.99	6.88	21.73	4.9	31.7	0.0	OK	OK
	B5	3/4 A325 - 2	DStlS30(8)	0.59	2.77	19.24	2.0	15.5	0.0	OK	OK
	B6	3/4 A325 - 2	DStlS30(8)	0.41	2.75	25.01	1.4	15.4	0.0	OK	OK
	B7	3/4 A325 - 2	DStlS30(8)	0.92	2.92	19.33	3.1	16.3	0.0	OK	OK
	B8	3/4 A325 - 2	DStlS30(8)	0.70	2.89	25.01	2.4	16.2	0.0	OK	OK
	B9	3/4 A325 - 2	DStlS33(18)	0.07	0.55	43.88	0.2	3.1	0.0	OK	OK
	B10	3/4 A325 - 2	DStlS33(18)	0.13	0.52	43.88	0.4	2.9	0.0	OK	OK
	B11	3/4 A325 - 2	DStlS17(9)	0.05	0.47	43.88	0.2	2.6	0.0	OK	OK
	B12	3/4 A325 - 2	DStlS17(9)	0.08	0.46	43.88	0.3	2.6	0.0	OK	OK
	B13	3/4 A325 - 2	DStlS17(9)	0.05	0.45	43.88	0.2	2.5	0.0	OK	OK
	B14	3/4 A325 - 2	DStlS17(9)	0.13	0.45	43.88	0.4	2.5	0.0	OK	OK
	B15	3/4 A325 - 2	DStlS33(18)	0.83	8.61	43.88	2.8	48.2	0.0	OK	OK
	B16	3/4 A325 - 2	DStlS33(18)	2.71	8.58	43.88	9.1	48.0	0.0	OK	OK
	B17	3/4 A325 - 2	DStlS33(18)	0.61	7.49	43.88	2.0	41.9	0.0	OK	OK
	B18	3/4 A325 - 2	DStlS33(18)	1.57	7.47	43.88	5.3	41.8	0.0	OK	OK
	B19	3/4 A325 - 2	DStlS33(18)	0.63	6.71	43.88	2.1	37.5	0.0	OK	OK
	B20	3/4 A325 - 2	DStlS33(18)	2.26	6.72	43.88	7.6	37.6	0.0	OK	OK
	B21	3/4 A325 - 2	DStlS33(18)	2.24	7.41	32.28	7.5	41.4	0.0	OK	OK
	B22	3/4 A325 - 2	DStlS33(18)	0.51	7.44	43.88	1.7	41.6	0.0	OK	OK
	B23	3/4 A325 - 2	DStlS33(18)	3.79	10.13	32.23	12.7	56.7	0.0	OK	OK
	B24	3/4 A325 - 2	DStlS33(18)	0.53	10.18	43.88	1.8	56.9	0.0	OK	OK
	B25	3/4 A325 - 2	DStlS31(3)	1.06	9.37	43.88	3.5	52.4	0.0	OK	OK
	B26	3/4 A325 - 2	DStlS31(3)	2.03	9.39	43.88	6.8	52.5	0.0	OK	OK
	B27	3/4 A325 - 2	DStlS31(3)	1.93	8.29	43.88	6.5	46.4	0.0	OK	OK
	B28	3/4 A325 - 2	DStlS31(3)	0.16	8.32	43.88	0.6	46.5	0.0	OK	OK
	B29	5/8 A325 - 3	DStlS32(14)	0.71	6.82	36.57	3.5	54.9	0.0	OK	OK
	B30	5/8 A325 - 3	DStlS32(14)	0.88	6.83	36.57	4.3	55.0	0.0	OK	OK
	B31	5/8 A325 - 3	DStlS32(14)	1.29	6.20	36.57	6.2	49.9	0.0	OK	OK
	B32	5/8 A325 - 3	DStlS32(14)	0.09	6.24	36.57	0.5	50.2	0.0	OK	OK
	B33	7/8 A325 - 1	DStlS30(8)	3.55	7.72	29.18	8.8	31.7	0.0	OK	OK
	B34	7/8 A325 - 1	DStlS30(8)	2.19	5.15	29.18	5.4	21.2	0.0	OK	OK

Design data

Grade	$\phi R_{n,tension}$ [kip]	$\phi R_{n,shear}$ [kip]
7/8 A325 - 1	40.55	24.33
3/4 A325 - 2	29.79	17.88
5/8 A325 - 3	20.69	12.41

Symbol explanation

F_t	Tension force
V	Resultant of bolt shear forces Vy and Vz in shear planes
$\phi R_{n,bearing}$	Bolt bearing resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
$\phi R_{n,tension}$	Bolt tension resistance - AISC 360-16 – J3.6
$\phi R_{n,shear}$	Bolt shear resistance - AISC 360-16 – J3.6

Detailed result for B24

Tension resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = 29.79 \text{ kip} \geq F_t = 0.53 \text{ kip}$$

Where:

$F_{nt} = 89.9$ ksi – nominal tensile stress AISC 360-16 – Table J3.2

$A_b = 0.44$ in^2 – gross bolt cross-sectional area

$\phi = 0.75$ – resistance factor

Shear resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = 17.88 \text{ kip} \geq V = 10.18 \text{ kip}$$

Where:

$F_{nv} = 54.0$ ksi – nominal shear stress AISC 360-16 – Table J3.2

$A_b = 0.44$ in^2 – gross bolt cross-sectional area

$\phi = 0.75$ – resistance factor

Bearing resistance check (AISC 360-16 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \leq 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = 43.88 \text{ kip} \geq V = 10.18 \text{ kip}$$

Where:

$l_c = 2.19$ in – clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material

$t = 0.50$ in – thickness of the plate

$d = 0.75$ in – diameter of a bolt

$F_u = 65.0$ ksi – specified minimum tensile strength of the connected material

$\phi = 0.75$ – resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-16 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
M380-tfl 1	M274-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS31(3)	1.27	4.41	28.9	13.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS31(3)	1.51	5.25	28.8	14.5	OK	OK
M380-tfl 1	M274-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS31(3)	1.71	4.97	34.4	18.6	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS31(3)	1.68	4.11	40.8	21.8	OK	OK
M380-w 1	GUSS1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	18.46	1.03	DStlS30(8)	8.17	10.67	76.6	43.9	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	18.46	1.03	DStlS30(8)	8.28	10.76	76.9	44.6	OK	OK
M380-tfl 1	M274-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.52	0.68	DStlS33(18)	0.53	4.56	11.6	0.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.54	0.69	DStlS31(3)	0.80	4.45	18.1	6.9	OK	OK
M380-w 1	FP1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	10.86	0.68	DStlS30(8)	3.15	5.92	53.3	30.8	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	10.86	0.68	DStlS30(8)	2.12	5.66	37.5	19.6	OK	OK
M380-w 1	FP2	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.92	0.35	DStlS30(8)	0.54	3.07	17.5	8.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.96	0.35	DStlS32(14)	0.42	2.64	15.8	6.3	OK	OK
M380-tfl 1	CPL1a	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	22.95	1.00	DStlS31(3)	3.17	8.87	35.8	18.3	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	22.95	1.00	DStlS31(3)	2.48	8.90	27.8	12.6	OK	OK
CPL1b	CPL1c	E70xx	-	-	9.00	-	-	-	-	-	-	OK	OK
CPL1b	M285-bfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.93	0.44	DStlS40(6)	0.10	5.19	1.9	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.93	0.44	DStlS40(6)	0.09	5.20	1.7	0.0	OK	OK
CPL1b	M285-tfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.93	0.44	DStlS17(9)	0.11	5.14	2.2	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.93	0.44	DStlS33(18)	0.13	5.20	2.5	0.0	OK	OK
CPL1b	M285-w 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.50	0.44	DStlS33(18)	0.05	5.11	1.0	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.50	0.44	DStlS17(9)	0.06	4.67	1.2	0.0	OK	OK
M380-tfl 1	CPL2a	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	22.95	1.00	DStlS31(3)	4.47	8.65	51.7	26.5	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	22.95	1.00	DStlS31(3)	4.61	10.45	44.1	20.1	OK	OK
CPL2b	CPL2c	E70xx	-	-	9.00	-	-	-	-	-	-	OK	OK
CPL2b	M286-bfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.93	0.44	DStlS33(18)	1.81	5.20	34.8	18.1	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.93	0.44	DStlS33(18)	1.61	5.14	31.4	16.1	OK	OK
CPL2b	M286-tfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.93	0.44	DStlS33(18)	1.21	4.56	26.5	13.6	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.93	0.44	DStlS33(18)	1.52	5.20	29.2	14.9	OK	OK
CPL2b	M286-w 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.50	0.44	DStlS33(18)	0.88	5.05	17.4	8.3	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	7.50	0.44	DStlS33(18)	0.74	5.21	14.2	6.0	OK	OK
M117-tfl 1	CPL3a	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	16.90	0.65	DStlS33(18)	2.58	5.34	48.3	30.4	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	16.90	0.65	DStlS33(18)	1.64	5.12	32.0	16.2	OK	OK
CPL3b	CPL3c	E70xx	-	-	6.00	-	-	-	-	-	-	OK	OK
M116-w 1	GUSS1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	16.70	0.67	DStlS31(3)	3.37	7.24	46.5	26.8	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	16.70	0.67	DStlS31(3)	3.51	7.15	49.1	28.7	OK	OK
M380-w 1	GUSS2	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	18.96	1.00	DStlS30(8)	7.71	10.12	76.2	42.4	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	18.96	1.00	DStlS30(8)	7.56	9.95	76.0	43.0	OK	OK
M116-w 1	GUSS2	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	19.88	0.66	DStlS33(18)	1.71	7.38	23.2	10.9	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	19.94	0.66	DStlS31(3)	2.13	7.15	29.9	12.6	OK	OK
M380-bfl 1	FP1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	3.74	0.62	DStlS30(8)	0.93	3.52	26.5	12.4	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	3.74	0.62	DStlS30(8)	1.07	3.59	29.9	14.6	OK	OK
M380-tfl 1	FP1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	3.74	0.62	DStlS33(18)	1.19	5.16	23.0	11.1	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	3.74	0.62	DStlS30(8)	0.68	4.61	14.9	5.8	OK	OK
CPL3b	M625	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	17.02	0.32	DStlS33(18)	1.85	3.82	48.5	27.8	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	17.02	0.32	DStlS33(18)	1.76	3.82	46.1	26.2	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Detailed result for M380-w 1 / GUSS1

Weld resistance check (AISC 360-16 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 10.76 kip ≥ $F_n =$ 8.28 kip

Where:

$F_{nw} =$ 56.0 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 49.6° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.26 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Buckling

Buckling analysis was not calculated.

Project item 167

Design

Name	167
Description	GL D - X Brace
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC - LRFD (2016)

Members

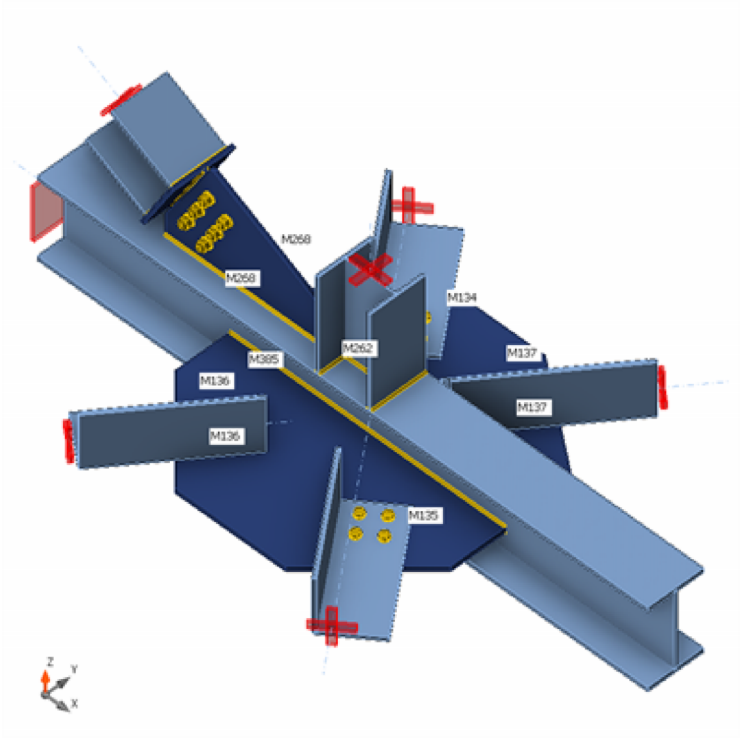
Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M385	33 - W12X50	0.0	0.0	0.0	0.00	0.00	0.00
M135	495 - L8X8X1/2	-52.3	0.0	0.0	0.00	0.00	0.00
M137	495 - L8X8X1/2	52.3	0.0	0.0	0.00	0.00	0.00
M134	495 - L8X8X1/2	-52.3	0.0	0.0	0.00	0.00	0.00
M136	495 - L8X8X1/2	52.3	0.0	0.0	0.00	0.00	0.00
M262	22 - W8X31	0.0	90.0	-180.0	0.00	0.00	0.00
M268	22 - W8X31	-180.0	28.9	0.0	0.00	0.00	0.00

Supports and forces

Name	Support	Forces in	X [in]
M385 / begin	N-Vy-Vz-Mx-My-Mz	Position	0.00
M385 / end		Position	0.00
M135 / end	Mx-My-Mz	Bolts	14.50
M137 / end	Mx-My-Mz	Bolts	11.54
M134 / begin	Mx-My-Mz	Bolts	14.50
M136 / begin	Mx-My-Mz	Bolts	14.54
M262 / end	Mx-My-Mz	Connected member face	6.10
M268 / end	Mx-My-Mz	Position	26.00

Project:	**AOF Hangar Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**



Cross-sections

Name	Material
33 - W12X50	A992
495 - L8X8X1/2	A992
22 - W8X31	A992

Bolts

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
5/8 A325	0.63	92.0	120.0	0.31
3/4 F1554 Gr.55	0.75	55.0	75.0	0.44

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS40(1)	M385 / Begin	-50.53	-0.01	-0.23	0.00	0.00	0.00
	M385 / End	52.14	0.01	-0.36	0.00	0.00	0.00
	M135 / End	1.30	0.00	-0.27	0.00	0.00	0.00
	M137 / End	13.66	0.00	-0.28	0.00	0.00	0.00
	M134 / Begin	1.17	0.00	-0.27	0.00	0.00	0.00
	M136 / Begin	-11.18	0.00	-0.27	0.00	0.00	0.00
	M262 / End	-0.67	0.00	0.00	0.00	0.00	0.00
	M268 / End	5.21	0.00	-0.19	0.00	0.00	0.00
DStlS33(2)	M385 / Begin	-157.04	0.00	-0.09	0.00	0.00	0.00
	M385 / End	162.69	0.00	-0.56	0.00	0.00	0.00
	M135 / End	29.88	0.00	-0.35	0.00	0.00	0.00
	M137 / End	23.14	0.00	-0.34	0.00	0.00	0.00
	M134 / Begin	-19.50	0.00	-0.33	0.00	0.00	0.00
	M136 / Begin	-12.75	0.00	-0.33	0.00	0.00	0.00
	M262 / End	-7.86	0.00	-0.01	0.00	0.00	0.00
	M268 / End	20.81	0.00	-0.23	0.00	0.00	0.00
DStlS31(3)	M385 / Begin	-161.93	0.00	-0.09	0.00	0.00	0.00
	M385 / End	166.97	0.00	-0.56	0.00	0.00	0.00
	M135 / End	25.36	0.01	-0.34	0.00	0.00	0.00
	M137 / End	24.79	-0.01	-0.34	0.00	0.00	0.00
	M134 / Begin	-15.26	0.00	-0.33	0.00	0.00	0.00
	M136 / Begin	-14.67	0.00	-0.33	0.00	0.00	0.00
	M262 / End	-7.35	0.00	-0.01	0.00	0.00	0.00
	M268 / End	19.74	0.00	-0.23	0.00	0.00	0.00
DStlS1(6)	M385 / Begin	-103.69	0.00	-0.28	0.00	0.00	0.00
	M385 / End	108.74	0.00	-0.59	0.00	0.00	0.00
	M135 / End	16.94	0.00	-0.42	0.00	0.00	0.00
	M137 / End	16.70	0.00	-0.42	0.00	0.00	0.00
	M134 / Begin	-11.24	0.00	-0.41	0.00	0.00	0.00
	M136 / Begin	-10.99	0.00	-0.41	0.00	0.00	0.00
	M262 / End	-3.77	0.00	-0.01	0.00	0.00	0.00
	M268 / End	13.57	0.00	-0.29	0.00	0.00	0.00
DStlS32(11)	M385 / Begin	-140.91	0.00	-0.14	0.00	0.00	0.00
	M385 / End	144.92	0.00	-0.54	0.00	0.00	0.00
	M135 / End	20.30	0.00	-0.35	0.00	0.00	0.00
	M137 / End	26.07	0.00	-0.35	0.00	0.00	0.00
	M134 / Begin	-11.11	0.00	-0.33	0.00	0.00	0.00
	M136 / Begin	-16.86	0.00	-0.34	0.00	0.00	0.00
	M262 / End	-6.10	0.00	-0.01	0.00	0.00	0.00
	M268 / End	17.29	0.00	-0.23	0.00	0.00	0.00
DStlS17(14)	M385 / Begin	-123.79	0.01	-0.15	0.00	0.00	0.00
	M385 / End	129.94	-0.01	-0.54	0.00	0.00	0.00

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
	M135 / End	27.42	0.00	-0.36	0.00	0.00	0.00
	M137 / End	14.58	0.00	-0.34	0.00	0.00	0.00
	M134 / Begin	-19.84	0.00	-0.34	0.00	0.00	0.00
	M136 / Begin	-6.99	0.00	-0.34	0.00	0.00	0.00
	M262 / End	-6.16	0.00	-0.01	0.00	0.00	0.00
	M268 / End	17.46	0.00	-0.24	0.00	0.00	0.00
DStlS6(17)	M385 / Begin	-62.97	0.00	-0.29	0.00	0.00	0.00
	M385 / End	66.90	0.00	-0.49	0.00	0.00	0.00
	M135 / End	13.98	0.00	-0.37	0.00	0.00	0.00
	M137 / End	13.93	0.00	-0.37	0.00	0.00	0.00
	M134 / Begin	-9.76	0.00	-0.36	0.00	0.00	0.00
	M136 / Begin	-9.70	0.00	-0.36	0.00	0.00	0.00
	M262 / End	-2.50	0.00	0.00	0.00	0.00	0.00
	M268 / End	10.24	0.00	-0.25	0.00	0.00	0.00

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS40(1)	0.00	0.00	0.00	0.05	-0.45	0.00
DStlS33(2)	0.00	0.00	0.00	0.08	-0.53	0.00
DStlS31(3)	0.00	0.00	0.00	0.08	-0.53	0.00
DStlS1(6)	0.00	0.00	0.00	0.09	-0.68	0.00
DStlS32(11)	0.00	0.00	0.00	0.07	-0.55	0.00
DStlS17(14)	0.00	0.00	0.00	0.09	-0.55	0.00
DStlS6(17)	0.00	0.00	0.00	0.08	-0.59	0.00

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Bolts	66.7 < 100%	OK
Welds	75.6 < 100%	OK
Buckling	Not calculated	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M385-bfl 1	A992	5/8	DStlS31(3)	12.8	0.0	0.0	OK
M385-tfl 1	A992	5/8	DStlS31(3)	13.0	0.0	0.0	OK
M385-w 1	A992	3/8	DStlS31(3)	23.4	0.0	0.0	OK
M135-bfl 1	A992	1/2	DStlS33(2)	27.8	0.0	3.6	OK
M135-w 1	A992	1/2	DStlS33(2)	11.2	0.0	0.0	OK
M137-bfl 1	A992	1/2	DStlS32(11)	23.1	0.0	1.0	OK
M137-w 1	A992	1/2	DStlS32(11)	6.5	0.0	0.0	OK
M134-bfl 1	A992	1/2	DStlS17(14)	18.1	0.0	2.6	OK
M134-w 1	A992	1/2	DStlS33(2)	9.7	0.0	0.0	OK
M136-bfl 1	A992	1/2	DStlS32(11)	16.2	0.0	5.2	OK
M136-w 1	A992	1/2	DStlS32(11)	8.4	0.0	0.0	OK
M262-bfl 1	A992	7/16	DStlS31(3)	8.4	0.0	0.0	OK
M262-tfl 1	A992	7/16	DStlS31(3)	5.6	0.0	0.0	OK
M262-w 1	A992	5/16	DStlS31(3)	13.2	0.0	0.0	OK
M268-bfl 1	A992	7/16	DStlS33(2)	5.2	0.0	0.0	OK
M268-tfl 1	A992	7/16	DStlS33(2)	5.1	0.0	0.0	OK
M268-w 1	A992	5/16	DStlS33(2)	6.1	0.0	0.0	OK
GUSS1	A572 Gr.50	3/4	DStlS32(11)	17.3	0.0	1.0	OK
GUSS2	A572 Gr.50	3/4	DStlS33(2)	17.2	0.0	1.2	OK
CPL1a	A572 Gr.50	1/2	DStlS33(2)	17.8	0.0	1.1	OK
CPL1b	A572 Gr.50	1/2	DStlS33(2)	5.2	0.0	0.0	OK
CPL1c	A572 Gr.50	1/2	DStlS33(2)	18.7	0.0	1.7	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for M385-bfl 1

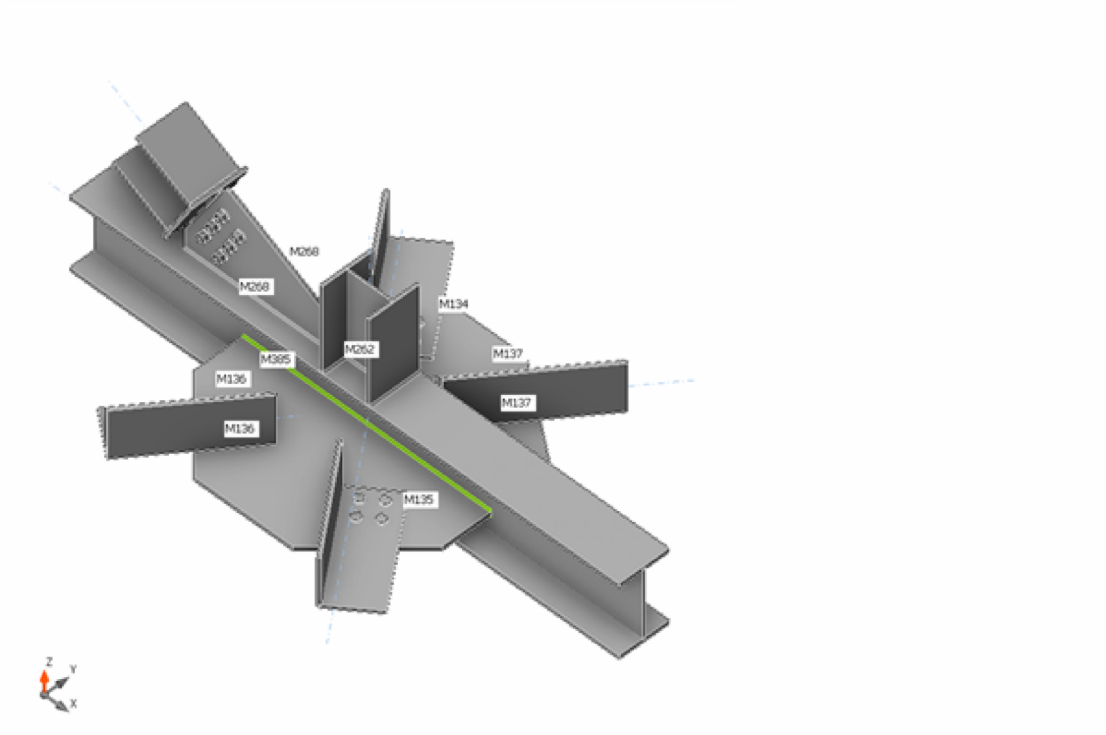
Design values used in the analysis

$\phi F_y =$ 45.0 ksi

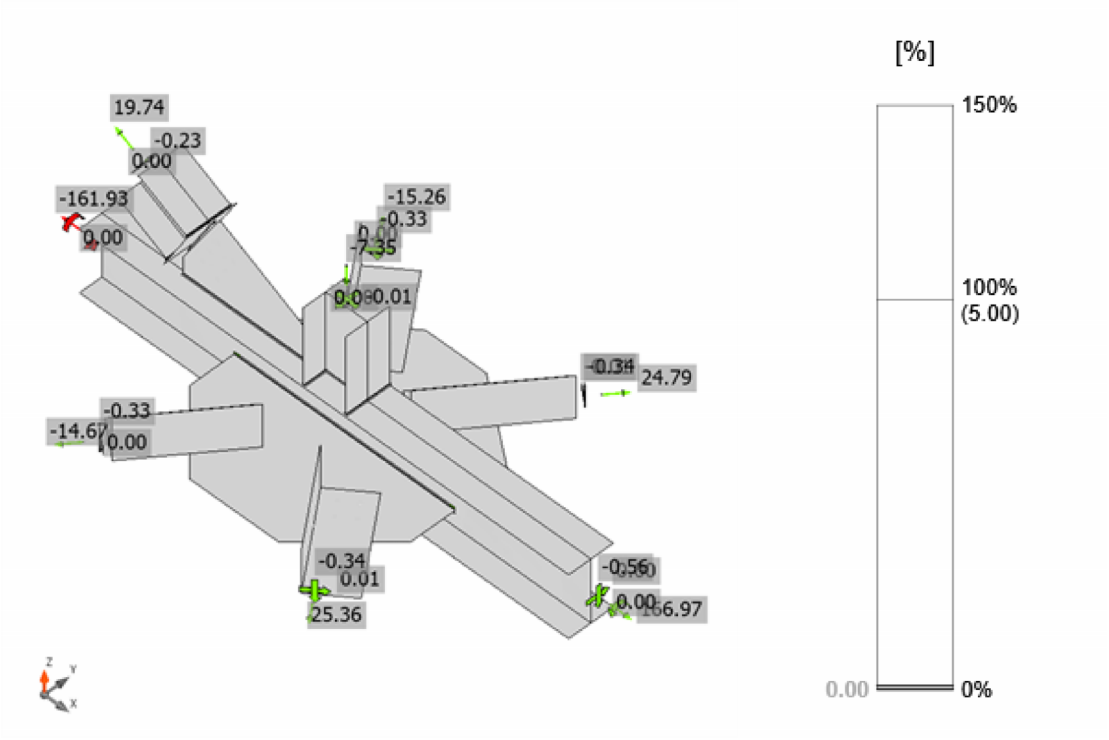
Where:

$F_y = 50.0$ ksi – characteristic yield strength

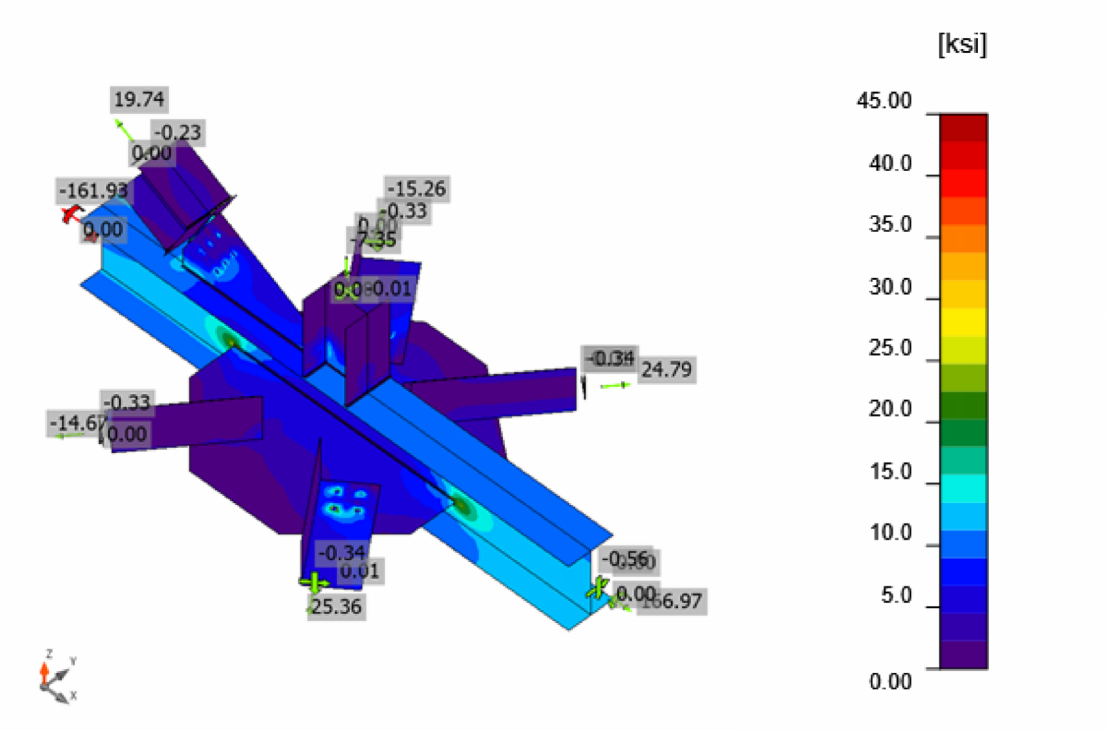
$\phi = 0.90$ – resistance factor for steel material AISC 360-16 – B3.1



Overall check, DStlS31(3)

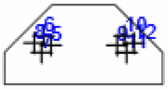
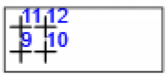
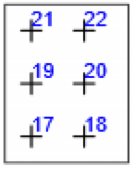


Strain check, DStlS31(3)



Equivalent stress, DStlS31(3)

Bolts

Shape	Item	Grade	Loads	F_t [kip]	V [kip]	$\phi R_{n,bearing}$ [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	B1	5/8 A325 - 1	DStlS32(11)	0.99	7.11	36.57	4.8	57.3	0.0	OK	OK
	B2	5/8 A325 - 1	DStlS32(11)	0.36	7.22	36.57	1.7	58.1	0.0	OK	OK
	B3	5/8 A325 - 1	DStlS32(11)	1.48	5.86	36.57	7.2	47.2	0.0	OK	OK
	B4	5/8 A325 - 1	DStlS32(11)	0.15	5.97	36.57	0.7	48.1	0.0	OK	OK
	B5	5/8 A325 - 1	DStlS32(11)	0.46	3.96	36.57	2.2	31.9	0.0	OK	OK
	B6	5/8 A325 - 1	DStlS32(11)	1.02	4.02	36.57	4.9	32.4	0.0	OK	OK
	B7	5/8 A325 - 1	DStlS32(11)	1.02	4.42	36.57	4.9	35.6	0.0	OK	OK
	B8	5/8 A325 - 1	DStlS32(11)	0.06	4.50	36.57	0.3	36.3	0.0	OK	OK
	B9	5/8 A325 - 1	DStlS33(2)	0.90	8.18	36.57	4.4	65.9	0.0	OK	OK
	B10	5/8 A325 - 1	DStlS33(2)	1.33	8.27	36.57	6.4	66.7	0.0	OK	OK
	B11	5/8 A325 - 1	DStlS33(2)	1.78	6.73	36.57	8.6	54.2	0.0	OK	OK
	B12	5/8 A325 - 1	DStlS33(2)	0.06	6.81	36.57	0.3	54.9	0.0	OK	OK
	B13	5/8 A325 - 1	DStlS17(14)	0.55	4.77	36.57	2.6	38.4	0.0	OK	OK
	B14	5/8 A325 - 1	DStlS17(14)	0.82	4.84	36.57	4.0	39.0	0.0	OK	OK
	B15	5/8 A325 - 1	DStlS33(2)	1.03	5.11	36.57	5.0	41.2	0.0	OK	OK
	B16	5/8 A325 - 1	DStlS33(2)	0.05	5.22	36.57	0.3	42.0	0.0	OK	OK
	B17	3/4 F1554 Gr.55 - 2	DStlS33(2)	1.39	3.57	31.99	7.4	31.9	0.0	OK	OK
	B18	3/4 F1554 Gr.55 - 2	DStlS33(2)	0.53	3.54	43.88	2.8	31.6	0.0	OK	OK
	B19	3/4 F1554 Gr.55 - 2	DStlS33(2)	0.86	3.44	31.99	4.6	30.8	0.0	OK	OK
	B20	3/4 F1554 Gr.55 - 2	DStlS33(2)	1.01	3.44	43.88	5.4	30.8	0.0	OK	OK
	B21	3/4 F1554 Gr.55 - 2	DStlS33(2)	0.83	3.40	31.99	4.5	30.4	0.0	OK	OK
	B22	3/4 F1554 Gr.55 - 2	DStlS33(2)	0.90	3.42	43.88	4.8	30.6	0.0	OK	OK

Design data

Grade	$\phi R_{n,tension}$ [kip]	$\phi R_{n,shear}$ [kip]
5/8 A325 - 1	20.69	12.41
3/4 F1554 Gr.55 - 2	18.64	11.18

Symbol explanation

F_t	Tension force
V	Resultant of bolt shear forces Vy and Vz in shear planes
$\phi R_{n,bearing}$	Bolt bearing resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
$\phi R_{n,tension}$	Bolt tension resistance - AISC 360-16 – J3.6
$\phi R_{n,shear}$	Bolt shear resistance - AISC 360-16 – J3.6

Detailed result for B10

Tension resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 20.69 \quad \text{kip} \quad \geq \quad F_t = \quad 1.33 \quad \text{kip}$$

Where:

$F_{nt} =$ 89.9 ksi – nominal tensile stress AISC 360-16 – Table J3.2

$A_b =$ 0.31 in^2 – gross bolt cross-sectional area

$\phi =$ 0.75 – resistance factor

Shear resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 12.41 \quad \text{kip} \quad \geq \quad V = \quad 8.27 \quad \text{kip}$$

Where:

$F_{nv} =$ 54.0 ksi – nominal shear stress AISC 360-16 – Table J3.2

$A_b =$ 0.31 in^2 – gross bolt cross-sectional area

$\phi =$ 0.75 – resistance factor

Bearing resistance check (AISC 360-16 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = \quad 36.57 \quad \text{kip} \quad \geq \quad V = \quad 8.27 \quad \text{kip}$$

Where:

$l_c =$ 2.31 in – clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material

$t =$ 0.50 in – thickness of the plate

$d =$ 0.63 in – diameter of a bolt

$F_u =$ 65.0 ksi – specified minimum tensile strength of the connected material

$\phi =$ 0.75 – resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-16 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
M385-w 1	GUSS1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	39.92	1.02	DStlS31(3)	5.74	7.59	75.6	50.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	39.92	1.02	DStlS31(3)	5.63	7.45	75.6	49.3	OK	OK
M385-w 1	GUSS2	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	39.92	1.02	DStlS31(3)	5.50	7.30	75.3	47.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	39.92	1.02	DStlS31(3)	5.89	7.81	75.4	48.7	OK	OK
M385-tfl 1	CPL1a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	24.95	1.00	DStlS31(3)	3.60	7.54	47.7	22.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	24.95	1.00	DStlS31(3)	2.10	6.10	34.5	14.7	OK	OK
M262-bfl 1	CPL1a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	3.99	0.66	DStlS31(3)	2.43	5.80	41.8	20.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	3.99	0.66	DStlS31(3)	1.60	4.85	33.0	19.0	OK	OK
CPL1b	CPL1c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.92	0.45	DStlS33(2)	0.57	3.91	14.6	6.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.92	0.45	DStlS33(2)	1.21	3.95	30.6	17.4	OK	OK
CPL1b	M268-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS33(2)	0.76	3.90	19.6	9.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS33(2)	0.63	3.88	16.2	6.9	OK	OK
CPL1b	M268-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS33(2)	0.59	3.85	15.4	6.8	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS33(2)	0.72	3.90	18.4	8.5	OK	OK
CPL1b	M268-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS33(2)	0.38	3.75	10.0	0.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS33(2)	0.35	3.87	9.0	0.0	OK	OK
M385-tfl 1	M262-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS31(3)	0.87	4.66	18.6	7.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS31(3)	0.53	5.84	9.1	0.0	OK	OK
M385-tfl 1	M262-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS31(3)	0.57	5.31	10.8	0.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS33(2)	0.55	5.84	9.5	0.0	OK	OK
M385-tfl 1	M262-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.54	0.69	DStlS31(3)	0.82	4.26	19.2	6.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.54	0.69	DStlS31(3)	0.83	4.27	19.4	6.6	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Detailed result for M385-w 1 / GUSS1

Weld resistance check (AISC 360-16 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 7.59 kip ≥ $F_n =$ 5.74 kip

Where:

$F_{nw} =$ 52.7 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 39.8° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.19 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Friction coefficient - concrete	0.40	-	ACI 349-01 – B.6.1.4
Friction coefficient in slip-resistance	0.30	-	AISC 360-16 – J3.8
Limit plastic strain	0.05	-	
Detailing	Yes		
Distance between bolts [d]	2.66	-	AISC 360-16 – J3.3
Concrete breakout resistance check	Both		
Base metal capacity check at weld fusion face	No		AISC 360-16 – J2-2
Deformation at bolt hole at service load is design consideration	Yes		AISC 360-16 – J3.10
Cracked concrete	Yes		ACI 318-14 – 17
Local deformation check	Yes		
Local deformation limit	0.03	-	CIDECT DG 1, 3 – 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints

Project: **Creech AOF Brace Connection(Model 2)**
Project no: **203434**
Author: **Allison Valencia**

Project data

Project name	Creech AOF Brace Connection(Model 2)
Project number	203434
Author	Allison Valencia
Description	
Date	3/26/2025
Code	AISC/ACI

Material

Steel	A992, A572 Gr.50
Concrete	4000 psi

Project item 88

Design

Name	88
Description	
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC - LRFD (2016)

Members

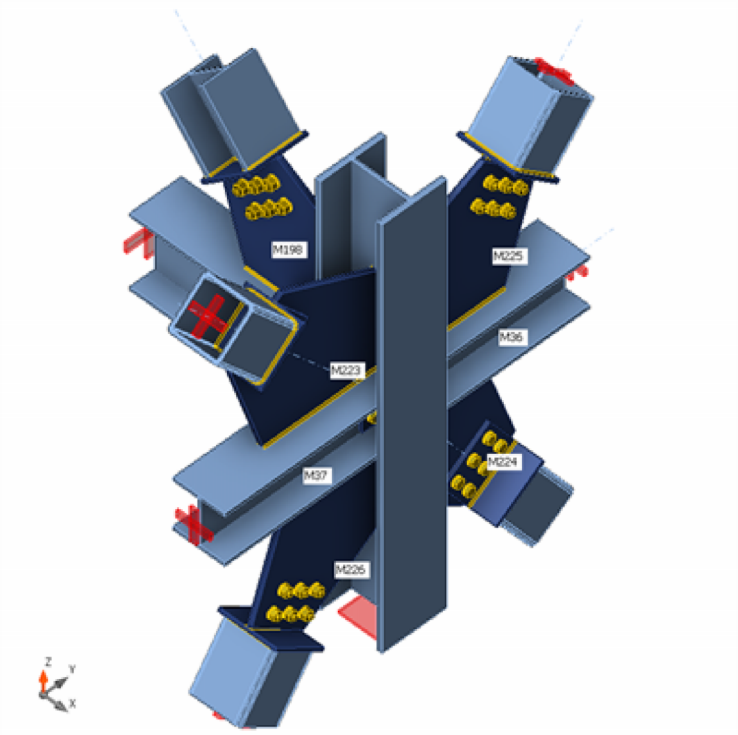
Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M45	388 - W12X45	0.0	0.0	0.0	0.00	0.00	0.00
M226	438 - HSS8X8X1/2(HSS8X8X1/2(HSS8X8X1/2(HSS(Imp)8X8X1/2)))	90.0	55.2	0.0	0.00	0.00	0.00
M37	23 - W8X40	90.0	0.0	0.0	0.00	0.00	0.00
M223	438 - HSS8X8X1/2(HSS8X8X1/2(HSS8X8X1/2(HSS(Imp)8X8X1/2)))	-90.0	48.9	0.0	0.00	0.00	0.00
M15	6 - W10X68	0.0	90.0	-180.0	0.00	0.00	0.00
M36	23 - W8X40	90.0	0.0	0.0	0.00	0.00	0.00
M198	710 - W8X58	-180.0	49.0	0.0	0.00	0.00	0.00
M224	438 - HSS8X8X1/2(HSS8X8X1/2(HSS8X8X1/2(HSS(Imp)8X8X1/2)))	-90.0	55.2	0.0	0.00	0.00	0.00
M225	438 - HSS8X8X1/2(HSS8X8X1/2(HSS8X8X1/2(HSS(Imp)8X8X1/2)))	90.0	48.9	0.0	0.00	0.00	0.00

Supports and forces

Name	Support	Forces in	X [in]
M45 / begin	Mx-My-Mz	Bolts	7.07
M226 / begin	Mx-My-Mz	Position	26.00
M37 / begin	Mx-My-Mz	Bolts	2.11
M223 / end	Mx-My-Mz	Position	26.00
M15 / begin	N-Vy-Vz-Mx-My-Mz	Position	0.00
M15 / end		Position	0.00
M36 / end	Mx-My-Mz	Bolts	2.11
M198 / end		Position	0.00
M224 / begin	Mx-My-Mz	Position	26.00
M225 / end	Mx-My-Mz	Position	26.00

Project:	**Creech AOF Brace Connection(Model 2)**
Project no:	**203434**
Author:	**Allison Valencia**



Cross-sections

Name	Material
388 - W12X45	A992
438 - HSS8X8X1/2(HSS8X8X1/2(HSS8X8X1/2(HSS(Imp)8X8X1/2)))	A992
23 - W8X40	A992
6 - W10X68	A992
710 - W8X58	A992

Bolts

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
3/4 A325	0.75	92.0	120.0	0.44
7/8 A325	0.88	92.0	120.0	0.60

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS14(1)	M45 / Begin	-61.55	-0.01	-0.65	0.00	-0.17	0.00
	M226 / Begin	71.58	-0.01	-0.51	0.00	0.00	0.00
	M37 / Begin	-49.63	0.67	-0.45	0.00	-0.16	-0.23
	M223 / End	7.08	0.01	-0.52	0.00	0.00	0.00
	M15 / Begin	62.93	0.01	-5.33	0.00	-32.11	0.21
	M15 / End	-14.64	-0.01	-4.55	0.00	33.06	-0.20
	M36 / End	16.95	0.64	-0.43	0.00	0.00	0.00
	M198 / End	-111.31	-0.01	-0.38	0.00	0.00	0.00
	M224 / Begin	-14.47	0.01	-0.52	0.00	0.00	0.00
	M225 / End	-17.91	-0.01	-0.52	0.00	0.00	0.00
DStlS29(2)	M45 / Begin	-36.02	0.01	-0.42	0.00	-0.13	0.00
	M226 / Begin	-32.49	-0.01	-0.39	0.00	0.00	0.00
	M37 / Begin	3.44	-0.65	-0.34	0.00	-0.12	0.23
	M223 / End	-14.55	0.00	-0.39	0.00	0.00	0.00
	M15 / Begin	23.48	-0.01	4.80	0.00	16.06	-0.21
	M15 / End	-5.13	0.01	3.86	0.00	-18.19	0.20
	M36 / End	29.32	-0.62	-0.32	0.00	0.00	0.00
	M198 / End	-40.13	0.01	-0.36	0.00	0.00	0.00
	M224 / Begin	53.60	0.01	-0.38	0.00	0.00	0.00
	M225 / End	10.33	0.00	-0.39	0.00	0.00	0.00
DStlS35-1(3)	M45 / Begin	-55.30	0.00	-0.65	0.00	-0.19	0.00
	M226 / Begin	22.76	-0.02	-0.57	0.00	0.00	0.00
	M37 / Begin	-31.71	0.01	-0.49	0.00	-0.18	0.00
	M223 / End	-4.29	0.00	-0.57	0.00	0.00	0.00
	M15 / Begin	50.37	0.00	-0.35	0.00	-11.15	0.00
	M15 / End	-12.96	0.00	-0.52	0.00	10.37	0.00
	M36 / End	31.76	0.01	-0.47	0.00	0.00	0.00
	M198 / End	-86.15	0.00	-0.49	0.00	0.00	0.00
	M224 / Begin	22.80	0.02	-0.57	0.00	0.00	0.00
	M225 / End	-4.35	0.00	-0.57	0.00	0.00	0.00
DStlS41-1(5)	M45 / Begin	-32.61	0.00	-0.39	0.00	-0.11	0.00
	M226 / Begin	-30.81	-0.01	-0.34	0.00	0.00	0.00
	M37 / Begin	-12.55	0.01	-0.29	0.00	-0.10	0.00
	M223 / End	-36.45	0.00	-0.34	0.00	0.00	0.00
	M15 / Begin	29.07	-0.02	-0.18	0.00	-5.39	0.07
	M15 / End	-6.60	0.00	-0.24	0.00	4.99	-0.08
	M36 / End	18.15	0.01	-0.28	0.00	0.00	0.00
	M198 / End	-50.67	0.03	-0.29	0.00	0.00	0.00
	M224 / Begin	57.08	0.01	-0.33	0.00	0.00	0.00
	M225 / End	31.31	0.00	-0.34	0.00	0.00	0.00
DStlS1(6)	M45 / Begin	-58.38	0.00	-0.69	0.00	-0.20	0.00
	M226 / Begin	23.51	-0.01	-0.60	0.00	0.00	0.00

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
	M37 / Begin	-27.43	0.01	-0.52	0.00	-0.19	0.00
	M223 / End	-4.55	0.00	-0.60	0.00	0.00	0.00
	M15 / Begin	52.04	0.00	-0.32	0.00	-9.65	0.00
	M15 / End	-11.82	0.00	-0.42	0.00	8.93	0.00
	M36 / End	27.48	0.01	-0.50	0.00	0.00	0.00
	M198 / End	-90.71	0.00	-0.51	0.00	0.00	0.00
	M224 / Begin	23.54	0.01	-0.60	0.00	0.00	0.00
	M225 / End	-4.62	-0.01	-0.60	0.00	0.00	0.00
DStlS11(10)	M45 / Begin	-57.89	0.00	-0.59	0.00	-0.17	0.00
	M226 / Begin	18.79	-0.02	-0.52	0.00	0.00	0.00
	M37 / Begin	-39.91	-0.64	-0.45	0.00	-0.16	0.23
	M223 / End	-2.61	0.00	-0.52	0.00	0.00	0.00
	M15 / Begin	41.65	0.00	4.65	0.00	11.49	0.00
	M15 / End	-9.69	0.00	3.66	0.00	-13.92	0.00
	M36 / End	39.97	-0.61	-0.43	0.00	0.00	0.00
	M198 / End	-74.06	0.00	-0.44	0.00	0.00	0.00
	M224 / Begin	18.84	0.02	-0.52	0.00	0.00	0.00
	M225 / End	-2.68	0.00	-0.52	0.00	0.00	0.00
DStlS28(11)	M45 / Begin	-39.68	0.00	-0.48	0.00	-0.13	0.00
	M226 / Begin	20.30	0.00	-0.39	0.00	0.00	0.00
	M37 / Begin	-6.29	0.67	-0.34	0.00	-0.12	-0.23
	M223 / End	-4.86	0.00	-0.39	0.00	0.00	0.00
	M15 / Begin	44.76	0.00	-5.19	0.00	-27.54	0.00
	M15 / End	-10.08	0.00	-4.35	0.00	28.78	0.00
	M36 / End	6.30	0.64	-0.32	0.00	0.00	0.00
	M198 / End	-77.38	0.00	-0.30	0.00	0.00	0.00
	M224 / Begin	20.29	0.00	-0.39	0.00	0.00	0.00
	M225 / End	-4.90	0.00	-0.39	0.00	0.00	0.00
DStlS37-1(7)	M45 / Begin	-54.96	0.00	-0.65	0.00	-0.19	0.00
	M226 / Begin	-21.81	-0.01	-0.57	0.00	0.00	0.00
	M37 / Begin	-23.05	0.01	-0.49	0.00	-0.18	0.00
	M223 / End	-38.19	0.00	-0.57	0.00	0.00	0.00
	M15 / Begin	48.99	-0.02	-0.30	0.00	-9.08	0.07
	M15 / End	-11.12	0.00	-0.40	0.00	8.41	-0.08
	M36 / End	28.67	0.01	-0.47	0.00	0.00	0.00
	M198 / End	-85.40	0.03	-0.48	0.00	0.00	0.00
	M224 / Begin	66.09	0.01	-0.56	0.00	0.00	0.00
	M225 / End	29.54	0.00	-0.57	0.00	0.00	0.00
DStlS42-1(8)	M45 / Begin	-32.61	0.00	-0.39	0.00	-0.11	0.00
	M226 / Begin	57.08	-0.01	-0.33	0.00	0.00	0.00
	M37 / Begin	-18.10	0.01	-0.29	0.00	-0.10	0.00
	M223 / End	31.36	0.00	-0.34	0.00	0.00	0.00
	M15 / Begin	29.07	0.02	-0.18	0.00	-5.39	-0.07
	M15 / End	-6.60	0.00	-0.24	0.00	4.99	0.08

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
	M36 / End	12.54	0.01	-0.28	0.00	0.00	0.00
	M198 / End	-50.66	-0.03	-0.29	0.00	0.00	0.00
	M224 / Begin	-30.79	0.01	-0.34	0.00	0.00	0.00
	M225 / End	-36.47	0.00	-0.34	0.00	0.00	0.00
DStlS22(12)	M45 / Begin	-82.80	0.00	-0.69	0.00	-0.17	0.00
	M226 / Begin	56.18	-0.02	-0.52	0.00	0.00	0.00
	M37 / Begin	-50.19	0.35	-0.45	0.00	-0.16	-0.12
	M223 / End	-0.13	0.01	-0.52	0.00	0.00	0.00
	M15 / Begin	76.32	0.00	-2.95	0.00	-24.45	0.11
	M15 / End	-17.93	-0.01	-2.61	0.00	24.33	-0.10
	M36 / End	33.89	0.33	-0.43	0.00	0.00	0.00
	M198 / End	-136.05	0.00	-0.33	0.00	0.00	0.00
	M224 / Begin	13.18	0.02	-0.52	0.00	0.00	0.00
	M225 / End	-12.68	-0.01	-0.52	0.00	0.00	0.00
DStlS20(14)	M45 / Begin	-83.12	0.00	-0.69	0.00	-0.17	0.00
	M226 / Begin	34.97	-0.02	-0.52	0.00	0.00	0.00
	M37 / Begin	-33.98	0.35	-0.45	0.00	-0.16	-0.12
	M223 / End	-6.90	0.01	-0.52	0.00	0.00	0.00
	M15 / Begin	76.99	0.00	-2.94	0.00	-23.98	0.00
	M15 / End	-17.94	0.00	-2.58	0.00	23.89	0.00
	M36 / End	34.03	0.33	-0.43	0.00	0.00	0.00
	M198 / End	-136.49	0.00	-0.33	0.00	0.00	0.00
	M224 / Begin	34.99	0.02	-0.52	0.00	0.00	0.00
	M225 / End	-7.00	-0.01	-0.52	0.00	0.00	0.00
DStlS27(15)	M45 / Begin	-35.38	0.00	-0.42	0.00	-0.13	0.00
	M226 / Begin	9.93	-0.01	-0.39	0.00	0.00	0.00
	M37 / Begin	-28.98	-0.65	-0.34	0.00	-0.12	0.23
	M223 / End	-1.00	0.00	-0.39	0.00	0.00	0.00
	M15 / Begin	22.15	0.00	4.78	0.00	15.13	0.00
	M15 / End	-5.11	0.00	3.80	0.00	-17.30	0.00
	M36 / End	29.03	-0.62	-0.32	0.00	0.00	0.00
	M198 / End	-39.24	0.00	-0.36	0.00	0.00	0.00
	M224 / Begin	9.97	0.01	-0.39	0.00	0.00	0.00
	M225 / End	-1.04	0.00	-0.39	0.00	0.00	0.00
DStlS12(13)	M45 / Begin	-62.19	0.00	-0.65	0.00	-0.17	0.00
	M226 / Begin	29.16	-0.01	-0.52	0.00	0.00	0.00
	M37 / Begin	-17.21	0.67	-0.45	0.00	-0.16	-0.23
	M223 / End	-6.47	0.01	-0.52	0.00	0.00	0.00
	M15 / Begin	64.26	0.00	-5.31	0.00	-31.18	0.00
	M15 / End	-14.67	0.00	-4.49	0.00	32.17	0.00
	M36 / End	17.24	0.64	-0.43	0.00	0.00	0.00
	M198 / End	-112.19	0.00	-0.38	0.00	0.00	0.00
	M224 / Begin	29.16	0.01	-0.52	0.00	0.00	0.00
	M225 / End	-6.54	-0.01	-0.52	0.00	0.00	0.00

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS38-1(16)	M45 / Begin	-54.96	0.00	-0.65	0.00	-0.19	0.00
	M226 / Begin	66.09	-0.01	-0.56	0.00	0.00	0.00
	M37 / Begin	-28.60	0.01	-0.49	0.00	-0.18	0.00
	M223 / End	29.61	0.00	-0.57	0.00	0.00	0.00
	M15 / Begin	48.99	0.02	-0.30	0.00	-9.08	-0.07
	M15 / End	-11.12	0.00	-0.40	0.00	8.41	0.08
	M36 / End	23.06	0.01	-0.47	0.00	0.00	0.00
	M198 / End	-85.39	-0.03	-0.48	0.00	0.00	0.00
	M224 / Begin	-21.77	0.01	-0.57	0.00	0.00	0.00
	M225 / End	-38.24	0.00	-0.57	0.00	0.00	0.00
DStlS30(17)	M45 / Begin	-39.03	-0.01	-0.47	0.00	-0.13	0.00
	M226 / Begin	62.73	-0.01	-0.38	0.00	0.00	0.00
	M37 / Begin	-38.71	0.67	-0.34	0.00	-0.12	-0.23
	M223 / End	8.69	0.00	-0.39	0.00	0.00	0.00
	M15 / Begin	43.43	0.01	-5.21	0.00	-28.47	0.21
	M15 / End	-10.06	-0.01	-4.40	0.00	29.67	-0.20
	M36 / End	6.01	0.64	-0.32	0.00	0.00	0.00
	M198 / End	-76.50	-0.01	-0.30	0.00	0.00	0.00
	M224 / Begin	-23.34	0.01	-0.39	0.00	0.00	0.00
	M225 / End	-16.27	0.00	-0.39	0.00	0.00	0.00
DStlS13(18)	M45 / Begin	-58.54	0.01	-0.59	0.00	-0.17	0.00
	M226 / Begin	-23.64	-0.01	-0.52	0.00	0.00	0.00
	M37 / Begin	-7.48	-0.65	-0.45	0.00	-0.16	0.23
	M223 / End	-16.16	0.00	-0.52	0.00	0.00	0.00
	M15 / Begin	42.98	-0.01	4.68	0.00	12.42	-0.21
	M15 / End	-9.72	0.01	3.71	0.00	-14.81	0.20
	M36 / End	40.26	-0.61	-0.43	0.00	0.00	0.00
	M198 / End	-74.94	0.01	-0.44	0.00	0.00	0.00
	M224 / Begin	62.47	0.01	-0.51	0.00	0.00	0.00
	M225 / End	8.69	0.00	-0.52	0.00	0.00	0.00
DStlS21(19)	M45 / Begin	-81.29	0.00	-0.67	0.00	-0.17	0.00
	M226 / Begin	8.57	-0.02	-0.52	0.00	0.00	0.00
	M37 / Begin	-29.11	-0.31	-0.45	0.00	-0.16	0.12
	M223 / End	-11.75	0.01	-0.52	0.00	0.00	0.00
	M15 / Begin	66.35	0.00	2.06	0.00	-2.18	-0.11
	M15 / End	-15.46	0.01	1.52	0.00	0.40	0.10
	M36 / End	45.54	-0.29	-0.43	0.00	0.00	0.00
	M198 / End	-117.86	0.00	-0.35	0.00	0.00	0.00
	M224 / Begin	51.65	0.02	-0.52	0.00	0.00	0.00
	M225 / End	0.62	-0.01	-0.52	0.00	0.00	0.00
DStlS3(20)	M45 / Begin	-47.89	0.00	-0.57	0.00	-0.17	0.00
	M226 / Begin	14.97	-0.01	-0.52	0.00	0.00	0.00
	M37 / Begin	-34.86	-0.65	-0.45	0.00	-0.16	0.23
	M223 / End	-1.97	0.00	-0.52	0.00	0.00	0.00

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
	M15 / Begin	33.30	0.00	4.71	0.00	13.07	0.00
	M15 / End	-7.64	0.00	3.71	0.00	-15.39	0.00
	M36 / End	34.92	-0.62	-0.43	0.00	0.00	0.00
	M198 / End	-58.68	0.00	-0.47	0.00	0.00	0.00
	M224 / Begin	15.02	0.01	-0.52	0.00	0.00	0.00
	M225 / End	-2.03	0.00	-0.52	0.00	0.00	0.00

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS14(1)	0.03	0.00	-0.04	0.15	-1.53	-0.24
DStlS29(2)	-0.03	0.00	-0.03	0.14	1.74	0.24
DStlS35-1(3)	0.00	0.00	-0.05	0.18	0.14	0.00
DStlS41-1(5)	0.00	0.00	-0.03	0.13	0.05	-0.01
DStlS1(6)	0.00	0.00	-0.05	0.19	0.08	0.00
DStlS11(10)	-0.03	0.00	-0.04	0.17	1.86	0.24
DStlS28(11)	0.03	0.00	-0.03	0.12	-1.65	-0.24
DStlS37-1(7)	0.00	0.00	-0.05	0.20	0.08	-0.01
DStlS42-1(8)	0.00	0.00	-0.03	0.09	0.05	0.01
DStlS22(12)	0.01	0.00	-0.04	0.16	-0.50	-0.12
DStlS20(14)	0.01	0.00	-0.04	0.17	-0.52	-0.12
DStlS27(15)	-0.03	0.00	-0.03	0.12	1.76	0.24
DStlS12(13)	0.03	0.00	-0.04	0.17	-1.55	-0.24
DStlS38-1(16)	0.00	0.00	-0.05	0.16	0.08	0.01
DStlS30(17)	0.03	0.00	-0.03	0.11	-1.63	-0.24
DStlS13(18)	-0.03	0.00	-0.04	0.18	1.84	0.24
DStlS21(19)	-0.01	0.00	-0.04	0.17	1.18	0.12
DStlS3(20)	-0.03	0.00	-0.04	0.17	1.78	0.24

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.4 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Bolts	99.9 < 100%	OK
Welds	97.3 < 100%	OK
Buckling	4.53	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M45-bfl 1	A992	9/16	DStlS22(12)	6.2	0.0	0.0	OK
M45-tfl 1	A992	9/16	DStlS22(12)	14.0	0.0	0.0	OK
M45-w 1	A992	5/16	DStlS22(12)	42.9	0.0	2.3	OK
M226	A992	1/2	DStlS14(1)	36.3	0.0	0.0	OK
M37-bfl 1	A992	9/16	DStlS38-1(16)	8.4	0.0	0.0	OK
M37-tfl 1	A992	9/16	DStlS14(1)	8.3	0.0	0.0	OK
M37-w 1	A992	3/8	DStlS38-1(16)	21.7	0.0	1.2	OK
M223	A992	1/2	DStlS37-1(7)	21.6	0.0	0.0	OK
M15-bfl 1	A992	3/4	DStlS20(14)	18.0	0.0	0.0	OK
M15-tfl 1	A992	3/4	DStlS11(10)	4.4	0.0	0.0	OK
M15-w 1	A992	1/2	DStlS20(14)	19.3	0.0	0.0	OK
M36-bfl 1	A992	9/16	DStlS37-1(7)	8.0	0.0	0.0	OK
M36-tfl 1	A992	9/16	DStlS11(10)	7.9	0.0	0.0	OK
M36-w 1	A992	3/8	DStlS37-1(7)	21.2	0.0	0.7	OK
M198-bfl 1	A992	13/16	DStlS20(14)	16.2	0.0	0.0	OK
M198-tfl 1	A992	13/16	DStlS20(14)	16.7	0.0	0.0	OK
M198-w 1	A992	1/2	DStlS20(14)	24.7	0.0	0.0	OK
M224	A992	1/2	DStlS37-1(7)	34.9	0.0	0.0	OK
M225	A992	1/2	DStlS38-1(16)	21.7	0.0	0.0	OK
FP1	A572 Gr.50	1/2	DStlS22(12)	32.6	0.0	2.4	OK
FP2	A572 Gr.50	1/2	DStlS38-1(16)	12.1	0.0	1.7	OK
FP3	A572 Gr.50	1/2	DStlS38-1(16)	10.3	0.0	1.2	OK
CPL1a	A572 Gr.50	3/4	DStlS20(14)	45.1	0.2	5.6	OK
CPL1b	A572 Gr.50	1/2	DStlS20(14)	18.3	0.0	0.0	OK
CPL1c	A572 Gr.50	1/2	DStlS20(14)	43.4	0.3	10.5	OK
CPL2a	A572 Gr.50	3/4	DStlS42-1(8)	17.3	0.0	1.4	OK
CPL2b	A572 Gr.50	1/2	DStlS37-1(7)	16.7	0.0	0.0	OK
CPL2c	A572 Gr.50	1/2	DStlS41-1(5)	44.5	0.0	2.5	OK
CPL3a	A572 Gr.50	3/4	DStlS41-1(5)	17.5	0.0	1.4	OK
CPL3b	A572 Gr.50	1/2	DStlS38-1(16)	17.9	0.0	0.0	OK
CPL3c	A572 Gr.50	1/2	DStlS42-1(8)	45.0	0.0	3.2	OK
CPL4a	A572 Gr.50	3/4	DStlS14(1)	30.6	0.0	3.1	OK
CPL4b	A572 Gr.50	1/2	DStlS14(1)	45.0	0.0	0.0	OK
CPL4c	A572 Gr.50	1/2	DStlS14(1)	45.1	0.4	4.1	OK
CPL5a	A572 Gr.50	3/4	DStlS37-1(7)	25.7	0.0	2.8	OK
CPL5b	A572 Gr.50	1/2	DStlS37-1(7)	44.7	0.0	0.0	OK
CPL5c	A572 Gr.50	1/2	DStlS37-1(7)	45.1	0.3	4.7	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for CPL4c

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y = 50.0$ ksi – characteristic yield strength

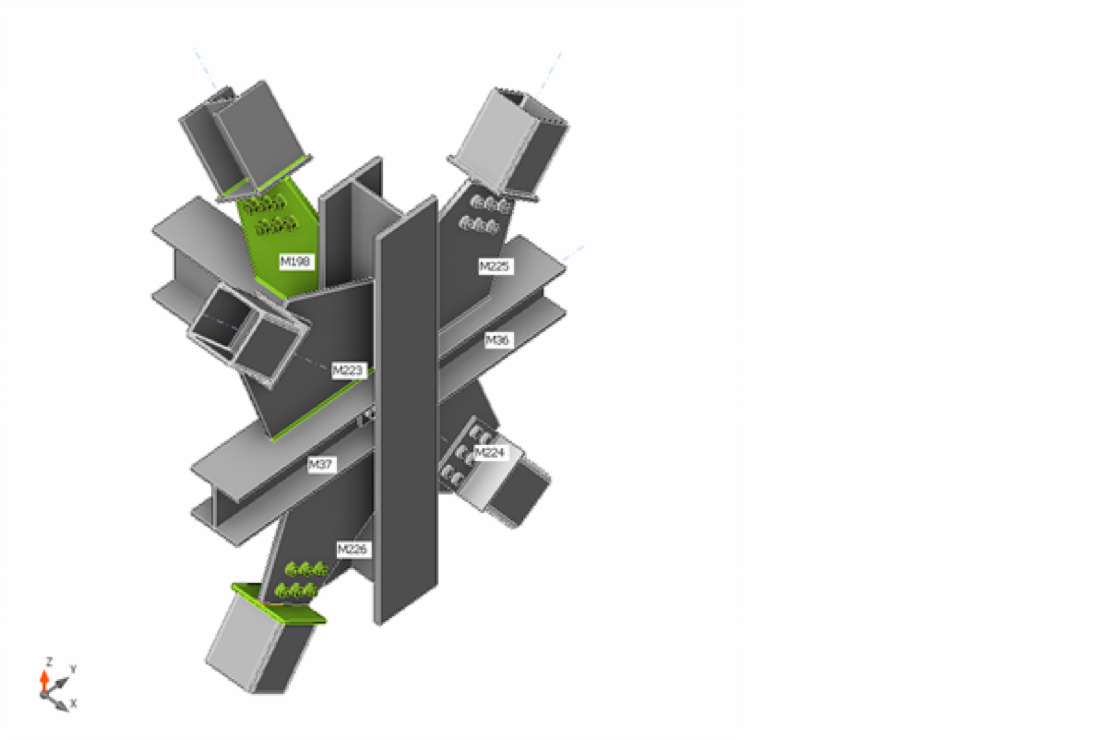
$\phi = 0.90$ – resistance factor for steel material AISC 360-16 – B3.1

Loc. deformation

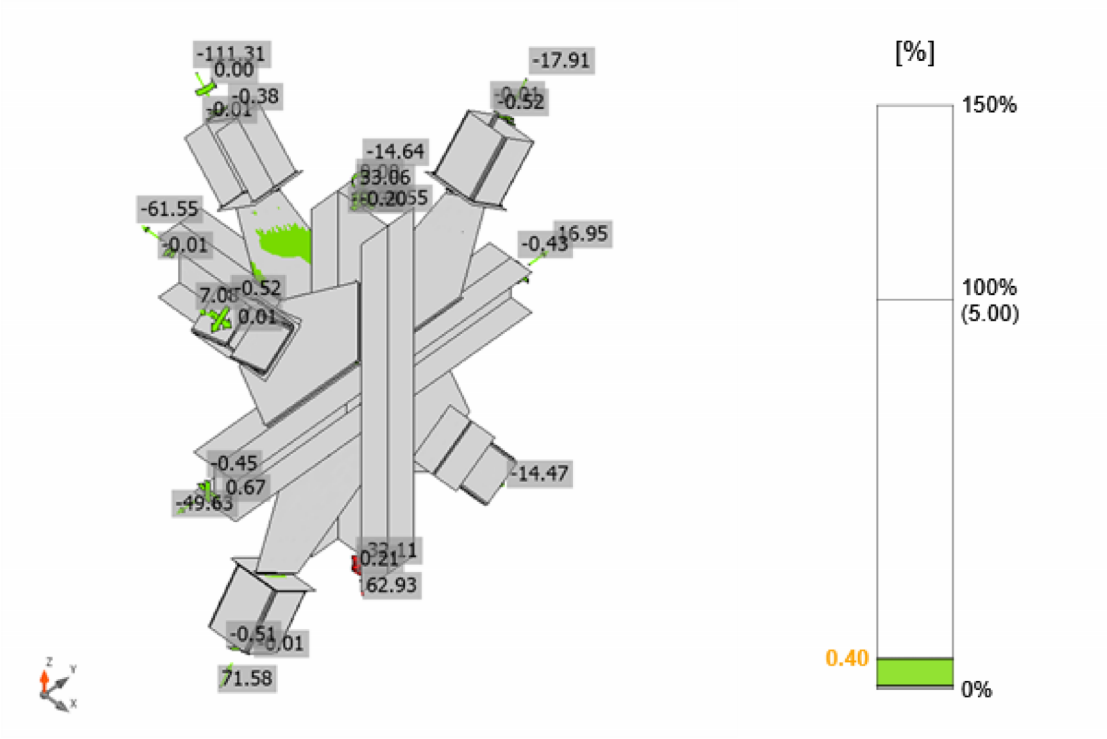
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M226	7.99	DStlS3(20)	0.00	0.24	0.0	OK
M223	7.99	DStlS3(20)	0.00	0.24	0.0	OK
M224	7.99	DStlS3(20)	0.00	0.24	0.0	OK
M225	7.99	DStlS3(20)	0.00	0.24	0.0	OK

Symbol explanation

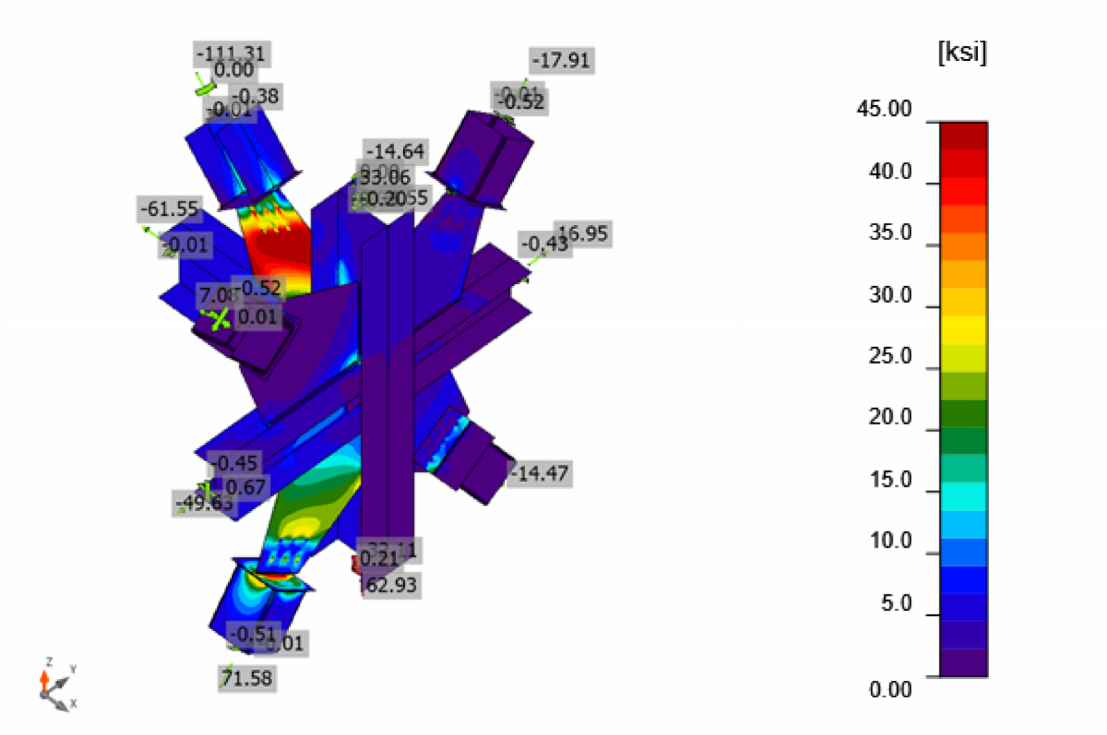
d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation



Overall check, DStlS14(1)

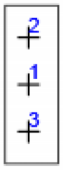
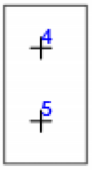
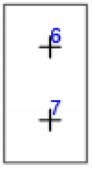
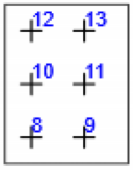
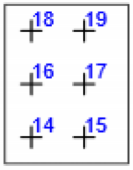
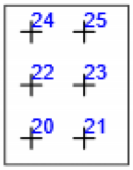
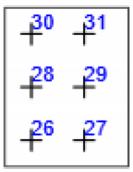


Strain check, DStlS14(1)

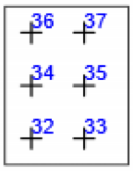


Equivalent stress, DStlS14(1)

Bolts

Shape	Item	Grade	Loads	F_t [kip]	V [kip]	$\phi R_{n,bearing}$ [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	B1	3/4 A325 - 1	DStlS22(12)	1.46	5.36	29.40	4.9	30.0	0.0	OK	OK
	B2	3/4 A325 - 1	DStlS22(12)	0.64	4.04	29.40	2.1	22.6	0.0	OK	OK
	B3	3/4 A325 - 1	DStlS22(12)	1.15	7.00	27.23	3.9	39.2	0.0	OK	OK
	B4	3/4 A325 - 1	DStlS38-1(16)	0.02	0.80	31.59	0.1	4.5	0.0	OK	OK
	B5	3/4 A325 - 1	DStlS38-1(16)	0.07	0.90	31.59	0.2	5.0	0.0	OK	OK
	B6	3/4 A325 - 1	DStlS37-1(7)	0.93	1.08	31.59	3.1	6.0	0.0	OK	OK
	B7	3/4 A325 - 1	DStlS37-1(7)	0.52	1.06	31.59	1.8	5.9	0.0	OK	OK
	B8	7/8 A325 - 2	DStlS20(14)	3.46	23.41	51.20	8.5	96.2	0.0	OK	OK
	B9	7/8 A325 - 2	DStlS20(14)	7.30	21.42	51.20	18.0	88.0	0.0	OK	OK
	B10	7/8 A325 - 2	DStlS20(14)	3.31	23.34	51.20	8.2	95.9	0.0	OK	OK
	B11	7/8 A325 - 2	DStlS20(14)	1.58	21.68	51.20	3.9	89.1	0.0	OK	OK
	B12	7/8 A325 - 2	DStlS20(14)	3.50	24.31	51.20	8.6	99.9	0.0	OK	OK
	B13	7/8 A325 - 2	DStlS20(14)	7.12	22.41	51.20	17.6	92.1	0.0	OK	OK
	B14	3/4 A325 - 1	DStlS37-1(7)	0.59	6.35	43.88	2.0	35.5	0.0	OK	OK
	B15	3/4 A325 - 1	DStlS37-1(7)	2.61	6.46	43.88	8.7	36.1	0.0	OK	OK
	B16	3/4 A325 - 1	DStlS37-1(7)	0.41	6.24	43.88	1.4	34.9	0.0	OK	OK
	B17	3/4 A325 - 1	DStlS37-1(7)	2.15	6.21	43.88	7.2	34.8	0.0	OK	OK
	B18	3/4 A325 - 1	DStlS37-1(7)	0.57	6.42	43.88	1.9	35.9	0.0	OK	OK
	B19	3/4 A325 - 1	DStlS37-1(7)	2.57	6.52	43.88	8.6	36.5	0.0	OK	OK
	B20	3/4 A325 - 1	DStlS38-1(16)	0.54	6.39	43.88	1.8	35.8	0.0	OK	OK
	B21	3/4 A325 - 1	DStlS38-1(16)	2.55	6.55	43.88	8.6	36.6	0.0	OK	OK
	B22	3/4 A325 - 1	DStlS38-1(16)	0.40	6.23	43.88	1.3	34.8	0.0	OK	OK
	B23	3/4 A325 - 1	DStlS38-1(16)	2.32	6.24	43.88	7.8	34.9	0.0	OK	OK
	B24	3/4 A325 - 1	DStlS38-1(16)	0.58	6.36	43.88	1.9	35.6	0.0	OK	OK
	B25	3/4 A325 - 1	DStlS38-1(16)	2.79	6.48	43.88	9.4	36.2	0.0	OK	OK
	B26	3/4 A325 - 1	DStlS14(1)	1.24	12.19	43.88	4.2	68.2	0.0	OK	OK
	B27	3/4 A325 - 1	DStlS14(1)	3.75	12.14	43.88	12.6	67.9	0.0	OK	OK
	B28	3/4 A325 - 1	DStlS14(1)	0.88	11.81	43.88	3.0	66.0	0.0	OK	OK
	B29	3/4 A325 - 1	DStlS14(1)	4.81	11.60	43.88	16.1	64.9	0.0	OK	OK
	B30	3/4 A325 - 1	DStlS14(1)	1.14	11.92	43.88	3.8	66.7	0.0	OK	OK
	B31	3/4 A325 - 1	DStlS14(1)	3.41	11.96	43.88	11.5	66.9	0.0	OK	OK

Project: Creech AOF Brace Connection(Model 2)
Project no: 203434
Author: Allison Valencia

Shape	Item	Grade	Loads	F_t [kip]	V [kip]	$\phi R_{n,bearing}$ [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	B32	3/4 A325 - 1	DStlS37-1(7)	1.07	11.41	43.88	3.6	63.8	0.0	OK	OK
	B33	3/4 A325 - 1	DStlS37-1(7)	3.61	11.47	43.88	12.1	64.1	0.0	OK	OK
	B34	3/4 A325 - 1	DStlS37-1(7)	0.76	10.86	43.88	2.6	60.8	0.0	OK	OK
	B35	3/4 A325 - 1	DStlS37-1(7)	4.75	10.73	43.88	16.0	60.0	0.0	OK	OK
	B36	3/4 A325 - 1	DStlS37-1(7)	1.04	10.77	43.88	3.5	60.3	0.0	OK	OK
	B37	3/4 A325 - 1	DStlS37-1(7)	3.41	10.86	43.88	11.5	60.8	0.0	OK	OK

Design data

Grade	$\phi R_{n,tension}$ [kip]	$\phi R_{n,shear}$ [kip]
3/4 A325 - 1	29.79	17.88
7/8 A325 - 2	40.55	24.33

Symbol explanation

F_t	Tension force
V	Resultant of bolt shear forces Vy and Vz in shear planes
$\phi R_{n,bearing}$	Bolt bearing resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
$\phi R_{n,tension}$	Bolt tension resistance - AISC 360-16 – J3.6
$\phi R_{n,shear}$	Bolt shear resistance - AISC 360-16 – J3.6

Detailed result for B12

Tension resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 40.55 \quad \text{kip} \quad \geq \quad F_t = \quad 3.50 \quad \text{kip}$$

Where:

$F_{nt} = 89.9$ ksi – nominal tensile stress AISC 360-16 – Table J3.2

$A_b = 0.60$ in^2 – gross bolt cross-sectional area

$\phi = 0.75$ – resistance factor

Shear resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 24.33 \quad \text{kip} \quad \geq \quad V = \quad 24.31 \quad \text{kip}$$

Where:

$F_{nv} = 54.0$ ksi – nominal shear stress AISC 360-16 – Table J3.2

$A_b = 0.60$ in^2 – gross bolt cross-sectional area

$\phi = 0.75$ – resistance factor

Bearing resistance check (AISC 360-16 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = \quad 51.20 \quad \text{kip} \quad \geq \quad V = \quad 24.31 \quad \text{kip}$$

Where:

$l_c = 2.06$ in	– clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material
$t = 0.50$ in	– thickness of the plate
$d = 0.88$ in	– diameter of a bolt
$F_u = 65.0$ ksi	– specified minimum tensile strength of the connected material
$\phi = 0.75$	– resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-16 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
M15-bfl 1	FP1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	10.06	0.50	DStlS22(12)	2.18	4.01	54.4	29.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	10.06	0.50	DStlS14(1)	1.42	3.30	43.0	25.7	OK	OK
M15-w 1	FP2	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.46	0.32	DStlS22(12)	0.72	2.20	32.7	16.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.46	0.32	DStlS22(12)	0.64	2.04	31.2	13.0	OK	OK
M15-w 1	FP3	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.46	0.32	DStlS22(12)	0.71	2.28	31.0	15.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.46	0.32	DStlS22(12)	0.74	2.17	34.2	14.4	OK	OK
M45-tfl 1	CPL1a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.60	0.97	DStlS20(14)	7.46	8.62	86.6	86.4	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.60	0.97	DStlS22(12)	5.94	7.76	76.5	59.8	OK	OK
M15-bfl 1	CPL1a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.47	0.85	DStlS20(14)	6.90	7.54	91.5	89.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.43	0.85	DStlS20(14)	4.22	5.45	77.5	63.9	OK	OK
CPL1b	CPL1c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.92	0.45	DStlS20(14)	3.71	3.94	94.2	94.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.92	0.45	DStlS20(14)	3.80	3.94	96.2	95.6	OK	OK
CPL1b	M198-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.15	0.48	DStlS20(14)	3.19	4.25	75.2	48.9	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.15	0.48	DStlS20(14)	2.09	3.98	52.5	30.3	OK	OK
CPL1b	M198-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.15	0.48	DStlS20(14)	2.26	3.97	57.0	33.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.15	0.48	DStlS20(14)	3.20	4.25	75.3	49.8	OK	OK
CPL1b	M198-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.88	0.49	DStlS20(14)	3.37	4.36	77.4	57.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.88	0.49	DStlS20(14)	3.38	4.36	77.6	58.7	OK	OK
M15-w 1	CPL2a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.97	0.88	DStlS22(12)	3.98	7.59	52.5	27.8	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.97	0.88	DStlS37-1(7)	2.06	5.44	37.9	18.9	OK	OK
M37-tfl 1	CPL2a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.57	0.68	DStlS14(1)	4.26	5.68	75.1	49.8	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.57	0.68	DStlS14(1)	1.47	4.74	31.1	12.1	OK	OK
CPL2b	CPL2c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.92	0.45	DStlS37-1(7)	1.94	3.92	49.5	29.8	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.96	0.45	DStlS37-1(7)	3.02	3.96	76.1	60.1	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
M15-w 1	CPL3a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.97	0.88	DStlS11(10)	4.88	7.76	62.9	33.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.97	0.88	DStlS38-1(16)	2.36	5.59	42.3	20.6	OK	OK
M36-tfl 1	CPL3a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.57	0.68	DStlS11(10)	3.29	4.36	75.3	51.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.57	0.68	DStlS11(10)	2.32	5.87	39.5	21.0	OK	OK
CPL3b	CPL3c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.92	0.45	DStlS38-1(16)	1.97	3.93	50.1	30.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.96	0.45	DStlS38-1(16)	3.03	3.96	76.5	61.2	OK	OK
M15-w 1	CPL4a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	13.97	0.87	DStlS14(1)	5.60	7.65	73.2	50.1	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	13.97	0.87	DStlS38-1(16)	3.26	5.58	58.3	31.9	OK	OK
M37-bfl 1	CPL4a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.58	0.69	DStlS11(10)	3.33	4.43	75.2	51.6	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.58	0.69	DStlS14(1)	2.53	5.71	44.4	27.8	OK	OK
CPL4b	CPL4c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.92	0.45	DStlS14(1)	3.15	3.91	80.6	74.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.92	0.45	DStlS14(1)	3.84	3.95	97.3	96.8	OK	OK
M15-w 1	CPL5a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	13.97	0.87	DStlS37-1(7)	4.51	7.61	59.3	39.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	13.97	0.87	DStlS37-1(7)	3.30	5.67	58.2	32.0	OK	OK
M36-bfl 1	CPL5a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.58	0.69	DStlS37-1(7)	4.12	5.48	75.2	52.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.54	0.69	DStlS37-1(7)	1.79	4.37	40.9	24.0	OK	OK
CPL5b	CPL5c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.92	0.45	DStlS37-1(7)	3.06	3.90	78.5	67.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.96	0.45	DStlS37-1(7)	3.69	3.97	93.1	92.3	OK	OK
CPL2b	M223	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	28.93	0.44	DStlS37-1(7)	2.51	3.84	65.2	39.7	OK	OK
CPL3b	M225	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	28.93	0.44	DStlS38-1(16)	2.51	3.84	65.2	39.9	OK	OK
CPL4b	M226	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	28.93	0.44	DStlS14(1)	3.03	3.86	78.6	57.7	OK	OK
CPL5b	M224	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	28.93	0.44	DStlS37-1(7)	2.99	3.85	77.6	54.8	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	28.93	0.44	DStlS37-1(7)	2.11	3.86	54.7	32.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	28.93	0.44	DStlS38-1(16)	2.11	3.86	54.8	32.8	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	28.93	0.44	DStlS14(1)	2.91	3.86	75.5	51.6	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	28.93	0.44	DStlS37-1(7)	2.90	3.86	75.2	50.2	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Detailed result for CPL4b / CPL4c

Weld resistance check (AISC 360-16 – J2-4)

$$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} = \quad 3.95 \quad \text{kip} \quad \geq \quad F_n = \quad 3.84 \quad \text{kip}$$

Where:

$F_{nw} = 63.0$ ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 86.8° – angle of loading measured from the weld longitudinal axis

$A_{we} = 0.08$ in^2 – effective area of weld critical element

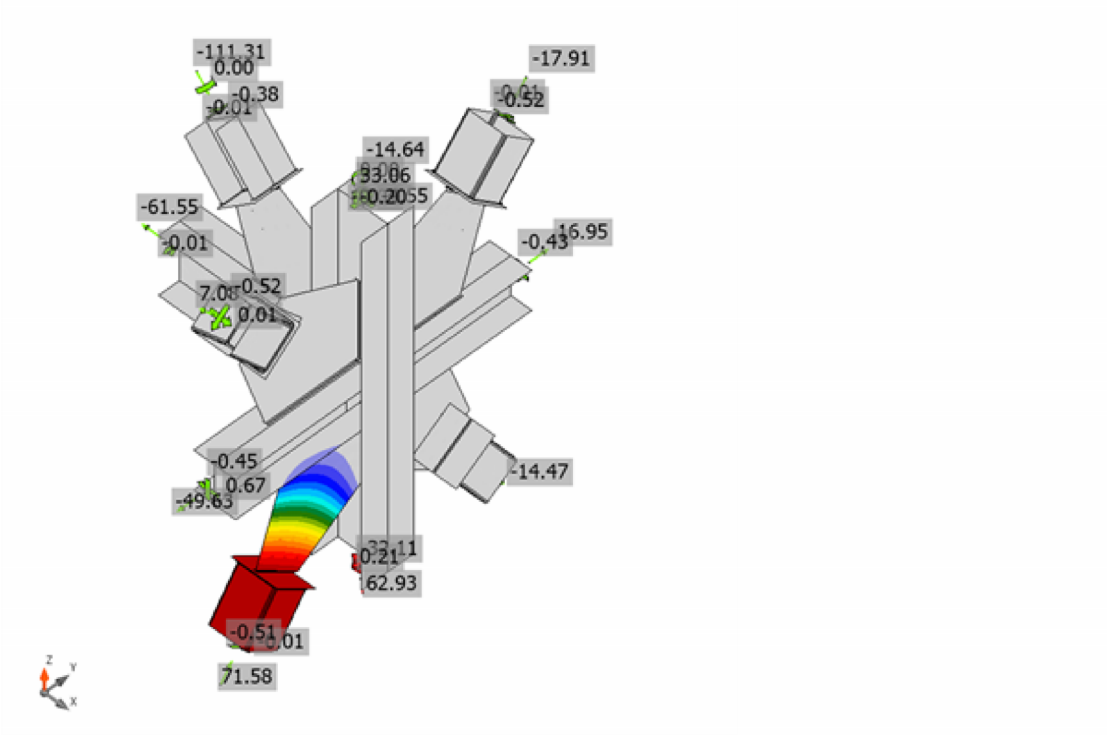
$\phi = 0.75$ – resistance factor for welded connections

Buckling

Loads	Shape	Factor [-]
DStlS14(1)	1	4.53
	2	16.10
	3	17.72
	4	19.27
	5	21.50
	6	25.42
DStlS29(2)	1	6.05
	2	23.51
	3	24.00
	4	46.56
	5	47.89
	6	58.89
DStlS35-1(3)	1	14.01
	2	14.43
	3	21.27
	4	28.04
	5	33.34
	6	42.09
DStlS41-1(5)	1	5.68
	2	9.51
	3	22.37
	4	36.26
	5	38.65
	6	43.63
DStlS1(6)	1	13.55
	2	13.96
	3	20.27
	4	26.70
	5	31.72
	6	41.13
DStlS11(10)	1	16.99
	2	17.49
	3	25.44
	4	33.27
	5	39.01
	6	61.05
DStlS28(11)	1	15.68
	2	16.16
	3	22.96
	4	30.57
	5	36.29
	6	37.42

Loads	Shape	Factor [-]
DStlS37-1(7)	1	4.91
	2	9.09
	3	19.31
	4	21.53
	5	28.45
	6	33.74
DStlS42-1(8)	1	5.68
	2	9.51
	3	22.34
	4	36.75
	5	38.71
	6	43.63
DStlS22(12)	1	5.77
	2	13.34
	3	17.88
	4	20.82
	5	22.55
	6	24.64
DStlS20(14)	1	9.13
	2	9.40
	3	13.30
	4	17.84
	5	20.76
	6	25.17
DStlS27(15)	1	32.08
	2	33.05
	3	48.86
	4	62.79
	5	74.94
	6	118.16
DStlS12(13)	1	10.93
	2	11.26
	3	16.00
	4	21.38
	5	25.26
	6	27.51
DStlS38-1(16)	1	4.90
	2	9.08
	3	19.27
	4	21.81
	5	32.34
	6	36.81
DStlS30(17)	1	5.17
	2	20.22

Loads	Shape	Factor [-]
	3	21.19
	4	23.16
	5	30.77
	6	36.35
DStlS13(18)	1	5.19
	2	20.38
	3	21.42
	4	25.17
	5	32.93
	6	38.58
DStlS21(19)	1	6.28
	2	15.69
	3	20.89
	4	24.18
	5	24.66
	6	29.49
DStlS3(20)	1	21.29
	2	21.93
	3	32.31
	4	41.81
	5	49.77
	6	77.75



First buckling mode shape, DStlS14(1)

Project item 116

Design

Name	116
Description	
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC - LRFD (2016)

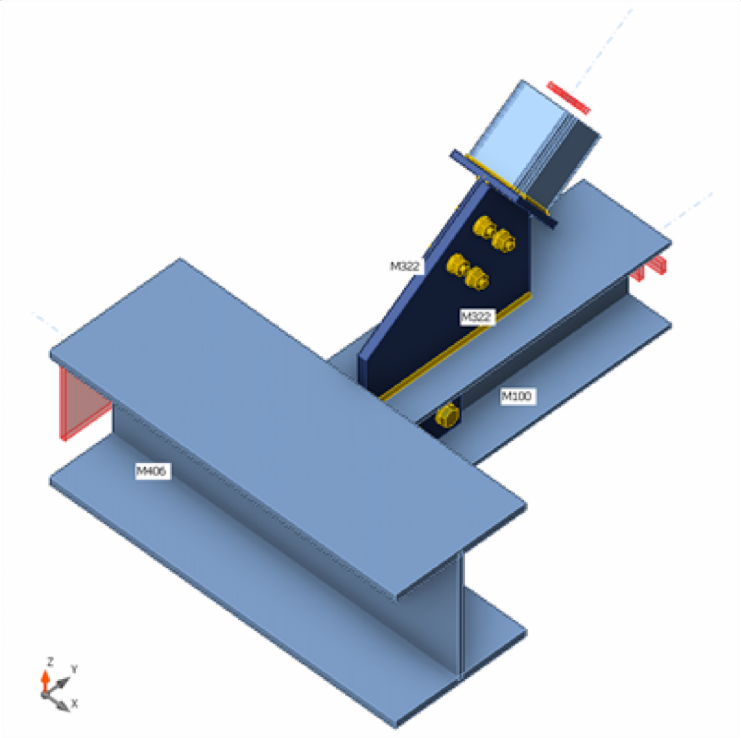
Members

Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M406	75 - W12X72	0.0	0.0	0.0	0.00	0.00	0.00
M100	17 - W8X31	90.0	0.0	0.0	0.00	0.00	0.00
M322	1807 - HSS5X5X1/2(HSS5X5X1/2(HSS5X5X1/2(HSS(Imp)5X5X1/2)))	90.0	35.1	0.0	0.00	0.00	0.00

Supports and forces

Name	Support	Forces in	X [in]
M406 / begin	N-Vy-Vz-Mx-My-Mz	Position	0.00
M406 / end		Position	0.00
M100 / end	Mx-My-Mz	Bolts	10.50
M322 / end	Mx-My-Mz	Position	20.00



Cross-sections

Name	Material
75 - W12X72	A992
17 - W8X31	A992
1807 - HSS5X5X1/2(HSS5X5X1/2(HSS5X5X1/2(HSS(Imp)5X5X1/2)))	A992

Bolts

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
3/4 A325	0.75	92.0	120.0	0.44
5/8 A325	0.63	92.0	120.0	0.31

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS27(1)	M406 / Begin	-22.56	-6.98	1.69	-0.01	7.97	29.01
	M406 / End	22.38	-2.44	0.36	0.00	-7.76	-26.55
	M100 / End	11.99	-0.18	-0.14	0.00	-0.01	-2.32
	M322 / End	-3.20	0.00	-0.09	0.00	0.00	0.00
DStlS20(2)	M406 / Begin	-138.58	8.22	6.40	-0.19	28.66	-34.11
	M406 / End	138.77	2.86	2.22	-0.05	-29.00	31.23
	M100 / End	0.96	0.20	-0.05	0.00	-0.25	2.64
	M322 / End	-14.78	-0.01	-0.10	0.00	0.00	0.00
DStlS12(3)	M406 / Begin	-124.96	11.39	5.35	-0.16	24.09	-47.29
	M406 / End	125.24	3.97	1.80	-0.04	-24.51	43.29
	M100 / End	-5.48	0.29	-0.10	0.00	-0.20	3.70
	M322 / End	-12.14	-0.01	-0.10	0.00	0.00	0.00
DStlS29(4)	M406 / Begin	-55.31	8.41	2.42	-0.06	11.09	-34.91
	M406 / End	55.51	2.93	0.68	-0.02	-11.38	31.97
	M100 / End	-7.23	0.21	-0.12	0.00	-0.08	2.74
	M322 / End	-5.08	-0.01	-0.08	0.00	0.00	0.00
DStlS14(5)	M406 / Begin	-92.21	-3.99	4.62	-0.11	20.97	16.63
	M406 / End	92.10	-1.41	1.47	-0.02	-20.89	-15.23
	M100 / End	13.73	-0.11	-0.11	0.00	-0.13	-1.35
	M322 / End	-10.26	-0.01	-0.11	0.00	0.00	0.00
DStlS37-1(8)	M406 / Begin	-80.85	2.21	3.77	-0.06	17.28	-9.15
	M406 / End	80.89	0.76	1.09	-0.01	-17.40	8.34
	M100 / End	3.46	0.05	-0.20	0.00	-0.08	0.73
	M322 / End	-7.94	-0.01	-0.12	0.00	0.00	0.00
DStlS1(13)	M406 / Begin	-88.97	2.59	4.22	-0.09	19.31	-10.74
	M406 / End	89.03	0.90	1.24	-0.02	-19.44	9.83
	M100 / End	3.83	0.06	-0.18	0.00	-0.12	0.82
	M322 / End	-9.03	-0.01	-0.13	0.00	0.00	0.00

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS27(1)	0.00	0.00	0.00	-0.27	0.21	-0.01
DStlS20(2)	0.00	0.00	0.00	-0.21	-0.32	-0.08
DStlS12(3)	0.00	0.00	0.00	-0.25	-0.41	-0.07
DStlS29(4)	0.00	0.00	0.00	-0.24	-0.28	-0.02
DStlS14(5)	0.00	0.00	0.00	-0.28	0.08	-0.05
DStlS37-1(8)	0.00	0.00	0.00	-0.37	-0.11	-0.04
DStlS1(13)	0.00	0.00	0.00	-0.37	-0.12	-0.05

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Bolts	39.6 < 100%	OK
Welds	73.1 < 100%	OK
Buckling	30.08	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M406-bfl 1	A992	11/16	DStlS12(3)	24.9	0.0	0.0	OK
M406-tfl 1	A992	11/16	DStlS12(3)	16.8	0.0	0.0	OK
M406-w 1	A992	7/16	DStlS20(2)	11.3	0.0	0.0	OK
M100-bfl 1	A992	7/16	DStlS27(1)	3.3	0.0	0.0	OK
M100-tfl 1	A992	7/16	DStlS20(2)	8.6	0.0	0.0	OK
M100-w 1	A992	5/16	DStlS20(2)	34.3	0.0	3.6	OK
M322	A992	1/2	DStlS20(2)	8.1	0.0	0.0	OK
FP1	A572 Gr.50	3/4	DStlS12(3)	13.9	0.0	3.5	OK
CPL1a	A572 Gr.50	3/4	DStlS20(2)	10.9	0.0	0.8	OK
CPL1b	A572 Gr.50	1/2	DStlS20(2)	7.6	0.0	0.0	OK
CPL1c	A572 Gr.50	1/2	DStlS20(2)	22.5	0.0	1.4	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for M406-bfl 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y = 50.0$ ksi – characteristic yield strength

