STRUCTURAL CALCULATIONS FOR

TM Fieldhouse
1600 SE Hamblen Rd
Lee's Summit, MO 64063

Project # 22453

5/3/2023

05/03/2023

Table of Contents

STRUCTURAL DESIGN CRITERIA (2018 IBC AND ASCE 7-16):

1. BUILDING OCCUPANCY RISK CATEGORY III.

2. LIVE LOADS [UNIFORM (PSF) / POINT LOADS (KIPS)]:
   -- ROOF:…….....20 PSF / 300#
   -- GROUND LEVEL SLAB .....100 PSF / 2.0 K
   -- MEZZANINE & STAIRS .....100 PSF / 300#

3. ROOF SNOW LOAD:
   -- GROUND SNOW LOAD (Pg):……..20 PSF
   -- FLAT ROOF SNOW LOAD (Pf): .....16.94 PSF W/ DRIFT
   -- MIN UNIFORM ROOF SNOW LOAD (Pm):…..…..22 PSF (NO DRIFT OR RAIN)
   -- RAIN ON SNOW SURCHARGE (Prs) .....5.0 PSF
   -- SNOW EXPOSURE FACTOR (Ce):……..1.0, EXPOSURE C
   -- SNOW LOAD IMPORTANCE FACTOR (Is):…....1.0
   -- THERMAL FACTOR (Ct):…….....1.1 (just above freezing)
   – SLOPE FACTOR (CS).....1.0

4. WIND DESIGN DATA:
   -- BASIC WIND SPEED (3 SEC GUST):……...117 MPH
   – ASD WIND SPEED, V(ASD).....90 MPH
   -- WIND EXPOSURE:……C
   -- GROUND ELEVATION ABOVE SEA LEVEL……..1,000 FT
   -- DIRECTIONALITY FACTOR (Kd) 0.85
   -- INTERNAL PRESSURE COEFF:……..0.18
   -- COMPONENTS AND CLADDING WIND (ULTIMATE 1.0*W) PRESSURES (BASED ON TRIB 10 S.F., EXP. C. MAY BE REDUCED FOR COMPONENTS WITH LARGER TRIB PER BLDG CODE):
   WALLS AT CORNERS & EDGES:……+31 / -41 PSF
   ALL OTHER MAIN WALL CONDITIONS:……+31 / -33.3 PSF
   ROOF CORNERS:…….....+14 / -96.3 PSF
   ROOF EDGES: .....+14 / -71 PSF
   ALL OTHER MAIN ROOF CONDITIONS:……+14/ -54 PSF
   PARAPET EDGES:.....

5. EARTHQUAKE DESIGN DATA:

-- SEISMIC IMPORTANCE FACTOR (Ie):…….....1.25
-- MAPPED SPECTRAL RESP ACCEL (Ss / S1):…..0.100 / 0.068
-- SITE CLASS:……D
-- SPECTRAL RESPONSE COEFF (Sds / Sd1):……0.107 / 0.110
-- SEISMIC DESIGN CATEGORY:……B
-- SEISMIC FORCE RESISTING SYSTEM:……R=3, STEEL
-- DESIGN BASE SHEAR:……..DETERMINED BY MB MFCR
-- SEISMIC RESPONSE COEFF (Cs):……0.044
-- ANALYSIS PROCEDURE:……..ELF

6. RAIN LOAD DATA:

– 15-MIN RAIN INTENSITY……..8.28 IN/HR
– 60-MIN RAIN INTENSITY……..3.9 IN/HR

DESIGN ASSUMES APPROPRIATE ROOF SLOPE AND DRAINAGE (INCLUDING OVERFLOWS) ARE PROVIDED. ROOF IS DESIGNED FOR LIVE LOAD INDICATED ABOVE

7. GUARD RAILS:.....50 PLF, AND/OR 200# CONCENTRATED LOAD APPLIED IN ANY DIRECTION.

8. ADDITIONAL DELEGATED DESIGN CRITERIA:

A. LOADS

--PEMB COLLATERAL ROOF LOAD:.....5 PSF
--MECHANICAL EQUIPMENT AND LOADS:.....AS INDICATED ON MEP PLANS
--BASKETBALL GOALS, DIVIDING CURTAINS, BASEBALL NETS: AS INDICATED ON ARCH AND MEP PLANS

B. MEMBER DEFLECTION LIMITS (UNDER ROOF LIVE, SNOW, 10 YR WIND, OR SOIL PRESSURE)

--ROOF, SUPPORTING PLASTER CEILING:.....L/360
--ROOF, SUPPORTING OTHER CEILING:.....L/240
--WALL GIRT, BACKING NON-BRITTLE FINISH…….L/180
--WALL GIRT, BACKING BRITTLE FINISH……..L/360

C. BUILDING DRIFT LIMITS (UNDER 10 YR WIND, SEISMIC, OR SOIL PRESSURE):

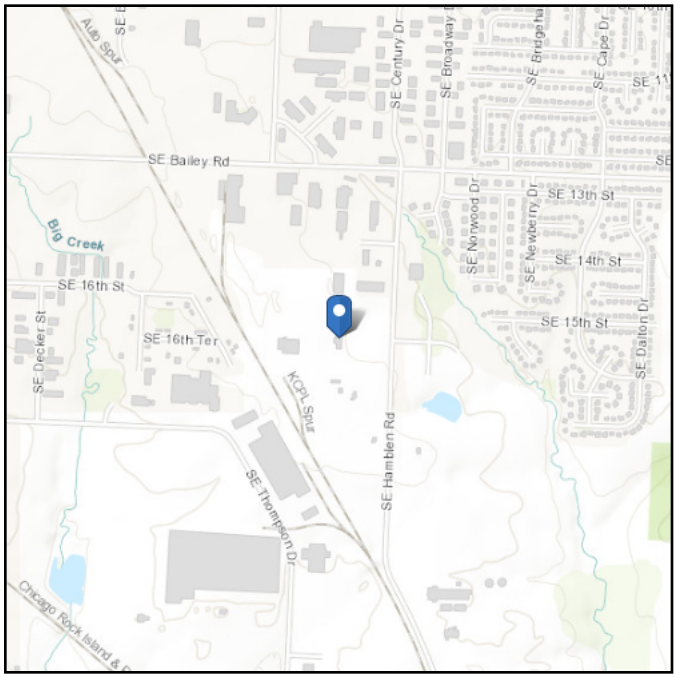
--BRITTLE EXTERIOR FINISH:.....H/240
--METAL WALL PANELS: H/100