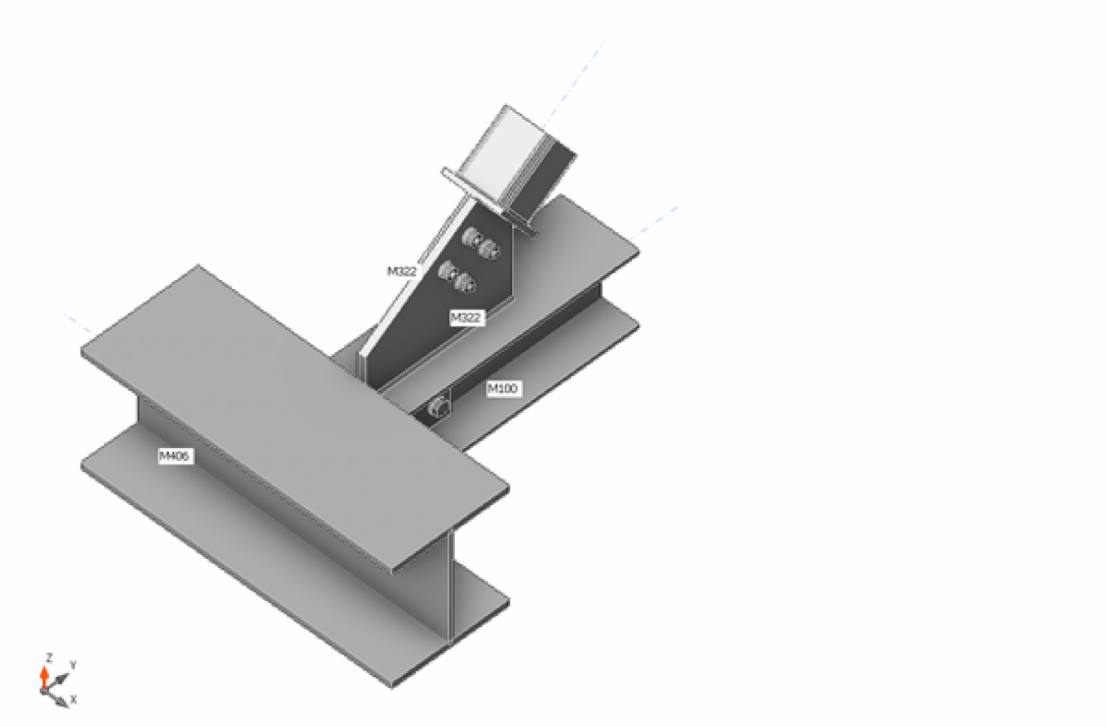
$\phi = 0.90$ – resistance factor for steel material AISC 360-16 – B3.1

Loc. deformation

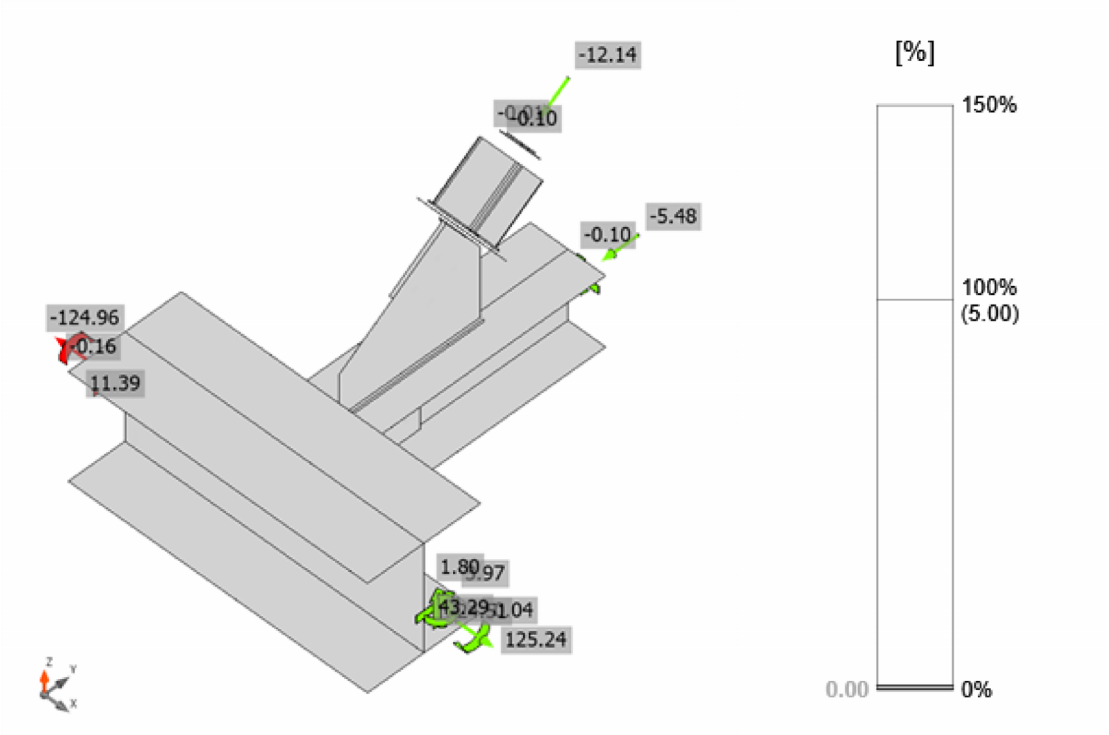
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M322	5.00	DStlS1(13)	0.00	0.15	0.0	OK

Symbol explanation

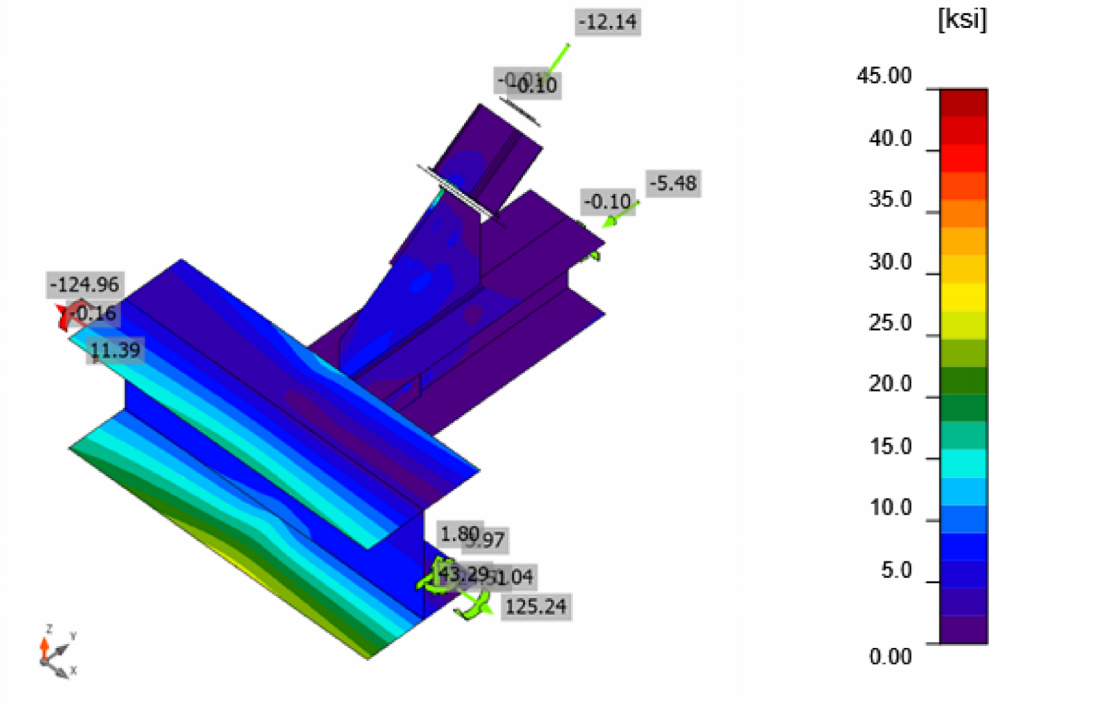
d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation



Overall check, DStlS12(3)



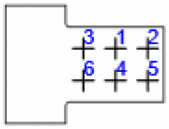
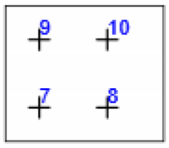
Strain check, DStlS12(3)



Equivalent stress, DStlS12(3)

Project:	**Creech AOF Brace Connection(Model 2)**
Project no:	**203434**
Author:	**Allison Valencia**

Bolts

Shape	Item	Grade	Loads	F_t [kip]	V [kip]	$\phi R_{n,bearing}$ [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	B1	3/4 A325 - 1	DStlS12(3)	1.21	4.55	25.01	4.1	25.4	0.0	OK	OK
	B2	3/4 A325 - 1	DStlS12(3)	1.04	4.94	25.01	3.5	27.7	0.0	OK	OK
	B3	3/4 A325 - 1	DStlS20(2)	2.51	7.08	25.01	8.4	39.6	0.0	OK	OK
	B4	3/4 A325 - 1	DStlS14(5)	0.49	2.62	25.01	1.7	14.7	0.0	OK	OK
	B5	3/4 A325 - 1	DStlS14(5)	0.74	3.14	25.01	2.5	17.6	0.0	OK	OK
	B6	3/4 A325 - 1	DStlS20(2)	0.84	5.66	25.01	2.8	31.7	0.0	OK	OK
	B7	5/8 A325 - 2	DStlS20(2)	0.28	3.42	36.57	1.4	27.5	0.0	OK	OK
	B8	5/8 A325 - 2	DStlS20(2)	1.06	3.43	36.57	5.1	27.6	0.0	OK	OK
	B9	5/8 A325 - 2	DStlS20(2)	0.33	3.98	36.57	1.6	32.1	0.0	OK	OK
	B10	5/8 A325 - 2	DStlS20(2)	1.08	3.97	36.57	5.2	32.0	0.0	OK	OK

Design data

Grade	$\phi R_{n,tension}$ [kip]	$\phi R_{n,shear}$ [kip]
3/4 A325 - 1	29.79	17.88
5/8 A325 - 2	20.69	12.41

Symbol explanation

F_t	Tension force
V	Resultant of bolt shear forces Vy and Vz in shear planes
$\phi R_{n,bearing}$	Bolt bearing resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
$\phi R_{n,tension}$	Bolt tension resistance - AISC 360-16 – J3.6
$\phi R_{n,shear}$	Bolt shear resistance - AISC 360-16 – J3.6

Detailed result for B3

Tension resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 29.79 \quad \text{kip} \quad \geq \quad F_t = \quad 2.51 \quad \text{kip}$$

Where:

$F_{nt} = 89.9$ ksi – nominal tensile stress AISC 360-16 – Table J3.2

$A_b = 0.44$ in^2 – gross bolt cross-sectional area

$\phi = 0.75$ – resistance factor

Shear resistance check (AISC 360-16 – J3-1)

$\phi R_n = \phi \cdot F_{nv} \cdot A_b =$ 17.88 kip ≥ $V =$ 7.08 kip

Where:

$F_{nv} =$ 54.0 ksi – nominal shear stress AISC 360-16 – Table J3.2

$A_b =$ 0.44 in^2 – gross bolt cross-sectional area

$\phi =$ 0.75 – resistance factor

Bearing resistance check (AISC 360-16 – J3-6)

$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$

$\phi R_n =$ 25.01 kip ≥ $V =$ 7.08 kip

Where:

$l_c =$ 2.40 in – clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material

$t =$ 0.28 in – thickness of the plate

$d =$ 0.75 in – diameter of a bolt

$F_u =$ 65.0 ksi – specified minimum tensile strength of the connected material

$\phi =$ 0.75 – resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-16 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
M406-w 1	FP1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	10.97	0.73	DStlS12(3)	0.77	4.63	16.7	5.8	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	10.97	0.73	DStlS12(3)	0.91	4.65	19.5	7.9	OK	OK
M100-tfl 1	CPL1a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.91	0.65	DStlS20(2)	1.42	4.46	31.8	18.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.95	0.65	DStlS20(2)	0.86	5.64	15.3	6.7	OK	OK
CPL1b	CPL1c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.93	0.31	DStlS20(2)	0.59	2.76	21.4	10.1	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.93	0.31	DStlS20(2)	1.06	2.76	38.4	23.1	OK	OK
M406-bfl 1	FP1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.62	0.70	DStlS12(3)	1.06	4.18	25.3	12.1	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.62	0.70	DStlS12(3)	1.01	4.33	23.3	10.8	OK	OK
M406-tfl 1	FP1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.62	0.70	DStlS12(3)	0.45	4.20	10.8	0.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.62	0.70	DStlS12(3)	0.54	3.99	13.7	5.6	OK	OK
CPL1b	M322	E70xx	◢ 3/16	◢ 1/4	17.04	0.32	DStlS20(2)	1.40	1.91	73.1	46.3	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Detailed result for CPL1b / M322

Weld resistance check (AISC 360-16 – J2-4)

$$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} = \quad 1.91 \quad \text{kip} \quad \geq \quad F_n = \quad 1.40 \quad \text{kip}$$

Where:

$F_{nw} = 42.0$ ksi – nominal stress of weld material:

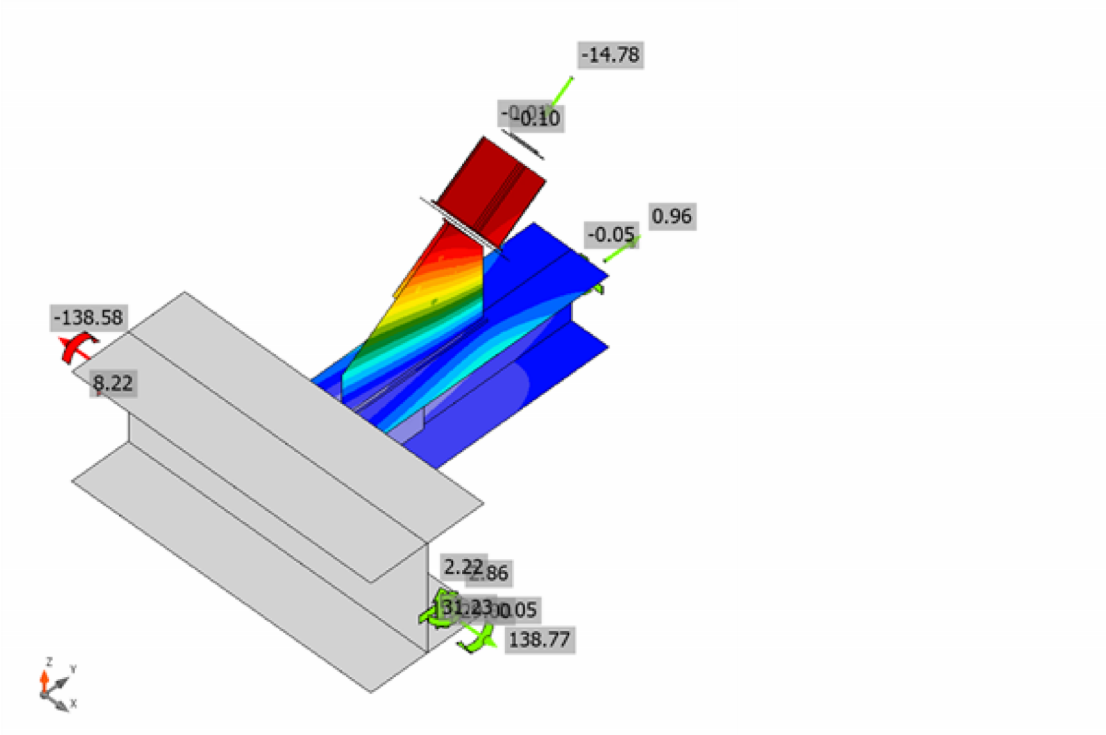
- $F_{nw} = 0.6 \cdot F_{EXX}$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - Directional strength increase is not used for HSS welds

$A_{we} = 0.06$ in^2 – effective area of weld critical element

$\phi = 0.75$ – resistance factor for welded connections

Buckling

Loads	Shape	Factor [-]
DStlS27(1)	1	46.55
	2	49.55
	3	65.34
	4	68.32
	5	71.24
	6	71.56
DStlS20(2)	1	30.08
	2	57.83
	3	75.13
	4	89.39
	5	100.46
	6	108.07
DStlS12(3)	1	36.12
	2	50.21
	3	53.34
	4	56.23
	5	61.52
	6	67.46
DStlS29(4)	1	57.62
	2	59.72
	3	66.27
	4	71.14
	5	74.03
	6	74.35
DStlS14(5)	1	45.05
	2	101.27
	3	114.19
	4	121.29
	5	181.59
	6	197.98
DStlS37-1(8)	1	56.42
	2	126.83
	3	200.52
	4	261.46
	5	327.67
	6	343.55
DStlS1(13)	1	49.60
	2	111.51
	3	175.69
	4	229.81
	5	276.97
	6	298.50



First buckling mode shape, DStlS20(2)

Project item 117

Design

Name	117
Description	
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC - LRFD (2016)

Members

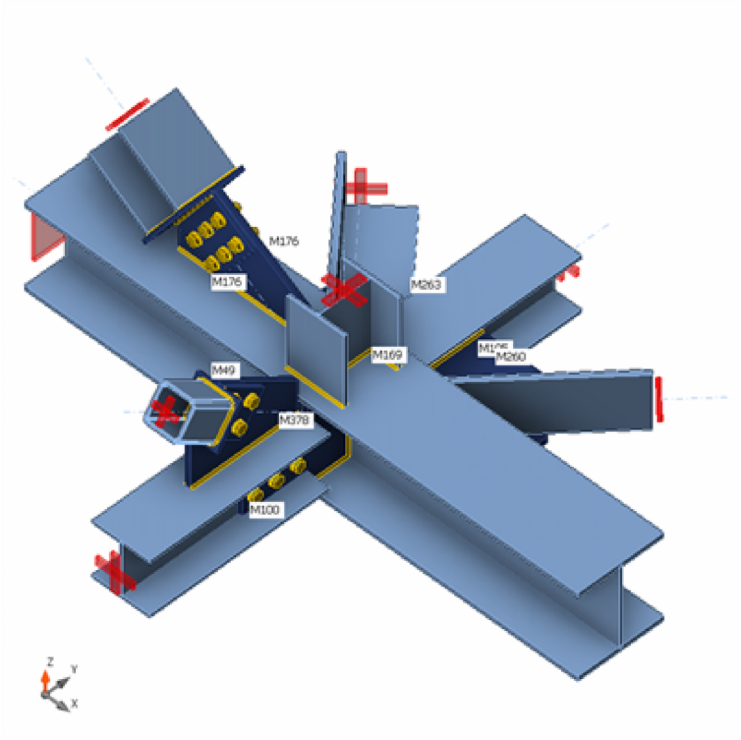
Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M49	75 - W12X72	0.0	0.0	0.0	0.00	0.00	0.00
M100	17 - W8X31	90.0	0.0	0.0	0.00	0.00	0.00
M105	17 - W8X31	90.0	0.0	0.0	0.00	0.00	0.00
M169	17 - W8X31	0.0	90.0	-90.0	0.00	0.00	0.00
M176	17 - W8X31	-180.0	33.5	0.0	0.00	0.00	0.00
M260	1831 - L8X8X3/4	48.0	0.0	0.0	0.00	0.00	0.00
M263	1831 - L8X8X3/4	-48.0	0.0	0.0	0.00	0.00	0.00
M378	1807 - HSS5X5X1/2(HSS5X5X1/2(HSS5X5X1/2(HSS(Imp)5X5X1/2)))	-90.0	35.1	0.0	0.00	0.00	0.00

Supports and forces

Name	Support	Forces in	X [in]
M49 / begin	N-Vy-Vz-Mx-My-Mz	Position	0.00
M49 / end		Position	0.00
M100 / begin	Mx-My-Mz	Bolts	10.51
M105 / end	Mx-My-Mz	Bolts	3.46
M169 / end	Mx-My-Mz	Connected member face	6.15
M176 / end	Mx-My-Mz	Position	21.00
M260 / end	Mx-My-Mz	Bolts	14.56
M263 / begin	Mx-My-Mz	Bolts	14.56
M378 / end	Mx-My-Mz	Position	19.00

Project:	**Creech AOF Brace Connection(Model 2)**
Project no:	**203434**
Author:	**Allison Valencia**



Cross-sections

Name	Material
75 - W12X72	A992
17 - W8X31	A992
1831 - L8X8X3/4	A992
1807 - HSS5X5X1/2(HSS5X5X1/2(HSS5X5X1/2(HSS(Imp)5X5X1/2)))	A992

Bolts

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
3/4 A325	0.75	92.0	120.0	0.44
7/8 A325	0.88	92.0	120.0	0.60

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS3(1)	M49 / Begin	-84.99	-0.04	-0.89	0.00	-0.61	0.56
	M49 / End	66.55	0.03	-0.75	0.00	0.55	0.52
	M100 / Begin	-12.81	0.17	-0.53	0.00	-3.31	-1.05
	M105 / End	-7.36	0.00	-0.68	0.00	3.32	0.01
	M169 / End	8.02	0.00	0.01	0.00	0.00	0.00
	M176 / End	-18.07	0.00	-0.31	0.00	0.00	0.00
	M260 / End	22.33	0.02	-0.52	0.00	0.00	0.00
	M263 / Begin	-16.76	0.03	-0.53	0.00	0.00	0.00
	M378 / End	10.81	-0.01	-0.11	0.00	0.00	0.00
DStlS12(2)	M49 / Begin	-177.59	0.07	-1.06	0.00	0.88	-0.82
	M49 / End	138.48	-0.03	-0.76	0.00	-0.95	-0.55
	M100 / Begin	5.48	-0.29	-0.61	0.00	-4.72	1.69
	M105 / End	-32.74	-0.02	-0.90	0.00	4.73	-0.26
	M169 / End	17.05	0.00	0.01	0.00	0.00	0.00
	M176 / End	-37.56	0.01	-0.31	0.00	0.00	0.00
	M260 / End	32.17	0.03	-0.56	0.00	0.00	0.00
	M263 / Begin	-20.78	0.05	-0.61	0.00	0.00	0.00
	M378 / End	14.83	0.02	-0.09	0.00	0.00	0.00
DStlS27(3)	M49 / Begin	-55.10	-0.04	-0.66	0.00	-0.61	0.59
	M49 / End	43.16	0.03	-0.56	0.00	0.57	0.52
	M100 / Begin	-11.99	0.18	-0.39	0.00	-2.37	-1.12
	M105 / End	-2.78	0.00	-0.49	0.00	2.38	0.04
	M169 / End	5.10	0.00	0.00	0.00	0.00	0.00
	M176 / End	-11.76	0.00	-0.23	0.00	0.00	0.00
	M260 / End	16.14	0.02	-0.39	0.00	0.00	0.00
	M263 / Begin	-12.48	0.02	-0.39	0.00	0.00	0.00
	M378 / End	7.90	-0.01	-0.08	0.00	0.00	0.00
DStlS29(8)	M49 / Begin	-69.31	0.04	-0.64	0.00	-0.25	-0.51
	M49 / End	59.24	-0.04	-0.54	0.00	0.23	-0.63
	M100 / Begin	7.23	-0.21	-0.40	0.00	-2.60	1.27
	M105 / End	-11.20	-0.01	-0.50	0.00	2.61	-0.12
	M169 / End	6.58	0.00	0.00	0.00	0.00	0.00
	M176 / End	-11.81	0.00	-0.23	0.00	0.00	0.00
	M260 / End	5.71	0.01	-0.38	0.00	0.00	0.00
	M263 / Begin	-5.54	0.02	-0.40	0.00	0.00	0.00
	M378 / End	5.34	0.01	-0.08	0.00	0.00	0.00
DStlS22(9)	M49 / Begin	-204.73	0.01	-1.17	0.01	1.03	0.00
	M49 / End	156.37	0.02	-0.80	0.01	-1.14	0.28
	M100 / Begin	-10.57	0.00	-0.65	0.00	-5.52	-0.04
	M105 / End	-30.76	-0.02	-1.05	0.00	5.54	-0.17
	M169 / End	18.24	0.00	0.02	0.00	0.00	0.00
	M176 / End	-45.38	0.01	-0.30	0.00	0.00	0.00

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
	M260 / End	47.29	0.04	-0.60	0.00	0.00	0.00
	M263 / Begin	-31.36	0.06	-0.65	0.00	0.00	0.00
	M378 / End	20.98	0.01	-0.09	0.00	0.00	0.00
DStlS20(4)	M49 / Begin	-211.84	0.05	-1.16	0.01	1.21	-0.55
	M49 / End	164.41	-0.01	-0.79	0.01	-1.31	-0.29
	M100 / Begin	-0.96	-0.20	-0.66	0.00	-5.63	1.16
	M105 / End	-34.97	-0.02	-1.05	0.00	5.65	-0.25
	M169 / End	18.98	0.00	0.02	0.00	0.00	0.00
	M176 / End	-45.40	0.01	-0.30	0.00	0.00	0.00
	M260 / End	42.07	0.04	-0.60	0.00	0.00	0.00
	M263 / Begin	-27.89	0.06	-0.65	0.00	0.00	0.00
	M378 / End	19.70	0.02	-0.09	0.00	0.00	0.00
DStlS1(13)	M49 / Begin	-139.51	0.02	-1.11	0.00	-0.01	-0.14
	M49 / End	109.15	0.00	-0.87	0.00	-0.06	-0.02
	M100 / Begin	-3.83	-0.06	-0.64	0.00	-4.38	0.34
	M105 / End	-21.35	-0.01	-0.88	0.00	4.40	-0.13
	M169 / End	13.62	0.00	0.01	0.00	0.00	0.00
	M176 / End	-29.42	0.01	-0.36	0.00	0.00	0.00
	M260 / End	28.85	0.03	-0.62	0.00	0.00	0.00
	M263 / Begin	-19.96	0.04	-0.65	0.00	0.00	0.00
	M378 / End	13.55	0.01	-0.12	0.00	0.00	0.00
DStlS13(18)	M49 / Begin	-122.63	0.05	-0.93	0.00	0.04	-0.57
	M49 / End	100.55	-0.04	-0.74	0.00	-0.09	-0.63
	M100 / Begin	5.64	-0.24	-0.57	0.00	-4.06	1.41
	M105 / End	-19.27	-0.01	-0.77	0.00	4.07	-0.17
	M169 / End	11.20	0.00	0.01	0.00	0.00	0.00
	M176 / End	-23.30	0.00	-0.31	0.00	0.00	0.00
	M260 / End	16.93	0.02	-0.54	0.00	0.00	0.00
	M263 / Begin	-13.13	0.03	-0.56	0.00	0.00	0.00
	M378 / End	10.64	0.02	-0.10	0.00	0.00	0.00
DStlS30(6)	M49 / Begin	-110.06	-0.02	-0.78	0.00	0.23	0.34
	M49 / End	81.09	0.04	-0.58	0.00	-0.30	0.60
	M100 / Begin	-12.15	0.13	-0.42	0.00	-3.03	-0.84
	M105 / End	-16.25	-0.01	-0.63	0.00	3.05	-0.05
	M169 / End	10.94	0.00	0.01	0.00	0.00	0.00
	M176 / End	-26.02	0.01	-0.23	0.00	0.00	0.00
	M260 / End	31.38	0.02	-0.41	0.00	0.00	0.00
	M263 / Begin	-20.13	0.03	-0.44	0.00	0.00	0.00
	M378 / End	12.09	0.00	-0.08	0.00	0.00	0.00
DStlS14(19)	M49 / Begin	-163.38	-0.01	-1.08	0.01	0.52	0.28
	M49 / End	122.40	0.04	-0.78	0.00	-0.62	0.59
	M100 / Begin	-13.73	0.11	-0.59	0.00	-4.49	-0.71
	M105 / End	-24.32	-0.01	-0.90	0.00	4.51	-0.10
	M169 / End	15.57	0.00	0.01	0.00	0.00	0.00

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
	M176 / End	-37.51	0.01	-0.31	0.00	0.00	0.00
	M260 / End	42.61	0.04	-0.56	0.00	0.00	0.00
	M263 / Begin	-27.72	0.05	-0.60	0.00	0.00	0.00
	M378 / End	17.39	0.00	-0.10	0.00	0.00	0.00
DStlS19(20)	M49 / Begin	-177.25	0.00	-1.10	0.01	0.61	0.13
	M49 / End	137.40	0.02	-0.80	0.00	-0.71	0.25
	M100 / Begin	-10.49	0.02	-0.63	0.00	-5.19	-0.18
	M105 / End	-24.03	-0.01	-0.98	0.00	5.21	-0.13
	M169 / End	15.32	0.00	0.01	0.00	0.00	0.00
	M176 / End	-38.25	0.01	-0.31	0.00	0.00	0.00
	M260 / End	39.67	0.04	-0.58	0.00	0.00	0.00
	M263 / Begin	-27.53	0.05	-0.62	0.00	0.00	0.00
	M378 / End	18.89	0.00	-0.10	0.00	0.00	0.00

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS3(1)	0.00	0.00	0.00	-0.52	-0.62	-0.12
DStlS12(2)	0.00	0.00	0.00	-0.65	-0.63	0.32
DStlS27(3)	0.00	0.00	0.00	-0.38	-0.46	-0.14
DStlS29(8)	0.00	0.00	0.00	-0.38	-0.43	0.21
DStlS22(9)	0.00	0.00	0.00	-0.72	-0.68	0.08
DStlS20(4)	0.00	0.00	0.00	-0.72	-0.66	0.26
DStlS1(13)	0.00	0.00	0.00	-0.65	-0.72	0.11
DStlS13(18)	0.00	0.00	0.00	-0.56	-0.60	0.25
DStlS30(6)	0.00	0.00	0.00	-0.46	-0.50	-0.07
DStlS14(19)	0.00	0.00	0.00	-0.65	-0.67	-0.03
DStlS19(20)	0.00	0.00	0.00	-0.67	-0.66	0.05

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Bolts	49.3 < 100%	OK
Welds	77.9 < 100%	OK
Buckling	28.17	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M49-bfl 1	A992	11/16	DStlS22(9)	13.7	0.0	0.0	OK
M49-tfl 1	A992	11/16	DStlS20(4)	14.8	0.0	0.0	OK
M49-w 1	A992	7/16	DStlS22(9)	34.4	0.0	0.0	OK
M100-bfl 1	A992	7/16	DStlS22(9)	6.0	0.0	0.0	OK
M100-tfl 1	A992	7/16	DStlS22(9)	10.4	0.0	0.0	OK
M100-w 1	A992	5/16	DStlS22(9)	36.0	0.0	3.4	OK
M105-bfl 1	A992	7/16	DStlS20(4)	5.6	0.0	0.0	OK
M105-tfl 1	A992	7/16	DStlS20(4)	3.8	0.0	0.0	OK
M105-w 1	A992	5/16	DStlS12(2)	13.2	0.0	0.3	OK
M169-bfl 1	A992	7/16	DStlS20(4)	11.9	0.0	0.0	OK
M169-tfl 1	A992	7/16	DStlS20(4)	15.0	0.0	0.0	OK
M169-w 1	A992	5/16	DStlS20(4)	20.4	0.0	0.0	OK
M176-bfl 1	A992	7/16	DStlS22(9)	11.1	0.0	0.0	OK
M176-tfl 1	A992	7/16	DStlS22(9)	11.9	0.0	0.0	OK
M176-w 1	A992	5/16	DStlS22(9)	14.5	0.0	0.0	OK
M260-bfl 1	A992	3/4	DStlS22(9)	24.7	0.0	3.0	OK
M260-w 1	A992	3/4	DStlS22(9)	7.1	0.0	0.0	OK
M263-bfl 1	A992	3/4	DStlS22(9)	15.7	0.0	2.0	OK
M263-w 1	A992	3/4	DStlS22(9)	5.2	0.0	0.0	OK
M378	A992	1/2	DStlS22(9)	14.6	0.0	0.0	OK
FP1	A572 Gr.50	5/8	DStlS22(9)	22.4	0.0	5.8	OK
FP2	A572 Gr.50	3/8	DStlS20(4)	8.9	0.0	1.2	OK
CPL1a	A572 Gr.50	3/4	DStlS20(4)	20.3	0.0	1.4	OK
CPL1b	A572 Gr.50	1/2	DStlS22(9)	11.3	0.0	0.0	OK
CPL1c	A572 Gr.50	1/2	DStlS22(9)	40.7	0.0	3.9	OK
CPL2a	A572 Gr.50	3/4	DStlS22(9)	21.4	0.0	1.5	OK
CPL2b	A572 Gr.50	1/2	DStlS22(9)	9.8	0.0	0.0	OK
CPL2c	A572 Gr.50	1/2	DStlS22(9)	26.9	0.0	2.1	OK
GUSS1	A572 Gr.50	3/4	DStlS22(9)	18.7	0.0	0.7	OK
GUSS2	A572 Gr.50	3/4	DStlS22(9)	26.7	0.0	1.2	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for M100-w 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y = 50.0$ ksi – characteristic yield strength

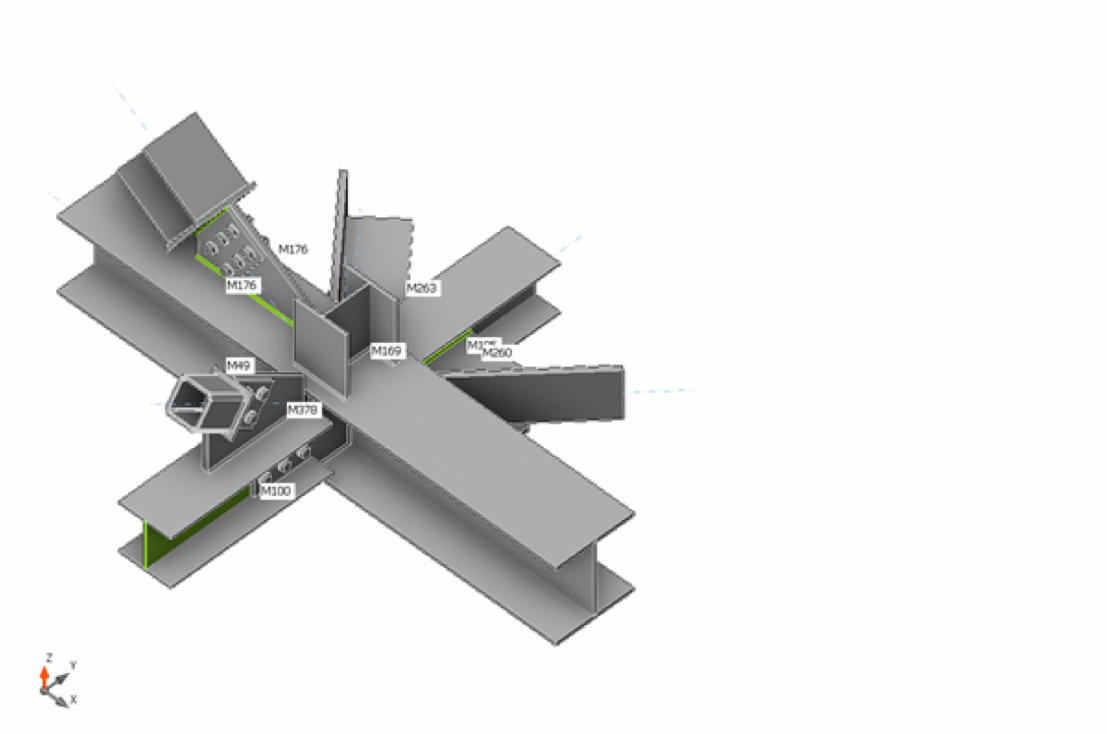
$\phi = 0.90$ – resistance factor for steel material AISC 360-16 – B3.1

Loc. deformation

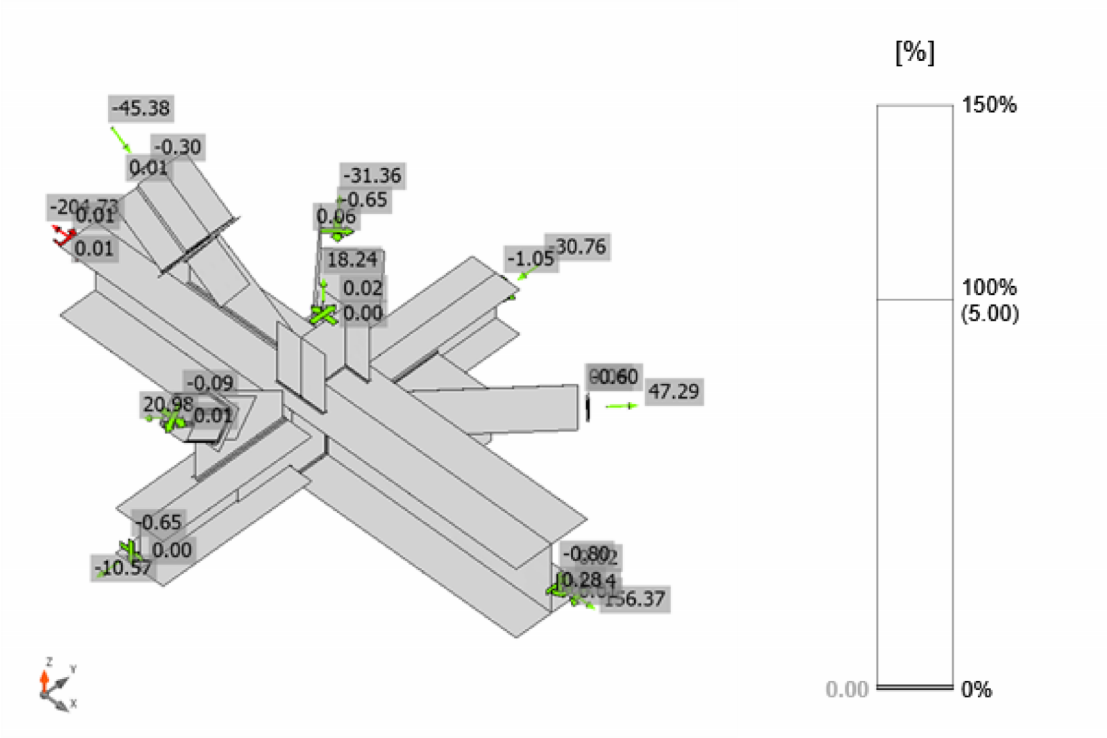
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M378	5.00	DStlS19(20)	0.00	0.15	0.0	OK

Symbol explanation

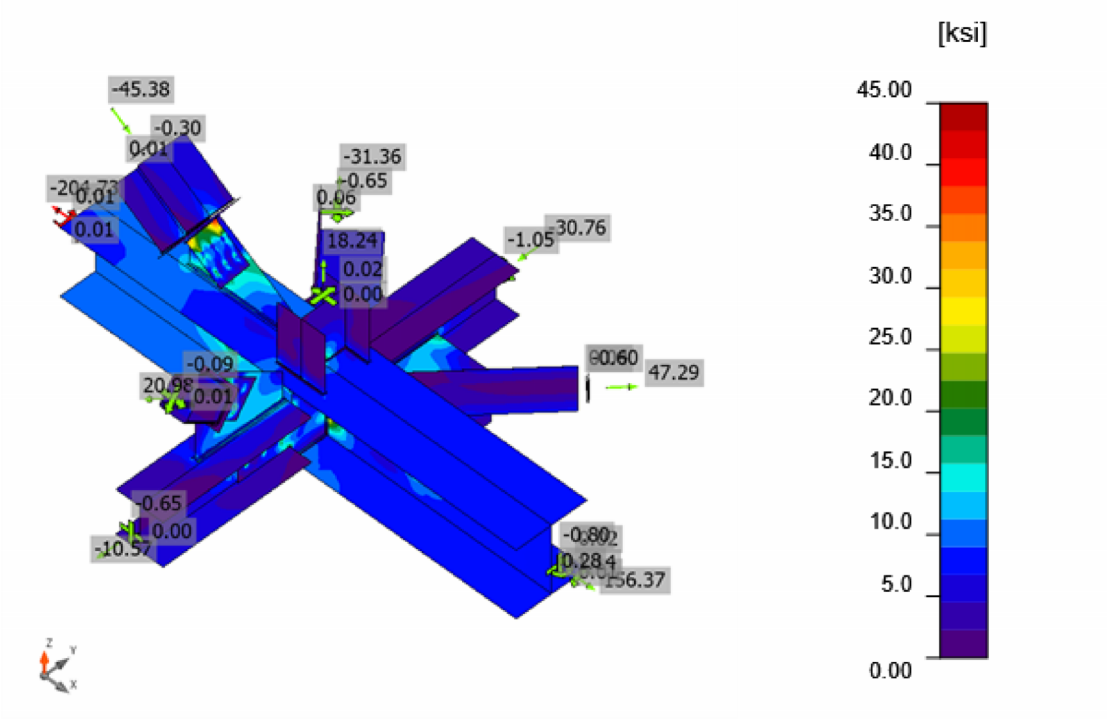
d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation



Overall check, DStlS22(9)

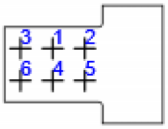
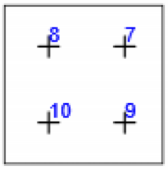
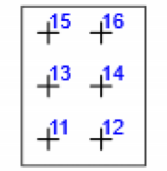
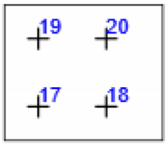
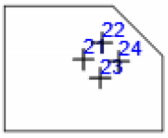
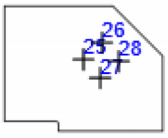


Strain check, DStlS22(9)



Equivalent stress, DStlS22(9)

Bolts

Shape	Item	Grade	Loads	F_t [kip]	V [kip]	$\phi R_{n,bearing}$ [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	B1	3/4 A325 - 1	DStlS22(9)	1.20	5.91	25.01	4.0	33.1	0.0	OK	OK
	B2	3/4 A325 - 1	DStlS22(9)	2.37	7.00	23.95	8.0	39.2	0.0	OK	OK
	B3	3/4 A325 - 1	DStlS22(9)	1.51	5.55	25.01	5.1	31.1	0.0	OK	OK
	B4	3/4 A325 - 1	DStlS14(19)	0.61	4.15	25.01	2.0	23.2	0.0	OK	OK
	B5	3/4 A325 - 1	DStlS22(9)	1.45	5.42	25.01	4.9	30.3	0.0	OK	OK
	B6	3/4 A325 - 1	DStlS14(19)	1.02	3.85	25.01	3.4	21.5	0.0	OK	OK
	B7	3/4 A325 - 1	DStlS12(2)	0.10	1.30	25.01	0.3	7.3	0.0	OK	OK
	B8	3/4 A325 - 1	DStlS12(2)	0.08	1.19	25.01	0.3	6.6	0.0	OK	OK
	B9	3/4 A325 - 1	DStlS12(2)	0.11	0.69	25.01	0.4	3.9	0.0	OK	OK
	B10	3/4 A325 - 1	DStlS14(19)	0.61	0.75	19.06	2.1	4.2	0.0	OK	OK
	B11	3/4 A325 - 1	DStlS20(4)	0.68	7.44	43.88	2.3	41.6	0.0	OK	OK
	B12	3/4 A325 - 1	DStlS22(9)	2.15	7.42	43.88	7.2	41.5	0.0	OK	OK
	B13	3/4 A325 - 1	DStlS20(4)	0.61	7.48	43.88	2.0	41.9	0.0	OK	OK
	B14	3/4 A325 - 1	DStlS22(9)	1.45	7.42	43.88	4.9	41.5	0.0	OK	OK
	B15	3/4 A325 - 1	DStlS20(4)	0.77	7.89	43.88	2.6	44.1	0.0	OK	OK
	B16	3/4 A325 - 1	DStlS20(4)	2.52	7.76	43.88	8.4	43.4	0.0	OK	OK
	B17	3/4 A325 - 1	DStlS22(9)	1.45	4.26	32.71	4.9	23.9	0.0	OK	OK
	B18	3/4 A325 - 1	DStlS22(9)	0.50	4.28	43.88	1.7	24.0	0.0	OK	OK
	B19	3/4 A325 - 1	DStlS22(9)	2.25	6.34	32.47	7.5	35.4	0.0	OK	OK
	B20	3/4 A325 - 1	DStlS22(9)	0.36	6.36	43.88	1.2	35.6	0.0	OK	OK
	B21	7/8 A325 - 2	DStlS22(9)	0.42	7.41	76.80	1.0	30.5	0.0	OK	OK
	B22	7/8 A325 - 2	DStlS22(9)	1.95	7.33	76.80	4.8	30.1	0.0	OK	OK
	B23	7/8 A325 - 2	DStlS22(9)	1.58	8.41	76.80	3.9	34.5	0.0	OK	OK
	B24	7/8 A325 - 2	DStlS22(9)	0.46	8.30	76.80	1.1	34.1	0.0	OK	OK
	B25	7/8 A325 - 2	DStlS22(9)	0.77	12.00	76.80	1.9	49.3	0.0	OK	OK
	B26	7/8 A325 - 2	DStlS22(9)	2.74	11.91	76.80	6.8	48.9	0.0	OK	OK
	B27	7/8 A325 - 2	DStlS22(9)	2.46	11.76	76.80	6.1	48.3	0.0	OK	OK
	B28	7/8 A325 - 2	DStlS22(9)	0.88	11.63	76.80	2.2	47.8	0.0	OK	OK

Design data

Grade	$\phi R_{n,tension}$ [kip]	$\phi R_{n,shear}$ [kip]
3/4 A325 - 1	29.79	17.88
7/8 A325 - 2	40.55	24.33

Symbol explanation

F_t	Tension force
V	Resultant of bolt shear forces Vy and Vz in shear planes
$\phi R_{n,bearing}$	Bolt bearing resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
$\phi R_{n,tension}$	Bolt tension resistance - AISC 360-16 – J3.6
$\phi R_{n,shear}$	Bolt shear resistance - AISC 360-16 – J3.6

Detailed result for B25

Tension resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 40.55 \quad \text{kip} \quad \geq \quad F_t = \quad 0.77 \quad \text{kip}$$

Where:

$F_{nt} =$ 89.9 ksi – nominal tensile stress AISC 360-16 – Table J3.2

$A_b =$ 0.60 in^2 – gross bolt cross-sectional area

$\phi =$ 0.75 – resistance factor

Shear resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 24.33 \quad \text{kip} \quad \geq \quad V = \quad 12.00 \quad \text{kip}$$

Where:

$F_{nv} =$ 54.0 ksi – nominal shear stress AISC 360-16 – Table J3.2

$A_b =$ 0.60 in^2 – gross bolt cross-sectional area

$\phi =$ 0.75 – resistance factor

Bearing resistance check (AISC 360-16 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = \quad 76.80 \quad \text{kip} \quad \geq \quad V = \quad 12.00 \quad \text{kip}$$

Where:

$l_c =$ 2.06 in – clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material

$t =$ 0.75 in – thickness of the plate

$d =$ 0.88 in – diameter of a bolt

$F_u =$ 65.0 ksi – specified minimum tensile strength of the connected material

$\phi =$ 0.75 – resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-16 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
M49-w 1	FP1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	10.94	0.73	DStlS22(9)	3.09	5.98	51.6	30.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	10.94	0.73	DStlS22(9)	2.80	5.87	47.6	26.5	OK	OK
M49-w 1	FP2	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.21	0.31	DStlS20(4)	0.44	2.75	16.1	6.4	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.17	0.31	DStlS14(19)	0.29	2.18	13.3	5.2	OK	OK
M49-tfl 1	M169-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.98	0.66	DStlS22(9)	1.76	4.88	36.0	15.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.98	0.66	DStlS22(9)	1.30	4.82	26.9	10.7	OK	OK
M49-tfl 1	M169-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.98	0.66	DStlS20(4)	2.56	5.16	49.6	24.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.98	0.66	DStlS20(4)	3.09	5.12	60.3	30.4	OK	OK
M49-tfl 1	M169-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.52	0.68	DStlS20(4)	2.93	6.06	48.3	25.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.52	0.68	DStlS20(4)	2.95	6.06	48.7	25.8	OK	OK
M49-tfl 1	CPL1a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.96	0.90	DStlS20(4)	3.20	5.54	57.8	37.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.96	0.90	DStlS20(4)	5.07	7.19	70.6	47.1	OK	OK
CPL1b	CPL1c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.92	0.45	DStlS20(4)	1.36	3.95	34.4	18.1	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	8.92	0.45	DStlS22(9)	2.74	3.93	69.5	49.8	OK	OK
CPL1b	M176-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS22(9)	1.62	3.90	41.4	22.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS22(9)	1.34	3.85	34.7	18.5	OK	OK
CPL1b	M176-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS22(9)	1.24	3.45	35.8	19.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS22(9)	1.65	3.90	42.4	22.9	OK	OK
CPL1b	M176-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS20(4)	0.70	3.91	18.0	8.6	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS22(9)	0.86	3.72	23.2	12.2	OK	OK
M100-tfl 1	CPL2a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.95	0.65	DStlS22(9)	2.51	4.78	52.5	33.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.95	0.65	DStlS22(9)	1.94	5.48	35.4	19.5	OK	OK
CPL2b	CPL2c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.93	0.31	DStlS22(9)	1.12	2.76	40.7	20.8	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.93	0.31	DStlS22(9)	1.57	2.76	57.0	35.2	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
M105-w 1	GUSS1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	18.69	0.67	DStlS12(2)	2.65	4.36	60.7	31.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	18.69	0.67	DStlS20(4)	3.42	5.10	66.9	41.8	OK	OK
M49-w 1	GUSS1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.97	0.94	DStlS22(9)	5.61	7.33	76.5	45.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.97	0.94	DStlS22(9)	5.36	6.88	77.9	51.9	OK	OK
M105-w 1	GUSS2	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	12.46	0.66	DStlS22(9)	3.50	5.01	69.8	43.4	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	12.46	0.66	DStlS22(9)	3.80	5.06	75.1	42.6	OK	OK
M49-w 1	GUSS2	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	13.79	0.92	DStlS22(9)	5.23	6.76	77.4	58.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	13.79	0.92	DStlS22(9)	5.13	6.62	77.5	55.7	OK	OK
M49-bfl 1	FP1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.61	0.70	DStlS22(9)	0.56	3.97	14.1	6.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.61	0.70	DStlS22(9)	0.40	4.04	10.0	0.0	OK	OK
M49-tfl 1	FP1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.61	0.70	DStlS20(4)	1.15	5.54	20.8	9.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.61	0.70	DStlS20(4)	0.70	5.76	12.1	0.0	OK	OK
CPL2b	M378	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.02	0.32	DStlS22(9)	1.21	2.86	42.2	23.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.02	0.32	DStlS22(9)	1.11	2.86	38.7	21.0	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Detailed result for M49-w 1 / GUSS1

Weld resistance check (AISC 360-16 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 6.88 kip ≥ $F_n =$ 5.36 kip

Where:

$F_{nw} =$ 55.5 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 48.1° – angle of loading measured from the weld longitudinal axis

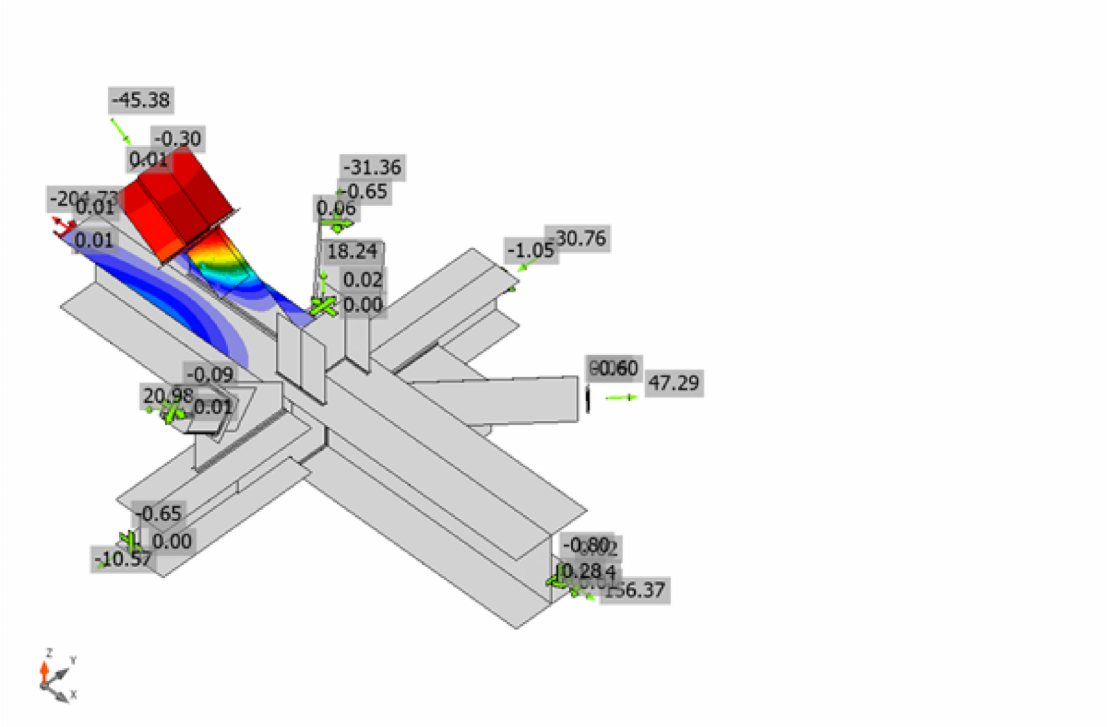
$A_{we} =$ 0.17 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Buckling

Loads	Shape	Factor [-]
DStlS3(1)	1	70.53
	2	99.28
	3	108.75
	4	133.70
	5	152.59
	6	180.32
DStlS12(2)	1	34.05
	2	47.80
	3	52.40
	4	52.66
	5	59.46
	6	64.49
DStlS27(3)	1	108.22
	2	152.43
	3	166.92
	4	205.23
	5	234.08
	6	247.08
DStlS29(8)	1	108.66
	2	147.96
	3	151.83
	4	166.42
	5	169.41
	6	180.04
DStlS22(9)	1	28.17
	2	39.57
	3	43.37
	4	53.40
	5	55.64
	6	60.74
DStlS20(4)	1	28.19
	2	39.55
	3	43.35
	4	49.20
	5	53.43
	6	55.46
DStlS1(13)	1	43.40
	2	61.01
	3	66.86
	4	82.20
	5	84.12
	6	93.88

Loads	Shape	Factor [-]
DStlS13(18)	1	55.02
	2	77.01
	3	84.42
	4	95.95
	5	103.35
	6	104.19
DStlS30(6)	1	48.93
	2	69.01
	3	75.61
	4	92.63
	5	104.13
	6	105.88
DStlS14(19)	1	33.99
	2	47.86
	3	52.45
	4	64.39
	5	70.06
	6	73.46
DStlS19(20)	1	33.44
	2	46.94
	3	51.44
	4	63.42
	5	72.09
	6	73.23



First buckling mode shape, DStlS22(9)

Project item 121

Design

Name	121
Description	
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC - LRFD (2016)

Members

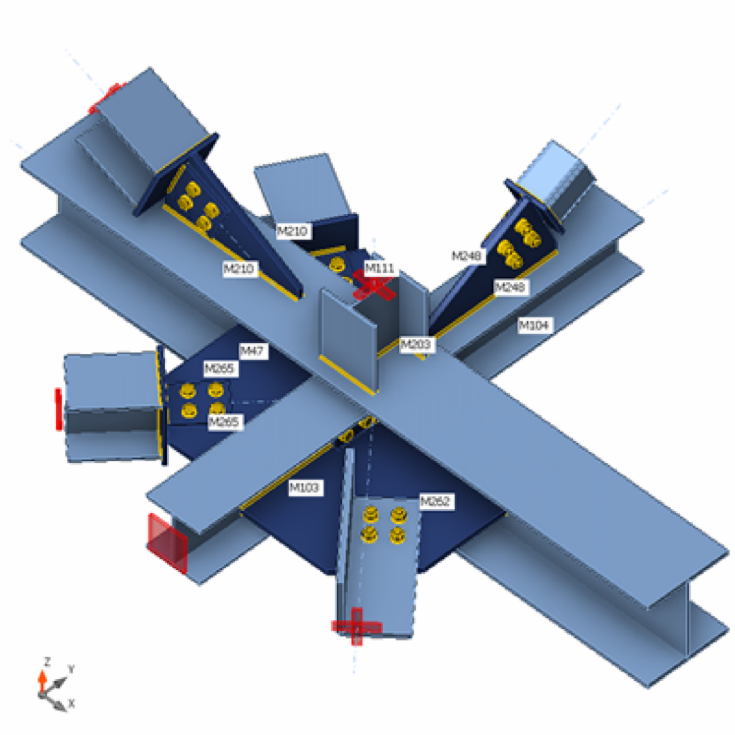
Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M47	75 - W12X72	0.0	0.0	0.0	0.00	0.00	0.00
M111	17 - W8X31	-29.2	0.0	0.0	0.00	0.00	0.00
M103	17 - W8X31	90.0	0.0	0.0	0.00	0.00	0.00
M104	17 - W8X31	90.0	0.0	0.0	0.00	0.00	0.00
M203	17 - W8X31	0.0	90.0	-90.0	0.00	0.00	0.00
M210	17 - W8X31	-180.0	22.7	0.0	0.00	0.00	0.00
M262	1831 - L8X8X3/4	-48.0	0.0	0.0	0.00	0.00	0.00
M265	17 - W8X31	48.0	0.0	0.0	0.00	0.00	0.00
M248	1807 - HSS5X5X1/2(HSS5X5X1/2(HSS5X5X1/2(HSS(Imp)5X5X1/2)))	90.0	25.8	0.0	0.00	0.00	0.00

Supports and forces

Name	Support	Forces in	X [in]
M47 / begin		Position	0.00
M47 / end		Position	0.00
M111 / begin	Mx-My-Mz	Position	18.25
M103 / begin	N-Vy-Vz-Mx-My-Mz	Position	0.00
M104 / end		Position	0.00
M203 / end	Mx-My-Mz	Connected member face	6.15
M210 / end	Mx-My-Mz	Position	28.00
M262 / end	Mx-My-Mz	Bolts	18.03
M265 / begin	Mx-My-Mz	Position	18.25
M248 / end		Position	22.50

Project:	**Creech AOF Brace Connection(Model 2)**
Project no:	**203434**
Author:	**Allison Valencia**



Cross-sections

Name	Material
75 - W12X72	A992
17 - W8X31	A992
1831 - L8X8X3/4	A992
1807 - HSS5X5X1/2(HSS5X5X1/2(HSS5X5X1/2(HSS(Imp)5X5X1/2)))	A992

Bolts

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
3/4 A325	0.75	92.0	120.0	0.44

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS19(91)	M47 / Begin	-124.20	0.02	-0.91	-0.01	5.73	-0.14
	M47 / End	182.06	0.00	-0.85	0.00	-5.72	0.15
	M111 / Begin	-18.93	0.00	-0.63	0.00	0.00	0.00
	M103 / Begin	21.84	0.01	-0.85	0.00	-4.43	-0.14
	M104 / End	4.62	0.02	-0.60	0.00	4.41	0.15
	M203 / End	-15.03	-0.02	0.01	0.00	0.00	0.00
	M210 / End	42.75	0.00	-0.24	0.00	0.00	0.00
	M262 / End	28.12	0.08	-0.59	0.00	0.00	0.00
	M265 / Begin	-30.82	0.02	-0.53	0.00	0.00	0.00
	M248 / End	8.83	-0.01	-0.11	-0.01	0.00	0.00
DStlS27(92)	M47 / Begin	-35.37	0.02	-0.57	0.00	1.41	-0.48
	M47 / End	56.40	-0.04	-0.55	0.00	-1.42	-0.68
	M111 / Begin	-5.05	0.00	-0.51	0.00	0.00	0.00
	M103 / Begin	-0.19	0.02	-0.43	0.00	-1.96	-0.21
	M104 / End	12.37	0.23	-0.37	0.00	1.95	1.36
	M203 / End	-5.49	-0.01	0.00	0.00	0.00	0.00
	M210 / End	18.16	0.00	-0.21	0.00	0.00	0.00
	M262 / End	12.87	0.02	-0.39	0.00	0.00	0.00
	M265 / Begin	-12.19	0.00	-0.32	0.00	0.00	0.00
	M248 / End	4.37	0.01	-0.09	0.01	0.00	0.00
DStlS12(93)	M47 / Begin	-129.05	0.00	-0.87	-0.01	5.57	0.59
	M47 / End	183.73	0.07	-0.84	0.00	-5.54	1.39
	M111 / Begin	-20.58	-0.01	-0.64	0.00	0.00	0.00
	M103 / Begin	34.42	-0.01	-0.82	0.00	-4.30	0.15
	M104 / End	-14.96	-0.36	-0.60	0.00	4.28	-2.10
	M203 / End	-11.11	-0.02	0.01	0.00	0.00	0.00
	M210 / End	36.74	0.00	-0.24	0.00	0.00	0.00
	M262 / End	20.59	0.07	-0.58	0.00	0.00	0.00
	M265 / Begin	-25.29	0.02	-0.52	0.00	0.00	0.00
	M248 / End	4.88	-0.03	-0.10	-0.04	0.00	0.00
DStlS1(94)	M47 / Begin	-98.41	0.01	-0.93	-0.01	4.06	0.06
	M47 / End	144.12	0.02	-0.91	0.00	-4.05	0.41
	M111 / Begin	-15.38	0.00	-0.78	0.00	0.00	0.00
	M103 / Begin	20.55	0.01	-0.79	0.00	-3.88	-0.04
	M104 / End	-1.58	-0.07	-0.63	0.00	3.87	-0.43
	M203 / End	-9.58	-0.01	0.01	0.00	0.00	0.00
	M210 / End	33.30	0.00	-0.31	0.00	0.00	0.00
	M262 / End	20.02	0.06	-0.63	0.00	0.00	0.00
	M265 / Begin	-22.33	0.02	-0.54	0.00	0.00	0.00
	M248 / End	5.38	-0.01	-0.13	-0.01	0.00	0.00
DStlS28(95)	M47 / Begin	-91.15	0.00	-0.63	-0.01	3.81	0.56
	M47 / End	128.89	0.06	-0.62	0.00	-3.79	1.21

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
	M111 / Begin	-14.73	0.00	-0.49	0.00	0.00	0.00
	M103 / Begin	26.61	-0.01	-0.58	0.00	-3.04	0.16
	M104 / End	-14.40	-0.32	-0.44	0.00	3.02	-1.92
	M203 / End	-6.82	-0.01	0.01	0.00	0.00	0.00
	M210 / End	24.66	0.00	-0.19	0.00	0.00	0.00
	M262 / End	12.87	0.05	-0.43	0.00	0.00	0.00
	M265 / Begin	-16.51	0.01	-0.38	0.00	0.00	0.00
	M248 / End	2.55	-0.02	-0.07	-0.03	0.00	0.00
DStlS11(96)	M47 / Begin	-73.27	0.02	-0.80	-0.01	3.17	-0.44
	M47 / End	111.24	-0.03	-0.77	0.00	-3.18	-0.51
	M111 / Begin	-10.90	0.00	-0.66	0.00	0.00	0.00
	M103 / Begin	7.63	0.02	-0.66	0.00	-3.22	-0.22
	M104 / End	11.81	0.20	-0.53	0.00	3.20	1.18
	M203 / End	-9.78	-0.01	0.01	0.00	0.00	0.00
	M210 / End	30.24	0.00	-0.27	0.00	0.00	0.00
	M262 / End	20.58	0.05	-0.54	0.00	0.00	0.00
	M265 / Begin	-20.96	0.01	-0.46	0.00	0.00	0.00
	M248 / End	6.70	0.00	-0.12	0.01	0.00	0.00
DStlS21(82)	M47 / Begin	-130.39	0.01	-0.89	-0.01	5.97	-0.06
	M47 / End	190.99	0.01	-0.84	0.00	-5.97	0.20
	M111 / Begin	-17.49	0.00	-0.63	0.00	0.00	0.00
	M103 / Begin	27.53	0.01	-0.85	0.00	-4.34	-0.13
	M104 / End	1.17	0.00	-0.60	0.00	4.32	0.00
	M203 / End	-13.95	-0.02	0.01	0.00	0.00	0.00
	M210 / End	40.61	0.00	-0.24	0.00	0.00	0.00
	M262 / End	24.25	0.08	-0.59	0.00	0.00	0.00
	M265 / Begin	-35.91	0.02	-0.53	0.00	0.00	0.00
	M248 / End	8.13	-0.01	-0.11	-0.01	0.00	0.00
DStlS20(84)	M47 / Begin	-152.09	0.01	-0.94	-0.01	6.93	0.37
	M47 / End	218.30	0.05	-0.88	0.00	-6.90	1.10
	M111 / Begin	-23.77	-0.01	-0.62	0.00	0.00	0.00
	M103 / Begin	35.24	0.00	-0.93	0.00	-4.97	0.04
	M104 / End	-8.76	-0.25	-0.64	0.00	4.95	-1.49
	M203 / End	-15.70	-0.02	0.01	0.00	0.00	0.00
	M210 / End	46.00	0.00	-0.23	0.00	0.00	0.00
	M262 / End	28.12	0.09	-0.61	0.00	0.00	0.00
	M265 / Begin	-32.98	0.02	-0.55	0.00	0.00	0.00
	M248 / End	7.92	-0.03	-0.10	-0.03	0.00	0.00
DStlS22(87)	M47 / Begin	-145.90	0.01	-0.96	-0.01	6.68	0.28
	M47 / End	209.37	0.04	-0.89	0.00	-6.66	1.04
	M111 / Begin	-25.21	0.00	-0.62	0.00	0.00	0.00
	M103 / Begin	29.55	0.00	-0.93	0.00	-5.05	0.03
	M104 / End	-5.31	-0.23	-0.64	0.00	5.03	-1.34
	M203 / End	-16.78	-0.02	0.01	0.00	0.00	0.00

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
	M210 / End	48.13	0.00	-0.23	0.00	0.00	0.00
	M262 / End	31.98	0.09	-0.62	0.00	0.00	0.00
	M265 / Begin	-27.88	0.02	-0.55	0.00	0.00	0.00
	M248 / End	8.61	-0.02	-0.11	-0.03	0.00	0.00

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS19(91)	0.00	0.00	-0.01	0.58	-1.35	0.08
DStlS27(92)	0.00	0.00	0.00	0.24	-1.12	0.05
DStlS12(93)	0.00	0.00	0.00	0.57	-1.35	0.04
DStlS1(94)	0.00	0.00	0.00	0.50	-1.67	0.05
DStlS28(95)	0.00	0.00	0.00	0.40	-1.03	0.02
DStlS11(96)	0.00	0.00	0.00	0.41	-1.45	0.07
DStlS21(82)	0.00	0.00	0.00	0.59	-1.35	0.07
DStlS20(84)	0.00	0.00	-0.01	0.66	-1.31	0.06
DStlS22(87)	0.00	0.00	-0.01	0.65	-1.31	0.06

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.1 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Bolts	77.5 < 100%	OK
Welds	82.9 < 100%	OK
Buckling	30.22	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M47-bfl 1	A992	11/16	DStlS20(84)	12.0	0.0	0.0	OK
M47-tfl 1	A992	11/16	DStlS22(87)	20.0	0.0	0.0	OK
M47-w 1	A992	7/16	DStlS20(84)	29.2	0.0	0.0	OK
M111-bfl 1	A992	7/16	DStlS22(87)	8.2	0.0	0.0	OK
M111-tfl 1	A992	7/16	DStlS22(87)	10.6	0.0	0.0	OK
M111-w 1	A992	5/16	DStlS22(87)	32.2	0.0	0.0	OK
M103-bfl 1	A992	7/16	DStlS22(87)	11.0	0.0	0.0	OK
M103-tfl 1	A992	7/16	DStlS22(87)	4.0	0.0	0.0	OK
M103-w 1	A992	5/16	DStlS22(87)	25.6	0.0	2.5	OK
M104-bfl 1	A992	7/16	DStlS12(93)	13.8	0.0	0.0	OK
M104-tfl 1	A992	7/16	DStlS11(96)	9.9	0.0	0.0	OK
M104-w 1	A992	5/16	DStlS12(93)	45.0	0.1	5.7	OK
M203-bfl 1	A992	7/16	DStlS22(87)	19.9	0.0	0.0	OK
M203-tfl 1	A992	7/16	DStlS22(87)	14.0	0.0	0.0	OK
M203-w 1	A992	5/16	DStlS22(87)	19.1	0.0	0.0	OK
M210-bfl 1	A992	7/16	DStlS22(87)	12.7	0.0	0.0	OK
M210-tfl 1	A992	7/16	DStlS22(87)	9.9	0.0	0.0	OK
M210-w 1	A992	5/16	DStlS22(87)	30.7	0.0	0.0	OK
M262-bfl 1	A992	3/4	DStlS22(87)	17.8	0.0	2.1	OK
M262-w 1	A992	3/4	DStlS22(87)	5.1	0.0	0.0	OK
M265-bfl 1	A992	7/16	DStlS21(82)	11.5	0.0	0.0	OK
M265-tfl 1	A992	7/16	DStlS21(82)	10.9	0.0	0.0	OK
M265-w 1	A992	5/16	DStlS21(82)	39.5	0.0	0.0	OK
M248	A992	1/2	DStlS19(91)	5.3	0.0	0.0	OK
FP1	A572 Gr.50	5/16	DStlS22(87)	40.1	0.0	5.4	OK
FP2	A572 Gr.50	5/16	DStlS22(87)	39.3	0.0	3.6	OK
CPL1a	A572 Gr.50	3/4	DStlS22(87)	36.3	0.0	3.1	OK
CPL1b	A572 Gr.50	1/2	DStlS22(87)	13.6	0.0	0.0	OK
CPL1c	A572 Gr.50	1/2	DStlS22(87)	40.3	0.0	4.9	OK
CPL2a	A572 Gr.50	3/4	DStlS19(91)	8.9	0.0	0.7	OK
CPL2b	A572 Gr.50	1/2	DStlS19(91)	3.6	0.0	0.0	OK
CPL2c	A572 Gr.50	1/2	DStlS19(91)	8.1	0.0	1.1	OK
CPL3a	A572 Gr.50	3/4	DStlS19(91)	33.7	0.0	1.1	OK
CPL3b	A992	1/2	DStlS22(87)	21.3	0.0	0.0	OK
CPL3c	A992	1/2	DStlS22(87)	38.5	0.0	2.2	OK
CPL4a	A572 Gr.50	3/4	DStlS21(82)	27.8	0.0	2.3	OK
CPL4b	A992	1/2	DStlS21(82)	31.7	0.0	0.0	OK
CPL4c	A992	1/2	DStlS21(82)	40.3	0.0	2.8	OK
GUSS1	A572 Gr.50	3/4	DStlS22(87)	20.5	0.0	0.8	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for M104-w 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y = 50.0$ ksi – characteristic yield strength

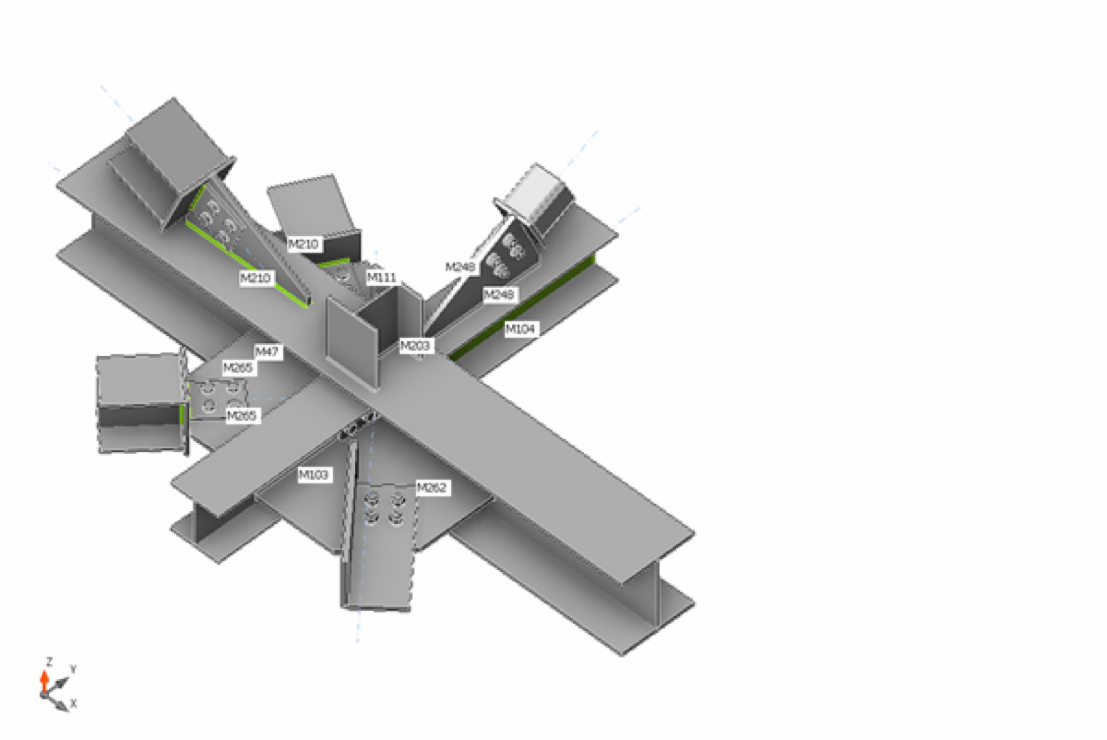
$\phi = 0.90$ – resistance factor for steel material AISC 360-16 – B3.1

Loc. deformation

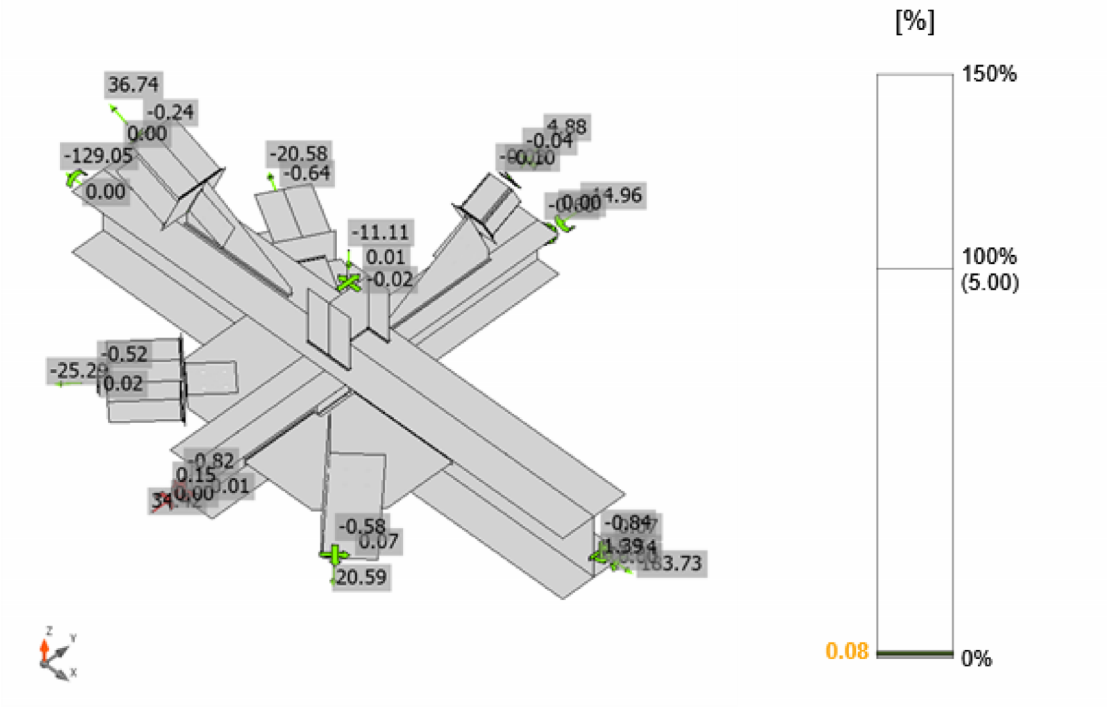
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M248	5.00	DStlS22(87)	0.00	0.15	0.0	OK

Symbol explanation

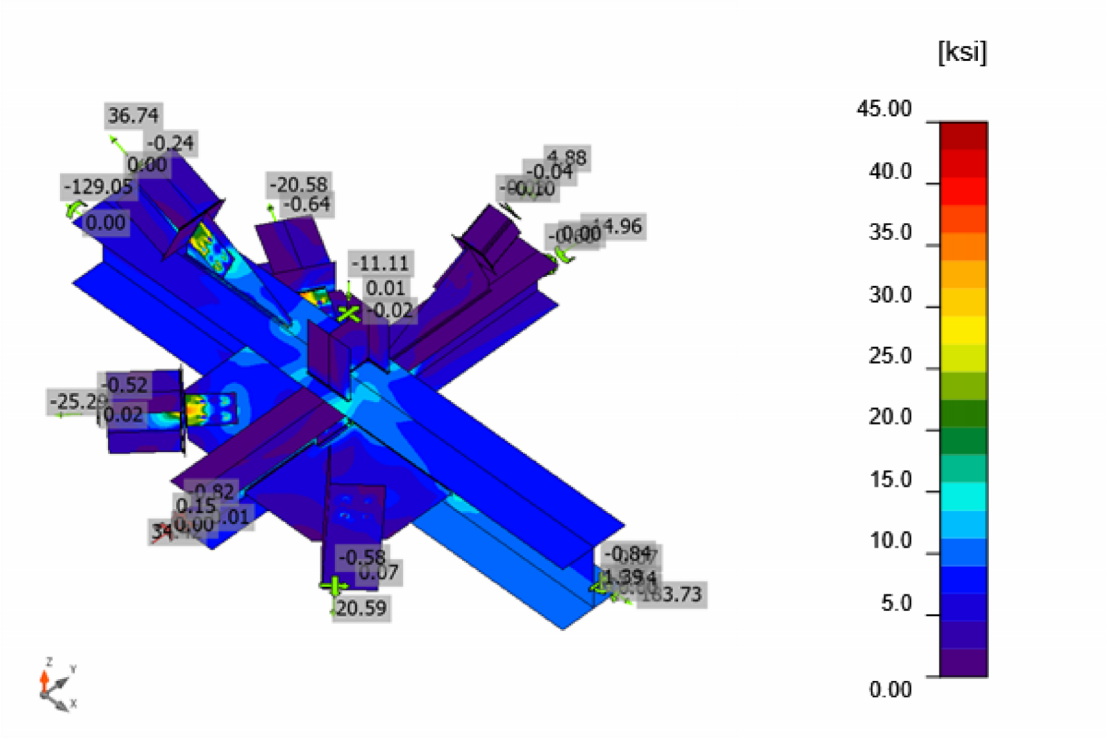
d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation



Overall check, DStlS12(93)

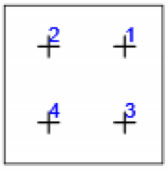
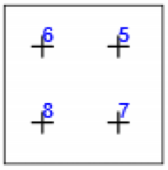
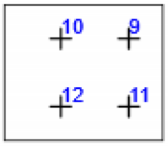
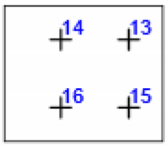
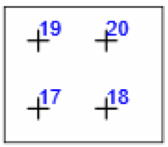
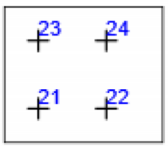
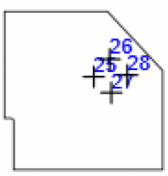


Strain check, DStlS12(93)



Equivalent stress, DStlS12(93)

Bolts

Shape	Item	Grade	Loads	F_t [kip]	V [kip]	$\phi R_{n,bearing}$ [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	B1	3/4 A325 - 1	DStlS19(91)	0.18	5.12	25.01	0.6	28.6	0.0	OK	OK
	B2	3/4 A325 - 1	DStlS19(91)	1.72	3.74	18.46	5.8	20.9	0.0	OK	OK
	B3	3/4 A325 - 1	DStlS22(87)	0.76	3.89	23.91	2.5	21.7	0.0	OK	OK
	B4	3/4 A325 - 1	DStlS12(93)	3.74	1.05	25.01	12.6	5.9	0.0	OK	OK
	B5	3/4 A325 - 1	DStlS19(91)	2.00	2.13	18.31	6.7	11.9	0.0	OK	OK
	B6	3/4 A325 - 1	DStlS22(87)	0.11	3.14	25.01	0.4	17.5	0.0	OK	OK
	B7	3/4 A325 - 1	DStlS20(84)	1.12	0.50	25.01	3.8	2.8	0.0	OK	OK
	B8	3/4 A325 - 1	DStlS22(87)	0.58	2.44	23.06	2.0	13.6	0.0	OK	OK
	B9	3/4 A325 - 1	DStlS22(87)	3.11	10.35	32.32	10.4	57.9	0.0	OK	OK
	B10	3/4 A325 - 1	DStlS22(87)	0.93	10.56	43.88	3.1	59.0	0.0	OK	OK
	B11	3/4 A325 - 1	DStlS22(87)	4.44	13.64	32.22	14.9	76.3	0.0	OK	OK
	B12	3/4 A325 - 1	DStlS22(87)	0.39	13.86	43.88	1.3	77.5	0.0	OK	OK
	B13	3/4 A325 - 1	DStlS19(91)	0.59	2.16	32.01	2.0	12.1	0.0	OK	OK
	B14	3/4 A325 - 1	DStlS19(91)	0.09	2.13	43.88	0.3	11.9	0.0	OK	OK
	B15	3/4 A325 - 1	DStlS19(91)	0.98	2.28	31.99	3.3	12.8	0.0	OK	OK
	B16	3/4 A325 - 1	DStlS19(91)	0.14	2.26	43.88	0.5	12.6	0.0	OK	OK
	B17	3/4 A325 - 1	DStlS22(87)	1.95	5.86	32.07	6.6	32.8	0.0	OK	OK
	B18	3/4 A325 - 1	DStlS22(87)	0.41	6.05	43.88	1.4	33.9	0.0	OK	OK
	B19	3/4 A325 - 1	DStlS22(87)	2.00	6.50	32.03	6.7	36.4	0.0	OK	OK
	B20	3/4 A325 - 1	DStlS22(87)	1.72	6.82	43.88	5.8	38.1	0.0	OK	OK
	B21	3/4 A325 - 1	DStlS21(82)	3.02	8.67	31.99	10.1	48.5	0.0	OK	OK
	B22	3/4 A325 - 1	DStlS21(82)	0.80	8.79	43.88	2.7	49.2	0.0	OK	OK
	B23	3/4 A325 - 1	DStlS21(82)	3.05	9.16	32.02	10.3	51.2	0.0	OK	OK
	B24	3/4 A325 - 1	DStlS21(82)	0.93	9.31	43.88	3.1	52.1	0.0	OK	OK
	B25	3/4 A325 - 1	DStlS22(87)	0.74	9.59	65.81	2.5	53.7	0.0	OK	OK
	B26	3/4 A325 - 1	DStlS22(87)	1.13	9.51	65.81	3.8	53.2	0.0	OK	OK
	B27	3/4 A325 - 1	DStlS22(87)	1.62	6.72	65.81	5.5	37.6	0.0	OK	OK
	B28	3/4 A325 - 1	DStlS22(87)	0.59	6.63	65.81	2.0	37.1	0.0	OK	OK

Design data

Grade	$\phi R_{n,tension}$ [kip]	$\phi R_{n,shear}$ [kip]
3/4 A325 - 1	29.79	17.88

Symbol explanation

F_t	Tension force
V	Resultant of bolt shear forces Vy and Vz in shear planes
$\phi R_{n,bearing}$	Bolt bearing resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
$\phi R_{n,tension}$	Bolt tension resistance - AISC 360-16 – J3.6
$\phi R_{n,shear}$	Bolt shear resistance - AISC 360-16 – J3.6

Detailed result for B12

Tension resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 29.79 \quad \text{kip} \quad \geq \quad F_t = \quad 0.39 \quad \text{kip}$$

Where:

$F_{nt} =$ 89.9 ksi – nominal tensile stress AISC 360-16 – Table J3.2

$A_b =$ 0.44 in^2 – gross bolt cross-sectional area

$\phi =$ 0.75 – resistance factor

Shear resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 17.88 \quad \text{kip} \quad \geq \quad V = \quad 13.86 \quad \text{kip}$$

Where:

$F_{nv} =$ 54.0 ksi – nominal shear stress AISC 360-16 – Table J3.2

$A_b =$ 0.44 in^2 – gross bolt cross-sectional area

$\phi =$ 0.75 – resistance factor

Bearing resistance check (AISC 360-16 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = \quad 43.88 \quad \text{kip} \quad \geq \quad V = \quad 13.86 \quad \text{kip}$$

Where:

$l_c =$ 2.19 in – clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material

$t =$ 0.50 in – thickness of the plate

$d =$ 0.75 in – diameter of a bolt

$F_u =$ 65.0 ksi – specified minimum tensile strength of the connected material

$\phi =$ 0.75 – resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-16 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
M47-tfl 1	M203-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.98	0.66	DStlS22(87)	3.23	5.36	60.4	38.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.98	0.66	DStlS22(87)	2.59	5.45	47.5	29.9	OK	OK
M47-tfl 1	M203-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS22(87)	1.24	3.75	33.2	16.9	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.98	0.66	DStlS22(87)	1.81	4.25	42.7	20.2	OK	OK
M47-tfl 1	M203-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.52	0.68	DStlS22(87)	2.68	6.06	44.3	22.9	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.52	0.68	DStlS22(87)	2.42	6.05	40.0	19.6	OK	OK
M47-w 1	FP1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.21	0.31	DStlS22(87)	2.06	2.74	75.2	51.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.21	0.31	DStlS22(87)	2.03	2.71	75.1	44.7	OK	OK
M47-w 1	FP2	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.17	0.31	DStlS22(87)	1.49	2.68	55.8	34.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.21	0.31	DStlS22(87)	1.25	2.21	56.4	30.8	OK	OK
M47-tfl 1	CPL1a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	19.96	1.00	DStlS22(87)	5.57	7.39	75.3	41.9	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	19.96	1.00	DStlS22(87)	5.50	7.31	75.2	40.5	OK	OK
CPL1b	CPL1c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.97	0.35	DStlS22(87)	2.26	2.96	76.2	55.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.97	0.35	DStlS22(87)	2.46	3.08	79.9	71.0	OK	OK
CPL1b	M210-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS22(87)	0.80	3.32	24.0	12.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS22(87)	0.34	3.01	11.2	0.0	OK	OK
CPL1b	M210-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS22(87)	0.36	2.83	12.6	5.1	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS22(87)	0.63	3.09	20.4	9.9	OK	OK
CPL1b	M210-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS22(87)	1.86	3.89	47.9	28.9	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS22(87)	2.03	3.83	53.2	33.6	OK	OK
M104-tfl 1	CPL2a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	19.94	0.66	DStlS19(91)	2.09	4.95	42.2	19.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	19.94	0.66	DStlS19(91)	1.41	4.91	28.8	11.1	OK	OK
CPL2b	CPL2c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.93	0.31	DStlS19(91)	0.44	2.75	16.1	7.4	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.93	0.31	DStlS19(91)	0.48	2.76	17.3	7.7	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
M47-w 1	CPL3a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	21.96	1.05	DStlS19(91)	7.04	9.18	76.7	53.9	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	21.96	1.05	DStlS22(87)	6.07	7.73	78.5	62.8	OK	OK
M104-w 1	CPL3a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	9.72	0.65	DStlS22(87)	4.26	5.14	82.9	73.6	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	9.72	0.65	DStlS19(91)	4.25	5.14	82.8	72.1	OK	OK
CPL3b	CPL3c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.93	0.35	DStlS22(87)	2.34	3.09	75.7	51.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.93	0.35	DStlS22(87)	1.58	3.09	51.0	29.5	OK	OK
CPL3b	M111-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.96	0.44	DStlS22(87)	0.38	3.65	10.4	0.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS22(87)	0.38	2.81	13.5	5.9	OK	OK
CPL3b	M111-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS22(87)	0.47	2.83	16.6	7.4	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.96	0.44	DStlS22(87)	0.61	3.54	17.2	6.7	OK	OK
CPL3b	M111-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS22(87)	2.93	3.90	75.0	45.1	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS22(87)	2.89	3.91	73.9	44.0	OK	OK
M103-w 1	CPL4a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	19.19	0.66	DStlS22(87)	3.88	5.07	76.5	44.4	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	19.19	0.66	DStlS22(87)	3.96	5.19	76.4	43.5	OK	OK
M47-w 1	CPL4a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.96	1.00	DStlS22(87)	6.53	8.69	75.2	42.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.96	1.00	DStlS22(87)	5.54	7.23	76.6	47.8	OK	OK
CPL4b	CPL4c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.93	0.35	DStlS21(82)	2.42	3.09	78.3	60.4	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.93	0.35	DStlS21(82)	2.33	3.09	75.3	49.9	OK	OK
CPL4b	M265-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.96	0.44	DStlS21(82)	0.63	3.53	17.9	8.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS21(82)	0.57	2.85	20.1	9.9	OK	OK
CPL4b	M265-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS21(82)	0.50	2.86	17.7	8.4	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.96	0.44	DStlS21(82)	0.61	3.53	17.3	7.2	OK	OK
CPL4b	M265-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS21(82)	2.95	3.91	75.4	50.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS21(82)	2.94	3.91	75.3	50.2	OK	OK
M47-w 1	GUSS1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	18.78	0.99	DStlS20(84)	3.25	5.87	55.4	34.1	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	18.78	0.99	DStlS20(84)	3.68	6.96	52.9	34.7	OK	OK
M103-w 1	GUSS1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	13.46	0.67	DStlS22(87)	2.28	5.21	43.8	21.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	13.46	0.67	DStlS22(87)	2.24	4.95	45.2	26.6	OK	OK
CPL2b	M248	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.02	0.32	DStlS19(91)	0.42	2.86	14.8	6.4	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.04	0.32	DStlS19(91)	0.37	2.86	12.9	5.2	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Detailed result for M104-w 1 / CPL3a

Weld resistance check (AISC 360-16 – J2-4)

$$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} = \quad 5.14 \quad \text{kip} \quad \geq \quad F_n = \quad 4.26 \quad \text{kip}$$

Where:

$F_{nw} = 56.4$ ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 51.1° – angle of loading measured from the weld longitudinal axis

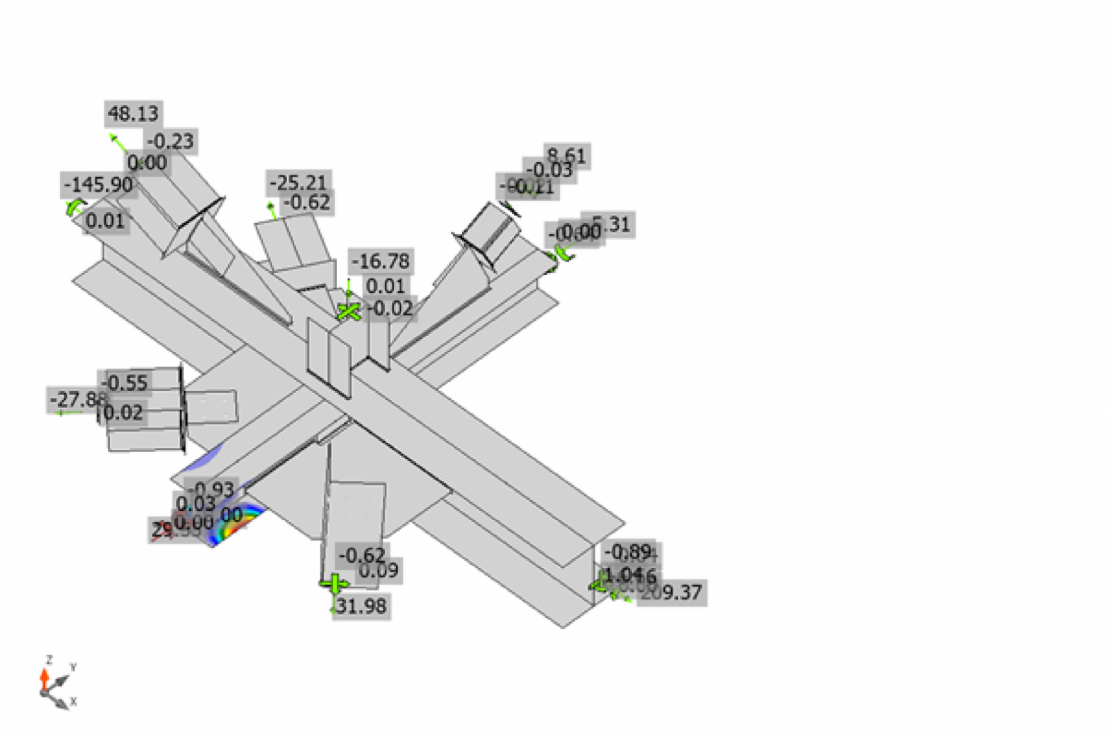
$A_{we} = 0.12$ in^2 – effective area of weld critical element

$\phi = 0.75$ – resistance factor for welded connections

Buckling

Loads	Shape	Factor [-]
DStlS19(91)	1	36.59
	2	39.62
	3	55.27
	4	59.77
	5	63.13
	6	70.23
DStlS27(92)	1	116.24
	2	124.00
	3	124.69
	4	142.26
	5	154.15
	6	173.00
DStlS12(93)	1	35.38
	2	38.83
	3	53.60
	4	53.93
	5	54.46
	6	58.36
DStlS1(94)	1	45.42
	2	49.35
	3	68.69
	4	74.28
	5	80.35
	6	86.22
DStlS28(95)	1	49.84
	2	54.96
	3	63.16
	4	64.06
	5	74.95
	6	76.09
DStlS11(96)	1	59.62
	2	64.07
	3	81.37
	4	89.40
	5	91.80
	6	96.60
DStlS21(82)	1	36.63
	2	39.95
	3	55.76
	4	60.36
	5	70.51
	6	75.93

Loads	Shape	Factor [-]
DStlS20(84)	1	30.22
	2	32.98
	3	45.94
	4	49.72
	5	62.76
	6	63.03
DStlS22(87)	1	30.22
	2	32.77
	3	45.64
	4	49.36
	5	57.09
	6	63.04



First buckling mode shape, DStlS22(87)

Project item 115

Design

Name	115
Description	
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC - LRFD (2016)