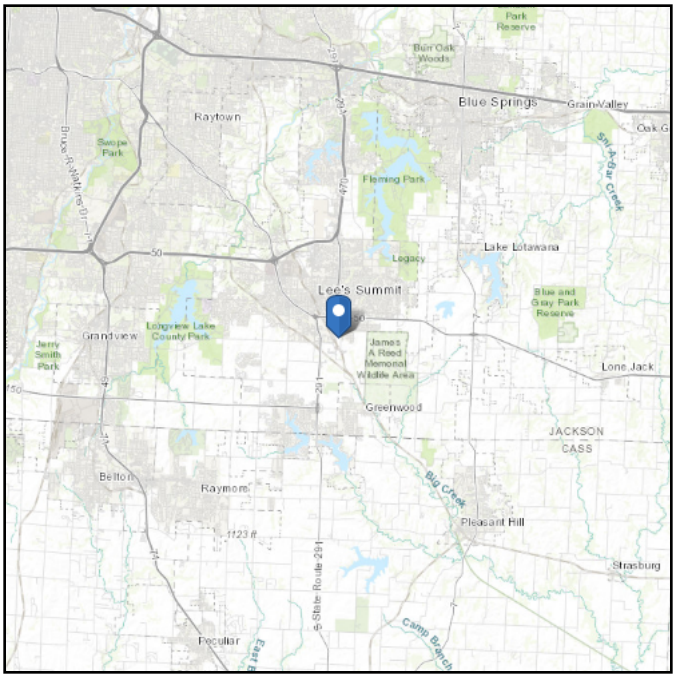
ASCE 7 Hazards Report

Address:
1600 SE Hamblen Rd
Lees Summit, Missouri
64081

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

Latitude: 38.89093
Longitude: -94.361076
Elevation: 1024.2 ft (NAVD 88)





Wind

Results:

Wind Speed	117 Vmph
10-year MRI	76 Vmph
25-year MRI	83 Vmph
50-year MRI	88 Vmph
100-year MRI	94 Vmph

Data Source: ASCE/SEI 7-16, Fig. 26.5-1C and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed: Tue Feb 21 2023

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

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

Seismic

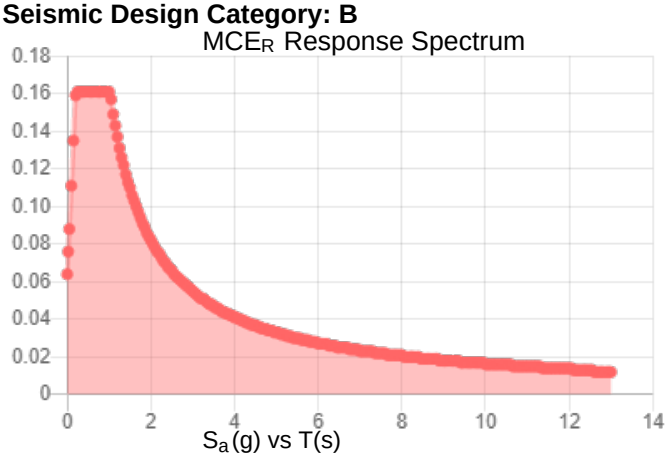
D - Stiff Soil

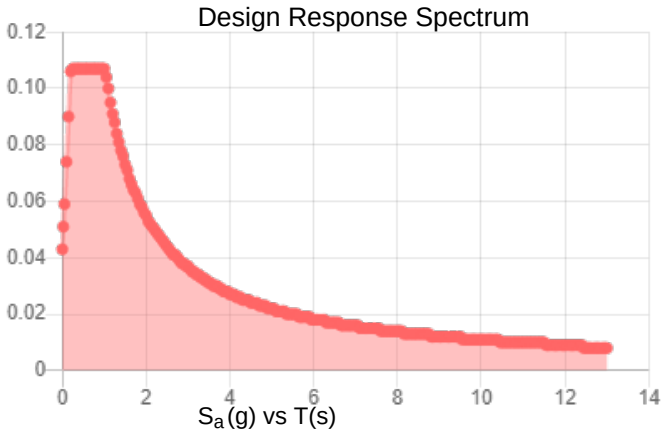
Site Soil Class:

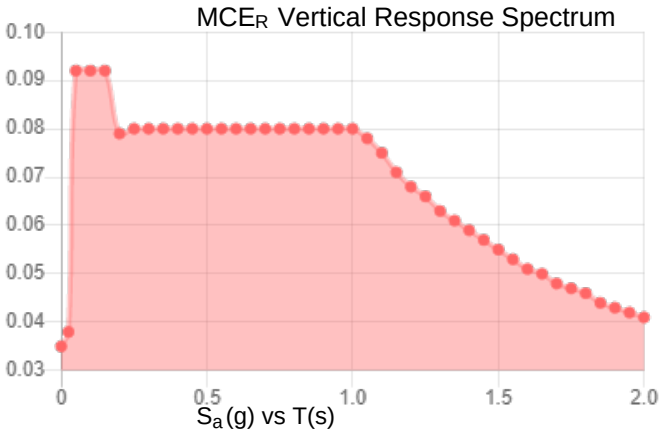
Results:

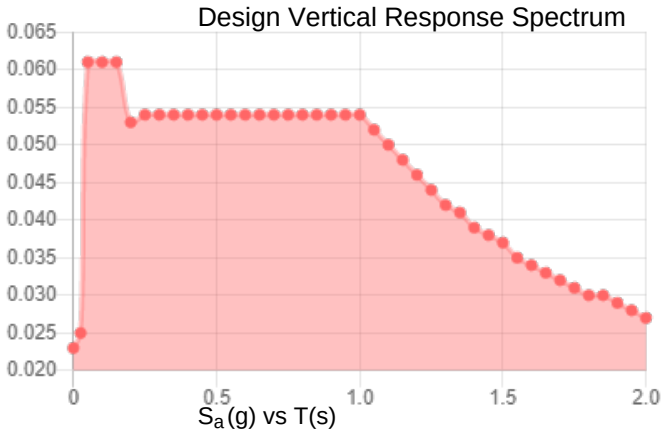
S_S :	0.1	S_{D1} :	0.11
S_1 :	0.068	T_L :	12
F_a :	1.6	PGA :	0.047
F_v :	2.4	PGA_M :	0.076
S_{MS} :	0.161	F_{PGA} :	1.6
S_{M1} :	0.164	I_e :	1.25
S_{DS} :	0.107	C_v :	0.7

Seismic Design Category: B









Data Accessed: **Tue Feb 21 2023**

Date Source:

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

Ice

Results:

Ice Thickness:	1.50 in.
Concurrent Temperature:	5 F
Gust Speed	40 mph
Data Source:	Standard ASCE/SEI 7-16, Figs. 10-2 through 10-8
Date Accessed:	Tue Feb 21 2023

Ice thicknesses on structures in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

Values provided are equivalent radial ice thicknesses due to freezing rain with concurrent 3-second gust speeds, for a 500-year mean recurrence interval, and temperatures concurrent with ice thicknesses due to freezing rain. Thicknesses for ice accretions caused by other sources shall be obtained from local meteorological studies. Ice thicknesses in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

Snow

Results:

Ground Snow Load, p_g:	20 lb/ft^2
Elevation:	1024.2 ft
Data Source:	ASCE/SEI 7-16, Table 7.2-8
Date Accessed:	Tue Feb 21 2023

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.

Rain

Results:

15-minute Precipitation Intensity: 8.28 in./h

60-minute Precipitation Intensity: 3.9 in./h

Data Source: NOAA National Weather Service, Precipitation Frequency Data Server, Atlas 14 (https://www.nws.noaa.gov/oh/hdsc/)

Date Accessed: Tue Feb 21 2023

Restrained Retaining Wall

LIC# : KW-06011423, Build:20.22.12.28 Stand Structural Engineering Inc.

DESCRIPTION: 8' retaining wall

Code Reference

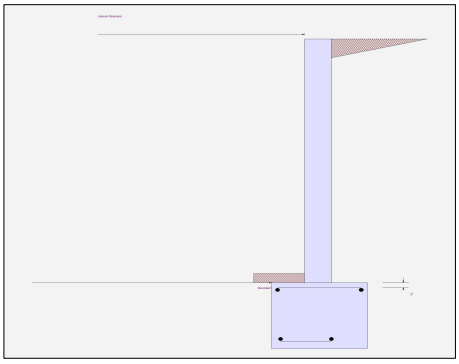
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	8.670 ft
Wall height above soil	=	ft
Total Wall Height	=	8.670 ft
Top Support Height	=	8.670 ft
Slope Behind Wall	=	0
Height of Soil over Toe	=	4.0 in

Soil Data

Allow Soil Bearing	=	1,500.0 psf
Equivalent Fluid Pressure Method		
At-Rest Heel Pressure	=	60.0 psf/ft
	=	0.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density	=	110 pcf
Footing||Soil Friction	=	0.4 psf
Soil height to ignore for passive pressure	=	12 in



Surcharge Loads

Surcharge Over Heel	=	psf
>>>Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	lbs
Axial Live Load	=	lbs
Axial Load Eccentricity	=	in

Earth Pressure Seismic Load

Uniform Lateral Load Applied to Stem

Lateral Load	=	#/ft
...Height to Top	=	ft
...Height to Bottom	=	ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	0.00 psf (Strength Level)

Wind acts left-to-right toward retention side.

Adjacent Footing Load

Adjacent Footing Load	=	lbs
Footing Width	=	ft
Eccentricity	=	in
Wall to Ftg CL Dist	=	ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	ft
Poisson's Ratio	=	0.3

K_h Soil Density Multiplier = 0.2 g Added seismic per unit area = 0.0 psf

Design Summary

Total Bearing Load	=	2,791.14 lbs	
...resultant ecc.	=	0.0 in	
Soil Pressure @ Toe	=	1,046.55 psf	OK
Soil Pressure @ Heel	=	1,046.55 psf	OK
Allowable	=	psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,255.85 psf	
ACI Factored @ Heel	=	1,255.85 psf	
Footing Shear @ Toe	=	1.644 psi	OK
Footing Shear @ Heel	=	-1.009 psi	OK
Allowable	=	94.868 psi	
Reaction at Top	=	449.971 lbs	
Reaction at Bottom	=	3,181.19 lbs	

Sliding Calcs
Lateral Sliding Force = 3,181.19 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Concrete Stem Construction

Thickness = 8.00 in
Wall Weight = 100.0 psf
Stem is FIXED to top of footing

		@ Top Support	Mmax Between Top & Base	@ Base of Wall
		Stem OK	Stem OK	Stem OK
Design Height Above Ftg	=	8.670 ft	0.03482 ft	0.00 ft
Rebar Size	=	# 5	# 5	# 5
Rebar Spacing	=	12.00 in	12.00 in	12.00 in
Rebar Placed at	=	Center	Center	Center
Rebar Depth 'd'	=	4.0 in	4.0 in	4.0 in
Design Data				
fb/FB + fa/Fa	=		0.793	0.793
Moment....Actual	=	0.0 ft-#	4,171.06 ft-#	4,171.06 ft-#
Moment.....Allowable	=	5,261.07 ft-#	5,261.07 ft-#	5,261.07 ft-#
Shear Force @ this height	=	721.61 lbs		2,886.50 lbs
Shear.....Actual	=	15.034 psi		60.135 psi
Shear.....Allowable	=	94.868 psi		94.868 psi

Restrained Retaining Wall

DESCRIPTION: 8' retaining wall

Footing Strengths & Dimensions

Toe Width	=	1 ft
Heel Width	=	1.667
Total Footing Width	=	2.667
Footing Thickness	=	28.0 in
Key Width	=	in
Key Depth	=	in
Key Distance from Toe	=	ft

f'c = 4,000.0 psi Fy = 60000 psi
Footing Concrete Density = 150 pcf
Min. As % = 0.0018
Cover @ Top = 2 in @ Btm.= 3 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	1,255.85	1,255.85	psf
Mu' : Upward	=	627.93		ft-#
Mu' : Downward	=	232.0		ft-#
Mu: Design	=	396	154	ft-#
Actual 1-Way Shear	=	1.644		psi
Allow 1-Way Shear	=	94.868	94.868	psi

Other Acceptable Sizes & Spacings:

Toe: # 5 @ 6.15 in	-or-	#4@ 3.96 in, #5@ 6.15 in, #6@ 8.73 in, #7@ 11.90
Heel: # 5 @ 6.15 in	-or-	#4@ 3.96 in, #5@ 6.15 in, #6@ 8.73 in, #7@ 11.90
Key: # 0 @ 0.00 in	-or-	No key defined

Min footing T&S reinf Area 1.61 in2
Min footing T&S reinf Area per foot 0.60 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 3.97 in	#4@ 7.94 in
#5@ 6.15 in	#5@ 12.30 in
#6@ 8.73 in	#6@ 17.46 in

Summary of Forces on Footing : Slab RESISTS sliding, stem is FIXED at footing

Forces acting on footing for soil pressure

>>> Sliding Forces are restrained by the adjacent slab

Load & Moment Summary For Footing : For Soil Pressure Calcs

Moment @ Top of Footing Applied from Stem			=	-2,606.91	ft-#
Surcharge Over Heel	=	0.0 lbs	0.0 ft	0.0	ft-#
Adjacent Footing Load	=	0.0 lbs	0.0 ft	0.0	ft-#
Axial Dead Load on Stem	=	0.0 lbs	0.0 ft	0.0	ft-#
Soil Over Toe	=	36.667 lbs	0.50 ft	18.333	ft-#
Surcharge Over Toe	=	0.0 lbs	0.0 ft	0.0	ft-#
Stem Weight	=	867.0 lbs	1.333 ft	1,156.0	ft-#
Soil Over Heel	=	954.02 lbs	2.167 ft	2,067.20	ft-#
Footing Weight	=	933.45 lbs	1.334 ft	1,244.76	ft-#
Total Vertical Force	=	2,791.14 lbs	Base Moment =	1,879.38	ft-#

Stem is specified to be fixed to footing, and top restraint is assumed to react out any tendency for moment at the footing/soil interface, so uniform soil pressure is assumed.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Restrained Retaining Wall