Members

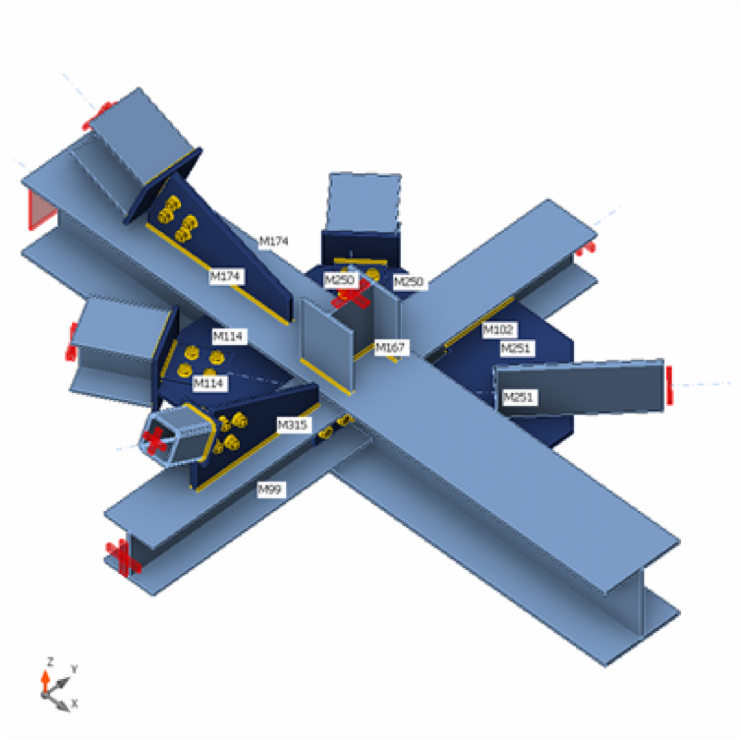
Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M49	75 - W12X72	0.0	0.0	0.0	0.00	0.00	0.00
M114	17 - W8X31	29.2	0.0	0.0	0.00	0.00	0.00
M99	17 - W8X31	90.0	0.0	0.0	0.00	0.00	0.00
M102	17 - W8X31	90.0	0.0	0.0	0.00	0.00	0.00
M167	17 - W8X31	0.0	90.0	-90.0	0.00	0.00	0.00
M174	17 - W8X31	-180.0	22.7	0.0	0.00	0.00	0.00
M250	17 - W8X31	-48.0	0.0	0.0	0.00	0.00	0.00
M251	1831 - L8X8X3/4	48.0	0.0	0.0	0.00	0.00	0.00
M315	1807 - HSS5X5X1/2(HSS5X5X1/2(HSS5X5X1/2(HSS(Imp)5X5X1/2)))	-90.0	25.8	0.0	0.00	0.00	0.00

Supports and forces

Name	Support	Forces in	X [in]
M49 / begin	N-Vy-Vz-Mx-My-Mz	Position	0.00
M49 / end		Position	0.00
M114 / begin	Mx-My-Mz	Position	18.00
M99 / begin	Mx-My-Mz	Bolts	3.47
M102 / end	Mx-My-Mz	Bolts	3.46
M167 / end	Mx-My-Mz	Connected member face	6.15
M174 / end	Mx-My-Mz	Position	29.00
M250 / begin	Mx-My-Mz	Position	18.00
M251 / end	Mx-My-Mz	Bolts	21.29
M315 / end	Mx-My-Mz	Position	24.00

Project:	**Creech AOF Brace Connection(Model 2)**
Project no:	**203434**
Author:	**Allison Valencia**



Cross-sections

Name	Material
75 - W12X72	A992
17 - W8X31	A992
1831 - L8X8X3/4	A992
1807 - HSS5X5X1/2(HSS5X5X1/2(HSS5X5X1/2(HSS(Imp)5X5X1/2)))	A992

Bolts

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
3/4 A325	0.75	92.0	120.0	0.44

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS22(94)	M49 / Begin	-143.17	-0.01	-0.95	0.01	6.87	0.06
	M49 / End	211.10	-0.01	-0.88	0.00	-6.86	-0.26
	M114 / Begin	-18.79	0.00	-0.62	0.00	0.00	0.00
	M99 / Begin	-2.23	-0.01	-0.62	0.00	-4.71	0.05
	M102 / End	-29.53	0.01	-0.91	0.00	4.74	0.14
	M167 / End	-17.02	-0.02	-0.01	0.00	0.00	0.00
	M174 / End	47.53	0.00	-0.23	0.00	0.00	0.00
	M250 / Begin	-38.93	-0.01	-0.53	0.00	0.00	0.00
	M251 / End	27.67	0.05	-0.61	0.00	0.00	0.00
	M315 / End	9.47	0.01	-0.11	0.00	0.00	0.00
DStlS12(95)	M49 / Begin	-128.90	0.00	-0.87	0.01	5.57	-0.59
	M49 / End	183.71	-0.07	-0.84	0.00	-5.54	-1.39
	M114 / Begin	-20.60	0.00	-0.64	0.00	0.00	0.00
	M99 / Begin	14.92	-0.36	-0.60	0.00	-4.29	2.10
	M102 / End	-34.41	-0.01	-0.82	0.00	4.30	-0.15
	M167 / End	-11.12	-0.02	-0.01	0.00	0.00	0.00
	M174 / End	36.72	0.00	-0.24	0.00	0.00	0.00
	M250 / Begin	-25.27	-0.01	-0.50	0.00	0.00	0.00
	M251 / End	20.51	0.04	-0.58	0.00	0.00	0.00
	M315 / End	4.88	0.03	-0.10	0.00	0.00	0.00
DStlS27(96)	M49 / Begin	-35.33	-0.02	-0.57	0.00	1.41	0.48
	M49 / End	56.38	0.04	-0.55	0.00	-1.42	0.69
	M114 / Begin	-5.04	0.00	-0.51	0.00	0.00	0.00
	M99 / Begin	-12.39	0.23	-0.37	0.00	-1.95	-1.37
	M102 / End	0.19	0.02	-0.43	0.00	1.96	0.21
	M167 / End	-5.49	-0.01	0.00	0.00	0.00	0.00
	M174 / End	18.15	0.00	-0.21	0.00	0.00	0.00
	M250 / Begin	-12.17	0.00	-0.32	0.00	0.00	0.00
	M251 / End	12.86	0.02	-0.38	0.00	0.00	0.00
	M315 / End	4.37	-0.01	-0.09	0.00	0.00	0.00
DStlS1(97)	M49 / Begin	-98.30	-0.01	-0.93	0.01	4.06	-0.06
	M49 / End	144.09	-0.02	-0.91	0.00	-4.05	-0.41
	M114 / Begin	-15.39	0.00	-0.78	0.00	0.00	0.00
	M99 / Begin	1.54	-0.07	-0.63	0.00	-3.87	0.43
	M102 / End	-20.54	0.01	-0.79	0.00	3.89	0.04
	M167 / End	-9.59	-0.01	-0.01	0.00	0.00	0.00
	M174 / End	33.29	0.00	-0.31	0.00	0.00	0.00
	M250 / Begin	-22.31	-0.01	-0.53	0.00	0.00	0.00
	M251 / End	19.97	0.04	-0.63	0.00	0.00	0.00
	M315 / End	5.39	0.01	-0.13	0.00	0.00	0.00
DStlS28(98)	M49 / Begin	-91.05	0.00	-0.63	0.01	3.81	-0.55
	M49 / End	128.88	-0.06	-0.62	0.00	-3.78	-1.21

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
	M114 / Begin	-14.74	0.00	-0.49	0.00	0.00	0.00
	M99 / Begin	14.37	-0.32	-0.44	0.00	-3.03	1.92
	M102 / End	-26.60	-0.01	-0.58	0.00	3.04	-0.16
	M167 / End	-6.83	-0.01	-0.01	0.00	0.00	0.00
	M174 / End	24.64	0.00	-0.19	0.00	0.00	0.00
	M250 / Begin	-16.51	-0.01	-0.37	0.00	0.00	0.00
	M251 / End	12.82	0.03	-0.43	0.00	0.00	0.00
	M315 / End	2.55	0.02	-0.07	0.00	0.00	0.00
DStlS11(99)	M49 / Begin	-73.18	-0.02	-0.80	0.01	3.17	0.44
	M49 / End	111.20	0.03	-0.77	0.00	-3.18	0.51
	M114 / Begin	-10.90	0.00	-0.66	0.00	0.00	0.00
	M99 / Begin	-11.84	0.20	-0.53	0.00	-3.21	-1.18
	M102 / End	-7.62	0.02	-0.66	0.00	3.22	0.22
	M167 / End	-9.79	-0.01	-0.01	0.00	0.00	0.00
	M174 / End	30.23	0.00	-0.27	0.00	0.00	0.00
	M250 / Begin	-20.94	-0.01	-0.46	0.00	0.00	0.00
	M251 / End	20.55	0.03	-0.54	0.00	0.00	0.00
	M315 / End	6.70	0.00	-0.12	0.00	0.00	0.00
DStlS21(84)	M49 / Begin	-132.77	-0.01	-0.90	0.01	5.77	-0.28
	M49 / End	189.17	-0.04	-0.86	0.00	-5.75	-0.98
	M114 / Begin	-23.96	0.00	-0.64	0.00	0.00	0.00
	M99 / Begin	6.29	-0.22	-0.62	0.00	-4.66	1.29
	M102 / End	-27.52	0.00	-0.87	0.00	4.68	-0.04
	M167 / End	-13.74	-0.02	-0.01	0.00	0.00	0.00
	M174 / End	41.17	0.00	-0.24	0.00	0.00	0.00
	M250 / Begin	-24.81	-0.01	-0.51	0.00	0.00	0.00
	M251 / End	28.41	0.05	-0.59	0.00	0.00	0.00
	M315 / End	7.27	0.02	-0.11	0.00	0.00	0.00
DStlS20(89)	M49 / Begin	-151.90	-0.01	-0.94	0.01	6.92	-0.37
	M49 / End	218.26	-0.05	-0.88	0.00	-6.90	-1.10
	M114 / Begin	-23.80	0.01	-0.62	0.00	0.00	0.00
	M99 / Begin	8.72	-0.25	-0.64	0.00	-4.95	1.49
	M102 / End	-35.22	0.00	-0.93	0.00	4.98	-0.04
	M167 / End	-15.71	-0.02	-0.01	0.00	0.00	0.00
	M174 / End	45.97	0.00	-0.23	0.00	0.00	0.00
	M250 / Begin	-32.95	-0.02	-0.53	0.00	0.00	0.00
	M251 / End	28.03	0.05	-0.61	0.00	0.00	0.00
	M315 / End	7.92	0.03	-0.10	0.00	0.00	0.00

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS22(94)	0.00	0.00	0.00	-0.81	-1.17	0.13
DStlS12(95)	0.00	0.00	0.00	-0.72	-1.20	0.22
DStlS27(96)	0.00	0.00	0.00	-0.32	-1.07	-0.04
DStlS1(97)	0.00	0.00	0.00	-0.65	-1.54	0.11
DStlS28(98)	0.00	0.00	0.00	-0.51	-0.91	0.18
DStlS11(99)	0.00	0.00	0.00	-0.53	-1.36	0.01
DStlS21(84)	0.00	0.00	0.00	-0.75	-1.20	0.19
DStlS20(89)	0.00	0.00	0.00	-0.83	-1.14	0.21

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Bolts	69.7 < 100%	OK
Welds	79.5 < 100%	OK
Buckling	51.26	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M49-bfl 1	A992	11/16	DStlS20(89)	11.9	0.0	0.0	OK
M49-tfl 1	A992	11/16	DStlS20(89)	16.3	0.0	0.0	OK
M49-w 1	A992	7/16	DStlS22(94)	27.9	0.0	0.0	OK
M114-bfl 1	A992	7/16	DStlS21(84)	9.2	0.0	0.0	OK
M114-tfl 1	A992	7/16	DStlS20(89)	5.4	0.0	0.0	OK
M114-w 1	A992	5/16	DStlS21(84)	29.9	0.0	0.0	OK
M99-bfl 1	A992	7/16	DStlS20(89)	3.6	0.0	0.0	OK
M99-tfl 1	A992	7/16	DStlS22(94)	4.3	0.0	0.0	OK
M99-w 1	A992	5/16	DStlS22(94)	21.2	0.0	2.2	OK
M102-bfl 1	A992	7/16	DStlS20(89)	6.2	0.0	0.0	OK
M102-tfl 1	A992	7/16	DStlS20(89)	4.6	0.0	0.0	OK
M102-w 1	A992	5/16	DStlS22(94)	22.8	0.0	1.0	OK
M167-bfl 1	A992	7/16	DStlS22(94)	9.6	0.0	0.0	OK
M167-tfl 1	A992	7/16	DStlS22(94)	8.4	0.0	0.0	OK
M167-w 1	A992	5/16	DStlS22(94)	16.1	0.0	0.0	OK
M174-bfl 1	A992	7/16	DStlS22(94)	11.4	0.0	0.0	OK
M174-tfl 1	A992	7/16	DStlS22(94)	10.9	0.0	0.0	OK
M174-w 1	A992	5/16	DStlS22(94)	26.1	0.0	0.0	OK
M250-bfl 1	A992	7/16	DStlS22(94)	13.7	0.0	0.0	OK
M250-tfl 1	A992	7/16	DStlS22(94)	10.7	0.0	0.0	OK
M250-w 1	A992	5/16	DStlS22(94)	40.6	0.0	0.0	OK
M251-bfl 1	A992	3/4	DStlS21(84)	17.6	0.0	1.9	OK
M251-w 1	A992	3/4	DStlS21(84)	6.3	0.0	0.0	OK
M315	A992	1/2	DStlS22(94)	6.3	0.0	0.0	OK
FP1	A572 Gr.50	3/8	DStlS22(94)	25.2	0.0	2.3	OK
FP2	A572 Gr.50	3/8	DStlS22(94)	19.8	0.0	3.2	OK
CPL1a	A572 Gr.50	3/4	DStlS21(84)	19.2	0.0	1.5	OK
CPL1b	A572 Gr.50	1/2	DStlS21(84)	19.7	0.0	0.0	OK
CPL1c	A572 Gr.50	1/2	DStlS21(84)	35.1	0.0	2.7	OK
CPL2a	A572 Gr.50	3/4	DStlS22(94)	30.0	0.0	2.4	OK
CPL2b	A572 Gr.50	1/2	DStlS22(94)	36.4	0.0	0.0	OK
CPL2c	A572 Gr.50	1/2	DStlS22(94)	42.8	0.0	4.0	OK
CPL3a	A572 Gr.50	3/4	DStlS22(94)	34.7	0.0	3.0	OK
CPL3b	A572 Gr.50	1/2	DStlS22(94)	11.6	0.0	0.0	OK
CPL3c	A572 Gr.50	1/2	DStlS22(94)	37.3	0.0	5.7	OK
CPL4a	A572 Gr.50	3/4	DStlS22(94)	8.6	0.0	0.6	OK
CPL4b	A572 Gr.50	1/2	DStlS22(94)	4.1	0.0	0.0	OK
CPL4c	A572 Gr.50	1/2	DStlS22(94)	11.9	0.0	1.4	OK
GUSS1	A572 Gr.50	3/4	DStlS21(84)	14.5	0.0	0.5	OK

Project:	**Creech AOF Brace Connection(Model 2)**
Project no:	**203434**
Author:	**Allison Valencia**

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for CPL2c

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y = 50.0$ ksi – characteristic yield strength

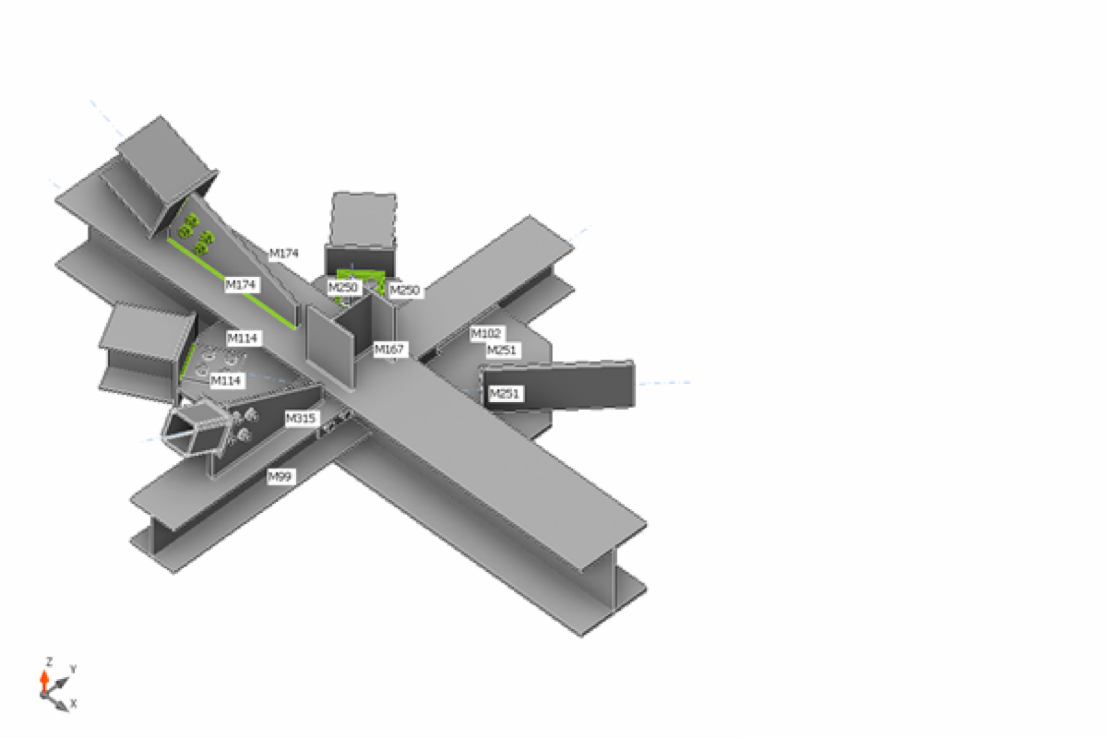
$\phi = 0.90$ – resistance factor for steel material AISC 360-16 – B3.1

Loc. deformation

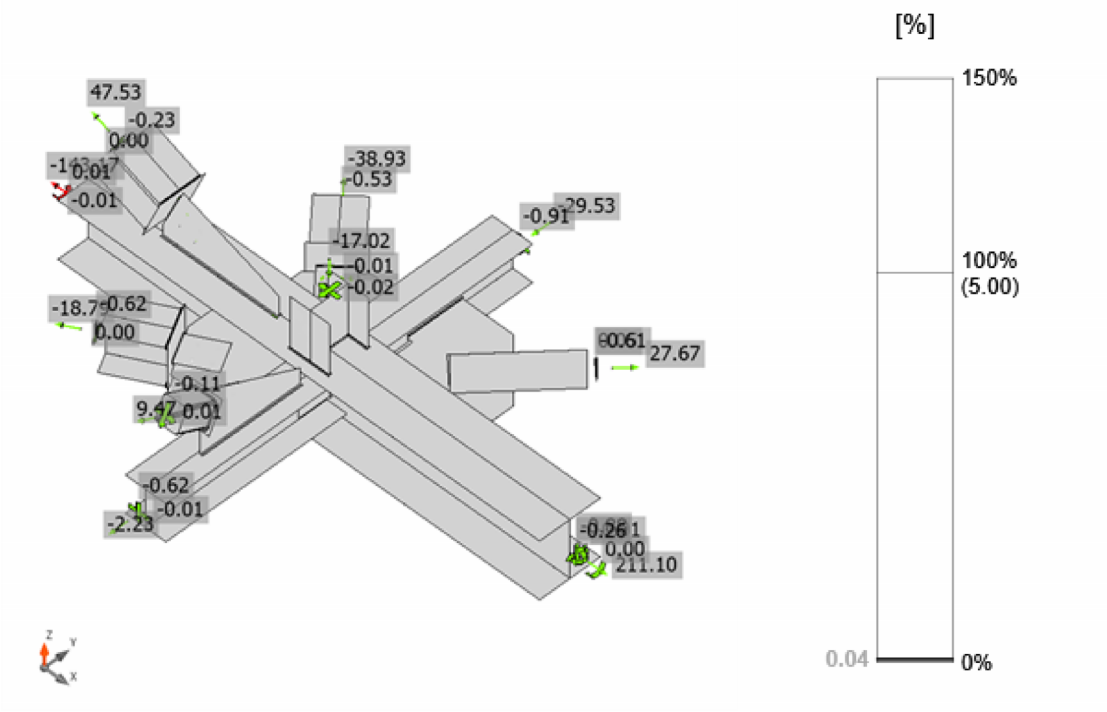
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M315	5.00	DStlS20(89)	0.00	0.15	0.0	OK

Symbol explanation

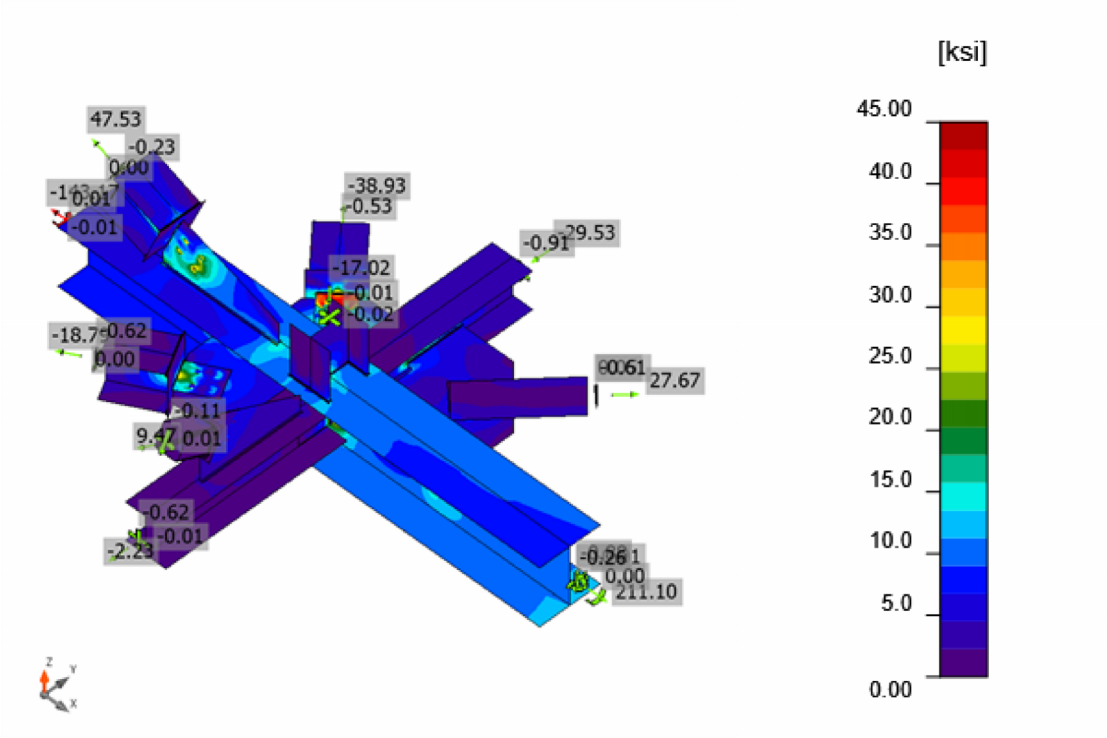
d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation



Overall check, DStlS22(94)

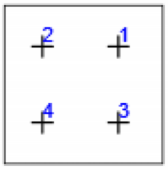
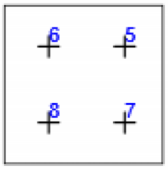
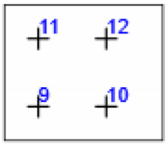
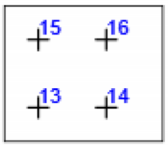
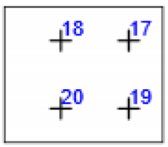
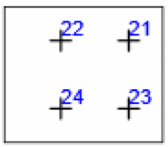
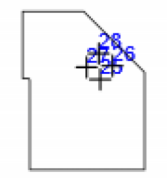


Strain check, DStlS22(94)



Equivalent stress, DStlS22(94)

Bolts

Shape	Item	Grade	Loads	F_t [kip]	V [kip]	$\phi R_{n,bearing}$ [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	B1	3/4 A325 - 1	DStlS20(89)	1.71	0.63	20.76	5.7	3.5	0.0	OK	OK
	B2	3/4 A325 - 1	DStlS11(99)	0.27	0.85	24.00	0.9	4.8	0.0	OK	OK
	B3	3/4 A325 - 1	DStlS22(94)	2.22	0.70	20.23	7.4	3.9	0.0	OK	OK
	B4	3/4 A325 - 1	DStlS22(94)	0.14	0.57	24.55	0.5	3.2	0.0	OK	OK
	B5	3/4 A325 - 1	DStlS11(99)	0.04	0.39	25.01	0.1	2.2	0.0	OK	OK
	B6	3/4 A325 - 1	DStlS22(94)	0.84	0.09	25.01	2.8	0.5	0.0	OK	OK
	B7	3/4 A325 - 1	DStlS21(84)	0.35	0.30	25.01	1.2	1.7	0.0	OK	OK
	B8	3/4 A325 - 1	DStlS20(89)	0.89	0.22	25.01	3.0	1.2	0.0	OK	OK
	B9	3/4 A325 - 1	DStlS21(84)	2.12	6.21	32.02	7.1	34.7	0.0	OK	OK
	B10	3/4 A325 - 1	DStlS21(84)	0.26	6.29	43.88	0.9	35.2	0.0	OK	OK
	B11	3/4 A325 - 1	DStlS21(84)	1.85	5.69	32.00	6.2	31.8	0.0	OK	OK
	B12	3/4 A325 - 1	DStlS21(84)	0.53	5.78	43.88	1.8	32.4	0.0	OK	OK
	B13	3/4 A325 - 1	DStlS22(94)	3.26	9.48	31.99	10.9	53.0	0.0	OK	OK
	B14	3/4 A325 - 1	DStlS22(94)	1.17	9.62	43.88	3.9	53.8	0.0	OK	OK
	B15	3/4 A325 - 1	DStlS22(94)	3.33	9.85	32.02	11.2	55.1	0.0	OK	OK
	B16	3/4 A325 - 1	DStlS22(94)	1.19	10.00	43.88	4.0	55.9	0.0	OK	OK
	B17	3/4 A325 - 1	DStlS22(94)	3.32	11.30	32.00	11.1	63.2	0.0	OK	OK
	B18	3/4 A325 - 1	DStlS22(94)	0.66	11.44	43.88	2.2	64.0	0.0	OK	OK
	B19	3/4 A325 - 1	DStlS22(94)	4.29	12.33	32.01	14.4	69.0	0.0	OK	OK
	B20	3/4 A325 - 1	DStlS22(94)	0.45	12.46	43.88	1.5	69.7	0.0	OK	OK
	B21	3/4 A325 - 1	DStlS22(94)	0.65	2.06	32.23	2.2	11.5	0.0	OK	OK
	B22	3/4 A325 - 1	DStlS22(94)	0.22	2.07	43.88	0.7	11.6	0.0	OK	OK
	B23	3/4 A325 - 1	DStlS22(94)	0.98	2.69	32.24	3.3	15.1	0.0	OK	OK
	B24	3/4 A325 - 1	DStlS22(94)	0.15	2.69	43.88	0.5	15.0	0.0	OK	OK
	B25	3/4 A325 - 1	DStlS21(84)	0.31	7.62	65.81	1.0	42.6	0.0	OK	OK
	B26	3/4 A325 - 1	DStlS21(84)	1.83	7.60	65.81	6.2	42.5	0.0	OK	OK
	B27	3/4 A325 - 1	DStlS21(84)	1.00	6.60	65.81	3.3	36.9	0.0	OK	OK
	B28	3/4 A325 - 1	DStlS21(84)	0.64	6.62	65.81	2.1	37.0	0.0	OK	OK

Design data

Grade	$\phi R_{n,tension}$ [kip]	$\phi R_{n,shear}$ [kip]
3/4 A325 - 1	29.79	17.88

Symbol explanation

F_t	Tension force
V	Resultant of bolt shear forces Vy and Vz in shear planes
$\phi R_{n,bearing}$	Bolt bearing resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
$\phi R_{n,tension}$	Bolt tension resistance - AISC 360-16 – J3.6
$\phi R_{n,shear}$	Bolt shear resistance - AISC 360-16 – J3.6

Detailed result for B20

Tension resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 29.79 \quad \text{kip} \quad \geq \quad F_t = \quad 0.45 \quad \text{kip}$$

Where:

$F_{nt} =$ 89.9 ksi – nominal tensile stress AISC 360-16 – Table J3.2

$A_b =$ 0.44 in^2 – gross bolt cross-sectional area

$\phi =$ 0.75 – resistance factor

Shear resistance check (AISC 360-16 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 17.88 \quad \text{kip} \quad \geq \quad V = \quad 12.46 \quad \text{kip}$$

Where:

$F_{nv} =$ 54.0 ksi – nominal shear stress AISC 360-16 – Table J3.2

$A_b =$ 0.44 in^2 – gross bolt cross-sectional area

$\phi =$ 0.75 – resistance factor

Bearing resistance check (AISC 360-16 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = \quad 43.88 \quad \text{kip} \quad \geq \quad V = \quad 12.46 \quad \text{kip}$$

Where:

$l_c =$ 2.19 in – clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material

$t =$ 0.50 in – thickness of the plate

$d =$ 0.75 in – diameter of a bolt

$F_u =$ 65.0 ksi – specified minimum tensile strength of the connected material

$\phi =$ 0.75 – resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-16 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
M49-tfl 1	M167-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS20(89)	0.62	3.71	16.8	6.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.95	0.66	DStlS20(89)	0.78	3.98	19.5	8.3	OK	OK
M49-tfl 1	M167-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.98	0.66	DStlS20(89)	1.19	3.90	30.4	12.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.98	0.66	DStlS20(89)	1.11	3.77	29.4	11.6	OK	OK
M49-tfl 1	M167-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.52	0.68	DStlS22(94)	2.60	6.06	43.0	21.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.52	0.68	DStlS22(94)	2.54	6.06	42.0	20.8	OK	OK
M49-w 1	FP1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.17	0.31	DStlS22(94)	0.55	2.73	20.0	9.4	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.21	0.31	DStlS20(89)	0.49	2.27	21.4	10.0	OK	OK
M49-w 1	FP2	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.21	0.31	DStlS22(94)	0.86	2.23	38.6	21.4	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	6.21	0.31	DStlS22(94)	1.04	2.35	44.2	25.4	OK	OK
M49-w 1	CPL1a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	21.46	1.02	DStlS22(94)	5.93	7.82	75.9	51.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	21.46	1.02	DStlS22(94)	6.15	8.18	75.2	50.1	OK	OK
M99-w 1	CPL1a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.21	0.68	DStlS11(99)	2.67	4.76	56.1	35.3	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	14.21	0.68	DStlS12(95)	1.46	4.90	29.7	14.3	OK	OK
CPL1b	CPL1c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.93	0.35	DStlS21(84)	1.72	3.09	55.6	32.4	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.93	0.35	DStlS21(84)	2.32	3.09	75.1	49.0	OK	OK
CPL1b	M114-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.96	0.44	DStlS21(84)	0.50	3.55	14.2	5.6	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS21(84)	0.42	2.81	14.9	6.7	OK	OK
CPL1b	M114-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS20(89)	0.28	2.84	9.9	0.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.96	0.44	DStlS20(89)	0.31	3.49	8.9	0.0	OK	OK
CPL1b	M114-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS21(84)	2.83	3.91	72.4	43.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS21(84)	2.78	3.91	71.2	41.8	OK	OK
M49-w 1	CPL2a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.96	0.95	DStlS22(94)	5.19	7.00	74.2	48.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.96	0.95	DStlS22(94)	4.61	6.82	67.5	44.5	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
M102-w 1	CPL2a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	18.69	0.67	DStlS12(95)	0.89	4.48	19.7	8.4	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	18.69	0.67	DStlS12(95)	1.14	4.20	27.2	14.1	OK	OK
CPL2b	CPL2c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.93	0.35	DStlS22(94)	2.46	3.09	79.5	64.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.93	0.35	DStlS22(94)	2.34	3.09	75.7	52.9	OK	OK
CPL2b	M250-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.96	0.44	DStlS22(94)	0.74	3.54	20.9	10.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS22(94)	0.65	2.86	22.6	11.6	OK	OK
CPL2b	M250-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS22(94)	0.50	2.88	17.5	8.4	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.96	0.44	DStlS22(94)	0.59	3.52	16.9	7.0	OK	OK
CPL2b	M250-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS22(94)	2.97	3.91	76.0	52.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS22(94)	2.96	3.91	75.9	51.9	OK	OK
M49-tfl 1	CPL3a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	22.96	1.04	DStlS20(89)	5.84	7.77	75.2	40.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	22.96	1.04	DStlS20(89)	5.86	7.78	75.3	42.6	OK	OK
CPL3b	CPL3c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.97	0.35	DStlS22(94)	2.37	3.06	77.4	63.4	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.97	0.35	DStlS22(94)	2.19	2.90	75.5	56.8	OK	OK
CPL3b	M174-bfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS22(94)	0.85	3.90	21.9	10.8	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS22(94)	0.28	3.05	9.3	0.0	OK	OK
CPL3b	M174-tfl 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS22(94)	0.32	2.92	10.9	0.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.93	0.44	DStlS22(94)	0.69	3.22	21.5	10.6	OK	OK
CPL3b	M174-w 1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS22(94)	1.73	3.78	45.9	28.5	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	7.50	0.44	DStlS22(94)	1.61	3.88	41.5	24.5	OK	OK
M99-tfl 1	CPL4a	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	19.94	0.66	DStlS20(89)	0.62	5.46	11.4	0.0	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	19.94	0.66	DStlS22(94)	1.28	5.18	24.6	10.5	OK	OK
CPL4b	CPL4c	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.93	0.31	DStlS22(94)	0.68	2.76	24.6	12.6	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	5.93	0.31	DStlS22(94)	0.45	2.76	16.3	6.6	OK	OK
M49-w 1	GUSS1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	18.78	1.04	DStlS22(94)	5.26	6.99	75.2	40.5	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	18.78	1.04	DStlS22(94)	5.22	6.95	75.1	39.9	OK	OK
M102-w 1	GUSS1	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	10.97	0.65	DStlS21(84)	1.89	4.70	40.1	21.7	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	10.97	0.65	DStlS21(84)	1.19	4.47	26.7	12.0	OK	OK
CPL4b	M315	E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.02	0.32	DStlS22(94)	0.51	2.86	18.0	8.2	OK	OK
		E70xx	◢ 3/16 ◣	◢ 1/4 ◣	17.02	0.32	DStlS22(94)	0.47	2.86	16.2	7.1	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Detailed result for CPL2b / CPL2c

Weld resistance check (AISC 360-16 – J2-4)

$$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} = \quad 3.09 \quad \text{kip} \quad \geq \quad F_n = \quad 2.46 \quad \text{kip}$$

Where:

$F_{nw} =$ 63.0 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 89.9° – angle of loading measured from the weld longitudinal axis

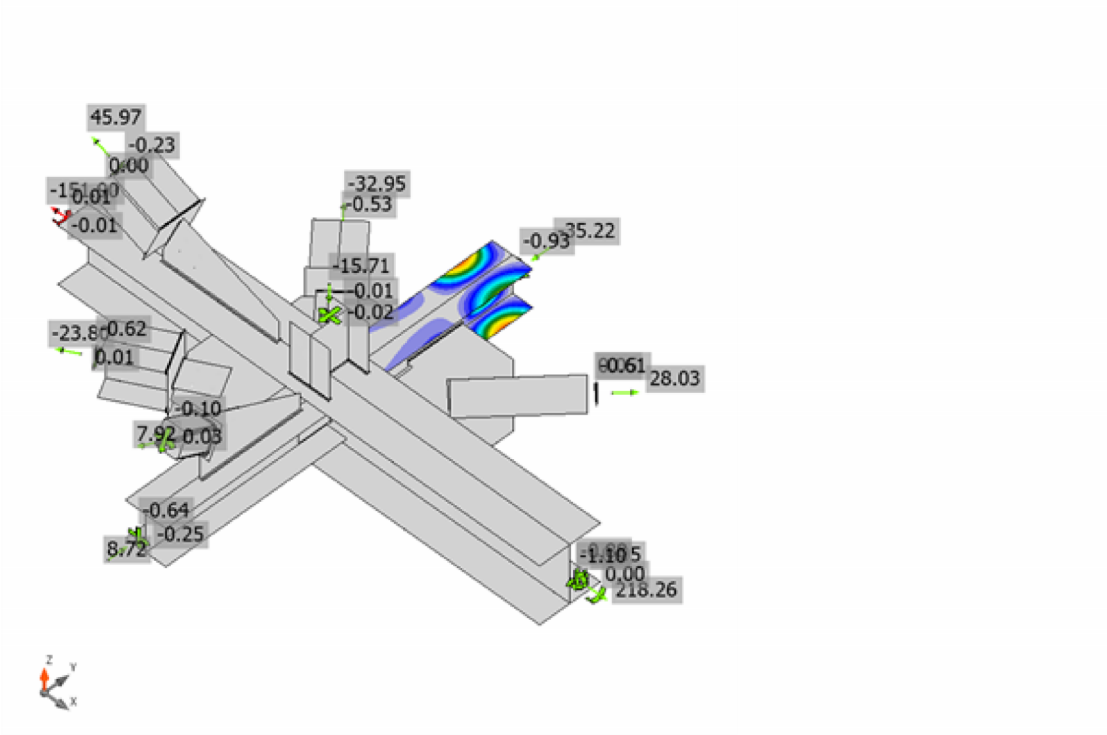
$A_{we} =$ 0.07 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Buckling

Loads	Shape	Factor [-]
DStlS22(94)	1	60.53
	2	63.85
	3	67.26
	4	69.22
	5	72.70
	6	79.63
DStlS12(95)	1	53.48
	2	59.71
	3	62.59
	4	65.29
	5	72.59
	6	75.67
DStlS27(96)	1	200.04
	2	204.90
	3	248.77
	4	300.50
	5	319.38
	6	357.14
DStlS1(97)	1	85.44
	2	93.85
	3	100.60
	4	106.25
	5	108.46
	6	111.51
DStlS28(98)	1	69.76
	2	77.86
	3	82.06
	4	85.52
	5	94.41
	6	99.06
DStlS11(99)	1	111.62
	2	119.61
	3	139.00
	4	167.10
	5	182.12
	6	198.39
DStlS21(84)	1	63.66
	2	70.50
	3	73.74
	4	76.54
	5	77.25
	6	78.37

Loads	Shape	Factor [-]
DStlS20(89)	1	51.26
	2	57.16
	3	59.60
	4	62.21
	5	68.52
	6	70.04



First buckling mode shape, DStlS20(89)

Code settings

Item	Value	Unit	Reference
Friction coefficient - concrete	0.40	-	ACI 349-01 – B.6.1.4
Friction coefficient in slip-resistance	0.30	-	AISC 360-16 – J3.8
Limit plastic strain	0.05	-	
Detailing	Yes		
Distance between bolts [d]	2.66	-	AISC 360-16 – J3.3
Concrete breakout resistance check	Both		
Base metal capacity check at weld fusion face	No		AISC 360-16 – J2-2
Deformation at bolt hole at service load is design consideration	Yes		AISC 360-16 – J3.10
Cracked concrete	Yes		ACI 318-14 – 17
Local deformation check	Yes		
Local deformation limit	0.03	-	CIDECT DG 1, 3 – 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints

Project:
Project no:
Author:

Project item A6 S521

Design

Name	A6 S521
Description	
Analysis	Capacity design
Design code	AISC 360-22 (LRFD) / ACI 318-19

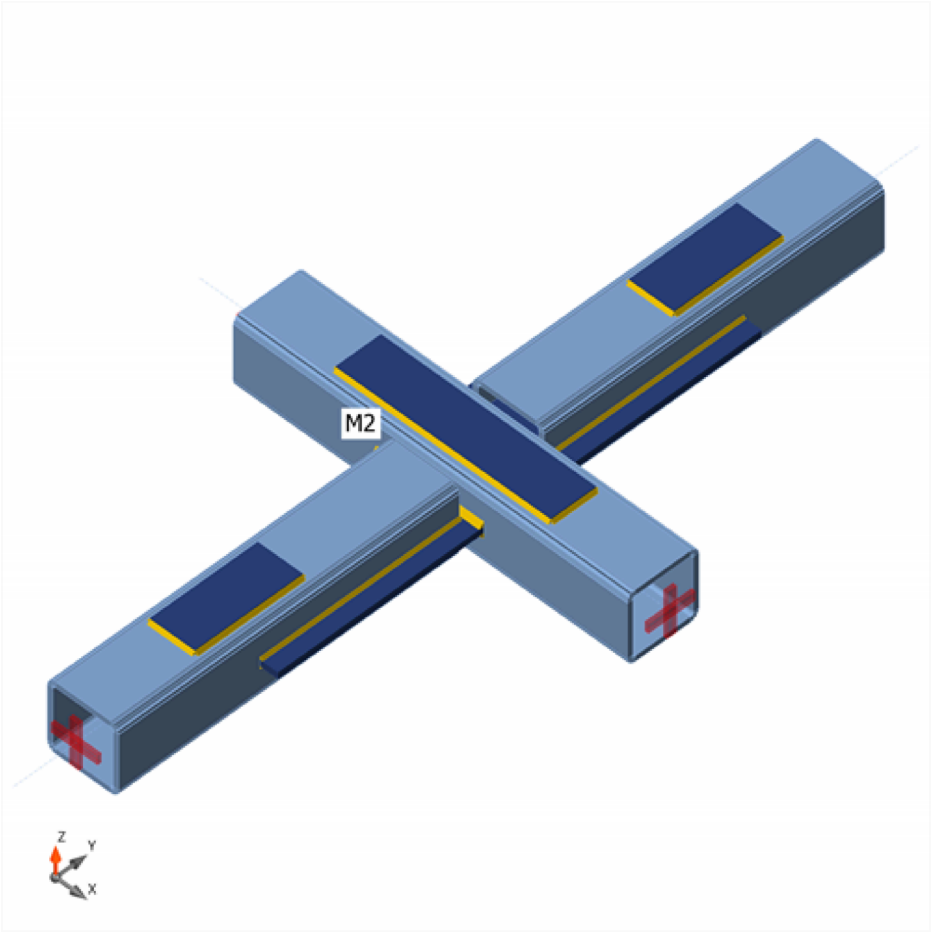
Members

Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M1	1 - HSS(Imp)8X8X5/8	90.0	0.0	0.0	0"	0"	0"
M2	1 - HSS(Imp)8X8X5/8	0.0	0.0	0.0	0"	0"	0"
M3	1 - HSS(Imp)8X8X5/8	-90.0	0.0	0.0	0"	0"	0"

Supports and forces

Name	Support	Forces in	X [in]
M1 / end	Mx-My-Mz	Position	4"3/4
M2 / begin	N-Vy-Vz-Mx-My-Mz	Node	0"
M2 / end	Mx-My-Mz	Node	0"
M3 / end	Mx-My-Mz	Position	4"3/4



Cross-sections

Name	Material
1 - HSS(Imp)8X8X5/8	A500. Gr. C

Load effects

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
LE-CD1	M1 / End	65.0	0.0	0.0	0.0	0.0	0.0
	M3 / End	65.0	0.0	0.0	0.0	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Welds	75.0 < 100%	OK
Buckling	Not calculated	
GMNA	Not calculated	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M1	A500. Gr. C *	5/8	LE-CD1	7.8	0.0	0.0	OK
M2	A500. Gr. C	5/8	LE-CD1	3.5	0.0	0.0	OK
M3	A500. Gr. C	5/8	LE-CD1	7.8	0.0	0.0	OK
SP1	A572 Gr.50	3/4	LE-CD1	7.3	0.0	0.0	OK
SP2	A572 Gr.50	1/2	LE-CD1	0.4	0.0	0.0	OK
SP3	A572 Gr.50	1/2	LE-CD1	0.4	0.0	0.0	OK
SP4	A572 Gr.50	1/2	LE-CD1	3.4	0.0	0.0	OK
SP5	A572 Gr.50	1/2	LE-CD1	3.4	0.0	0.0	OK
SP6	A572 Gr.50	1/2	LE-CD1	3.4	0.0	0.0	OK
SP7	A572 Gr.50	1/2	LE-CD1	3.4	0.0	0.0	OK

Design data

Material	Φ [-]	R_y [-]	F_y [ksi]	$F_{y,FEM}$ [ksi]	C_{pr} [-]	ε_{lim} [%]
A500. Gr. C *	-	1.30	50.0	65.0	1.12	5.0
A500. Gr. C	0.90	-	50.0	45.0	-	5.0
A572 Gr.50	0.90	-	50.0	45.0	-	5.0

Symbol explanation

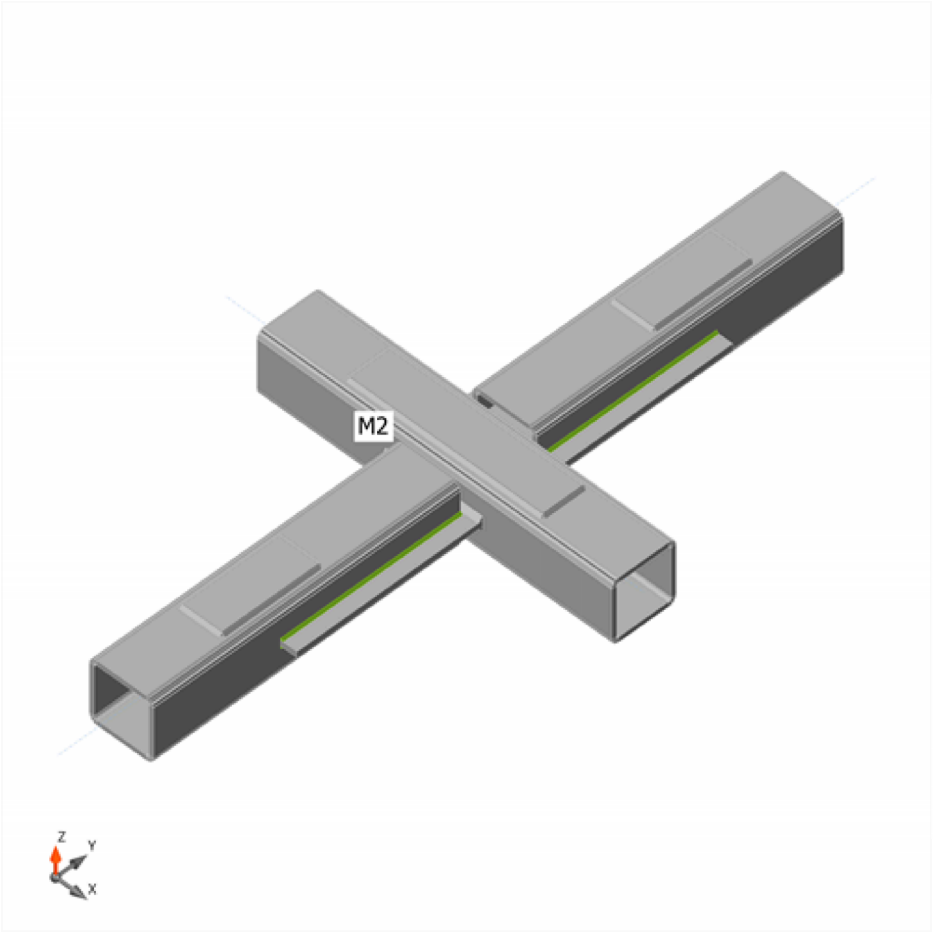
t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
Φ	Safety factor
R_y	Material overstrength factor
F_y	Yield strength
$F_{y,FEM}$	Yield strength used in finite element analysis
C_{pr}	Strain hardening
ε_{lim}	Limit of plastic strain
*	Dissipative item

Loc. deformation

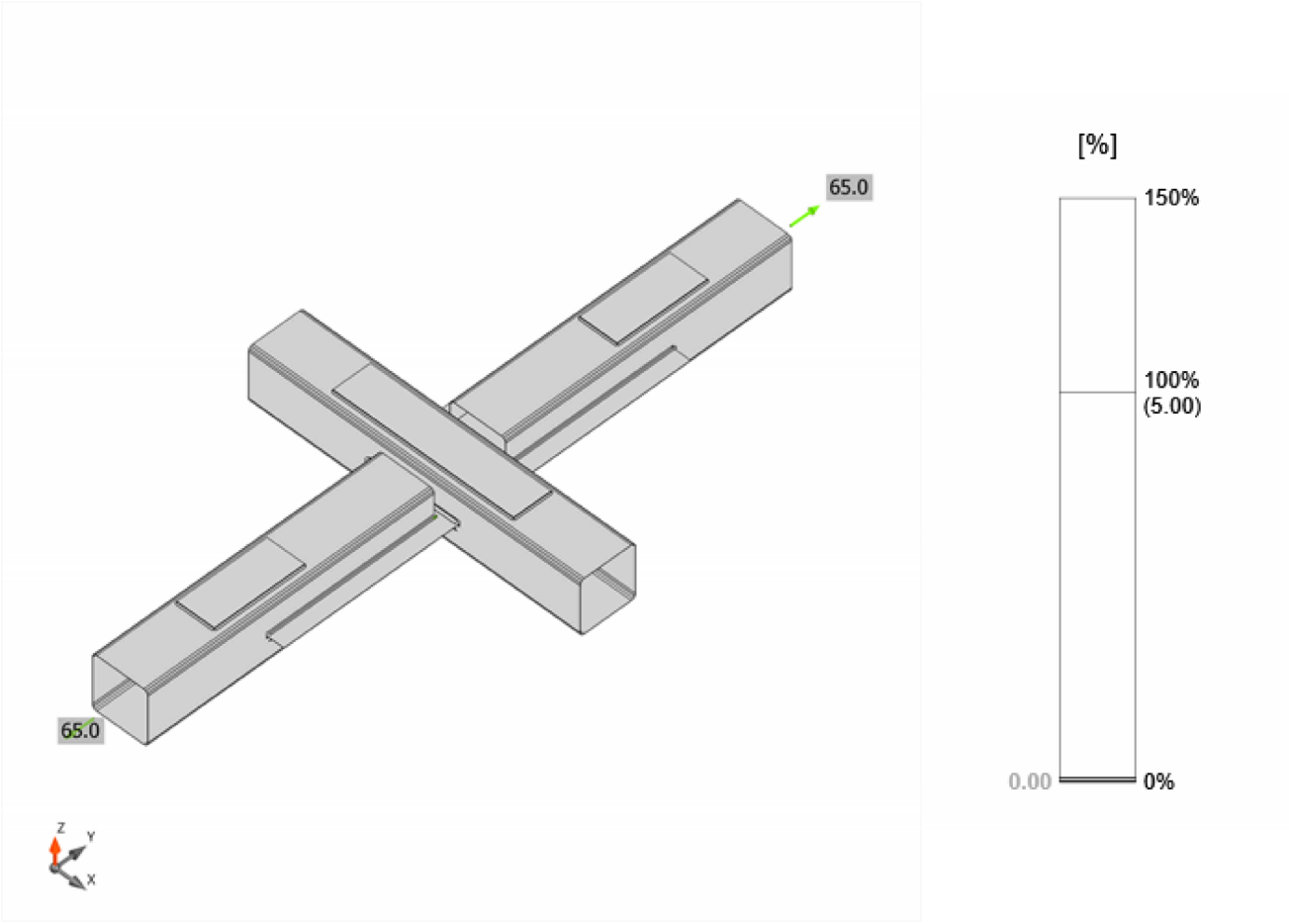
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M1	8"	LE-CD1	0"	1/4	0.0	OK
M2	8"	LE-CD1	0"	1/4	0.0	OK
M3	8"	LE-CD1	0"	1/4	0.0	OK

Symbol explanation

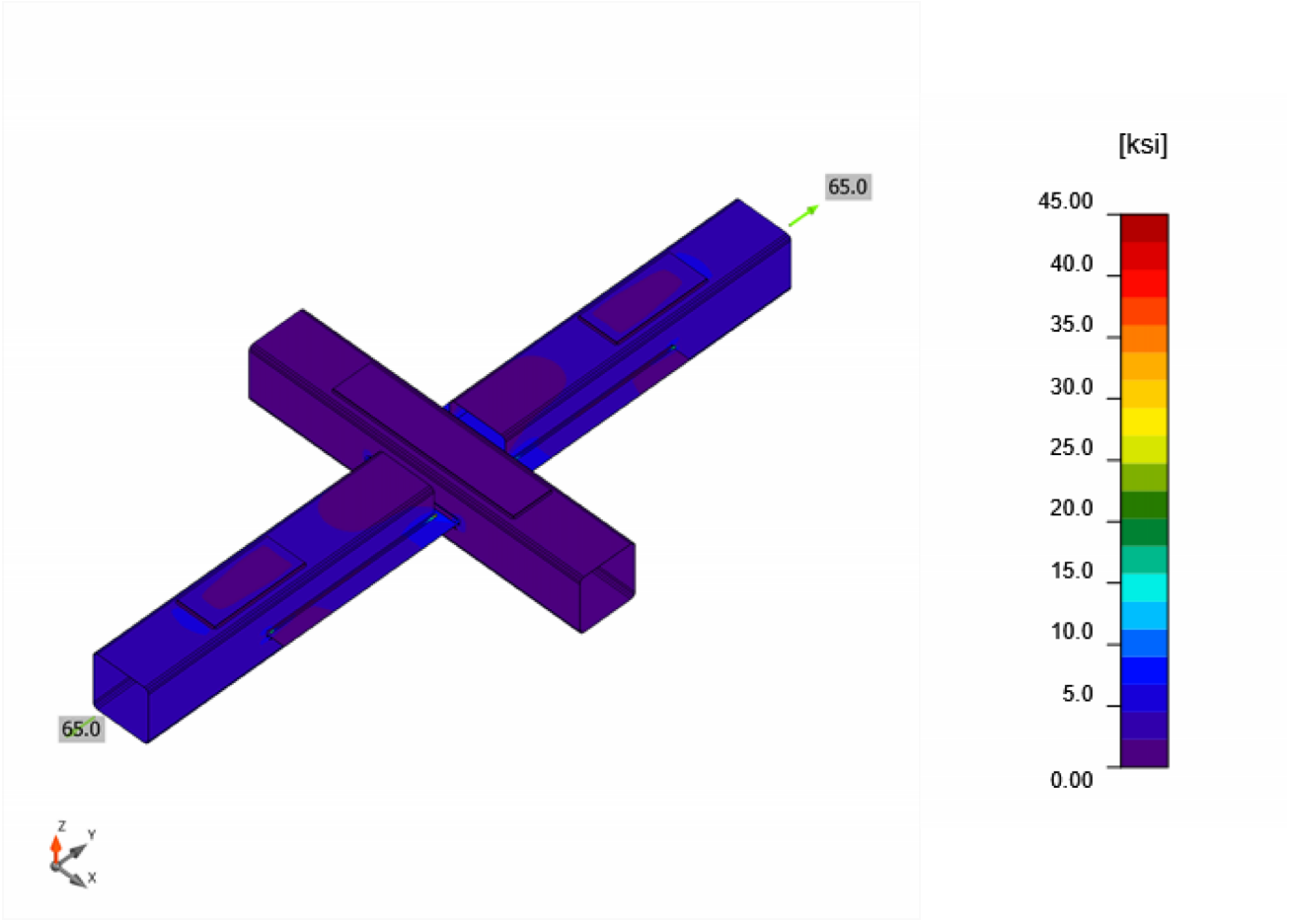
d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation



Overall check, LE-CD1



Strain check, LE-CD1



Equivalent stress, LE-CD1

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
SP1	M1-w 2	E70xx	◢ 3/16	◢ 1/4	1'-10"3/16	1/2	LE-CD1	2.3	3.1	75.0	48.7	OK	OK
SP1	M1-w 2	E70xx	◢ 3/16	◢ 1/4	1'-10"3/16	1/2	LE-CD1	2.3	3.1	75.0	40.9	OK	OK
SP1	M1-w 4	E70xx	◢ 3/16	◢ 1/4	1'-10"3/16	1/2	LE-CD1	2.3	3.1	75.0	48.7	OK	OK
SP1	M1-w 4	E70xx	◢ 3/16	◢ 1/4	1'-10"3/16	1/2	LE-CD1	2.3	3.1	75.0	40.9	OK	OK
SP1	M3-w 2	E70xx	◢ 3/16	◢ 1/4	1'-10"3/16	1/2	LE-CD1	2.3	3.1	75.0	48.7	OK	OK
SP1	M3-w 2	E70xx	◢ 3/16	◢ 1/4	1'-10"3/16	1/2	LE-CD1	2.3	3.1	75.0	40.8	OK	OK
SP1	M3-w 4	E70xx	◢ 3/16	◢ 1/4	1'-10"3/16	1/2	LE-CD1	2.3	3.1	75.0	48.7	OK	OK
SP1	M3-w 4	E70xx	◢ 3/16	◢ 1/4	1'-10"3/16	1/2	LE-CD1	2.3	3.1	75.0	40.8	OK	OK
SP1	M2-w 2	E70xx	◢ 3/8	◢ 1/2	11"15/16	1/2	LE-CD1	0.9	5.9	15.2	5.4	OK	OK
SP1	M2-w 2	E70xx	◢ 3/8	◢ 1/2	11"15/16	1/2	LE-CD1	0.9	5.9	15.2	5.4	OK	OK
SP1	M2-w 4	E70xx	◢ 3/8	◢ 1/2	11"15/16	1/2	LE-CD1	0.9	5.9	15.2	5.4	OK	OK
SP1	M2-w 4	E70xx	◢ 3/8	◢ 1/2	11"15/16	1/2	LE-CD1	0.9	5.9	15.2	5.4	OK	OK
M1-w 3	SP6	E70xx	◢ 1/4	◢ 5/16	4"15/16	1/2	LE-CD1	0.3	5.5	5.9	0.0	OK	OK
M1-w 3	SP6	E70xx	◢ 1/4	◢ 5/16	11"15/16	1/2	LE-CD1	0.3	4.0	7.5	0.0	OK	OK
M1-w 3	SP6	E70xx	◢ 1/4	◢ 5/16	5"	1/2	LE-CD1	0.3	5.3	4.9	0.0	OK	OK
M1-w 3	SP6	E70xx	◢ 1/4	◢ 5/16	11"15/16	1/2	LE-CD1	0.3	4.0	7.5	0.0	OK	OK
M3-w 3	SP5	E70xx	◢ 1/4	◢ 3/8	4"15/16	1/2	LE-CD1	0.3	5.8	5.8	0.0	OK	OK
M3-w 3	SP5	E70xx	◢ 1/4	◢ 3/8	11"15/16	1/2	LE-CD1	0.3	4.2	7.2	0.0	OK	OK
M3-w 3	SP5	E70xx	◢ 1/4	◢ 3/8	4"15/16	1/2	LE-CD1	0.3	5.8	4.7	0.0	OK	OK
M3-w 3	SP5	E70xx	◢ 1/4	◢ 3/8	11"15/16	1/2	LE-CD1	0.3	4.2	7.2	0.0	OK	OK
M3-w 1	SP4	E70xx	◢ 1/4	◢ 5/16	4"15/16	1/2	LE-CD1	0.3	5.5	6.1	0.0	OK	OK
M3-w 1	SP4	E70xx	◢ 1/4	◢ 5/16	11"15/16	1/2	LE-CD1	0.3	4.0	7.6	0.0	OK	OK
M3-w 1	SP4	E70xx	◢ 1/4	◢ 5/16	4"15/16	1/2	LE-CD1	0.3	5.5	5.0	0.0	OK	OK
M3-w 1	SP4	E70xx	◢ 1/4	◢ 5/16	11"15/16	1/2	LE-CD1	0.3	4.0	7.6	0.0	OK	OK
M1-w 1	SP7	E70xx	◢ 1/4	◢ 5/16	4"15/16	1/2	LE-CD1	0.3	5.5	5.9	0.0	OK	OK
M1-w 1	SP7	E70xx	◢ 1/4	◢ 5/16	11"15/16	1/2	LE-CD1	0.3	4.0	7.5	0.0	OK	OK
M1-w 1	SP7	E70xx	◢ 1/4	◢ 5/16	5"	1/2	LE-CD1	0.3	5.3	4.9	0.0	OK	OK
M1-w 1	SP7	E70xx	◢ 1/4	◢ 5/16	11"15/16	1/2	LE-CD1	0.3	4.0	7.5	0.0	OK	OK
M2-w 3	SP2	E70xx	◢ 1/4	◢ 5/16	1'-11"13/16	1/2	LE-CD1	0.0	4.6	0.8	0.0	OK	OK
M2-w 3	SP2	E70xx	◢ 1/4	◢ 5/16	4"15/16	1/2	LE-CD1	0.0	4.8	0.3	0.0	OK	OK
M2-w 3	SP2	E70xx	◢ 1/4	◢ 5/16	1'-11"13/16	1/2	LE-CD1	0.0	4.6	0.8	0.0	OK	OK
M2-w 3	SP2	E70xx	◢ 1/4	◢ 5/16	4"15/16	1/2	LE-CD1	0.0	4.8	0.3	0.0	OK	OK
M2-w 1	SP3	E70xx	◢ 1/4	◢ 5/16	1'-11"13/16	1/2	LE-CD1	0.0	4.6	0.8	0.0	OK	OK
M2-w 1	SP3	E70xx	◢ 1/4	◢ 5/16	4"15/16	1/2	LE-CD1	0.0	4.8	0.3	0.0	OK	OK
M2-w 1	SP3	E70xx	◢ 1/4	◢ 5/16	1'-11"13/16	1/2	LE-CD1	0.0	4.6	0.8	0.0	OK	OK
M2-w 1	SP3	E70xx	◢ 1/4	◢ 5/16	4"15/16	1/2	LE-CD1	0.0	4.8	0.3	0.0	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

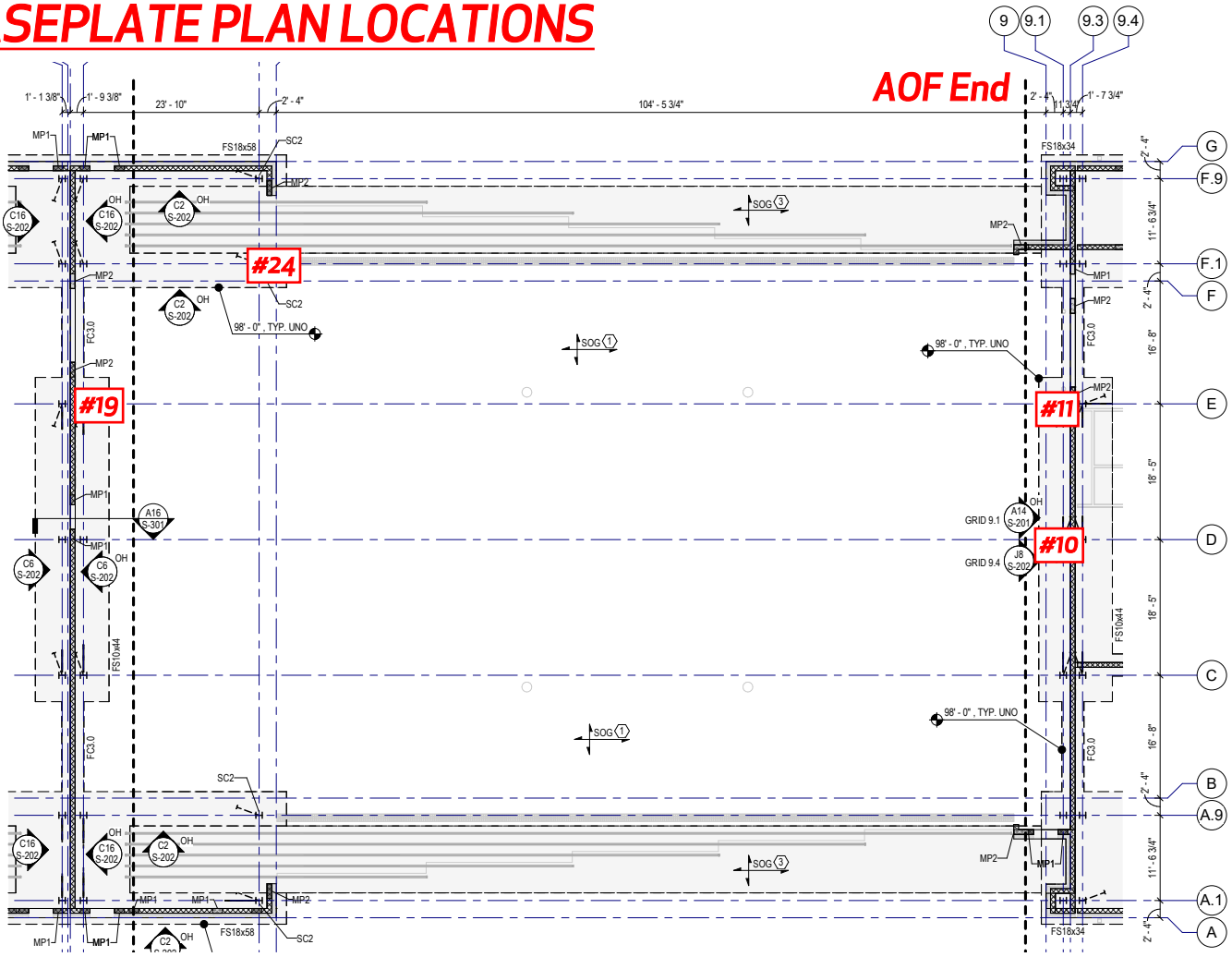
t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-22 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Code settings

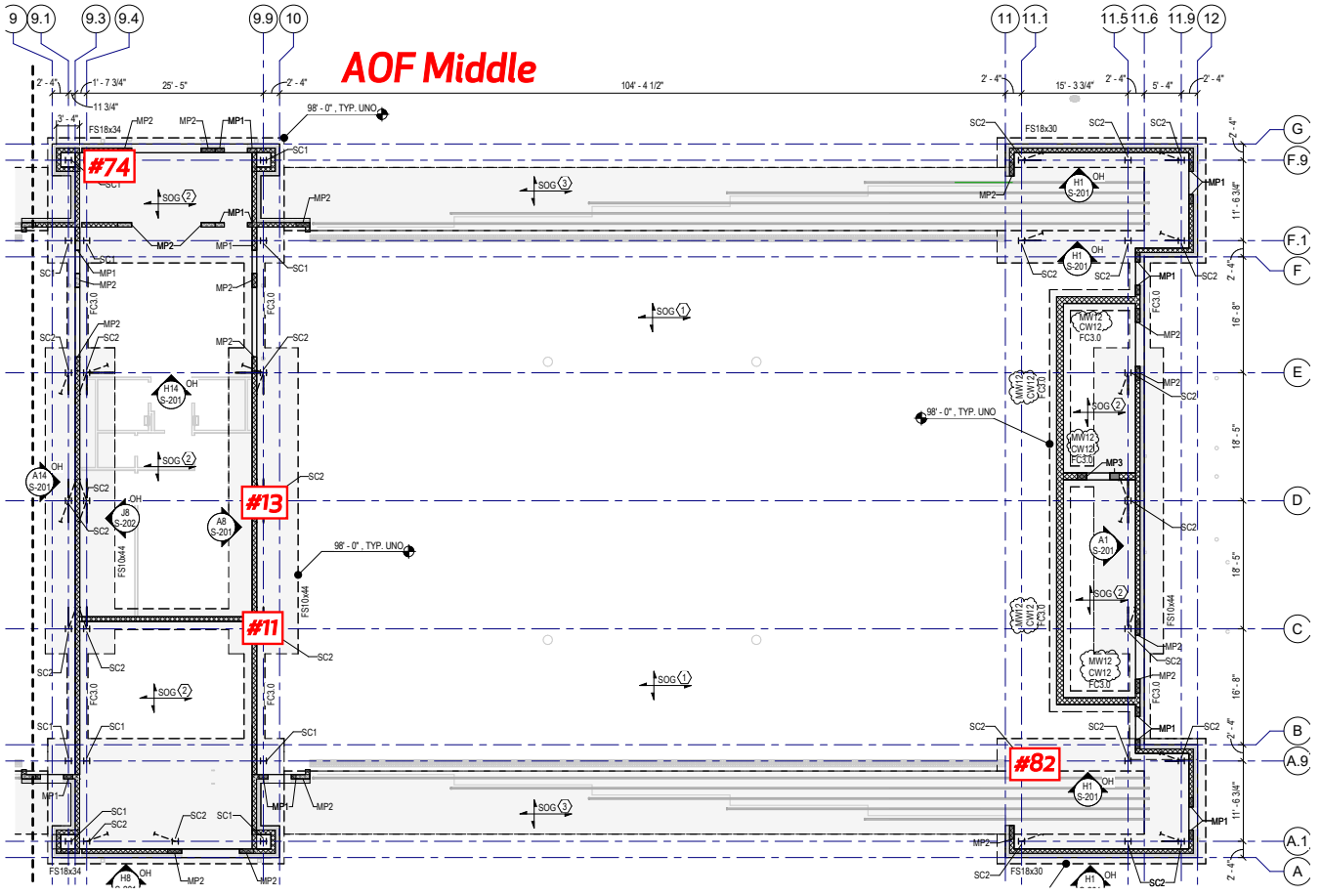
Item	Value	Unit	Reference
Friction coefficient - concrete	0.40	-	ACI 349-01 – B.6.1.4
Friction coefficient in slip-resistance	0.30	-	AISC 360-22 – J3.9
Limit plastic strain	0.05	-	
Detailing	Yes		
Distance between bolts [d]	2.66	-	AISC 360-22 – J3.4
Concrete breakout resistance check	Both		
Base metal capacity check at weld fusion face	No		AISC 360-22 – J2-2
Deformation at bolt hole at service load is design consideration	Yes		AISC 360-22 – J3.11
Cracked concrete	Yes		ACI 318-19 – 17
Local deformation check	Yes		
Local deformation limit	0.03	-	CIDECT DG 1, 3 – 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints

BASEPLATE PLAN LOCATIONS

AOF End



AOF Middle



Project: **AOF Baseplate Connection (Model 1)**
Project no: **203434**
Author: **Allison Valencia**

Project data

Project name	AOF Baseplate Connection (Model 1)
Project number	203434
Author	Allison Valencia
Description	
Date	3/26/2025
Code	AISC/ACI

Material

Steel	A992, A572 Gr.50
Concrete	4000 psi

Project:	**AOF Baseplate Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**

AOF End - Baseplate Connection

IDEA StatiCa® Calculate yesterday's estimates

Project item 11

Design

Name	11
Description	
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC - LRFD (2016)

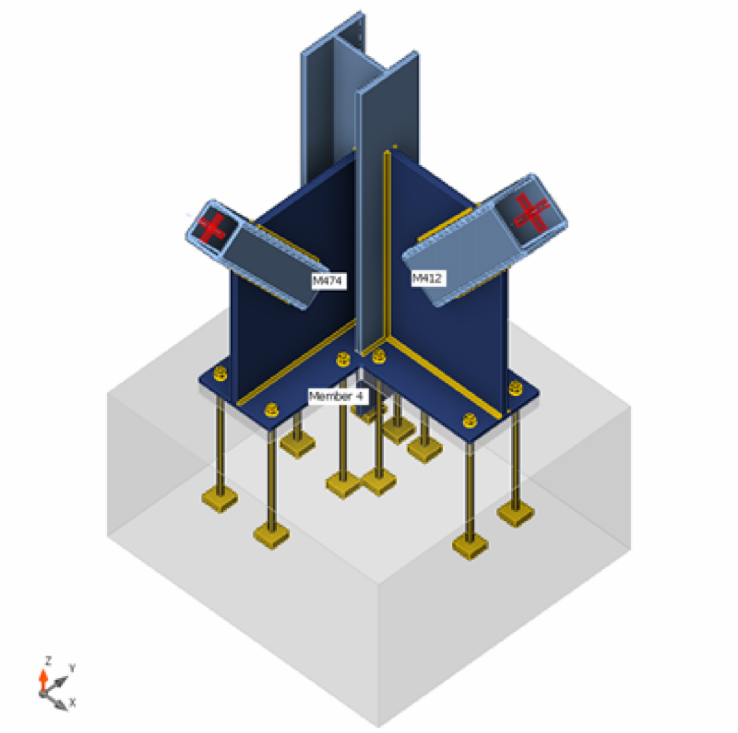
Members

Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M11	121 - W10X68	0.0	90.0	-180.0	0.00	0.00	0.00
M412	127 - HSS8X8X1/2(HSS8X8X1/2(HSS8X8X1/2(HSS(Imp)8X8X1/2)))	0.0	52.3	0.0	0.00	0.00	0.00
M474	133 - HSS6X6X1/2(HSS6X6X1/2(HSS6X6X1/2(HSS(Imp)6X6X1/2)))	-90.0	52.0	0.0	0.00	0.00	0.00

Supports and forces

Name	Support	Forces in	X [in]
M11 / end		Position	0.00
M412 / end	Mx-My-Mz	Connected member face	8.50
M474 / end	Mx-My-Mz	Connected member face	0.38



Project:	**AOF Baseplate Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**

Cross-sections

Name	Material
121 - W10X68	A992
127 - HSS8X8X1/2(HSS8X8X1/2(HSS8X8X1/2(HSS(Imp)8X8X1/2)))	A992
133 - HSS6X6X1/2(HSS6X6X1/2(HSS6X6X1/2(HSS(Imp)6X6X1/2)))	A992
3644 - W(Imp)10X68	A992

Anchors

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
3/4 F1554 Gr.55	0.75	55.0	75.0	0.44

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS48-1(1)	M11 / End	-44.88	0.01	-0.18	0.00	-0.03	0.03
	M412 / End	78.65	0.01	-0.41	0.00	0.00	0.00
	M474 / End	-39.59	0.00	-0.16	0.00	0.00	0.00
DStlS53-1(2)	M11 / End	5.39	-0.01	-0.15	0.00	0.00	0.00
	M412 / End	44.74	-0.01	-0.24	0.00	0.00	0.00
	M474 / End	17.77	0.00	-0.09	0.00	0.00	0.00
DStlS16(3)	M11 / End	-35.98	0.02	-0.16	0.03	-0.09	0.11
	M412 / End	74.25	0.01	-0.38	0.00	0.00	0.00
	M474 / End	-32.86	-0.01	-0.14	0.00	0.00	0.00
DStlS41(4)	M11 / End	-8.60	-0.01	-0.21	-0.03	0.05	-0.07
	M412 / End	63.14	-0.01	-0.28	0.00	0.00	0.00
	M474 / End	8.35	0.01	-0.10	0.00	0.00	0.00
DStlS33(8)	M11 / End	-34.02	0.00	-0.34	-0.01	0.00	-0.01
	M412 / End	120.53	0.00	-0.39	0.00	0.00	0.00
	M474 / End	-12.04	0.01	-0.14	0.00	0.00	0.00
DStlS1(11)	M11 / End	-26.60	0.00	-0.22	0.00	-0.02	0.02
	M412 / End	82.13	0.00	-0.43	0.00	0.00	0.00
	M474 / End	-14.69	0.00	-0.16	0.00	0.00	0.00

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS48-1(1)	48.24	24.25	-14.19	0.02	0.32	0.00
DStlS53-1(2)	27.40	-11.01	54.59	0.01	0.17	0.00
DStlS16(3)	45.53	20.11	-3.45	0.11	0.35	0.03
DStlS41(4)	38.64	-5.22	47.70	-0.07	0.15	-0.03
DStlS33(8)	73.68	7.31	51.54	-0.01	0.28	-0.01
DStlS1(11)	50.35	8.92	26.44	0.02	0.33	0.00

Project:	**AOF Baseplate Connection (Model 1)**
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Foundation block

Item	Value	Unit
CB 1		
Dimensions	44.10 x 47.40	in
Depth	25.00	in
Anchor	3/4 F1554 Gr.55	
Anchoring length	18.00	in
Shear force transfer	Shear lug	
Cross-section of shear lug	W(Imp)10X68	
Length of shear lug	10.00	in
Mortar joint	2.00	in

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Anchors	75.2 < 100%	OK
Welds	69.6 < 100%	OK
Concrete block	13.4 < 100%	OK
Shear	43.6 < 100%	OK
Buckling	Not calculated	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M11-bfl 1	A992	3/4	DStlS33(8)	22.3	0.0	0.0	OK
M11-tfl 1	A992	3/4	DStlS33(8)	14.8	0.0	0.0	OK
M11-w 1	A992	1/2	DStlS33(8)	11.2	0.0	0.0	OK
M412	A992	1/2	DStlS33(8)	25.3	0.0	0.0	OK
M474	A992	1/2	DStlS33(8)	8.3	0.0	0.0	OK
Member 4-bfl 1	A992	3/4	DStlS33(8)	30.6	0.0	0.0	OK
Member 4-tfl 1	A992	3/4	DStlS33(8)	32.1	0.0	0.0	OK
Member 4-w 1	A992	7/16	DStlS33(8)	26.3	0.0	0.0	OK
BP1	A572 Gr.50	3/4	DStlS33(8)	36.3	0.0	0.0	OK
GUSS1	A572 Gr.50	1"	DStlS48-1(1)	5.5	0.0	0.0	OK
GUSS2	A572 Gr.50	1"	DStlS33(8)	12.9	0.0	0.0	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for M11-bfl 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y = 50.0$ ksi – characteristic yield strength

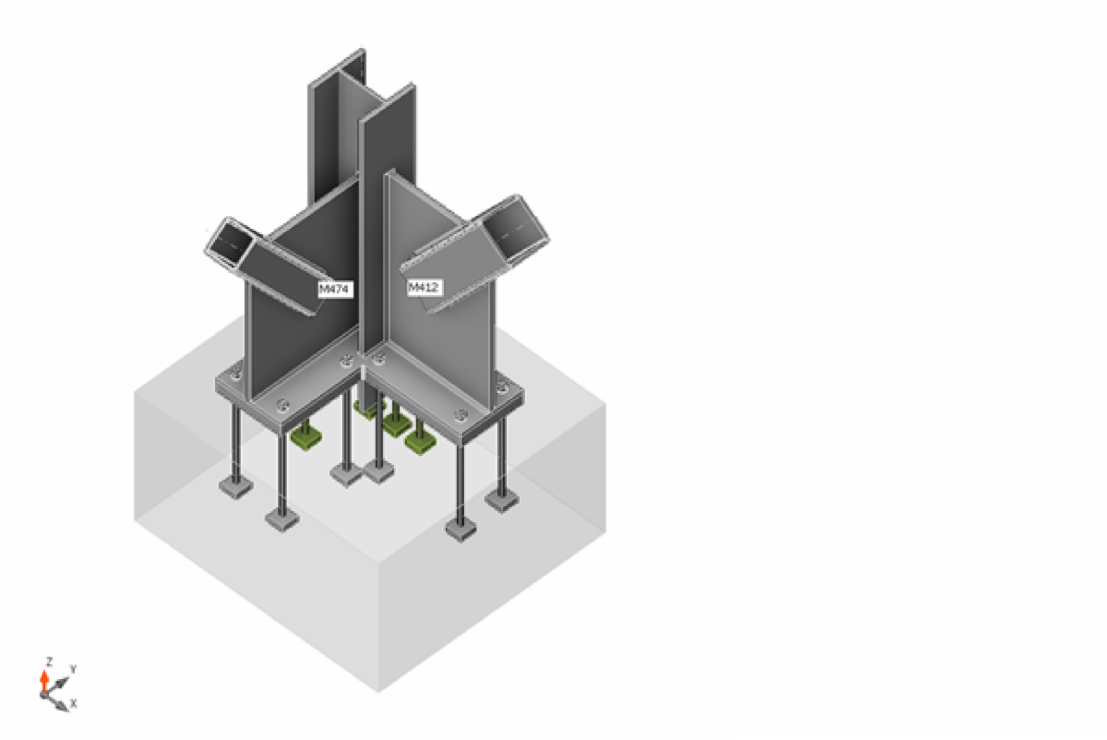
$\phi = 0.90$ – resistance factor for steel material AISC 360-16 – B3.1

Loc. deformation

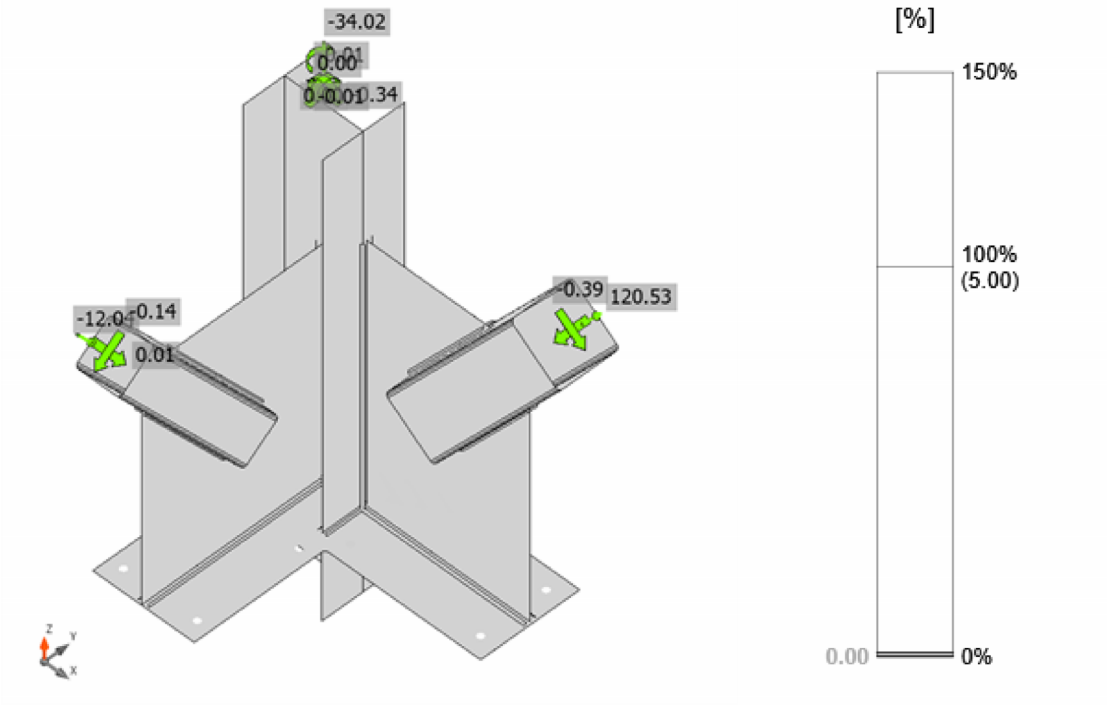
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M412	7.99	DStlS1(11)	0.00	0.24	0.0	OK
M474	5.98	DStlS1(11)	0.00	0.18	0.0	OK

Symbol explanation

d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation



Overall check, DStlS33(8)



Strain check, DStlS33(8)

Project:	**AOF Baseplate Connection (Model 1)**
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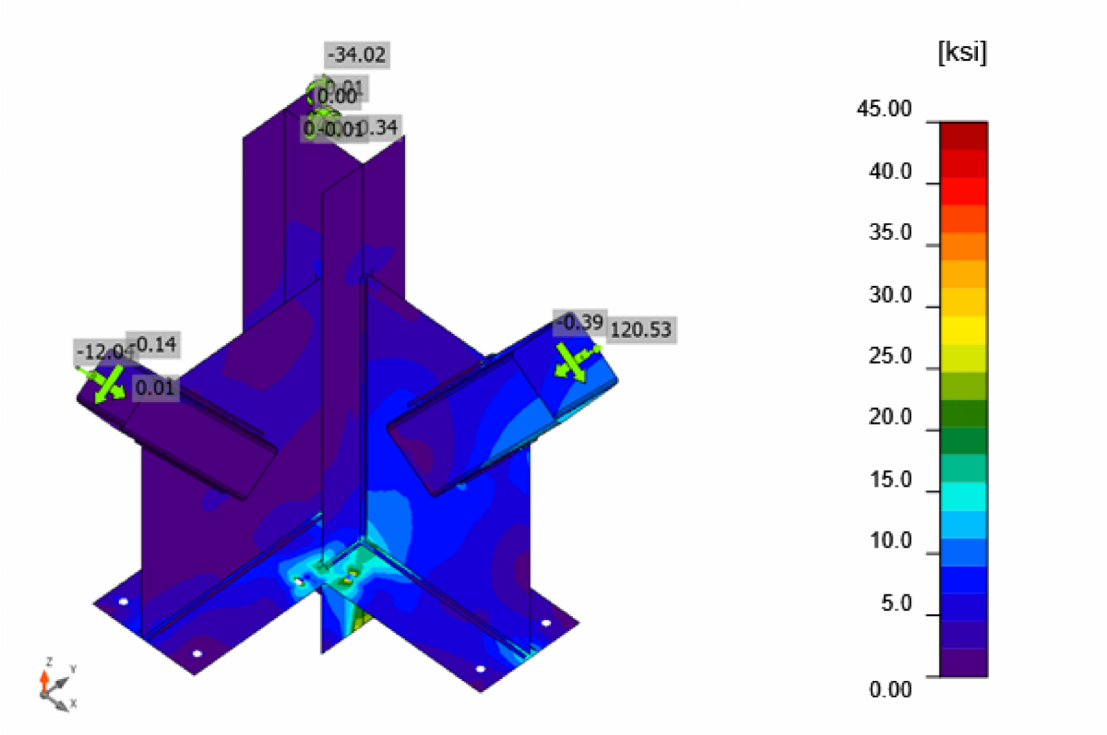
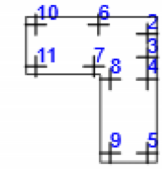


Equivalent stress, DStlS33(8)

Anchors

Shape	Item	Loads	N_f [kip]	ϕN_p [kip]	ϕN_{sb} [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	A2	DStlS33(8)	13.19	191.70	102.23	75.2	0.0	62.2	OK	OK
	A3	DStlS33(8)	13.05	191.70	102.23	74.4	0.0	61.1	OK	OK
	A4	DStlS33(8)	12.91	191.70	102.23	73.6	0.0	60.0	OK	OK
	A5	DStlS53-1(2)	0.21	191.70	102.23	1.2	0.0	0.1	OK	OK
	A6	DStlS33(8)	13.19	191.70	102.23	75.2	0.0	62.2	OK	OK
	A7	DStlS33(8)	9.43	191.70	102.23	53.8	0.0	35.5	OK	OK
	A8	DStlS33(8)	9.37	191.70	102.23	53.5	0.0	35.2	OK	OK
	A9	DStlS48-1(1)	0.07	191.70	102.23	0.4	0.0	0.0	OK	OK
	A10	DStlS33(8)	3.24	191.70	102.23	18.5	0.0	6.0	OK	OK
	A11	DStlS33(8)	1.41	191.70	102.23	8.0	0.0	1.5	OK	OK

Design data

Grade	ϕN_{sa} [kip]
3/4 F1554 Gr.55 - 1	17.53

Symbol explanation

N_f	Tension force
ϕN_p	Pullout strength in tension – ACI 318-14 – 17.4.3
ϕN_{sb}	Concrete side-face blowout strength in tension – ACI 318-14 – 17.4.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
ϕN_{sa}	Steel strength of anchor in tension - ACI 318-14 – 17.4.1

Detailed result for A2

Concrete splitting failure during installation should be evaluated by ACI 355.2 requirements.

Anchor tensile resistance (ACI 318-14 – 17.4.1)

$$\phi N_{sa} = \phi \cdot A_{se,N} \cdot f_{uta} = \quad 17.53 \quad \text{kip} \quad \geq \quad N_f = \quad 13.19 \quad \text{kip}$$

Where:

$\phi = 0.70$ – resistance factor

$A_{se,N} = 0.33$ in^2 – tensile stress area

$f_{uta} = 75.0$ ksi – specified tensile strength of anchor steel:

- $f_{uta} = \min(125 \text{ ksi}, 1.9 \cdot f_{ya},\ f_u)$, where:
  - $f_{ya} =$ 55.0 ksi – specified yield strength of anchor steel
  - $f_u =$ 75.0 ksi – specified ultimate strength of anchor steel

Concrete pullout resistance (ACI 318-14 – 17.4.3)

$$\phi N_{pn} = \phi \cdot \Psi_{c,P} \cdot N_p = \quad 191.70 \quad \text{kip} \quad \geq \quad N_f = \quad 13.19 \quad \text{kip}$$

Where:

$\phi = 0.70$ – resistance factor

$\Psi_{c,P} = 1.00$ – modification factor for concrete condition

$N_p = 273.86$ kip – basic concrete pullout strength for headed anchor:

- $N_{pr} = 8 \cdot A_{brg} \cdot f'_c$, where:
  - $A_{brg} =$ 8.56 in^2 – bearing area of the head of stud or anchor bolt
  - $f'_c =$ 4.0 ksi – concrete compressive strength

Concrete sideface blowout resistance (ACI 318-14 – 17.4.4)

$\phi N_{sb} = r_c \cdot N_{sbg} =$ 102.23 kip ≥ $N_f =$ 13.19 kip

Where:

$r_c = 0.51$ – reduction factor for anchor close to an edge or multiple anchors with small spacing:

- $r_c = \min(\frac{1+\frac{c_{a2}}{c_{a1}}}{4}, \frac{1+\frac{s}{6 \cdot c_{a1}}}{2}),\ 0.5 \ \leq r_c \leq 1$, where:
  - $c_{a1} =$ 9.70 in – shorter distance from an anchor to an edge
  - $c_{a2} =$ 10.05 in – longer distance from an anchor to an edge
  - $s =$ 1.00 in – spacing between anchors

$N_{sbg} = 201.01$ kip – concrete side-face blowout strength of headed anchor in tension:

- $N_{sb} = \phi \cdot 160.0 \cdot c_{a1} \cdot \sqrt{A_{bgr}} \cdot \sqrt{f'_c}$, where:
  - $A_{bgr} =$ 8.56 in^2 – bearing area of the head of stud or anchor bolt
  - $f'_c =$ 4.0 ksi – concrete compressive strength
  - $\phi =$ 0.70 – resistance factor

Interaction of tensile and shear forces (ACI 318-14 – R17.6)

${U_{tt}}^{5/3} + {U_{ts}}^{5/3} =$ 0.62 ≤ 1.0

Where:

$U_{tt} = 0.75$ – maximum ratio of factored tensile force and tensile resistance determined from all appropriate failure modes

$U_{ts} = 0.00$ – maximum ratio of factored shear force and shear resistance determined from all appropriate failure modes

Supplementary reinforcement (ACI 318-14 – 17.4.2.9)

Supplementary reinforcement should resist force of 75.77 kip in tension.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
BP1	M11-bfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10.05	0.84	DStlS33(8)	4.71	6.76	69.6	44.8	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10.08	0.84	DStlS53-1(2)	4.76	8.22	57.9	37.6	OK	OK
BP1	M11-tfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10.08	0.84	DStlS33(8)	4.53	8.80	51.4	33.5	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10.08	0.84	DStlS33(8)	4.72	9.67	48.8	27.3	OK	OK
BP1	M11-w 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9.59	0.87	DStlS33(8)	1.80	7.65	23.6	11.9	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9.61	0.87	DStlS33(8)	2.84	9.76	29.1	12.0	OK	OK
BP1	Member 4-bfl 1	E70xx	-	-	10.12	-	-	-	-	-	-	OK	OK
BP1	Member 4-tfl 1	E70xx	-	-	10.12	-	-	-	-	-	-	OK	OK
BP1	Member 4-w 1	E70xx	-	-	9.62	-	-	-	-	-	-	OK	OK
M11-w 1	GUSS1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	28.44	0.86	DStlS53-1(2)	2.59	8.55	30.3	14.5	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	28.44	0.86	DStlS53-1(2)	2.68	8.84	30.4	14.5	OK	OK
BP1	GUSS1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	21.79	1.45	DStlS33(8)	2.96	17.47	16.9	7.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	21.79	1.45	DStlS33(8)	4.11	15.51	26.5	11.8	OK	OK
GUSS1	M474-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	15.66	0.51	DStlS48-1(1)	0.99	3.82	25.8	9.5	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	15.66	0.51	DStlS48-1(1)	1.02	3.69	27.6	10.1	OK	OK
GUSS1	M474-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	15.66	0.51	DStlS48-1(1)	0.99	3.76	26.3	11.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	15.66	0.51	DStlS48-1(1)	1.04	3.65	28.5	12.7	OK	OK
GUSS1	M474-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	17.07	0.50	DStlS48-1(1)	1.01	3.64	27.8	10.8	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	17.07	0.50	DStlS48-1(1)	0.97	3.68	26.4	10.0	OK	OK
GUSS1	M474-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	17.07	0.50	DStlS48-1(1)	1.02	3.61	28.3	12.6	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	17.07	0.50	DStlS48-1(1)	1.00	3.64	27.6	12.2	OK	OK
M11-tfl 1	GUSS2	E70xx	◢ 3/8 ◣	◢ 1/2 ◣	32.43	0.85	DStlS33(8)	4.48	11.21	40.0	21.8	OK	OK
		E70xx	◢ 3/8 ◣	◢ 1/2 ◣	32.43	0.85	DStlS33(8)	4.70	11.00	42.7	24.0	OK	OK
BP1	GUSS2	E70xx	◢ 3/8 ◣	◢ 1/2 ◣	19.97	1.54	DStlS33(8)	7.32	21.44	34.1	15.4	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
		E70xx	◢ 3/8 ◣	◢ 1/2 ◣	19.97	1.54	DStlS33(8)	7.45	21.31	35.0	16.7	OK	OK
GUSS2	M412-w 1	E70xx	◢ 5/16 ◣	◢ 7/16 ◣	13.15	0.51	DStlS33(8)	2.99	5.36	55.8	29.8	OK	OK
		E70xx	◢ 5/16 ◣	◢ 7/16 ◣	13.15	0.51	DStlS33(8)	3.09	5.24	59.0	31.8	OK	OK
GUSS2	M412-w 1	E70xx	◢ 5/16 ◣	◢ 7/16 ◣	13.15	0.51	DStlS33(8)	2.99	5.28	56.5	35.7	OK	OK
		E70xx	◢ 5/16 ◣	◢ 7/16 ◣	13.15	0.51	DStlS33(8)	3.11	5.19	59.9	38.7	OK	OK
GUSS2	M412-w 3	E70xx	◢ 5/16 ◣	◢ 7/16 ◣	14.96	0.50	DStlS33(8)	2.16	5.04	42.9	19.9	OK	OK
		E70xx	◢ 5/16 ◣	◢ 7/16 ◣	14.96	0.50	DStlS33(8)	1.96	5.20	37.7	16.2	OK	OK
GUSS2	M412-w 3	E70xx	◢ 5/16 ◣	◢ 7/16 ◣	14.96	0.50	DStlS33(8)	2.16	5.08	42.5	24.3	OK	OK
		E70xx	◢ 5/16 ◣	◢ 7/16 ◣	14.96	0.50	DStlS33(8)	2.12	5.12	41.5	23.3	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Project:	**AOF Baseplate Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**

Detailed result for BP1 / M11-bfl 1

Weld resistance check (AISC 360-16 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 6.76 kip ≥ $F_n =$ 4.71 kip

Where:

$F_{nw} =$ 43.0 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 7.8° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.21 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Concrete block

Item	Loads	A_1 [in^2]	A_2 [in^2]	σ [ksi]	$\phi f_{p,max}$ [ksi]	Ut [%]	Status
CB 1	DStlS33(8)	43.84	1120.38	0.6	4.4	13.4	OK

Symbol explanation

A_1	Loaded area
A_2	Supporting area
σ	Average stress in concrete
$\phi f_{p,max}$	Concrete bearing resistance
Ut	Utilization

Detailed result for CB 1

Concrete block compressive resistance check (AISC 360-16 – J8)

$\phi_c f_{p,max} =$ 4.4 ksi ≥ $\sigma =$ 0.6 ksi

Where:

$f_{p,max} =$ 6.8 ksi – concrete block design bearing strength:

- $f_{p,max} = 0.85 \cdot f'_c \cdot \sqrt{\frac{A_2}{A_1}} \leq 1.7 \cdot f'_c$, where:
  - $f'_c =$ 4.0 ksi – concrete compressive strength
  - $A_1 =$ 43.84 in^2 – base plate area in contact with concrete surface
  - $A_2 =$ 1120.38 in^2 – concrete supporting surface

$\phi_c =$ 0.65 – resistance factor for concrete

Shear in contact plane

Item	Loads	V [kip]	P_{br} [kip]	V_{cb} [kip]	Ut [%]	Status
BP1	DStlS33(8)	73.69	473.30	169.02	43.6	OK

Symbol explanation

V	Shear force
P_{br}	Concrete block bearing capacity
V_{cb}	Concrete cone breakout resistance
Ut	Utilization

Detailed result for BP1

Bearing capacity check (ACI 349-01 – B.4.5, ACI 349-01 – RB.11)

$$\phi_c P_{br} = \phi \cdot 1.3 \cdot f'_c \cdot A_1 + \phi \cdot K_c \cdot (N_y - P_a) = \quad 473.30 \quad \text{kip} \quad \geq \quad V = \quad 73.69 \quad \text{kip}$$

Where:

$\phi = 0.7$ – resistance factor for bearing of bolts on steel

$f'_c = 4.0$ ksi – concrete compressive strength

$A_1 = 88.84$ in^2 – projected area of the embedded area of the shear lug in the direction of the force excluding the portion of the lug in contact with the grout above concrete member

$K_c = 1.60$ – confinement coefficient

$N_y = 183.70$ kip – yield strength of tensioned anchors

- $N_y = n \cdot A_{se} \cdot F_y$, where:
  - $n =$ 10.0 – number of tensioned anchors
  - $A_{se} =$ 0.33 in^2 – tensile stress area of an anchor
  - $F_y =$ 55.0 ksi – anchor yield strength

$P_a = 49.85$ kip – external axial load

Concrete breakout strength check (ACI 349 – B11)

$$\phi V_{cb} = \phi \cdot \Psi_{\alpha,v} \cdot A_{vc} \cdot 4.0 \cdot \sqrt{f'_c} = \quad 169.02 \quad \text{kip} \quad \geq \quad V = \quad 73.69 \quad \text{kip}$$

Where:

$\phi = 0.85$ – steel embedment material resistance factor for reinforcement

$\Psi_{\alpha,V} = 1.97$ – modification factor for shear lug loaded at an angle with the concrete edge

- $\Psi_{\alpha,V} = \sqrt{\frac{1}{(\cos\ \alpha_V)^2 + (0.5 \cdot \sin \alpha_V)^2}}$, where:
  - $\alpha_V =$ 84.3 ° – angle between direction of shear force and direction perpendicular to concrete edge

$A_{vc} = 398.98$ in^2 – effective stress area defined by projecting a 45° plane from the bearing edges of the shear lug to the free surface in the direction of the shear load. The bearing area of the shear lug is excluded from the projected area.