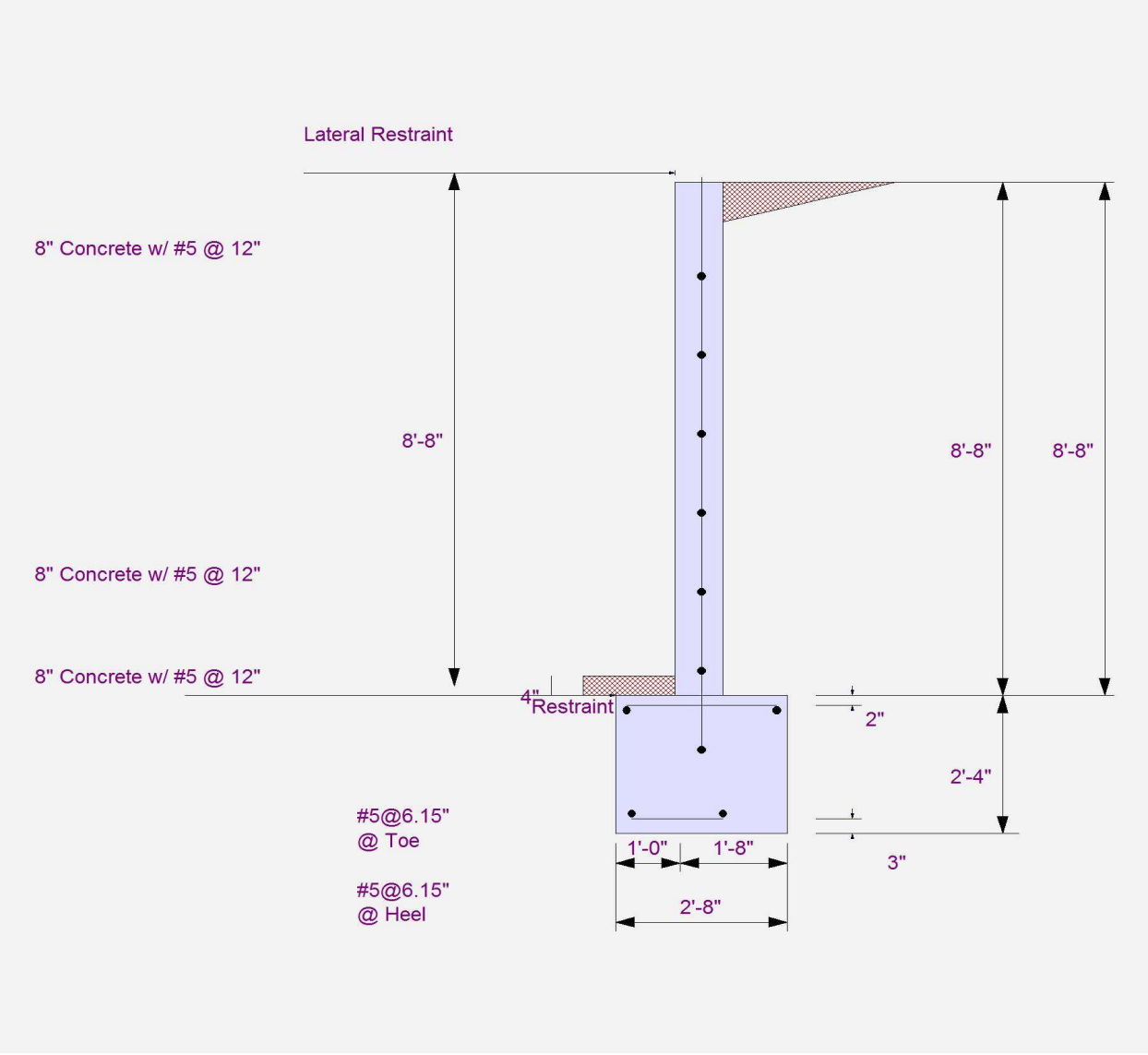
DESCRIPTION: 8' retaining wall

Rebar Lap & Embedment Lengths Information

Restrained Retaining Wall

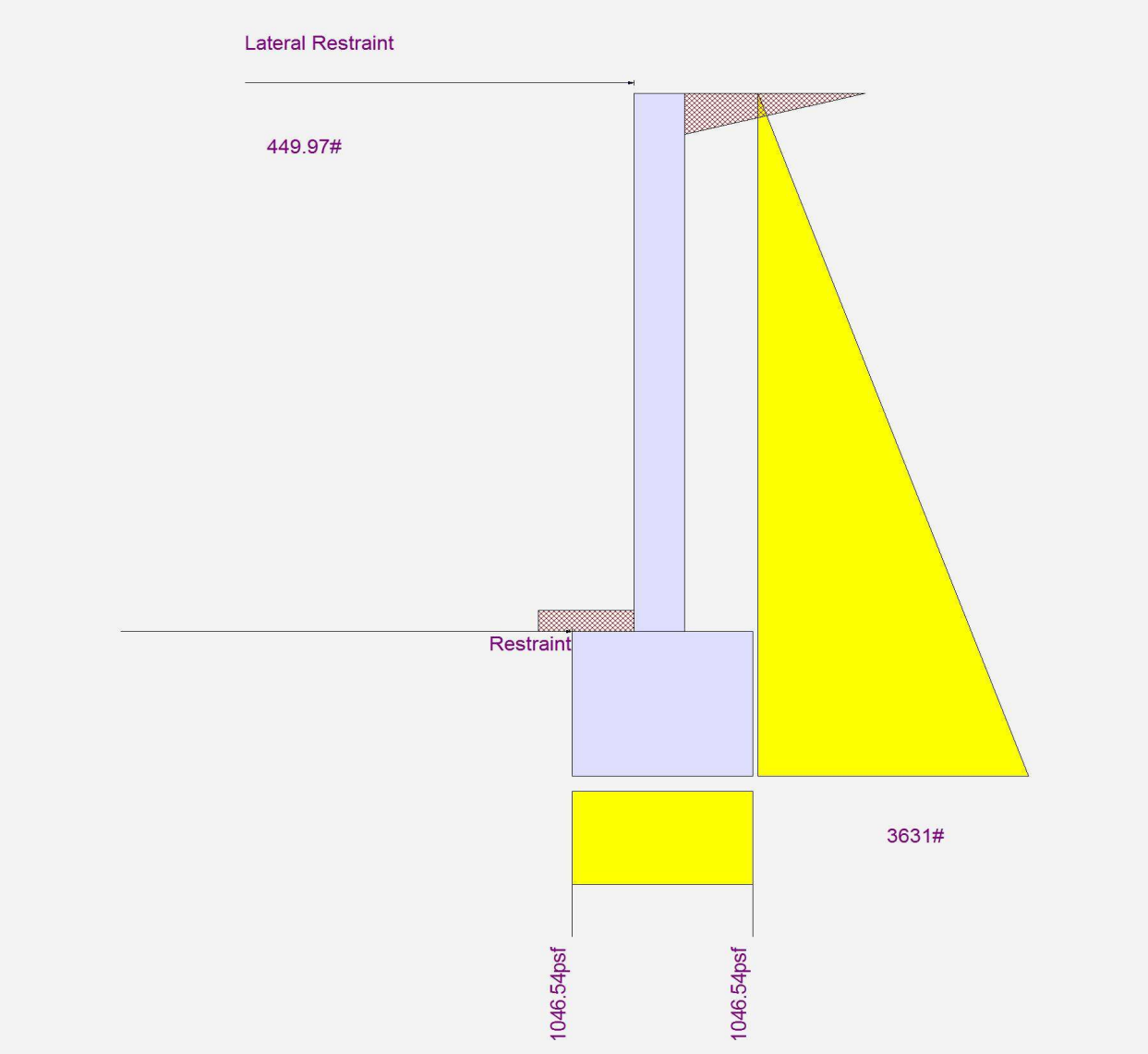
LIC# : KW-06011423, Build:20.22.12.28 Stand Structural Engineering Inc. (c) ENERCALC INC 1983-2022

DESCRIPTION: 8' retaining wall



Restrained Retaining Wall

DESCRIPTION: 8' retaining wall



Restrained Retaining Wall

LIC# : KW-06011423, Build:20.22.12.28 Stand Structural Engineering Inc.