$f'_c = 4.0$ ksi – concrete compressive strength

Buckling

Buckling analysis was not calculated.

Project:	**AOF Baseplate Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**

Project item 13

Design

Name	13
Description	
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC - LRFD (2016)

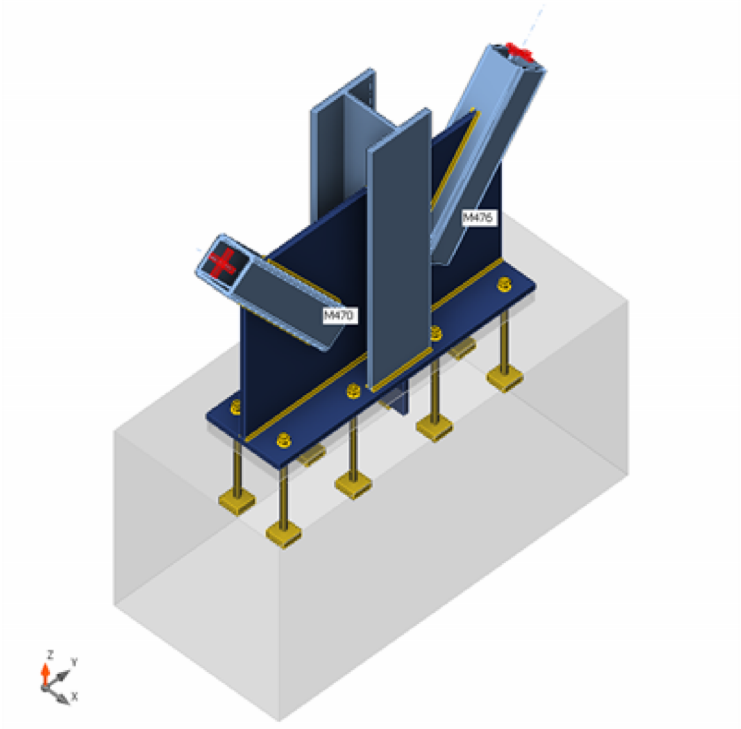
Members

Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M13	121 - W10X68	0.0	90.0	-180.0	0.00	0.00	0.00
M470	133 - HSS6X6X1/2(HSS6X6X1/2(HSS6X6X1/2(HSS(Imp)6X6X1/2)))	-90.0	52.0	0.0	0.00	0.00	0.00
M476	133 - HSS6X6X1/2(HSS6X6X1/2(HSS6X6X1/2(HSS(Imp)6X6X1/2)))	90.0	52.0	0.0	0.00	0.00	0.00

Supports and forces

Name	Support	Forces in	X [in]
M13 / end		Position	0.00
M470 / end	Mx-My-Mz	Connected member face	0.38
M476 / end	Mx-My-Mz	Connected member face	0.38



Cross-sections

Name	Material
121 - W10X68	A992
133 - HSS6X6X1/2(HSS6X6X1/2(HSS6X6X1/2(HSS(Imp)6X6X1/2)))	A992
3640 - 3/4" Plate(3/4" Plate(3/4" Plate(3/4" Plate(3/4" Plate(3/4" Plate(3/4" Plate(3/4" Plate(3/4" Plate(Plate 12, 0.75)))))))))	A572 Gr.50

Anchors

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
3/4 F1554 Gr.55	0.75	55.0	75.0	0.44

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS49-1(17)	M13 / End	-47.46	-0.01	-0.05	0.00	-0.11	0.00
	M470 / End	6.94	0.01	-0.15	0.00	0.00	0.00
	M476 / End	-25.56	-0.03	-0.16	0.00	0.00	0.00
DStlS52-1(18)	M13 / End	-27.95	0.01	-0.03	0.00	-0.07	0.00
	M470 / End	-28.07	0.01	-0.10	0.00	0.00	0.00
	M476 / End	18.91	-0.01	-0.09	0.00	0.00	0.00
DStlS40(19)	M13 / End	-21.27	0.01	-0.02	-0.02	-0.06	0.00
	M470 / End	-24.23	0.02	-0.11	0.00	0.00	0.00
	M476 / End	17.04	0.01	-0.11	0.00	0.00	0.00
DStlS17(20)	M13 / End	-63.51	-0.01	-0.06	0.02	-0.14	0.00
	M470 / End	0.81	0.00	-0.14	0.00	0.00	0.00
	M476 / End	-24.46	-0.06	-0.15	0.00	0.00	0.00
DStlS1(21)	M13 / End	-50.26	0.00	-0.05	0.00	-0.12	0.00
	M470 / End	-13.56	0.01	-0.17	0.00	0.00	0.00
	M476 / End	-4.36	-0.03	-0.17	0.00	0.00	0.00
DStlS33(22)	M13 / End	-77.77	-0.01	-0.07	0.01	-0.18	0.00
	M470 / End	-10.90	0.01	-0.14	0.00	0.00	0.00
	M476 / End	-15.89	-0.05	-0.15	0.00	0.00	0.00
DStlS53-1(23)	M13 / End	-28.20	-0.01	-0.03	0.00	-0.07	0.00
	M470 / End	12.93	0.01	-0.09	0.00	0.00	0.00
	M476 / End	-23.79	-0.02	-0.10	0.00	0.00	0.00
DStlS48-1(9)	M13 / End	-47.21	0.01	-0.05	0.00	-0.11	0.00
	M470 / End	-34.07	0.01	-0.16	0.00	0.00	0.00
	M476 / End	17.14	-0.03	-0.16	0.00	0.00	0.00
DStlS15(11)	M13 / End	-61.13	0.00	-0.05	-0.02	-0.15	0.00
	M470 / End	-18.01	0.03	-0.14	0.00	0.00	0.00
	M476 / End	-6.81	-0.02	-0.15	0.00	0.00	0.00
DStlS38(12)	M13 / End	-23.65	0.00	-0.03	0.02	-0.05	0.00
	M470 / End	-5.41	-0.01	-0.11	0.00	0.00	0.00
	M476 / End	-0.61	-0.03	-0.11	0.00	0.00	0.00
DStlS31(14)	M13 / End	-76.58	0.00	-0.07	-0.01	-0.18	0.00
	M470 / End	-20.31	0.03	-0.15	0.00	0.00	0.00
	M476 / End	-7.06	-0.04	-0.15	0.00	0.00	0.00
DStlS51-1(5)	M13 / End	-28.41	0.00	-0.01	0.00	-0.06	0.00
	M470 / End	-7.45	0.01	-0.09	0.00	0.00	0.00
	M476 / End	-5.95	-0.01	-0.09	0.00	0.00	0.00

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS49-1(17)	-0.01	-19.99	-62.33	0.00	0.12	0.00
DStlS52-1(18)	0.00	28.92	-35.27	0.00	0.07	0.00
DStlS40(19)	-0.01	25.41	-27.06	0.00	0.06	-0.02
DStlS17(20)	0.00	-15.54	-82.33	0.00	0.14	0.02
DStlS1(21)	-0.01	5.67	-64.58	0.00	0.12	0.00
DStlS33(22)	-0.01	-3.06	-99.06	0.00	0.18	0.01
DStlS53-1(23)	0.00	-22.59	-36.87	0.00	0.07	0.00
DStlS48-1(9)	-0.01	31.52	-60.73	0.00	0.11	0.00
DStlS15(11)	0.00	6.91	-80.87	0.00	0.15	-0.02
DStlS38(12)	-0.01	2.96	-28.52	0.00	0.05	0.02
DStlS31(14)	-0.01	8.17	-98.33	0.00	0.18	-0.01
DStlS51-1(5)	0.02	0.93	-39.08	0.00	0.06	0.00

Foundation block

Item	Value	Unit
CB 1		
Dimensions	60.10 x 28.40	in
Depth	30.00	in
Anchor	3/4 F1554 Gr.55	
Anchoring length	12.00	in
Shear force transfer	Shear lug	
Cross-section of shear lug	3/4" Plate(3/4" Plate(3/4" Plate(3/4" Plate(3/4" Plate(3/4" Plate(3/4" Plate(3/4" Plate(3/4" Plate(Plate 12, 0.75))))))))))	
Length of shear lug	6.00	in
Mortar joint	2.00	in

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	7.5 > 5.0%	**Not OK!**
Loc. deformation	0.0 < 3%	OK
Anchors	0.0 < 100%	OK
Welds	36.5 < 100%	OK
Concrete block	5.4 < 100%	OK
Shear	26.2 < 100%	OK
Buckling	Not calculated	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M13-bfl 1	A992	3/4	DStlS31(14)	5.8	0.0	0.0	OK
M13-tfl 1	A992	3/4	DStlS31(14)	5.7	0.0	0.0	OK
M13-w 1	A992	1/2	DStlS31(14)	9.5	0.0	0.0	OK
M470	A992	1/2	DStlS48-1(9)	7.2	0.0	0.0	OK
M476	A992	1/2	DStlS49-1(17)	5.5	0.0	0.0	OK
Member 4-bfl 1	A572 Gr.50	1'-0"	DStlS48-1(9)	47.2	7.5	0.0	Not OK!
BP1	A572 Gr.50	1"	DStlS53-1(23)	5.6	0.0	0.0	OK
GUSS1	A572 Gr.50	3/4	DStlS33(22)	6.7	0.0	0.0	OK
GUSS2	A572 Gr.50	3/4	DStlS48-1(9)	5.5	0.0	0.0	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for Member 4-bfl 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y = 50.0$ ksi – characteristic yield strength

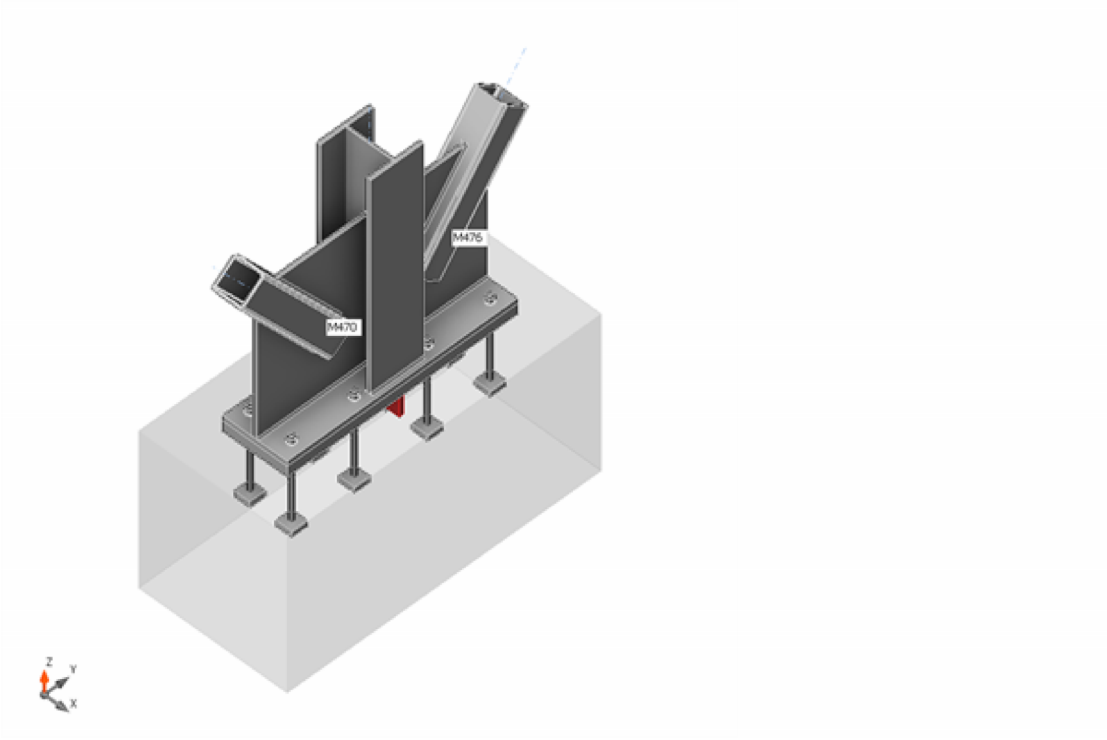
$\phi = 0.90$ – resistance factor for steel material AISC 360-16 – B3.1

Loc. deformation

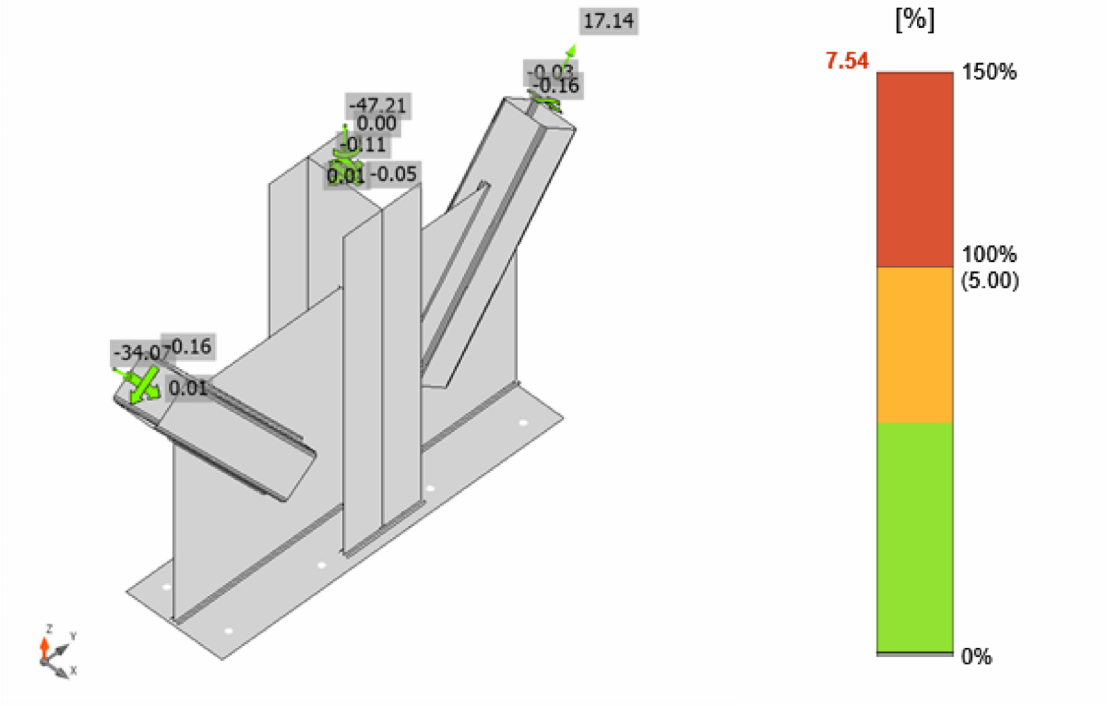
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M470	5.98	DStlS51-1(5)	0.00	0.18	0.0	OK
M476	5.98	DStlS51-1(5)	0.00	0.18	0.0	OK

Symbol explanation

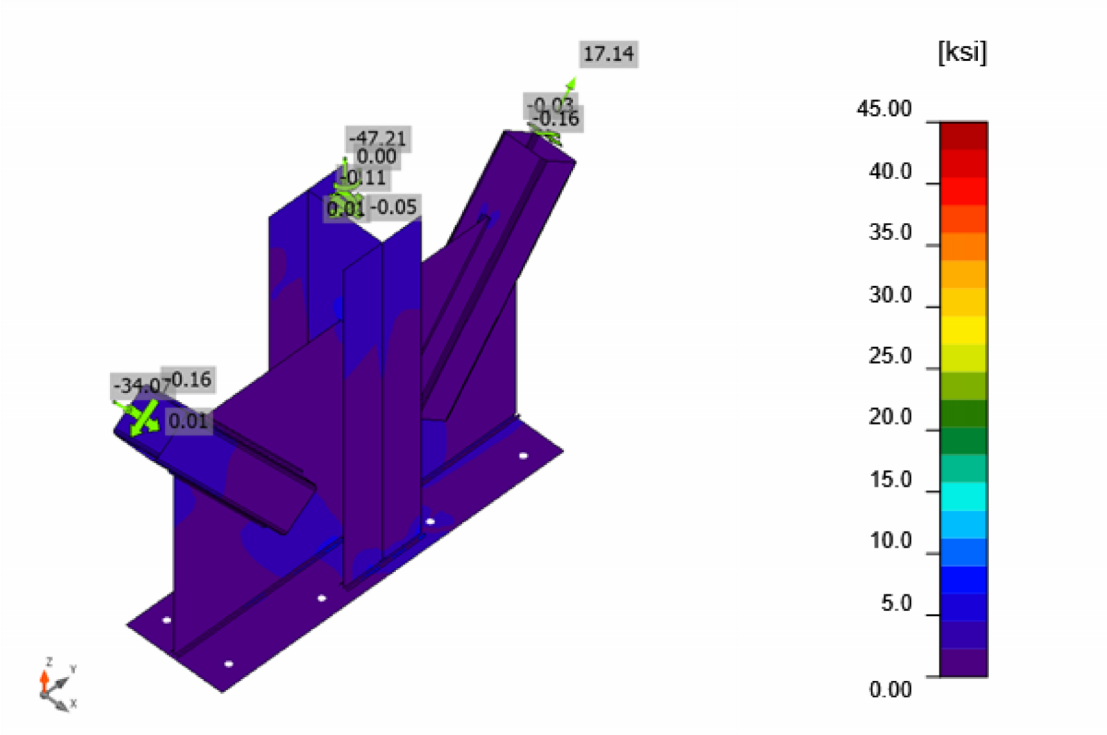
d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation



Overall check, DStlS48-1(9)

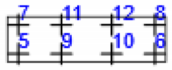


Strain check, DStlS48-1(9)



Equivalent stress, DStlS48-1(9)

Anchors

Shape	Item	Loads	N_f [kip]	ϕN_p [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	A5	DStlS51-1(5)	0.00	191.70	0.0	0.0	0.0	OK	OK
	A6	DStlS51-1(5)	0.00	191.70	0.0	0.0	0.0	OK	OK
	A7	DStlS51-1(5)	0.00	191.70	0.0	0.0	0.0	OK	OK
	A8	DStlS51-1(5)	0.00	191.70	0.0	0.0	0.0	OK	OK
	A9	DStlS51-1(5)	0.00	191.70	0.0	0.0	0.0	OK	OK
	A10	DStlS51-1(5)	0.00	191.70	0.0	0.0	0.0	OK	OK
	A11	DStlS51-1(5)	0.00	191.70	0.0	0.0	0.0	OK	OK
	A12	DStlS51-1(5)	0.00	191.70	0.0	0.0	0.0	OK	OK

Design data

Grade	ϕN_{sa} [kip]
3/4 F1554 Gr.55 - 1	17.53

Symbol explanation

N_f	Tension force
ϕN_p	Pullout strength in tension – ACI 318-14 – 17.4.3
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
ϕN_{sa}	Steel strength of anchor in tension - ACI 318-14 – 17.4.1

Detailed result for A5

Anchor tensile resistance (ACI 318-14 – 17.4.1)

$\phi N_{sa} = \phi \cdot A_{se,N} \cdot f_{uta} =$ 17.53 kip ≥ $N_f =$ 0.00 kip

Where:

$\phi =$ 0.70 – resistance factor

$A_{se,N} =$ 0.33 in^2 – tensile stress area

$f_{uta} =$ 75.0 ksi – specified tensile strength of anchor steel:

- $f_{uta} = \min(125 \text{ ksi}, 1.9 \cdot f_{ya},\ f_u)$, where:
  - $f_{ya} =$ 55.0 ksi – specified yield strength of anchor steel
  - $f_u =$ 75.0 ksi – specified ultimate strength of anchor steel

Concrete pullout resistance (ACI 318-14 – 17.4.3)

$\phi N_{pn} = \phi \cdot \Psi_{c,P} \cdot N_p =$ 191.70 kip ≥ $N_f =$ 0.00 kip

Where:

$\phi =$ 0.70 – resistance factor

$\Psi_{c,P} =$ 1.00 – modification factor for concrete condition

$N_p =$ 273.86 kip – basic concrete pullout strength for headed anchor:

- $N_{pr} = 8 \cdot A_{brg} \cdot f'_c$, where:
  - $A_{brg} =$ 8.56 in^2 – bearing area of the head of stud or anchor bolt
  - $f'_c =$ 4.0 ksi – concrete compressive strength

Interaction of tensile and shear forces (ACI 318-14 – R17.6)

${U_{tt}}^{5/3} + {U_{ts}}^{5/3} =$ 0.00 ≤ 1.0

Where:

$U_{tt} =$ 0.00 – maximum ratio of factored tensile force and tensile resistance determined from all appropriate failure modes

$U_{ts} =$ 0.00 – maximum ratio of factored shear force and shear resistance determined from all appropriate failure modes

Supplementary reinforcement (ACI 318-14 – 17.4.2.9)

Supplementary reinforcement should resist force of 0.00 kip in tension.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
BP1	M13-bfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10.08	0.84	DStlS31(14)	2.61	9.07	28.8	12.1	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10.08	0.84	DStlS31(14)	2.64	8.96	29.5	12.2	OK	OK
BP1	M13-tfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10.08	0.84	DStlS31(14)	2.29	9.05	25.3	9.7	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10.08	0.84	DStlS31(14)	2.26	9.18	24.6	9.8	OK	OK
BP1	M13-w 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9.61	0.87	DStlS48-1(9)	0.60	9.78	6.1	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9.61	0.87	DStlS53-1(23)	0.66	9.07	7.3	0.0	OK	OK
BP1	Member 4-bfl 1	E70xx	-	-	0.75	-	-	-	-	-	-	OK	OK
M13-w 1	GUSS1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	27.54	0.86	DStlS33(22)	2.94	8.09	36.4	18.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	27.54	0.86	DStlS33(22)	2.95	8.09	36.5	18.3	OK	OK
BP1	GUSS1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	21.75	1.36	DStlS48-1(9)	2.77	12.91	21.5	9.5	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	21.75	1.36	DStlS48-1(9)	2.78	12.93	21.5	9.6	OK	OK
GUSS1	M470-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	18.57	0.37	DStlS48-1(9)	0.57	2.75	20.6	7.6	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	18.57	0.37	DStlS48-1(9)	0.56	2.70	20.7	7.7	OK	OK
GUSS1	M470-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	18.57	0.37	DStlS48-1(9)	0.57	2.74	20.6	8.8	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	18.57	0.37	DStlS48-1(9)	0.56	2.70	20.8	8.8	OK	OK
GUSS1	M470-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	19.67	0.37	DStlS48-1(9)	0.56	2.72	20.5	7.4	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	19.67	0.37	DStlS48-1(9)	0.56	2.70	20.9	7.6	OK	OK
GUSS1	M470-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	19.67	0.37	DStlS48-1(9)	0.56	2.72	20.5	8.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	19.67	0.37	DStlS48-1(9)	0.56	2.70	20.9	8.4	OK	OK
M13-w 1	GUSS2	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	27.54	0.86	DStlS31(14)	2.19	7.89	27.7	12.7	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	27.54	0.86	DStlS31(14)	2.19	7.89	27.8	12.8	OK	OK
BP1	GUSS2	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	21.39	1.43	DStlS53-1(23)	2.71	14.89	18.2	7.7	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	21.39	1.43	DStlS53-1(23)	2.73	14.89	18.3	7.8	OK	OK
GUSS2	M476-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	18.58	0.37	DStlS49-1(17)	0.45	2.75	16.2	5.3	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	18.58	0.37	DStlS49-1(17)	0.44	2.69	16.5	5.4	OK	OK
GUSS2	M476-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	18.58	0.37	DStlS49-1(17)	0.44	2.75	16.2	5.9	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	18.58	0.37	DStlS49-1(17)	0.44	2.69	16.4	6.0	OK	OK
GUSS2	M476-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	19.65	0.37	DStlS49-1(17)	0.40	2.72	14.6	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	19.65	0.37	DStlS49-1(17)	0.40	2.71	14.6	0.0	OK	OK
GUSS2	M476-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	19.65	0.37	DStlS49-1(17)	0.40	2.72	14.7	5.1	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	19.65	0.37	DStlS49-1(17)	0.40	2.71	14.7	5.2	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Detailed result for M13-w 1 / GUSS1

Weld resistance check (AISC 360-16 – J2-4)

$$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} = \quad 8.09 \quad \text{kip} \quad \geq \quad F_n = \quad 2.95 \quad \text{kip}$$

Where:

$F_{nw} =$ 56.7 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 52.1° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.19 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Project:	**AOF Baseplate Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**

Concrete block

Item	Loads	A_1 [in^2]	A_2 [in^2]	σ [ksi]	$\phi f_{p,max}$ [ksi]	Ut [%]	Status
CB 1	DStlS33(22)	455.21	1547.23	0.2	4.1	5.4	OK

Symbol explanation

A_1	Loaded area
A_2	Supporting area
σ	Average stress in concrete
$\phi f_{p,max}$	Concrete bearing resistance
Ut	Utilization

Detailed result for CB 1

Concrete block compressive resistance check (AISC 360-16 – J8)

$\phi_c f_{p,max} =$ 4.1 ksi ≥ $\sigma =$ 0.2 ksi

Where:

$f_{p,max} =$ 6.3 ksi – concrete block design bearing strength:

- $f_{p,max} = 0.85 \cdot f'_c \cdot \sqrt{\frac{A_2}{A_1}} \leq 1.7 \cdot f'_c$, where:
  - $f'_c =$ 4.0 ksi – concrete compressive strength
  - $A_1 =$ 455.21 in^2 – base plate area in contact with concrete surface
  - $A_2 =$ 1547.23 in^2 – concrete supporting surface

$\phi_c =$ 0.65 – resistance factor for concrete

Shear in contact plane

Item	Loads	V [kip]	P_{br} [kip]	V_{cb} [kip]	Ut [%]	Status
BP1	DStlS48-1(9)	23.22	407.77	88.67	26.2	OK

Symbol explanation

V	Shear force
P_{br}	Concrete block bearing capacity
V_{cb}	Concrete cone breakout resistance
Ut	Utilization

Detailed result for BP1

Bearing capacity check (ACI 349-01 – B.4.5, ACI 349-01 – RB.11)

$\phi_c P_{br} = \phi \cdot 1.3 \cdot f'_c \cdot A_1 + \phi \cdot K_c \cdot (N_y - P_a) =$ 407.77 kip ≥ $V =$ 23.22 kip

Where:

$\phi = 0.7$ – resistance factor for bearing of bolts on steel

$f'_c = 4.0$ ksi – concrete compressive strength

$A_1 = 48.00$ in^2 – projected area of the embedded area of the shear lug in the direction of the force excluding the portion of the lug in contact with the grout above concrete member

$K_c = 1.60$ – confinement coefficient

$N_y = 146.96$ kip – yield strength of tensioned anchors

- $N_y = n \cdot A_{se} \cdot F_y$, where:
  - $n =$ 8.0 – number of tensioned anchors
  - $A_{se} =$ 0.33 in^2 – tensile stress area of an anchor
  - $F_y =$ 55.0 ksi – anchor yield strength

$P_a =$ -61.12 kip – external axial load

Concrete breakout strength check (ACI 349 – B11)

$\phi V_{cb} = \phi \cdot \Psi_{\alpha,v} \cdot A_{vc} \cdot 4.0 \cdot \sqrt{f'_c} =$ 88.67 kip ≥ $V =$ 23.22 kip

Where:

$\phi = 0.85$ – steel embedment material resistance factor for reinforcement

$\Psi_{\alpha,V} = 2.0$ – modification factor for shear lug loaded at an angle with the concrete edge

- $\Psi_{\alpha,V} = \sqrt{\frac{1}{(\cos\ \alpha_V)^2 + (0.5 \cdot \sin \alpha_V)^2}}$, where:
  - $\alpha_V =$ 90.0 ° – angle between direction of shear force and direction perpendicular to concrete edge

$A_{vc} = 206.23$ in^2 – effective stress area defined by projecting a 45^o plane from the bearing edges of the shear lug to the free surface in the direction of the shear load. The bearing area of the shear lug is excluded from the projected area.

$f'_c = 4.0$ ksi – concrete compressive strength

Buckling

Buckling analysis was not calculated.

Project:	**AOF Baseplate Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**

Project item 74

Design

Name	74
Description	
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC - LRFD (2016)

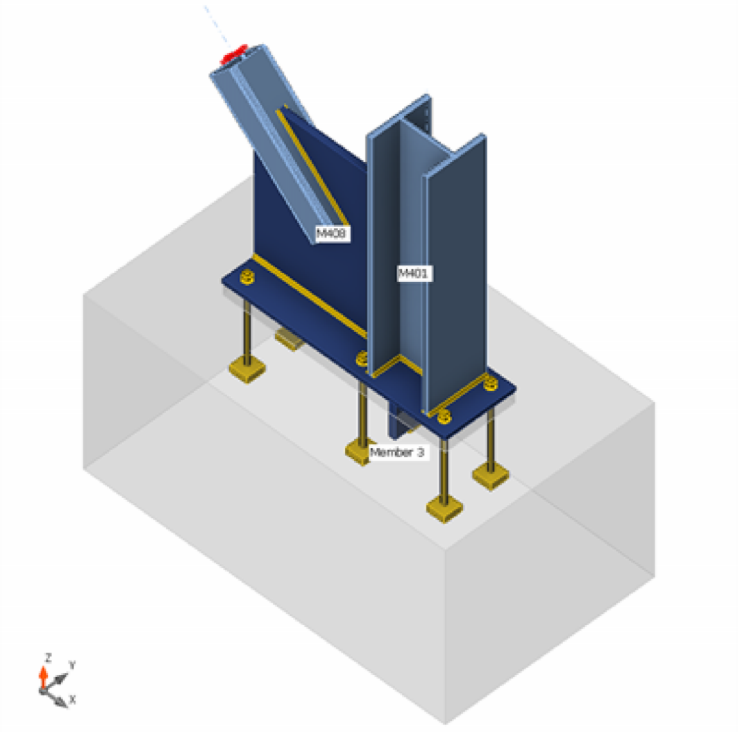
Members

Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M401	121 - W10X68	0.0	90.0	-180.0	0.00	0.00	0.00
M408	133 - HSS6X6X1/2(HSS6X6X1/2(HSS6X6X1/2(HSS(Imp)6X6X1/2)))	-180.0	43.5	0.0	0.00	0.00	0.00

Supports and forces

Name	Support	Forces in	X [in]
M401 / end		Position	0.00
M408 / end	Mx-My-Mz	Connected member face	7.16



Cross-sections

Name	Material
121 - W10X68	A992
133 - HSS6X6X1/2(HSS6X6X1/2(HSS6X6X1/2(HSS(Imp)6X6X1/2)))	A992
3639 - 1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(Plate 1, 12))))))))))	A572 Gr.50

Anchors

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
3/4 F1554 Gr.55	0.75	55.0	75.0	0.44

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS33(1)	M401 / End	-118.83	0.53	-0.47	0.00	0.00	0.00
	M408 / End	-39.80	-0.03	-0.20	0.00	0.00	0.00
DStlS14(8)	M401 / End	-85.27	1.28	-0.28	-0.02	0.00	0.02
	M408 / End	-28.64	0.01	-0.16	0.00	0.00	0.00
DStlS39(9)	M401 / End	-52.58	-0.85	-0.22	0.00	0.00	0.00
	M408 / End	-16.37	0.06	-0.11	0.00	0.00	0.00
DStlS37(5)	M401 / End	-105.95	0.17	-0.52	-0.01	0.00	0.01
	M408 / End	-35.44	0.06	-0.19	0.00	0.00	0.00
DStlS16(10)	M401 / End	-60.91	-0.40	-0.21	-0.03	0.00	0.03
	M408 / End	-19.73	0.22	-0.14	0.00	0.00	0.00
DStlS41(11)	M401 / End	-76.95	0.83	-0.30	0.01	0.00	-0.01
	M408 / End	-25.28	-0.14	-0.14	0.00	0.00	0.00
DStlS46-1(12)	M401 / End	-118.43	0.35	-0.45	-0.01	0.00	0.01
	M408 / End	-39.15	0.06	-0.21	0.00	0.00	0.00

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS33(1)	28.28	-0.50	-146.35	-0.01	-0.12	-0.02
DStlS14(8)	20.40	-1.29	-105.09	0.03	-0.10	-0.01
DStlS39(9)	11.58	0.78	-63.92	0.03	-0.07	0.03
DStlS37(5)	25.08	-0.23	-130.46	0.04	-0.11	0.01
DStlS16(10)	14.02	0.18	-74.58	0.12	-0.08	0.07
DStlS41(11)	17.96	-0.68	-94.43	-0.07	-0.08	-0.05
DStlS46-1(12)	27.83	-0.41	-145.51	0.04	-0.12	0.01

Project:	**AOF Baseplate Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**

Foundation block

Item	Value	Unit
CB 1		
Dimensions	36.10 x 62.40	in
Depth	30.00	in
Anchor	3/4 F1554 Gr.55	
Anchoring length	12.00	in
Shear force transfer	Shear lug	
Cross-section of shear lug	1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(Plate 1, 12))))))))))	
Length of shear lug	6.00	in
Mortar joint	2.00	in

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Anchors	9.6 < 100%	OK
Welds	57.1 < 100%	OK
Concrete block	14.6 < 100%	OK
Shear	16.3 < 100%	OK
Buckling	Not calculated	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M401-bfl 1	A992	3/4	DStlS33(1)	14.2	0.0	0.0	OK
M401-tfl 1	A992	3/4	DStlS33(1)	17.0	0.0	0.0	OK
M401-w 1	A992	1/2	DStlS33(1)	19.0	0.0	0.0	OK
M408	A992	1/2	DStlS33(1)	14.0	0.0	0.0	OK
Member 3-bfl 1	A572 Gr.50	1"	DStlS33(1)	45.0	0.0	0.0	OK
BP1	A572 Gr.50	3/4	DStlS33(1)	24.7	0.0	0.0	OK
GUSS1	A572 Gr.50	1"	DStlS33(1)	5.1	0.0	0.0	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for Member 3-bfl 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y = 50.0$ ksi – characteristic yield strength

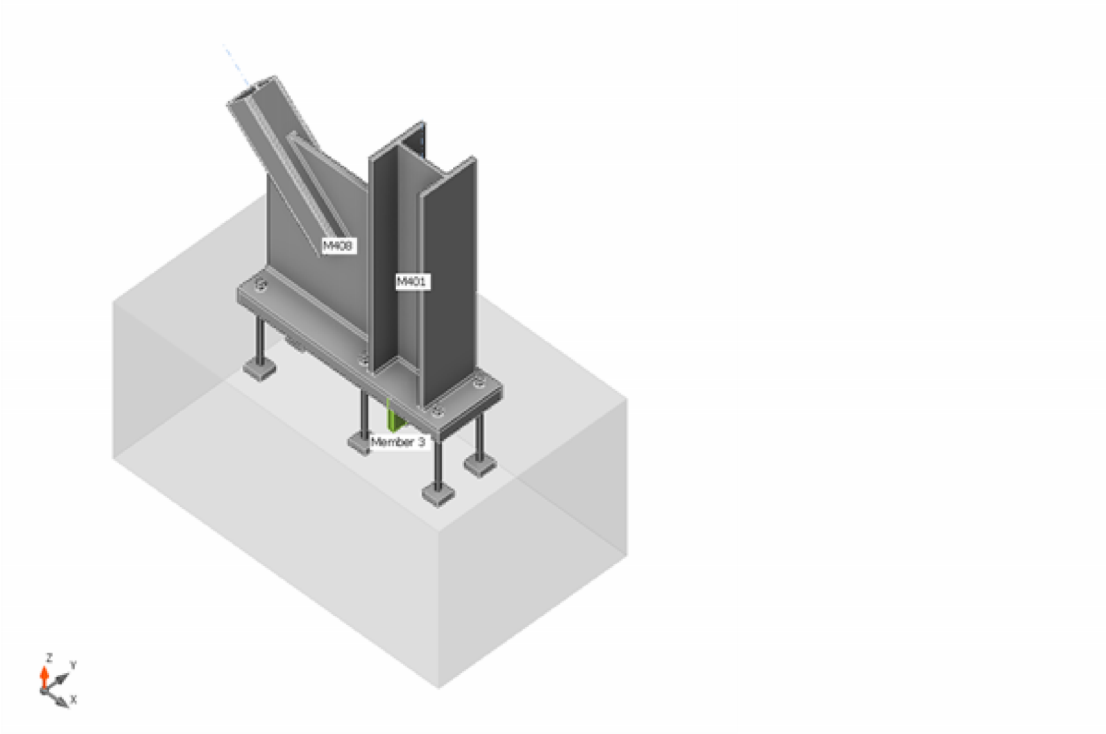
$\phi = 0.90$ – resistance factor for steel material AISC 360-16 – B3.1

Loc. deformation

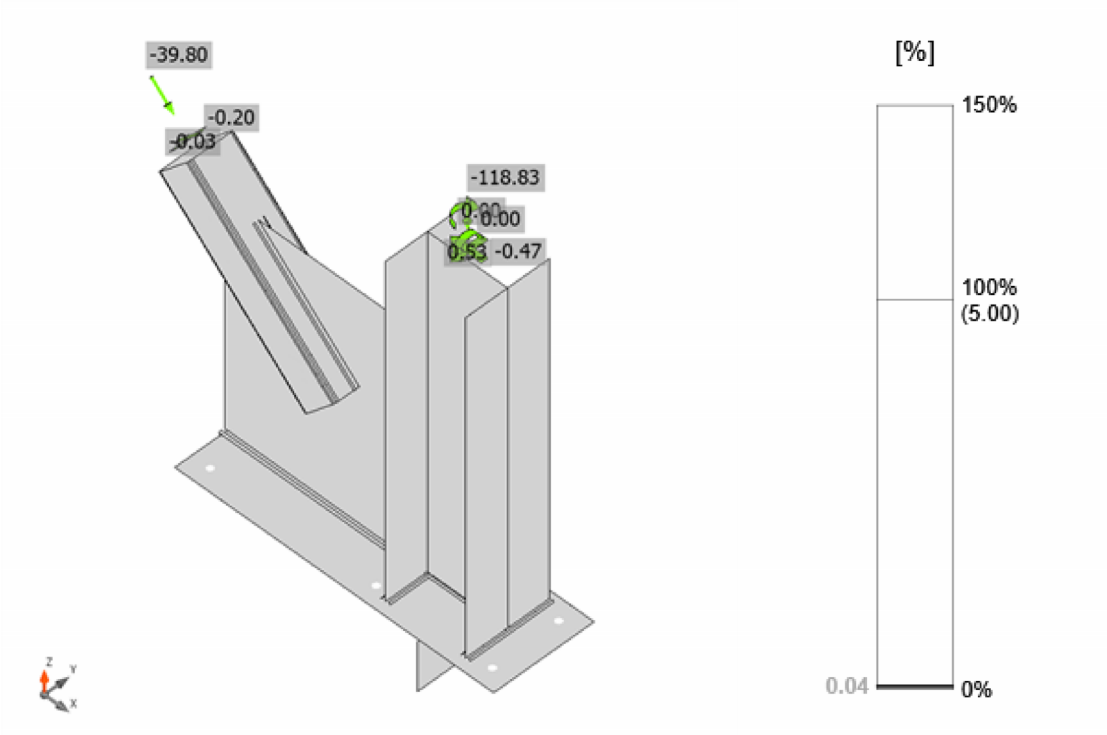
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M408	5.98	DStlS46-1(12)	0.00	0.18	0.0	OK

Symbol explanation

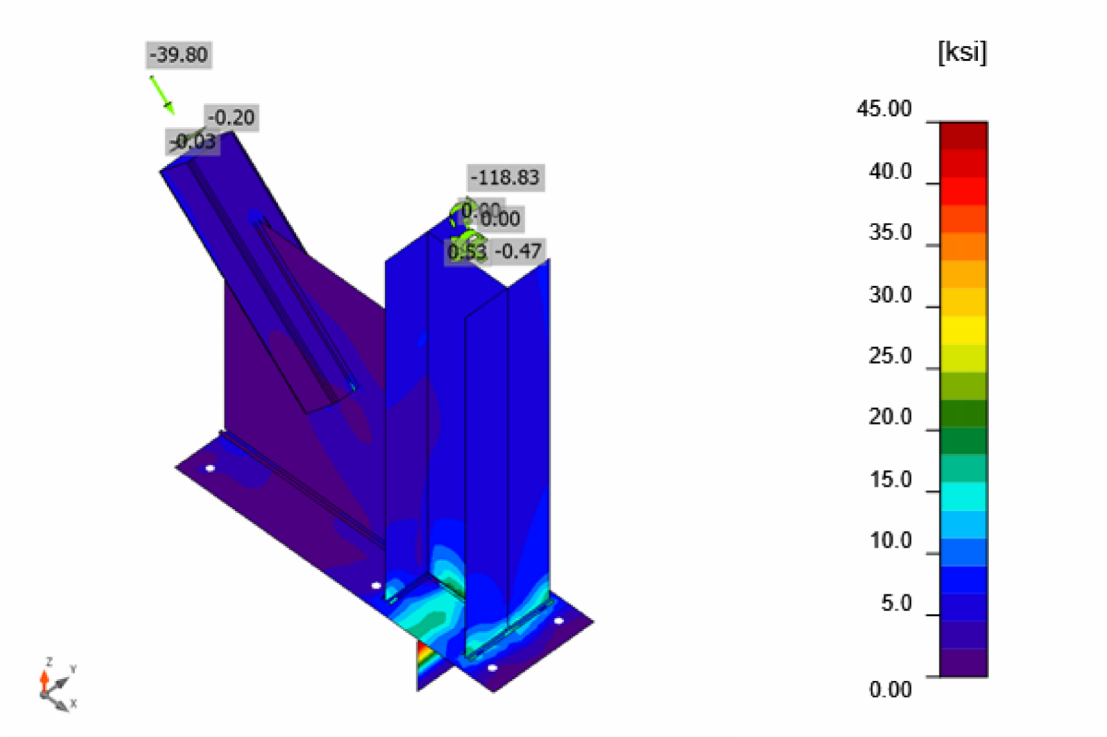
d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation



Overall check, DStlS33(1)

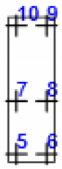


Strain check, DStlS33(1)



Equivalent stress, DStlS33(1)

Anchors

Shape	Item	Loads	N_f [kip]	ϕN_p [kip]	ϕN_{sb} [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	A5	DStlS46-1(12)	0.00	191.70	0.00	0.0	0.0	0.0	OK	OK
	A6	DStlS46-1(12)	0.00	191.70	0.00	0.0	0.0	0.0	OK	OK
	A7	DStlS46-1(12)	0.00	191.70	0.00	0.0	0.0	0.0	OK	OK
	A8	DStlS46-1(12)	0.00	191.70	0.00	0.0	0.0	0.0	OK	OK
	A9	DStlS33(1)	1.68	191.70	146.35	9.6	0.0	2.0	OK	OK
	A10	DStlS33(1)	1.68	191.70	146.35	9.6	0.0	2.0	OK	OK

Design data

Grade	ϕN_{sa} [kip]
3/4 F1554 Gr.55 - 1	17.53

Symbol explanation

N_f	Tension force
ϕN_p	Pullout strength in tension – ACI 318-14 – 17.4.3
ϕN_{sb}	Concrete side-face blowout strength in tension – ACI 318-14 – 17.4.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
ϕN_{sa}	Steel strength of anchor in tension - ACI 318-14 – 17.4.1

Detailed result for A10

Concrete splitting failure during installation should be evaluated by ACI 355.2 requirements.

Anchor tensile resistance (ACI 318-14 – 17.4.1)

$$\phi N_{sa} = \phi \cdot A_{se,N} \cdot f_{uta} = \quad 17.53 \quad \text{kip} \quad \geq \quad N_f = \quad 1.68 \quad \text{kip}$$

Where:

$\phi = 0.70$ – resistance factor

$A_{se,N} = 0.33$ in^2 – tensile stress area

$f_{uta} = 75.0$ ksi – specified tensile strength of anchor steel:

- $f_{uta} = \min(125 \text{ ksi}, 1.9 \cdot f_{ya}, f_u)$, where:
  - $f_{ya} =$ 55.0 ksi – specified yield strength of anchor steel
  - $f_u =$ 75.0 ksi – specified ultimate strength of anchor steel

Concrete pullout resistance (ACI 318-14 – 17.4.3)

$\phi N_{pn} = \phi \cdot \Psi_{c,P} \cdot N_p =$ 191.70 kip ≥ $N_f =$ 1.68 kip

Where:

$\phi =$ 0.70 – resistance factor

$\Psi_{c,P} =$ 1.00 – modification factor for concrete condition

$N_p =$ 273.86 kip – basic concrete pullout strength for headed anchor:

- $N_{pr} = 8 \cdot A_{brg} \cdot f'_c$, where:
  - $A_{brg} =$ 8.56 in^2 – bearing area of the head of stud or anchor bolt
  - $f'_c =$ 4.0 ksi – concrete compressive strength

Concrete sideface blowout resistance (ACI 318-14 – 17.4.4)

$\phi N_{sb} = r_c \cdot N_{sbg} =$ 146.35 kip ≥ $N_f =$ 1.68 kip

Where:

$r_c =$ 0.50 – reduction factor for anchor close to an edge or multiple anchors with small spacing:

- $r_c = \min(\frac{1+\frac{c_{a2}}{c_{a1}}}{4}, \frac{1+\frac{s}{6 \cdot c_{a1}}}{2}),\ 0.5 \le r_c \le 1$, where:
  - $c_{a1} =$ 14.05 in – shorter distance from an anchor to an edge
  - $c_{a2} =$ 14.20 in – longer distance from an anchor to an edge
  - $s =$ 8.00 in – spacing between anchors

$N_{sbg} =$ 291.15 kip – concrete side-face blowout strength of headed anchor in tension:

- $N_{sb} = \phi \cdot 160.0 \cdot c_{a1} \cdot \sqrt{A_{bgr}} \cdot \sqrt{f'_c}$, where:
  - $A_{bgr} =$ 8.56 in^2 – bearing area of the head of stud or anchor bolt
  - $f'_c =$ 4.0 ksi – concrete compressive strength
  - $\phi =$ 0.70 – resistance factor

Interaction of tensile and shear forces (ACI 318-14 – R17.6)

${U_{tt}}^{5/3} + {U_{ts}}^{5/3} =$ 0.02 ≤ 1.0

Where:

$U_{tt} =$ 0.10 – maximum ratio of factored tensile force and tensile resistance determined from all appropriate failure modes

$U_{ts} =$ 0.00 – maximum ratio of factored shear force and shear resistance determined from all appropriate failure modes

Supplementary reinforcement (ACI 318-14 – 17.4.2.9)

Supplementary reinforcement should resist force of 3.36 kip in tension.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
BP1	M401-bfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10.08	0.84	DStlS46-1(12)	4.63	9.33	49.6	31.5	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10.08	0.84	DStlS46-1(12)	3.32	9.44	35.1	18.5	OK	OK
BP1	M401-tfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10.08	0.84	DStlS33(1)	5.20	9.27	56.1	37.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10.08	0.84	DStlS33(1)	3.53	9.32	37.8	21.6	OK	OK
BP1	M401-w 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9.59	0.87	DStlS33(1)	5.53	9.71	57.0	34.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9.59	0.87	DStlS33(1)	5.54	9.70	57.1	34.1	OK	OK
BP1	Member 3-bfl 1	E70xx	-	-	12.00	-	-	-	-	-	-	OK	OK
M401-bfl 1	GUSS1	E70xx	◢ 5/16 ◣	◢ 7/16 ◣	27.54	0.86	DStlS46-1(12)	2.16	9.26	23.3	10.0	OK	OK
		E70xx	◢ 5/16 ◣	◢ 7/16 ◣	27.54	0.86	DStlS33(1)	2.17	9.20	23.6	10.1	OK	OK
BP1	GUSS1	E70xx	◢ 5/16 ◣	◢ 7/16 ◣	23.54	1.38	DStlS33(1)	2.13	20.06	10.6	0.0	OK	OK
		E70xx	◢ 5/16 ◣	◢ 7/16 ◣	23.54	1.38	DStlS33(1)	2.15	20.02	10.7	0.0	OK	OK
M408-w 1	GUSS1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	16.52	0.38	DStlS33(1)	1.36	3.33	40.9	24.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	16.52	0.38	DStlS33(1)	1.36	3.33	40.8	24.1	OK	OK
M408-w 3	GUSS1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	16.69	0.37	DStlS33(1)	1.22	3.28	37.2	19.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	16.69	0.37	DStlS33(1)	1.21	3.29	36.8	18.9	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Project:	**AOF Baseplate Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**

Detailed result for BP1 / M401-w 1

Weld resistance check (AISC 360-16 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 9.70 kip ≥ $F_n =$ 5.54 kip

Where:

$F_{nw} =$ 59.4 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 61.8° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.22 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Concrete block

Item	Loads	A_1 [in^2]	A_2 [in^2]	σ [ksi]	$\phi f_{p,max}$ [ksi]	Ut [%]	Status
CB 1	DStlS33(1)	234.57	1486.58	0.6	4.4	14.6	OK

Symbol explanation

A_1	Loaded area
A_2	Supporting area
σ	Average stress in concrete
$\phi f_{p,max}$	Concrete bearing resistance
Ut	Utilization

Detailed result for CB 1

Concrete block compressive resistance check (AISC 360-16 – J8)

$\phi_c f_{p,max} =$ 4.4 ksi ≥ $\sigma =$ 0.6 ksi

Where:

$f_{p,max} =$ 6.8 ksi – concrete block design bearing strength:

- $f_{p,max} = 0.85 \cdot f'_c \cdot \sqrt{\frac{A_2}{A_1}} \leq 1.7 \cdot f'_c$, where:
  - $f'_c =$ 4.0 ksi – concrete compressive strength
  - $A_1 =$ 234.57 in^2 – base plate area in contact with concrete surface
  - $A_2 =$ 1486.58 in^2 – concrete supporting surface

$\phi_c =$ 0.65 – resistance factor for concrete

Shear in contact plane

Item	Loads	V [kip]	P_{br} [kip]	V_{cb} [kip]	Ut [%]	Status
BP1	DStlS33(1)	28.00	464.47	171.40	16.3	OK

Project:	**AOF Baseplate Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**

Symbol explanation

V	Shear force
P_{br}	Concrete block bearing capacity
V_{cb}	Concrete cone breakout resistance
Ut	Utilization

Detailed result for BP1

Bearing capacity check (ACI 349-01 – B.4.5, ACI 349-01 – RB.11)

$$\phi_c P_{br} = \phi \cdot 1.3 \cdot f'_c \cdot A_1 + \phi \cdot K_c \cdot (N_y - P_a) = \quad 464.47 \quad \text{kip} \quad \geq \quad V = \quad 28.00 \quad \text{kip}$$

Where:

$\phi = 0.7$ – resistance factor for bearing of bolts on steel

$f'_c = 4.0$ ksi – concrete compressive strength

$A_1 = 48.06$ in^2 – projected area of the embedded area of the shear lug in the direction of the force excluding the portion of the lug in contact with the grout above concrete member

$K_c = 1.60$ – confinement coefficient

$N_y = 110.22$ kip – yield strength of tensioned anchors

- $N_y = n \cdot A_{se} \cdot F_y$, where:
  - $n =$ 6.0 – number of tensioned anchors
  - $A_{se} =$ 0.33 in^2 – tensile stress area of an anchor
  - $F_y =$ 55.0 ksi – anchor yield strength

$P_a =$ -148.28 kip – external axial load

Concrete breakout strength check (ACI 349 – B11)

$$\phi V_{cb} = \phi \cdot \Psi_{\alpha,v} \cdot A_{vc} \cdot 4.0 \cdot \sqrt{f'_c} = \quad 171.40 \quad \text{kip} \quad \geq \quad V = \quad 28.00 \quad \text{kip}$$

Where:

$\phi = 0.85$ – steel embedment material resistance factor for reinforcement

$\Psi_{\alpha,V} = 2.$ – modification factor for shear lug loaded at an angle with the concrete edge

- $\Psi_{\alpha,V} = \sqrt{\frac{1}{(\cos\ \alpha_V)^2 + (0.5 \cdot \sin \alpha_V)^2}}$, where:
  - $\alpha_V =$ 89.0 ° – angle between direction of shear force and direction perpendicular to concrete edge

$A_{vc} = 398.85$ in^2 – effective stress area defined by projecting a 45° plane from the bearing edges of the shear lug to the free surface in the direction of the shear load. The bearing area of the shear lug is excluded from the projected area.

$f'_c = 4.0$ ksi – concrete compressive strength

Buckling

Buckling analysis was not calculated.

Project item 82

Design

Name	82
Description	
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC - LRFD (2016)

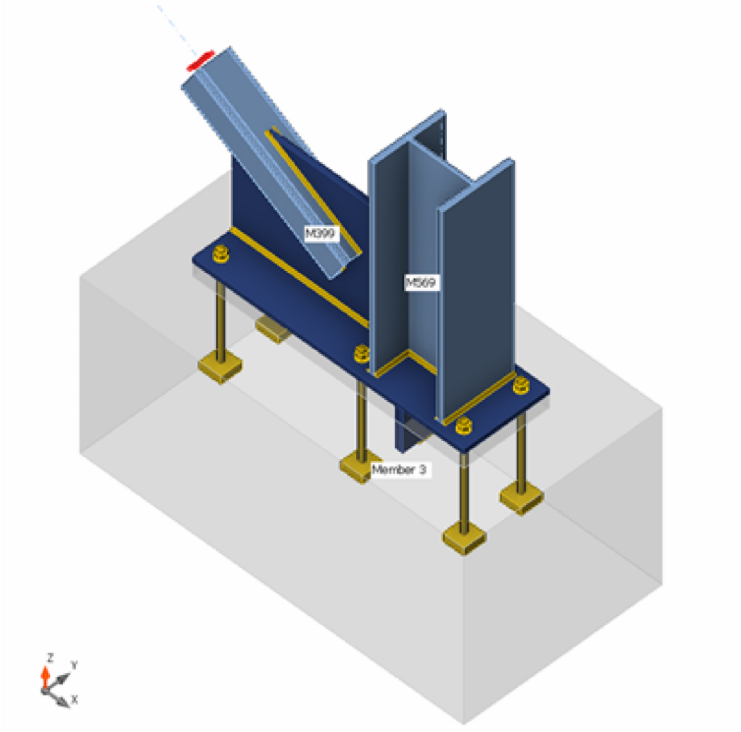
Members

Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M399	345 - HSS5X5X1/2(HSS5X5X1/2(HSS5X5X1/2(HSS(Imp)5X5X1/2)))	-180.0	30.4	0.0	0.00	0.00	0.00
M569	121 - W10X68	0.0	90.0	-180.0	0.00	0.00	0.00

Supports and forces

Name	Support	Forces in	X [in]
M399 / end	Mx-My-Mz	Connected member face	6.03
M569 / end		Position	0.00



Cross-sections

Name	Material
345 - HSS5X5X1/2(HSS5X5X1/2(HSS5X5X1/2(HSS(Imp)5X5X1/2)))	A992
121 - W10X68	A992
3639 - 1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(Plate 1, 12))))))))))	A572 Gr.50

Anchors

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
3/4 F1554 Gr.55	0.75	55.0	75.0	0.44

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS50-1(1)	M399 / End	-3.22	0.00	-0.16	0.00	0.00	0.00
	M569 / End	-65.08	-0.02	-0.23	0.00	0.00	0.00
DStlS31(2)	M399 / End	42.35	0.00	-0.25	0.00	0.00	0.00
	M569 / End	-121.78	-0.05	-0.40	0.00	0.00	0.00
DStlS1(3)	M399 / End	24.72	0.00	-0.29	0.00	0.00	0.00
	M569 / End	-85.21	-0.03	-0.27	0.00	0.00	0.00
DStlS33(9)	M399 / End	37.99	0.00	-0.25	0.00	0.00	0.00
	M569 / End	-122.46	-0.06	-0.39	0.00	0.00	0.00

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS50-1(1)	2.46	0.02	-66.85	0.00	-0.08	0.00
DStlS31(2)	-37.05	0.05	-100.56	0.00	-0.13	0.00
DStlS1(3)	-21.74	0.03	-72.95	0.00	-0.15	0.00
DStlS33(9)	-33.28	0.06	-103.44	0.00	-0.13	0.00

Project:	**AOF Baseplate Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**

Foundation block

Item	Value	Unit
CB 1		
Dimensions	28.10 x 54.40	in
Depth	25.00	in
Anchor	3/4 F1554 Gr.55	
Anchoring length	12.00	in
Shear force transfer	Shear lug	
Cross-section of shear lug	1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(1" Plate(Plate 12, 1)(Plate 1, 12))))))))))	
Length of shear lug	6.00	in
Mortar joint	2.00	in

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.1 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Anchors	2.7 < 100%	OK
Welds	51.4 < 100%	OK
Concrete block	10.0 < 100%	OK
Shear	42.2 < 100%	OK
Buckling	Not calculated	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M399	A992	1/2	DStlS31(2)	10.5	0.0	0.0	OK
M569-bfl 1	A992	3/4	DStlS31(2)	9.0	0.0	0.0	OK
M569-tfl 1	A992	3/4	DStlS31(2)	13.1	0.0	0.0	OK
M569-w 1	A992	1/2	DStlS31(2)	20.3	0.0	0.0	OK
Member 3-bfl 1	A572 Gr.50	1"	DStlS31(2)	45.0	0.1	0.0	OK
BP1	A572 Gr.50	3/4	DStlS31(2)	28.8	0.0	0.0	OK
GUSS1	A572 Gr.50	3/4	DStlS31(2)	7.4	0.0	0.0	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for Member 3-bfl 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y = 50.0$ ksi – characteristic yield strength

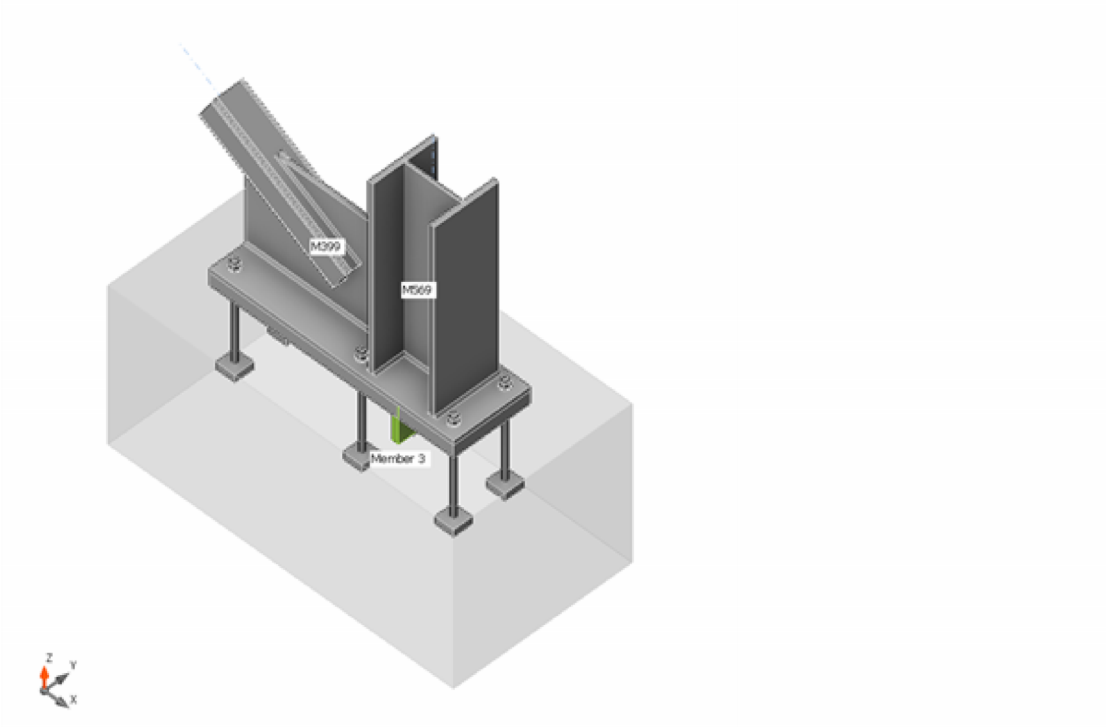
$\phi = 0.90$ – resistance factor for steel material AISC 360-16 – B3.1

Loc. deformation

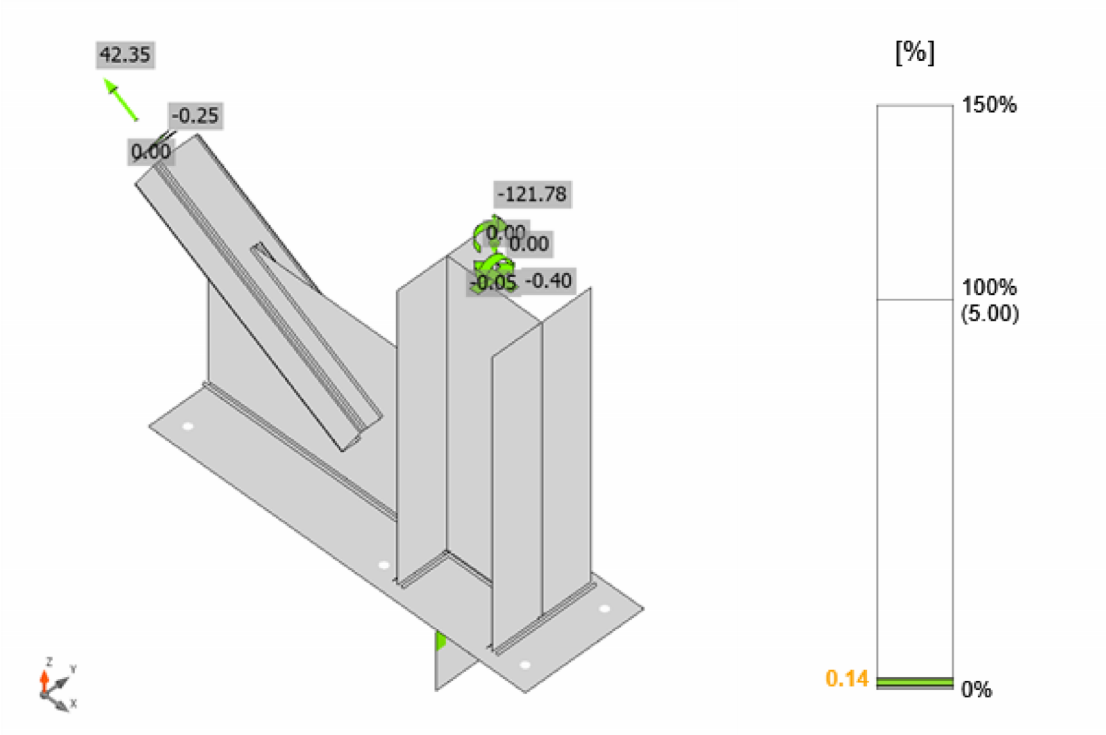
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M399	5.00	DStlS33(9)	0.00	0.15	0.0	OK

Symbol explanation

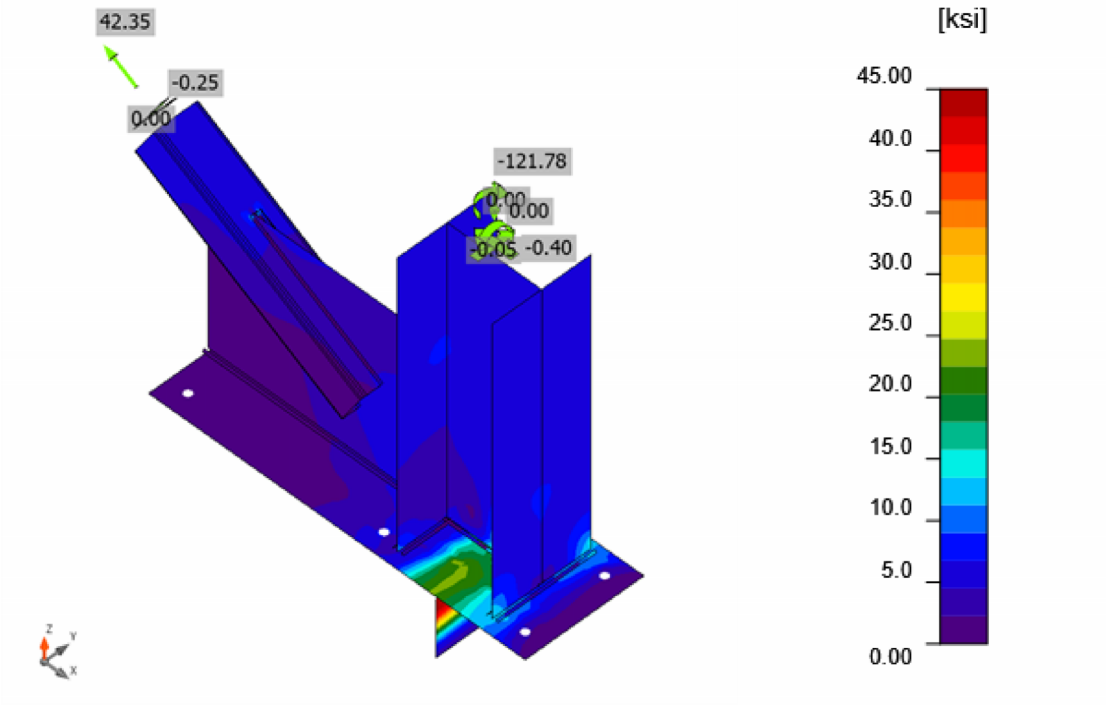
d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation



Overall check, DStlS31(2)



Strain check, DStlS31(2)



Equivalent stress, DStlS31(2)

Anchors

Shape	Item	Loads	N_f [kip]	ϕN_p [kip]	ϕN_{sb} [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	A5	DStlS33(9)	0.00	191.70	0.00	0.0	0.0	0.0	OK	OK
	A6	DStlS33(9)	0.00	191.70	0.00	0.0	0.0	0.0	OK	OK
	A7	DStlS33(9)	0.00	191.70	0.00	0.0	0.0	0.0	OK	OK
	A8	DStlS33(9)	0.00	191.70	0.00	0.0	0.0	0.0	OK	OK
	A9	DStlS50-1(1)	0.47	191.70	103.61	2.7	0.0	0.2	OK	OK
	A10	DStlS50-1(1)	0.47	191.70	103.61	2.7	0.0	0.2	OK	OK

Design data

Grade	ϕN_{sa} [kip]
3/4 F1554 Gr.55 - 1	17.53

Symbol explanation

N_f	Tension force
ϕN_p	Pullout strength in tension – ACI 318-14 – 17.4.3
ϕN_{sb}	Concrete side-face blowout strength in tension – ACI 318-14 – 17.4.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
ϕN_{sa}	Steel strength of anchor in tension - ACI 318-14 – 17.4.1

Detailed result for A10

Concrete splitting failure during installation should be evaluated by ACI 355.2 requirements.

Anchor tensile resistance (ACI 318-14 – 17.4.1)

$$\phi N_{sa} = \phi \cdot A_{se,N} \cdot f_{uta} = \quad 17.53 \quad \text{kip} \quad \geq \quad N_f = \quad 0.47 \quad \text{kip}$$

Where:

$\phi = 0.70$ – resistance factor

$A_{se,N} = 0.33$ in^2 – tensile stress area

$f_{uta} = 75.0$ ksi – specified tensile strength of anchor steel:

- $f_{uta} = \min(125 \text{ ksi}, 1.9 \cdot f_{ya}, f_u)$, where:
  - $f_{ya} =$ 55.0 ksi – specified yield strength of anchor steel
  - $f_u =$ 75.0 ksi – specified ultimate strength of anchor steel

Concrete pullout resistance (ACI 318-14 – 17.4.3)

$\phi N_{pn} = \phi \cdot \Psi_{c,P} \cdot N_p =$ 191.70 kip ≥ $N_f =$ 0.47 kip

Where:

$\phi =$ 0.70 – resistance factor

$\Psi_{c,P} =$ 1.00 – modification factor for concrete condition

$N_p =$ 273.86 kip – basic concrete pullout strength for headed anchor:

- $N_{pr} = 8 \cdot A_{brg} \cdot f'_c$, where:
  - $A_{brg} =$ 8.56 in^2 – bearing area of the head of stud or anchor bolt
  - $f'_c =$ 4.0 ksi – concrete compressive strength

Concrete sideface blowout resistance (ACI 318-14 – 17.4.4)

$\phi N_{sb} = r_c \cdot N_{sbg} =$ 103.61 kip ≥ $N_f =$ 0.47 kip

Where:

$r_c =$ 0.50 – reduction factor for anchor close to an edge or multiple anchors with small spacing:

- $r_c = \min(\frac{1+\frac{c_{a2}}{c_{a1}}}{4}, \frac{1+\frac{s}{6 \cdot c_{a1}}}{2}),\ 0.5 \le r_c \le 1$, where:
  - $c_{a1} =$ 10.00 in – shorter distance from an anchor to an edge
  - $c_{a2} =$ 10.00 in – longer distance from an anchor to an edge
  - $s =$ 8.10 in – spacing between anchors

$N_{sbg} =$ 207.22 kip – concrete side-face blowout strength of headed anchor in tension:

- $N_{sb} = \phi \cdot 160.0 \cdot c_{a1} \cdot \sqrt{A_{bgr}} \cdot \sqrt{f'_c}$, where:
  - $A_{bgr} =$ 8.56 in^2 – bearing area of the head of stud or anchor bolt
  - $f'_c =$ 4.0 ksi – concrete compressive strength
  - $\phi =$ 0.70 – resistance factor

Interaction of tensile and shear forces (ACI 318-14 – R17.6)

${U_{tt}}^{5/3} + {U_{ts}}^{5/3} =$ 0.00 ≤ 1.0

Where:

$U_{tt} =$ 0.03 – maximum ratio of factored tensile force and tensile resistance determined from all appropriate failure modes

$U_{ts} =$ 0.00 – maximum ratio of factored shear force and shear resistance determined from all appropriate failure modes

Supplementary reinforcement (ACI 318-14 – 17.4.2.9)

Supplementary reinforcement should resist force of 0.94 kip in tension.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
BP1	M569-bfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10.08	0.84	DStlS50-1(1)	1.64	9.47	17.3	7.3	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10.08	0.84	DStlS33(9)	2.51	9.17	27.4	14.2	OK	OK
BP1	M569-tfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10.08	0.84	DStlS33(9)	3.59	9.43	38.1	20.7	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10.08	0.84	DStlS31(2)	4.74	9.23	51.4	28.3	OK	OK
BP1	M569-w 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9.59	0.87	DStlS31(2)	5.05	10.15	49.7	27.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9.59	0.87	DStlS31(2)	5.09	10.22	49.8	26.8	OK	OK
BP1	Member 3-bfl 1	E70xx	-	-	12.00	-	-	-	-	-	-	OK	OK
M569-bfl 1	GUSS1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	16.57	0.87	DStlS31(2)	2.55	8.60	29.6	14.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	16.57	0.87	DStlS31(2)	2.54	8.60	29.6	13.9	OK	OK
BP1	GUSS1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	23.57	1.18	DStlS31(2)	2.04	10.92	18.6	7.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	23.57	1.18	DStlS31(2)	2.03	10.92	18.6	6.9	OK	OK
GUSS1	M399-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	18.12	0.31	DStlS31(2)	0.68	2.29	29.6	12.1	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	18.12	0.31	DStlS31(2)	0.66	2.32	28.3	11.5	OK	OK
GUSS1	M399-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	18.12	0.31	DStlS31(2)	0.68	2.29	29.6	14.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	18.12	0.31	DStlS31(2)	0.66	2.31	28.4	13.4	OK	OK
GUSS1	M399-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	15.35	0.31	DStlS31(2)	0.72	2.31	31.1	12.8	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	15.35	0.31	DStlS31(2)	0.73	2.27	32.1	13.2	OK	OK
GUSS1	M399-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	15.35	0.31	DStlS31(2)	0.72	2.31	31.1	15.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	15.35	0.31	DStlS31(2)	0.73	2.27	32.1	16.0	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Detailed result for BP1 / M569-tfl 1

Weld resistance check (AISC 360-16 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 9.23 kip ≥ $F_n =$ 4.74 kip

Where:

$F_{nw} =$ 58.6 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 58.8° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.21 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Concrete block

Item	Loads	A_1 [in^2]	A_2 [in^2]	σ [ksi]	$\phi f_{p,max}$ [ksi]	Ut [%]	Status
CB 1	DStlS31(2)	233.03	1023.79	0.4	4.4	10.0	OK

Symbol explanation

A_1	Loaded area
A_2	Supporting area
σ	Average stress in concrete
$\phi f_{p,max}$	Concrete bearing resistance
Ut	Utilization

Detailed result for CB 1

Concrete block compressive resistance check (AISC 360-16 – J8)

$\phi_c f_{p,max} =$ 4.4 ksi ≥ $\sigma =$ 0.4 ksi

Where:

$f_{p,max} =$ 6.8 ksi – concrete block design bearing strength:

- $f_{p,max} = 0.85 \cdot f'_c \cdot \sqrt{\frac{A_2}{A_1}} \leq 1.7 \cdot f'_c$, where:
  - $f'_c =$ 4.0 ksi – concrete compressive strength
  - $A_1 =$ 233.03 in^2 – base plate area in contact with concrete surface
  - $A_2 =$ 1023.79 in^2 – concrete supporting surface

$\phi_c =$ 0.65 – resistance factor for concrete

Shear in contact plane

Item	Loads	V [kip]	P_{br} [kip]	V_{cb} [kip]	Ut [%]	Status
BP1	DStlS31(2)	36.67	413.03	86.87	42.2	OK

Symbol explanation

V	Shear force
P_{br}	Concrete block bearing capacity
V_{cb}	Concrete cone breakout resistance
Ut	Utilization

Detailed result for BP1

Bearing capacity check (ACI 349-01 – B.4.5, ACI 349-01 – RB.11)

$\phi_c P_{br} = \phi \cdot 1.3 \cdot f'_c \cdot A_1 + \phi \cdot K_c \cdot (N_y - P_a) =$ 413.03 kip ≥ $V =$ 36.67 kip

Where:

$\phi =$ 0.7 – resistance factor for bearing of bolts on steel

$f'_c =$ 4.0 ksi – concrete compressive strength

$A_1 =$ 48.01 in^2 – projected area of the embedded area of the shear lug in the direction of the force excluding the portion of the lug in contact with the grout above concrete member

$K_c =$ 1.60 – confinement coefficient

$N_y =$ 110.22 kip – yield strength of tensioned anchors

- $N_y = n \cdot A_{se} \cdot F_y$, where:
  - $n =$ 6.0 – number of tensioned anchors
  - $A_{se} =$ 0.33 in^2 – tensile stress area of an anchor
  - $F_y =$ 55.0 ksi – anchor yield strength

$P_a =$ -102.54 kip – external axial load

Concrete breakout strength check (ACI 349 – B11)

$\phi V_{cb} = \phi \cdot \Psi_{\alpha,v} \cdot A_{vc} \cdot 4.0 \cdot \sqrt{f'_c} =$ 86.87 kip ≥ $V =$ 36.67 kip

Where:

$\phi = 0.85$ – steel embedment material resistance factor for reinforcement

$\Psi_{\alpha,V} = 2.$ – modification factor for shear lug loaded at an angle with the concrete edge

- $\Psi_{\alpha,V} = \sqrt{\frac{1}{(\cos\ \alpha_V)^2+(0.5 \cdot \sin \alpha_V)^2}}$, where:
  - $\alpha_V =$ 89.9 ° – angle between direction of shear force and direction perpendicular to concrete edge

$A_{vc} =$ 202.06 in^2 – effective stress area defined by projecting a 45^o plane from the bearing edges of the shear lug to the free surface in the direction of the shear load. The bearing area of the shear lug is excluded from the projected area.

$f'_c =$ 4.0 ksi – concrete compressive strength

Buckling

Buckling analysis was not calculated.

Project: Creech AOF Baseplate Connections(Model 2)
Project no: 203434
Author: Allison Valencia

Project data

Project name	Creech AOF Baseplate Connections(Model 2)
Project number	203434
Author	Allison Valencia
Description	
Date	3/26/2025
Code	AISC/ACI

Material

Steel	A992, A572 Gr.50
Concrete	4000 psi

Project item 24

Design

Name	24
Description	
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC 360-16 (LRFD) / ACI 318-14

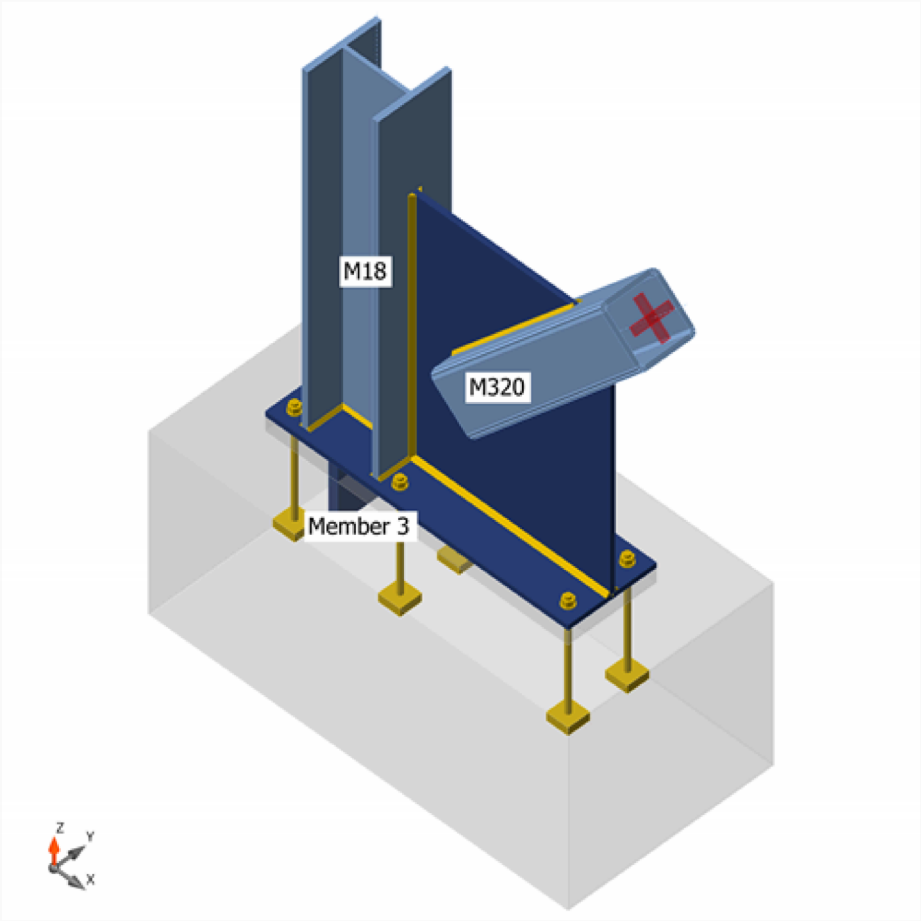
Members

Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M320	471 - HSS8X8X5/8(HSS8X8X5/8(HSS8X8X5/8(HSS(Imp)8X8X5/8)))	0.0	47.8	0.0	0"	0"	0"
M18	6 - W10X68	0.0	90.0	-180.0	0"	0"	0"

Supports and forces

Name	Support	Forces in	X [in]
M320 / end	Mx-My-Mz	Connected member face	7"3/4
M18 / end		Position	0"



Cross-sections

Name	Material
471 - HSS8X8X5/8(HSS8X8X5/8(HSS8X8X5/8(HSS(Imp)8X8X5/8)))	A992
6 - W10X68	A992
2356 - Plate 1.25, 12	A572 Gr.50

Anchors

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
3/4 F1554 Gr.55	3/4	55.0	75.0	0.4418

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS40-1(1)	M320 / End	-57.1	0.0	-0.5	0.0	0.0	0.0
	M18 / End	-113.4	0.0	0.1	0.0	0.0	0.0
DStlS35-1(2)	M320 / End	68.2	0.0	-0.9	0.0	0.0	0.0
	M18 / End	-164.5	0.0	0.0	0.0	0.0	0.0
DStlS1(3)	M320 / End	7.4	0.0	-1.0	0.0	0.0	0.0
	M18 / End	-185.3	0.0	0.1	0.0	0.0	0.0
DStlS20(8)	M320 / End	2.9	0.0	-0.8	0.0	0.0	0.0
	M18 / End	-271.0	0.1	0.1	0.0	0.0	0.0
DStlS13(10)	M320 / End	12.4	0.0	-0.8	0.0	0.0	0.0
	M18 / End	-163.9	0.2	0.1	0.0	0.0	0.0
DStlS30(11)	M320 / End	0.3	0.0	-0.6	0.0	0.0	0.0
	M18 / End	-142.7	-0.1	0.1	0.0	0.0	0.0

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS40-1(1)	-37.9	0.0	-156.0	0.0	0.3	0.0
DStlS35-1(2)	46.5	0.0	-114.6	0.0	0.6	0.0
DStlS1(3)	5.8	0.0	-180.4	0.0	0.6	0.0
DStlS20(8)	2.7	-0.1	-269.4	0.0	0.5	0.0
DStlS13(10)	9.0	-0.2	-155.3	0.0	0.5	0.0
DStlS30(11)	0.7	0.1	-142.9	0.0	0.4	0.0

Project:	**Creech AOF Baseplate Connections(Model 2)**
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Foundation block

Item	Value	Unit
CB 1		
Dimensions	2'-4"1/8 x 4'-9"3/8	in
Depth	2'-1"	in
Anchor	3/4 F1554 Gr.55	
Anchoring length	1'-0"	in
Shear force transfer	Shear lug	
Cross-section of shear lug	Plate 1.25, 12	
Length of shear lug	8"	in
Mortar joint	2"	in

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.2 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Anchors	11.3 < 100%	OK
Welds	75.9 < 100%	OK
Concrete block	24.1 < 100%	OK
Shear	45.2 < 100%	OK
Buckling	25.47	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M320	A992	5/8	DStlS35-1(2)	8.6	0.0	0.0	OK
M18-bfl 1	A992	3/4	DStlS20(8)	25.6	0.0	0.0	OK
M18-tfl 1	A992	3/4	DStlS40-1(1)	18.0	0.0	0.0	OK
M18-w 1	A992	1/2	DStlS20(8)	26.6	0.0	0.0	OK
Member 3-bfl 1	A572 Gr.50	1"1/4	DStlS35-1(2)	45.1	0.2	0.0	OK
BP1	A572 Gr.50	3/4	DStlS35-1(2)	43.9	0.0	0.0	OK
GUSS1	A572 Gr.50	3/4	DStlS20(8)	10.6	0.0	0.0	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for Member 3-bfl 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y = 50.0$ ksi – characteristic yield strength

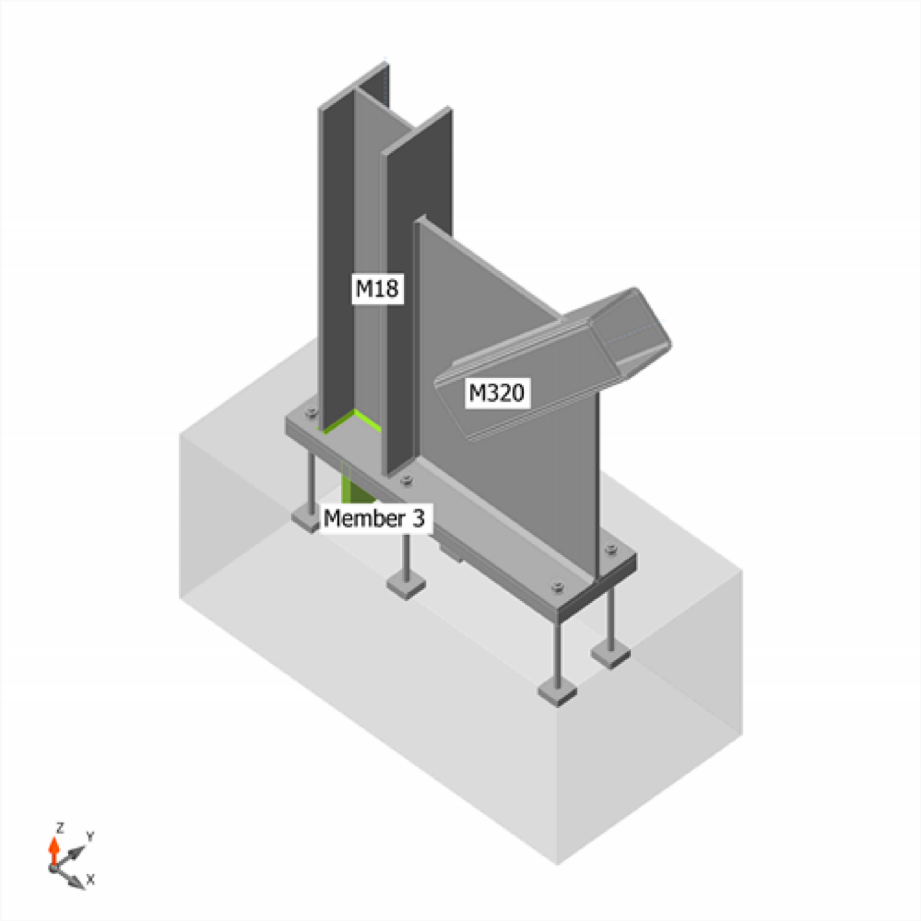
$\phi = 0.90$ – resistance factor for steel material AISC 360-16 – B3.1

Loc. deformation

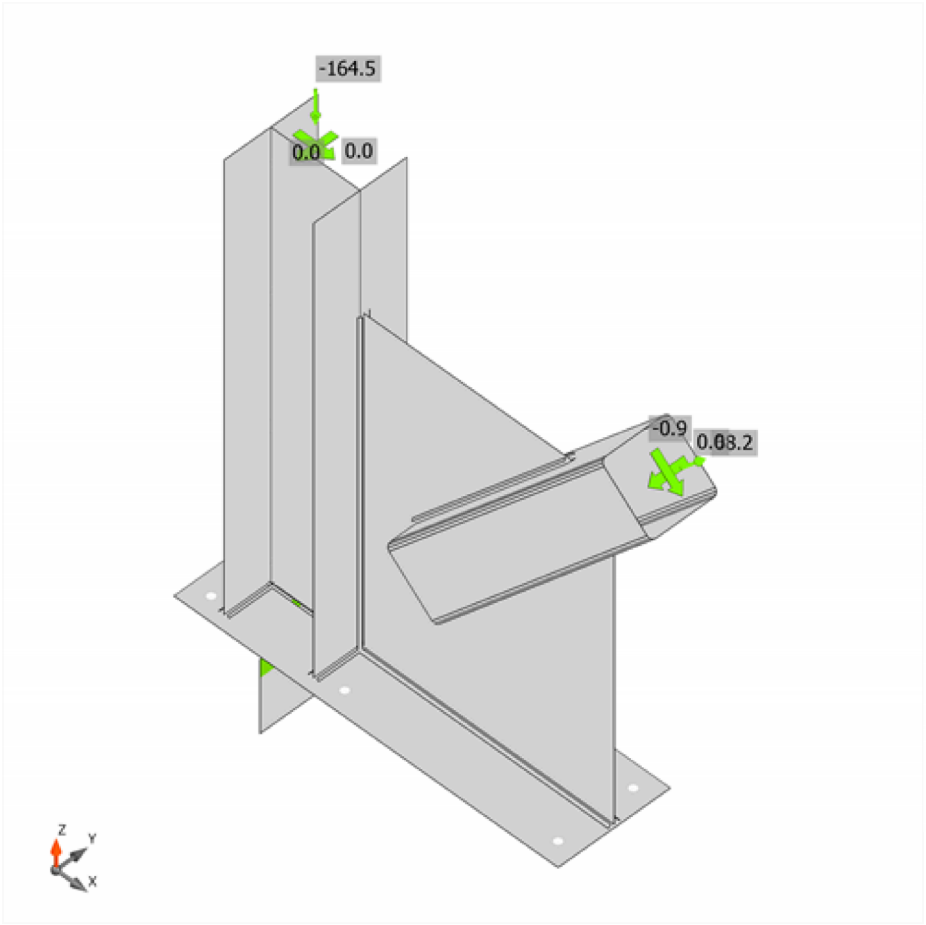
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M320	8"	DStlS30(11)	0"	1/4	0.0	OK

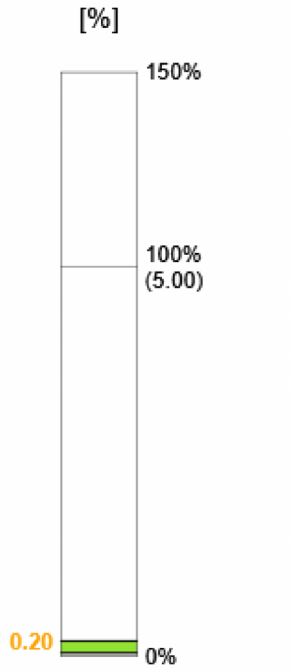
Symbol explanation

d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation

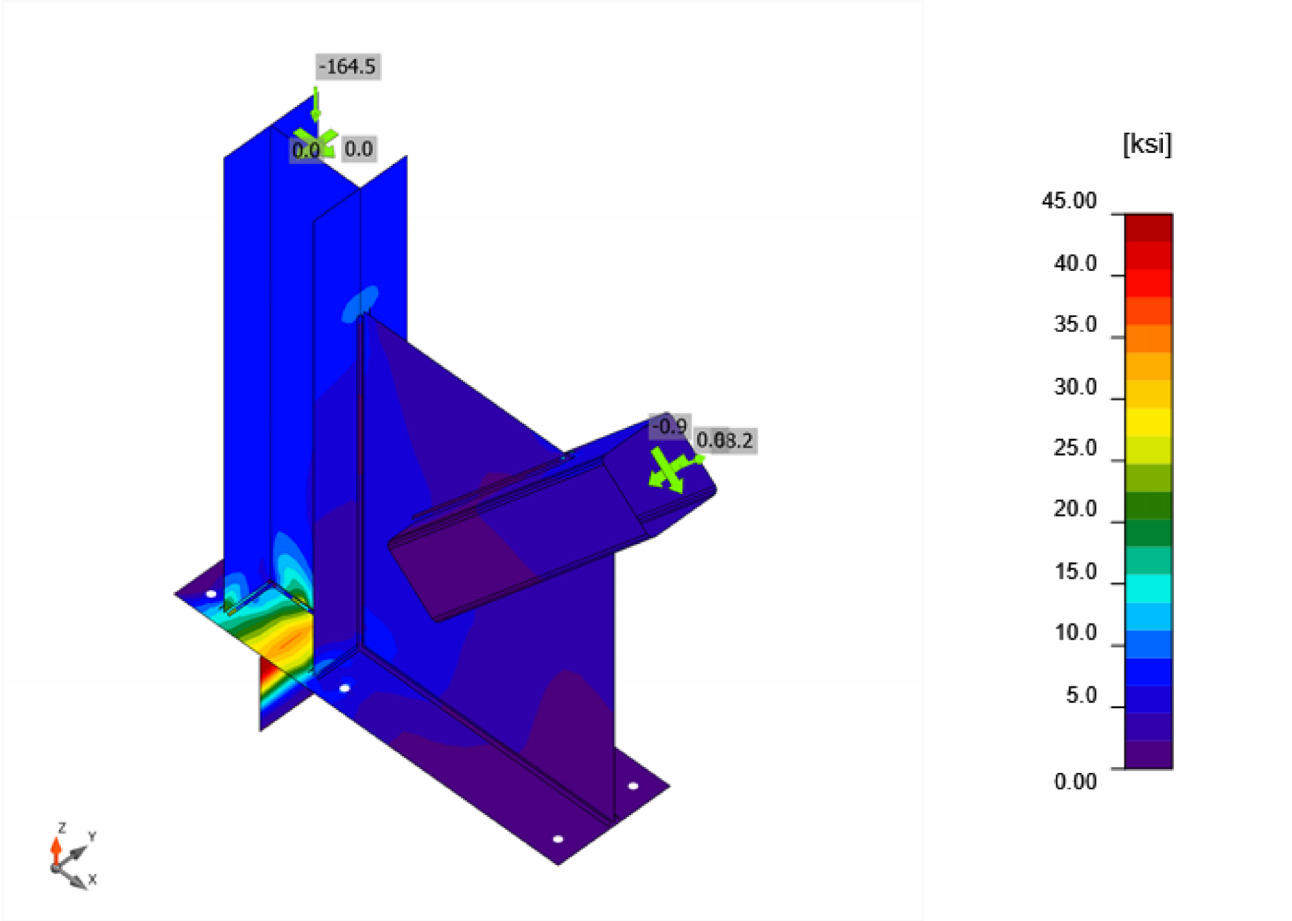


Overall check, DStlS35-1(2)



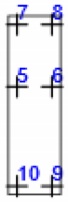


Strain check, DStlS35-1(2)



Equivalent stress, DStlS35-1(2)

Anchors

Shape	Item	Loads	N_f [kip]	ϕN_p [kip]	ϕN_{sb} [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	A5	DStlS30(11)	0.0	191.7	0.0	0.0	0.0	0.0	OK	OK
	A6	DStlS30(11)	0.0	191.7	0.0	0.0	0.0	0.0	OK	OK
	A7	DStlS30(11)	0.0	191.7	0.0	0.0	0.0	0.0	OK	OK
	A8	DStlS30(11)	0.0	191.7	0.0	0.0	0.0	0.0	OK	OK
	A9	DStlS20(8)	2.0	191.7	103.6	11.3	0.0	2.7	OK	OK
	A10	DStlS20(8)	2.0	191.7	103.6	11.2	0.0	2.6	OK	OK

Design data

Grade	ϕN_{sa} [kip]
3/4 F1554 Gr.55 - 1	17.5

Symbol explanation

N_f	Tension force
ϕN_p	Pullout strength in tension - ACI 318-14 – 17.4.3
ϕN_{sb}	Concrete side-face blowout strength in tension - ACI 318-14 – 17.4.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
ϕN_{sa}	Steel strength of anchor in tension - ACI 318-14 – 17.4.1

Detailed result for A9

Concrete splitting failure during installation should be evaluated by ACI 355.2 requirements.