DESCRIPTION: 6' retaining wall

Code Reference

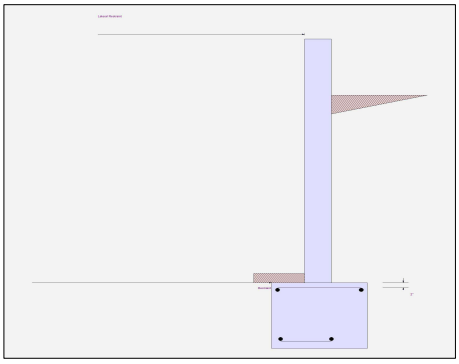
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	6.670 ft
Wall height above soil	=	2.0 ft
Total Wall Height	=	8.670 ft
Top Support Height	=	8.670 ft
Slope Behind Wall	=	0
Height of Soil over Toe	=	4.0 in

Soil Data

Allow Soil Bearing	=	1,500.0 psf
Equivalent Fluid Pressure Method		
At-Rest Heel Pressure	=	60.0 psf/ft
	=	0.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density	=	110 pcf
Footing||Soil Friction	=	0.4 psf
Soil height to ignore for passive pressure	=	12 in



Surcharge Loads

Surcharge Over Heel = psf
>>>Used To Resist Sliding & Overturning
Surcharge Over Toe = psf
Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Dead Load	=	lbs
Axial Live Load	=	lbs
Axial Load Eccentricity	=	in

Earth Pressure Seismic Load

Uniform Lateral Load Applied to Stem

Lateral Load	=	#/ft
...Height to Top	=	ft
...Height to Bottom	=	ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	0.00 psf (Strength Level)

Wind acts left-to-right toward retention side.

Adjacent Footing Load

Adjacent Footing Load	=	lbs
Footing Width	=	ft
Eccentricity	=	in
Wall to Ftg CL Dist	=	ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	ft
Poisson's Ratio	=	0.3

K_h Soil Density Multiplier = 0.2 g Added seismic per unit area = 0.0 psf

Design Summary

Total Bearing Load	=	2,571.06 lbs	
...resultant ecc.	=	0.0 in	
Soil Pressure @ Toe	=	964.03 psf	OK
Soil Pressure @ Heel	=	964.03 psf	OK
Allowable	=	psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,156.83 psf	
ACI Factored @ Heel	=	1,156.83 psf	
Footing Shear @ Toe	=	1.644 psi	OK
Footing Shear @ Heel	=	-0.4695 psi	OK
Allowable	=	94.868 psi	
Reaction at Top	=	166.093 lbs	
Reaction at Bottom	=	2,264.71 lbs	

Sliding Calcs
Lateral Sliding Force = 2,264.71 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Concrete Stem Construction

Thickness = 8.00 in
Wall Weight = 100.0 psf
Stem is FIXED to top of footing

		@ Top Support	Mmax Between Top & Base	@ Base of Wall
		Stem OK	Stem OK	Stem OK
Design Height Above Ftg	=	8.670 ft	0.03482 ft	0.00 ft
Rebar Size	=	# 5	# 5	# 5
Rebar Spacing	=	12.00 in	12.00 in	12.00 in
Rebar Placed at	=	Center	Center	Center
Rebar Depth 'd'	=	4.0 in	4.0 in	4.0 in
Design Data				
fb/FB + fa/Fa	=		0.462	0.462
Moment....Actual	=	0.0 ft-#	2,429.94 ft-#	2,429.94 ft-#
Moment.....Allowable	=	5,261.07 ft-#	5,261.07 ft-#	5,261.07 ft-#
Shear Force @ this height	=	267.349 lbs		1,868.12 lbs
Shear.....Actual	=	5.570 psi		38.919 psi
Shear.....Allowable	=	94.868 psi		94.868 psi

Restrained Retaining Wall

LIC# : KW-06011423, Build:20.22.12.28 Stand Structural Engineering Inc.

DESCRIPTION: 6' retaining wall

Footing Strengths & Dimensions

Toe Width	=	1 ft
Heel Width	=	1.667
Total Footing Width	=	2.667
Footing Thickness	=	28.0 in
Key Width	=	in
Key Depth	=	in
Key Distance from Toe	=	ft

f'c = 4,000.0 psi Fy = 60000 psi
Footing Concrete Density = 150 pcf
Min. As % = 0.0018
Cover @ Top = 2 in @ Btm.= 3 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	1,156.83	1,156.83	psf
Mu' : Upward	=	578.42		ft-#
Mu' : Downward	=	232.0		ft-#
Mu: Design	=	346	72	ft-#
Actual 1-Way Shear	=	1.644		psi
Allow 1-Way Shear	=	94.868	94.868	psi

Other Acceptable Sizes & Spacings:

Toe: # 5 @ 6.15 in	-or-	#4@ 3.96 in, #5@ 6.15 in, #6@ 8.73 in, #7@ 11.90
Heel: # 5 @ 6.15 in	-or-	#4@ 3.96 in, #5@ 6.15 in, #6@ 8.73 in, #7@ 11.90
Key: # 0 @ 0.00 in	-or-	No key defined

Min footing T&S reinf Area 1.61 in2
Min footing T&S reinf Area per foot 0.60 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 3.97 in	#4@ 7.94 in
#5@ 6.15 in	#5@ 12.30 in
#6@ 8.73 in	#6@ 17.46 in

Summary of Forces on Footing : Slab RESISTS sliding, stem is FIXED at footing

Forces acting on footing for soil pressure

>>> Sliding Forces are restrained by the adjacent slab

Load & Moment Summary For Footing : For Soil Pressure Calcs

Moment @ Top of Footing Applied from Stem			=		-1,518.71 ft-#
Surcharge Over Heel	=	0.0 lbs	0.0 ft		0.0 ft-#
Adjacent Footing Load	=	0.0 lbs	0.0 ft		0.0 ft-#
Axial Dead Load on Stem	=	0.0 lbs	0.0 ft		0.0 ft-#
Soil Over Toe	=	36.667 lbs	0.50 ft		18.333 ft-#
Surcharge Over Toe	=	0.0 lbs	0.0 ft		0.0 ft-#
Stem Weight	=	867.0 lbs	1.333 ft		1,156.0 ft-#
Soil Over Heel	=	733.94 lbs	2.167 ft		1,590.34 ft-#
Footing Weight	=	933.45 lbs	1.334 ft		1,244.76 ft-#
Total Vertical Force	=	2,571.06 lbs	Base Moment	=	2,490.71 ft-#

Stem is specified to be fixed to footing, and top restraint is assumed to react out any tendency for moment at the footing/soil interface, so uniform soil pressure is assumed.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