Anchor tensile resistance (ACI 318-14 – 17.4.1)

$$\phi N_{sa} = \phi \cdot A_{se,N} \cdot f_{uta} = \quad 17.5 \quad \text{kip} \quad \geq \quad N_f = \quad 2.0 \quad \text{kip}$$

Where:

$\phi = 0.70$ – resistance factor

$A_{se,N} = 0.3340$ in^2 – tensile stress area

$f_{uta} = 75.0$ ksi – specified tensile strength of anchor steel:

- $f_{uta} = \min(125 \text{ ksi}, 1.9 \cdot f_{ya},\ f_u)$, where:
  - $f_{ya} =$ 55.0 ksi – specified yield strength of anchor steel
  - $f_u =$ 75.0 ksi – specified ultimate strength of anchor steel

Concrete pullout resistance (ACI 318-14 – 17.4.3)

$$\phi N_{pn} = \phi \cdot \Psi_{c,P} \cdot N_p = \quad 191.7 \quad \text{kip} \quad \geq \quad N_f = \quad 2.0 \quad \text{kip}$$

Where:

$\phi = 0.70$ – resistance factor

$\Psi_{c,P} = 1.00$ – modification factor for concrete condition

$N_p = 273.9$ kip – basic concrete pullout strength for headed anchor:

- $N_{pr} = 8 \cdot A_{brg} \cdot f'_c$, where:
  - $A_{brg} =$ 8.5582 in^2 – bearing area of the head of stud or anchor bolt
  - $f'_c =$ 4.0 ksi – concrete compressive strength

Concrete sideface blowout resistance (ACI 318-14 – 17.4.4)

$\phi N_{sb} = r_c \cdot N_{sbg} =$ 103.6 kip ≥ $N_f =$ 2.0 kip

Where:

$r_c = 0.50$ – reduction factor for anchor close to an edge or multiple anchors with small spacing:

- $r_c = \min(\frac{1+\frac{c_{a2}}{c_{a1}}}{4}, \frac{1+\frac{s}{6 \cdot c_{a1}}}{2}),\ 0.5 \ \leq r_c \leq 1$, where:
  - $c_{a1} =$ 10" in – shorter distance from an anchor to an edge
  - $c_{a2} =$ 10" in – longer distance from an anchor to an edge
  - $s =$ 8"1/8 in – spacing between anchors

$N_{sbg} = 207.2$ kip – concrete side-face blowout strength of headed anchor in tension:

- $N_{sb} = \phi \cdot 160.0 \cdot c_{a1} \cdot \sqrt{A_{bgr}} \cdot \sqrt{f'_c}$, where:
  - $A_{bgr} =$ 8.5582 in^2 – bearing area of the head of stud or anchor bolt
  - $f'_c =$ 4.0 ksi – concrete compressive strength
  - $\phi =$ 0.70 – resistance factor

Interaction of tensile and shear forces (ACI 318-14 – R17.6)

${U_{tt}}^{5/3} + {U_{ts}}^{5/3} =$ 0.03 ≤ 1.0

Where:

$U_{tt} = 0.11$ – maximum ratio of factored tensile force and tensile resistance determined from all appropriate failure modes

$U_{ts} = 0.00$ – maximum ratio of factored shear force and shear resistance determined from all appropriate failure modes

Supplementary reinforcement (ACI 318-14 – 17.4.2.9)

Supplementary reinforcement should resist force of 4.0 kip in tension. Only current load effect considered.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
BP1	M18-bfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS20(8)	7.2	9.6	75.6	54.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS20(8)	7.3	9.6	75.9	57.9	OK	OK
BP1	M18-tfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS20(8)	6.0	9.2	64.6	42.4	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS20(8)	5.7	9.3	61.9	41.5	OK	OK
BP1	M18-w 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9"9/16	7/8	DStlS20(8)	7.6	10.1	75.1	43.5	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9"9/16	7/8	DStlS20(8)	7.6	10.1	75.1	44.2	OK	OK
BP1	Member 3-bfl 1	E70xx	-	-	1'-0"	-	-	-	-	-	-	OK	OK
M18-tfl 1	GUSS1	E70xx	◢ 3/8 ◣	◢ 1/2 ◣	2'-11"15/16	7/8	DStlS20(8)	4.4	11.2	39.3	17.3	OK	OK
		E70xx	◢ 3/8 ◣	◢ 1/2 ◣	2'-11"15/16	7/8	DStlS20(8)	4.4	11.3	39.5	17.4	OK	OK
BP1	GUSS1	E70xx	◢ 3/8 ◣	◢ 1/2 ◣	2'-2"15/16	1"13/16	DStlS20(8)	5.2	31.8	16.3	6.9	OK	OK
		E70xx	◢ 3/8 ◣	◢ 1/2 ◣	2'-2"15/16	1"13/16	DStlS20(8)	5.2	31.8	16.4	7.0	OK	OK
GUSS1	M320-w 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	1'-11"1/16	1/2	DStlS40-1(1)	1.1	4.4	24.4	9.3	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	1'-11"1/16	1/2	DStlS40-1(1)	1.2	4.2	29.4	11.8	OK	OK
GUSS1	M320-w 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	1'-11"1/16	1/2	DStlS40-1(1)	1.1	4.4	24.3	10.9	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	1'-11"1/16	1/2	DStlS40-1(1)	1.2	4.2	29.2	13.9	OK	OK
GUSS1	M320-w 3	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	2'-0"7/16	1/2	DStlS35-1(2)	1.5	4.4	33.6	14.3	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	2'-0"7/16	1/2	DStlS35-1(2)	1.7	4.2	40.0	17.8	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
GUSS1	M320-w 3	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	2'-0"7/16	1/2	DStlS35-1(2)	1.5	4.4	33.7	16.8	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	2'-0"7/16	1/2	DStlS35-1(2)	1.7	4.2	40.0	21.5	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Detailed result for BP1 / M18-bfl 1

Weld resistance check (AISC 360-16 – J2-4)

$$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} = \quad 9.6 \quad \text{kip} \quad \geq \quad F_n = \quad 7.3 \quad \text{kip}$$

Where:

$F_{nw} = 61.1$ ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 69.9° – angle of loading measured from the weld longitudinal axis

$A_{we} = 0.2099$ in^2 – effective area of weld critical element

$\phi = 0.75$ – resistance factor for welded connections

Concrete block

Item	Loads	A_1 [in^2]	A_2 [in^2]	σ [ksi]	$\phi f_{p,max}$ [ksi]	Ut [%]	Status
CB 1	DStlS20(8)	260.5225	1042.2529	1.1	4.4	24.1	OK

Symbol explanation

A_1	Loaded area
A_2	Supporting area
σ	Average stress in concrete
$\phi f_{p,max}$	Concrete bearing resistance
Ut	Utilization

Detailed result for CB 1

Concrete block compressive resistance check (AISC 360-16 – J8)

$\phi_c f_{p,max} =$ 4.4 ksi ≥ $\sigma =$ 1.1 ksi

Where:

$f_{p,max} =$ 6.8 ksi – concrete block design bearing strength:

- $f_{p,max} = 0.85 \cdot f'_c \cdot \sqrt{\frac{A_2}{A_1}} \leq 1.7 \cdot f'_c$, where:
  - $f'_c =$ 4.0 ksi – concrete compressive strength
  - $A_1 =$ 260.5225 in^2 – base plate area in contact with concrete surface
  - $A_2 =$ 1042.2529 in^2 – concrete supporting surface

$\phi_c =$ 0.65 – resistance factor for concrete

Shear in contact plane

Item	Loads	V [kip]	P_{br} [kip]	V_{cb} [kip]	Ut [%]	Status
BP1	DStlS35-1(2)	46.0	520.5	101.6	45.2	OK

Symbol explanation

V	Shear force
P_{br}	Concrete block bearing capacity
V_{cb}	Concrete cone breakout resistance
Ut	Utilization

Detailed result for BP1

Bearing capacity check (ACI 349-01 – B.4.5, ACI 349-01 – RB.11)

$\phi_c P_{br} = \phi \cdot 1.3 \cdot f'_c \cdot A_1 + \phi \cdot K_c \cdot (N_y - P_a) =$ 520.5 kip ≥ $V =$ 46.0 kip

Where:

$\phi = 0.7$ – resistance factor for bearing of bolts on steel

$f'_c = 4.0$ ksi – concrete compressive strength

$A_1 = 72.0043$ in^2 – projected area of the embedded area of the shear lug in the direction of the force excluding the portion of the lug in contact with the grout above concrete member

$K_c = 1.60$ – confinement coefficient

$N_y = 110.2$ kip – yield strength of tensioned anchors

- $N_y = n \cdot A_{se} \cdot F_y$, where:
  - $n =$ 6.0 – number of tensioned anchors
  - $A_{se} =$ 0.3340 in^2 – tensile stress area of an anchor
  - $F_y =$ 55.0 ksi – anchor yield strength

$P_a =$ -120.5 kip – external axial load

Concrete breakout strength check (ACI 349 – B11)

$\phi V_{cb} = \phi \cdot \Psi_{\alpha,v} \cdot A_{vc} \cdot 4.0 \cdot \sqrt{f'_c} =$ 101.6 kip ≥ $V =$ 46.0 kip

Where:

$\phi = 0.85$ – steel embedment material resistance factor for reinforcement

$\Psi_{\alpha,V} = 2.$ – modification factor for shear lug loaded at an angle with the concrete edge

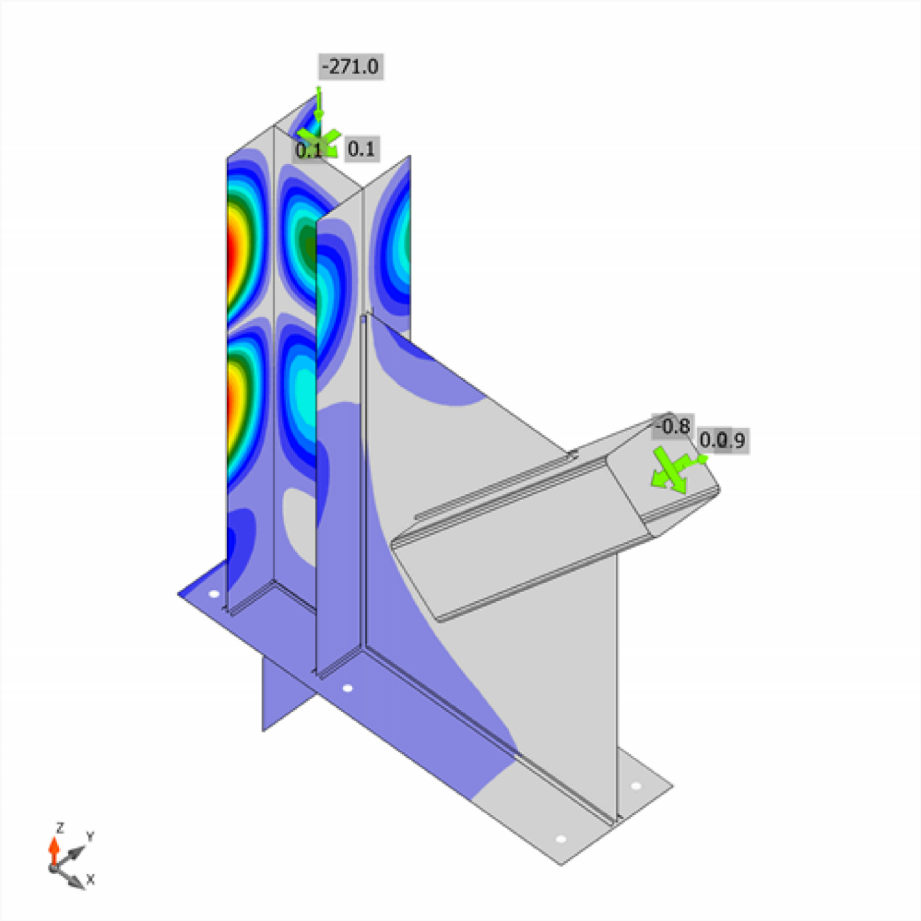
- $\Psi_{\alpha,V} = \sqrt{\frac{1}{(\cos\ \alpha_V)^2 + (0.5 \cdot \sin \alpha_V)^2}}$, where:
  - $\alpha_V =$ 89.9 ° – angle between direction of shear force and direction perpendicular to concrete edge

$A_{vc} = 236.2675$ in^2 – effective stress area defined by projecting a 45^o plane from the bearing edges of the shear lug to the free surface in the direction of the shear load. The bearing area of the shear lug is excluded from the projected area.

$f'_c = 4.0$ ksi – concrete compressive strength

Buckling

Loads	Shape	Factor [-]
DStlS40-1(1)	1	41.60
	2	55.75
	3	57.21
	4	59.92
	5	61.91
	6	65.56
DStlS35-1(2)	1	42.90
	2	44.53
	3	48.94
	4	50.63
	5	54.55
	6	56.63
DStlS1(3)	1	37.36
	2	38.17
	3	41.56
	4	43.50
	5	46.34
	6	47.68
DStlS20(8)	1	25.47
	2	25.97
	3	28.27
	4	29.63
	5	31.54
	6	32.34
DStlS13(10)	1	42.30
	2	43.30
	3	47.21
	4	49.34
	5	52.61
	6	54.21
DStlS30(11)	1	48.37
	2	49.31
	3	53.63
	4	56.23
	5	59.85
	6	61.29



First buckling mode shape, DStlS20(8)

Project item 19

Design

Name	19
Description	
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC 360-16 (LRFD) / ACI 318-14

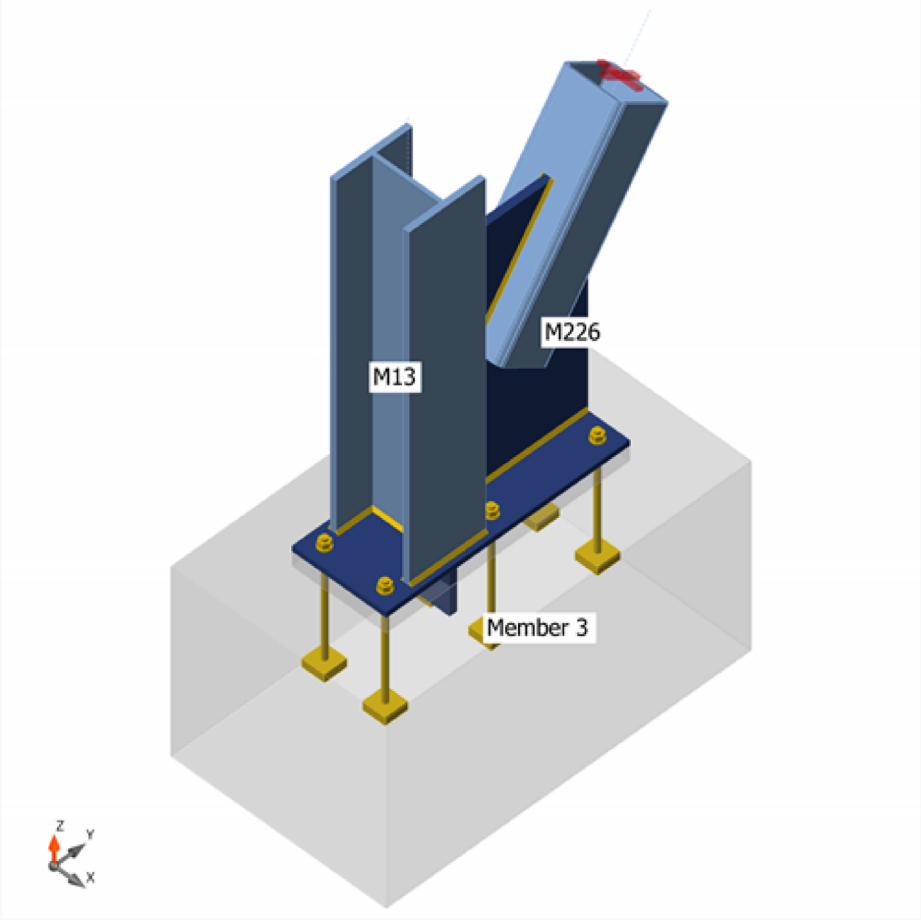
Members

Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M13	6 - W10X68	0.0	90.0	-180.0	0"	0"	0"
M226	438 - HSS8X8X1/2(HSS8X8X1/2(HSS8X8X1/2(HSS(Imp)8X8X1/2)))	90.0	55.2	0.0	0"	0"	0"

Supports and forces

Name	Support	Forces in	X [in]
M13 / end		Position	0"
M226 / end	Mx-My-Mz	Connected member face	7/16



Cross-sections

Name	Material
6 - W10X68	A992
438 - HSS8X8X1/2(HSS8X8X1/2(HSS8X8X1/2(HSS(Imp)8X8X1/2)))	A992
2355 - FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(Plate 1, 12)))))))))))	A572 Gr.50

Anchors

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
3/4 F1554 Gr.55	3/4	55.0	75.0	0.4418

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS22(1)	M13 / End	-72.3	0.0	-1.3	0.0	0.0	0.0
	M226 / End	-57.7	0.0	-0.5	0.0	0.0	0.0
DStlS11(5)	M13 / End	-39.2	0.0	3.4	0.0	0.0	0.0
	M226 / End	-20.3	0.0	-0.5	0.0	0.0	0.0
DStlS28(6)	M13 / End	-40.2	0.0	-3.1	0.0	0.0	0.0
	M226 / End	-21.4	0.0	-0.4	0.0	0.0	0.0
DStlS14(7)	M13 / End	-65.5	0.0	-3.0	0.0	0.0	0.0
	M226 / End	-73.1	0.0	-0.5	0.0	0.0	0.0
DStlS29(8)	M13 / End	-13.9	0.0	3.4	0.0	0.0	0.0
	M226 / End	31.4	0.0	-0.4	0.0	0.0	0.0
DStlS35-1(9)	M13 / End	-48.0	0.0	0.2	0.0	0.0	0.0
	M226 / End	-24.4	0.0	-0.6	0.0	0.0	0.0
DStlS1(11)	M13 / End	-48.3	0.0	0.2	0.0	0.0	0.0
	M226 / End	-25.3	0.0	-0.6	0.0	0.0	0.0

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS22(1)	-1.4	-32.5	-120.0	0.0	0.0	0.0
DStlS11(5)	3.4	-11.2	-56.1	0.0	0.0	0.0
DStlS28(6)	-3.1	-11.9	-58.0	0.0	0.0	0.0
DStlS14(7)	-3.0	-41.3	-125.8	0.0	0.0	0.0
DStlS29(8)	3.4	18.2	11.6	0.0	0.0	0.0
DStlS35-1(9)	0.2	-13.5	-68.3	0.0	0.0	0.0
DStlS1(11)	0.2	-13.9	-69.3	0.0	0.0	0.0

Foundation block

Item	Value	Unit
CB 1		
Dimensions	4'-0"1/8 x 2'-4"3/8	in
Depth	2'-1"	in
Anchor	3/4 F1554 Gr.55	
Anchoring length	1'-0"	in
Shear force transfer	Shear lug	
Cross-section of shear lug	FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(Plate 1, 12)))))))))))	
Length of shear lug	6"	in
Mortar joint	2"	in

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.9 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Anchors	29.2 < 100%	OK
Welds	76.1 < 100%	OK
Concrete block	15.7 < 100%	OK
Shear	45.7 < 100%	OK
Buckling	54.67	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M13-bfl 1	A992	3/4	DStlS14(7)	19.1	0.0	0.0	OK
M13-tfl 1	A992	3/4	DStlS14(7)	19.2	0.0	0.0	OK
M13-w 1	A992	1/2	DStlS14(7)	22.8	0.0	0.0	OK
M226	A992	1/2	DStlS14(7)	12.5	0.0	0.0	OK
Member 3-bfl 1	A572 Gr.50	1"	DStlS14(7)	45.3	0.9	0.0	OK
BP1	A572 Gr.50	3/4	DStlS14(7)	32.8	0.0	0.0	OK
GUSS1	A572 Gr.50	1"	DStlS14(7)	11.4	0.0	0.0	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for Member 3-bfl 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y =$ 50.0 ksi – characteristic yield strength

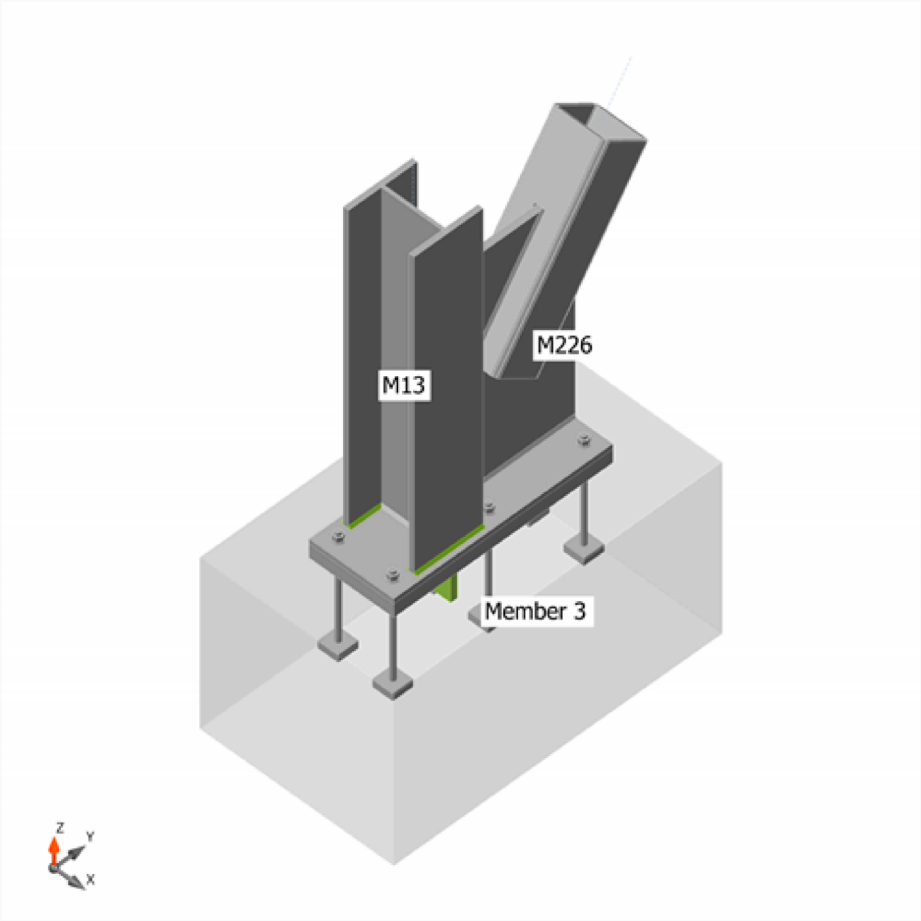
$\phi =$ 0.90 – resistance factor for steel material AISC 360-16 – B3.1

Loc. deformation

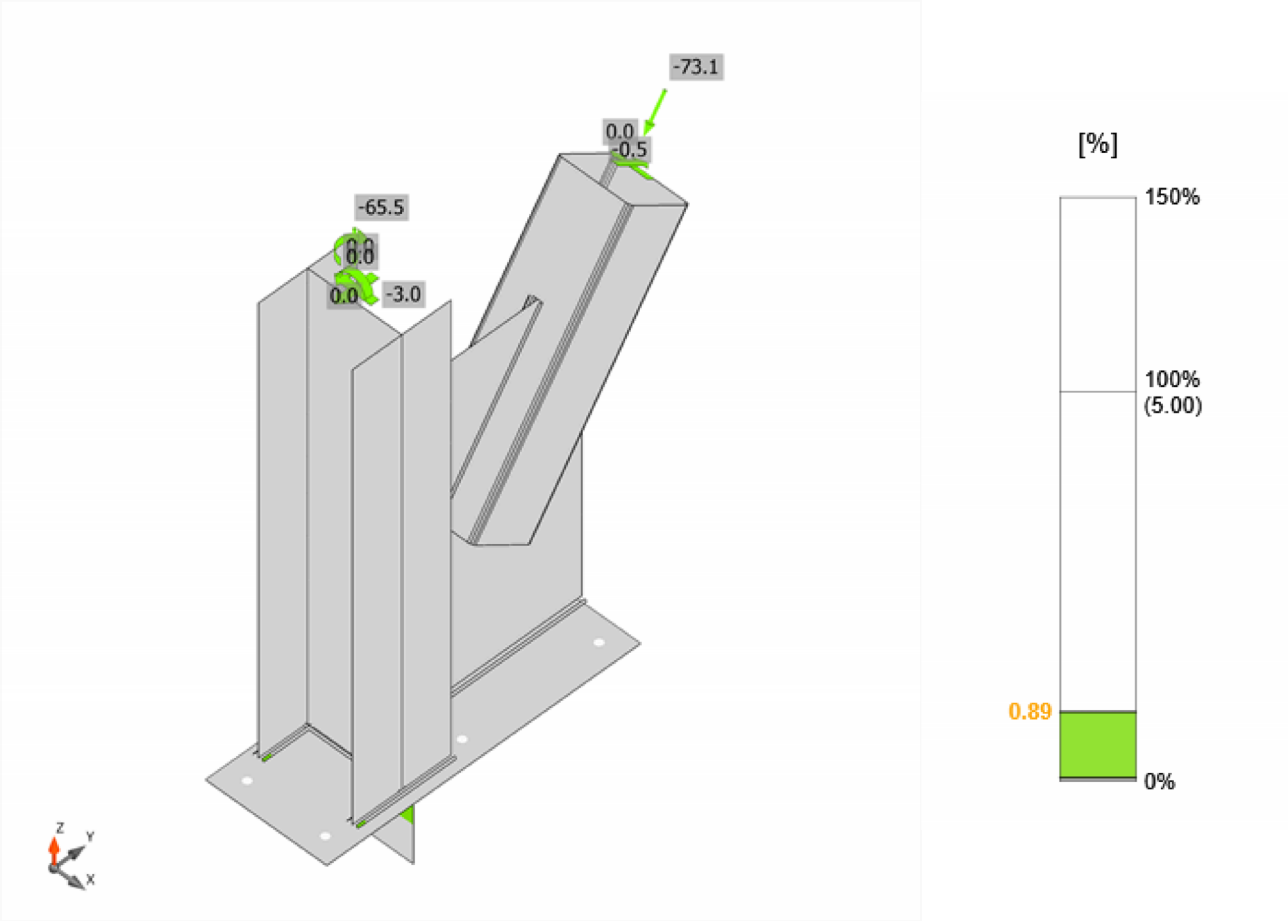
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M226	8"	DStlS1(11)	0"	1/4	0.0	OK

Symbol explanation

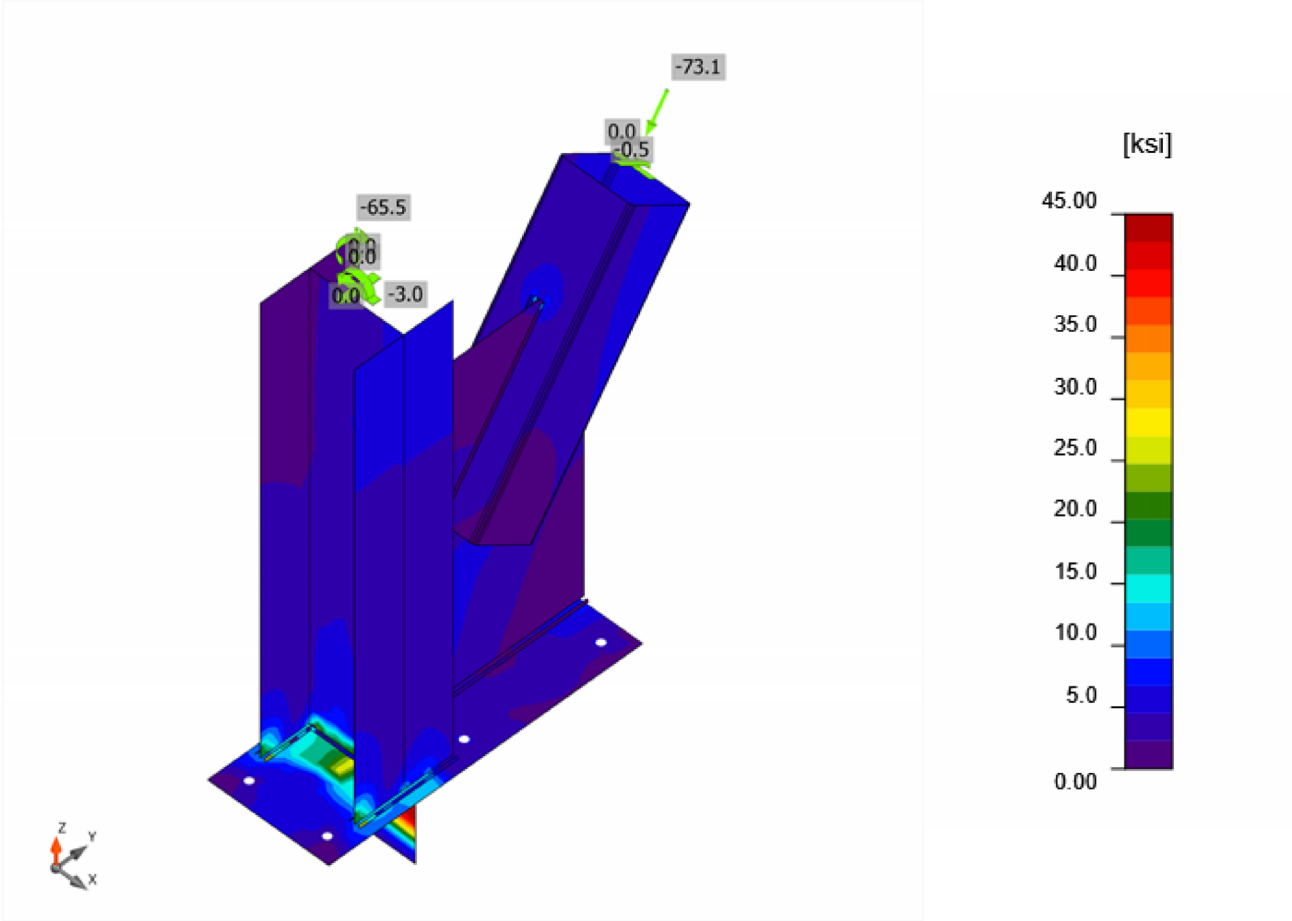
d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation



Overall check, DStlS14(7)

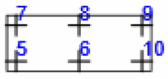


Strain check, DStlS14(7)



Equivalent stress, DStlS14(7)

Anchors

Shape	Item	Loads	N_f [kip]	ϕN_p [kip]	ϕN_{sb} [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	A5	DStlS29(8)	4.2	191.7	104.9	24.1	0.0	9.3	OK	OK
	A6	DStlS29(8)	2.4	191.7	104.9	13.6	0.0	3.6	OK	OK
	A7	DStlS29(8)	5.1	191.7	104.9	29.2	0.0	12.8	OK	OK
	A8	DStlS29(8)	4.0	191.7	104.9	22.6	0.0	8.4	OK	OK
	A9	DStlS14(7)	2.1	191.7	104.9	11.9	0.0	2.9	OK	OK
	A10	DStlS14(7)	2.1	191.7	104.9	12.1	0.0	3.0	OK	OK

Design data

Grade	ϕN_{sa} [kip]
3/4 F1554 Gr.55 - 1	17.5

Symbol explanation

N_f	Tension force
ϕN_p	Pullout strength in tension - ACI 318-14 – 17.4.3
ϕN_{sb}	Concrete side-face blowout strength in tension - ACI 318-14 – 17.4.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
ϕN_{sa}	Steel strength of anchor in tension - ACI 318-14 – 17.4.1

Detailed result for A7

Concrete splitting failure during installation should be evaluated by ACI 355.2 requirements.

Anchor tensile resistance (ACI 318-14 – 17.4.1)

$\phi N_{sa} = \phi \cdot A_{se,N} \cdot f_{uta} =$ 17.5 kip ≥ $N_f =$ 5.1 kip

Where:

$\phi =$ 0.70 – resistance factor

$A_{se,N} =$ 0.3340 in^2 – tensile stress area

$f_{uta} =$ 75.0 ksi – specified tensile strength of anchor steel:

- $f_{uta} = \min(125 \text{ ksi}, 1.9 \cdot f_{ya},\ f_u)$, where:
  - $f_{ya} =$ 55.0 ksi – specified yield strength of anchor steel
  - $f_u =$ 75.0 ksi – specified ultimate strength of anchor steel

Concrete pullout resistance (ACI 318-14 – 17.4.3)

$\phi N_{pn} = \phi \cdot \Psi_{c,P} \cdot N_p =$ 191.7 kip ≥ $N_f =$ 5.1 kip

Where:

$\phi =$ 0.70 – resistance factor

$\Psi_{c,P} =$ 1.00 – modification factor for concrete condition

$N_p =$ 273.9 kip – basic concrete pullout strength for headed anchor:

- $N_{pr} = 8 \cdot A_{brg} \cdot f'_c$, where:
  - $A_{brg} =$ 8.5582 in^2 – bearing area of the head of stud or anchor bolt
  - $f'_c =$ 4.0 ksi – concrete compressive strength

Concrete sideface blowout resistance (ACI 318-14 – 17.4.4)

$\phi N_{sb} = r_c \cdot N_{sbg} =$ 104.9 kip ≥ $N_f =$ 5.1 kip

Where:

$r_c = 0.50$ – reduction factor for anchor close to an edge or multiple anchors with small spacing:

- $r_c = \min(\frac{1+\frac{c_{a2}}{c_{a1}}}{4}, \frac{1+\frac{s}{6 \cdot c_{a1}}}{2}),\ 0.5 \ \leq r_c \leq 1$, where:
  - $c_{a1} =$ 10"1/16 in – shorter distance from an anchor to an edge
  - $c_{a2} =$ 10"3/16 in – longer distance from an anchor to an edge
  - $s =$ 8" in – spacing between anchors

$N_{sbg} =$ 208.3 kip – concrete side-face blowout strength of headed anchor in tension:

- $N_{sb} = \phi \cdot 160.0 \cdot c_{a1} \cdot \sqrt{A_{bgr}} \cdot \sqrt{f'_c}$, where:
  - $A_{bgr} =$ 8.5582 in^2 – bearing area of the head of stud or anchor bolt
  - $f'_c =$ 4.0 ksi – concrete compressive strength
  - $\phi =$ 0.70 – resistance factor

Interaction of tensile and shear forces (ACI 318-14 – R17.6)

${U_{tt}}^{5/3} + {U_{ts}}^{5/3} =$ 0.13 ≤ 1.0

Where:

$U_{tt} = 0.29$ – maximum ratio of factored tensile force and tensile resistance determined from all appropriate failure modes

$U_{ts} = 0.00$ – maximum ratio of factored shear force and shear resistance determined from all appropriate failure modes

Supplementary reinforcement (ACI 318-14 – 17.4.2.9)

Supplementary reinforcement should resist force of 15.7 kip in tension. Only current load effect considered.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
BP1	M13-bfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS14(7)	6.7	8.8	76.1	54.1	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS14(7)	6.6	8.8	75.5	51.1	OK	OK
BP1	M13-tfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS14(7)	6.6	8.8	75.5	50.4	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS14(7)	6.7	8.8	76.1	53.2	OK	OK
BP1	M13-w 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9"5/8	7/8	DStlS14(7)	4.3	9.2	47.1	28.9	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9"5/8	7/8	DStlS14(7)	4.6	9.6	48.4	30.8	OK	OK
BP1	Member 3-bfl 1	E70xx	-	-	1'-0"	-	-	-	-	-	-	OK	OK
M13-w 1	GUSS1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	2'-9"7/16	7/8	DStlS14(7)	2.2	9.7	22.4	9.8	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	2'-9"7/16	7/8	DStlS14(7)	2.0	9.5	21.4	9.1	OK	OK
BP1	GUSS1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	1'-10"13/16	1"5/8	DStlS14(7)	9.4	17.6	53.4	32.5	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	1'-10"13/16	1"5/8	DStlS14(7)	9.3	17.6	52.9	32.2	OK	OK
GUSS1	M226-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-3"7/16	1/2	DStlS14(7)	1.6	3.7	42.9	20.3	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-3"7/16	1/2	DStlS14(7)	1.6	3.6	45.7	22.1	OK	OK
GUSS1	M226-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-3"7/16	1/2	DStlS14(7)	1.6	3.7	42.8	24.9	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-3"7/16	1/2	DStlS14(7)	1.6	3.6	45.6	26.9	OK	OK
GUSS1	M226-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-6"5/16	1/2	DStlS14(7)	1.4	3.5	39.9	18.1	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-6"5/16	1/2	DStlS14(7)	1.1	3.7	31.1	13.0	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
GUSS1	M226-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-6"5/16	1/2	DStlS14(7)	1.4	3.5	40.3	22.3	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-6"5/16	1/2	DStlS14(7)	1.1	3.7	31.3	15.5	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Detailed result for BP1 / M13-tfl 1

Weld resistance check (AISC 360-16 – J2-4)

$$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} = \quad 8.8 \quad \text{kip} \quad \geq \quad F_n = \quad 6.7 \quad \text{kip}$$

Where:

$F_{nw} = 56.1$ ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 49.9° – angle of loading measured from the weld longitudinal axis

$A_{we} = 0.2099$ in^2 – effective area of weld critical element

$\phi = 0.75$ – resistance factor for welded connections

Concrete block

Item	Loads	A_1 [in^2]	A_2 [in^2]	σ [ksi]	$\phi f_{p,max}$ [ksi]	Ut [%]	Status
CB 1	DStlS14(7)	188.5370	886.8647	0.7	4.4	15.7	OK

Symbol explanation

A_1	Loaded area
A_2	Supporting area
σ	Average stress in concrete
$\phi f_{p,max}$	Concrete bearing resistance
Ut	Utilization

Detailed result for CB 1

Concrete block compressive resistance check (AISC 360-16 – J8)

$\phi_c f_{p,max} =$ 4.4 ksi ≥ $\sigma =$ 0.7 ksi

Where:

$f_{p,max} =$ 6.8 ksi – concrete block design bearing strength:

- $f_{p,max} = 0.85 \cdot f'_c \cdot \sqrt{\frac{A_2}{A_1}} \leq 1.7 \cdot f'_c$, where:
  - $f'_c =$ 4.0 ksi – concrete compressive strength
  - $A_1 =$ 188.5370 in^2 – base plate area in contact with concrete surface
  - $A_2 =$ 886.8647 in^2 – concrete supporting surface

$\phi_c =$ 0.65 – resistance factor for concrete

Shear in contact plane

Item	Loads	V [kip]	P_{br} [kip]	V_{cb} [kip]	Ut [%]	Status
BP1	DStlS14(7)	40.6	292.8	88.8	45.7	OK

Symbol explanation

V	Shear force
P_{br}	Concrete block bearing capacity
V_{cb}	Concrete cone breakout resistance
Ut	Utilization

Detailed result for BP1

Bearing capacity check (ACI 349-01 – B.4.5, ACI 349-01 – RB.11)

$\phi_c P_{br} = \phi \cdot 1.3 \cdot f'_c \cdot A_1 + \phi \cdot K_c \cdot (N_y - P_a) =$ 292.8 kip ≥ $V =$ 40.6 kip

Where:

$\phi = 0.7$ – resistance factor for bearing of bolts on steel

$f'_c = 4.0$ ksi – concrete compressive strength

$A_1 = 7.5724$ in^2 – projected area of the embedded area of the shear lug in the direction of the force excluding the portion of the lug in contact with the grout above concrete member

$K_c = 1.60$ – confinement coefficient

$N_y = 110.2$ kip – yield strength of tensioned anchors

- $N_y = n \cdot A_{se} \cdot F_y$, where:
  - $n =$ 6.0 – number of tensioned anchors
  - $A_{se} =$ 0.3340 in^2 – tensile stress area of an anchor
  - $F_y =$ 55.0 ksi – anchor yield strength

$P_a =$ -126.6 kip – external axial load

Concrete breakout strength check (ACI 349 – B11)

$\phi V_{cb} = \phi \cdot \Psi_{\alpha,v} \cdot A_{vc} \cdot 4.0 \cdot \sqrt{f'_c} =$ 88.8 kip ≥ $V =$ 40.6 kip

Where:

$\phi = 0.85$ – steel embedment material resistance factor for reinforcement

$\Psi_{\alpha,V} = 1.98$ – modification factor for shear lug loaded at an angle with the concrete edge

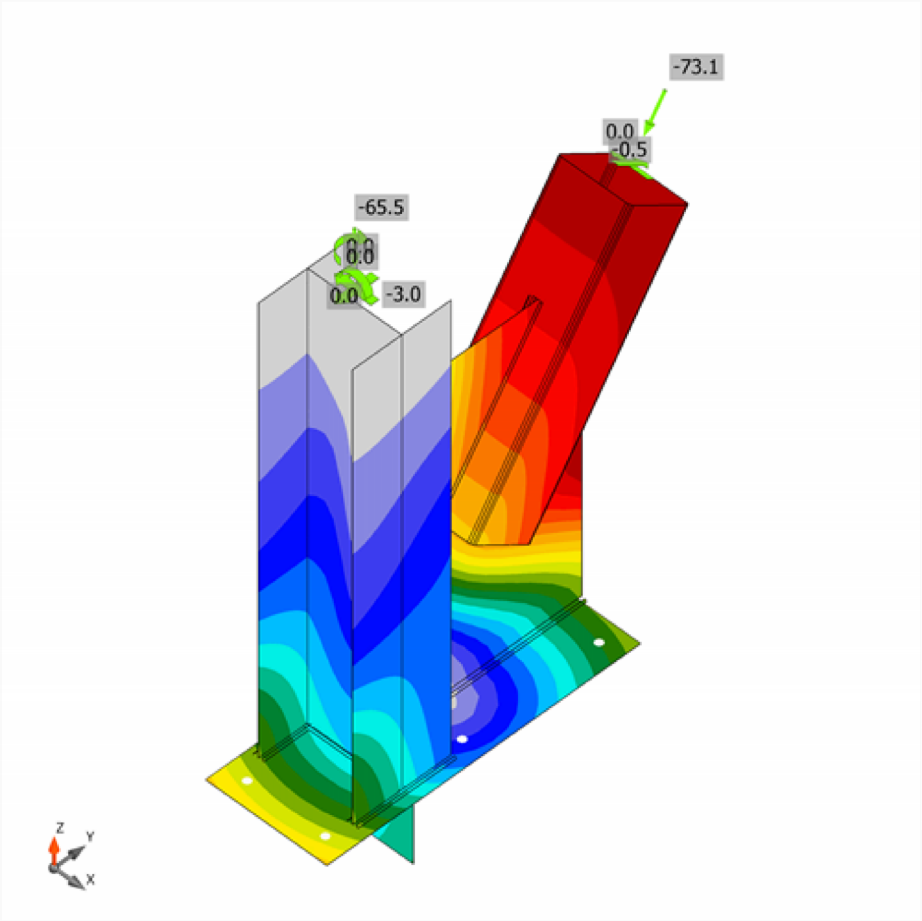
- $\Psi_{\alpha,V} = \sqrt{\frac{1}{(\cos\ \alpha_V)^2 + (0.5 \cdot \sin \alpha_V)^2}}$, where:
  - $\alpha_V =$ 85.7 ° – angle between direction of shear force and direction perpendicular to concrete edge

$A_{vc} = 208.2798$ in^2 – effective stress area defined by projecting a 45^o plane from the bearing edges of the shear lug to the free surface in the direction of the shear load. The bearing area of the shear lug is excluded from the projected area.

$f'_c = 4.0$ ksi – concrete compressive strength

Buckling

Loads	Shape	Factor [-]
DStlS22(1)	1	66.33
	2	95.01
	3	102.88
	4	104.84
	5	105.18
	6	110.65
DStlS11(5)	1	119.65
	2	131.68
	3	161.47
	4	164.87
	5	174.77
	6	193.36
DStlS28(6)	1	122.90
	2	135.12
	3	161.85
	4	164.39
	5	170.97
	6	194.23
DStlS14(7)	1	54.67
	2	87.65
	3	88.28
	4	92.05
	5	93.31
	6	95.67
DStlS29(8)	1	194.06
	2	217.26
	3	298.70
	4	319.70
	5	331.94
	6	341.42
DStlS35-1(9)	1	143.28
	2	154.11
	3	172.98
	4	176.46
	5	182.97
	6	185.14
DStlS1(11)	1	139.54
	2	153.41
	3	172.37
	4	174.91
	5	181.44
	6	183.05



First buckling mode shape, DStlS14(7)

Project item 10

Design

Name	10
Description	
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC 360-16 (LRFD) / ACI 318-14

Members

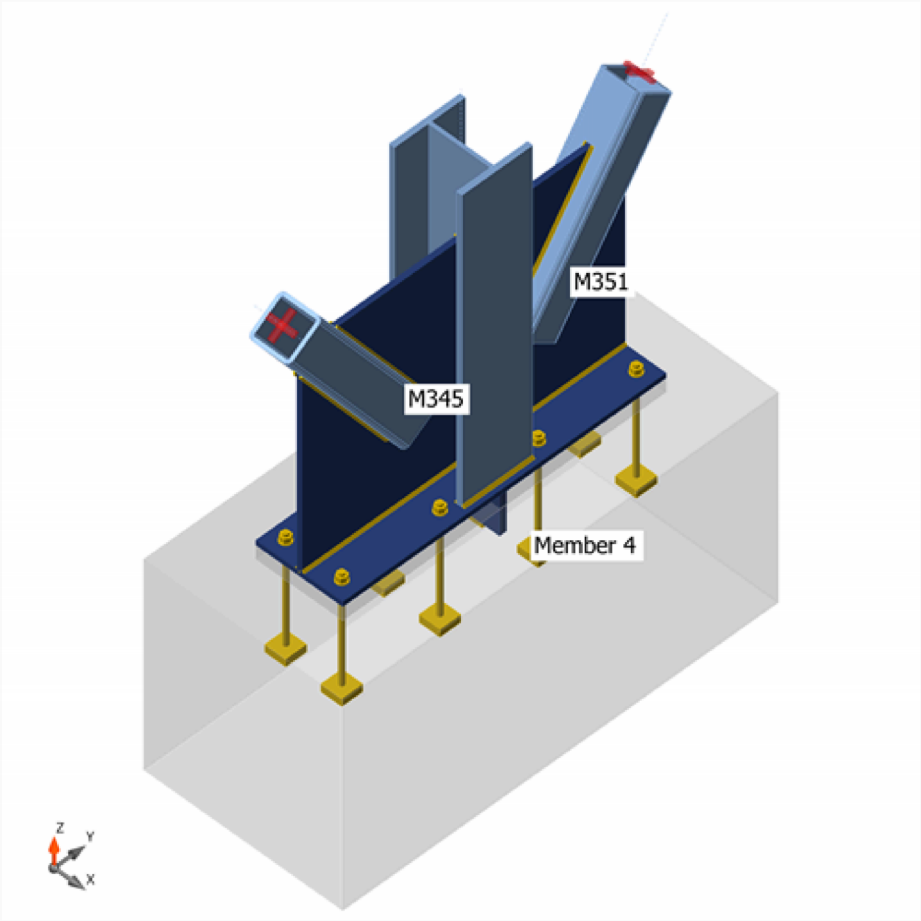
Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M5	6 - W10X68	0.0	90.0	-180.0	0"	0"	0"
M345	37 - HSS6X6X1/2(HSS6X6X1/2(HSS6X6X1/2(HSS(Imp)6X6X1/2)))	-90.0	55.2	0.0	0"	0"	0"
M351	37 - HSS6X6X1/2(HSS6X6X1/2(HSS6X6X1/2(HSS(Imp)6X6X1/2)))	90.0	55.2	0.0	0"	0"	0"

Supports and forces

Name	Support	Forces in	X [in]
M5 / end		Position	0"
M345 / end	Mx-My-Mz	Connected member face	7/16
M351 / end	Mx-My-Mz	Connected member face	7/16

Project:	**Creech AOF Baseplate Connections(Model 2)**
Project no:	**203434**
Author:	**Allison Valencia**



Cross-sections

Name	Material
6 - W10X68	A992
37 - HSS6X6X1/2(HSS6X6X1/2(HSS6X6X1/2(HSS(Imp)6X6X1/2)))	A992
2355 - FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(Plate 1, 12)))))))))	A572 Gr.50

Anchors

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
3/4 F1554 Gr.55	3/4	55.0	75.0	0.4418

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS22(1)	M5 / End	-68.0	0.0	0.9	0.0	0.0	0.0
	M345 / End	-4.5	0.0	-0.1	0.0	0.0	0.0
	M351 / End	-33.3	0.0	-0.1	0.0	0.0	0.0
DStlS41-1(6)	M5 / End	-25.9	0.0	-0.3	0.0	0.1	0.0
	M345 / End	-38.3	0.0	-0.1	0.0	0.0	0.0
	M351 / End	23.4	0.0	-0.1	0.0	0.0	0.0
DStlS38-1(7)	M5 / End	-43.6	0.0	-0.5	0.0	0.2	0.0
	M345 / End	18.3	0.0	-0.2	0.0	0.0	0.0
	M351 / End	-43.3	0.0	-0.2	0.0	0.0	0.0
DStlS27(3)	M5 / End	-22.4	0.0	3.1	0.0	-0.4	0.0
	M345 / End	-5.3	0.0	-0.1	0.0	0.0	0.0
	M351 / End	-5.3	0.0	-0.1	0.0	0.0	0.0
DStlS12(4)	M5 / End	-54.6	0.0	-3.9	0.0	0.7	0.0
	M345 / End	-16.6	0.0	-0.1	0.0	0.0	0.0
	M351 / End	-16.6	0.0	-0.1	0.0	0.0	0.0
DStlS14(5)	M5 / End	-56.2	0.0	2.7	0.0	-0.3	0.0
	M345 / End	13.1	0.0	-0.1	0.0	0.0	0.0
	M351 / End	-44.8	0.0	-0.1	0.0	0.0	0.0
DStlS37-1(10)	M5 / End	-43.6	0.0	-0.5	0.0	0.2	0.0
	M345 / End	-43.4	0.0	-0.2	0.0	0.0	0.0
	M351 / End	18.3	0.0	-0.1	0.0	0.0	0.0
DStlS42-1(11)	M5 / End	-25.9	0.0	-0.3	0.0	0.1	0.0
	M345 / End	23.4	0.0	-0.1	0.0	0.0	0.0
	M351 / End	-38.3	0.0	-0.1	0.0	0.0	0.0
DStlS1(12)	M5 / End	-46.3	0.0	-0.5	0.0	0.2	0.0
	M345 / End	-13.3	0.0	-0.2	0.0	0.0	0.0
	M351 / End	-13.3	0.0	-0.2	0.0	0.0	0.0

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS22(1)	0.9	-16.5	-99.3	0.0	0.0	0.0
DStlS41-1(6)	-0.3	35.2	-38.2	0.0	-0.1	0.0
DStlS38-1(7)	-0.5	-35.1	-64.4	0.0	-0.2	0.0
DStlS27(3)	3.1	0.0	-31.2	0.0	0.4	0.0
DStlS12(4)	-4.0	0.0	-82.0	0.0	-0.7	0.0
DStlS14(5)	2.7	-33.0	-82.5	0.0	0.3	0.0
DStlS37-1(10)	-0.5	35.2	-64.4	0.0	-0.2	0.0
DStlS42-1(11)	-0.3	-35.1	-38.2	0.0	-0.1	0.0
DStlS1(12)	-0.5	0.0	-68.4	0.0	-0.2	0.0

Project:	**Creech AOF Baseplate Connections(Model 2)**
Project no:	**203434**
Author:	**Allison Valencia**

Foundation block

Item	Value	Unit
CB 1		
Dimensions	5'-2"1/8 x 2'-4"3/8	in
Depth	2'-6"	in
Anchor	3/4 F1554 Gr.55	
Anchoring length	1'-0"	in
Shear force transfer	Shear lug	
Cross-section of shear lug	FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(Plate 1, 12)))))))))))	
Length of shear lug	6"	in
Mortar joint	2"	in

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.1 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Anchors	0.4 < 100%	OK
Welds	46.1 < 100%	OK
Concrete block	5.6 < 100%	OK
Shear	38.8 < 100%	OK
Buckling	55.56	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M5-bfl 1	A992	3/4	DStlS37-1(10)	8.0	0.0	0.0	OK
M5-tfl 1	A992	3/4	DStlS37-1(10)	8.6	0.0	0.0	OK
M5-w 1	A992	1/2	DStlS38-1(7)	17.5	0.0	0.0	OK
M345	A992	1/2	DStlS37-1(10)	7.6	0.0	0.0	OK
M351	A992	1/2	DStlS14(5)	8.3	0.0	0.0	OK
Member 4-bfl 1	A572 Gr.50	1"	DStlS37-1(10)	45.0	0.1	0.0	OK
BP1	A572 Gr.50	3/4	DStlS37-1(10)	19.8	0.0	0.0	OK
GUSS1	A572 Gr.50	3/4	DStlS37-1(10)	8.0	0.0	0.0	OK
GUSS2	A572 Gr.50	3/4	DStlS38-1(7)	7.8	0.0	0.0	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for Member 4-bfl 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y = 50.0$ ksi – characteristic yield strength

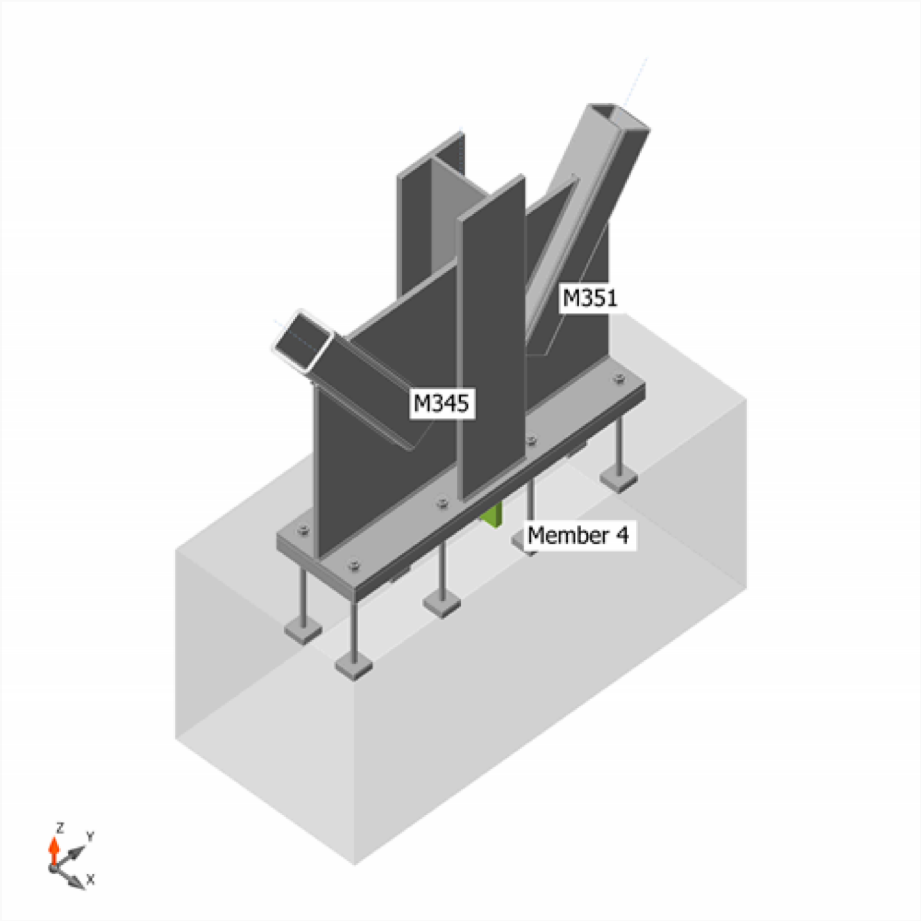
$\phi = 0.90$ – resistance factor for steel material AISC 360-16 – B3.1

Loc. deformation

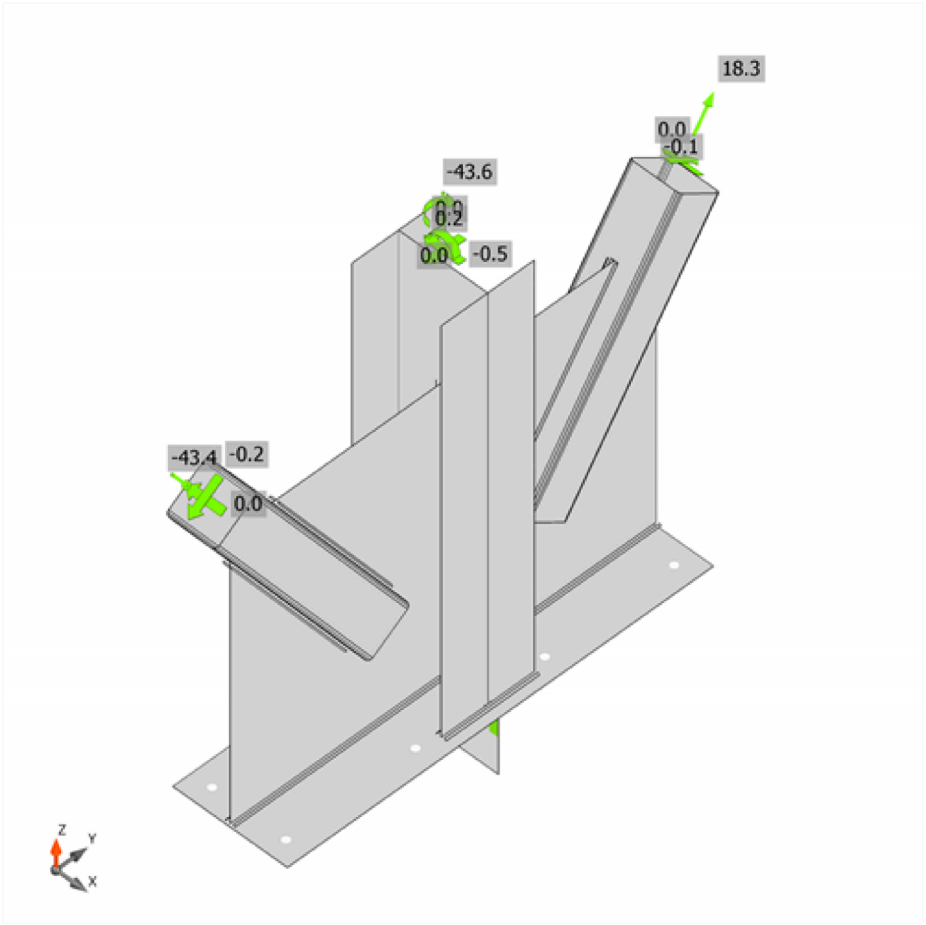
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M345	6"	DStlS1(12)	0"	3/16	0.0	OK
M351	6"	DStlS1(12)	0"	3/16	0.0	OK

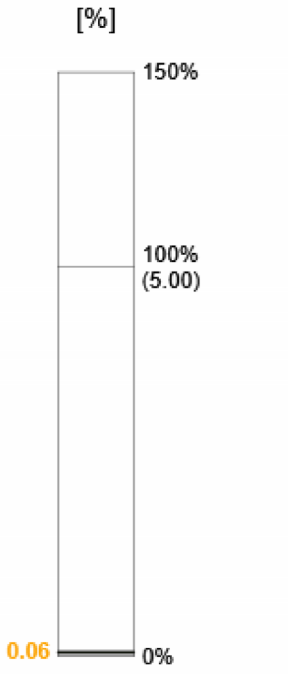
Symbol explanation

d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation

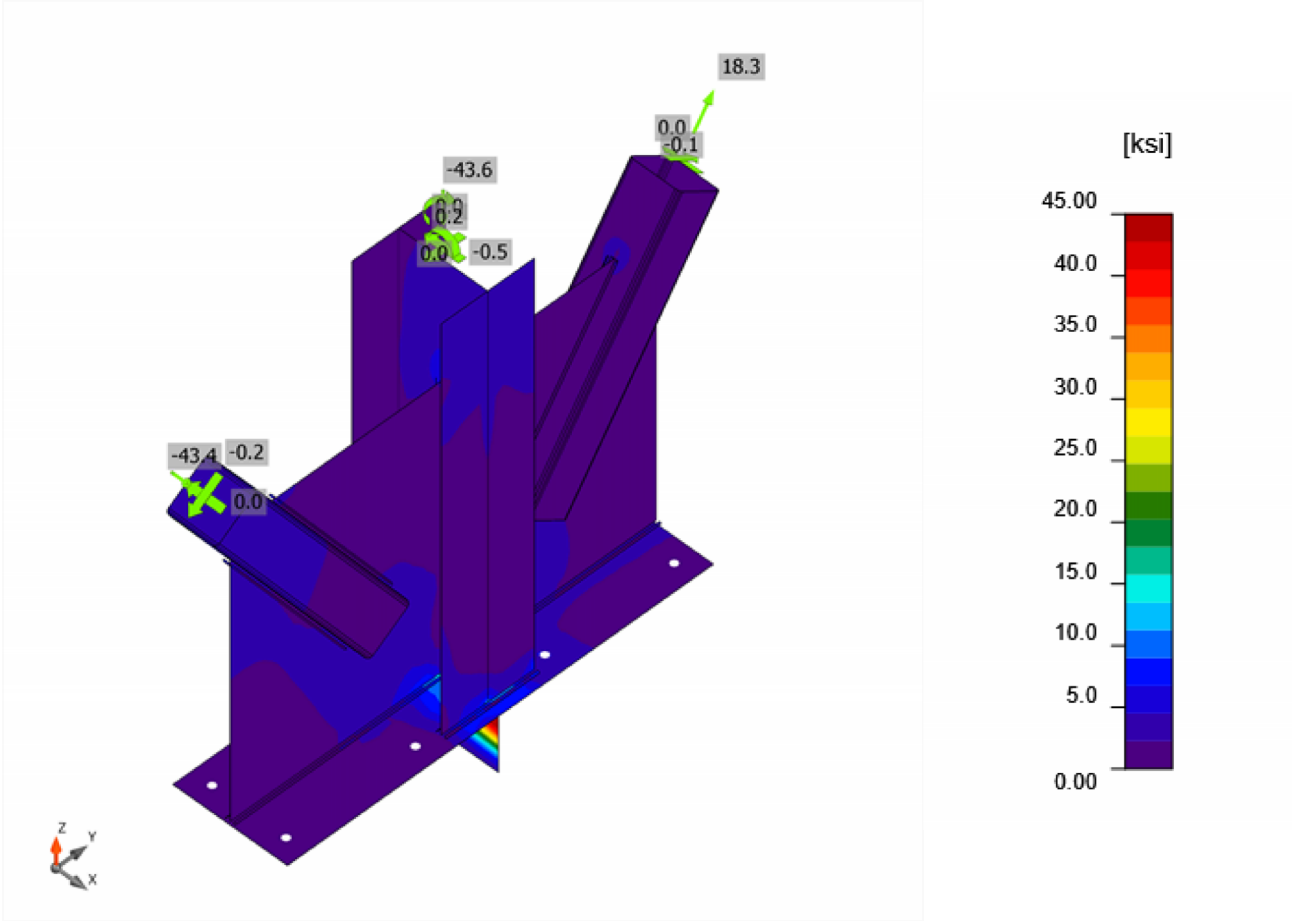


Overall check, DStlS37-1(10)



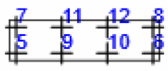


Strain check, DStlS37-1(10)



Equivalent stress, DStlS37-1(10)

Anchors

Shape	Item	Loads	N_f [kip]	ϕN_p [kip]	ϕN_{sb} [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	A5	DStlS37-1(10)	0.1	191.7	104.9	0.3	0.0	0.0	OK	OK
	A6	DStlS38-1(7)	0.1	191.7	104.9	0.3	0.0	0.0	OK	OK
	A7	DStlS37-1(10)	0.0	191.7	104.9	0.3	0.0	0.0	OK	OK
	A8	DStlS14(5)	0.1	191.7	104.9	0.4	0.0	0.0	OK	OK
	A9	DStlS41-1(6)	0.0	191.7	104.9	0.2	0.0	0.0	OK	OK
	A10	DStlS42-1(11)	0.0	191.7	104.9	0.2	0.0	0.0	OK	OK
	A11	DStlS1(12)	0.0	191.7	0.0	0.0	0.0	0.0	OK	OK
	A12	DStlS1(12)	0.0	191.7	0.0	0.0	0.0	0.0	OK	OK

Design data

Grade	ϕN_{sa} [kip]
3/4 F1554 Gr.55 - 1	17.5

Symbol explanation

N_f	Tension force
ϕN_p	Pullout strength in tension - ACI 318-14 – 17.4.3
ϕN_{sb}	Concrete side-face blowout strength in tension - ACI 318-14 – 17.4.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
ϕN_{sa}	Steel strength of anchor in tension - ACI 318-14 – 17.4.1

Detailed result for A8

Concrete splitting failure during installation should be evaluated by ACI 355.2 requirements.

Anchor tensile resistance (ACI 318-14 – 17.4.1)

$$\phi N_{sa} = \phi \cdot A_{se,N} \cdot f_{uta} = \quad 17.5 \quad \text{kip} \quad \geq \quad N_f = \quad 0.1 \quad \text{kip}$$

Where:

$\phi = 0.70$ – resistance factor

$A_{se,N} = 0.3340$ in^2 – tensile stress area

$f_{uta} = 75.0$ ksi – specified tensile strength of anchor steel:

- $f_{uta} = \min(125 \text{ ksi}, 1.9 \cdot f_{ya},\ f_u)$, where:
  - $f_{ya} =$ 55.0 ksi – specified yield strength of anchor steel
  - $f_u =$ 75.0 ksi – specified ultimate strength of anchor steel

Concrete pullout resistance (ACI 318-14 – 17.4.3)

$$\phi N_{pn} = \phi \cdot \Psi_{c,P} \cdot N_p = \quad 191.7 \quad \text{kip} \quad \geq \quad N_f = \quad 0.1 \quad \text{kip}$$

Where:

$\phi = 0.70$ – resistance factor

$\Psi_{c,P} = 1.00$ – modification factor for concrete condition

$N_p = 273.9$ kip – basic concrete pullout strength for headed anchor:

- $N_{pr} = 8 \cdot A_{brg} \cdot f'_c$, where:
  - $A_{brg} =$ 8.5582 in^2 – bearing area of the head of stud or anchor bolt
  - $f'_c =$ 4.0 ksi – concrete compressive strength

Concrete sideface blowout resistance (ACI 318-14 – 17.4.4)

$\phi N_{sb} = r_c \cdot N_{sbg} =$ 104.9 kip ≥ $N_f =$ 0.1 kip

Where:

$r_c = 0.50$ – reduction factor for anchor close to an edge or multiple anchors with small spacing:

- $r_c = \min(\frac{1+\frac{c_{a2}}{c_{a1}}}{4}, \frac{1+\frac{s}{6 \cdot c_{a1}}}{2}),\ 0.5 \ \leq r_c \leq 1$, where:
  - $c_{a1} =$ 10"1/16 in – shorter distance from an anchor to an edge
  - $c_{a2} =$ 10"3/16 in – longer distance from an anchor to an edge
  - $s =$ 8" in – spacing between anchors

$N_{sbg} =$ 208.3 kip – concrete side-face blowout strength of headed anchor in tension:

- $N_{sb} = \phi \cdot 160.0 \cdot c_{a1} \cdot \sqrt{A_{bgr}} \cdot \sqrt{f'_c}$, where:
  - $A_{bgr} =$ 8.5582 in^2 – bearing area of the head of stud or anchor bolt
  - $f'_c =$ 4.0 ksi – concrete compressive strength
  - $\phi =$ 0.70 – resistance factor

Interaction of tensile and shear forces (ACI 318-14 – R17.6)

${U_{tt}}^{5/3} + {U_{ts}}^{5/3} =$ 0.00 ≤ 1.0

Where:

$U_{tt} = 0.00$ – maximum ratio of factored tensile force and tensile resistance determined from all appropriate failure modes

$U_{ts} = 0.00$ – maximum ratio of factored shear force and shear resistance determined from all appropriate failure modes

Supplementary reinforcement (ACI 318-14 – 17.4.2.9)

Supplementary reinforcement should resist force of 0.1 kip in tension. Only current load effect considered.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
BP1	M5-bfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS37-1(10)	2.6	9.1	28.3	10.8	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS37-1(10)	2.3	9.1	25.3	9.8	OK	OK
BP1	M5-tfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS14(5)	2.6	9.1	29.1	13.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS14(5)	2.9	9.1	32.0	14.6	OK	OK
BP1	M5-w 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9"5/8	7/8	DStlS38-1(7)	4.3	9.4	45.5	24.3	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9"5/8	7/8	DStlS42-1(11)	4.4	9.5	46.1	24.1	OK	OK
BP1	Member 4-bfl 1	E70xx	-	-	1'-0"	-	-	-	-	-	-	OK	OK
M5-w 1	GUSS1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	2'-7"7/16	7/8	DStlS22(1)	2.4	7.7	31.8	13.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	2'-7"7/16	7/8	DStlS22(1)	2.5	7.7	31.9	13.3	OK	OK
BP1	GUSS1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-10"13/16	1"5/8	DStlS38-1(7)	3.9	15.5	25.0	11.9	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-10"13/16	1"5/8	DStlS37-1(10)	4.3	16.0	27.2	12.8	OK	OK
GUSS1	M345-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-9"7/16	3/8	DStlS37-1(10)	0.8	2.7	29.0	11.8	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-9"7/16	3/8	DStlS37-1(10)	0.8	2.6	28.5	11.7	OK	OK
GUSS1	M345-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-9"7/16	3/8	DStlS37-1(10)	0.8	2.7	28.8	13.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-9"7/16	3/8	DStlS37-1(10)	0.8	2.6	28.4	12.7	OK	OK
GUSS1	M345-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-9"1/2	3/8	DStlS37-1(10)	0.7	2.7	26.8	10.8	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-9"1/2	3/8	DStlS37-1(10)	0.7	2.6	27.1	10.8	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
GUSS1	M345-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-9"1/2	3/8	DStlS37-1(10)	0.7	2.7	26.7	12.1	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-9"1/2	3/8	DStlS37-1(10)	0.7	2.6	26.9	12.3	OK	OK
M5-w 1	GUSS2	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	2'-7"7/16	7/8	DStlS37-1(10)	2.9	9.0	32.6	16.1	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	2'-7"7/16	7/8	DStlS37-1(10)	3.1	9.0	33.9	17.1	OK	OK
BP1	GUSS2	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-10"3/4	1"5/8	DStlS38-1(7)	5.7	16.8	33.6	16.4	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-10"13/16	1"5/8	DStlS37-1(10)	3.8	11.5	33.6	18.2	OK	OK
GUSS2	M351-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-9"1/2	3/8	DStlS14(5)	0.8	2.7	30.1	12.1	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-9"1/2	3/8	DStlS14(5)	0.8	2.6	29.9	12.1	OK	OK
GUSS2	M351-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-9"1/2	3/8	DStlS14(5)	0.8	2.7	29.9	13.4	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-9"1/2	3/8	DStlS14(5)	0.8	2.6	29.5	13.2	OK	OK
GUSS2	M351-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-9"7/16	3/8	DStlS14(5)	0.8	2.7	28.6	11.8	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-9"7/16	3/8	DStlS14(5)	0.8	2.6	28.9	11.8	OK	OK
GUSS2	M351-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-9"7/16	3/8	DStlS14(5)	0.8	2.7	28.4	13.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-9"7/16	3/8	DStlS14(5)	0.7	2.6	28.4	13.2	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Detailed result for BP1 / M5-w 1

Weld resistance check (AISC 360-16 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 9.5 kip ≥ $F_n =$ 4.4 kip

Where:

$F_{nw} =$ 58.2 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 57.3° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.2184 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Concrete block

Item	Loads	A_1 [in^2]	A_2 [in^2]	σ [ksi]	$\phi f_{p,max}$ [ksi]	Ut [%]	Status
CB 1	DStlS22(1)	422.5492	1534.7160	0.2	4.2	5.6	OK

Symbol explanation

A_1	Loaded area
A_2	Supporting area
σ	Average stress in concrete
$\phi f_{p,max}$	Concrete bearing resistance
Ut	Utilization

Detailed result for CB 1

Concrete block compressive resistance check (AISC 360-16 – J8)

$\phi_c f_{p,max} =$ 4.2 ksi ≥ $\sigma =$ 0.2 ksi

Where:

$f_{p,max} =$ 6.5 ksi – concrete block design bearing strength:

- $f_{p,max} = 0.85 \cdot f'_c \cdot \sqrt{\frac{A_2}{A_1}} \leq 1.7 \cdot f'_c$, where:
  - $f'_c =$ 4.0 ksi – concrete compressive strength
  - $A_1 =$ 422.5492 in^2 – base plate area in contact with concrete surface
  - $A_2 =$ 1534.7160 in^2 – concrete supporting surface

$\phi_c =$ 0.65 – resistance factor for concrete

Shear in contact plane

Item	Loads	V [kip]	P_{br} [kip]	V_{cb} [kip]	Ut [%]	Status
BP1	DStlS37-1(10)	34.7	254.4	89.5	38.8	OK

Symbol explanation

V	Shear force
P_{br}	Concrete block bearing capacity
V_{cb}	Concrete cone breakout resistance
Ut	Utilization

Detailed result for BP1

Bearing capacity check (ACI 349-01 – B.4.5, ACI 349-01 – RB.11)

$\phi_c P_{br} = \phi \cdot 1.3 \cdot f'_c \cdot A_1 + \phi \cdot K_c \cdot (N_y - P_a) =$ 254.4 kip ≥ $V =$ 34.7 kip

Where:

$\phi =$ 0.7 – resistance factor for bearing of bolts on steel

$f'_c =$ 4.0 ksi – concrete compressive strength

$A_1 =$ 4.6649 in^2 – projected area of the embedded area of the shear lug in the direction of the force excluding the portion of the lug in contact with the grout above concrete member

$K_c =$ 1.60 – confinement coefficient

$N_y =$ 147.0 kip – yield strength of tensioned anchors

- $N_y = n \cdot A_{se} \cdot F_y$, where:
  - $n =$ 8.0 – number of tensioned anchors
  - $A_{se} =$ 0.3340 in^2 – tensile stress area of an anchor
  - $F_y =$ 55.0 ksi – anchor yield strength

$P_a =$ -65.0 kip – external axial load

Concrete breakout strength check (ACI 349 – B11)

$\phi V_{cb} = \phi \cdot \Psi_{\alpha,v} \cdot A_{vc} \cdot 4.0 \cdot \sqrt{f'_c} =$ 89.5 kip ≥ $V =$ 34.7 kip

Where:

$\phi = 0.85$ – steel embedment material resistance factor for reinforcement

$\Psi_{\alpha,V} = 2.$ – modification factor for shear lug loaded at an angle with the concrete edge

- $\Psi_{\alpha,V} = \sqrt{\frac{1}{(\cos\ \alpha_V)^2+(0.5 \cdot \sin \alpha_V)^2}}$, where:
  - $\alpha_V =$ 89.2 ° – angle between direction of shear force and direction perpendicular to concrete edge

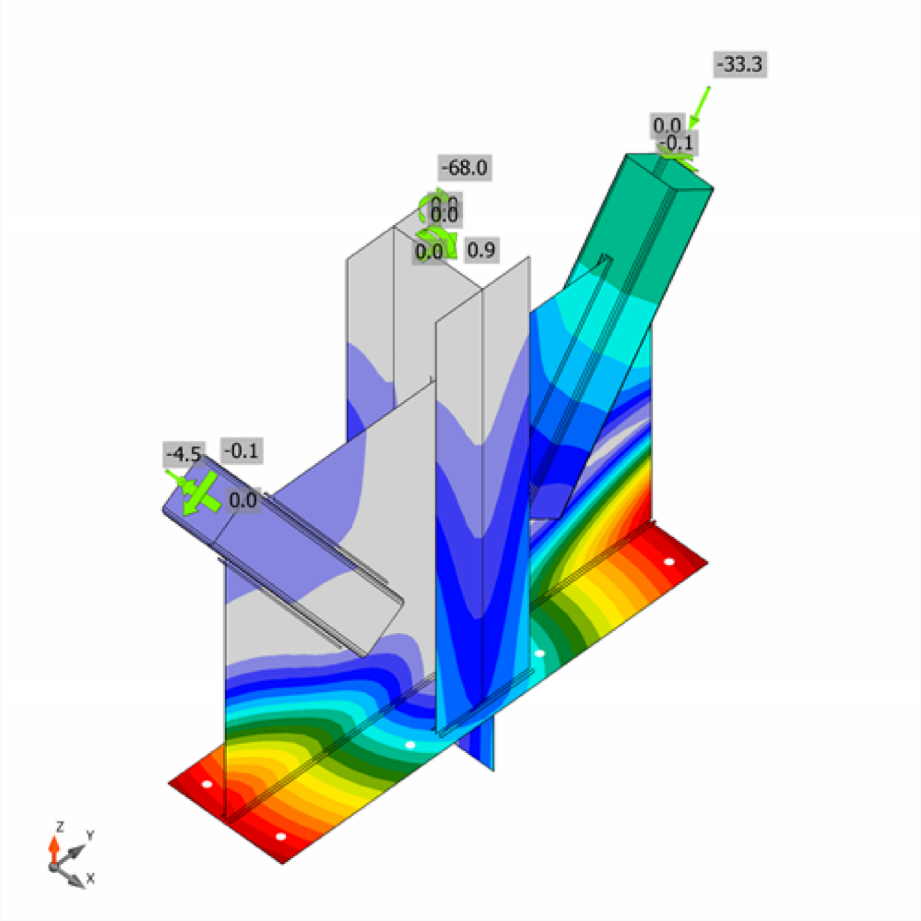
$A_{vc} =$ 208.2798 in^2 – effective stress area defined by projecting a 45^o plane from the bearing edges of the shear lug to the free surface in the direction of the shear load. The bearing area of the shear lug is excluded from the projected area.

$f'_c =$ 4.0 ksi – concrete compressive strength

Buckling

Loads	Shape	Factor [-]
DStlS22(1)	1	55.56
	2	79.71
	3	98.85
	4	105.79
	5	118.37
	6	133.48
DStlS41-1(6)	1	76.09
	2	114.61
	3	119.40
	4	187.78
	5	211.59
	6	270.50
DStlS38-1(7)	1	61.96
	2	88.61
	3	94.17
	4	155.04
	5	165.35
	6	167.01
DStlS27(3)	1	178.92
	2	188.54
	3	201.77
	4	271.69
	5	288.72
	6	308.34
DStlS12(4)	1	68.66
	2	99.68
	3	111.66
	4	117.05
	5	124.75
	6	144.65
DStlS14(5)	1	55.77
	2	76.54
	3	86.68
	4	108.66
	5	122.02
	6	142.77
DStlS37-1(10)	1	61.94
	2	88.50
	3	94.16
	4	155.02
	5	165.30
	6	167.05

Loads	Shape	Factor [-]
DStlS42-1(11)	1	76.12
	2	114.58
	3	119.57
	4	187.80
	5	211.61
	6	270.64
DStlS1(12)	1	82.88
	2	142.80
	3	154.45
	4	157.18
	5	175.51
	6	188.47



First buckling mode shape, DStlS22(1)

Project item 11

Design

Name	11
Description	
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC 360-16 (LRFD) / ACI 318-14

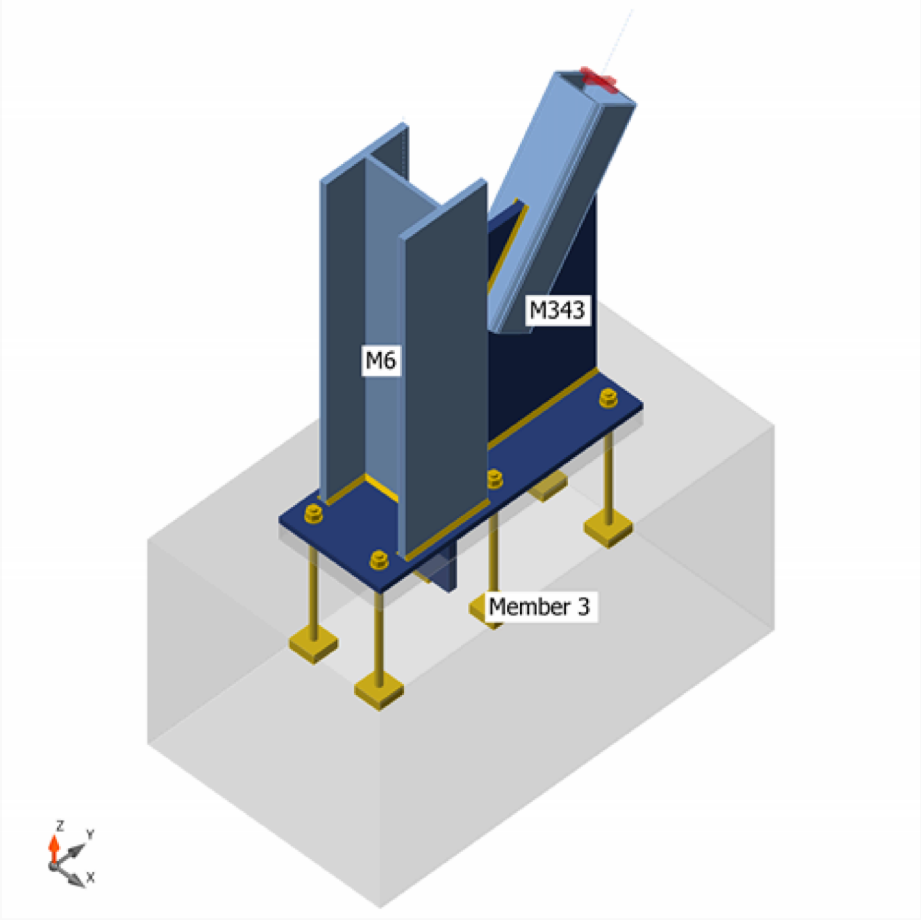
Members

Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M6	6 - W10X68	0.0	90.0	-180.0	0"	0"	0"
M343	37 - HSS6X6X1/2(HSS6X6X1/2(HSS6X6X1/2(HSS(Imp)6X6X1/2)))	90.0	55.2	0.0	0"	0"	0"

Supports and forces

Name	Support	Forces in	X [in]
M6 / end		Position	0"
M343 / end	Mx-My-Mz	Connected member face	7/16



Cross-sections

Name	Material
6 - W10X68	A992
37 - HSS6X6X1/2(HSS6X6X1/2(HSS6X6X1/2(HSS(Imp)6X6X1/2)))	A992
2355 - FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(Plate 1, 12))))))))))	A572 Gr.50

Anchors

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
3/4 F1554 Gr.55	3/4	55.0	75.0	0.4418

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS22(1)	M6 / End	-86.9	0.0	1.1	0.0	0.0	0.0
	M343 / End	-39.5	0.0	-0.1	0.0	0.0	0.0
DStlS29(2)	M6 / End	2.1	0.0	-3.4	0.0	0.0	0.0
	M343 / End	26.3	0.0	-0.1	0.0	0.0	0.0
DStlS37-1(6)	M6 / End	-18.4	0.0	-0.3	0.0	0.0	0.0
	M343 / End	23.3	0.0	-0.1	0.0	0.0	0.0
DStlS42-1(7)	M6 / End	-58.1	0.0	-0.2	0.0	0.0	0.0
	M343 / End	-46.9	0.0	-0.1	0.0	0.0	0.0
DStlS27(4)	M6 / End	-25.0	0.0	3.1	0.0	0.0	0.0
	M343 / End	-7.6	0.0	-0.1	0.0	0.0	0.0
DStlS12(5)	M6 / End	-59.6	0.0	-3.7	0.0	0.0	0.0
	M343 / End	-18.3	0.0	-0.1	0.0	0.0	0.0
DStlS14(3)	M6 / End	-86.7	0.0	2.8	0.0	0.0	0.0
	M343 / End	-52.3	0.0	-0.2	0.0	0.0	0.0
DStlS38-1(8)	M6 / End	-77.6	0.0	-0.3	0.0	0.0	0.0
	M343 / End	-52.9	0.0	-0.2	0.0	0.0	0.0
DStlS41-1(9)	M6 / End	1.1	0.0	-0.2	0.0	0.0	0.0
	M343 / End	29.4	0.0	-0.1	0.0	0.0	0.0
DStlS1(10)	M6 / End	-51.0	0.0	-0.3	0.0	0.0	0.0
	M343 / End	-15.7	0.0	-0.2	0.0	0.0	0.0

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS22(1)	1.2	-22.4	-119.4	0.0	0.0	0.0
DStlS29(2)	-3.4	15.1	23.6	0.0	0.0	0.0
DStlS37-1(6)	-0.3	13.4	0.7	0.0	0.0	0.0
DStlS42-1(7)	-0.2	-26.6	-96.7	0.0	0.0	0.0
DStlS27(4)	3.1	-4.3	-31.3	0.0	0.0	0.0
DStlS12(5)	-3.7	-10.4	-74.7	0.0	0.0	0.0
DStlS14(3)	2.8	-29.7	-129.7	0.0	0.0	0.0
DStlS38-1(8)	-0.3	-30.0	-121.2	0.0	0.0	0.0
DStlS41-1(9)	-0.2	16.8	25.2	0.0	0.0	0.0
DStlS1(10)	-0.3	-8.8	-64.0	0.0	0.0	0.0

Foundation block

Item	Value	Unit
CB 1		
Dimensions	4'-0"1/8 x 2'-4"3/8	in
Depth	2'-1"	in
Anchor	3/4 F1554 Gr.55	
Anchoring length	1'-0"	in
Shear force transfer	Shear lug	
Cross-section of shear lug	FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(FLA12/1(Plate 1, 12)))))))))))	
Length of shear lug	6"	in
Mortar joint	2"	in

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Anchors	44.7 < 100%	OK
Welds	76.7 < 100%	OK
Concrete block	16.1 < 100%	OK
Shear	33.5 < 100%	OK
Buckling	64.91	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M6-bfl 1	A992	3/4	DStlS14(3)	19.3	0.0	0.0	OK
M6-tfl 1	A992	3/4	DStlS14(3)	19.1	0.0	0.0	OK
M6-w 1	A992	1/2	DStlS38-1(8)	16.4	0.0	0.0	OK
M343	A992	1/2	DStlS14(3)	14.2	0.0	0.0	OK
Member 3-bfl 1	A572 Gr.50	1"	DStlS38-1(8)	45.0	0.0	0.0	OK
BP1	A572 Gr.50	3/4	DStlS14(3)	25.6	0.0	0.0	OK
GUSS1	A572 Gr.50	1"	DStlS14(3)	9.0	0.0	0.0	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for Member 3-bfl 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y = 50.0$ ksi – characteristic yield strength

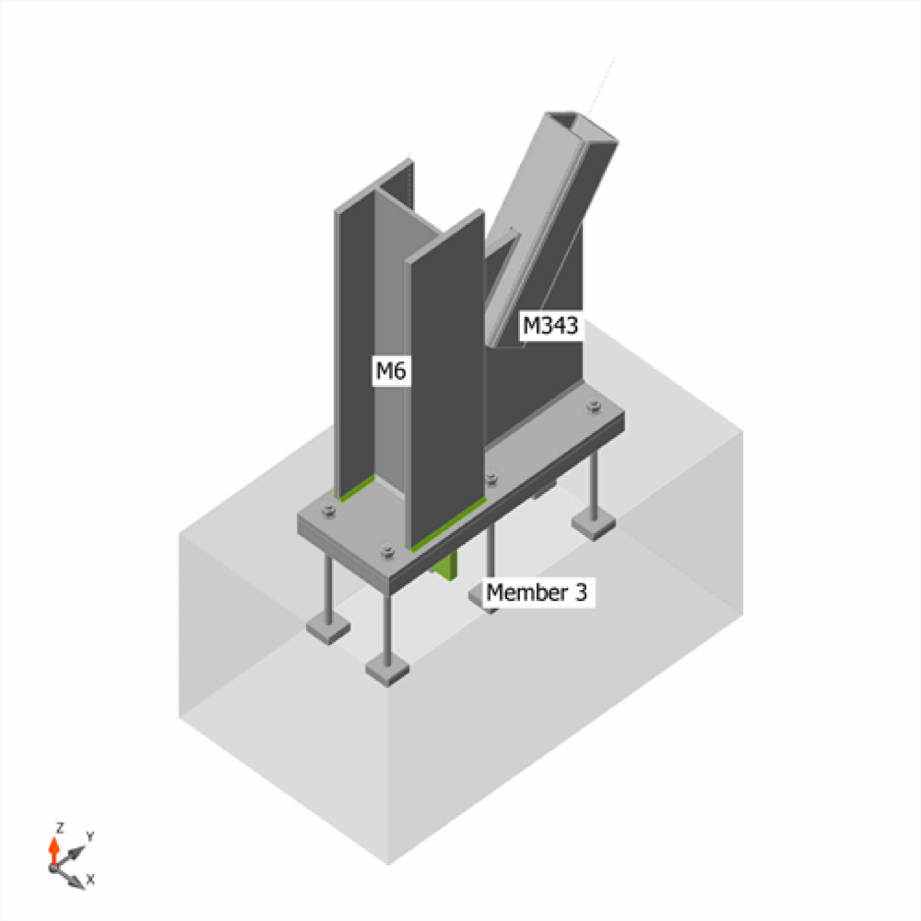
$\phi = 0.90$ – resistance factor for steel material AISC 360-16 – B3.1

Loc. deformation

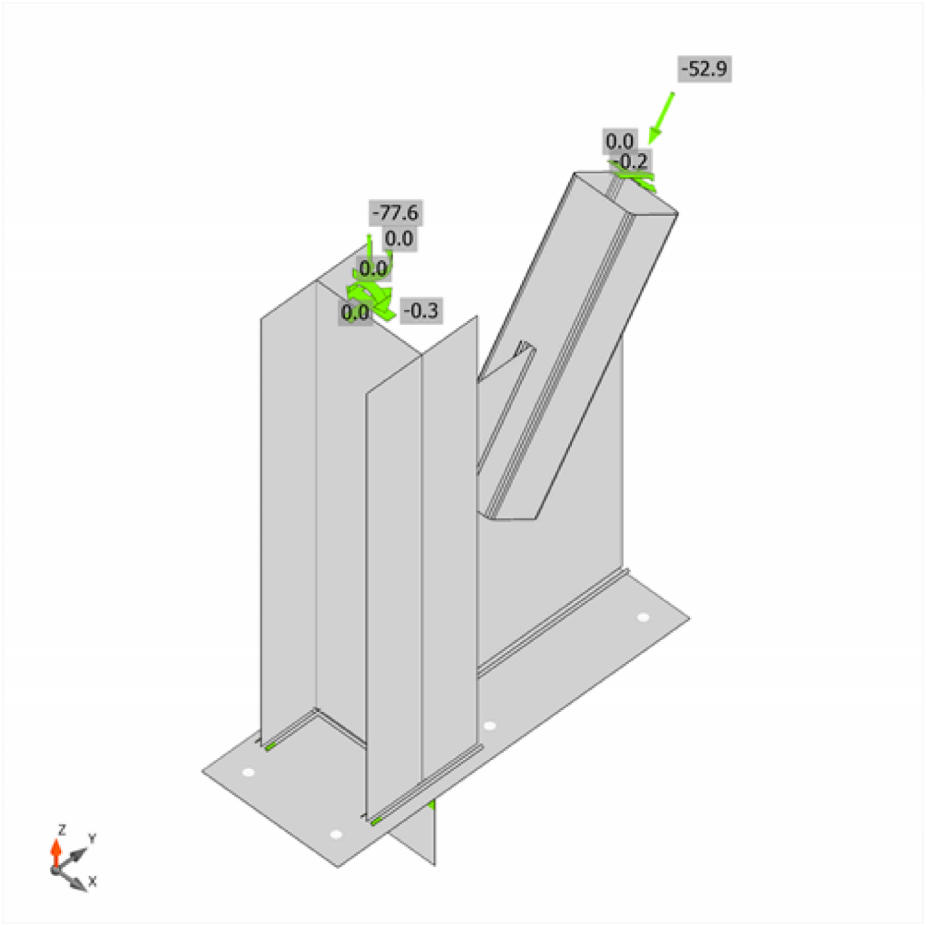
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M343	6"	DStlS1(10)	0"	3/16	0.0	OK

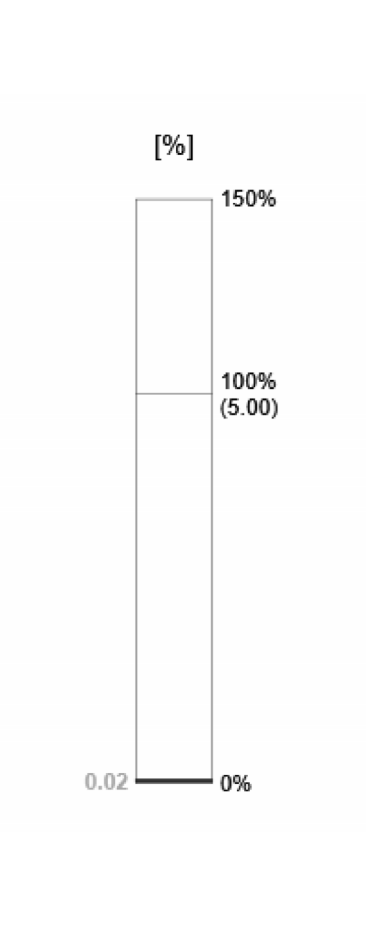
Symbol explanation

d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation

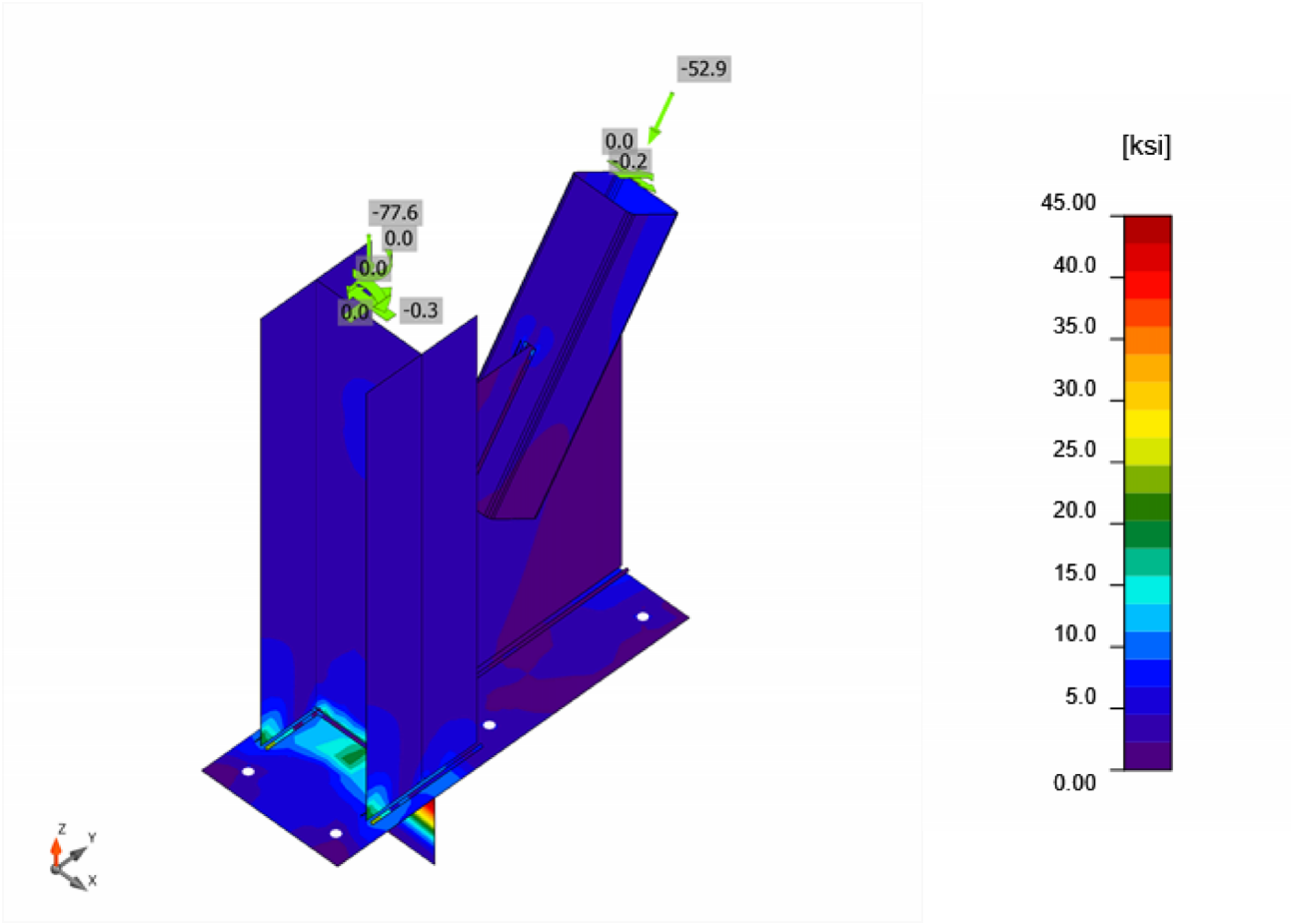


Overall check, DStlS38-1(8)



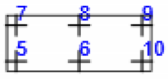


Strain check, DStlS38-1(8)



Equivalent stress, DStlS38-1(8)

Anchors

Shape	Item	Loads	N_f [kip]	ϕN_p [kip]	ϕN_{sb} [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	A5	DStlS41-1(9)	7.8	191.7	104.9	44.7	0.0	26.2	OK	OK
	A6	DStlS29(2)	7.5	191.7	104.9	42.9	0.0	24.4	OK	OK
	A7	DStlS41-1(9)	7.8	191.7	104.9	44.6	0.0	26.0	OK	OK
	A8	DStlS41-1(9)	7.1	191.7	104.9	40.5	0.0	22.2	OK	OK
	A9	DStlS14(3)	2.3	191.7	104.9	13.1	0.0	3.4	OK	OK
	A10	DStlS14(3)	2.3	191.7	104.9	12.9	0.0	3.3	OK	OK

Design data

Grade	ϕN_{sa} [kip]
3/4 F1554 Gr.55 - 1	17.5

Project:	**Creech AOF Baseplate Connections(Model 2)**
Project no:	**203434**
Author:	**Allison Valencia**

Symbol explanation

N_f	Tension force
ϕN_p	Pullout strength in tension - ACI 318-14 – 17.4.3
ϕN_{sb}	Concrete side-face blowout strength in tension - ACI 318-14 – 17.4.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
ϕN_{sa}	Steel strength of anchor in tension - ACI 318-14 – 17.4.1

Detailed result for A5

Concrete splitting failure during installation should be evaluated by ACI 355.2 requirements.