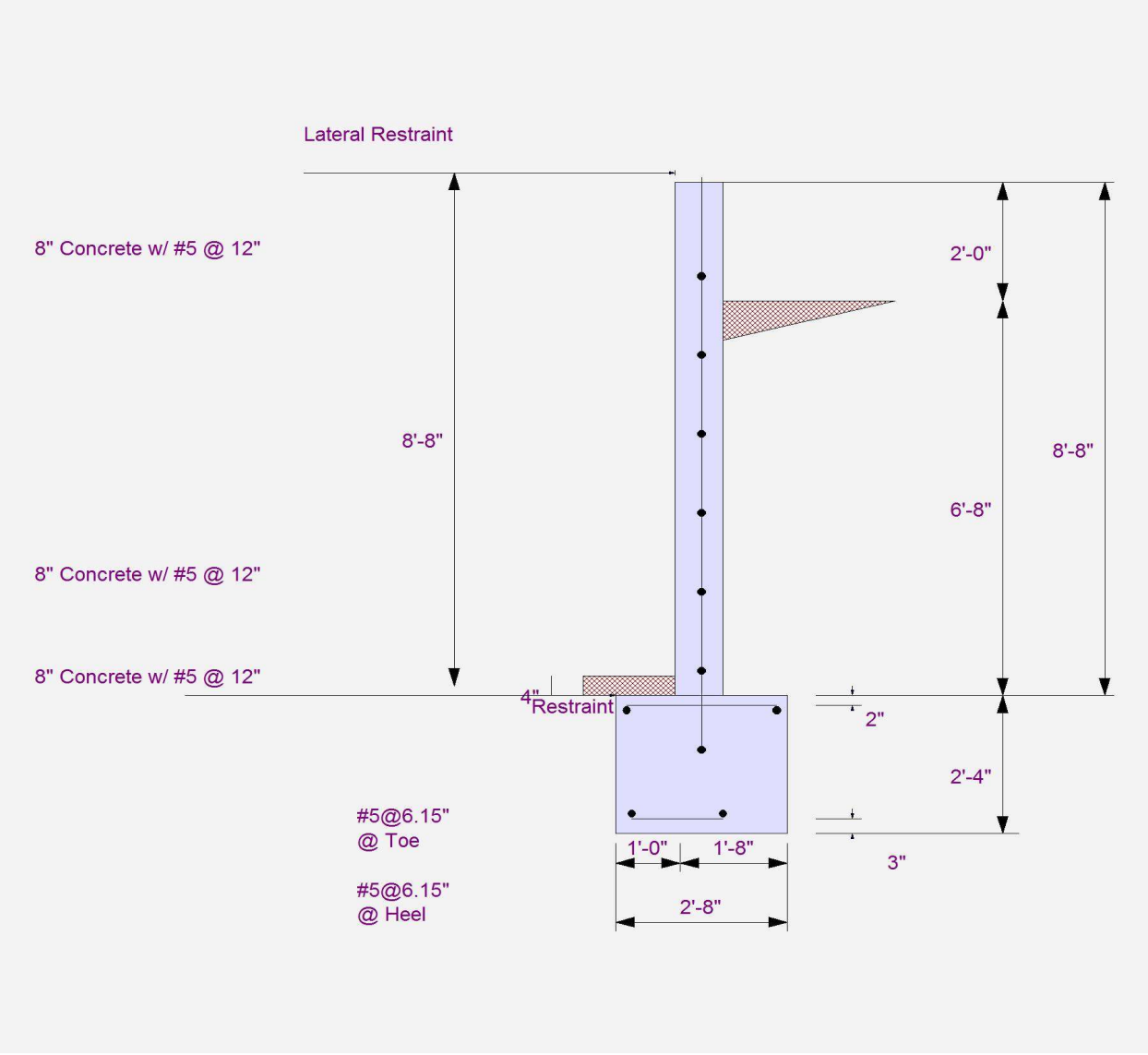
Restrained Retaining Wall

DESCRIPTION: 6' retaining wall

Rebar Lap & Embedment Lengths Information

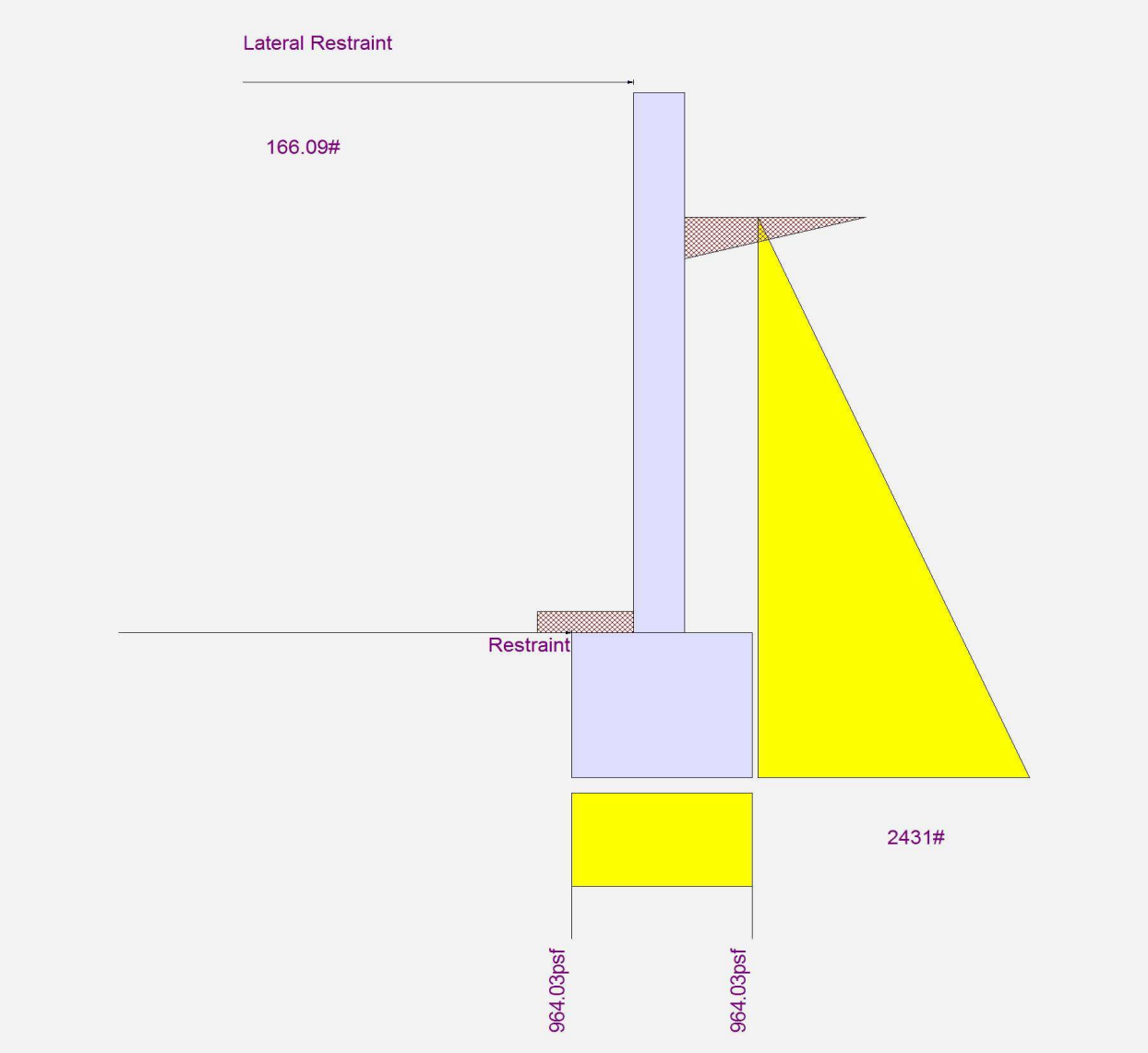
Restrained Retaining Wall

DESCRIPTION: 6' retaining wall



Restrained Retaining Wall

DESCRIPTION: 6' retaining wall



STAND STRUCTURAL ENGINEERING INC
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Date: 05/03/2023

Checked by:
Date:

Square Spread Footing Design

f'c:	3	ksi	W Col BP	8	in	LRFD Factor:	1.6	
fy:	60	ksi	Rebar Clr:	3	in	Allowable Bearing, qa:	1.5	ksf
						Ultimate Bearing, qu:	2.4	ksf

ϕ-v:	0.75
ϕ-f:	0.9

Footings assume reinforcement in top and bottom, so the min temp and shrinkage reinforcement on one side meets .0009

v-beam:	82.2	psi	<<Allowable Beam Shear Stress
v-punch:	164.3	psi	<<Allowable Punching Shear Stress

Bar Areas

3	0.11
4	0.2
5	0.31
6	0.44
7	0.6
8	0.79
9	1

Width	Thickness	Depth	Reaction	BEAM SHEAR		PUNCHING SHEAR		LRFD Moment	Beam Min	Temp. & Shrinkage	Rebar Size 5	Rebar Size 6	Footing Weight
b (ft):	h (in):	d (in):	**P-allow:**	σact	Unity	σact	Unity	Mu (kft)	As reqd	As reqd	0.31 num reqd	0.44 num reqd	kips
3	**30**	26	**13.50**	0.0	0.00	0.7	0.00	4.900	0.056	0.972	4	3	3.38
4	**30**	26	**24.00**	0.0	0.00	5.4	0.03	13.333	0.152	1.296	5	3	6.00
5	**30**	26	**37.50**	0.0	0.00	11.5	0.07	28.167	0.322	1.620	6	4	9.38
6	**30**	26	**54.00**	3.8	0.05	19.0	0.12	51.200	0.585	1.944	7	5	13.50
6.5	**30**	26	**63.38**	5.8	0.07	23.2	0.14	66.354	0.759	2.106	7	5	15.84
7	**30**	26	**73.50**	7.7	0.09	27.8	0.17	84.233	0.964	2.268	8	6	18.38
7.5	**30**	26	**84.38**	9.6	0.12	32.7	0.20	105.063	1.203	2.430	8	6	21.09

Grade Beam Width:	12	in
Grade Beam Height:	30	in
Slab Thickness:	4	in
Grade Beam Weight:	0.375	klf
Wall Weight:	0.25	klf
Grade Beam Span:	25	ft
ASD Moment:	49	kip-ft
(LRFD) 1.4*Moment:	68	kip-ft
ASD Shear:	8	kip
(LRFD) 1.4*Shear:	11	kip

Uplift Check		Footing Weight	Resisting Slab		Resisting Grade Beam		Bldg Self Weight	Total Weight	Allow. Uplift
Width	Thickness		Area	Weight	Length	Weight			
b (ft):	h (in):	kips	ft^2	kips	ft	kips	kips	kips	kips
3	**30**	**3.4**	**100**	**5.0**	**25**	**9.4**	**1.0**	18.75	**12.5**
4	**30**	**6.0**	**100**	**5.0**	**25**	**9.4**	**1.0**	21.38	**14.3**
5	**30**	**9.4**	**100**	**5.0**	**25**	**9.4**	**1.0**	24.75	**16.5**
6	**30**	**13.5**	**100**	**5.0**	**25**	**9.4**	**1.0**	28.88	**19.3**
6.5	**30**	**15.8**	**125**	**6.3**	**25**	**9.4**	**1.0**	32.47	**21.6**
7	**30**	**18.4**	**125**	**6.3**	**25**	**9.4**	**1.0**	35.00	**23.3**
7.5	**30**	**21.1**	**125**	**6.3**	**25**	**9.4**	**1.0**	37.72	**25.1**

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Footing Description	Footing Width (ft)	Footing Thickness (inches)	Max ASD Gravity Reaction (kips)	Gravity Allow. Bearing (kips)	Unity Check	Max ASD Uplift Reaction (kips)	Allow. Uplift (kips)	Unity Check	Hairpin Bar Size #	Max ASD Kickout Force (kips)	Allow. Kickout Force (kips)	Unity Check
120' Footings	7	30	45	73.5	0.61	23.1	23.3	0.99	6	25	14.9	1.67
105' Footings	6.5	30	40	63.4	0.63	20.8	21.65	0.96	6	20	14.93	1.34

Use tie beam. See next page

Reaction Verification

Dead Load:	5	psf	Total Gravity Load:	30	psf
Collateral Load:	5	psf	Approx. ASD Roof Uplift Load:	17.01	psf
Roof Live/Snow Load:	20	psf	Net ASD Roof Uplift Load:	14.01	psf
Wind Base Pressure:	30	psf	Approx. ASD Wall Load:	19.89	psf
Interior P/S Coeff:	0.18				

Anchor Rod Design (ASD)

3/4" CIP Anchors (12" embed)	18 kips uplift	12 kips kickout
1" CIP Anchors (15" embed)	25 kips uplift	15 kips kickout

Footing Description	Bay Spacing	Frame Width	Eave Height	Snow Drift Load	Est. Gravity Reaction	Est. Uplift Reaction	Est. Out Kickout Reaction	Est. In Kickout Reaction
	feet	feet	feet	psf	kips	kips	kips	kips
120' Footings	25	120	32	0	45	23.14	24.44	19.37
105' Footings	25	105	32	0	39.375	20.81	18.52	16.61

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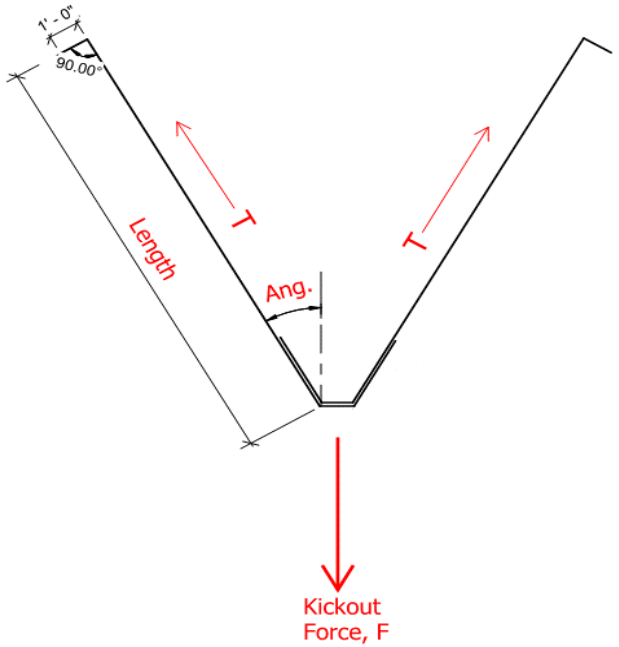
Hairpin Design

Slab Bar Area: **0.05** in^2/ft

Hairpin Bar Used		Allowable Tension	Allowable Kickout	Develop. Length	Required Length
Bar #	Area	kips	kips	inches	feet
4	0.2	**4.8**	**6.8**	**24**	**7.7**
5	0.31	**7.4**	**10.5**	**30**	**11.3**
6	0.44	**10.6**	**14.9**	**36**	**15.4**
7	0.6	**14.4**	**20.4**	**42**	**20.5**