Anchor tensile resistance (ACI 318-14 – 17.4.1)

$\phi N_{sa} = \phi \cdot A_{se,N} \cdot f_{uta} =$ 17.5 kip ≥ $N_f =$ 7.8 kip

Where:

$\phi =$ 0.70 – resistance factor

$A_{se,N} =$ 0.3340 in^2 – tensile stress area

$f_{uta} =$ 75.0 ksi – specified tensile strength of anchor steel:

- $f_{uta} = \min(125 \text{ ksi}, 1.9 \cdot f_{ya},\ f_u)$, where:
  - $f_{ya} =$ 55.0 ksi – specified yield strength of anchor steel
  - $f_u =$ 75.0 ksi – specified ultimate strength of anchor steel

Concrete pullout resistance (ACI 318-14 – 17.4.3)

$\phi N_{pn} = \phi \cdot \Psi_{c,P} \cdot N_p =$ 191.7 kip ≥ $N_f =$ 7.8 kip

Where:

$\phi =$ 0.70 – resistance factor

$\Psi_{c,P} =$ 1.00 – modification factor for concrete condition

$N_p =$ 273.9 kip – basic concrete pullout strength for headed anchor:

- $N_{pr} = 8 \cdot A_{brg} \cdot f'_c$, where:
  - $A_{brg} =$ 8.5582 in^2 – bearing area of the head of stud or anchor bolt
  - $f'_c =$ 4.0 ksi – concrete compressive strength

Concrete sideface blowout resistance (ACI 318-14 – 17.4.4)

$\phi N_{sb} = r_c \cdot N_{sbg} =$ 104.9 kip ≥ $N_f =$ 7.8 kip

Where:

$r_c = 0.50$ – reduction factor for anchor close to an edge or multiple anchors with small spacing:

- $r_c = \min(\frac{1+\frac{c_{a2}}{c_{a1}}}{4}, \frac{1+\frac{s}{6 \cdot c_{a1}}}{2}),\ 0.5 \ \leq r_c \leq 1$, where:
  - $c_{a1} =$ 10"1/16 in – shorter distance from an anchor to an edge
  - $c_{a2} =$ 10"3/16 in – longer distance from an anchor to an edge
  - $s =$ 8" in – spacing between anchors

$N_{sbg} =$ 208.3 kip – concrete side-face blowout strength of headed anchor in tension:

- $N_{sb} = \phi \cdot 160.0 \cdot c_{a1} \cdot \sqrt{A_{bgr}} \cdot \sqrt{f'_c}$, where:
  - $A_{bgr} =$ 8.5582 in^2 – bearing area of the head of stud or anchor bolt
  - $f'_c =$ 4.0 ksi – concrete compressive strength
  - $\phi =$ 0.70 – resistance factor

Interaction of tensile and shear forces (ACI 318-14 – R17.6)

${U_{tt}}^{5/3} + {U_{ts}}^{5/3} =$ 0.26 ≤ 1.0

Where:

$U_{tt} = 0.45$ – maximum ratio of factored tensile force and tensile resistance determined from all appropriate failure modes

$U_{ts} = 0.00$ – maximum ratio of factored shear force and shear resistance determined from all appropriate failure modes

Supplementary reinforcement (ACI 318-14 – 17.4.2.9)

Supplementary reinforcement should resist force of 30.0 kip in tension. Only current load effect considered.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
BP1	M6-bfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS41-1(9)	6.5	8.5	76.6	53.6	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS41-1(9)	6.3	8.3	75.9	50.8	OK	OK
BP1	M6-tfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS41-1(9)	6.3	8.3	76.1	50.9	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS41-1(9)	6.5	8.5	76.7	53.8	OK	OK
BP1	M6-w 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9"5/8	7/8	DStlS38-1(8)	3.0	9.2	33.0	17.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9"5/8	7/8	DStlS14(3)	3.5	9.5	36.3	20.4	OK	OK
BP1	Member 3-bfl 1	E70xx	-	-	1'-0"	-	-	-	-	-	-	OK	OK
M6-w 1	GUSS1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	2'-1"15/16	7/8	DStlS22(1)	1.3	7.0	18.6	6.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	2'-1"15/16	7/8	DStlS22(1)	1.3	7.0	18.4	6.0	OK	OK
BP1	GUSS1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	1'-10"3/4	1"1/4	DStlS38-1(8)	4.7	13.7	34.7	19.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	1'-10"3/4	1"1/4	DStlS14(3)	4.7	13.7	34.5	18.8	OK	OK
GUSS1	M343-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-3"1/8	3/8	DStlS14(3)	1.5	2.7	53.1	26.7	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-3"1/8	3/8	DStlS14(3)	1.7	2.6	65.3	34.4	OK	OK
GUSS1	M343-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-3"1/8	3/8	DStlS38-1(8)	1.5	2.8	52.9	32.8	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-3"1/8	3/8	DStlS14(3)	1.7	2.6	64.9	40.2	OK	OK
GUSS1	M343-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	11"5/16	3/8	DStlS38-1(8)	0.9	2.7	31.3	13.4	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	11"5/16	3/8	DStlS38-1(8)	0.9	2.7	32.8	13.9	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
GUSS1	M343-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	11"5/16	3/8	DStlS38-1(8)	0.9	2.8	31.3	15.6	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	11"5/16	3/8	DStlS38-1(8)	0.9	2.7	33.0	16.7	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Detailed result for BP1 / M6-tfl 1

Weld resistance check (AISC 360-16 – J2-4)

$$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} = \quad 8.5 \quad \text{kip} \quad \geq \quad F_n = \quad 6.5 \quad \text{kip}$$

Where:

$F_{nw} = 53.8$ ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 42.9° – angle of loading measured from the weld longitudinal axis

$A_{we} = 0.2099$ in^2 – effective area of weld critical element

$\phi = 0.75$ – resistance factor for welded connections

Concrete block

Item	Loads	A_1 [in^2]	A_2 [in^2]	σ [ksi]	$\phi f_{p,max}$ [ksi]	Ut [%]	Status
CB 1	DStlS14(3)	189.4955	885.1105	0.7	4.4	16.1	OK

Symbol explanation

A_1	Loaded area
A_2	Supporting area
σ	Average stress in concrete
$\phi f_{p,max}$	Concrete bearing resistance
Ut	Utilization

Detailed result for CB 1

Concrete block compressive resistance check (AISC 360-16 – J8)

$\phi_c f_{p,max} =$ 4.4 ksi ≥ $\sigma =$ 0.7 ksi

Where:

$f_{p,max} =$ 6.8 ksi – concrete block design bearing strength:

- $f_{p,max} = 0.85 \cdot f'_c \cdot \sqrt{\frac{A_2}{A_1}} \leq 1.7 \cdot f'_c$, where:
  - $f'_c =$ 4.0 ksi – concrete compressive strength
  - $A_1 =$ 189.4955 in^2 – base plate area in contact with concrete surface
  - $A_2 =$ 885.1105 in^2 – concrete supporting surface

$\phi_c =$ 0.65 – resistance factor for concrete

Shear in contact plane

Item	Loads	V [kip]	P_{br} [kip]	V_{cb} [kip]	Ut [%]	Status
BP1	DStlS14(3)	29.6	300.9	88.3	33.5	OK

Symbol explanation

V	Shear force
P_{br}	Concrete block bearing capacity
V_{cb}	Concrete cone breakout resistance
Ut	Utilization

Detailed result for BP1

Bearing capacity check (ACI 349-01 – B.4.5, ACI 349-01 – RB.11)

$\phi_c P_{br} = \phi \cdot 1.3 \cdot f'_c \cdot A_1 + \phi \cdot K_c \cdot (N_y - P_a) =$ 300.9 kip ≥ $V =$ 29.6 kip

Where:

$\phi = 0.7$ – resistance factor for bearing of bolts on steel

$f'_c = 4.0$ ksi – concrete compressive strength

$A_1 = 8.6010$ in^2 – projected area of the embedded area of the shear lug in the direction of the force excluding the portion of the lug in contact with the grout above concrete member

$K_c = 1.60$ – confinement coefficient

$N_y = 110.2$ kip – yield strength of tensioned anchors

- $N_y = n \cdot A_{se} \cdot F_y$, where:
  - $n =$ 6.0 – number of tensioned anchors
  - $A_{se} =$ 0.3340 in^2 – tensile stress area of an anchor
  - $F_y =$ 55.0 ksi – anchor yield strength

$P_a =$ -130.5 kip – external axial load

Concrete breakout strength check (ACI 349 – B11)

$\phi V_{cb} = \phi \cdot \Psi_{\alpha,v} \cdot A_{vc} \cdot 4.0 \cdot \sqrt{f'_c} =$ 88.3 kip ≥ $V =$ 29.6 kip

Where:

$\phi = 0.85$ – steel embedment material resistance factor for reinforcement

$\Psi_{\alpha,V} = 1.97$ – modification factor for shear lug loaded at an angle with the concrete edge

- $\Psi_{\alpha,V} = \sqrt{\frac{1}{(\cos\ \alpha_V)^2 + (0.5 \cdot \sin \alpha_V)^2}}$, where:
  - $\alpha_V =$ 84.5 ° – angle between direction of shear force and direction perpendicular to concrete edge

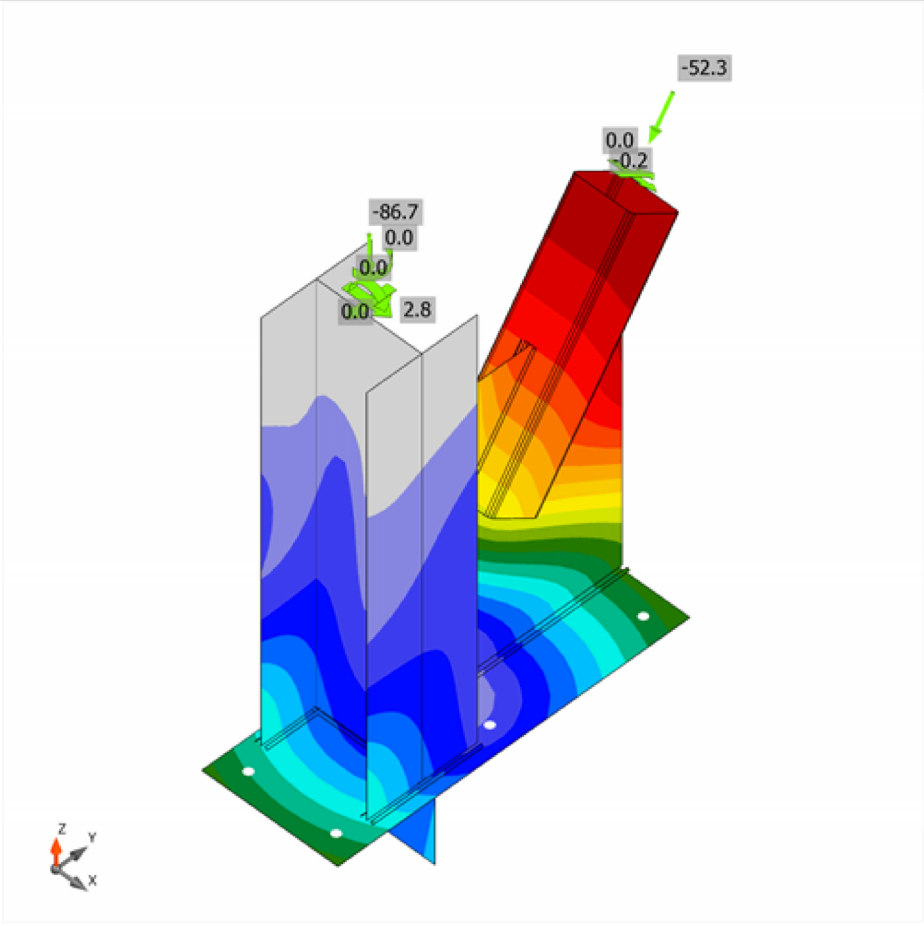
$A_{vc} = 208.2802$ in^2 – effective stress area defined by projecting a 45^o plane from the bearing edges of the shear lug to the free surface in the direction of the shear load. The bearing area of the shear lug is excluded from the projected area.

$f'_c = 4.0$ ksi – concrete compressive strength

Buckling

Loads	Shape	Factor [-]
DStlS22(1)	1	82.10
	2	83.29
	3	91.31
	4	99.52
	5	100.13
	6	103.92
DStlS29(2)	1	375.58
	2	434.45
	3	552.69
	4	625.38
	5	653.33
	6	673.49
DStlS37-1(6)	1	393.60
	2	438.78
	3	501.21
	4	509.19
	5	516.61
	6	582.54
DStlS42-1(7)	1	74.16
	2	123.81
	3	125.93
	4	131.61
	5	134.07
	6	140.79
DStlS27(4)	1	176.07
	2	195.64
	3	249.12
	4	264.72
	5	303.86
	6	310.98
DStlS12(5)	1	96.40
	2	106.40
	3	128.39
	4	135.61
	5	150.07
	6	154.91
DStlS14(3)	1	64.91
	2	75.62
	3	82.04
	4	91.77
	5	97.75
	6	104.56

Loads	Shape	Factor [-]
DStlS38-1(8)	1	65.00
	2	94.51
	3	101.25
	4	103.76
	5	104.89
	6	110.40
DStlS41-1(9)	1	507.26
	2	1644.93
	3	1654.46
	4	1753.02
	5	1764.72
	6	1849.32
DStlS1(10)	1	144.51
	2	161.72
	3	169.32
	4	172.07
	5	180.79
	6	188.21



First buckling mode shape, DStlS14(3)

Code settings

Item	Value	Unit	Reference
Friction coefficient - concrete	0.40	-	ACI 349-01 – B.6.1.4
Friction coefficient in slip-resistance	0.30	-	AISC 360-16 – J3.8
Limit plastic strain	0.05	-	
Detailing	Yes		
Distance between bolts [d]	2.66	-	AISC 360-16 – J3.3
Concrete breakout resistance check	Shear		
Base metal capacity check at weld fusion face	No		AISC 360-16 – J2-2
Deformation at bolt hole at service load is design consideration	Yes		AISC 360-16 – J3.10
Cracked concrete	Yes		ACI 318-14 – 17
Local deformation check	Yes		
Local deformation limit	0.03	-	CIDECT DG 1, 3 – 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints

Project item 73

Design

Name	73
Description	
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC 360-16 (LRFD) / ACI 318-14

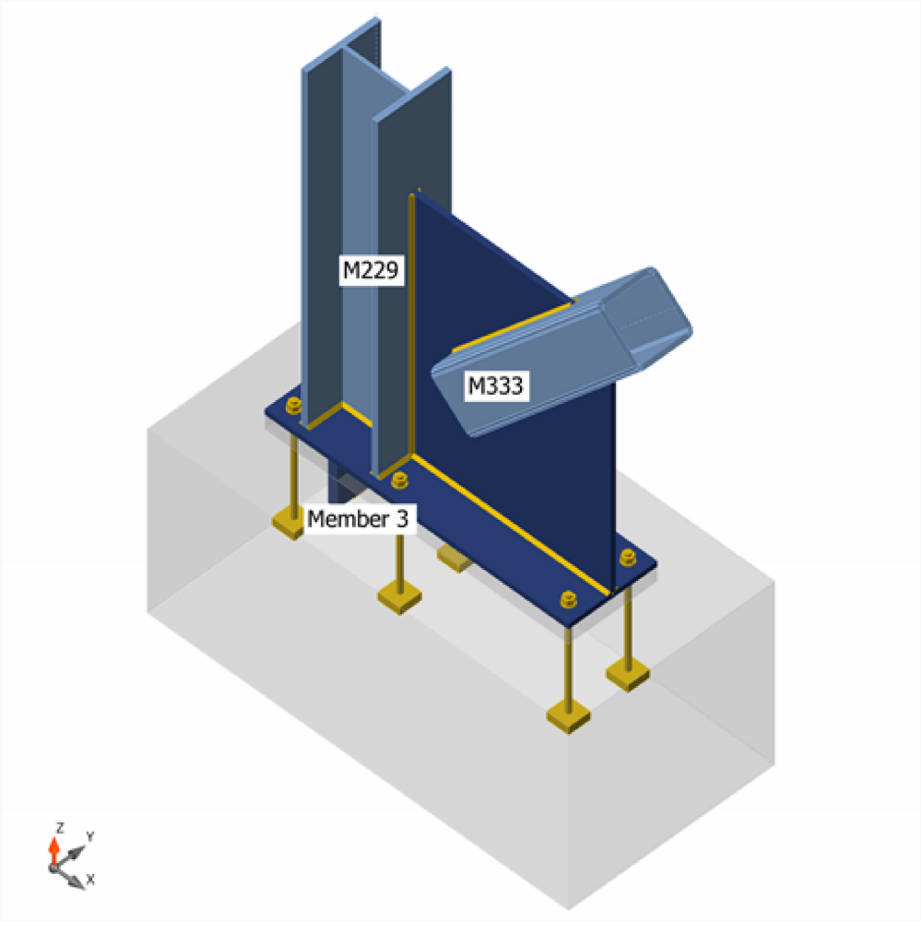
Members

Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M333	471 - HSS8X8X5/8(HSS8X8X5/8(HSS8X8X5/8(HSS(Imp)8X8X5/8)))	0.0	47.8	0.0	0"	0"	0"
M229	6 - W10X68	0.0	90.0	-180.0	0"	0"	0"

Supports and forces

Name	Support	Forces in	X [in]
M333 / end		Position	0"
M229 / end		Position	0"



Cross-sections

Name	Material
471 - HSS8X8X5/8(HSS8X8X5/8(HSS8X8X5/8(HSS(Imp)8X8X5/8)))	A992
6 - W10X68	A992
2356 - Plate 1.25, 12	A572 Gr.50

Anchors

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
3/4 F1554 Gr.55	3/4	55.0	75.0	0.4418

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS40-1(1)	M333 / End	-57.1	0.0	-0.5	0.0	0.0	0.0
	M229 / End	-113.3	0.0	0.1	0.0	0.0	0.0
DStlS35-1(2)	M333 / End	68.2	0.0	-0.9	0.0	0.0	0.0
	M229 / End	-164.5	0.0	0.0	0.0	0.0	0.0
DStlS13(6)	M333 / End	4.7	0.0	-0.8	0.0	0.0	0.0
	M229 / End	-150.2	0.1	0.1	0.0	0.0	0.0
DStlS30(7)	M333 / End	8.0	0.0	-0.6	0.0	0.0	0.0
	M229 / End	-156.3	-0.2	0.1	0.0	0.0	0.0
DStlS1(3)	M333 / End	7.4	0.0	-1.0	0.0	0.0	0.0
	M229 / End	-185.2	0.0	0.1	0.0	0.0	0.0
DStlS11(8)	M333 / End	25.0	0.0	-0.8	0.0	0.0	0.0
	M229 / End	-146.8	0.1	0.0	0.0	0.0	0.0
DStlS28(9)	M333 / End	-12.3	0.0	-0.6	0.0	0.0	0.0
	M229 / End	-159.7	-0.1	0.1	0.0	0.0	0.0
DStlS36-1(4)	M333 / End	-54.2	0.0	-0.9	0.0	0.0	0.0
	M229 / End	-184.2	0.0	0.1	0.0	0.0	0.0
DStlS39-1(5)	M333 / End	65.4	0.0	-0.5	0.0	0.0	0.0
	M229 / End	-93.6	0.0	0.0	0.0	0.0	0.0
DStlS20(10)	M333 / End	2.8	0.0	-0.8	0.0	0.0	0.0
	M229 / End	-270.9	-0.1	0.1	0.0	0.0	0.0
DStlS27(11)	M333 / End	21.9	0.0	-0.6	0.0	0.0	0.0
	M229 / End	-78.4	0.1	0.0	0.0	0.0	0.0
DStlS29(12)	M333 / End	1.6	0.0	-0.6	0.0	0.0	0.0
	M229 / End	-81.8	0.1	0.0	0.0	0.0	0.0
DStlS14(13)	M333 / End	11.1	0.0	-0.8	0.0	0.0	0.0
	M229 / End	-224.7	-0.2	0.1	0.0	0.0	0.0
DStlS22(14)	M333 / End	13.0	0.0	-0.8	0.0	0.0	0.0
	M229 / End	-269.1	-0.1	0.1	0.0	0.0	0.0

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS40-1(1)	-37.9	0.0	-156.0	0.0	0.0	0.0
DStlS35-1(2)	46.5	0.0	-114.5	0.0	0.0	0.0
DStlS13(6)	3.8	-0.1	-147.2	0.0	0.0	0.0
DStlS30(7)	5.9	0.2	-150.8	0.0	0.0	0.0
DStlS1(3)	5.8	0.0	-180.3	0.0	0.0	0.0
DStlS11(8)	17.5	-0.1	-128.8	0.0	0.0	0.0
DStlS28(9)	-7.7	0.1	-169.3	0.0	0.0	0.0
DStlS36-1(4)	-35.7	0.0	-225.0	0.0	0.0	0.0
DStlS39-1(5)	44.3	0.0	-45.5	0.0	0.0	0.0
DStlS20(10)	2.6	0.1	-269.3	0.0	0.0	0.0
DStlS27(11)	15.2	-0.1	-62.6	0.0	0.0	0.0
DStlS29(12)	1.5	-0.1	-81.1	0.0	0.0	0.0
DStlS14(13)	8.2	0.2	-217.0	0.0	0.0	0.0
DStlS22(14)	9.5	0.1	-260.1	0.0	0.0	0.0

Foundation block

Item	Value	Unit
CB 1		
Dimensions	2'-4"1/8 x 4'-9"3/8	in
Depth	2'-1"	in
Anchor	3/4 F1554 Gr.55	
Anchoring length	1'-0"	in
Shear force transfer	Shear lug	
Cross-section of shear lug	Plate 1.25, 12	
Length of shear lug	6"	in
Mortar joint	2"	in

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	1.4 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Anchors	21.8 < 100%	OK
Welds	76.3 < 100%	OK
Concrete block	25.1 < 100%	OK
Shear	39.3 < 100%	OK
Buckling	Not calculated	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M333	A992	5/8	DStlS35-1(2)	8.2	0.0	0.0	OK
M229-bfl 1	A992	3/4	DStlS36-1(4)	26.4	0.0	0.0	OK
M229-tfl 1	A992	3/4	DStlS36-1(4)	20.8	0.0	0.0	OK
M229-w 1	A992	1/2	DStlS36-1(4)	26.9	0.0	0.0	OK
Member 3-bfl 1	A572 Gr.50	1"1/4	DStlS35-1(2)	45.4	1.4	0.0	OK
BP1	A572 Gr.50	3/4	DStlS39-1(5)	45.0	0.0	0.0	OK
GUSS1	A572 Gr.50	3/4	DStlS20(10)	10.5	0.0	0.0	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

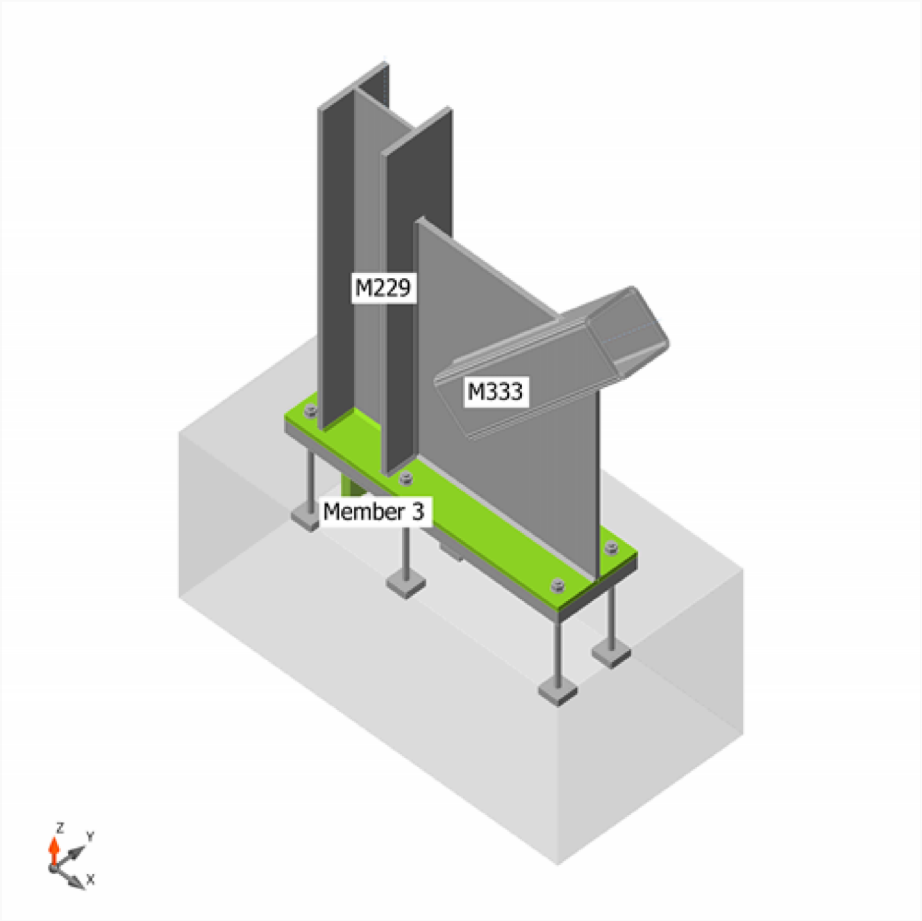
t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Loc. deformation

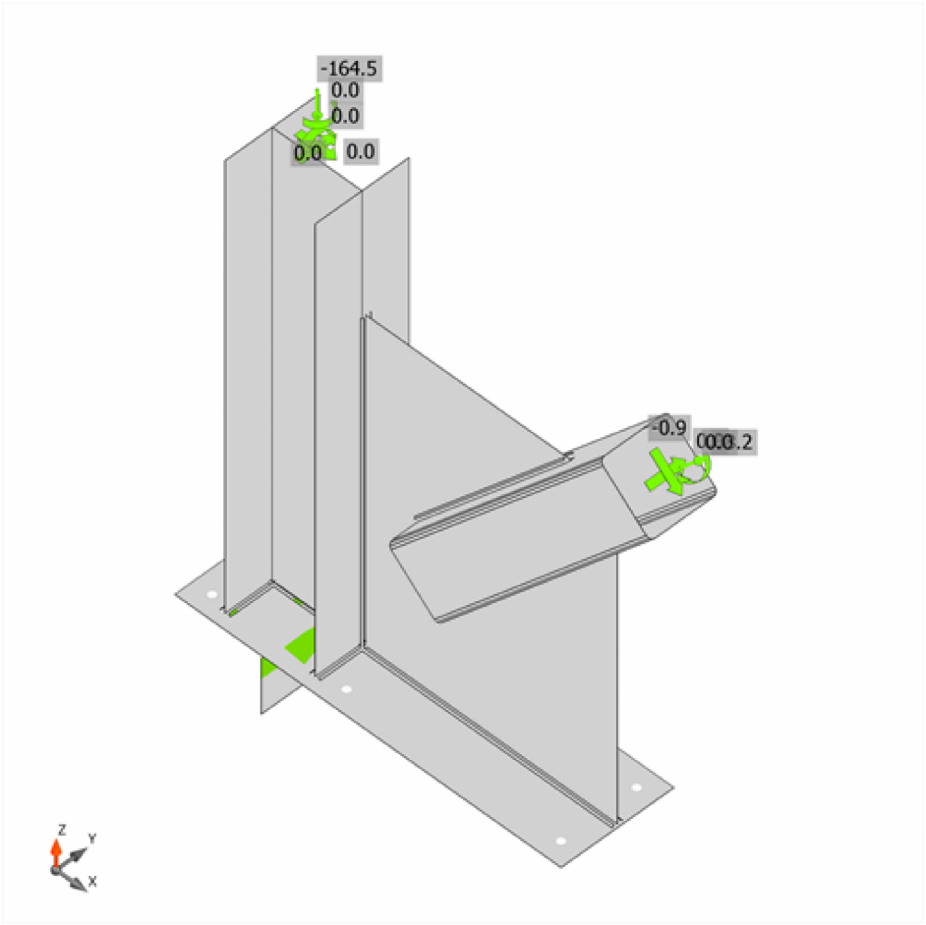
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M333	8"	DStlS22(14)	0"	1/4	0.0	OK

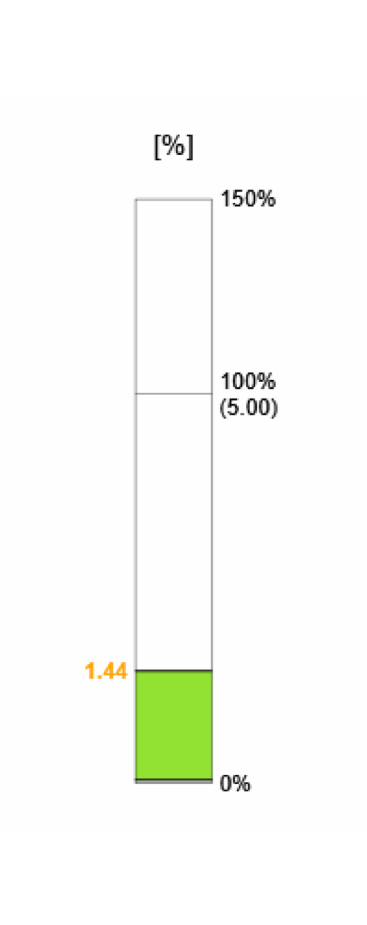
Symbol explanation

d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation

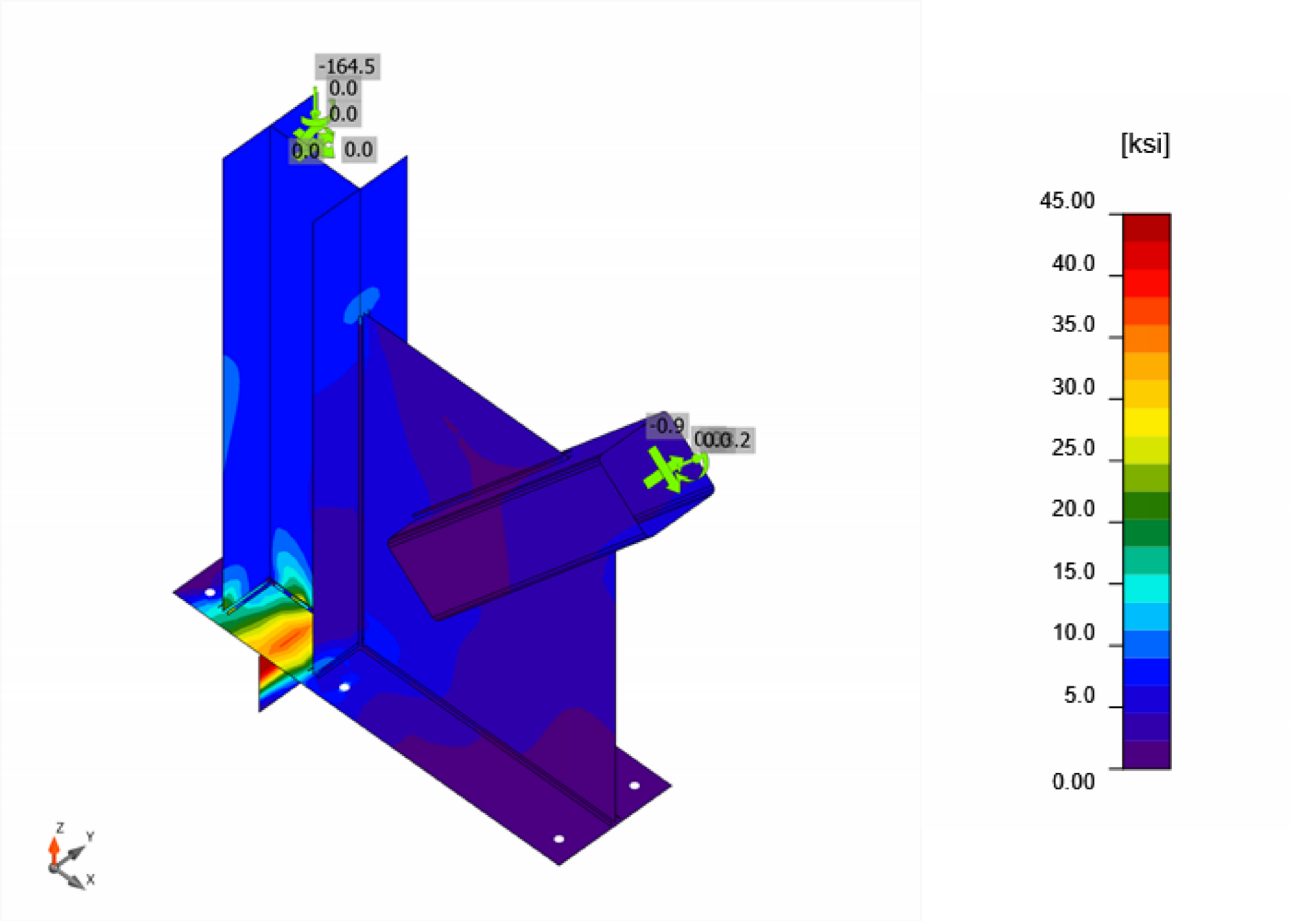


Overall check, DStlS35-1(2)



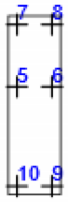


Strain check, DStlS35-1(2)



Equivalent stress, DStlS35-1(2)

Anchors

Shape	Item	Loads	N_f [kip]	ϕN_{cbg} [kip]	ϕN_p [kip]	ϕN_{sb} [kip]	ϕV_{cp} [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	A5	DStlS35-1(2)	0.0	0.0	191.7	0.0	136.1	0.0	0.6	0.0	OK	OK
	A6	DStlS35-1(2)	0.0	0.0	191.7	0.0	136.1	0.0	0.6	0.0	OK	OK
	A7	DStlS35-1(2)	0.0	0.0	191.7	0.0	136.1	0.0	0.6	0.0	OK	OK
	A8	DStlS35-1(2)	0.0	0.0	191.7	0.0	136.1	0.0	0.6	0.0	OK	OK
	A9	DStlS36-1(4)	3.0	27.4	191.7	103.6	136.1	21.8	0.3	7.9	OK	OK
	A10	DStlS36-1(4)	3.0	27.4	191.7	103.6	136.1	21.8	0.3	7.9	OK	OK

Design data

Grade	ϕN_{sa} [kip]
3/4 F1554 Gr.55 - 1	17.5

Symbol explanation

N_f	Tension force
ϕN_{cbg}	Concrete breakout strength in tension - ACI 318-14 – 17.4.2
ϕN_p	Pullout strength in tension - ACI 318-14 – 17.4.3
ϕN_{sb}	Concrete side-face blowout strength in tension - ACI 318-14 – 17.4.4
ϕV_{cp}	Concrete pryout strength in shear - ACI 318-14 – 17.5.3
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
ϕN_{sa}	Steel strength of anchor in tension - ACI 318-14 – 17.4.1

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
BP1	M229-bfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS20(10)	7.3	9.6	76.0	57.1	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS20(10)	7.4	9.7	76.3	59.5	OK	OK
BP1	M229-tfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS20(10)	6.4	9.3	68.6	44.4	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS36-1(4)	7.0	9.3	75.0	51.9	OK	OK
BP1	M229-w 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9"9/16	7/8	DStlS36-1(4)	7.5	10.0	75.1	47.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9"9/16	7/8	DStlS36-1(4)	7.5	10.0	75.1	48.0	OK	OK
BP1	Member 3-bfl 1	E70xx	-	-	9"	-	-	-	-	-	-	OK	OK
M229-tfl 1	GUSS1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	2'-11"7/16	7/8	DStlS20(10)	4.6	8.2	56.3	28.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	2'-11"7/16	7/8	DStlS20(10)	4.6	8.2	56.6	28.2	OK	OK
BP1	GUSS1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	2'-2"15/16	1"13/16	DStlS20(10)	5.5	22.5	24.4	11.5	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	2'-2"15/16	1"13/16	DStlS20(10)	5.6	22.5	24.7	11.6	OK	OK
GUSS1	M333-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-11"1/16	1/2	DStlS35-1(2)	1.1	3.7	30.0	13.1	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-11"1/16	1/2	DStlS35-1(2)	1.1	3.6	31.4	13.6	OK	OK
GUSS1	M333-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-11"1/16	1/2	DStlS35-1(2)	1.1	3.7	29.5	14.7	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-11"1/16	1/2	DStlS35-1(2)	1.1	3.6	31.1	15.7	OK	OK
GUSS1	M333-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-11"3/4	1/2	DStlS36-1(4)	1.1	3.6	30.9	12.5	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-11"3/4	1/2	DStlS36-1(4)	1.1	3.5	30.7	12.4	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
GUSS1	M333-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-11"3/4	1/2	DStlS36-1(4)	1.1	3.6	31.0	14.8	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-11"3/4	1/2	DStlS36-1(4)	1.1	3.5	30.7	14.7	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Concrete block

Item	Loads	A_1 [in^2]	A_2 [in^2]	σ [ksi]	$\phi f_{p,max}$ [ksi]	Ut [%]	Status
CB 1	DStlS20(10)	251.0875	1009.8618	1.1	4.4	25.1	OK

Symbol explanation

A_1	Loaded area
A_2	Supporting area
σ	Average stress in concrete
$\phi f_{p,max}$	Concrete bearing resistance
Ut	Utilization

Shear in contact plane

Item	Loads	V [kip]	P_{br} [kip]	V_{cb} [kip]	Ut [%]	Status
BP1	DStlS35-1(2)	45.8	387.3	116.4	39.3	OK

Symbol explanation

V	Shear force
P_{br}	Concrete block bearing capacity
V_{cb}	Concrete cone breakout resistance
Ut	Utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Friction coefficient - concrete	0.40	-	ACI 349-01 – B.6.1.4
Friction coefficient in slip-resistance	0.30	-	AISC 360-16 – J3.8
Limit plastic strain	0.05	-	
Detailing	Yes		
Distance between bolts [d]	2.66	-	AISC 360-16 – J3.3
Concrete breakout resistance check	Both		
Base metal capacity check at weld fusion face	No		AISC 360-16 – J2-2
Deformation at bolt hole at service load is design consideration	Yes		AISC 360-16 – J3.10
Cracked concrete	Yes		ACI 318-14 – 17
Local deformation check	Yes		
Local deformation limit	0.03	-	CIDECT DG 1, 3 – 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints

Project item 11

Design

Name	11
Description	GL 3.1 - FL C
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC 360-16 (LRFD) / ACI 318-14

Members

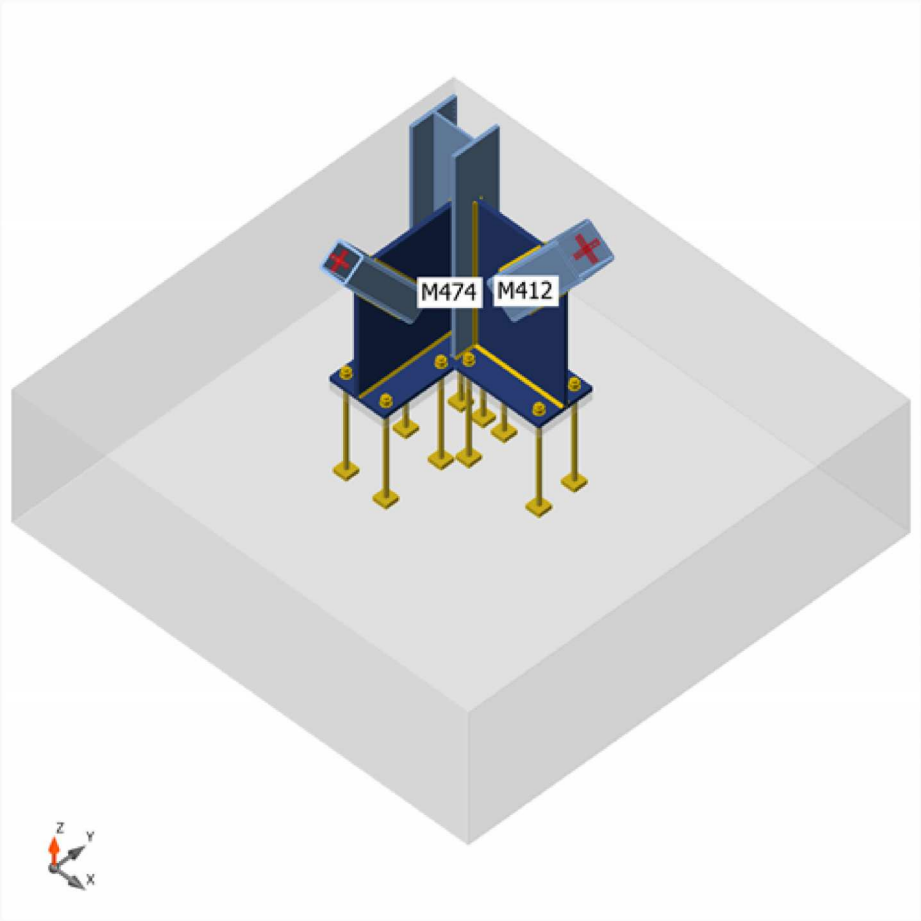
Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M11	121 - W10X68	0.0	90.0	-180.0	0"	0"	0"
M412	127 - HSS8X8X1/2(HSS8X8X1/2(HSS8X8X1/2(HSS(Imp)8X8X1/2)))	0.0	52.3	0.0	0"	0"	0"
M474	133 - HSS6X6X1/2(HSS6X6X1/2(HSS6X6X1/2(HSS(Imp)6X6X1/2)))	-90.0	52.0	0.0	0"	0"	0"

Supports and forces

Name	Support	Forces in	X [in]
M11 / end		Position	0"
M412 / end	Mx-My-Mz	Connected member face	8"1/2
M474 / end	Mx-My-Mz	Connected member face	3/8

Project:	**AOF Baseplate Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**



Cross-sections

Name	Material
121 - W10X68	A992
127 - HSS8X8X1/2(HSS8X8X1/2(HSS8X8X1/2(HSS(Imp)8X8X1/2)))	A992
133 - HSS6X6X1/2(HSS6X6X1/2(HSS6X6X1/2(HSS(Imp)6X6X1/2)))	A992
3639 - 1" PL	A572 Gr.50

Anchors

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
1 F1554 Gr.55	1"	55.0	75.0	0.7854

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS48-1(1)	M11 / End	-44.9	0.0	-0.2	0.0	0.0	0.0
	M412 / End	78.6	0.0	-0.4	0.0	0.0	0.0
	M474 / End	-39.6	0.0	-0.2	0.0	0.0	0.0
DStlS53-1(2)	M11 / End	5.4	0.0	-0.1	0.0	0.0	0.0
	M412 / End	44.7	0.0	-0.2	0.0	0.0	0.0
	M474 / End	17.8	0.0	-0.1	0.0	0.0	0.0
DStlS16(3)	M11 / End	-36.0	0.0	-0.2	0.0	-0.1	0.1
	M412 / End	74.2	0.0	-0.4	0.0	0.0	0.0
	M474 / End	-32.9	0.0	-0.1	0.0	0.0	0.0
DStlS41(4)	M11 / End	-8.6	0.0	-0.2	0.0	0.1	-0.1
	M412 / End	63.1	0.0	-0.3	0.0	0.0	0.0
	M474 / End	8.4	0.0	-0.1	0.0	0.0	0.0
DStlS33(8)	M11 / End	-34.0	0.0	-0.3	0.0	0.0	0.0
	M412 / End	120.5	0.0	-0.4	0.0	0.0	0.0
	M474 / End	-12.0	0.0	-0.1	0.0	0.0	0.0
DStlS1(11)	M11 / End	-26.6	0.0	-0.2	0.0	0.0	0.0
	M412 / End	82.1	0.0	-0.4	0.0	0.0	0.0
	M474 / End	-14.7	0.0	-0.2	0.0	0.0	0.0

Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
DStlS48-1(1)	48.2	24.2	-14.2	0.0	0.3	0.0
DStlS53-1(2)	27.4	-11.0	54.6	0.0	0.2	0.0
DStlS16(3)	45.5	20.1	-3.4	0.1	0.4	0.0
DStlS41(4)	38.6	-5.2	47.7	-0.1	0.1	0.0
DStlS33(8)	73.7	7.3	51.5	0.0	0.3	0.0
DStlS1(11)	50.3	8.9	26.4	0.0	0.3	0.0

Foundation block

Item	Value	Unit
CB 1		
Dimensions	8'-4"1/8 x 8'-7"3/8	in
Depth	2'-6"	in
Anchor	1 F1554 Gr.55	
Anchoring length	1'-6"	in
Shear force transfer	Shear lug	
Cross-section of shear lug	1" PL	
Length of shear lug	6"	in
Mortar joint	2"	in

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	2.6 < 5.0%	OK
Loc. deformation	0.0 < 3%	OK
Anchors	56.4 < 100%	OK
Welds	75.3 < 100%	OK
Concrete block	6.9 < 100%	OK
Shear	17.6 < 100%	OK
Buckling	Not calculated	

Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M11-bfl 1	A992	3/4	DStlS33(8)	20.7	0.0	0.0	OK
M11-tfl 1	A992	3/4	DStlS33(8)	16.3	0.0	0.0	OK
M11-w 1	A992	1/2	DStlS48-1(1)	28.5	0.0	0.0	OK
M412	A992	1/2	DStlS33(8)	18.6	0.0	0.0	OK
M474	A992	1/2	DStlS48-1(1)	13.3	0.0	0.0	OK
Member 4-bfl 1	A572 Gr.50	1"	DStlS48-1(1)	45.7	2.6	0.0	OK
BP1	A572 Gr.50	1"	DStlS33(8)	25.9	0.0	0.0	OK
GUSS1	A572 Gr.50	1"	DStlS33(8)	10.4	0.0	0.0	OK
GUSS2	A572 Gr.50	1"	DStlS33(8)	13.7	0.0	0.0	OK

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A572 Gr.50	50.0	5.0

Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for Member 4-bfl 1

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y = 50.0$ ksi – characteristic yield strength

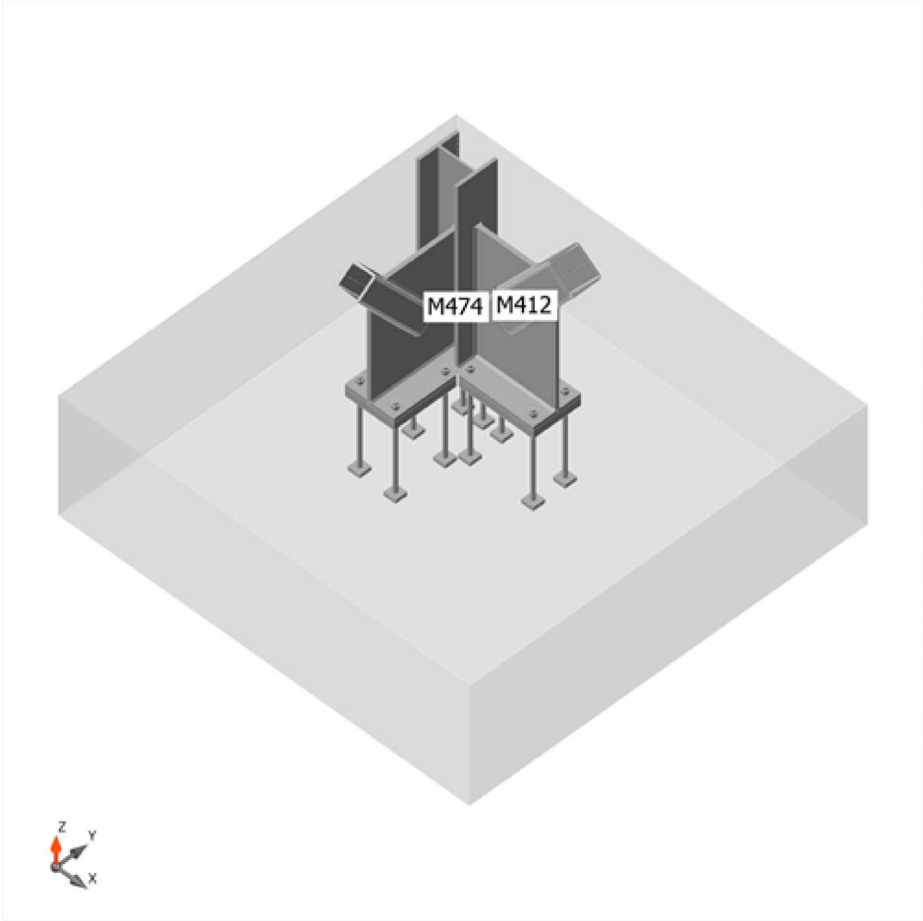
$\phi = 0.90$ – resistance factor for steel material AISC 360-16 – B3.1

Loc. deformation

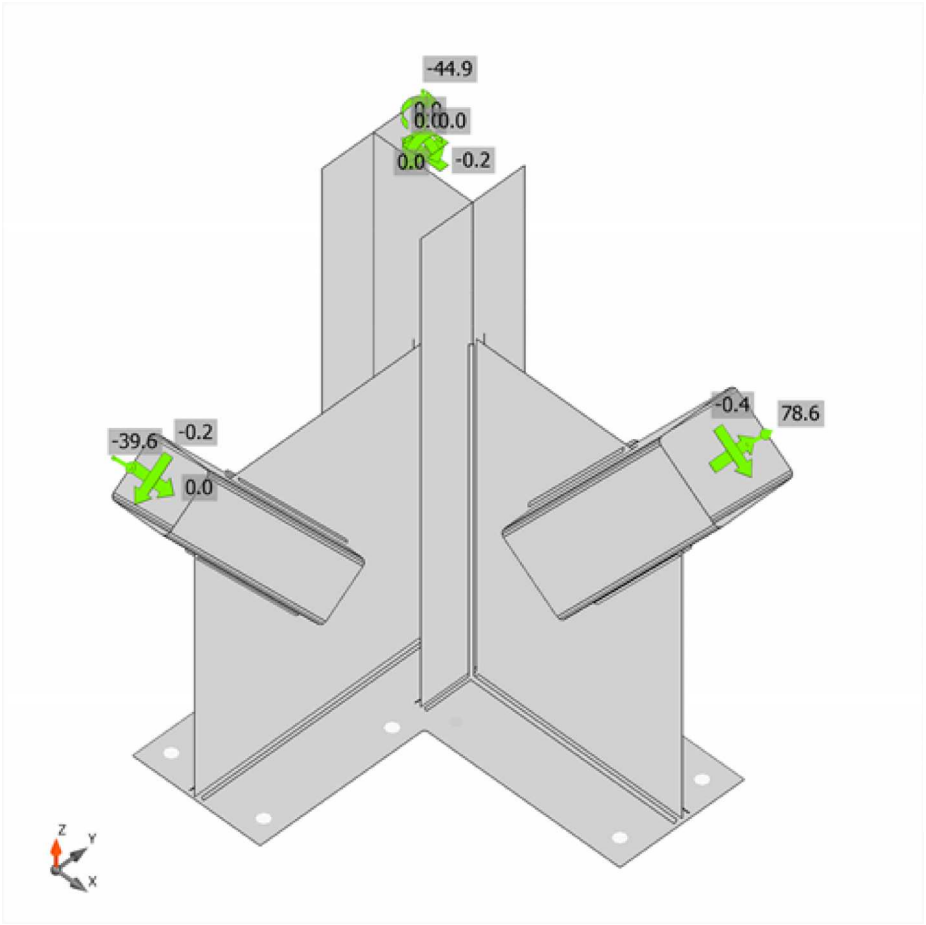
Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M412	8"	DStlS1(11)	0"	1/4	0.0	OK
M474	6"	DStlS1(11)	0"	3/16	0.0	OK

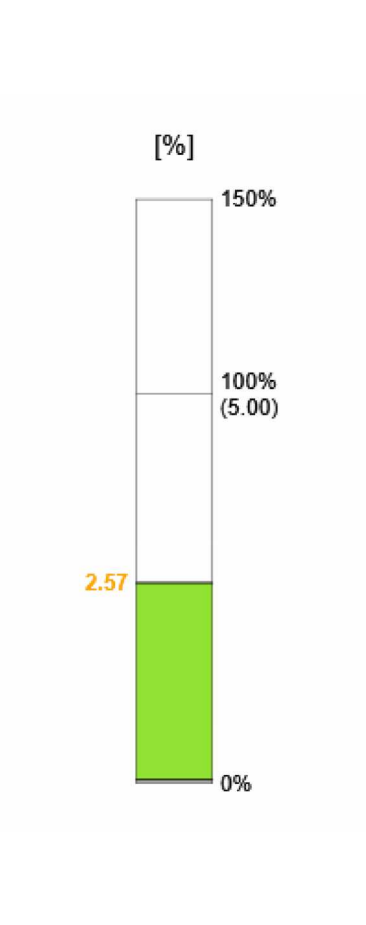
Symbol explanation

d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation

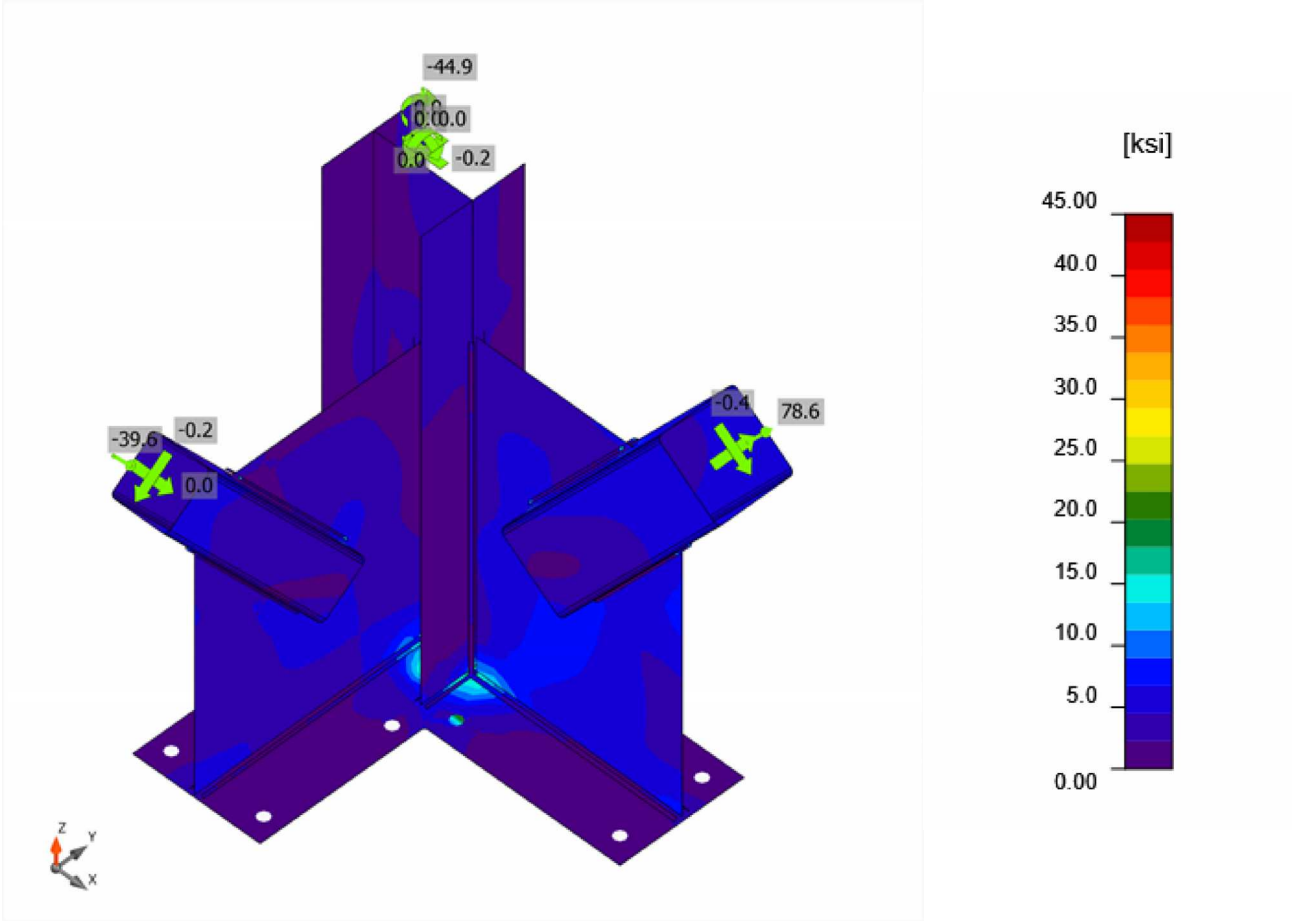


Overall check, DStlS48-1(1)



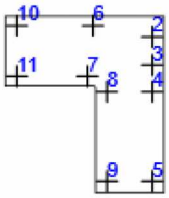


Strain check, DStlS48-1(1)



Equivalent stress, DStlS48-1(1)

Anchors

Shape	Item	Loads	N_f [kip]	ϕN_p [kip]	ϕN_{sb} [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	A2	DStlS33(8)	17.9	184.0	384.4	56.4	0.0	38.5	OK	OK
	A3	DStlS53-1(2)	13.1	184.0	384.4	41.3	0.0	22.9	OK	OK
	A4	DStlS53-1(2)	10.4	184.0	384.4	32.7	0.0	15.5	OK	OK
	A5	DStlS1(11)	0.0	184.0	0.0	0.0	0.0	0.0	OK	OK
	A6	DStlS33(8)	15.3	184.0	384.4	48.1	0.0	29.5	OK	OK
	A7	DStlS33(8)	6.5	184.0	384.4	20.5	0.0	7.1	OK	OK
	A8	DStlS33(8)	6.1	184.0	384.4	19.1	0.0	6.4	OK	OK
	A9	DStlS48-1(1)	0.3	184.0	384.4	0.9	0.0	0.0	OK	OK
	A10	DStlS33(8)	1.6	184.0	384.4	5.0	0.0	0.7	OK	OK
	A11	DStlS33(8)	0.3	184.0	384.4	1.0	0.0	0.0	OK	OK

Design data

Grade	ϕN_{sa} [kip]
1 F1554 Gr.55 - 1	31.8

Symbol explanation

N_f	Tension force
ϕN_p	Pullout strength in tension - ACI 318-14 – 17.4.3
ϕN_{sb}	Concrete side-face blowout strength in tension - ACI 318-14 – 17.4.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
ϕN_{sa}	Steel strength of anchor in tension - ACI 318-14 – 17.4.1

Detailed result for A2

Concrete splitting failure during installation should be evaluated by ACI 355.2 requirements.

Anchor tensile resistance (ACI 318-14 – 17.4.1)

$$\phi N_{sa} = \phi \cdot A_{se,N} \cdot f_{uta} = \quad 31.8 \quad \text{kip} \quad \geq \quad N_f = \quad 17.9 \quad \text{kip}$$

Where:

$\phi = 0.70$ – resistance factor

$A_{se,N} = 0.6060$ in^2 – tensile stress area

$f_{uta} = 75.0$ ksi – specified tensile strength of anchor steel:

- $f_{uta} = \min(125 \text{ ksi}, 1.9 \cdot f_{ya},\ f_u)$, where:
  - $f_{ya} =$ 55.0 ksi – specified yield strength of anchor steel
  - $f_u =$ 75.0 ksi – specified ultimate strength of anchor steel

Concrete pullout resistance (ACI 318-14 – 17.4.3)

$$\phi N_{pn} = \phi \cdot \Psi_{c,P} \cdot N_p = \quad 184.0 \quad \text{kip} \quad \geq \quad N_f = \quad 17.9 \quad \text{kip}$$

Where:

$\phi = 0.70$ – resistance factor

$\Psi_{c,P} = 1.00$ – modification factor for concrete condition

$N_p = 262.9$ kip – basic concrete pullout strength for headed anchor:

- $N_{pr} = 8 \cdot A_{brg} \cdot f'_c$, where:
  - $A_{brg} =$ 8.2146 in^2 – bearing area of the head of stud or anchor bolt
  - $f'_c =$ 4.0 ksi – concrete compressive strength

Concrete sideface blowout resistance (ACI 318-14 – 17.4.4)

$\phi N_{sb} = r_c \cdot N_{sbg} =$ 384.4 kip ≥ $N_f =$ 17.9 kip

Where:

$r_c =$ 0.50 – reduction factor for anchor close to an edge or multiple anchors with small spacing:

- $r_c = \min(\frac{1+\frac{c_{a2}}{c_{a1}}}{4}, \frac{1+\frac{s}{6 \cdot c_{a1}}}{2}),\ 0.5 \le r_c \le 1$, where:
  - $c_{a1} =$ 3'-1"11/16 in – shorter distance from an anchor to an edge
  - $c_{a2} =$ 3'-2"1/16 in – longer distance from an anchor to an edge
  - $s =$ 1" in – spacing between anchors

$N_{sbg} =$ 765.4 kip – concrete side-face blowout strength of headed anchor in tension:

- $N_{sb} = \phi \cdot 160.0 \cdot c_{a1} \cdot \sqrt{A_{bgr}} \cdot \sqrt{f'_c}$, where:
  - $A_{bgr} =$ 8.2146 in^2 – bearing area of the head of stud or anchor bolt
  - $f'_c =$ 4.0 ksi – concrete compressive strength
  - $\phi =$ 0.70 – resistance factor

Interaction of tensile and shear forces (ACI 318-14 – R17.6)

${U_{tt}}^{5/3} + {U_{ts}}^{5/3} =$ 0.38 ≤ 1.0

Where:

$U_{tt} =$ 0.56 – maximum ratio of factored tensile force and tensile resistance determined from all appropriate failure modes

$U_{ts} =$ 0.00 – maximum ratio of factored shear force and shear resistance determined from all appropriate failure modes

Supplementary reinforcement (ACI 318-14 – 17.4.2.9)

Supplementary reinforcement should resist force of 68.3 kip in tension. Only current load effect considered.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
BP1	M11-bfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS33(8)	6.6	8.8	74.6	50.6	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS33(8)	6.6	8.8	75.3	52.7	OK	OK
BP1	M11-tfl 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS53-1(2)	4.5	9.7	46.9	22.4	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	10"1/16	13/16	DStlS33(8)	6.0	9.4	64.3	36.0	OK	OK
BP1	M11-w 1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9"9/16	7/8	DStlS48-1(1)	6.3	8.4	75.1	46.1	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	9"9/16	7/8	DStlS48-1(1)	4.4	9.9	43.8	22.5	OK	OK
BP1	Member 4-bfl 1	E70xx	-	-	7"	-	-	-	-	-	-	OK	OK
M11-w 1	GUSS1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	2'-4"7/16	7/8	DStlS33(8)	2.4	10.5	22.9	10.1	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	2'-4"7/16	7/8	DStlS48-1(1)	2.1	7.9	27.0	12.8	OK	OK
BP1	GUSS1	E70xx	◢ 1/4 ◣	◢ 3/8 ◣	1'-9"13/16	1"7/16	DStlS33(8)	8.0	16.8	47.8	27.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 3/8 ◣	1'-9"13/16	1"7/16	DStlS33(8)	4.4	15.0	29.3	14.3	OK	OK
GUSS1	M474-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-3"11/16	1/2	DStlS48-1(1)	0.9	4.0	23.8	8.9	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-3"11/16	1/2	DStlS48-1(1)	0.8	3.9	20.9	7.5	OK	OK
GUSS1	M474-w 1	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-3"11/16	1/2	DStlS48-1(1)	1.0	3.6	28.1	13.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-3"11/16	1/2	DStlS48-1(1)	1.2	3.5	33.6	17.9	OK	OK
GUSS1	M474-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-5"1/16	1/2	DStlS48-1(1)	1.2	3.8	31.6	12.8	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-5"1/16	1/2	DStlS48-1(1)	1.0	3.8	27.1	10.5	OK	OK
GUSS1	M474-w 3	E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-5"1/16	1/2	DStlS48-1(1)	1.4	3.5	39.5	21.3	OK	OK
		E70xx	◢ 1/4 ◣	◢ 5/16 ◣	1'-5"1/16	1/2	DStlS48-1(1)	1.4	3.5	39.0	21.4	OK	OK
M11-tfl 1	GUSS2	E70xx	◢ 3/8 ◣	◢ 1/2 ◣	2'-8"7/16	7/8	DStlS33(8)	2.0	14.2	14.2	5.5	OK	OK
		E70xx	◢ 3/8 ◣	◢ 1/2 ◣	2'-8"3/8	7/8	DStlS33(8)	1.5	9.5	15.5	6.7	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
BP1	GUSS2	E70xx	◢ 3/8 ◣	◢ 1/2 ◣	1'-7"15/16	1"9/16	DStlS33(8)	10.9	24.4	44.8	26.3	OK	OK
		E70xx	◢ 3/8 ◣	◢ 1/2 ◣	1'-7"15/16	1"9/16	DStlS33(8)	11.3	25.1	44.8	24.8	OK	OK
GUSS2	M412-w 1	E70xx	◢ 5/16 ◣	◢ 7/16 ◣	1'-1"1/8	1/2	DStlS33(8)	2.8	5.2	53.8	27.2	OK	OK
		E70xx	◢ 5/16 ◣	◢ 7/16 ◣	1'-1"1/8	1/2	DStlS33(8)	2.9	5.1	57.4	29.9	OK	OK
GUSS2	M412-w 1	E70xx	◢ 5/16 ◣	◢ 7/16 ◣	1'-1"1/8	1/2	DStlS33(8)	2.8	5.2	54.7	33.9	OK	OK
		E70xx	◢ 5/16 ◣	◢ 7/16 ◣	1'-1"1/8	1/2	DStlS33(8)	2.9	5.1	57.0	36.0	OK	OK
GUSS2	M412-w 3	E70xx	◢ 5/16 ◣	◢ 7/16 ◣	1'-2"15/16	1/2	DStlS33(8)	2.5	5.0	49.6	24.7	OK	OK
		E70xx	◢ 5/16 ◣	◢ 7/16 ◣	1'-2"15/16	1/2	DStlS33(8)	2.4	5.0	46.7	22.6	OK	OK
GUSS2	M412-w 3	E70xx	◢ 5/16 ◣	◢ 7/16 ◣	1'-2"15/16	1/2	DStlS33(8)	2.5	5.1	48.7	28.3	OK	OK
		E70xx	◢ 5/16 ◣	◢ 7/16 ◣	1'-2"15/16	1/2	DStlS33(8)	2.4	5.0	47.4	27.3	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-16 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Project:	**AOF Baseplate Connection (Model 1)**
Project no:	**203434**
Author:	**Allison Valencia**

Detailed result for BP1 / M11-bfl 1

Weld resistance check (AISC 360-16 – J2-4)

$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} =$ 8.8 kip ≥ $F_n =$ 6.6 kip

Where:

$F_{nw} =$ 55.9 ksi – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot sin^{1.5}\theta)$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - $\theta =$ 49.4° – angle of loading measured from the weld longitudinal axis

$A_{we} =$ 0.2099 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Concrete block

Item	Loads	A_1 [in^2]	A_2 [in^2]	σ [ksi]	$\phi f_{p,max}$ [ksi]	Ut [%]	Status
CB 1	DStlS33(8)	56.4875	5373.1521	0.3	4.4	6.9	OK

Symbol explanation

A_1	Loaded area
A_2	Supporting area
σ	Average stress in concrete
$\phi f_{p,max}$	Concrete bearing resistance
Ut	Utilization

Detailed result for CB 1

Concrete block compressive resistance check (AISC 360-16 – J8)

$\phi_c f_{p,max} =$ 4.4 ksi ≥ $\sigma =$ 0.3 ksi

Where:

$f_{p,max} =$ 6.8 ksi – concrete block design bearing strength:

- $f_{p,max} = 0.85 \cdot f'_c \cdot \sqrt{\frac{A_2}{A_1}} \leq 1.7 \cdot f'_c$, where:
  - $f'_c =$ 4.0 ksi – concrete compressive strength
  - $A_1 =$ 56.4875 in^2 – base plate area in contact with concrete surface
  - $A_2 =$ 5373.1521 in^2 – concrete supporting surface

$\phi_c =$ 0.65 – resistance factor for concrete

Shear in contact plane

Item	Loads	V [kip]	P_{br} [kip]	V_{cb} [kip]	Ut [%]	Status
BP1	DStlS33(8)	73.8	419.0	647.1	17.6	OK

Symbol explanation

V	Shear force
P_{br}	Concrete block bearing capacity
V_{cb}	Concrete cone breakout resistance
Ut	Utilization

Detailed result for BP1

Bearing capacity check (ACI 349-01 – B.4.5, ACI 349-01 – RB.11)

$$\phi_c P_{br} = \phi \cdot 1.3 \cdot f'_c \cdot A_1 + \phi \cdot K_c \cdot (N_y - P_a) = \quad 419.0 \quad \text{kip} \quad \geq \quad V = \quad 73.8 \quad \text{kip}$$

Where:

$\phi = 0.7$ – resistance factor for bearing of bolts on steel

$f'_c = 4.0$ ksi – concrete compressive strength

$A_1 = 28.2544$ in^2 – projected area of the embedded area of the shear lug in the direction of the force excluding the portion of the lug in contact with the grout above concrete member

$K_c = 1.60$ – confinement coefficient

$N_y = 333.3$ kip – yield strength of tensioned anchors

- $N_y = n \cdot A_{se} \cdot F_y$, where:
  - $n =$ 10.0 – number of tensioned anchors
  - $A_{se} =$ 0.6060 in^2 – tensile stress area of an anchor
  - $F_y =$ 55.0 ksi – anchor yield strength

$P_a = 51.0$ kip – external axial load

Concrete breakout strength check (ACI 349 – B11)

$$\phi V_{cb} = \phi \cdot \Psi_{\alpha,v} \cdot A_{vc} \cdot 4.0 \cdot \sqrt{f'_c} = \quad 647.1 \quad \text{kip} \quad \geq \quad V = \quad 73.8 \quad \text{kip}$$

Where:

$\phi = 0.85$ – steel embedment material resistance factor for reinforcement

$\Psi_{\alpha,V} = 1.$ – modification factor for shear lug loaded at an angle with the concrete edge

- $\Psi_{\alpha,V} = \sqrt{\frac{1}{(\cos\ \alpha_V)^2 + (0.5 \cdot \sin \alpha_V)^2}}$, where:
  - $\alpha_V =$ 5.7 ° – angle between direction of shear force and direction perpendicular to concrete edge

$A_{vc} = 2999.0000$ in^2 – effective stress area defined by projecting a 45^o plane from the bearing edges of the shear lug to the free surface in the direction of the shear load. The bearing area of the shear lug is excluded from the projected area.

$f'_c = 4.0$ ksi – concrete compressive strength

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
Friction coefficient - concrete	0.40	-	ACI 349-01 – B.6.1.4
Friction coefficient in slip-resistance	0.30	-	AISC 360-16 – J3.8
Limit plastic strain	0.05	-	
Detailing	Yes		
Distance between bolts [d]	2.66	-	AISC 360-16 – J3.3
Concrete breakout resistance check	Shear		
Base metal capacity check at weld fusion face	No		AISC 360-16 – J2-2
Deformation at bolt hole at service load is design consideration	Yes		AISC 360-16 – J3.10
Cracked concrete	Yes		ACI 318-14 – 17
Local deformation check	Yes		
Local deformation limit	0.03	-	CIDECT DG 1, 3 – 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints

Hilti PROFIS Engineering 3.1.14

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Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Masonry - Apr 23, 2025 (1)	Date:	4/23/2025
Fastening point:	Wind Grit Anchor		

Specifier's comments:

1 Input data

Anchor type and diameter:	**HY 270 + threaded rod 5.8 5/8**
Item number:	385428 HAS 5.8 5/8"x8" (element) / 2194247 HIT-HY 270 (adhesive)
Specification text:	Hilti ∅ 5/8 HY 270 + threaded rod 5.8 with 5.625 in nominal embedment depth per Technical data , Hammer drilled installation per MPII,
Effective embedment depth:	h_{ef} = 5.625 in.
Material:	5.8
Evaluation Service Report:	Hilti Technical Data
Issued I Valid:	- | -
Proof:	Design Method ASD Masonry
Stand-off installation:	
Profile:	
Base material:	Grout-filled CMU, L x W x H: 16.000 in. x 8.000 in. x 8.000 in.; Joints: vertical: 0.375 in.; horizontal: 0.375 in. Base material temperature: 68 °F
Installation:	Face installation
Seismic loads	no

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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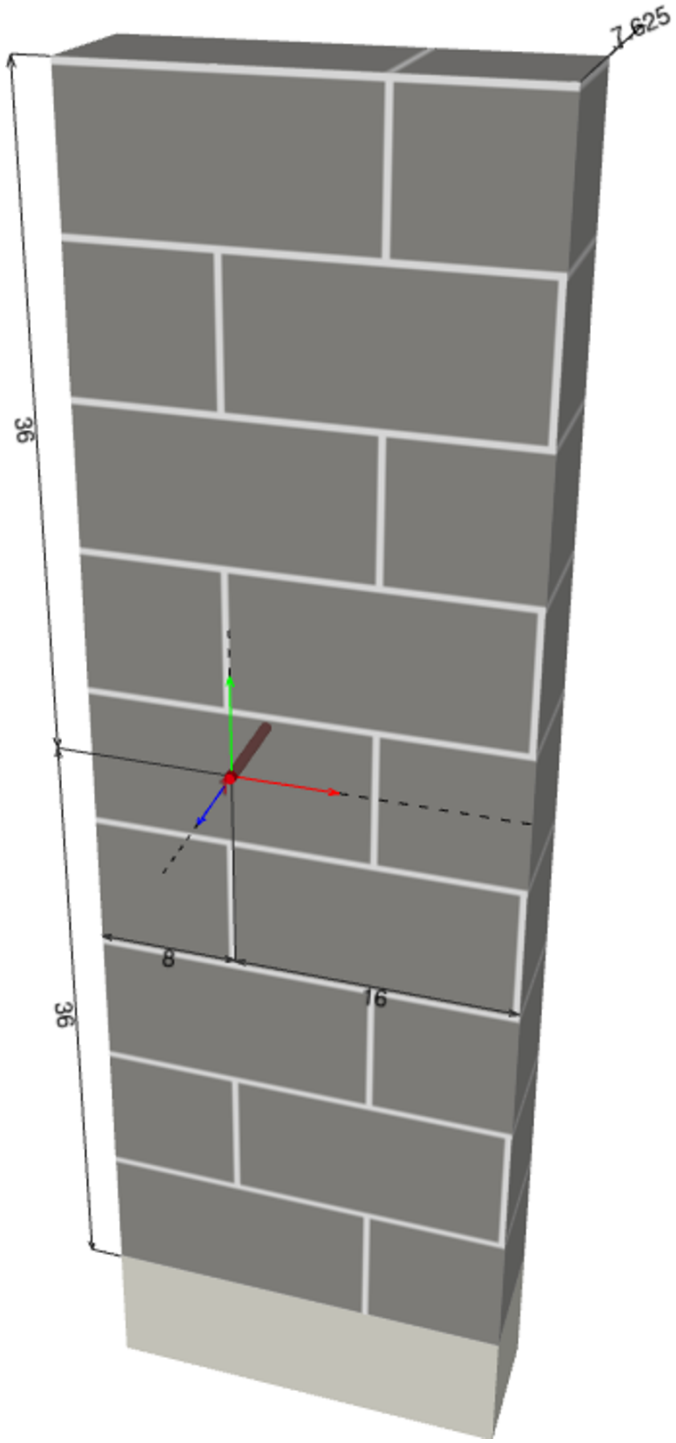
Geometry [in.]



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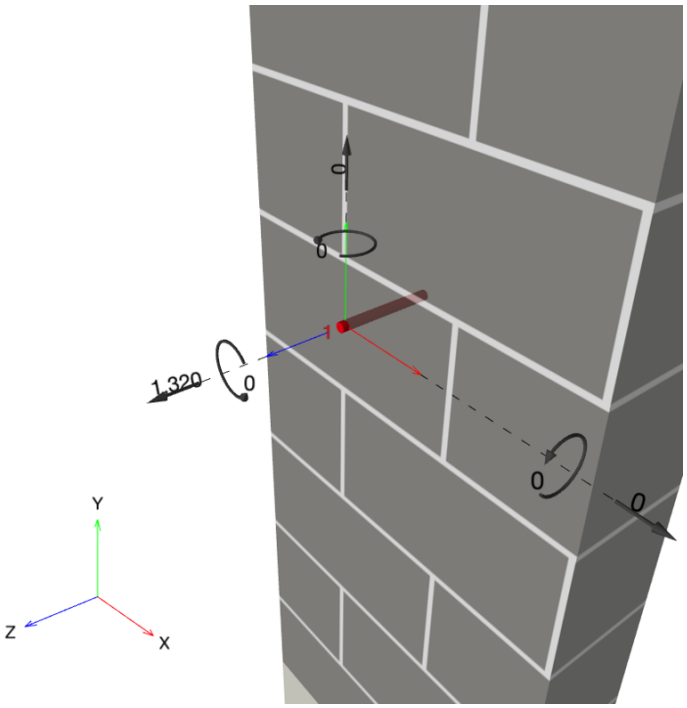
Design:	Masonry - Apr 23, 2025 (1)	Date:	4/23/2025
Fastening point:	Wind Grit Anchor		

Geometry [in.] & Loading [lb, in.lb]



1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 1,320; V_x = 0; V_y = 0; M_x = 0; M_y = 0; M_z = 0;	no	65

Wp = 126x10x16/12 = 1700 lb
Ka = 1+Lf/100 = 1+10/100 = 1.1
Fp = 0.4 SDS Ka Ie Wp = 0.4x0.59x1.1x1.25x1700 = 552 lb

2 Load case/Resulting anchor forces

Load case: Service loads

Anchor reactions [lb]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	1,320	0	0	0

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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Design:	Masonry - Apr 23, 2025 (1)	Date:	4/23/2025
Fastening point:	Wind Grit Anchor		

3 Tension load (Most utilized anchor 1)

	Load P_s [lb]	Capacity P_t [lb]	Utilization $\beta_P = P_s/P_t$ [%]	Status
Steel strength	1,320	7,340	18	OK
Bond strength	1,320	2,061	65	OK

3.1 Steel strength

$P_{t,s}$ = Value refer to Hilti Technical Data
$P_{t,s} \geq P_s$

Results

$P_{t,s}$ [lb]	P_s [lb]
7,340	1,320

3.2 Bond strength

$P_{t,b,Base}$ = Value refer to Hilti Technical Data
$P_{t,b} = P_{t,b,Base} \cdot f_{red,E} \cdot f_{red,s} \cdot f_{red,Temp} \cdot f_{red,Bedjoint}$
$P_{t,b} \geq P_s$

Variables

c_{min} [in.]	c_{cr} [in.]	s_{min} [in.]	s_{cr} [in.]	Temperature [°F]
4.000	20.000	4.000	22.500	68

Results

$P_{t,b}$ [lb]	$P_{t,b,Base}$ [lb]	P_s [lb]	$f_{red,E}$	$f_{red,S}$	$f_{red,Temp}$	$f_{red,Bedjoint}$
2,061	2,840	1,320	0.726	1.000	1.000	1.000

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Fastening point:	Wind Grit Anchor		

4 Shear load (Most utilized anchor 1)

	Load V_s [lb]	Capacity V_t [lb]	Utilization $\beta_V = V_s/V_t$ [%]	Status
Overall strength	N/A	N/A	N/A	N/A

5 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- The equations presented in this report are based on imperial units. When inputs are displayed in metric units, the user should be aware that the equations remain in their imperial format.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- The min. sizes of the bricks, the masonry compressive strength, the type / strength of the mortar and the grout (in case of fully grouted CMU walls) has to fulfill the requirements given in the relevant ESR-approval or in the PTG.
- Only the local load transfer from the anchor(s) to the wall is considered, a further load transfer in the wall is not covered by PROFIS!
- Wall is assumed as being perfectly aligned vertically – checking required(!): Noncompliance can lead to significantly different distribution of forces and higher tension loads than those calculated by PROFIS. Masonry wall must not have any damages (neither visible nor not visible)! While installation, the positioning of the anchors needs to be maintained as in the design phase i.e. either relative to the brick or relative to the mortar joints.
- The effect of the joints on the compressive stress distribution on the plate / bricks was not taken into consideration.
- If no significant resistance is felt over the entire depth of the hole when drilling (e.g. in unfilled butt joints), the anchor should not be set at this position or the area should be assessed and reinforced. Hilti recommends the anchoring in masonry always with sieve sleeve. Anchors can only be installed without sieve sleeves in solid bricks when it is guaranteed that it has not any hole or void.
- The accessories and installation remarks listed on this report are for the information of the user only. In any case, the instructions for use provided with the product have to be followed to ensure a proper installation.
- The compliance with current standards (e.g. 2018, 2015, 2012, 2009 and 2006 IBC) is the responsibility of the user.
- Drilling method (hammer, rotary) to be in accordance with the approval!
- Masonry should be built according to industry standards.

Fastening meets the design criteria!

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Fastening point:	Wind Grit Anchor		

6 Installation data

Profile: -

Hole diameter in the fixture: -

Plate thickness (input): -

Drilling method: Drilled in hammer mode

Anchor type and diameter: HY 270 + threaded rod 5.8 5/8
Item number: 385428 HAS 5.8 5/8"x8" (element) / 2194247
HIT-HY 270 (adhesive)

Maximum installation torque: 90 in.lb

Hole diameter in the base material: 0.750 in.

Hole depth in the base material: 5.625 in.

Minimum thickness of the base material: 7.625 in.

Hilti ∅ 5/8 HY 270 + threaded rod 5.8 with 5.625 in nominal embedment depth per Technical data , Hammer drilled installation per MPII

Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.000	0.000	8.000	16.000	36.000	36.000

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Fastening point:	Wind Grit Anchor		

7 Remarks; Your Cooperation Duties

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S.O. No. _____

Subject: Creech AOF - Extreme Torsional Irregularity Check

Sheet No. _____ of _____

Drawing No. _____

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$\delta_{ave} = \frac{\delta_{max} + \delta_{min}}{2}$ $\frac{\delta_{max}}{\delta_{ave}} > 1.4 \rightarrow$ extreme

under Ex (seismic E/W direction) in ETABS:

$\delta_{max} = 0.05''$ $\delta_{min} = 0.035''$ $\delta_{ave} = 0.0425''$

$\frac{\delta_{max}}{\delta_{ave}} < 1.4$ ✓

under Ey (seismic N/S direction) in ETABS:

$\delta_{max} = 0.08''$ $\delta_{min} = 0.04''$ $\delta_{ave} = 0.06''$

$\frac{\delta_{max}}{\delta_{ave}} < 1.4$ ✓

AOF End

under Ex (seismic E/W direction) in ETABS:

$\delta_{max} = 0.083''$ $\delta_{min} = 0.08''$ $\delta_{ave} = 0.0815''$

$\frac{\delta_{max}}{\delta_{min}} < 1.4$ ✓

under Ey (seismic N/S direction) in ETABS:

$\delta_{max} = 0.071''$ $\delta_{min} = 0.043''$ $\delta_{ave} = 0.057''$

$\frac{\delta_{max}}{\delta_{min}} < 1.4$ ✓

AOF Middle

S.O. No. _____

Subject: Creech AOF - Drift Check

_____ Sheet No. _____ of _____

_____ Drawing No. _____

Computed by BT Checked by _____ Date 05/13/2025

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AOF End

Seismic drift check

$$\delta_x = \frac{C_d\,\delta_{xe}}{I_e} = \frac{5 \times 0.08}{1.25} = 0.32'' < 4.5'' \checkmark$$

Allowable story drift:

Risk Category III $\rightarrow$ $\Delta_a = 0.015\,h_x = 0.015 \times 25 \times 12 = 4.5''$

wind drift check

max drift under wind from ETABS = $0.6'' < 0.7'' \checkmark$

Allowable drift = $H/600 = \frac{35 \times 12}{600} = 0.7''$

AOF Middle

Seismic drift check

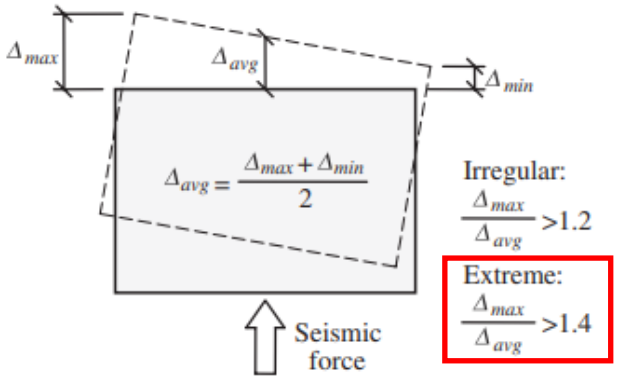
$$\delta_x = \frac{5 \times 0.083}{1.25} = 0.33'' < 4.5''$$

$\Delta_a = 4.5''$

wind drift check

max drift under wind from ETABS = $0.21'' < 0.84'' \checkmark$

Allowable drift = $H/600 = \frac{42 \times 12}{600} = 0.84''$



Type 1. Torsional

ties required by this section shall be in addition to the diaphragm sheathing. Anchorage shall not be accomplished by use of toenails or nails subject to withdrawal, nor shall wood ledgers or framing be used in cross-grain bending or cross-grain tension. The diaphragm sheathing shall not be considered effective for providing the ties or struts required by this section.

12.11.2.2.4 Metal Deck Diaphragms. In metal deck diaphragms, the metal deck shall not be used as the continuous ties required by this section in the direction perpendicular to the deck span.

12.11.2.2.5 Embedded Straps. Diaphragm to structural wall anchorage using embedded straps shall be attached to, or hooked around, the reinforcing steel or otherwise terminated so as to effectively transfer forces to the reinforcing steel.

12.12.3 Structural Separation. All portions of the structure shall be designed and constructed to act as an integral unit in resisting seismic forces unless separated structurally by a distance sufficient to avoid damaging contact as set forth in this section.

Separations shall allow for the maximum inelastic response displacement (δ_M). δ_M shall be determined at critical locations with consideration for translational and torsional displacements of the structure including torsional amplifications, where applicable, using the following equation:

$$\delta_M = \frac{C_d \delta_{max}}{I_e} \qquad (12.12\text{-}1)$$

where δ_{max} = maximum elastic displacement at the critical location.

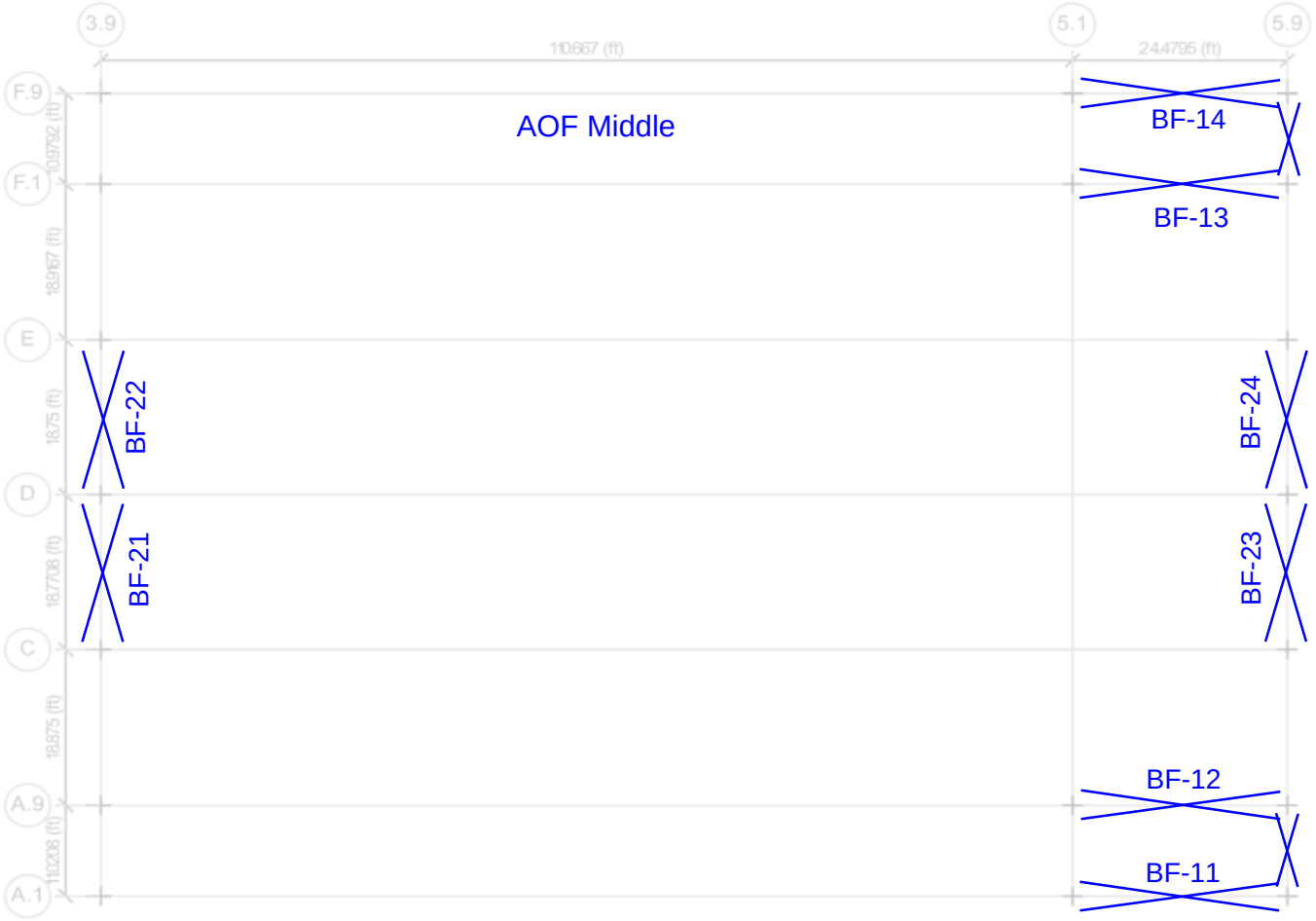
Table 12.12-1 Allowable Story Drift, Δ_a [a,b]

Structure	Risk Category I or II	Risk Category III	Risk Category IV
Structures, other than masonry shear wall structures, four stories or less above the base as defined in Section 11.2, with interior walls, partitions, ceilings, and exterior wall systems that have been designed to accommodate the story drifts	$0.025h_{sx}$ [c]	$0.020h_{sx}$	$0.015h_{sx}$
Masonry cantilever shear wall structures[d]	$0.010h_{sx}$	$0.010h_{sx}$	$0.010h_{sx}$
Other masonry shear wall structures	$0.007h_{sx}$	$0.007h_{sx}$	$0.007h_{sx}$
All other structures	$0.020h_{sx}$	$0.015h_{sx}$	$0.010h_{sx}$

[a] h_{sx} is the story height below level x.
[b] For seismic force-resisting systems solely comprising moment frames in Seismic Design Categories D, E, and F, the allowable story drift shall comply with the requirements of Section 12.12.1.1.
[c] There shall be no drift limit for single-story structures with interior walls, partitions, ceilings, and exterior wall systems that have been designed to accommodate the story drifts. The structure separation requirement of Section 12.12.3 is not waived.
[d] Structures in which the basic structural system consists of masonry shear walls designed as vertical elements cantilevered from their base or foundation support that are so constructed that moment transfer between shear walls (coupling) is negligible.

CC.2.2 Drift of Walls and Frames. Drifts (lateral deflections) of concern in serviceability checking arise primarily from the effects of wind. Drift limits in common usage for building design are on the order of 1/600 to 1/400 of the building or story height (ASCE Task Committee on Drift Control of Steel Building Structures 1988; Griffis 1993). These limits generally are

Lateral System Overview



S.O. No. _____

Subject: Creech AOF - Diaphragm Loads (Low Roof)

Sheet No. 1 of 2

Drawing No. _____

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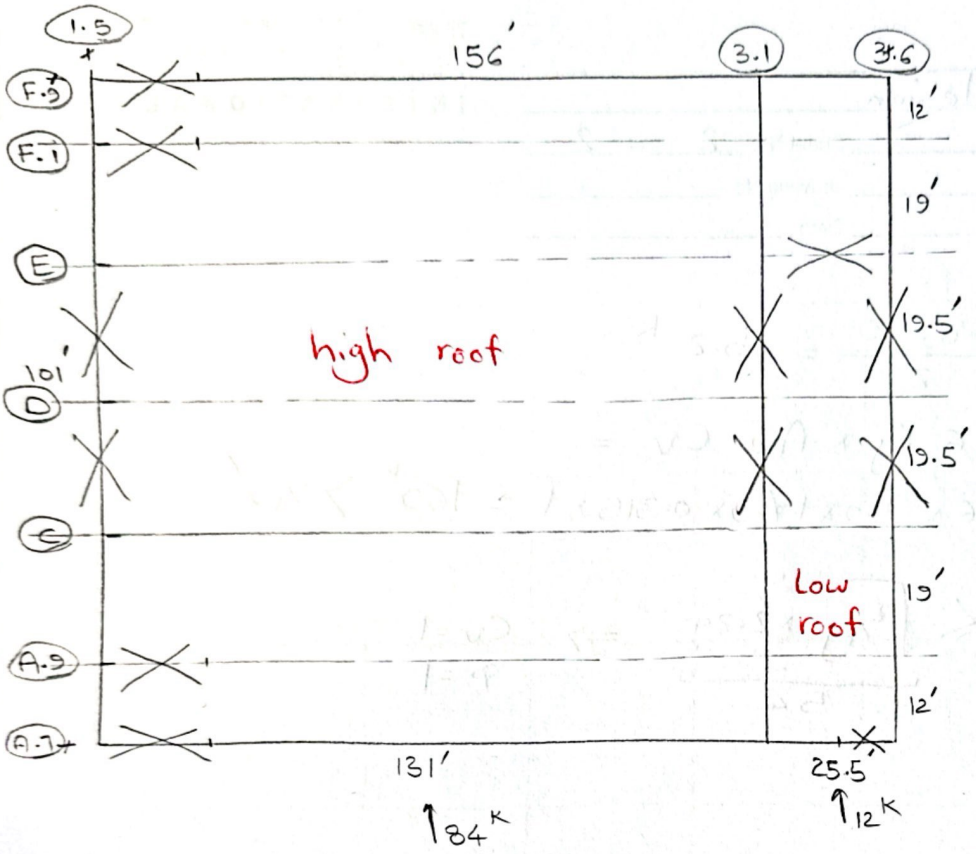


J

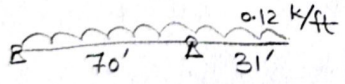
$V_{seismic\ high\ roof} = 84^K$ $\quad V_{ax\ 3.1} = \frac{84}{2} = 42^K$

$V_{seismic\ low\ roof} = 12^K$ $\quad V_{ax\ 3.1} = \frac{12}{2} = 6^K$

$V_{ax\ 3.1} = 42 + 6 = 48^K$ $\quad \frac{48}{2 \times 19.5} = 1.263\ K/ft = 1263\ plf = V_{BF-18,\ BF-19}$

X

$V_{seismic\ low\ roof} = 12^K$ $\quad w = 12/101 = 0.12\ K/ft$



$V_{ax\ A.7} = \frac{0.12 \times 70}{2} = 4.2\ K/ft$

$V_{ax\ E} = \frac{0.12 \times 70}{2} + 0.12 \times 31 = 7.92\ K/ft$

$V_{BF-3} = \frac{4.2}{13'} = 0.32\ K/ft = 323\ plf$

$V_{BF-6} = \frac{8}{25.5'} = 0.32\ K/ft = 330\ plf$

S.O. No. _____

Subject: Creech AOF - Diaphragm Loads (Low Roof)

Sheet No. 1 of 2

Drawing No. _____

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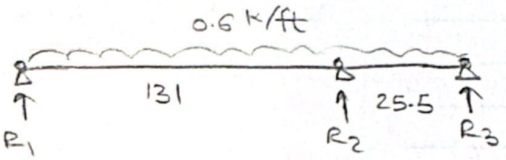
Y { $V_{wind} = 88^k$ $\quad \frac{88}{156'} = 0.6\ k/ft$



$V_{ax\,1.5} = \frac{0.6 \times 131}{2} = 39.3^k$ $\quad V_{ax\,3.1} = \frac{0.6 \times 131}{2} + \frac{0.6 \times 25.5}{2} = 47^k$

$V_{ax\,3.6} = \frac{0.6 \times 25.5}{2} = 8^k$

$V_{BF-18} = V_{BF-19} = \frac{47}{2 \times 19.5} = 1.2\ k/ft = 1206\ plf$

X { $V_{wind} = 57^k \rightarrow$ does not govern.

S.O. No. _____

Subject: Creech AOF - Diaphragm Loads (Mezzanine)

_____ Sheet No. _____ of _____

_____ Drawing No. _____

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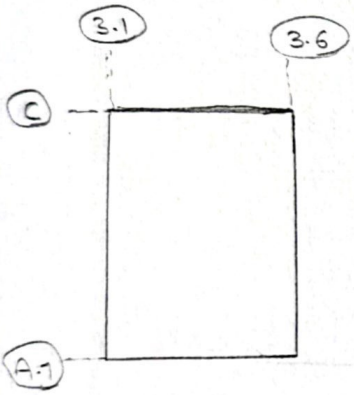


$$w = (25.5' \times 30.5') \times 90\ psf + (2 \times 25.5' + 2 \times 30.5') \times 126\ psf \times (4.5' + 7.5') = 240^{k}$$

$$V = 30^{k}$$

$$F_p = 0.2\, S_{DS}\, I_e\, w_{px} = 0.2 \times 0.59 \times 1.25 \times 240 = 36^{k}$$

$$\frac{36^{k}}{2 \times 25.5} = 0.7\ ^{k}/_{ft} = 706\ plf$$

20 ga 1.5PLB-36 Grade 50 Roof Deck

Diaphragm Shear & Wind Uplift Interaction

For Both Ends Lapped Deck
with MWFRS Design Net Wind Uplift (LRFD) of 16 psf

Hilti X-HSN24 PAF Connections to Supports
36 / 7 / 4 Perpendicular Connection Pattern to Supports
PunchLok II Connection Sidelap Connections

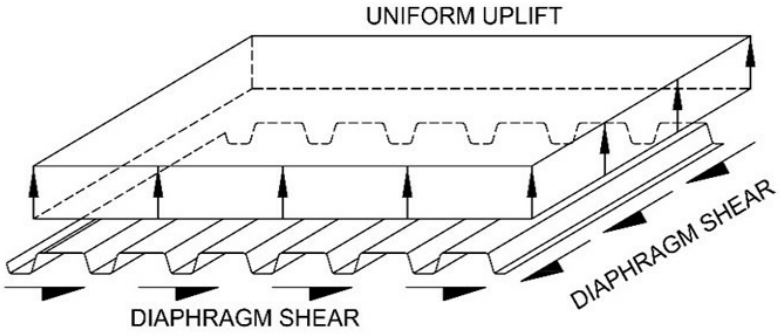
A572 GR50 Support Member or Equivalent
0.188 ≤ Support Thickness (in.) ≤ 0.375
6 in. Minimum Deck End Bearing Length

LRFD Design Combined Wind Uplift & Diaphragm Shear Strength ΦSn (plf) Generic 3 Span Condition

Sidelap Connection Spacing (in.)	Span 6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	8'-6"	9'-0"	9'-6"	10'-0"
4	2559	2533	2507	2481	2377	2105	1878	1685	1521
6	2559	2533	2507	2481	2377	2105	1878	1685	1521
8	2361	2359	2354	2347	2277	2105	1878	1685	1521
12	1999	2048	1957	2000	1921	1958	1878	1685	1521
18	1612	1724	1633	1549	1644	1571	1503	1583	1521
24	1360	1515	1428	1348	1276	1402	1337	1277	1222
36	1065	1270	1190	1119	1055	997	945	1096	1046

Average Connection Spacing to Supports at Parallel Chords & Collectors (in.)

Sidelap Connection Spacing (in.)	Span 6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	8'-6"	9'-0"	9'-6"	10'-0"
4	6	6	6	6	6	6	6	6	6
6	7	7	7	6	6	7	8	9	9
8	7	7	7	7	7	7	8	9	10
12	8	8	8	8	8	8	8	9	10
18	10	10	11	10	10	10	10	10	10
24	12	11	12	13	12	11	12	11	12
36	18	13	14	15	16	17	18	14	15



20 ga 1.5PLB-36 Grade 50 Roof Deck

Seismic Diaphragm Shear

For Both Ends Lapped Deck

Hilti X-HSN24 PAF Connections to Supports
36 / 7 / 4 Perpendicular Connection Pattern to Supports
PunchLok II Connection Sidelap Connections

A572 GR50 Support Member or Equivalent
0.188 ≤ Support Thickness (in.) ≤ 0.375
6 in. Minimum Deck End Bearing Length

Seismic or Wind Diaphragm Shear Stiffness, G' (kip/in.) — Generic 3 Span Condition

Sidelap Connection Spacing (in.)	Span 6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	8'-6"	9'-0"	9'-6"	10'-0"
4	228	229	228	228	227	228	227	227	226
6	208	207	207	207	206	206	206	205	205
8	192	193	193	194	190	190	191	192	188
12	169	172	167	170	165	168	164	167	163
18	147	153	148	143	148	144	140	145	141
24	132	141	136	131	126	134	129	126	122
36	115	127	121	117	112	108	104	114	110

LRFD Design Seismic Diaphragm Shear Strength ΦSn (plf) — Generic 3 Span Condition

Sidelap Connection Spacing (in.)	Span 6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	8'-6"	9'-0"	9'-6"	10'-0"
4	2513	2513	2513	2513	2377	2105	1878	1685	1521
6	2445	2440	2436	2433	2377	2105	1878	1685	1521
8	2224	2238	2249	2259	2199	2105	1878	1685	1521
12	1854	1912	1830	1884	1812	1861	1797	1685	1521
18	1480	1592	1510	1434	1531	1464	1402	1488	1431
24	1245	1393	1314	1243	1178	1300	1241	1187	1136
36	977	1165	1094	1030	973	922	875	1016	971

Average Connection Spacing to Supports at Parallel Chords & Collectors (in.)

Sidelap Connection Spacing (in.)	Span 6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	8'-6"	9'-0"	9'-6"	10'-0"
4	6	6	6	6	6	6	6	6	6
6	7	7	7	6	7	7	8	9	9
8	7	7	7	7	7	7	8	10	11
12	9	9	8	8	9	9	9	10	11
18	12	10	11	11	11	11	12	10	11
24	14	11	12	13	14	13	14	14	15
36	18	16	17	18	16	17	18	16	17

Bare Deck Diaphragm V5.4 in accordance with:
AISI S100-16 (2020) w/ S2-20
IAPMO UES ER-0423
IAPMO UES ER-0652
CAN/CSA-S136 (R2021) for Canadian references

Date: 5/13/2025

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Deck-Slab Diaphragm Shear Strength

20 ga 1.5VL-36 Grade 50 Composite Deck

4 in. total slab depth, f'c = 4000 psi, 145 pcf NWC

Single Mat of Rebar #4 x #4 - 12 x 12 in o.c.

NUCOR® VULCRAFT

Hilti X-HSN-24 PAF at Chords & Collectors for Shear Transfer

Perpendicular Connection Pattern[1]			2 per rib	
Parallel Connection Attachment (maximum)	1	row at	3	in. o.c.

Minimum Connections to Supporting Members[2]

Minimum connections to all supports may be any of the following: arc spot welds, fillet welds, PAF's, screws, Shearflex® anchors, welded studs or other mechanical connections[3].

Perpendicular Connection Pattern[1]	1 every other rib		
Parallel Perimeter Connections for deck spans greater than 5 ft	36	in. o.c.	

Governing Deck-Slab Strength and Stiffness

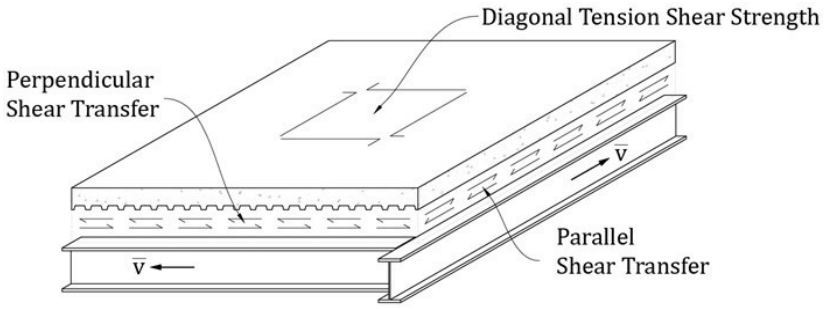
Available Diaphragm Design Strength Controlled by Connections to Chords and Collectors	**Va = (ΦPn)N =**	**5028**	**plf**
Deck-Slab Diaphragm Design Shear Stiffness	G' =	1050	kip/in

Deck-Slab Shear Strength

Reinforced Concrete Slab Design Shear Strength	Vu =	11384	plf

Chords & Collector Shear Transfer Strength

Chord & Collectors Design Shear Transfer Strength	(ΦPn)N =	5028	plf



Notes:

1. For UL Fire rated assemblies, refer to UL Design Number for support and sidelap connection requirements.
2. Minimum connections to supporting members do not contribute to the diaphragm shear strength.
3. Support welds at interlocking sidelaps may be 3/8" x 1-1/4" arc seam welds in lieu of arc spot welds.
4. Sidelap connections between steel deck panels may be VSC2, button punch, screw, 1-1/2 in. arc seam weld or 1-1/2 in. top arc seam weld. The maximum sidelap connection spacing shall not exceed 36 in. o.c.
5. Dramix Steel Fibers up to 66 lb/cy are approved in lieu of welded wire fabric in all UL D700, D800 , and 900 Series Designs, and G229.

Deck-Slab Diaphragm V2.1 in accordance with: Date: 5/13/2025

AISI S100-16 (2020) w/ S2-20 & AISI S310-16 as modified by IAPMO ER-0652 or ER-0423

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AOF End – Horizontal bottom chord beams and braces showing DC ratio (designed with omega seismic load combinations)

Label	Section	D/C Ratio	Load Combination
20	W12X50	0.083 = 0.08 + 0.004 + 0	DStlS48-1
21	W12X45	0.007 = 0.006 + 0.001 + 0	DStlS49-1
22	W12X45	0.1 = 0.093 + 0.007 + 0	DStlS48-1
23	W12X45	0.008 = 0.007 + 0.001 + 0	DStlS47-1
24	W12X45	0.095 = 0.088 + 0.007 + 0	DStlS48-1
28	W12X45	0.008 = 0.007 + 0.001 + 0	DStlS49-1
29	W12X45	0.096 = 0.089 + 0.007 + 0	DStlS46-1
30	W12X45	0.007 = 0.006 + 0.001 + 0	DStlS46-1
31	W12X45	0.1 = 0.093 + 0.007 + 0	DStlS48-1
32	W8X31	0.012 = 0 + 0.011 + 0	DStlS49-1
33	W8X31	0.023 = 0.019 + 0.005 + 0	DStlS49-1
34	W8X31	0.051 = 0.035 + 0.016 + 0	DStlS48-1
35	W8X40	0.048 = 0.034 + 0.014 + 0	DStlS49-1
36	W8X40	0.049 = 0.035 + 0.014 + 0	DStlS49-1
37	W8X31	0.052 = 0.036 + 0.016 + 0	DStlS48-1
38	W8X31	0.024 = 0.019 + 0.005 + 0	DStlS48-1
39	W8X31	0.012 = 0 + 0.012 + 0	DStlS48-1
40	W8X31	0.052 = 0.022 + 0.03 + 0	DStlS48-1
41	W8X31	0.053 = 0.022 + 0.031 + 0	DStlS49-1
48	W8X31	0.032 = 0 + 0.024 + 0.007	DStlS49-1
49	W8X31	0.016 = 0.011 + 0.005 + 0	DStlS48-1
50	W8X31	0.021 = 0.016 + 0.005 + 0	DStlS48-1
51	W8X31	0.028 = 0.015 + 0.013 + 3.743E-04	DStlS49-1
52	W8X31	0.031 = 0.026 + 0.005 + 0	DStlS49-1
53	W8X31	0.032 = 0.027 + 0.005 + 0	DStlS49-1
54	W8X31	0.02 = 0.009 + 0.011 + 1.833E-04	DStlS48-1
55	W8X31	0.018 = 0 + 0.013 + 0.005	DStlS48-1
56	W8X31	0.017 = 0.011 + 0.006 + 0	DStlS48-1
57	L6X6X7/8	0.264 = 0.184 + 0.069 + 0.011	DStlS46-1
59	L6X6X5/16	0.095 = 0.039 + 0.023 + 0.033	DStlS46-1
60	L6X6X5/16	0.086 = 0.028 + 0.022 + 0.036	DStlS49-1
61	L6X6X5/16	0.109 = 0.061 + 0.014 + 0.033	DStlS46-1
62	L6X6X5/16	0.15 = 0.093 + 0.018 + 0.039	DStlS47-1
63	L6X6X5/16	0.104 = 0.047 + 0.019 + 0.038	DStlS47-1
64	L6X6X5/16	0.158 = 0.098 + 0.019 + 0.041	DStlS47-1
65	L6X6X7/8	0.387 = 0.361 + 0.015 + 0.01	DStlS47-1
67	L6X6X5/16	0.071 = 0.046 + 0.015 + 0.01	DStlS47-1
68	L6X6X7/8	0.619 = 0.546 + 0.064 + 0.01	DStlS49-1

70	L6X6X5/16	0.09 = 0.038 + 0.028 + 0.023	DStlS48-1
71	L6X6X5/16	0.099 = 0.049 + 0.018 + 0.032	DStlS49-1
72	L6X6X5/16	0.099 = 0.04 + 0.02 + 0.039	DStlS46-1
73	L6X6X5/16	0.106 = 0.047 + 0.02 + 0.039	DStlS46-1
74	L6X6X5/16	0.152 = 0.093 + 0.018 + 0.04	DStlS46-1
75	L6X6X5/16	0.105 = 0.052 + 0.019 + 0.034	DStlS46-1
78	L6X6X5/16	0.128 = 0.098 + 0.016 + 0.014	DStlS49-1
79	W8X31	0.032 = 0 + 0.024 + 0.007	DStlS47-1
80	W8X31	0.016 = 0.01 + 0.005 + 0	DStlS49-1
81	W8X31	0.02 = 0.015 + 0.005 + 0	DStlS49-1
82	W8X31	0.028 = 0.014 + 0.013 + 0.001	DStlS49-1
83	W8X31	0.03 = 0.025 + 0.005 + 0	DStlS49-1
84	W8X31	0.031 = 0.026 + 0.005 + 0	DStlS47-1
85	W8X31	0.02 = 0.01 + 0.01 + 2.767E-04	DStlS49-1
86	W8X31	0.016 = 0 + 0.013 + 0.004	DStlS49-1
87	W8X31	0.018 = 0.012 + 0.006 + 0	DStlS49-1
88	L6X6X7/8	0.618 = 0.543 + 0.065 + 0.009	DStlS49-1
90	L6X6X5/16	0.093 = 0.041 + 0.021 + 0.031	DStlS49-1
91	L6X6X5/16	0.1 = 0.05 + 0.018 + 0.032	DStlS49-1
92	L6X6X5/16	0.095 = 0.036 + 0.021 + 0.038	DStlS47-1
93	L6X6X5/16	0.108 = 0.049 + 0.021 + 0.037	DStlS49-1
94	L6X6X5/16	0.143 = 0.084 + 0.018 + 0.041	DStlS49-1
95	L6X6X5/16	0.108 = 0.055 + 0.015 + 0.039	DStlS47-1
99	L6X6X7/8	0.266 = 0.187 + 0.067 + 0.013	DStlS49-1
101	L6X6X5/16	0.096 = 0.04 + 0.025 + 0.03	DStlS49-1
102	L6X6X5/16	0.083 = 0.025 + 0.021 + 0.037	DStlS48-1
103	L6X6X5/16	0.11 = 0.062 + 0.016 + 0.032	DStlS49-1
104	L6X6X5/16	0.142 = 0.084 + 0.018 + 0.04	DStlS49-1
105	L6X6X5/16	0.107 = 0.05 + 0.017 + 0.039	DStlS48-1
106	L6X6X5/16	0.149 = 0.088 + 0.02 + 0.041	DStlS47-1
110	W8X31	0.022 = 0.011 + 0.011 + 3.345E-04	DStlS49-1
111	W8X31	0.02 = 0.01 + 0.01 + 1.542E-04	DStlS47-1
112	W8X31	0.015 = 0.005 + 0.009 + 1.174E-04	DStlS49-1
113	W8X31	0.028 = 0.018 + 0.009 + 0.001	DStlS47-1
114	W8X31	0.041 = 0.028 + 0.012 + 0.001	DStlS47-1
115	W8X31	0.035 = 0.025 + 0.011 + 0	DStlS46-1
116	W8X31	0.035 = 0.024 + 0.011 + 0	DStlS46-1
117	W8X31	0.042 = 0.029 + 0.012 + 0.001	DStlS46-1
118	W8X31	0.039 = 0.016 + 0.023 + 0.001	DStlS49-1
119	W8X31	0.035 = 0.019 + 0.016 + 1.138E-04	DStlS49-1
120	W8X31	0.035 = 0.019 + 0.016 + 2.244E-04	DStlS49-1
121	W8X31	0.039 = 0.016 + 0.023 + 0.001	DStlS46-1

122	W8X31	0.296 = 0.244 + 0.046 + 0.006	DStlS47-1
123	W8X31	0.111 = 0.031 + 0.073 + 0.008	DStlS49-1
124	W8X31	0.111 = 0.031 + 0.072 + 0.008	DStlS46-1
125	W8X31	0.297 = 0.245 + 0.046 + 0.006	DStlS47-1
126	W8X31	0.149 = 0.029 + 0.12 + 0	DStlS46-1
127	W8X31	0.146 = 0.012 + 0.134 + 0	DStlS49-1
128	W8X31	0.146 = 0.013 + 0.133 + 0	DStlS46-1
129	W8X31	0.156 = 0.045 + 0.111 + 0	DStlS49-1
130	L8X8X1/2	0.232 = 0.135 + 0.051 + 0.046	DStlS49-1
131	L8X8X1/2	0.189 = 0.088 + 0.053 + 0.048	DStlS49-1
132	L8X8X1/2	0.252 = 0.154 + 0.051 + 0.046	DStlS47-1
133	L8X8X1/2	0.186 = 0.085 + 0.053 + 0.048	DStlS47-1
134	L8X8X1/2	0.151 = 0.05 + 0.053 + 0.048	DStlS49-1
135	L8X8X1/2	0.179 = 0.078 + 0.053 + 0.048	DStlS46-1
136	L8X8X1/2	0.148 = 0.047 + 0.053 + 0.048	DStlS49-1
137	L8X8X1/2	0.176 = 0.075 + 0.053 + 0.048	DStlS46-1
138	L8X8X1/2	0.2 = 0.086 + 0.06 + 0.053	DStlS47-1
139	L8X8X1/2	0.188 = 0.075 + 0.06 + 0.053	DStlS47-1
140	L8X8X1/2	0.193 = 0.079 + 0.06 + 0.053	DStlS49-1
141	L8X8X1/2	0.181 = 0.067 + 0.06 + 0.053	DStlS49-1
142	L8X8X5/8	0.172 = 0.061 + 0.055 + 0.055	DStlS46-1
143	L8X8X5/8	0.269 = 0.162 + 0.054 + 0.054	DStlS46-1
144	L8X8X5/8	0.152 = 0.041 + 0.055 + 0.055	DStlS46-1
145	L8X8X5/8	0.556 = 0.449 + 0.054 + 0.054	DStlS49-1
159	W8X31	0.034 = 0.012 + 0.021 + 0.001	DStlS46-1
161	W8X31	0.024 = 0 + 0.019 + 0.004	DStlS49-1
162	W8X31	0.027 = 0 + 0.019 + 0.008	DStlS49-1
163	L6X6X5/16	0.247 = 0.229 + 0.006 + 0.012	DStlS49-1
164	L6X6X5/16	0.087 = 0.068 + 0.006 + 0.012	DStlS49-1
165	L6X6X5/16	0.066 = 0.037 + 0.016 + 0.013	DStlS46-1
166	L6X6X5/16	0.063 = 0.037 + 0.011 + 0.016	DStlS46-1
167	L6X6X7/8	0.053 = 0.028 + 0.018 + 0.007	DStlS49-1
184	W12X50	0.079 = 0.078 + 0.001 + 0	DStlS48-1
185	W12X50	0.026 = 0.025 + 0.001 + 0	DStlS47-1
240	W12X50	0.065 = 0.063 + 0.002 + 0	DStlS48-1
241	W12X50	0.051 = 0.049 + 0.002 + 0	DStlS48-1
318	W12X50	0.031 = 0.029 + 0.003 + 0	DStlS48-1
322	W12X50	0.051 = 0.049 + 0.003 + 0	DStlS47-1
323	W12X50	0.062 = 0.059 + 0.003 + 0	DStlS47-1
332	W12X50	0.064 = 0.062 + 0.002 + 0	DStlS46-1
374	W8X31	0.053 = 0.008 + 0.045 + 0	DStlS46-1
375	W8X31	0.164 = 0.004 + 0.16 + 0	DStlS46-1

376	W8X40	0.131 = 0.017 + 0.114 + 0	DStlS48-1
377	W8X40	0.133 = 0.02 + 0.113 + 0	DStlS48-1
378	W8X31	0.171 = 0.013 + 0.158 + 0	DStlS48-1
379	W8X31	0.052 = 0.007 + 0.045 + 0	DStlS46-1
380	W12X50	0.255 = 0.232 + 0.022 + 0.001	DStlS48-1
381	W12X50	0.013 = 0.011 + 0.002 + 0	DStlS47-1
384	W12X50	0.017 = 0.015 + 0.002 + 0	DStlS48-1
385	W12X50	0.007 = 2.535E-04 + 0.006 + 0	DStlS48-1
386	W12X50	0.097 = 0.054 + 0.043 + 0.001	DStlS48-1
387	W12X50	0.253 = 0.23 + 0.022 + 0.001	DStlS48-1
388	W12X50	0.055 = 0.046 + 0.009 + 0	DStlS48-1
389	W12X50	0.046 = 0.044 + 0.002 + 0	DStlS48-1
390	W12X50	0.31 = 0.263 + 0.047 + 0.001	DStlS48-1
391	W12X50	0.05 = 0.049 + 0.001 + 0	DStlS48-1
392	W12X50	0.022 = 0.02 + 0.002 + 0	DStlS48-1
393	W12X50	0.051 = 0.05 + 0.001 + 0	DStlS47-1
394	W12X50	0.006 = 0.004 + 0.002 + 0	DStlS47-1
430	W12X50	0.026 = 0.024 + 0.002 + 0	DStlS46-1
431	W12X50	0.022 = 0.021 + 0.001 + 0	DStlS48-1
437	W8X31	0.03 = 0 + 0.023 + 0.007	DStlS48-1
606	W12X50	0.093 = 0.089 + 0.004 + 0	DStlS48-1
611	W12X50	0.095 = 0.091 + 0.004 + 0	DStlS49-1
614	W12X50	0.023 = 0.02 + 0.003 + 0	DStlS48-1
615	W12X50	0.049 = 0.046 + 0.003 + 0	DStlS46-1
616	W12X50	0.068 = 0.065 + 0.003 + 0	DStlS48-1
623	W8X31	0.029 = 0 + 0.023 + 0.005	DStlS48-1
624	L6X6X5/16	0.05 = 0.02 + 0.014 + 0.015	DStlS46-1
629	L6X6X5/16	0.049 = 0.02 + 0.012 + 0.017	DStlS49-1
630	L6X6X5/16	0.031 = 0.008 + 0.01 + 0.013	DStlS47-1
631	L6X6X5/16	0.022 = 0.001 + 0.01 + 0.011	DStlS48-1
632	L6X6X5/16	0.111 = 0.081 + 0.014 + 0.017	DStlS46-1
636	L6X6X5/16	0.088 = 0.063 + 0.011 + 0.014	DStlS47-1
638	W8X31	0.034 = 0.012 + 0.021 + 0.001	DStlS48-1
641	W12X50	0.086 = 0.082 + 0.004 + 0	DStlS46-1
642	L6X6X7/8	0.061 = 0.032 + 0.024 + 0.005	DStlS48-1
643	W12X50	0.081 = 0.077 + 0.004 + 0	DStlS48-1
644	W12X50	0.062 = 0.06 + 0.002 + 0	DStlS46-1
646	W12X50	0.036 = 0.03 + 0.006 + 0	DStlS48-1
647	W12X50	0.053 = 0.046 + 0.006 + 0	DStlS48-1
648	W12X50	0.055 = 0.048 + 0.006 + 0	DStlS49-1
649	W12X50	0.086 = 0.082 + 0.004 + 0	DStlS48-1
650	W12X50	0.067 = 0.059 + 0.008 + 0	DStlS48-1

651	W12X50	0.041 = 0.032 + 0.009 + 0	DStlS47-1
652	L6X6X7/8	0.384 = 0.36 + 0.014 + 0.01	DStlS48-1
655	W12X50	0.08 = 0.076 + 0.004 + 0	DStlS48-1
656	W12X50	0.088 = 0.084 + 0.004 + 0	DStlS47-1
657	W12X50	0.088 = 0.085 + 0.004 + 0	DStlS48-1
661	W12X50	0.047 = 0.044 + 0.003 + 0	DStlS48-1
662	W12X50	0.066 = 0.064 + 0.003 + 0	DStlS48-1
663	W12X50	0.084 = 0.081 + 0.004 + 0	DStlS48-1
664	W12X50	0.085 = 0.081 + 0.004 + 0	DStlS48-1
665	W12X50	0.08 = 0.077 + 0.004 + 0	DStlS48-1
667	W12X50	0.034 = 0.032 + 0.002 + 0	DStlS48-1
669	W12X50	0.066 = 0.058 + 0.008 + 0	DStlS48-1
670	W12X50	0.079 = 0.078 + 0.001 + 0	DStlS47-1
671	W12X50	0.026 = 0.025 + 0.001 + 0	DStlS47-1
673	W12X50	0.034 = 0.031 + 0.003 + 0	DStlS48-1
674	W12X50	0.055 = 0.052 + 0.003 + 0	DStlS49-1
675	W12X50	0.067 = 0.064 + 0.003 + 0	DStlS47-1
679	W12X50	0.062 = 0.06 + 0.002 + 0	DStlS47-1
680	W12X50	0.044 = 0.042 + 0.002 + 0	DStlS48-1
681	W12X50	0.028 = 0.026 + 0.002 + 0	DStlS47-1
710	W12X50	0.022 = 0.021 + 0.001 + 0	DStlS49-1
711	W12X50	0.025 = 0.023 + 0.003 + 0	DStlS48-1
712	W12X50	0.047 = 0.045 + 0.002 + 0	DStlS46-1
713	W12X50	0.025 = 0.023 + 0.002 + 0	DStlS47-1

AOF Middle – Horizontal bottom chord beams and braces showing DC ratio (designed with omega seismic load combinations)

Label	Section	D/C Ratio	Load Combination
20	W8X31	0.014 = 0.009 + 0.005 + 0	DStlS38-1
21	W8X31	0.045 = 0.028 + 0.017 + 0	DStlS37-1
22	W8X40	0.037 = 0.023 + 0.014 + 0	DStlS38-1
23	W8X40	0.037 = 0.023 + 0.014 + 0	DStlS37-1
24	W8X31	0.045 = 0.028 + 0.017 + 0	DStlS38-1
25	W8X31	0.014 = 0.009 + 0.005 + 0	DStlS37-1
26	W8X31	0.01 = 0.005 + 0.005 + 0	DStlS37-1
27	W8X31	0.022 = 0.006 + 0.016 + 0	DStlS36-1
28	W8X40	0.021 = 0.006 + 0.015 + 0	DStlS36-1
29	W8X40	0.021 = 0.006 + 0.015 + 0	DStlS36-1
30	W8X31	0.022 = 0.006 + 0.016 + 0	DStlS36-1
31	W8X31	0.01 = 0.005 + 0.005 + 0	DStlS38-1
32	W8X40	0.103 = 0.056 + 0.045 + 0.002	DStlS35-1
33	W8X40	0.025 = 0.02 + 0.005 + 0	DStlS36-1
34	W8X31	0.021 = 0.003 + 0.015 + 0.003	DStlS37-1
35	W8X31	0.029 = 0.013 + 0.016 + 0	DStlS38-1
36	W8X40	0.038 = 0.023 + 0.014 + 0	DStlS35-1
37	W8X40	0.038 = 0.023 + 0.014 + 0	DStlS35-1
38	W8X31	0.029 = 0.013 + 0.016 + 0	DStlS37-1
39	W8X40	0.025 = 0.02 + 0.005 + 0	DStlS36-1
40	W8X40	0.103 = 0.056 + 0.045 + 0.002	DStlS35-1
41	W8X31	0.022 = 0.003 + 0.016 + 0.003	DStlS38-1
42	W8X40	0.099 = 0.051 + 0.045 + 0.002	DStlS35-1
43	W8X31	0.014 = 0.007 + 0.005 + 0.002	DStlS35-1
44	W8X31	0.014 = 0.007 + 0.005 + 0.002	DStlS35-1
45	W12X45	0.034 = 0.033 + 0 + 1.379E-04	DStlS36-1
47	W12X72	0.281 = 0.264 + 0.018 + 0	DStlS36-1
49	W12X72	0.281 = 0.263 + 0.018 + 0	DStlS36-1
51	W8X31	0.012 = 0.007 + 0.005 + 0	DStlS36-1
52	W8X31	0.018 = 0.006 + 0.011 + 0.001	DStlS37-1
53	W8X31	0.026 = 0.02 + 0.006 + 0	DStlS36-1
54	W8X31	0.029 = 0.017 + 0.011 + 0.001	DStlS37-1
55	W8X31	0.018 = 0.013 + 0.006 + 0	DStlS36-1
56	W8X31	0.033 = 0.019 + 0.014 + 2.047E-04	DStlS36-1
57	W8X31	0.012 = 0.007 + 0.006 + 0	DStlS36-1
58	W8X31	0.018 = 0.006 + 0.011 + 0.001	DStlS38-1
59	W8X31	0.026 = 0.02 + 0.006 + 0	DStlS36-1
60	W8X31	0.029 = 0.017 + 0.011 + 0.001	DStlS38-1

61	W8X31	0.018 = 0.013 + 0.006 + 0	DStlS36-1
62	W8X31	0.033 = 0.019 + 0.014 + 1.539E-04	DStlS36-1
63	L6X6X5/16	0.161 = 0.141 + 0.009 + 0.011	DStlS36-1
64	L6X6X5/16	0.091 = 0.064 + 0.014 + 0.013	DStlS36-1
65	L6X6X5/16	0.085 = 0.062 + 0.008 + 0.015	DStlS36-1
66	L6X6X5/16	0.099 = 0.075 + 0.01 + 0.014	DStlS36-1
67	L6X6X5/16	0.096 = 0.071 + 0.013 + 0.013	DStlS37-1
68	L6X6X5/16	0.19 = 0.165 + 0.015 + 0.01	DStlS35-1
69	L6X6X5/16	0.099 = 0.032 + 0.034 + 0.032	DStlS37-1
70	L6X6X5/16	0.41 = 0.346 + 0.028 + 0.036	DStlS35-1
71	L6X6X5/16	0.114 = 0.036 + 0.036 + 0.042	DStlS37-1
72	L6X6X5/16	0.422 = 0.357 + 0.028 + 0.038	DStlS35-1
73	L6X6X5/16	0.119 = 0.042 + 0.038 + 0.04	DStlS37-1
74	L6X6X5/16	0.253 = 0.215 + 0.016 + 0.021	DStlS37-1
75	L6X6X5/16	0.071 = 0.045 + 0.013 + 0.012	DStlS36-1
76	L6X6X5/16	0.065 = 0.041 + 0.009 + 0.015	DStlS36-1
77	L6X6X5/16	0.082 = 0.056 + 0.01 + 0.016	DStlS36-1
78	L6X6X5/16	0.107 = 0.081 + 0.011 + 0.015	DStlS36-1
79	L6X6X5/16	0.053 = 0.029 + 0.015 + 0.008	DStlS36-1
80	L6X6X5/16	0.049 = 0.019 + 0.015 + 0.016	DStlS37-1
81	W12X72	0.015 = 0.002 + 0.012 + 0.001	DStlS38-1
83	W8X31	0.017 = 0 + 0.014 + 0.003	DStlS38-1
84	W12X72	0.062 = 0.047 + 0.012 + 0.003	DStlS36-1
86	W12X72	0.045 = 0.03 + 0.012 + 0.003	DStlS36-1
87	L6X6X5/16	0.1 = 0.033 + 0.029 + 0.038	DStlS38-1
88	L6X6X5/16	0.417 = 0.352 + 0.027 + 0.037	DStlS35-1
89	L6X6X5/16	0.115 = 0.037 + 0.04 + 0.038	DStlS38-1
90	L6X6X5/16	0.427 = 0.362 + 0.036 + 0.029	DStlS35-1
91	L6X6X5/16	0.12 = 0.042 + 0.038 + 0.04	DStlS38-1
92	L6X6X5/16	0.255 = 0.218 + 0.019 + 0.019	DStlS38-1
94	W12X72	0.074 = 0.059 + 0.012 + 0.003	DStlS36-1
95	W8X31	0.083 = 0.073 + 0.01 + 0	DStlS38-1
96	W12X72	0.072 = 0.056 + 0.012 + 0.004	DStlS36-1
97	W8X31	0.083 = 0.073 + 0.01 + 0	DStlS36-1
98	W12X72	0.05 = 0.036 + 0.012 + 0.001	DStlS36-1
99	W8X31	0.027 = 0.015 + 0.011 + 0.001	DStlS38-1
100	W8X31	0.033 = 0.022 + 0.011 + 1.744E-04	DStlS36-1
101	W8X31	0.025 = 0.011 + 0.014 + 1.319E-04	DStlS36-1
102	W8X31	0.012 = 0.002 + 0.01 + 0	DStlS35-1
103	W8X31	0.012 = 0.003 + 0.01 + 0	DStlS35-1
104	W8X31	0.027 = 0.015 + 0.011 + 0.001	DStlS37-1
105	W8X31	0.018 = 0.007 + 0.01 + 1.777E-04	DStlS35-1

106	W8X31	0.018 = 0.007 + 0.01 + 1.715E-04	DStlS35-1
107	W8X31	0.034 = 0.023 + 0.011 + 2.309E-04	DStlS36-1
108	W8X31	0.029 = 0.018 + 0.011 + 2.214E-04	DStlS36-1
109	W8X31	0.029 = 0.018 + 0.011 + 2.071E-04	DStlS36-1
110	W8X31	0.025 = 0.011 + 0.014 + 1.833E-04	DStlS36-1
111	W8X31	0.08 = 0.006 + 0.071 + 0.004	DStlS35-1
112	W8X31	0.111 = 0.029 + 0.078 + 0.005	DStlS36-1
113	W8X31	0.111 = 0.028 + 0.077 + 0.005	DStlS36-1
114	W8X31	0.081 = 0.007 + 0.071 + 0.004	DStlS35-1
115	W8X31	0.124 = 0.032 + 0.085 + 0.008	DStlS35-1
116	W8X31	0.359 = 0.285 + 0.069 + 0.005	DStlS35-1
117	W8X31	0.359 = 0.284 + 0.069 + 0.005	DStlS35-1
118	W8X31	0.124 = 0.032 + 0.085 + 0.008	DStlS35-1
131	L6X6X5/16	0.15 = 0.129 + 0.012 + 0.009	DStlS36-1
132	W8X31	0.229 = 0.219 + 0.009 + 0.001	DStlS38-1
136	L6X6X5/16	0.09 = 0.063 + 0.014 + 0.013	DStlS36-1
137	W8X31	0.229 = 0.219 + 0.01 + 0.001	DStlS37-1
138	L6X6X5/16	0.087 = 0.064 + 0.016 + 0.008	DStlS36-1
139	W8X31	0.26 = 0.247 + 0.011 + 0.002	DStlS38-1
140	L6X6X5/16	0.097 = 0.073 + 0.015 + 0.01	DStlS36-1
141	W8X31	0.261 = 0.248 + 0.012 + 0.002	DStlS37-1
163	W12X72	0.015 = 0.002 + 0.012 + 0.001	DStlS37-1
165	W8X40	0.013 = 0.003 + 0.001 + 0.009	DStlS38-1
173	W8X31	0.243 = 0.231 + 0.011 + 0	DStlS36-1
183	W8X31	0.013 = 0.004 + 0.001 + 0.009	DStlS37-1
191	W8X31	0.237 = 0.228 + 0.008 + 3.319E-04	DStlS36-1
201	W8X31	0.012 = 0.004 + 0.001 + 0.007	DStlS35-1
209	W8X31	0.243 = 0.231 + 0.011 + 0	DStlS36-1
217	W8X40	0.006 = 0.001 + 0.005 + 0	DStlS35-1
218	W8X31	0.018 = 0.002 + 0.016 + 0	DStlS35-1
219	W8X40	0.02 = 0.006 + 0.014 + 0	DStlS36-1
220	W8X40	0.02 = 0.006 + 0.014 + 0	DStlS36-1
221	W8X31	0.019 = 0.002 + 0.017 + 0	DStlS35-1
222	W8X40	0.006 = 0.002 + 0.005 + 0	DStlS35-1
230	W8X40	0.098 = 0.05 + 0.045 + 0.002	DStlS35-1
231	W12X72	0.015 = 0.002 + 0.012 + 0.002	DStlS38-1
248	W12X72	0.049 = 0.036 + 0.012 + 0.001	DStlS36-1
249	W8X31	0.078 = 0.053 + 0.024 + 0.002	DStlS37-1
250	W8X31	0.061 = 0.032 + 0.028 + 2.541E-04	DStlS38-1
251	L8X8X3/4	0.164 = 0.051 + 0.064 + 0.049	DStlS35-1
252	L8X8X3/4	0.156 = 0.055 + 0.053 + 0.047	DStlS36-1
253	L8X8X3/4	0.166 = 0.059 + 0.057 + 0.05	DStlS37-1

255	L8X8X3/4	0.145 = 0.035 + 0.061 + 0.049	DStlS36-1
256	W8X31	0.063 = 0.039 + 0.024 + 4.095E-04	DStlS38-1
257	W8X31	0.115 = 0.088 + 0.025 + 0.002	DStlS37-1
258	W8X31	0.066 = 0.039 + 0.025 + 0.002	DStlS37-1
259	W8X31	0.11 = 0.087 + 0.023 + 0	DStlS38-1
260	L8X8X3/4	0.172 = 0.058 + 0.064 + 0.05	DStlS38-1
261	L8X8X3/4	0.145 = 0.034 + 0.062 + 0.049	DStlS36-1
262	L8X8X3/4	0.158 = 0.05 + 0.058 + 0.05	DStlS35-1
263	L8X8X3/4	0.155 = 0.055 + 0.057 + 0.042	DStlS36-1
264	W8X31	0.074 = 0.051 + 0.023 + 0	DStlS38-1
265	W8X31	0.061 = 0.033 + 0.028 + 0.001	DStlS37-1
266	W12X72	0.074 = 0.059 + 0.012 + 0.003	DStlS36-1
267	W12X72	0.015 = 0.002 + 0.012 + 0.002	DStlS37-1
268	W8X31	0.01 = 0.002 + 0.004 + 0.005	DStlS38-1
269	W8X31	0.023 = 0.004 + 0.01 + 0.008	DStlS35-1
270	L6X6X5/16	0.098 = 0.072 + 0.013 + 0.012	DStlS38-1
272	L6X6X5/16	0.201 = 0.176 + 0.01 + 0.015	DStlS35-1
274	W8X31	0.025 = 0.002 + 0.01 + 0.013	DStlS37-1
275	W8X31	0.014 = 0.004 + 0.001 + 0.009	DStlS35-1
276	W8X40	0.013 = 0.001 + 0.002 + 0.011	DStlS37-1
279	W8X40	0.012 = 0.001 + 0.002 + 0.009	DStlS38-1
281	L6X6X5/16	0.072 = 0.047 + 0.013 + 0.013	DStlS38-1
283	L6X6X5/16	0.064 = 0.04 + 0.016 + 0.008	DStlS36-1
284	W8X31	0.008 = 1.014E-04 + 0.003 + 0.005	DStlS35-1
285	W8X31	0.027 = 0.012 + 0.011 + 0.004	DStlS35-1
286	W8X31	0.007 = 4.094E-04 + 0.005 + 0.002	DStlS38-1
287	W8X31	0.05 = 0.008 + 0.02 + 0.022	DStlS38-1
288	W8X31	0.025 = 0.002 + 0.01 + 0.013	DStlS38-1
289	W12X72	0.072 = 0.056 + 0.012 + 0.004	DStlS36-1
290	W12X72	0.048 = 0.035 + 0.012 + 0.001	DStlS36-1
293	W12X72	0.063 = 0.05 + 0.012 + 3.702E-04	DStlS36-1
295	W8X31	0.048 = 0.005 + 0.02 + 0.022	DStlS37-1
296	W8X31	0.009 = 0.001 + 0.003 + 0.005	DStlS37-1
297	W8X31	0.025 = 0.011 + 0.01 + 0.004	DStlS36-1
298	W8X31	0.007 = 3.731E-04 + 0.005 + 0.002	DStlS35-1
299	W8X31	0.02 = 0.004 + 0.01 + 0.006	DStlS35-1
300	W8X31	0.008 = 0.001 + 0.003 + 0.003	DStlS37-1
301	W12X72	0.062 = 0.047 + 0.012 + 0.003	DStlS36-1
303	W12X72	0.046 = 0.03 + 0.012 + 0.003	DStlS36-1
305	W8X31	0.017 = 0 + 0.014 + 0.003	DStlS37-1
306	W8X31	0.015 = 0 + 0.014 + 0.002	DStlS36-1
307	W8X31	0.015 = 0 + 0.013 + 0.002	DStlS36-1

309	L6X6X5/16	0.084 = 0.058 + 0.017 + 0.009	DStlS36-1
311	W12X72	0.062 = 0.049 + 0.012 + 0.001	DStlS36-1
312	W12X72	0.055 = 0.041 + 0.012 + 0.001	DStlS36-1
313	W12X72	0.037 = 0.023 + 0.012 + 0.001	DStlS36-1
315	W8X31	0.015 = 2.084E-04 + 0.014 + 0.001	DStlS36-1
316	L6X6X5/16	0.105 = 0.079 + 0.016 + 0.011	DStlS36-1
318	L6X6X5/16	0.054 = 0.031 + 0.015 + 0.009	DStlS36-1
321	W8X31	0.017 = 0 + 0.014 + 0.003	DStlS35-1
322	W8X31	0.017 = 1.776E-04 + 0.014 + 0.003	DStlS35-1
334	W12X72	0.02 = 0.018 + 0.002 + 0	DStlS35-1
335	L6X6X5/16	0.047 = 0.017 + 0.016 + 0.014	DStlS38-1
338	W8X31	0.015 = 0 + 0.014 + 0.001	DStlS36-1
339	W8X31	0.015 = 0 + 0.014 + 0.002	DStlS36-1
340	W8X31	0.015 = 2.111E-04 + 0.014 + 0.001	DStlS36-1
341	HSS3X3X3/8	0.768 = 0.758 + 0.011 + 1.938E-04	DStlS37-1
342	HSS3X3X3/8	0.738 = 0.73 + 0.007 + 0.001	DStlS41-1
347	HSS3X3X3/8	0.455 = 0.449 + 0.005 + 0.001	DStlS42-1
348	HSS3X3X3/8	0.434 = 0.428 + 0.006 + 0	DStlS42-1
349	HSS3X3X3/8	0.446 = 0.441 + 0.005 + 0.001	DStlS41-1
350	HSS3X3X3/8	0.426 = 0.42 + 0.006 + 0	DStlS41-1
355	HSS3X3X3/8	0.778 = 0.767 + 0.011 + 2.031E-04	DStlS38-1
356	HSS3X3X3/8	0.743 = 0.735 + 0.007 + 0.001	DStlS42-1
361	W8X31	0.017 = 0 + 0.014 + 0.003	DStlS35-1
362	W8X31	0.017 = 1.738E-04 + 0.014 + 0.003	DStlS35-1
379	WT6X36	0.057 = -0.001 + 0.048 + 0.009	DStlS38-1
380	W12X72	0.116 = 0.007 + 0.039 + 0.069	DStlS38-1
391	W12X45	0.097 = 0.012 + 0.073 + 0.012	DStlS38-1
392	W12X45	0.014 = 0.001 + 0.004 + 0.01	DStlS38-1
395	W12X45	0.17 = 0.016 + 0.135 + 0.019	DStlS37-1
396	W12X45	0.032 = 3.955E-04 + 0.008 + 0.024	DStlS36-1
399	W8X31	0.062 = 0.049 + 0.009 + 0.004	DStlS35-1
400	W12X72	0.024 = 1.578E-04 + 0.006 + 0.017	DStlS38-1
401	W8X31	0.061 = 0.048 + 0.009 + 0.004	DStlS35-1
402	W8X31	0.085 = 0.075 + 0.01 + 4.181E-04	DStlS38-1
403	W8X31	0.084 = 0.074 + 0.01 + 4.208E-04	DStlS37-1
404	W12X72	0.014 = 1.51E-04 + 0.006 + 0.007	DStlS38-1
405	W8X31	0.106 = 0.083 + 0.02 + 0.004	DStlS38-1
407	W8X31	0.106 = 0.083 + 0.02 + 0.004	DStlS37-1
408	W12X72	0.024 = 1.716E-04 + 0.006 + 0.017	DStlS37-1
410	W12X72	0.02 = 0.018 + 0.002 + 0	DStlS35-1
411	W12X45	0.169 = 0.016 + 0.135 + 0.018	DStlS38-1
412	W12X45	0.032 = 4.498E-04 + 0.008 + 0.024	DStlS36-1

413	W12X45	0.064 = 0.049 + 0.015 + 0	DStlS36-1
414	W12X45	0.082 = 0.069 + 0.014 + 1.339E-04	DStlS36-1
415	W12X45	0.1 = 0.016 + 0.072 + 0.012	DStlS37-1
416	W12X45	0.016 = 0.001 + 0.004 + 0.012	DStlS37-1
417	W12X45	0.079 = 0.065 + 0.015 + 0	DStlS36-1
418	W12X45	0.058 = 0.045 + 0.013 + 0	DStlS36-1
419	W12X45	0.058 = 0.042 + 0.016 + 0	DStlS36-1
420	WT6X36	0.137 = -0.002 + 0.12 + 0.019	DStlS35-1
421	W12X72	0.151 = 0.004 + 0.07 + 0.077	DStlS38-1
422	W12X45	0.033 = 0.015 + 0.018 + 0	DStlS36-1
423	W12X45	0.043 = 0.027 + 0.016 + 0	DStlS36-1
424	WT6X25	0.184 = 0 + 0.175 + 0.009	DStlS35-1
425	W12X72	0.121 = 0.023 + 0.098 + 2.189E-04	DStlS36-1
428	WT6X25	0.175 = -4.603E-04 + -0.175 + 0	DStlS35-1
429	W12X72	0.12 = 0.026 + 0.094 + 0	DStlS36-1
432	WT6X25	0.163 = 3.189E-04 + 0.153 + 0.01	DStlS35-1
433	W12X72	0.121 = 0.023 + 0.098 + 2.338E-04	DStlS36-1
435	W12X72	0.02 = 0.018 + 0.002 + 0	DStlS35-1
436	WT6X36	0.137 = -0.002 + 0.12 + 0.019	DStlS35-1
437	W12X72	0.147 = 0.005 + 0.07 + 0.073	DStlS37-1
438	W12X72	0.049 = 0.035 + 0.012 + 0.001	DStlS36-1
439	W12X72	0.063 = 0.05 + 0.012 + 4.811E-04	DStlS36-1
440	WT6X36	0.061 = -0.001 + 0.048 + 0.014	DStlS37-1
441	W12X72	0.106 = 0.002 + 0.04 + 0.064	DStlS37-1
442	W12X72	0.062 = 0.049 + 0.012 + 0.001	DStlS36-1
443	W12X72	0.055 = 0.041 + 0.012 + 0.001	DStlS36-1
444	W12X72	0.037 = 0.023 + 0.012 + 0.001	DStlS36-1
445	W12X72	0.021 = 0.018 + 0.002 + 0	DStlS35-1

Project:
Project no:
Author:

Project item L16 S512

Design

Name	L16 S512
Description	
Analysis	Stress, strain/ loads in equilibrium
Design code	AISC 360-22 (LRFD) / ACI 318-19

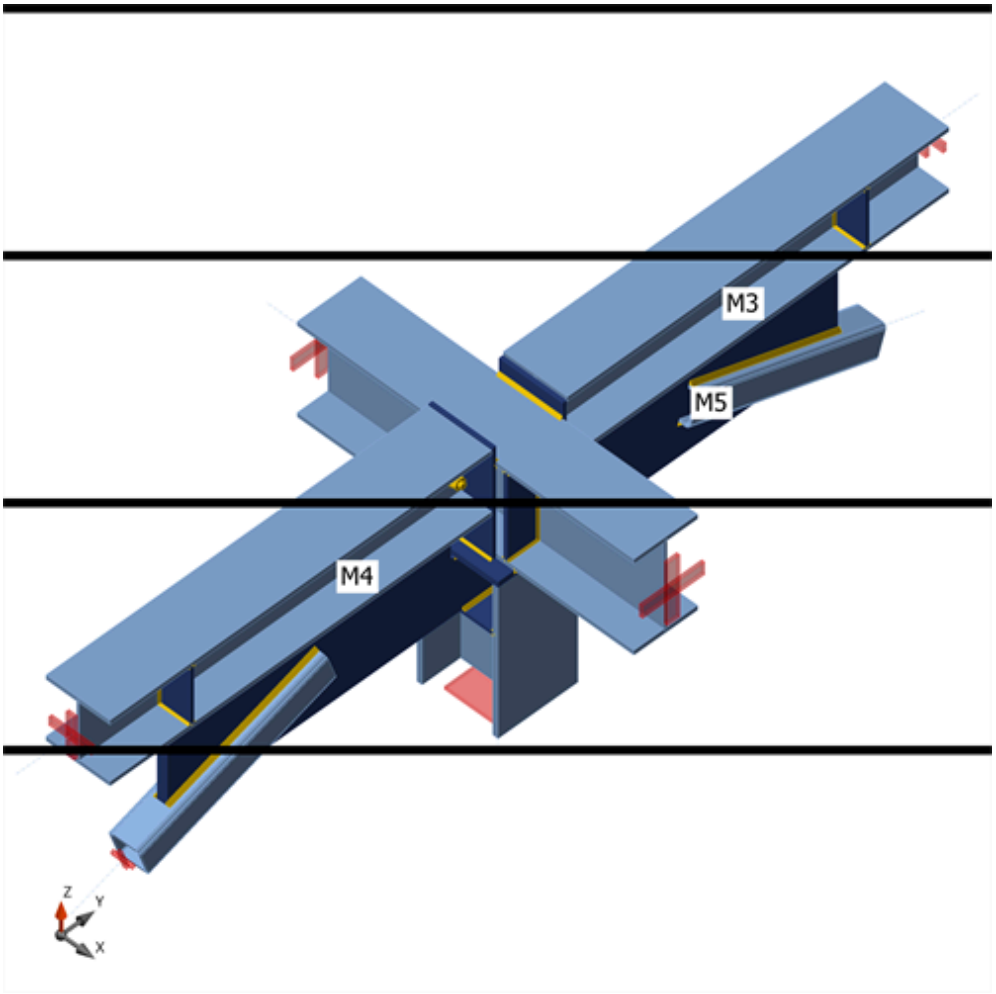
Members

Geometry

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [in]	Offset ey [in]	Offset ez [in]
M1	5 - W(Imp)10X60	0.0	-90.0	0.0	0"	0"	0"
M2	1 - W(Imp)12X45	0.0	0.0	0.0	0"	0"	0"
M3	2 - W(Imp)8X40	90.0	0.0	0.0	0"	0"	4"
M4	2 - W(Imp)8X40	-90.0	0.0	0.0	0"	0"	4"
M5	3 - HSS(Imp)4X4X3/8	90.0	-19.0	0.0	0"	0"	0"
M6	4 - HSS(Imp)4X4X3/8	-90.0	-19.0	90.0	0"	0"	0"

Supports and forces

Name	Support	Forces in	X [in]
M1 / end	N-Vy-Vz-Mx-My-Mz	Node	0"
M2 / begin	Mx-My-Mz	Node	0"
M2 / end	Mx-My-Mz	Node	0"
M3 / end	Mx-My-Mz	Bolts	5"3/4
M4 / end	Mx-My-Mz	Bolts	5"3/4
M5 / end	Mx-My-Mz	Position	3'-0"
M6 / end	Mx-My-Mz	Position	3'-0"



Cross-sections

Name	Material
5 - W(Imp)10X60	A992
1 - W(Imp)12X45	A992
2 - W(Imp)8X40	A992
3 - HSS(Imp)4X4X3/8	A500. Gr. C
4 - HSS(Imp)4X4X3/8	A500. Gr. C

Bolts

Name	Diameter [in]	f_y [ksi]	f_u [ksi]	Gross area [in^2]
3/4 A325	3/4	92.0	120.0	0.44

Load effects (forces in equilibrium)

Name	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
LE1	M1 / End	-54.9	0.0	0.0	0.0	0.0	0.0
	M2 / Begin	0.0	0.0	0.0	0.0	0.0	0.0
	M2 / End	0.0	0.0	0.0	0.0	0.0	0.0
	M3 / End	-214.3	0.0	0.0	0.0	0.0	0.0
	M4 / End	214.3	0.0	0.0	0.0	0.0	0.0
	M5 / End	311.0	0.0	0.0	0.0	0.0	0.0
	M6 / End	-142.3	0.0	0.0	0.0	0.0	0.0

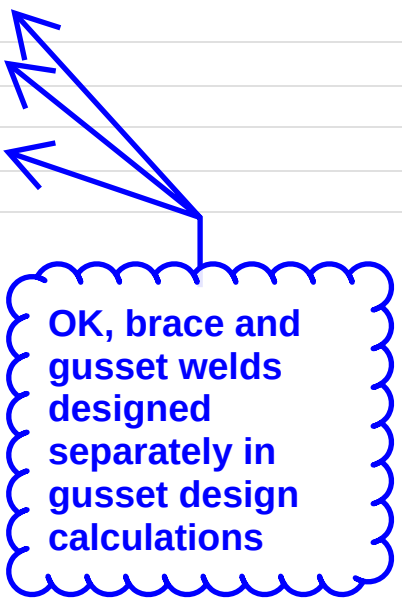
Unbalanced forces

Name	X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
LE1	0.0	0.0	0.0	142.9	0.0	0.0

Check

Summary

Name	Value	Check status
Analysis	100.0%	OK
Plates	286.1 > 5.0%	**Not OK!**
Loc. deformation	52.2 > 3%	**Not OK!**
Bolts	0.5 < 100%	OK
Welds	690.0 > 100%	**Not OK!**
Buckling	11.31	



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Plates

Name	Material	t_p [in]	Loads	σ_{Ed} [ksi]	ε_{Pl} [%]	$\sigma_{c,Ed}$ [ksi]	Status
M1-bfl 1	A992	3/4	LE1	11.8	0.0	0.0	OK
M1-tfl 1	A992	3/4	LE1	11.8	0.0	0.0	OK
M1-w 1	A992	1/2	LE1	11.0	0.0	0.0	OK
M2-bfl 1	A992	1/2	LE1	3.9	0.0	0.4	OK
M2-tfl 1	A992	1/2	LE1	5.8	0.0	0.0	OK
M2-w 1	A992	1/4	LE1	2.2	0.0	0.0	OK
M3-bfl 1	A992	1/2	LE1	39.3	0.0	0.0	OK
M3-tfl 1	A992	1/2	LE1	13.9	0.0	0.0	OK
M3-w 1	A992	1/4	LE1	30.3	0.0	0.0	OK
M4-bfl 1	A992	1/2	LE1	45.0	0.1	0.0	OK
M4-tfl 1	A992	1/2	LE1	16.6	0.0	0.0	OK
M4-w 1	A992	1/4	LE1	45.0	0.1	0.0	OK
M5	A500. Gr. C	1/4	LE1	128.1	286.1	0.0	Not OK!
M6	A500. Gr. C	1/4	LE1	45.8	2.9	0.0	OK
EP1	A572 Gr.50	3/4	LE1	22.7	0.0	0.5	OK
SP2	A572 Gr.50	1/2	LE1	13.2	0.0	0.0	OK
SP3	A572 Gr.50	1/2	LE1	0.3	0.0	0.0	OK
SP4	A572 Gr.50	1/2	LE1	6.1	0.0	0.0	OK
SP5	A572 Gr.50	1/2	LE1	0.1	0.0	0.0	OK
GUSS1	A572 Gr.50	1"1/4	LE1	40.5	0.2	0.0	OK
GUSS2	A572 Gr.50	1"1/4	LE1	46.4	5.0	0.0	OK
STIFF1a	A572 Gr.50	1/2	LE1	12.0	0.0	0.0	OK
STIFF1b	A572 Gr.50	1/2	LE1	16.6	0.0	0.0	OK
STIFF2a	A572 Gr.50	1/2	LE1	7.3	0.0	0.0	OK
STIFF2b	A572 Gr.50	1/2	LE1	7.4	0.0	0.0	OK
STIFF3a	A572 Gr.50	1/2	LE1	13.6	0.0	0.0	OK
STIFF3b	A572 Gr.50	1/2	LE1	13.6	0.0	0.0	OK
STIFF4a	A572 Gr.50	1/2	LE1	6.3	0.0	0.0	OK
STIFF4b	A572 Gr.50	1/2	LE1	3.9	0.0	0.0	OK
STIFF4c	A572 Gr.50	1/2	LE1	5.4	0.0	0.0	OK
STIFF4d	A572 Gr.50	1/2	LE1	3.2	0.0	0.0	OK

OK, brace and gusset welds designed separately in gusset design calculations

Design data

Material	F_y [ksi]	ε_{lim} [%]
A992	50.0	5.0
A500. Gr. C	50.0	5.0
A572 Gr.50	50.0	5.0

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Symbol explanation

t_p	Plate thickness
σ_{Ed}	Equivalent stress
ε_{Pl}	Plastic strain
$\sigma_{c,Ed}$	Contact stress
F_y	Yield strength
ε_{lim}	Limit of plastic strain

Detailed result for M5

Design values used in the analysis

$\phi F_y =$ 45.0 ksi

Where:

$F_y = 50.0$ ksi – characteristic yield strength

$\phi = 0.90$ – resistance factor for steel material AISC 360-22 – B3.1

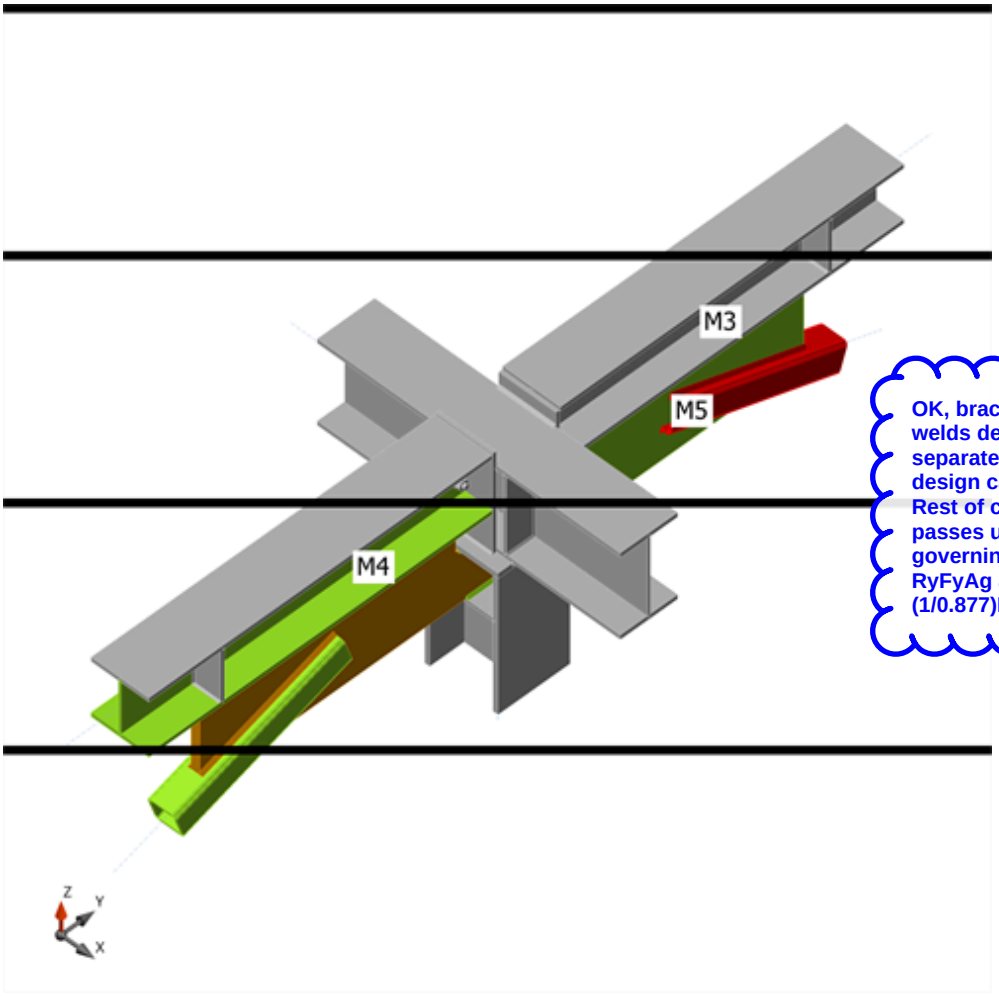
Loc. deformation

Name	d_0 [in]	Loads	δ [in]	δ_{lim} [in]	δ/d_0 [%]	Check status
M5	4"	LE1	2"	0"	52.2	Not OK!
M6	4"	LE1	0"	0"	0.2	OK

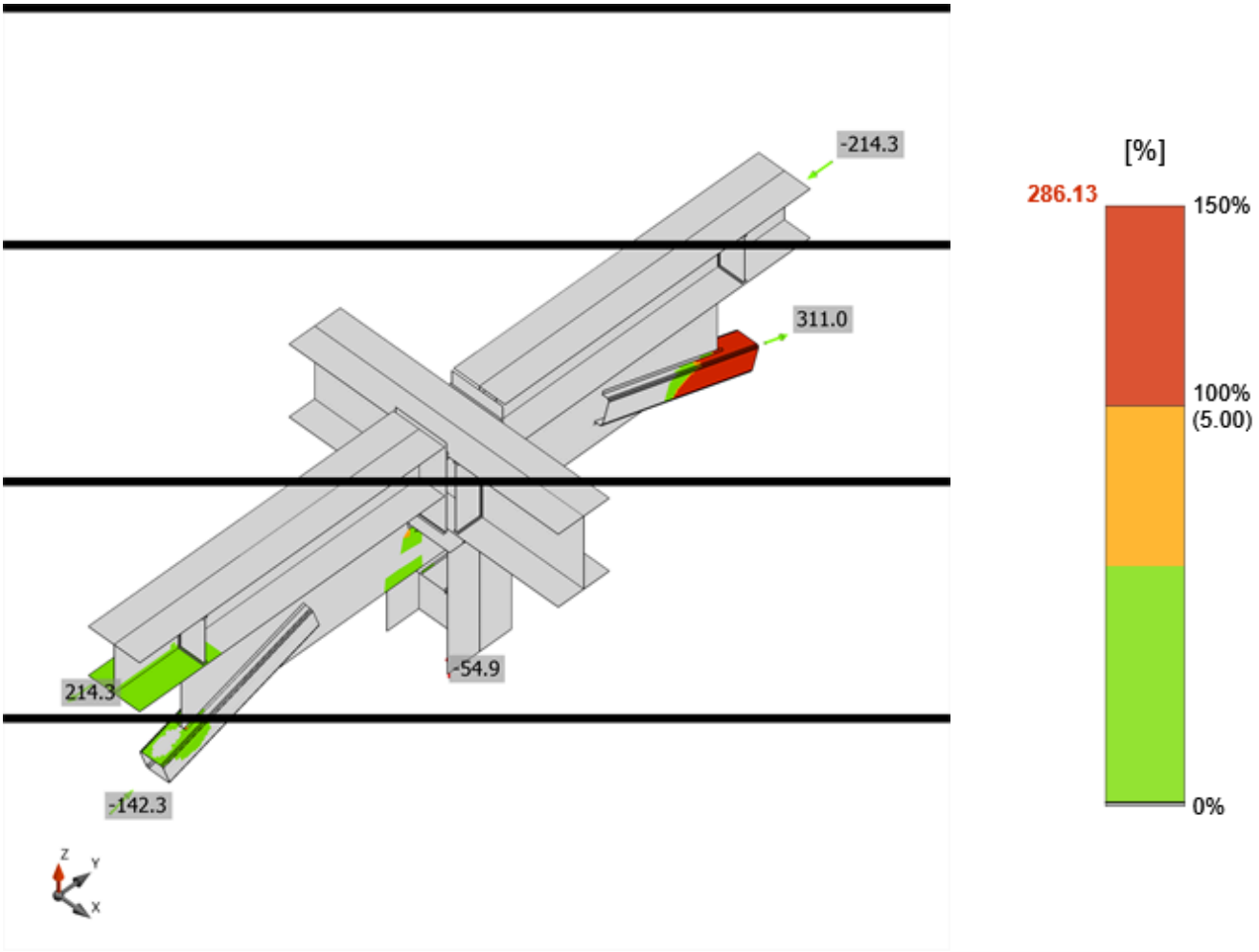
OK, brace and gusset welds designed separately in gusset design calculations

Symbol explanation

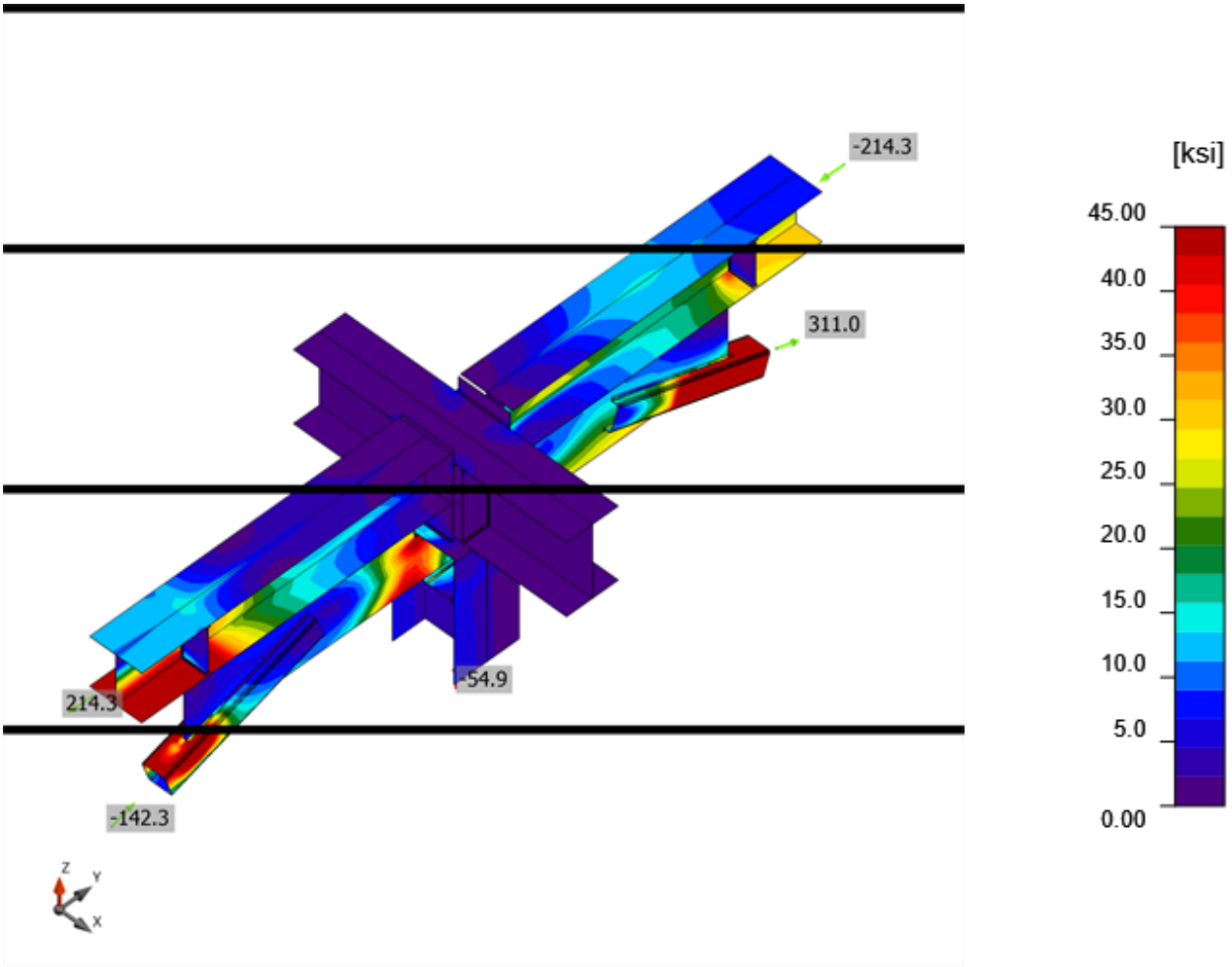
d_0	Cross-section size
δ	Local cross-section deformation
δ_{lim}	Allowed deformation



Overall check, LE1

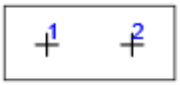
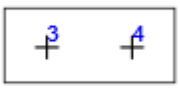


Strain check, LE1



Equivalent stress, LE1

Bolts

Shape	Item	Grade	Loads	F_t [kip]	V [kip]	$\phi R_{n,bearing}$ [kip]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Detailing	Status
	B1	3/4 A325 - 1	LE1	0.0	0.1	31.4	0.0	0.5	0.0	OK	OK
	B2	3/4 A325 - 1	LE1	0.0	0.1	31.4	0.0	0.5	0.0	OK	OK
	B3	3/4 A325 - 1	LE1	0.0	0.0	25.2	0.0	0.1	0.0	OK	OK
	B4	3/4 A325 - 1	LE1	0.0	0.0	25.2	0.0	0.1	0.0	OK	OK

Design data

Grade	$\phi R_{n,tension}$ [kip]	$\phi R_{n,shear}$ [kip]
3/4 A325 - 1	29.8	17.9

Project:
Project no:
Author:

Michael Baker INTERNATIONAL

Symbol explanation

F_t	Tension force
V	Resultant of bolt shear forces Vy and Vz in shear planes
$\phi R_{n,bearing}$	Bolt bearing resistance
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
$\phi R_{n,tension}$	Bolt tension resistance - AISC 360-22 – J3.7
$\phi R_{n,shear}$	Bolt shear resistance - AISC 360-22 – J3.7

Detailed result for B1

Tension resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nt} \cdot A_b = \quad 29.8 \quad \text{kip} \quad \geq \quad F_t = \quad 0.0 \quad \text{kip}$$

Where:

$F_{nt} =$ 89.9 ksi – nominal tensile stress AISC 360-22 – Table J3.2

$A_b =$ 0.44 in^2 – gross bolt cross-sectional area

$\phi =$ 0.75 – resistance factor

Shear resistance check (AISC 360-22 – J3-1)

$$\phi R_n = \phi \cdot F_{nv} \cdot A_b = \quad 17.9 \quad \text{kip} \quad \geq \quad V = \quad 0.1 \quad \text{kip}$$

Where:

$F_{nv} =$ 54.0 ksi – nominal shear stress AISC 360-22 – Table J3.2

$A_b =$ 0.44 in^2 – gross bolt cross-sectional area

$\phi =$ 0.75 – resistance factor

Bearing resistance check (AISC 360-22 – J3-6)

$$R_n = 1.20 \cdot l_c \cdot t \cdot F_u \quad \leq \quad 2.40 \cdot d \cdot t \cdot F_u$$

$$\phi R_n = \quad 31.4 \quad \text{kip} \quad \geq \quad V = \quad 0.1 \quad \text{kip}$$

Where:

$l_c =$ 2" in – clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material

$t =$ 1/4 in – thickness of the plate

$d =$ 3/4 in – diameter of a bolt

$F_u =$ 65.0 ksi – specified minimum tensile strength of the connected material

$\phi =$ 0.75 – resistance factor for bearing at bolt holes

Interaction of tension and shear check (AISC 360-22 – J3-2)

The required stress, in either shear or tension, is less than or equal to 30% of the corresponding available stress and the effects of combined stresses need not to be investigated.

Welds

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
M2-bfl 1	EP1	E70xx	◢ 1/4	◢ 1/4	8"	1/2	LE1	0.9	6.4	14.7	5.4	OK	OK
M2-bfl 1	EP1	E70xx	◢ 1/4	◢ 1/4	8"	1/2	LE1	0.9	6.3	13.9	5.5	OK	OK
SP4	M2-tfl 1	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	8"	3/4	LE1	0.7	7.3	9.4	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	8"	3/4	LE1	0.9	6.6	14.0	0.0	OK	OK
EP1	M1-bfl 1	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	10"	3/4	LE1	2.2	7.0	32.0	16.5	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	10"	3/4	LE1	0.9	6.6	14.0	5.4	OK	OK
EP1	M1-tfl 1	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	10"	3/4	LE1	1.1	7.6	14.7	5.9	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	10"	3/4	LE1	2.3	7.1	32.0	16.7	OK	OK
EP1	M1-w 1	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	9"1/2	1/2	LE1	1.5	6.6	23.3	11.6	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	9"1/2	1/2	LE1	1.8	6.2	29.3	14.6	OK	OK
SP2	M2-tfl 1	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	8"	3/4	LE1	1.8	7.1	25.7	9.3	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	8"	3/4	LE1	1.6	7.6	21.5	7.5	OK	OK
M3-bfl 1	GUSS1	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	2'-11"3/4	3/4	LE1	5.2	6.6	78.7	64.7	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	2'-11"3/4	3/4	LE1	5.2	6.6	78.8	64.7	OK	OK
M1-w 1	GUSS1	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	7"1/4	3/4	LE1	5.8	7.7	75.3	55.8	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	7"1/4	3/4	LE1	5.8	7.7	75.3	55.8	OK	OK
M4-bfl 1	GUSS2	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	2'-11"3/4	3/4	LE1	6.1	6.9	88.5	85.5	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	2'-11"3/4	3/4	LE1	6.1	6.9	88.5	85.5	OK	OK
M1-w 1	GUSS2	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	7"1/4	3/4	LE1	6.8	9.0	75.8	53.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	7"1/4	3/4	LE1	6.8	9.0	75.8	53.1	OK	OK
STIFF1a	GUSS1	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	4"3/4	1"	LE1	3.0	8.3	35.6	21.6	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	4"3/4	1"	LE1	3.0	8.3	35.5	21.6	OK	OK
STIFF1b	GUSS2	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	4"3/4	1"	LE1	6.8	8.6	79.0	64.7	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	4"3/4	1"	LE1	6.8	8.6	79.0	64.6	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
EP1	GUSS2	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	5"3/4	1/2	LE1	4.3	5.2	83.2	78.5	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	5"3/4	1/2	LE1	4.3	5.2	83.2	78.5	OK	OK
EP1	GUSS1	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	5"3/4	1/2	LE1	3.6	5.4	66.7	43.9	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	5"3/4	1/2	LE1	3.6	5.5	66.1	43.4	OK	OK
GUSS2	M6-w 2	E70xx	◢ 1/4	◢ 1/2	1'-7"3/4	1/4	LE1	3.0	3.1	97.5	87.1	OK	OK
GUSS2	M6-w 2	E70xx	◢ 1/4	◢ 1/2	1'-7"3/4	1/4	LE1	3.0	3.1	97.0	92.5	OK	OK
GUSS2	M6-w 4	E70xx	◢ 1/4	◢ 1/2	1'-2"	1/4	LE1	2.3	3.1	75.4	47.4	OK	OK
GUSS2	M6-w 4	E70xx	◢ 1/4	◢ 1/2	1'-2"	1/4	LE1	2.3	3.1	75.3	53.9	OK	OK
GUSS1	M5-w 1	E70xx	◢ 1/4	◢ 1/2	1'-2"	1/4	LE1	12.0	3.1	385.0	100.0	OK	
GUSS1	M5-w 1	E70xx	◢ 1/4	◢ 1/2	1'-2"	1/4	LE1	12.0	3.1	385.3	100.0	OK	
GUSS1	M5-w 3	E70xx	◢ 1/4	◢ 1/2	1'-7"3/4	1/4	LE1	20.5	3.1	664.0	100.0	OK	
GUSS1	M5-w 3	E70xx	◢ 1/4	◢ 1/2	1'-7"3/4	1/4	LE1	21.3	3.1	690.0	100.0	OK	
EP1	SP2	E70xx	◢ 1/4	◢ 1/4	8"	1/2	LE1	5.0	6.7	75.0	50.3	OK	OK
EP1	SP4	E70xx	◢ 1/4	◢ 1/4	8"	1/2	LE1	1.4	7.2	19.0	8.4	OK	OK
M1-bfl 1	STIFF1a	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	4"3/4	3/4	LE1	0.5	4.2	12.4	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	4"3/4	3/4	LE1	0.6	4.3	13.5	5.8	OK	OK
M1-w 1	STIFF1a	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	8"3/4	1"	LE1	2.5	6.5	37.6	21.6	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	8"3/4	1"	LE1	1.1	6.5	17.2	8.5	OK	OK
M1-tfl 1	STIFF1a	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	4"3/4	3/4	LE1	0.5	4.2	12.3	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	4"3/4	3/4	LE1	0.6	4.3	13.9	6.2	OK	OK
M1-bfl 1	STIFF1b	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	4"3/4	3/4	LE1	0.6	4.3	14.6	5.9	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	4"3/4	3/4	LE1	0.7	4.3	15.7	6.7	OK	OK
M1-w 1	STIFF1b	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	8"3/4	1"	LE1	3.3	6.6	49.9	30.6	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	8"3/4	1"	LE1	3.3	6.6	50.8	31.4	OK	OK
M1-tfl 1	STIFF1b	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	4"3/4	3/4	LE1	0.6	4.3	14.9	6.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	4"3/4	3/4	LE1	0.7	4.4	15.7	7.0	OK	OK
M3-bfl 1	STIFF2a	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	3/4	LE1	0.8	3.7	21.2	9.3	OK	OK

OK, brace and gusset welds designed separately in gusset design calculations

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	3/4	LE1	0.7	3.9	17.9	8.8	OK	OK
M3-w 1	STIFF2a	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	7"1/4	3/4	LE1	0.8	5.3	14.5	6.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	7"	3/4	LE1	0.7	5.3	13.8	5.7	OK	OK
M3-tfl 1	STIFF2a	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	3/4	LE1	0.3	4.8	6.9	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	3/4	LE1	0.2	4.4	5.6	0.0	OK	OK
M3-bfl 1	STIFF2b	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	3/4	LE1	0.7	4.0	17.7	8.6	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	3/4	LE1	0.8	3.7	20.9	9.2	OK	OK
M3-w 1	STIFF2b	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	7"	3/4	LE1	0.7	5.3	13.9	5.7	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	7"1/4	3/4	LE1	0.8	5.3	14.6	5.9	OK	OK
M3-tfl 1	STIFF2b	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	3/4	LE1	0.2	4.5	5.6	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	3/4	LE1	0.3	4.8	6.9	0.0	OK	OK
M4-bfl 1	STIFF3a	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	3/4	LE1	1.1	4.1	27.3	14.6	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	3/4	LE1	1.2	3.9	30.8	17.7	OK	OK
M4-w 1	STIFF3a	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	7"1/4	3/4	LE1	1.6	5.3	31.0	14.8	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	7"	3/4	LE1	1.5	5.2	28.4	14.5	OK	OK
M4-tfl 1	STIFF3a	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	3/4	LE1	0.4	4.3	10.2	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	3/4	LE1	0.6	4.7	12.3	0.0	OK	OK
M4-bfl 1	STIFF3b	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	3/4	LE1	1.2	3.9	30.7	17.7	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	3/4	LE1	1.1	4.1	27.3	14.6	OK	OK
M4-w 1	STIFF3b	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	7"	3/4	LE1	1.5	5.2	28.4	14.5	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	7"1/4	3/4	LE1	1.6	5.3	30.9	14.8	OK	OK
M4-tfl 1	STIFF3b	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	3/4	LE1	0.6	4.7	12.3	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	3/4	LE1	0.4	4.3	10.2	0.0	OK	OK
M2-bfl 1	STIFF4a	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	1"	LE1	0.4	5.7	6.6	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	1"	LE1	0.7	6.8	9.7	0.0	OK	OK

Item	Edge	Xu	t_w [in]	w [in]	L [in]	L_c [in]	Loads	F_n [kip]	ϕR_n [kip]	Ut [%]	Ut_c [%]	Detailing	Status
M2-w 1	STIFF4a	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	10"3/4	1"	LE1	0.2	7.2	2.7	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	11"	1"	LE1	0.2	5.1	3.4	0.0	OK	OK
M2-tfl 1	STIFF4a	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	1"	LE1	1.9	6.5	29.6	13.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	1"	LE1	1.2	6.9	17.0	7.2	OK	OK
M2-bfl 1	STIFF4b	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	1"	LE1	0.2	6.4	2.8	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	1"	LE1	0.2	6.0	2.7	0.0	OK	OK
M2-w 1	STIFF4b	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	11"	1"	LE1	0.2	4.9	4.8	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	11"	1"	LE1	0.2	4.9	3.8	0.0	OK	OK
M2-tfl 1	STIFF4b	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	1"	LE1	0.8	6.7	12.6	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	1"	LE1	1.3	6.4	20.2	7.3	OK	OK
M2-bfl 1	STIFF4c	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	1"	LE1	0.7	6.8	9.9	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	1"	LE1	0.3	6.1	5.5	0.0	OK	OK
M2-w 1	STIFF4c	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	10"3/4	1"	LE1	0.2	7.1	2.4	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	10"3/4	1"	LE1	0.1	7.3	1.9	0.0	OK	OK
M2-tfl 1	STIFF4c	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	1"	LE1	0.7	4.9	13.3	5.1	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	1"	LE1	1.4	6.6	21.6	9.3	OK	OK
M2-bfl 1	STIFF4d	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	1"	LE1	0.2	5.7	2.7	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	1"	LE1	0.2	6.5	2.9	0.0	OK	OK
M2-w 1	STIFF4d	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	11"	1"	LE1	0.1	5.1	1.9	0.0	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	11"	1"	LE1	0.2	5.0	3.4	0.0	OK	OK
M2-tfl 1	STIFF4d	E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	1"	LE1	0.9	6.5	13.7	5.2	OK	OK
		E70xx	◢ 1/4 ◣	◢ 1/4 ◣	3"3/4	1"	LE1	0.4	4.9	7.5	0.0	OK	OK

Design data

Material	F_{exx} [ksi]
E70xx	70.0

Symbol explanation

t_w	Throat thickness of weld
w	Leg size of weld
L	Length of weld
L_c	Length of weld critical element
F_n	Force in weld critical element
ϕR_n	Weld resistance - AISC 360-22 – J2-4
Ut	Utilization
Ut_c	Weld capacity estimation
◢	Fillet weld
F_{exx}	Ultimate strength as rated by electrode classification number

Detailed result for GUSS1 / M5-w 3

Weld resistance check (AISC 360-22 – J2-4)

$$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} = \quad 3.1 \quad \text{kip} \quad < \quad F_n = \quad 21.3 \quad \text{kip}$$

Where:

$F_{nw} =$ 42.0 ksi – nominal stress of weld material:

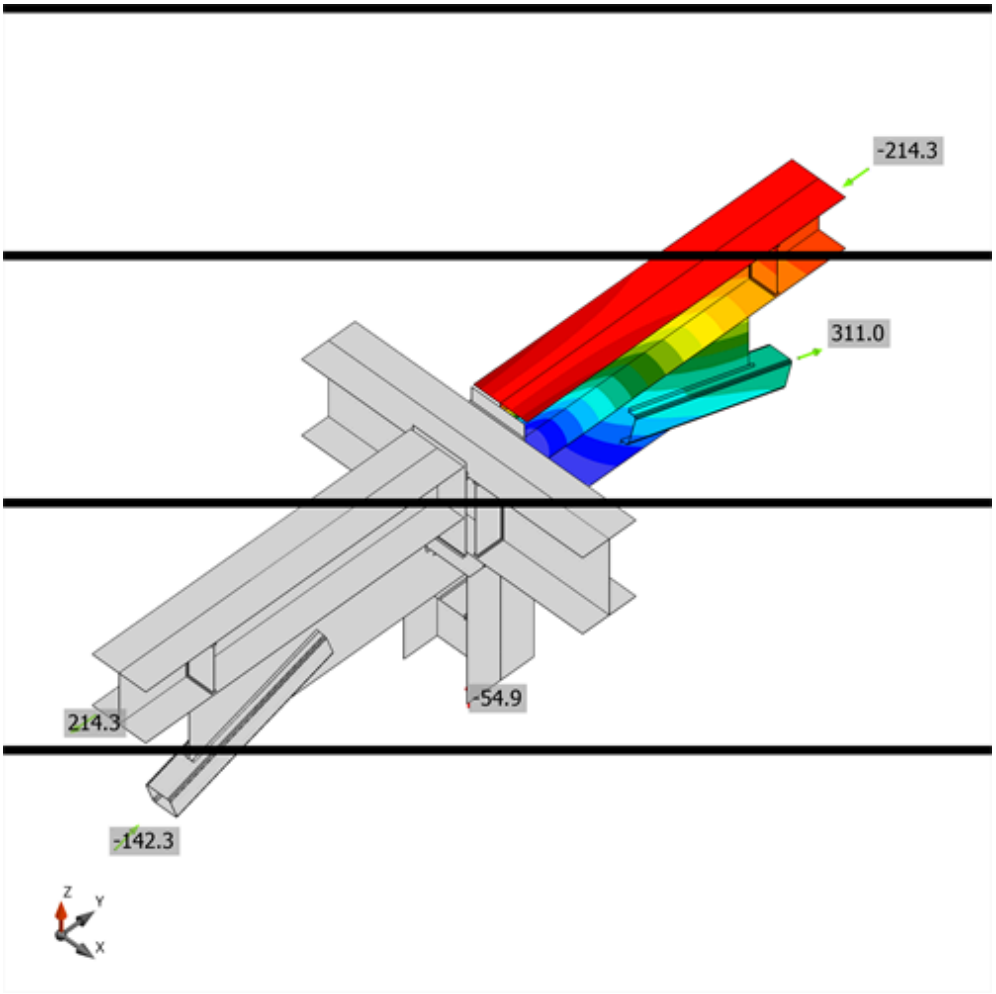
- $F_{nw} = 0.6 \cdot F_{EXX}$, where:
  - $F_{EXX} =$ 70.0 ksi – electrode classification number, i.e. minimum specified tensile strength
  - Directional strength increase is not used for HSS welds

$A_{we} =$ 0.10 in^2 – effective area of weld critical element

$\phi =$ 0.75 – resistance factor for welded connections

Buckling

Loads	Shape	Factor [-]
LE1	1	11.31
	2	15.11
	3	18.26
	4	20.54
	5	20.71
	6	24.43



First buckling mode shape, LE1

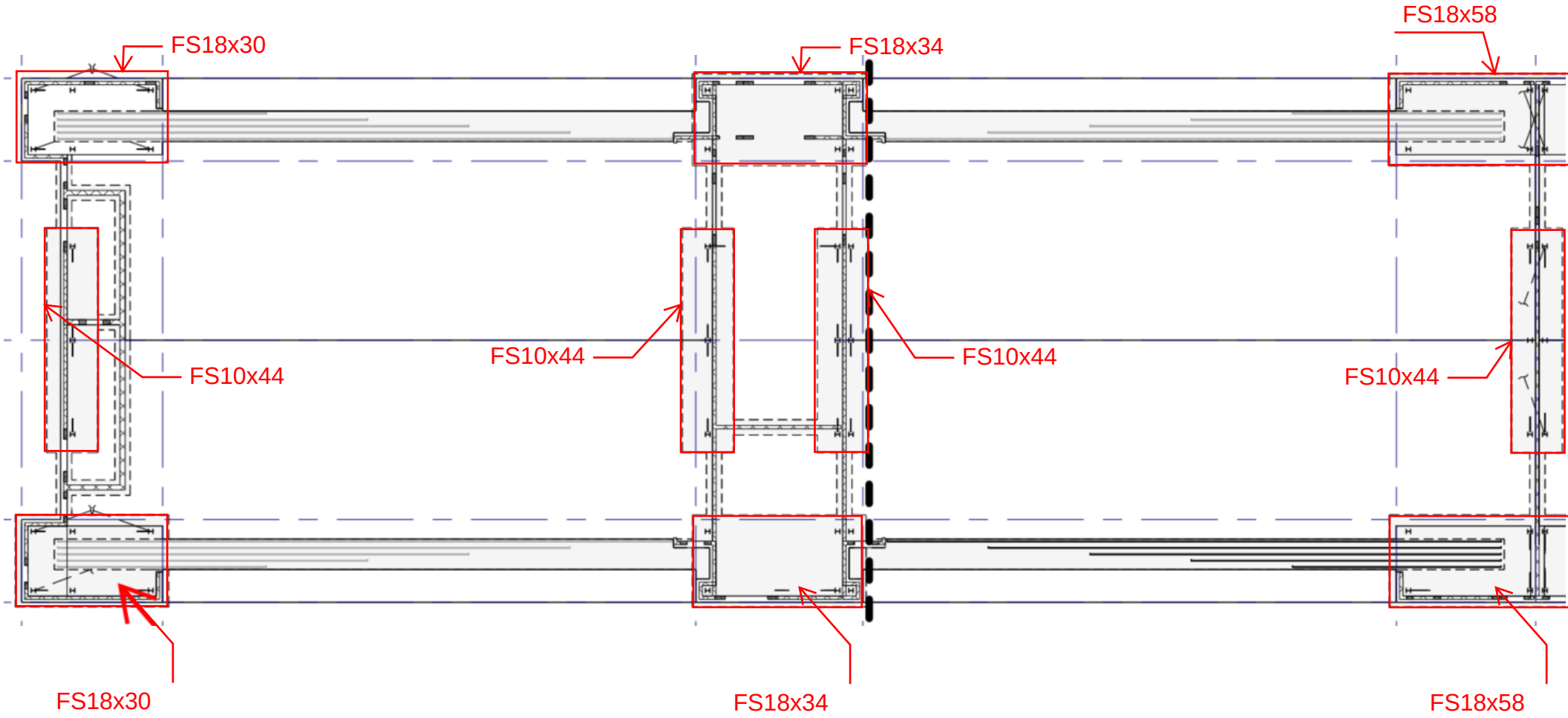
Code settings

Item	Value	Unit	Reference
Friction coefficient - concrete	0.40	-	ACI 349-01 – B.6.1.4
Friction coefficient in slip-resistance	0.30	-	AISC 360-22 – J3.9
Limit plastic strain	0.05	-	
Detailing	Yes		
Distance between bolts [d]	2.66	-	AISC 360-22 – J3.4
Concrete breakout resistance check	Both		
Base metal capacity check at weld fusion face	No		AISC 360-22 – J2-2
Deformation at bolt hole at service load is design consideration	Yes		AISC 360-22 – J3.11
Cracked concrete	Yes		ACI 318-19 – 17
Local deformation check	Yes		
Local deformation limit	0.03	-	CIDECT DG 1, 3 – 1.1
Geometrical nonlinearity (GMNA)	Yes		Analysis with large deformations for hollow section joints

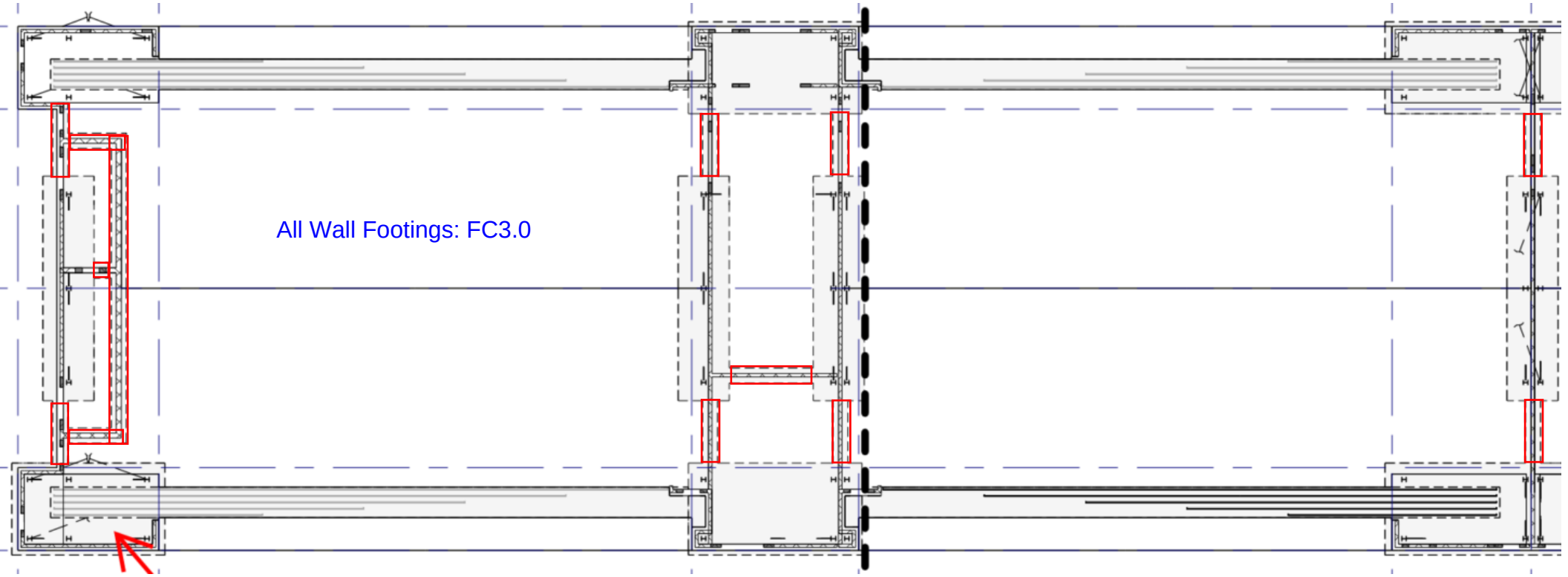
Michael Baker
INTERNATIONAL

Foundation Calculations

Overall Foundation Plan with Labels



Wall Loads and Wall Footing Layout



As CMU walls are only self-weight and do not act as bearing or shear walls, wall loads are only their self-weight.

8'' CMU walls: DL = 126x24 = 3024 plf

12'' CMU walls: DL = 75x27/2 = 1013 plf

FOOTING ANALYSIS

In accordance with ACI318-19 (22)

Tedds calculation version 3.3.08

Summary results

Overall design status PASS

Overall design utilisation 0.625

Description	Unit	Applied	Resisting	FoS	Result
Uplift verification	kips	4.5			Pass
Description	**Unit**	**Applied**	**Resisting**	**Utilization**	**Result**
Soil bearing	ksf	1.874	3	0.625	Pass
Description	**Unit**	**Required**	**Provided**	**Utilization**	**Result**
Moment, positive, y-direction	kip_ft	1.4	11.8	0.116	Pass
Shear, one-way, y-direction	kips	0.7	5.7	0.123	Pass
Min.area of reinf, bot., y-direction	in^2	0.259	0.310		Pass
Max.reinf.spacing, bot, y-direction	in	18.0	12.0		Pass

Strip footing details - considering a one meter strip

Length of footing L_x = **1** ft

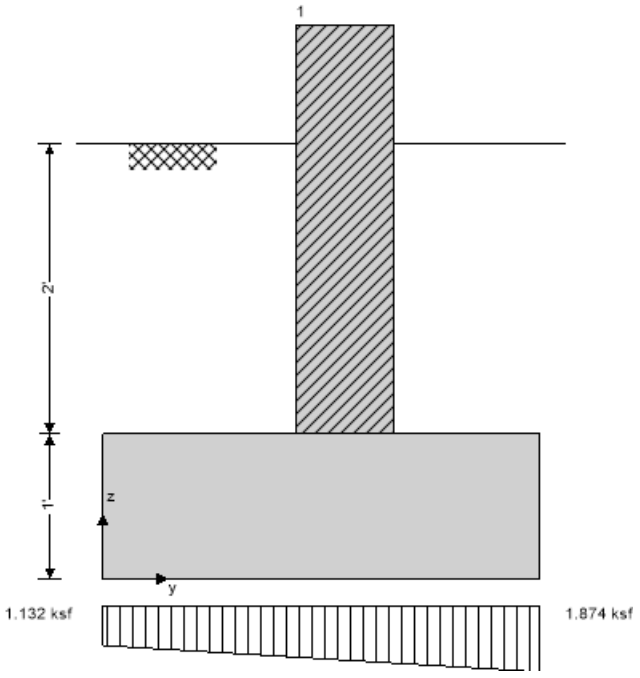
Width of footing L_y = **3** ft

Footing area $A = L_x \times L_y$ = **3** ft^2

Depth of footing h = **12** in

Depth of soil over footing h_{soil} = **24** in

Density of concrete γ_{conc} = **150.0** lb/ft^3



Wall no.1 details

Width of wall — l_{y1} = **8** in

position in y-axis — y_1 = **20** in

Soil properties

Gross allowable bearing pressure — q_{allow_Gross} = **3** ksf

Density of soil — γ_{soil} = **120.0** lb/ft^3

Angle of internal friction — ϕ_b = **30.0** deg

Design base friction angle — δ_{bb} = **30.0** deg

Coefficient of base friction — $\tan(\delta_{bb})$ = **0.577**

Footing loads

Self weight — $F_{swt} = h \times \gamma_{conc}$ = **150** psf

Soil weight — $F_{soil} = h_{soil} \times \gamma_{soil}$ = **240** psf

Wall no.1 loads per linear foot

Dead load in z — F_{Dz1} = **3.5** kips

Footing analysis for soil and stability

Load combinations per ASCE 7-22

1.0D (0.625)
1.0D + 1.0L (0.625)
1.0D + 1.0Lr (0.625)
1.0D + 0.7S (0.625)
1.0D + 1.0R (0.625)
1.0D + 0.75L + 0.75Lr (0.625)
1.0D + 0.75L + 0.525S (0.625)
1.0D + 0.75L + 0.75R (0.625)

Combination 1 results: 1.0D

Forces on footing per linear foot

Force in z-axis — $F_{dz} = \gamma_D \times A \times (F_{swt} + F_{soil}) + \gamma_D \times (F_{Dz1} - l_{x1} \times l_{y1} \times h_{soil} \times \gamma_{soil})$ = **4.5** kips

Moments on footing per linear foot

Moment in y-axis, about y is 0 — $M_{dy} = \gamma_D \times (A \times (F_{swt} + F_{soil}) \times L_y / 2) + \gamma_D \times (((F_{Dz1} - l_{x1} \times l_{y1} \times h_{soil} \times \gamma_{soil})) \times y_1)$ = **7.3** kip_ft

Uplift verification

Vertical force — F_{dz} = **4.51** kips

PASS - Footing is not subject to uplift

Stability against sliding

Resistance due to base friction — $F_{RFriction} = \max(F_{dz}, 0\ kN) \times \tan(\delta_{bb})$ = **2.604** kips

Bearing resistance

Eccentricity of base reaction

Eccentricity of base reaction in y-axis — $e_{dy} = M_{dy} / F_{dz} - L_y / 2$ = **1.481** in

Strip base pressures

$q_1 = F_{dz} \times (1 - 6 \times e_{dy} / L_y) / (L_y \times 1\ ft)$ = **1.132** ksf

$q_2 = F_{dz} \times (1 + 6 \times e_{dy} / L_y) / (L_y \times 1\ ft) =$ **1.874** ksf

Minimum base pressure $q_{min} = \min(q_1,q_2) =$ **1.132** ksf

Maximum base pressure $q_{max} = \max(q_1,q_2) =$ **1.874** ksf

Allowable bearing capacity

Allowable bearing capacity $q_{allow} = q_{allow_Gross} =$ **3** ksf

$q_{max} / q_{allow} =$ **0.625**

PASS - Allowable bearing capacity exceeds design base pressure

FOOTING DESIGN

In accordance with ACI318-19 (22)

Tedds calculation version 3.3.08

Material details

Compressive strength of concrete	$f'_c =$ **4000** psi
Yield strength of reinforcement	$f_y =$ **60000** psi
Compression-controlled strain limit (21.2.2)	$\varepsilon_{ty} =$ **0.00200**
Cover to top of footing	$c_{nom_t} =$ **3** in
Cover to side of footing	$c_{nom_s} =$ **3** in
Cover to bottom of footing	$c_{nom_b} =$ **3** in
Concrete type	Normal weight
Concrete modification factor	$\lambda =$ **1.00**
Wall type	Masonry

Analysis and design of concrete footing

Load combinations per ASCE 7-22

1.4D (0.123)
1.2D + 1.6L + 0.5Lr (0.105)
1.2D + 1.6L + 0.3S (0.105)
1.2D + 1.6L + 0.5R (0.105)
1.2D + 1.0L + 1.6Lr (0.105)
1.2D + 1.0L + 1.0S (0.105)
1.2D + 1.0L + 1.6R (0.105)

Combination 1 results: 1.4D

Forces on footing per linear foot

Ultimate force in z-axis $F_{uz} = \gamma_D \times A \times (F_{swt} + F_{soil}) + \gamma_D \times (F_{Dz1} - l_{x1} \times l_{y1} \times h_{soil} \times \gamma_{soil}) =$ **6.3** kips

Moments on footing per linear foot

Ultimate moment in y-axis, about y is 0 $M_{uy} = \gamma_D \times (A \times (F_{swt} + F_{soil}) \times L_y / 2) + \gamma_D \times (((F_{Dz1} - l_{x1} \times l_{y1} \times h_{soil} \times \gamma_{soil})) \times y_1)$ = **10.3** kip_ft

Eccentricity of base reaction

Eccentricity of base reaction in y-axis $e_{uy} = M_{uy} / F_{uz} - L_y / 2 =$ **1.481** in

Strip base pressures

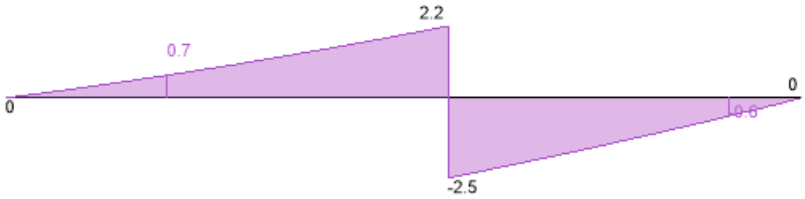
$q_{u1} = F_{uz} \times (1 - 6 \times e_{uy} / L_y) / (L_y \times 1\ ft) =$ **1.585** ksf

$q_{u2} = F_{uz} \times (1 + 6 \times e_{uy} / L_y) / (L_y \times 1\ ft) =$ **2.624** ksf

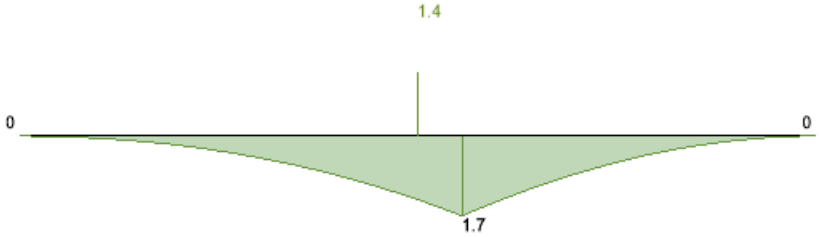
Minimum ultimate base pressure $q_{umin} = \min(q_{u1},q_{u2}) =$ **1.585** ksf

Maximum ultimate base pressure $q_{umax} = \max(q_{u1},q_{u2}) =$ **2.624** ksf

Shear diagram (kips)



Moment diagram (kip_ft)



Moment design, y direction, positive moment

Ultimate bending moment	$M_{u.y.max}$ = **1.364** kip_ft
Tension reinforcement provided	No.5 bars at 12.0 in c/c bottom
Area of tension reinforcement provided	$A_{sy.bot.prov}$ = **0.31** in^2
Minimum area of reinforcement (7.6.1.1)	$A_{s.min}$ = 0.0018 × L_x × h = **0.259** in^2
	PASS - Area of reinforcement provided exceeds minimum
Maximum spacing of reinforcement (7.7.2.3)	s_{max} = min(3 × h, 18 in) = **18** in
	PASS - Maximum permissible reinforcement spacing exceeds actual spacing
Depth to tension reinforcement	d = h - c_{nom_b} - $\phi_{y.bot}$ / 2 = **8.688** in
Depth of compression block	a = $A_{sy.bot.prov}$ × f_y / (0.85 × f'$_c$ × L_x) = **0.456** in
Neutral axis factor	β_1 = **0.85**
Depth to neutral axis	c = a / β_1 = **0.536** in
Strain in tensile reinforcement	ε_t = 0.003 × d / c - 0.003 = **0.04559**
Minimum tensile strain(7.3.3.1)	ε_{min} = ε_{ty} + 0.003 = **0.00500**
	PASS - Tensile strain exceeds minimum required
Nominal moment capacity	M_n = $A_{sy.bot.prov}$ × f_y × (d - a / 2) = **13.112** kip_ft
Flexural strength reduction factor	ϕ_f = min(max(0.65 + 0.25 × (ε_t - ε_{ty}) / (0.003), 0.65), 0.9) = **0.900**
Design moment capacity	ϕM_n = ϕ_f × M_n = **11.801** kip_ft
	$M_{u.y.max}$ / ϕM_n = **0.116**
	PASS - Design moment capacity exceeds ultimate moment load

One-way shear design, y direction

Ultimate shear force	$V_{u.y}$ = **0.698** kips
Depth to reinforcement	d_v = h - c_{nom_b} - $\phi_{y.bot}$ / 2 = **8.687** in
Size effect factor (22.5.5.1.3)	λ_s = **1**
Ratio of longitudinal reinforcement	ρ_w = $A_{sy.bot.prov}$ / (L_x × d_v) = **0.00297**
Shear strength reduction factor	ϕ_v = **0.75**

Nominal shear capacity (Eq. 22.5.5.1)

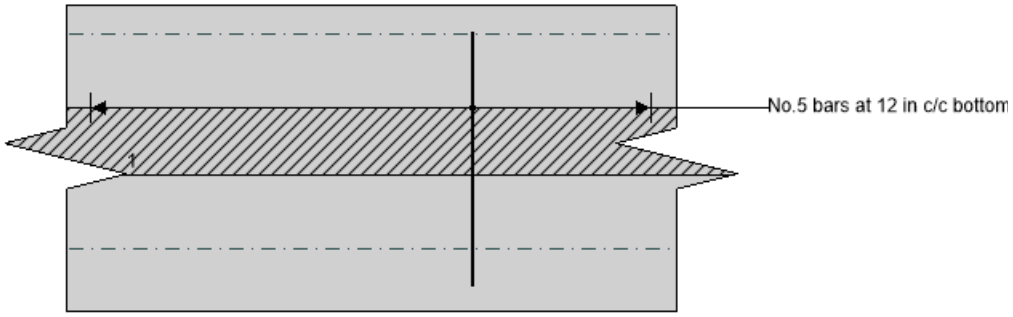
$V_n = \min(8 \times \lambda_s \times \lambda \times (\rho_w)^{1/3} \times \sqrt{f'_c \times 1\ psi} \times L_x \times d_v, 5 \times \lambda \times \sqrt{f'_c \times 1\ psi} \times L_x \times d_v) =$ **7.585** kips

Design shear capacity

$\phi V_n = \phi_v \times V_n =$ **5.689** kips

$V_{u,y} / \phi V_n =$ **0.123**

PASS - Design shear capacity exceeds ultimate shear load



FOOTING ANALYSIS

In accordance with ACI318-19 (22)

Tedds calculation version 3.3.08

Summary results

Overall design status PASS

Overall design utilisation 0.391

Description	Unit	Applied	Resisting	FoS	Result
Uplift verification	kips	2.9			Pass
Description	**Unit**	**Applied**	**Resisting**	**Utilization**	**Result**
Soil bearing	ksf	1.172	3	0.391	Pass
Description	**Unit**	**Required**	**Provided**	**Utilization**	**Result**
Moment, positive, y-direction	kip_ft	0.6	11.8	0.054	Pass
Shear, one-way, y-direction	kips	0.3	5.7	0.046	Pass
Min.area of reinf, bot., y-direction	in^2	0.259	0.310		Pass
Max.reinf.spacing, bot, y-direction	in	18.0	12.0		Pass

Strip footing details - considering a one meter strip

Length of footing L_x = **1** ft

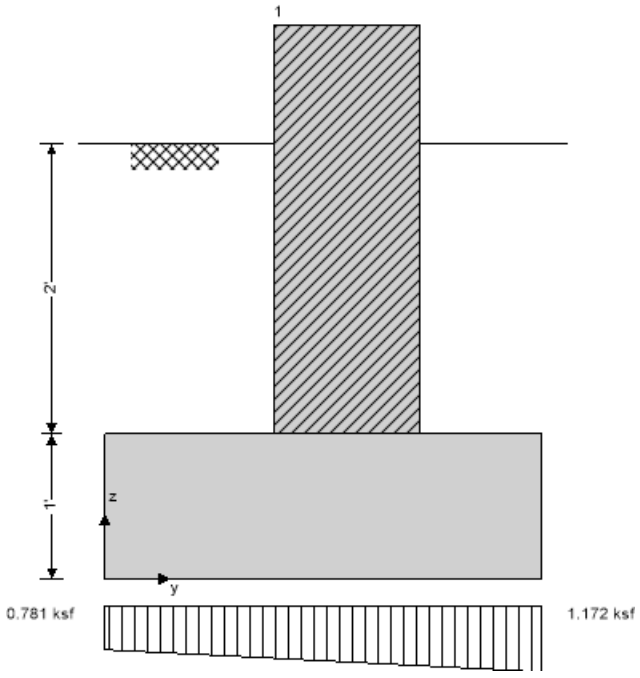
Width of footing L_y = **3** ft

Footing area $A = L_x \times L_y$ = **3** ft^2

Depth of footing h = **12** in

Depth of soil over footing h_{soil} = **24** in

Density of concrete γ_{conc} = **150.0** lb/ft^3



Wall no.1 details

Width of wall — l_{y1} = **12** in

position in y-axis — y_1 = **20** in

Soil properties

Gross allowable bearing pressure — q_{allow_Gross} = **3** ksf

Density of soil — γ_{soil} = **120.0** lb/ft^3

Angle of internal friction — ϕ_b = **30.0** deg

Design base friction angle — δ_{bb} = **30.0** deg

Coefficient of base friction — $\tan(\delta_{bb})$ = **0.577**

Footing loads

Self weight — $F_{swt} = h \times \gamma_{conc}$ = **150** psf

Soil weight — $F_{soil} = h_{soil} \times \gamma_{soil}$ = **240** psf

Wall no.1 loads per linear foot

Dead load in z — F_{Dz1} = **2.0** kips

Footing analysis for soil and stability

Load combinations per ASCE 7-22

1.0D (0.391)
1.0D + 1.0L (0.391)
1.0D + 1.0Lr (0.391)
1.0D + 0.7S (0.391)
1.0D + 1.0R (0.391)
1.0D + 0.75L + 0.75Lr (0.391)
1.0D + 0.75L + 0.525S (0.391)
1.0D + 0.75L + 0.75R (0.391)

Combination 1 results: 1.0D

Forces on footing per linear foot

Force in z-axis — $F_{dz} = \gamma_D \times A \times (F_{swt} + F_{soil}) + \gamma_D \times (F_{Dz1} - l_{x1} \times l_{y1} \times h_{soil} \times \gamma_{soil})$ = **2.9** kips

Moments on footing per linear foot

Moment in y-axis, about y is 0 — $M_{dy} = \gamma_D \times (A \times (F_{swt} + F_{soil}) \times L_y / 2) + \gamma_D \times (((F_{Dz1} - l_{x1} \times l_{y1} \times h_{soil} \times \gamma_{soil})) \times y_1)$ = **4.7** kip_ft

Uplift verification

Vertical force — F_{dz} = **2.93** kips

PASS - Footing is not subject to uplift

Stability against sliding

Resistance due to base friction — $F_{RFriction} = \max(F_{dz}, 0\ kN) \times \tan(\delta_{bb})$ = **1.692** kips

Bearing resistance

Eccentricity of base reaction

Eccentricity of base reaction in y-axis — $e_{dy} = M_{dy} / F_{dz} - L_y / 2$ = **1.201** in

Strip base pressures

$q_1 = F_{dz} \times (1 - 6 \times e_{dy} / L_y) / (L_y \times 1\ ft)$ = **0.781** ksf

$q_2 = F_{dz} \times (1 + 6 \times e_{dy} / L_y) / (L_y \times 1\ ft) =$ **1.172** ksf

Minimum base pressure $q_{min} = \min(q_1,q_2) =$ **0.781** ksf

Maximum base pressure $q_{max} = \max(q_1,q_2) =$ **1.172** ksf

Allowable bearing capacity

Allowable bearing capacity $q_{allow} = q_{allow_Gross} =$ **3** ksf

$q_{max} / q_{allow} =$ **0.391**

PASS - Allowable bearing capacity exceeds design base pressure

FOOTING DESIGN

In accordance with ACI318-19 (22)

Tedds calculation version 3.3.08

Material details

Compressive strength of concrete	$f'_c =$ **4000** psi
Yield strength of reinforcement	$f_y =$ **60000** psi
Compression-controlled strain limit (21.2.2)	$\varepsilon_{ty} =$ **0.00200**
Cover to top of footing	$c_{nom_t} =$ **3** in
Cover to side of footing	$c_{nom_s} =$ **3** in
Cover to bottom of footing	$c_{nom_b} =$ **3** in
Concrete type	Normal weight
Concrete modification factor	$\lambda =$ **1.00**
Wall type	Masonry

Analysis and design of concrete footing

Load combinations per ASCE 7-22

1.4D (0.054)
1.2D + 1.6L + 0.5Lr (0.046)
1.2D + 1.6L + 0.3S (0.046)
1.2D + 1.6L + 0.5R (0.046)
1.2D + 1.0L + 1.6Lr (0.046)
1.2D + 1.0L + 1.0S (0.046)
1.2D + 1.0L + 1.6R (0.046)

Combination 1 results: 1.4D

Forces on footing per linear foot

Ultimate force in z-axis $F_{uz} = \gamma_D \times A \times (F_{swt} + F_{soil}) + \gamma_D \times (F_{Dz1} - l_{x1} \times l_{y1} \times h_{soil} \times \gamma_{soil}) =$ **4.1** kips

Moments on footing per linear foot

Ultimate moment in y-axis, about y is 0 $M_{uy} = \gamma_D \times (A \times (F_{swt} + F_{soil}) \times L_y / 2) + \gamma_D \times (((F_{Dz1} - l_{x1} \times l_{y1} \times h_{soil} \times \gamma_{soil})) \times y_1)$ = **6.6** kip_ft

Eccentricity of base reaction

Eccentricity of base reaction in y-axis $e_{uy} = M_{uy} / F_{uz} - L_y / 2 =$ **1.201** in

Strip base pressures

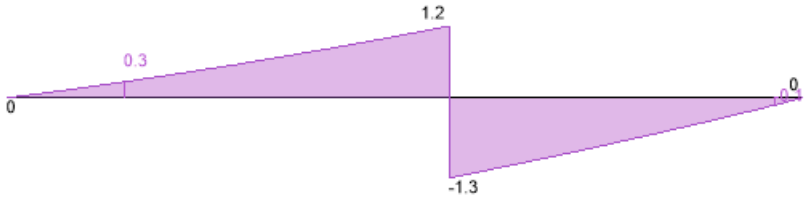
$q_{u1} = F_{uz} \times (1 - 6 \times e_{uy} / L_y) / (L_y \times 1\ ft) =$ **1.094** ksf

$q_{u2} = F_{uz} \times (1 + 6 \times e_{uy} / L_y) / (L_y \times 1\ ft) =$ **1.641** ksf

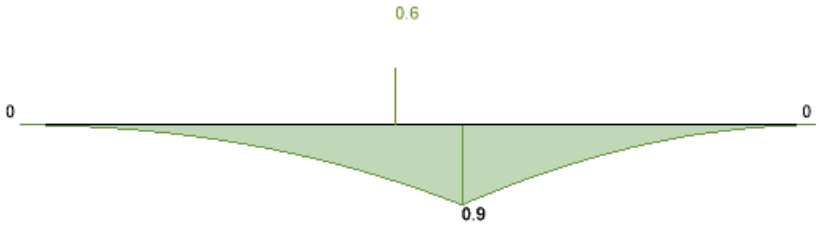
Minimum ultimate base pressure $q_{umin} = \min(q_{u1},q_{u2}) =$ **1.094** ksf

Maximum ultimate base pressure $q_{umax} = \max(q_{u1},q_{u2}) =$ **1.641** ksf

Shear diagram (kips)



Moment diagram (kip_ft)



Moment design, y direction, positive moment

Ultimate bending moment	$M_{u.y.max}$ = **0.636** kip_ft
Tension reinforcement provided	No.5 bars at 12.0 in c/c bottom
Area of tension reinforcement provided	$A_{sy.bot.prov}$ = **0.31** in^2
Minimum area of reinforcement (7.6.1.1)	$A_{s.min}$ = 0.0018 × L_x × h = **0.259** in^2
	PASS - Area of reinforcement provided exceeds minimum
Maximum spacing of reinforcement (7.7.2.3)	s_{max} = min(3 × h, 18 in) = **18** in
	PASS - Maximum permissible reinforcement spacing exceeds actual spacing
Depth to tension reinforcement	d = h - c_{nom_b} - $\phi_{y.bot}$ / 2 = **8.688** in
Depth of compression block	a = $A_{sy.bot.prov}$ × f_y / (0.85 × f'$_c$ × L_x) = **0.456** in
Neutral axis factor	β_1 = **0.85**
Depth to neutral axis	c = a / β_1 = **0.536** in
Strain in tensile reinforcement	ε_t = 0.003 × d / c - 0.003 = **0.04559**
Minimum tensile strain(7.3.3.1)	ε_{min} = ε_{ty} + 0.003 = **0.00500**
	PASS - Tensile strain exceeds minimum required
Nominal moment capacity	M_n = $A_{sy.bot.prov}$ × f_y × (d - a / 2) = **13.112** kip_ft
Flexural strength reduction factor	ϕ_f = min(max(0.65 + 0.25 × (ε_t - ε_{ty}) / (0.003), 0.65), 0.9) = **0.900**
Design moment capacity	ϕM_n = ϕ_f × M_n = **11.801** kip_ft
	$M_{u.y.max}$ / ϕM_n = **0.054**
	PASS - Design moment capacity exceeds ultimate moment load

One-way shear design, y direction

Ultimate shear force	$V_{u.y}$ = **0.26** kips
Depth to reinforcement	d_v = h - c_{nom_b} - $\phi_{y.bot}$ / 2 = **8.687** in
Size effect factor (22.5.5.1.3)	λ_s = **1**
Ratio of longitudinal reinforcement	ρ_w = $A_{sy.bot.prov}$ / (L_x × d_v) = **0.00297**
Shear strength reduction factor	ϕ_v = **0.75**

Nominal shear capacity (Eq. 22.5.5.1)

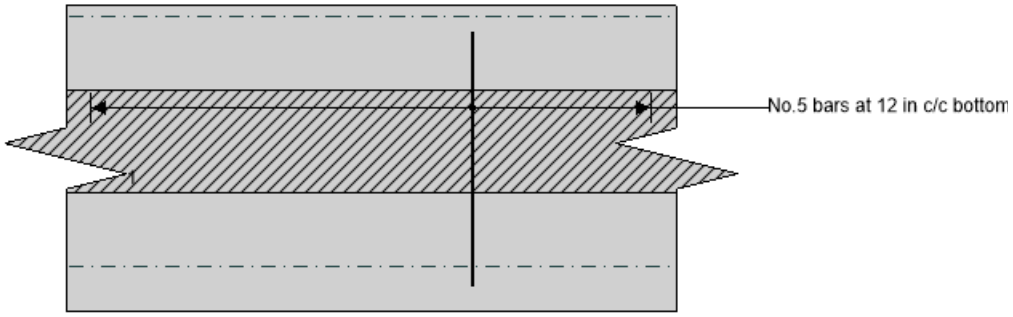
$V_n = \min(8 \times \lambda_s \times \lambda \times (\rho_w)^{1/3} \times \sqrt{f'_c \times 1\ psi} \times L_x \times d_v,\ 5 \times \lambda \times \sqrt{f'_c \times 1\ psi} \times L_x \times d_v) =$ **7.585** kips

Design shear capacity

$\phi V_n = \phi_v \times V_n =$ **5.689** kips

$V_{u,y} / \phi V_n =$ **0.046**

PASS - Design shear capacity exceeds ultimate shear load



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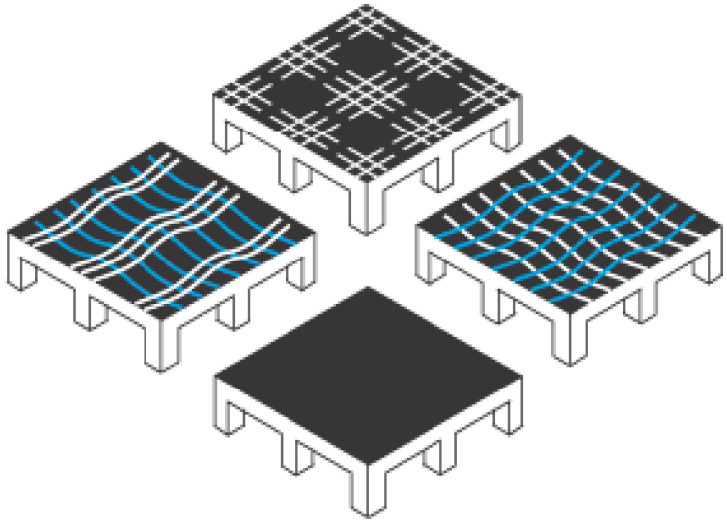

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Mon Jan 27 2025

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Units

Geometry Units

Plan Dimensions: feet
Angles: degrees
Slab Thickness: inches
Elevations: inches
Support Dimensions: inches
Support Height: feet

Loading and Reaction Units

Point Force: Kips
- Report As Zero: 0 Kips

Point Moment: kip-ft
- Report As Zero: 0 kip-ft

Line Force: kips/ft
- Report As Zero: 0 kips/ft

Line Moment: Kips
- Report As Zero: 0 Kips

Area Force: psf
- Report As Zero: 0 psf

Area Moment: #/foot
- Report As Zero: 0 #/foot

Spring and Stiffness Units

Point Force Spring: kips/in
Point Moment Spring: k-ft/°
Line Force Spring: ksi
Line Moment Spring: k/°
Area Force Spring: pci
Area Moment Spring: k/ft°

Slab Analysis Units

Force: Kips
- Report As Zero: 0 Kips

Force Per Width: kips/ft
- Report As Zero: 0 kips/ft

Moment: kip-ft
- Report As Zero: 0 kip-ft

Moment Per Width: Kips
- Report As Zero: 0 Kips

Concrete Stress: psi
- Report As Zero: 0 psi

Deflection: inches
- Report As Zero: 0 inches

Units (2)

Materials Units

Concrete Volume: yd³
Reinforcing Area: in²
Reinforcement Weight: tons
Tendon Force: Kips
Tendon Force Per Width: kips/ft
Tendon Profile: inches
Reinforcing Stress: ksi
PT Weight: pounds
Cover: inches

Miscellaneous Units

Floor Area: ft²
Density: pcf
Elongations: inches
Tendon Angles (for friction): radians
Temperature Change: °F

Materials

Concrete Mix

Mix Name	Density (pcf)	Density For Loads (pcf)	f'ci (psi)	f'c (psi)	fcui (psi)	fcu (psi)	Poissons Ratio	Thermal Exp. Coeff	Ec Calc	User Eci (psi)	User Ec (psi)
3000 psi	150	150	3000	3000	3725	3725	0.2	5.556e-6	Code	2500000	3000000
4000 psi	150	150	3000	4000	3725	4975	0.2	5.556e-6	Code	2500000	3000000
5000 psi	150	150	3000	5000	3725	6399	0.2	5.556e-6	Code	2500000	3000000
6000 psi	150	150	3000	6000	3725	7450	0.2	5.556e-6	Code	2500000	3000000
4500 psi	150	150	3000	4500	3725	5590	0.2	5.556e-6	Code	2500000	3000000

PT Systems

System Name	Strand	Duct	Anchor	fse (ksi)	Long-Term Losses (ksi)	Min Radius (feet)
½" Unbonded	½" 7-Wire Strand	½" Unbonded Sheathing	Monostrand Anchor	175	22	6
0.6" Unbonded	0.6" 7-Wire Strand	0.6" Unbonded Sheathing	Monostrand Anchor	175	22	8
½" Bonded Flat Duct	½" 7-Wire Strand	½" Bonded Flat Duct	Flat Duct Anchor	175	22	6
0.6" Bonded Flat Duct	0.6" 7-Wire Strand	0.6" Bonded Flat Duct	Flat Duct Anchor	175	22	8

Strand Materials

Strand Name	Aps (in²)	Eps (ksi)	fpy (ksi)	fpu (ksi)
½" 7-Wire Strand	0.153	28000	243	270
0.6" 7-Wire Strand	0.217	28000	243	270

Duct Systems

Duct Name	Type	Shape	Material	Duct Height (inches)	Duct Width (inches)	Max Strands Per Duct	Wobble Friction (1/feet)	Angular Friction (1/radians)
½" Unbonded Sheathing	unbonded	Round	Tightly Sheathed	0.5	0.5	1	0.0014	0.07
0.6" Unbonded Sheathing	unbonded	Round	Tightly Sheathed	0.6	0.6	1	0.0014	0.07
½" Bonded Flat Duct	bonded	Flat	Corrugated Plastic	1	3	5	0.0002	0.14
0.6" Bonded Flat Duct	bonded	Flat	Corrugated Plastic	1	3	4	0.0002	0.14

Materials (2)

Anchor Systems

Anchor Name	Type	Jacking Stress (ksi)	Anchor Friction	Seating Distance (inches)
Monostrand Anchor	Monostrand	216	0	0.25
Flat Duct Anchor	Flat Multi-Plane	216	0.02	0.25

Reinforcing Bars

Bar Name	As (in²)	Es (ksi)	Fy (ksi)	Coating	Straight Ld/Db	90 Hook Ld/Db	180 Hook Ld/Db
#3	0.11	29000	60	None	Code	Code	Code
#4	0.2	29000	60	None	Code	Code	Code
#5	0.31	29000	60	None	Code	Code	Code
#6	0.44	29000	60	None	Code	Code	Code
#7	0.6	29000	60	None	Code	Code	Code
#8	0.79	29000	60	None	Code	Code	Code
#9	1	29000	60	None	Code	Code	Code
#10	1.27	29000	60	None	Code	Code	Code
#11	1.56	29000	60	None	Code	Code	Code

SSR Systems

SSR System Name	Stud Area (in²)	Head Area (in²)	Min Clear Head Spacing (inches)	Specified Stud Spacing (inches)	Fy (ksi)	Stud Spacing Rounding Increment (inches)	Min Studs Per Rail	System Type
3/8" SSR	0.11	1.11	0.5	infinite	50	0.25	2	Rail
1/2" SSR	0.196	1.96	0.5	infinite	50	0.25	2	Rail
5/8" SSR	0.307	3.07	0.5	infinite	50	0.25	2	Rail
3/4" SSR	0.442	4.42	0.5	infinite	50	0.25	2	Rail

Loadings

Loading Name	*Type*	*Analysis*	*On-Pattern Factor*	*Off-Pattern Factor*
Self-Dead Loading	Self-Weight	Normal	1	1
Balance Loading	Balance	Normal	1	1
Hyperstatic Loading	Hyperstatic	Hyperstatic	1	1
Temporary Construction (At Stressing) Loading	Stressing Dead	Normal	1	1
Other Dead Loading	Dead	Normal	1	1
Live (Reducible) Loading	Live (Reducible)	Normal	1	0
Live (Unreducible) Loading	Live (Unreducible)	Normal	1	0
Live (Storage) Loading	Live (Storage)	Normal	1	0
Live (Parking) Loading	Live (Parking)	Normal	1	0
Live (Roof) Loading	Live (Roof)	Normal	1	0
Snow Loading	Snow	Normal	1	1
Ultimate Wind North Loading	Ultimate Wind 1	Normal	1	1
Ultimate Wind East Loading	Ultimate Wind 2	Normal	1	1
Ultimate Seismic North Loading	Ultimate Seismic 1	Normal	1	1
Ultimate Seismic East Loading	Ultimate Seismic 2	Normal	1	1

Load Combinations

All Dead LC

Active Design Criteria: <none>
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	1
Other Dead Loading	1

Dead + Balance LC

Active Design Criteria: <none>
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1
Other Dead Loading	1

Initial Service LC

Active Design Criteria: Initial Service Design
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1.13
Temporary Construction (At Stressing) Loading	1

Load Combinations (2)

Service LC: D + L

Active Design Criteria: User Minimum Design, Code Minimum Design, Service Design, Soil Bearing Design
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1
Other Dead Loading	1
Live (Reducible) Loading	1
Live (Unreducible) Loading	1
Live (Storage) Loading	1
Live (Parking) Loading	1

Service LC: D

Active Design Criteria: User Minimum Design, Code Minimum Design, Service Design, Soil Bearing Design
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1
Other Dead Loading	1

Service LC: D + Lr

Active Design Criteria: User Minimum Design, Code Minimum Design, Service Design, Soil Bearing Design
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1
Other Dead Loading	1
Live (Roof) Loading	1

Load Combinations (3)

Service LC: D + S

Active Design Criteria: User Minimum Design, Code Minimum Design, Service Design, Soil Bearing Design
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1
Other Dead Loading	1
Snow Loading	1

Service LC: D + 0.75L + 0.75Lr

Active Design Criteria: User Minimum Design, Code Minimum Design, Service Design, Soil Bearing Design
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1
Other Dead Loading	1
Live (Reducible) Loading	0.75
Live (Unreducible) Loading	0.75
Live (Storage) Loading	0.75
Live (Parking) Loading	0.75
Live (Roof) Loading	0.75

Load Combinations (4)

Service LC: D + 0.75L + 0.75S

Active Design Criteria: User Minimum Design, Code Minimum Design, Service Design, Soil Bearing Design
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1
Other Dead Loading	1
Live (Reducible) Loading	0.75
Live (Unreducible) Loading	0.75
Live (Storage) Loading	0.75
Live (Parking) Loading	0.75
Snow Loading	0.75

Service Wind LC: D + 0.6W

Active Design Criteria: Soil Bearing Design
Analysis: Zero-Tension
Key Lateral Loading: Wind-Ultimate Standard Factor: 0.6

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1
Other Dead Loading	1

Service Wind LC: D - 0.6W

Active Design Criteria: Soil Bearing Design
Analysis: Zero-Tension
Key Lateral Loading: Wind-Ultimate Standard Factor: -0.6

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1
Other Dead Loading	1

Load Combinations (5)

Service Wind LC: D + 0.75L + 0.75Lr + 0.45W

Active Design Criteria: Soil Bearing Design
Analysis: Zero-Tension
Key Lateral Loading: Wind-Ultimate Standard Factor: 0.45

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1
Other Dead Loading	1
Live (Reducible) Loading	0.75
Live (Unreducible) Loading	0.75
Live (Storage) Loading	0.75
Live (Parking) Loading	0.75
Live (Roof) Loading	0.75

Service Wind LC: D + 0.75L + 0.75Lr - 0.45W

Active Design Criteria: Soil Bearing Design
Analysis: Zero-Tension
Key Lateral Loading: Wind-Ultimate Standard Factor: -0.45

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1
Other Dead Loading	1
Live (Reducible) Loading	0.75
Live (Unreducible) Loading	0.75
Live (Storage) Loading	0.75
Live (Parking) Loading	0.75
Live (Roof) Loading	0.75

Load Combinations (6)

Service Wind LC: D + 0.75L + 0.75S + 0.45W

Active Design Criteria: Soil Bearing Design
Analysis: Zero-Tension
Key Lateral Loading: Wind-Ultimate Standard Factor: 0.45

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1
Other Dead Loading	1
Live (Reducible) Loading	0.75
Live (Unreducible) Loading	0.75
Live (Storage) Loading	0.75
Live (Parking) Loading	0.75
Snow Loading	0.75

Service Wind LC: D + 0.75L + 0.75S - 0.45W

Active Design Criteria: Soil Bearing Design
Analysis: Zero-Tension
Key Lateral Loading: Wind-Ultimate Standard Factor: -0.45

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1
Other Dead Loading	1
Live (Reducible) Loading	0.75
Live (Unreducible) Loading	0.75
Live (Storage) Loading	0.75
Live (Parking) Loading	0.75
Snow Loading	0.75

Load Combinations (7)

Service Wind LC: 0.6D + 0.6W

Active Design Criteria: Soil Bearing Design
Analysis: Zero-Tension
Key Lateral Loading: Wind-Ultimate Standard Factor: 0.6

Loading	*Standard Factor*
Self-Dead Loading	0.6
Balance Loading	1
Other Dead Loading	0.6

Service Wind LC: 0.6D - 0.6W

Active Design Criteria: Soil Bearing Design
Analysis: Zero-Tension
Key Lateral Loading: Wind-Ultimate Standard Factor: -0.6

Loading	*Standard Factor*
Self-Dead Loading	0.6
Balance Loading	1
Other Dead Loading	0.6

Service Seismic LC: D + 0.7E

Active Design Criteria: Soil Bearing Design
Analysis: Zero-Tension
Key Lateral Loading: Seismic-Ultimate Standard Factor: 0.7

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1
Other Dead Loading	1

Load Combinations (8)

Service Seismic LC: D - 0.7E

Active Design Criteria: Soil Bearing Design
Analysis: Zero-Tension
Key Lateral Loading: Seismic-Ultimate Standard Factor: -0.7

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1
Other Dead Loading	1

Service Seismic LC: D + 0.75L + 0.75S + 0.525E

Active Design Criteria: Soil Bearing Design
Analysis: Zero-Tension
Key Lateral Loading: Seismic-Ultimate Standard Factor: 0.525

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1
Other Dead Loading	1
Live (Reducible) Loading	0.75
Live (Unreducible) Loading	0.75
Live (Storage) Loading	0.75
Live (Parking) Loading	0.75
Snow Loading	0.75

Load Combinations (9)

Service Seismic LC: D + 0.75L + 0.75S - 0.525E

Active Design Criteria: Soil Bearing Design
Analysis: Zero-Tension
Key Lateral Loading: Seismic-Ultimate Standard Factor: -0.525

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1
Other Dead Loading	1
Live (Reducible) Loading	0.75
Live (Unreducible) Loading	0.75
Live (Storage) Loading	0.75
Live (Parking) Loading	0.75
Snow Loading	0.75

Service Seismic LC: 0.6D + 0.7E

Active Design Criteria: Soil Bearing Design
Analysis: Zero-Tension
Key Lateral Loading: Seismic-Ultimate Standard Factor: 0.7

Loading	*Standard Factor*
Self-Dead Loading	0.6
Balance Loading	1
Other Dead Loading	0.6

Service Seismic LC: 0.6D - 0.7E

Active Design Criteria: Soil Bearing Design
Analysis: Zero-Tension
Key Lateral Loading: Seismic-Ultimate Standard Factor: -0.7

Loading	*Standard Factor*
Self-Dead Loading	0.6
Balance Loading	1
Other Dead Loading	0.6

Load Combinations (10)

Sustained Service LC

Active Design Criteria: Sustained Service Design
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	1
Balance Loading	1
Other Dead Loading	1
Live (Reducible) Loading	0.5
Live (Unreducible) Loading	0.5
Live (Storage) Loading	1
Live (Parking) Loading	0.5
Live (Roof) Loading	0.5

Factored LC: 1.4D

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	1.4
Hyperstatic Loading	1
Other Dead Loading	1.4

Factored LC: 0.9D

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	0.9
Hyperstatic Loading	1
Other Dead Loading	0.9

Load Combinations (11)

Factored LC: 1.2D + 1.6L + 0.5Lr

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	1.2
Hyperstatic Loading	1
Other Dead Loading	1.2
Live (Reducible) Loading	1.6
Live (Unreducible) Loading	1.6
Live (Storage) Loading	1.6
Live (Parking) Loading	1.6
Live (Roof) Loading	0.5

Factored LC: 1.2D + 1.6L + 0.5S

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	1.2
Hyperstatic Loading	1
Other Dead Loading	1.2
Live (Reducible) Loading	1.6
Live (Unreducible) Loading	1.6
Live (Storage) Loading	1.6
Live (Parking) Loading	1.6
Snow Loading	0.5

Load Combinations (12)

Factored LC: 0.9D + 1.6L + 0.5Lr

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	0.9
Hyperstatic Loading	1
Other Dead Loading	0.9
Live (Reducible) Loading	1.6
Live (Unreducible) Loading	1.6
Live (Storage) Loading	1.6
Live (Parking) Loading	1.6
Live (Roof) Loading	0.5

Factored LC: 0.9D + 1.6L + 0.5S

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	0.9
Hyperstatic Loading	1
Other Dead Loading	0.9
Live (Reducible) Loading	1.6
Live (Unreducible) Loading	1.6
Live (Storage) Loading	1.6
Live (Parking) Loading	1.6
Snow Loading	0.5

Load Combinations (13)

Factored LC: 1.2D + f1L + 1.6Lr

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	1.2
Hyperstatic Loading	1
Other Dead Loading	1.2
Live (Reducible) Loading	0.5
Live (Unreducible) Loading	1
Live (Storage) Loading	1
Live (Parking) Loading	1
Live (Roof) Loading	1.6

Factored LC: 1.2D + f1L + 1.6S

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	1.2
Hyperstatic Loading	1
Other Dead Loading	1.2
Live (Reducible) Loading	0.5
Live (Unreducible) Loading	1
Live (Storage) Loading	1
Live (Parking) Loading	1
Snow Loading	1.6

Load Combinations (14)

Factored LC: 0.9D + f1L + 1.6Lr

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	0.9
Hyperstatic Loading	1
Other Dead Loading	0.9
Live (Reducible) Loading	0.5
Live (Unreducible) Loading	1
Live (Storage) Loading	1
Live (Parking) Loading	1
Live (Roof) Loading	1.6

Factored LC: 0.9D + f1L + 1.6S

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension

Loading	*Standard Factor*
Self-Dead Loading	0.9
Hyperstatic Loading	1
Other Dead Loading	0.9
Live (Reducible) Loading	0.5
Live (Unreducible) Loading	1
Live (Storage) Loading	1
Live (Parking) Loading	1
Snow Loading	1.6

Load Combinations (15)

Factored Wind LC: 1.2D + f1L + 0.5Lr + 1.0W

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension
Key Lateral Loading: Wind-Ultimate Standard Factor: 1

Loading	*Standard Factor*
Self-Dead Loading	1.2
Hyperstatic Loading	1
Other Dead Loading	1.2
Live (Reducible) Loading	0.5
Live (Unreducible) Loading	1
Live (Storage) Loading	1
Live (Parking) Loading	1
Live (Roof) Loading	0.5

Factored Wind LC: 1.2D + f1L + 0.5Lr - 1.0W

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension
Key Lateral Loading: Wind-Ultimate Standard Factor: -1

Loading	*Standard Factor*
Self-Dead Loading	1.2
Hyperstatic Loading	1
Other Dead Loading	1.2
Live (Reducible) Loading	0.5
Live (Unreducible) Loading	1
Live (Storage) Loading	1
Live (Parking) Loading	1
Live (Roof) Loading	0.5

Load Combinations (16)

Factored Wind LC: 1.2D + f1L + 0.5S + 1.0W

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension
Key Lateral Loading: Wind-Ultimate Standard Factor: 1

Loading	*Standard Factor*
Self-Dead Loading	1.2
Hyperstatic Loading	1
Other Dead Loading	1.2
Live (Reducible) Loading	0.5
Live (Unreducible) Loading	1
Live (Storage) Loading	1
Live (Parking) Loading	1
Snow Loading	0.5

Factored Wind LC: 1.2D + f1L + 0.5S - 1.0W

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension
Key Lateral Loading: Wind-Ultimate Standard Factor: -1

Loading	*Standard Factor*
Self-Dead Loading	1.2
Hyperstatic Loading	1
Other Dead Loading	1.2
Live (Reducible) Loading	0.5
Live (Unreducible) Loading	1
Live (Storage) Loading	1
Live (Parking) Loading	1
Snow Loading	0.5

Load Combinations (17)

Factored Wind LC: 1.2D + 1.6Lr + 0.5W

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension
Key Lateral Loading: Wind-Ultimate Standard Factor: 0.5

Loading	*Standard Factor*
Self-Dead Loading	1.2
Hyperstatic Loading	1
Other Dead Loading	1.2
Live (Roof) Loading	1.6

Factored Wind LC: 1.2D + 1.6Lr - 0.5W

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension
Key Lateral Loading: Wind-Ultimate Standard Factor: -0.5

Loading	*Standard Factor*
Self-Dead Loading	1.2
Hyperstatic Loading	1
Other Dead Loading	1.2
Live (Roof) Loading	1.6

Factored Wind LC: 1.2D + 1.6S + 0.5W

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension
Key Lateral Loading: Wind-Ultimate Standard Factor: 0.5

Loading	*Standard Factor*
Self-Dead Loading	1.2
Hyperstatic Loading	1
Other Dead Loading	1.2
Snow Loading	1.6

Load Combinations (18)

Factored Wind LC: 1.2D + 1.6S - 0.5W

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension
Key Lateral Loading: Wind-Ultimate Standard Factor: -0.5

Loading	*Standard Factor*
Self-Dead Loading	1.2
Hyperstatic Loading	1
Other Dead Loading	1.2
Snow Loading	1.6

Factored Wind LC: 0.9D + W

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension
Key Lateral Loading: Wind-Ultimate Standard Factor: 1

Loading	*Standard Factor*
Self-Dead Loading	0.9
Hyperstatic Loading	1
Other Dead Loading	0.9

Factored Wind LC: 0.9D - W

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension
Key Lateral Loading: Wind-Ultimate Standard Factor: -1

Loading	*Standard Factor*
Self-Dead Loading	0.9
Hyperstatic Loading	1
Other Dead Loading	0.9

Load Combinations (19)

Factored Seismic LC: 1.2D + f1L + 0.2S + E

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension
Key Lateral Loading: Seismic-Ultimate Standard Factor: 1

Loading	*Standard Factor*
Self-Dead Loading	1.2
Hyperstatic Loading	1
Other Dead Loading	1.2
Live (Reducible) Loading	0.5
Live (Unreducible) Loading	1
Live (Storage) Loading	1
Live (Parking) Loading	1
Snow Loading	0.2

Factored Seismic LC: 1.2D + f1L + 0.2S - E

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension
Key Lateral Loading: Seismic-Ultimate Standard Factor: -1

Loading	*Standard Factor*
Self-Dead Loading	1.2
Hyperstatic Loading	1
Other Dead Loading	1.2
Live (Reducible) Loading	0.5
Live (Unreducible) Loading	1
Live (Storage) Loading	1
Live (Parking) Loading	1
Snow Loading	0.2

Load Combinations (20)

Factored Seismic LC: 0.9D + E

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension
Key Lateral Loading: Seismic-Ultimate Standard Factor: 1

Loading	*Standard Factor*
Self-Dead Loading	0.9
Hyperstatic Loading	1
Other Dead Loading	0.9

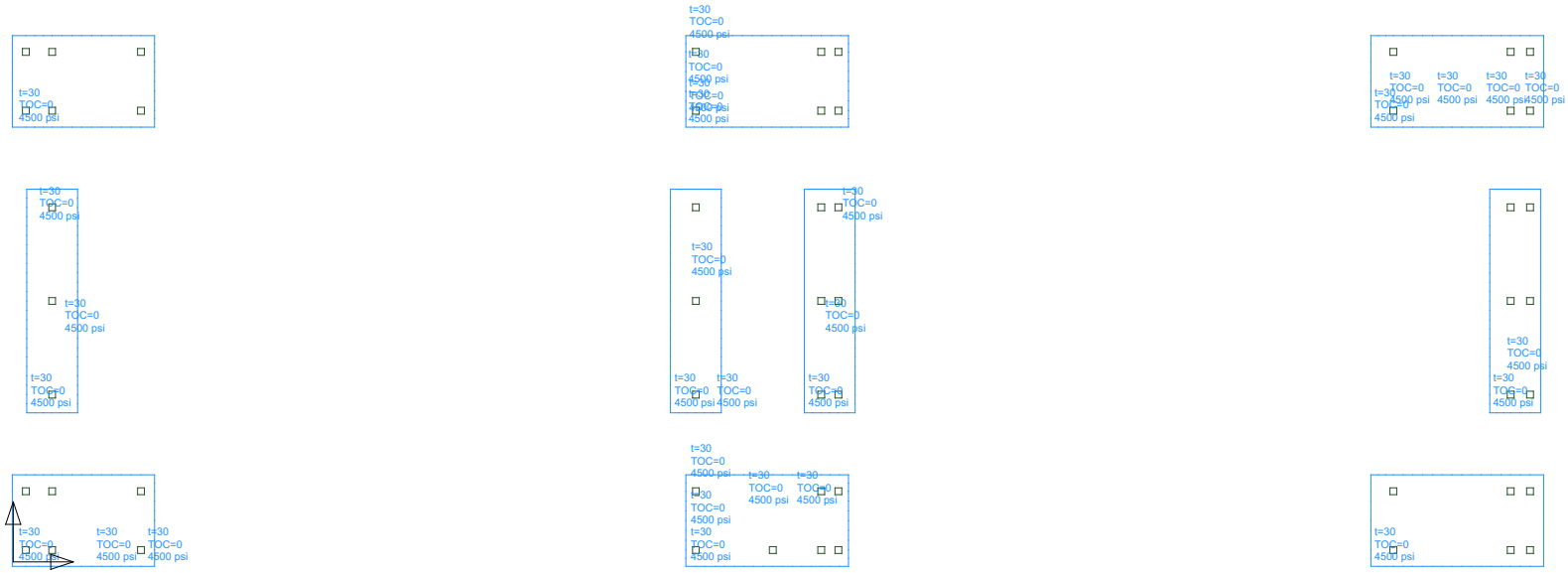
Factored Seismic LC: 0.9D - E

Active Design Criteria: User Minimum Design, Code Minimum Design, Strength Design, Ductility Design
Analysis: Zero-Tension
Key Lateral Loading: Seismic-Ultimate Standard Factor: -1

Loading	*Standard Factor*
Self-Dead Loading	0.9
Hyperstatic Loading	1
Other Dead Loading	0.9

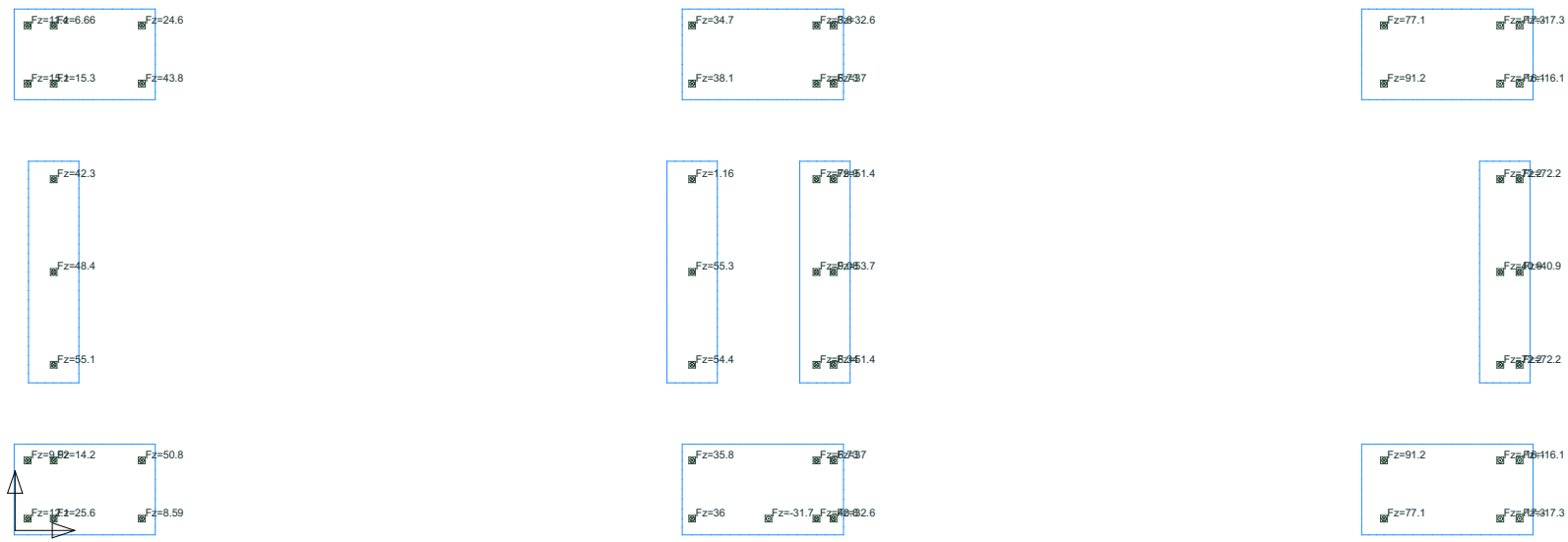
Element: Slab Summary Plan

Element: User Lines; User Notes; User Dimensions; Wall Elements Below; Wall Elements Above; Column Elements Below; Column Elements Above; Point Springs; Point Spring Icons; Line Springs; Line Spring Icons; Slab Elements; Slab Element Outline Only; Slab Element Thicknesses; Slab Element Elevations; Slab Element Concrete Models;
Scale = 1:450



Other Dead Loading: All Loads Plan

Other Dead Loading: User Lines; User Notes; User Dimensions; Point Loads; Point Load Icons; Point Load Values; Line Loads; Line Load Icons; Line Load Values; Area Loads; Area Load Icons; Area Load Values;
Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;
Scale = 1:450



Live (Roof) Loading: All Loads Plan

Live (Roof) Loading: User Lines; User Notes; User Dimensions; Point Loads; Point Load Icons; Point Load Values; Line Loads; Line Load Icons; Line Load Values; Area Loads; Area Load Icons; Area Load Values;
Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;
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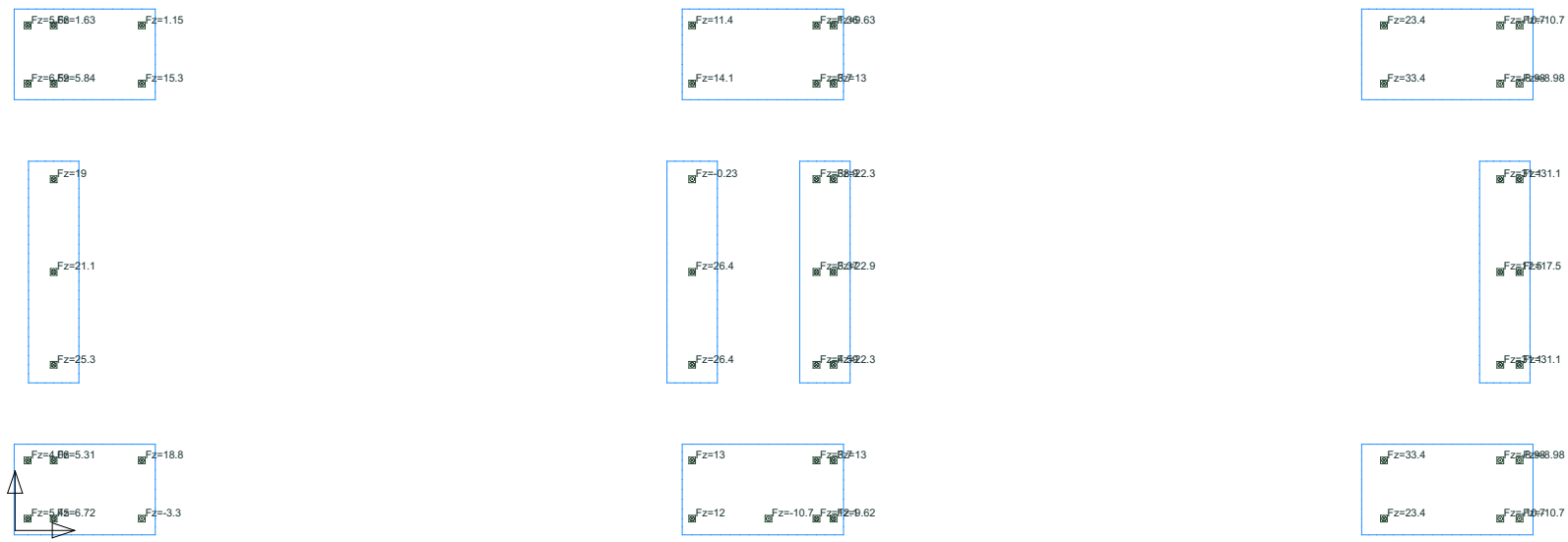
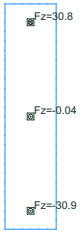


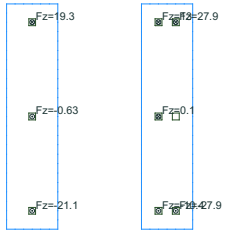
Ultimate Seismic East Loading: All Loads Plan

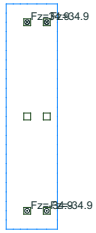
Ultimate Seismic East Loading: User Lines; User Notes; User Dimensions; Point Loads; Point Load Icons; Point Load Values; Line Loads; Line Load Icons; Line Load Values; Area Loads; Area Load Icons; Area Load Values; Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;
Scale = 1:450

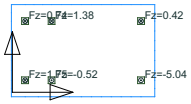
Ultimate Seismic North Loading: All Loads Plan

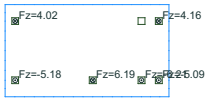
Ultimate Seismic North Loading: User Lines; User Notes; User Dimensions; Point Loads; Point Load Icons; Point Load Values; Line Loads; Line Load Icons; Line Load Values; Area Loads; Area Load Icons; Area Load Values;
Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;
Scale = 1:450





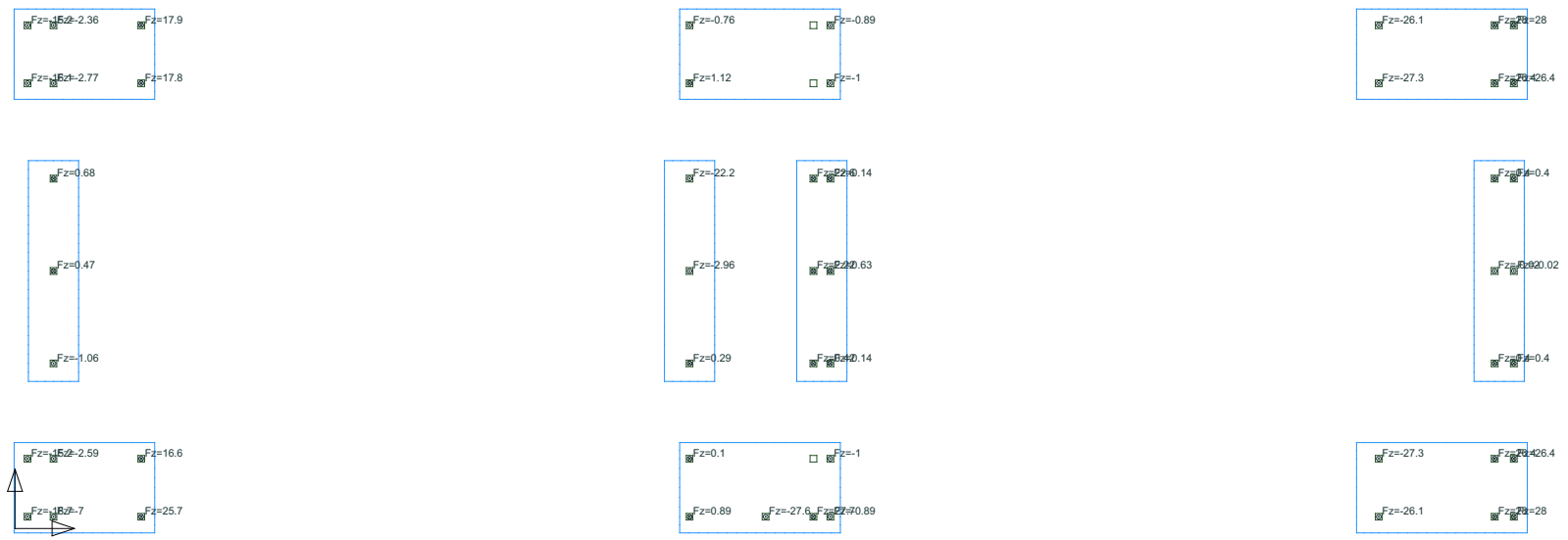






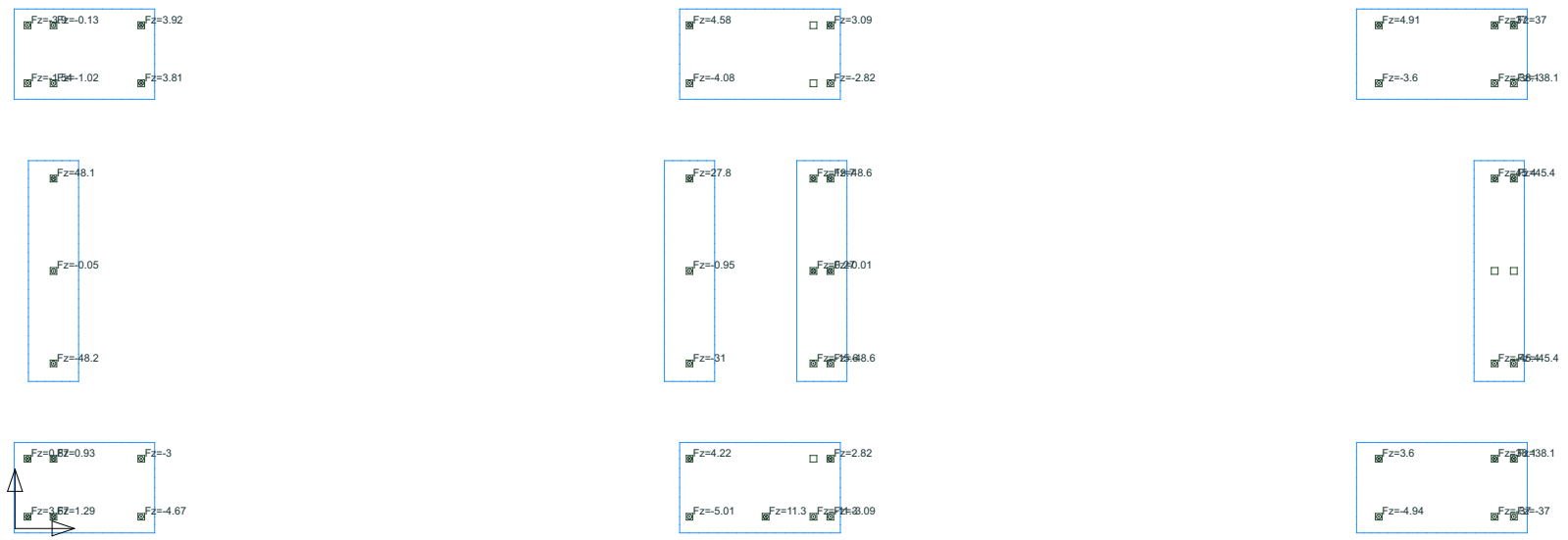
Ultimate Wind East Loading: All Loads Plan

Ultimate Wind East Loading: User Lines; User Notes; User Dimensions; Point Loads; Point Load Icons; Point Load Values; Line Loads; Line Load Icons; Line Load Values; Area Loads; Area Load Icons; Area Load Values;
Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;
Scale = 1:450



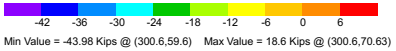
Ultimate Wind North Loading: All Loads Plan

Ultimate Wind North Loading: User Lines; User Notes; User Dimensions; Point Loads; Point Load Icons; Point Load Values; Line Loads; Line Load Icons; Line Load Values; Area Loads; Area Load Icons; Area Load Values;
Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;
Scale = 1:450

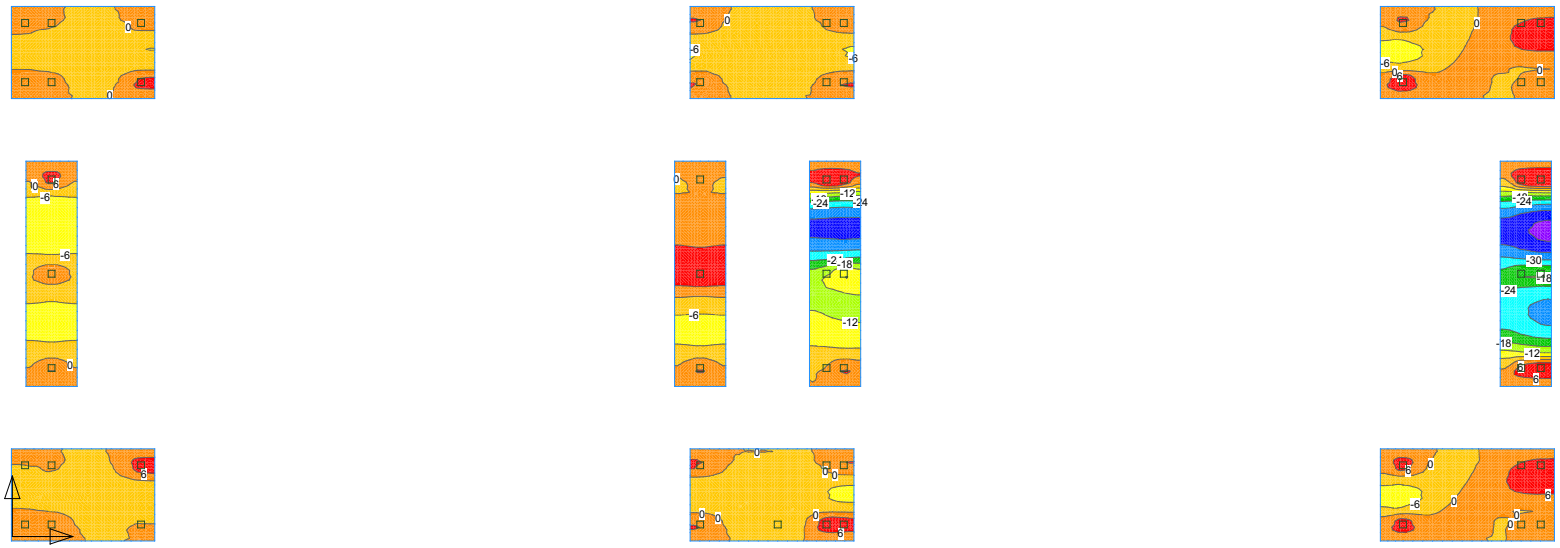


Factored Wind LC: 1.2D + f1L + 0.5Lr + 1.0W: Max Mx Plan

Factored Wind LC: 1.2D + f1L + 0.5Lr + 1.0W: User Lines; User Notes; User Dimensions;
Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;
Scale = 1:450
Factored Wind LC: 1.2D + f1L + 0.5Lr + 1.0W - Bending Moment Plot (Maximum Values) (X-Axis Direction)



Min Value = -43.98 Kips @ (300.6,59.6) Max Value = 18.6 Kips @ (300.6,70.63)

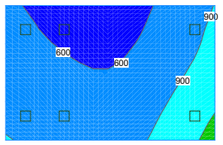


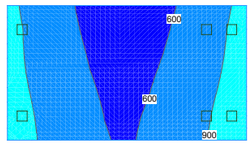
Soil Bearing Design: Max Soil Bearing Pressure Plan

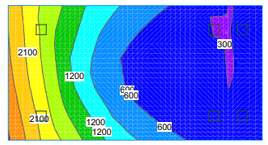
Soil Bearing Design: User Lines; User Notes; User Dimensions; Latitude Span Designs; Longitude Span Designs; Latitude DS Designs; Longitude DS Designs; PC Designs;
Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;
Scale = 1:250
Soil Bearing Design - Area Spring Vertical Reactions Plot (Maximum Values)

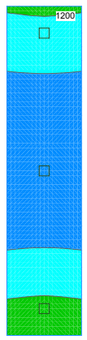
300 600 900 1200 1500 1800 2100 2400 2700

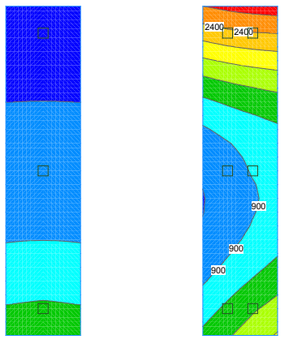
Min Value = 293.5 psf @ (294.7,101.9) Max Value = 3735 psf @ (300.6,73.31)

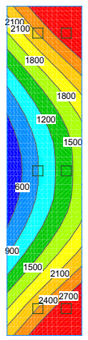


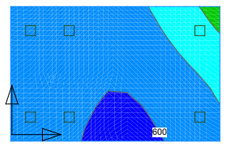


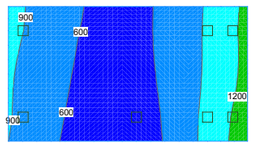


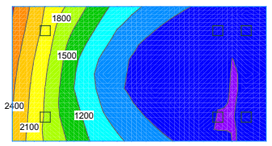










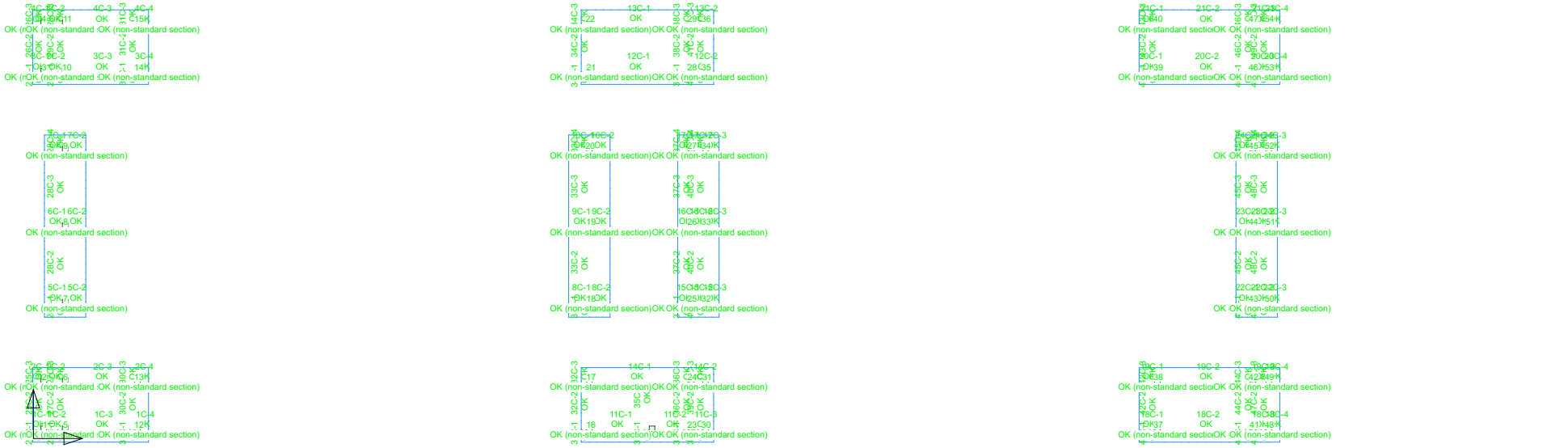


To check sliding: seismic mass x coefficient of friction = 0.36W = 0.36x646 = 233K
Seismic base shear = seismic mass x Cs = 0.123W < 0.36W
Wind base shear = 175K < 233K

There is no tension in the soil, and the foundation is stable against overturning.

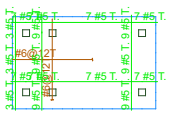
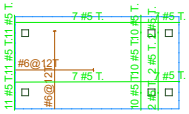
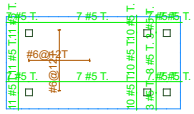
Design Status: Status Plan

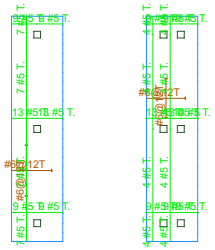
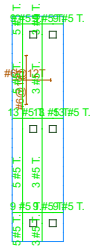
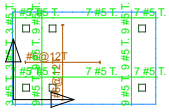
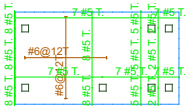
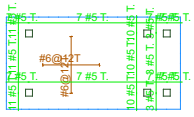
Design Status: User Lines; User Notes; User Dimensions; Latitude Span Designs; Longitude Span Designs; Span Design Numbers; Span Design Status; Latitude DS Designs; Longitude DS Designs; DS Design Numbers; DS Design Status; PC Designs; PC Design Numbers; PC Design Status; Latitude Span Segment Deflection Checks; Longitude Span Segment Deflection Checks; Span Segment Deflecti
Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;
Scale = 1:450



Design Status: Top Reinforcement Plan

Design Status: User Lines; User Notes; User Dimensions; Latitude Span Designs; Longitude Span Designs; Span Design Top Bars; Span Design Bar Descriptions; Latitude DS Designs; Longitude DS Designs; DS Design Top Bars;
Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;
Reinforcement: Top Face Concentrated Reinf.; Both Faces Concentrated Reinf.; Auto Face Concentrated Reinf.; Concentrated Reinf. Descriptions; Top Face Distributed Reinf.; Both Faces Distributed Reinf.; Auto Face Distributed Reinf.; Distributed Reinf. Descriptions; Latitude User Concentrated Reinf.; Longitude User Concentrated Reinf.; Latitude User Distributed Reinf.; Longitude User Distributed Reinf.;
Scale = 1:450

Design Status: Bottom Reinforcement Plan

Design Status: User Lines; User Notes; User Dimensions; Latitude Span Designs; Longitude Span Designs; Span Design Bottom Bars; Span Design Bar Descriptions; Latitude DS Designs; Longitude DS Designs; DS Design Bottom Bars;
Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;
Reinforcement: Bottom Face Concentrated Reinf.; Both Faces Concentrated Reinf.; Auto Face Concentrated Reinf.; Concentrated Reinf. Descriptions; Bottom Face Distributed Reinf.; Both Faces Distributed Reinf.; Auto Face Distributed Reinf.; Distributed Reinf. Descriptions; Latitude User Concentrated Reinf.; Longitude User Concentrated Reinf.; Latitude User Distributed Reinf.; Longitude User Distributed
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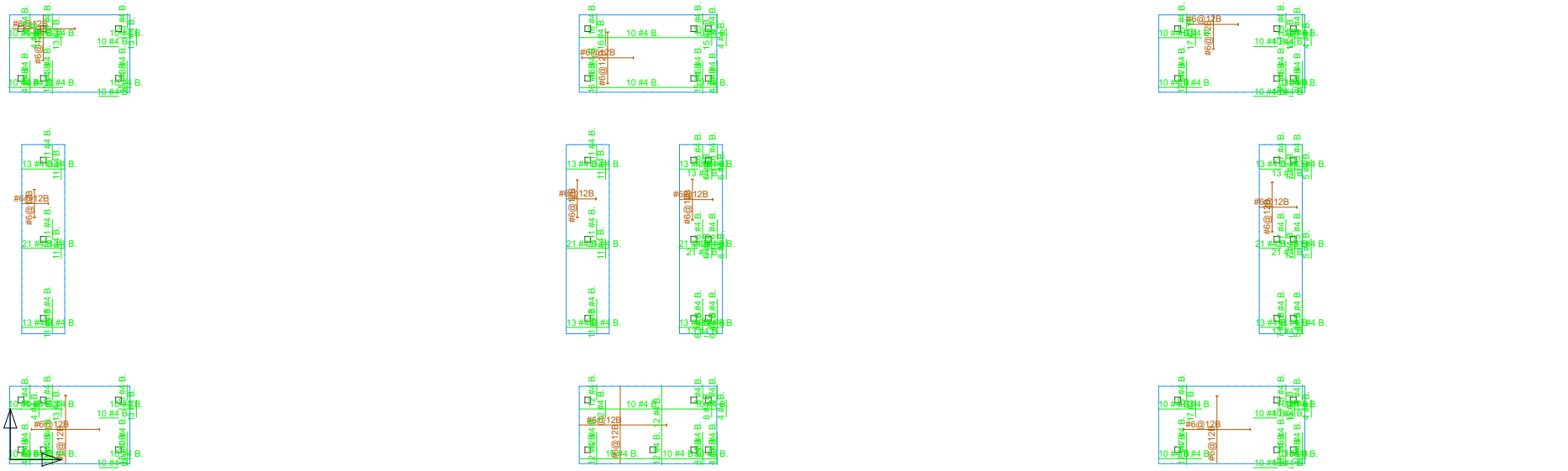

Design Status: Punching Shear Status Plan

Design Status: User Lines; User Notes; User Dimensions; PC Designs; PC Design Numbers; PC Design Status; PC Design Stress Ratios; PC Design Sections; PC Design Flexural Sections; PC Design Flexural Section Design; PC Design Flexural Section Analysis;
Element: Wall Elements Below; Wall Elements Above; Wall Element Outline Only; Column Elements Below; Column Elements Above; Slab Elements; Slab Element Outline Only;
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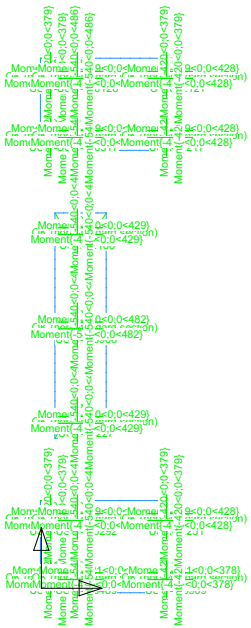

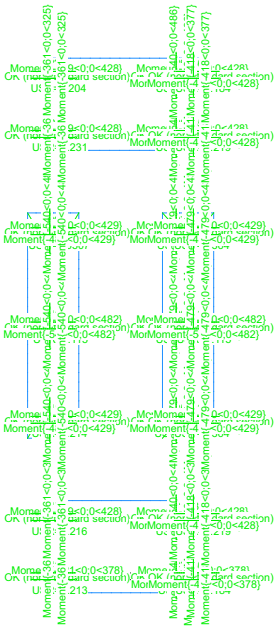

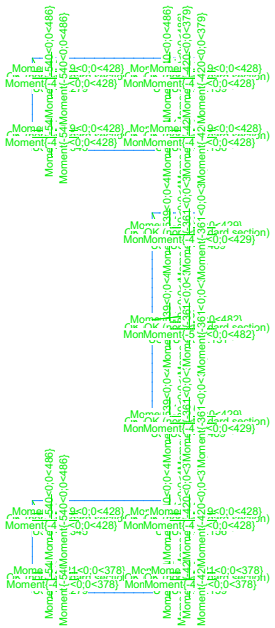

S.O. No. 203434

Subject: Creech DRP Phase 1, AOF Hangar SOG

Sheet No. _____ of _____

Drawing No. _____

Computed by DSC Checked by _____ Date 04/9/2025

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AOF HANGAR BAY SOG CRITERIA

- From RFP: 01 10 10.06 Paragraph 1.4.8.6:
"Design the AOF hangar bay slabs on ground for the minimum wheel loads in accordance with latest edition of UFC 4-211-01. Determine the concrete slab on ground thickness for the AOF hangar bay slabs in accordance with the latest edition of UFC 3-260-02, utilizing a non-reinforced concrete section."

- From RFP Bidder Inquiry Response #10824885:
"The minimum design wheel load for the hangar slab is 30,000 pounds from a tire with a 240 psi pressure. The trench cover plate must be designed to withstand a minimum proof-load of 50,000 pounds from a tire with a 250 psi pressure. By: James Elsberry; SPL PPMD - Military Support Branch; (702-652-8443) On: May 28 2024"

-From UFC 4-211-01:

3-4.2.3.1 Aircraft Maintenance Bay - Slab on Ground Design

Determine the concrete slab on ground thickness for the Aircraft Maintenance Bay in accordance with UFC 3-260-02, utilizing a non-reinforced concrete section with the Service-specific minimum loads shown in this UFC. It is acceptable to design and install reinforcing for temperature and/or crack control but the reinforcing cannot be used to decrease the slab on ground thickness from the calculated non-reinforced slab thickness. If point loads other than wheel loads require a thicker slab section, then reinforcing can be utilized in the area of the point load to keep from increasing the slab thickness for the point load. A typical cross-section is shown in

- Minimum concrete slab on ground thickness will be 8 inches. Increase slab thickness in 1/2" increments.
- Minimum concrete flexural strength will be 550 pounds per square inch (psi) at 90 days.
- Maximum concrete flexural strength will be 650 psi at 90 days.

  \1\
- In hangar bays that allow for multiple aircraft parking positions, provide a uniform slab on ground design throughout the hangar bay. Do not reduce the slab on ground thickness in areas not subject to the design aircraft wheel loads.

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-From UFC 4-211-01:

3-4.2.3.2 Aircraft Maintenance Bay - Concrete Slab on Ground Joint Spacing

Space the Aircraft Maintenance Bay slab on ground joints in accordance with Table 3-1: Aircraft Maintenance Bay Slab on Ground Joint Spacing. Locate the joints considering the column line spacing while not exceeding the maximums listed in Table 3-1: Aircraft Maintenance Bay Slab on Ground Joint Spacing.

Table 3-1: Aircraft Maintenance Bay Slab on Ground Joint Spacing

SLAB TYPE	CONCRETE THICKNESS* (T) MILLIMETERS (INCHES)	SPACING METERS (FEET)
NONREINFORCED SLAB	205 (8) ≤ T ≤ 230 (9) 230 (9) < T ≤ 305 (12) T > 305 (12)	3.8 TO 4.6 (12.5 TO 15) 4.6 TO 6.1 (15 TO 20) 6.1 (20) MAX
SLAB WITH REINFORCEMENT (MINIMUM 0.05% STEEL IN BOTH DIRECTIONS)	ALL THICKNESSES	7.6 (25) MAX

Table 3-2: Concrete Slab on Ground Dowel Size and Spacing

CONCRETE SLAB THICKNESS IN INCHES	\2\ MINIMUM DOWEL LENGTH IN INCHES /2/	\2\ MAXIMUM DOWEL SPACING IN INCHES /2/	DOWEL DIAMETER AND TYPE
8 TO AND INCLUDING 11.5	16	12	1 INCH BAR
12 TO AND INCLUDING 15.5	20	15	1 TO 1-1/4 INCH BAR
16 TO AND INCLUDING 20.5	20	18	1-1/4 TO 1-1/2 INCH BAR
21 TO AND INCLUDING 25.5	24	18	2 INCH BAR
OVER 26	30	18	3 INCH BAR

S.O. No. 203434

Subject: Creech DRP Phase 1, AOF Hangar SOG

Sheet No. _____ of _____

Drawing No. _____

Computed by DSC Checked by _____ Date 04/9/2025

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-From UFC 4-211-01:

5-4 STRUCTURAL

5-4.1 Aircraft Maintenance Bay - Slab on Ground Loading

Air Force traffic loadings are designated in Table 3-1 of UFC 3-260-02 Pavement Design for Airfields. Air Force hangar pavement thickness will be designed in accordance with UFC 3-260-02, Chapter 3, paragraph 2c, titled Type C Traffic Areas. Obtain approval for deviations of aircraft traffic mixes or deviation of airfield design type (heavy, modified-heavy, medium, light) from the AFCEC pavements engineer.

-From Geotech report: k = 120 pci

-From UFC 3-260-02:

Figure 12-6 - Plain concrete design curves for Air Force light-load pavements
Use 12.5" unreinforced pavement thickness (see next page)

Confirmed passing with ACI 360R check on following pages

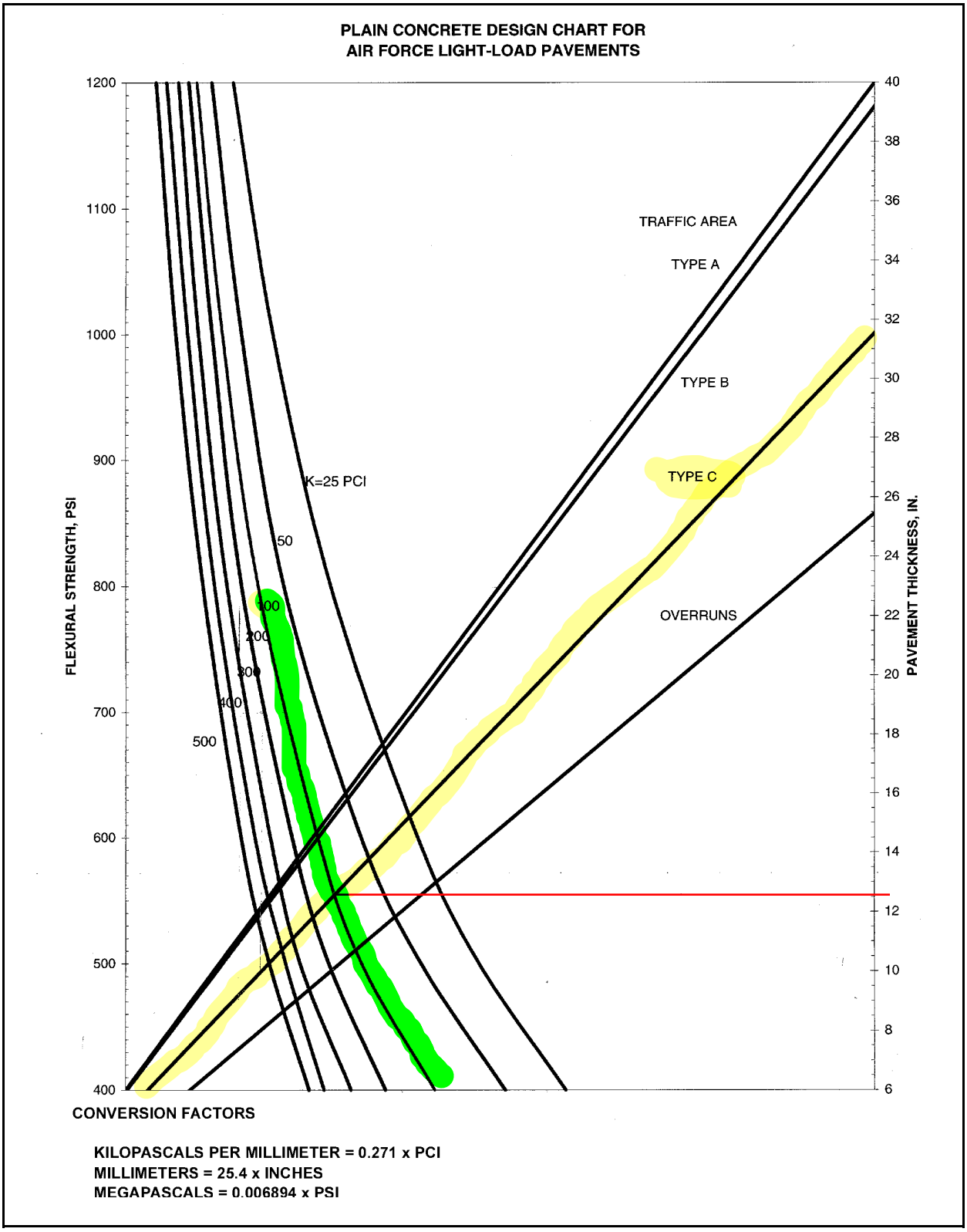

Figure 12-6. Plain concrete design curves for Air Force light-load pavements

SLAB ON GROUND (ACI 360R)

In accordance with Guide to Design of Slab-on-Ground per ACI 360R-10

Tedds calculation version 1.0.03

Design summary

Description	Unit	Provided	Required	Utilization	Result
Slab thickness	in	12.5	9.02	0.722	PASS
Joint spacing	ft	20	22.25	0.899	PASS

Slab foundation-refer to Section 4.1 of ACI 360R

Design method

Design method publisher	**Wire Reinforcement Institute**

Materials and site properties

Slab thickness	h = **12.5** in
Specified compressive strength of concrete	f'_c = **5000** psi
Subgrade modulus	k = **120** lb/in^3
Concrete modulus of elasticity	E = **3605** ksi

Wheel specifications

Axle type	**Single-axle**
Number of wheels at end of each axle	**Single wheel**
Wheel center to center spacing	S = **40** in
Wheel contact area	A_{wheel} = **125** in^2
Diameter of equivalent circle	$d_{eqv_circle} = \sqrt{((A_{wheel} \times 4) / \pi)}$ = **12.6** in

Loading details

Load location	**Interior**
Axle load	P_a = **30** kips
Wheel load	$P_{wheel} = P_a / 2$ = **15** kips
Safety factor	FS = **2**

Slab thickness design

By iteration assumend trial thickness	h_{trial} = **9** in

The following output is based on the use of this trial thickness in the design charts in Appendix A of ACI 360R

Relative stiffness parameter (Fig. A2.1)	Dbyk = **1.94×10^6** in^4
Modulus of rupture of concrete	$f_r = 9 \times \sqrt{(f'_c \times 1\ psi)}$ = **636.4** psi
Allowable tensile stress	$f_{t_allow} = f_r / FS$ = **318.2** psi
Basic bending moments (Fig. A2.2)	M_{basic} = **235.84** lb_in/in/kips
Additional moments (Fig. A2.2)	$M_{additional}$ = **49.5** lb_in/in/kips
Total unit moments	$M_{unit} = M_{basic} + M_{additional}$ = **285.34** lb_in/in/kips

Design bending moments	$M_{design} = M_{unit} \times P_{wheel}$ = **4280** lb_ft/ft
Required slab thickness (Fig. A2.3)	h_{min} = **9.02** in
	h_{min} / h = **0.722**
	PASS - Slab thickness is adequate to avoid live load-induced cracks

Crack control options

Reinforcement type	**Unreinforced**
Concrete type	**Typical concrete**
Actual joint spacing	S_{joint} = **20.0** ft
Recommended joint spacing (Fig.6.6)	S_{joint_max} = **22.3** ft
	S_{joint} / S_{joint_max} = **0.899**
	PASS - Joint spacing is adequate to avoid live load-induced cracks