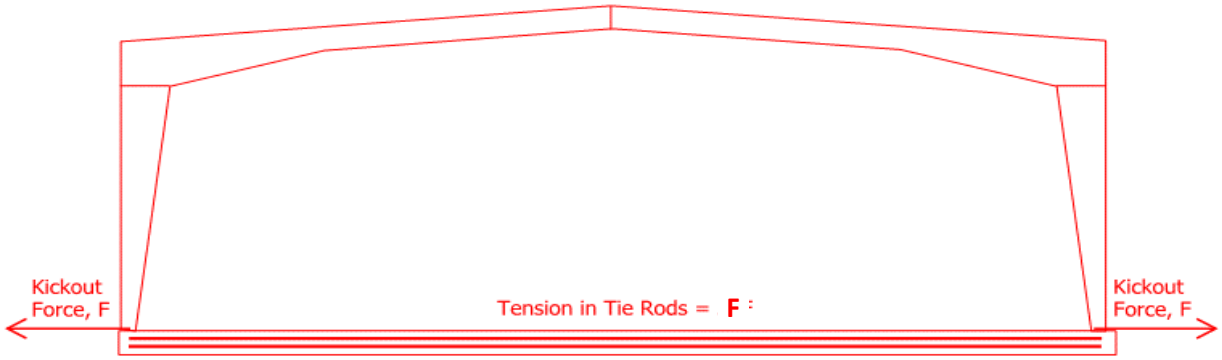


For Kickout forces of 5 kips or less and min. slab reinforcement of #3&18" OC or #4@ 24"OC - Use (4) #4 Slab Dowels (3'x3') @ 24" OC

For Kickout forces of greater than 15 kips it is recommended to use tie rods in a grade beam or thickened slab instead of hairpins.

Tie Rod Design

Tie Rod Length:	**120**	feet
Allow. Elongation:	**0.75**	inch
Kickout Force, F:	**25**	kips
Req'd As (Elongation):	**1.66**	in^2
Req'd As (Tension):	**1.04**	in^2
Bar Size Selected: #	**5**	
# of Bars:	**6**	
Actual Area of Steel:	**1.9**	in^2
Unity Check:	0.89	



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Floor Loads & Deck Checks

Location	2nd Floor Mezzanine					
Deck Selection	1.0C	26	gauge	Width	36	inches
Total Slab Depth	4	inches		Grade	50	ksi
Concrete Thickness above Deck	3	inches				
Concrete Type	Normal Weight					
Fire Rating	0	hour	Per IBC / Vulcraft Catalog			
Joist / Beam Spacing	3	feet				
Clear Span	2.67	feet	(Assumes 4" beam/joist flange)			

Construction Loads

Construction Live Load	20	psf	
Concrete Weight	43	psf	
Extra Concrete Weight	6	psf	Assume 1/2" extra concrete for ponding. This and the deck self weight should be added in 'Deck Loads' spreadsheet under 'Super DL' in RISA Floor.
Deck Self Weight	1	psf	
Construction Dead Load	50	psf	
Total Load on Deck	70	psf	Construction Dead + Construction Live
Max Const. Clear Span	3.92	feet	2 Span Minimum
Total / Allowable Clear Span	0.68		
Allowable Deck Uniform Load	185	psf	Deflection = L/240
Total / Allowable Load	0.38		

Final in-place loads

Live Load	100	psf	Offices - 50 psf + 15 psf for partitions. Corridors above first floor = 80 psf
Partition Loading (if not included in LL)	0	psf	
Is partition loading based on ASCE 7-16 4.3.2 (movable)?	YES	psf	If 'YES', partition loading is included in LL
MEP/finishes	5	psf	to included MEP, flooring, ceiling, misc
Superimposed DL	5	psf	input in RISA Floor under 'uniform area loads'
Superimposed TL	105	psf	LL + partitions + MEP
Allowable Superimposed Load	400	psf	Reinforce Slab with 6x6-W2.9xW2.9
Total / Allowable Load	0.26		
Total Final DL	55	psf	Load applied to floor beams
Self Weight Beams/Girders/Col	5	psf	
Overall Floor DL	60	psf	This dead load is total load to columns and footings.
Floor DL for Seismic	70	psf	Includes allowance for partitions. If actual partition weight is greater than 10 psf when counted as LL, engineer to manually add the difference.

ASD

STANDARD LOAD TABLE FOR OPEN WEB STEEL JOISTS, K-SERIES
Based on a 50 ksi Maximum Yield Strength - Loads Shown In Pounds Per Linear Foot (plf)

Joist Designation	10K1	12K1	12K3	12K5	14K1	14K3	14K4	14K6	16K2	16K3	16K4	16K5	16K6	16K7	16K9
Depth (in.)	10	12	12	12	14	14	14	14	16	16	16	16	16	16	16
Approx. Wt (lbs./ft.)	5.0	5.0	5.7	7.1	5.2	6.0	6.7	7.7	5.5	6.3	7.0	7.5	8.1	8.6	10.0
Span (ft.) ↓															
10	550 550														
11	550 542														
12	550 455	550 550	550 550	550 550											
13	479 363	550 510	550 510	550 510											
14	412 289	500 425	550 463	550 463	550 550	550 550	550 550	550 550							
15	358 234	434 344	543 428	550 434	511 475	550 507	550 507	550 507							
16	313 192	380 282	476 351	550 396	448 390	550 467	550 467	550 467	550 550	550 550	550 550	550 550	550 550	550 550	550 550
17	277 159	336 234	420 291	550 366	395 324	495 404	550 443	550 443	512 488	550 526	550 526	550 526	550 526	550 526	550 526
18	246 134	299 197	374 245	507 317	352 272	441 339	530 397	550 408	456 409	508 456	550 490	550 490	550 490	550 490	550 490
19	221 113	268 167	335 207	454 269	315 230	395 287	475 336	550 383	408 347	455 386	547 452	550 455	550 455	550 455	550 455
20	199 97	241 142	302 177	409 230	284 197	356 246	428 287	525 347	368 297	410 330	493 386	550 426	550 426	550 426	550 426
21		218 123	273 153	370 198	257 170	322 212	388 248	475 299	333 255	371 285	447 333	503 373	548 405	550 406	550 406
22		199 106	249 132	337 172	234 147	293 184	353 215	432 259	303 222	337 247	406 289	458 323	498 351	550 385	550 385
23		181 93	227 116	308 150	214 128	268 160	322 188	395 226	277 194	308 216	371 252	418 282	455 307	507 339	550 363
24		166 81	208 101	282 132	196 113	245 141	295 165	362 199	254 170	283 189	340 221	384 248	418 269	465 298	550 346
25					180 100	226 124	272 145	334 175	234 150	260 167	313 195	353 219	384 238	428 263	514 311
26					166 88	209 110	251 129	308 156	216 133	240 148	289 173	326 194	355 211	395 233	474 276
27					154 79	193 98	233 115	285 139	200 119	223 132	268 155	302 173	329 188	366 208	439 246
28					143 70	180 88	216 103	265 124	186 106	207 118	249 138	281 155	306 168	340 186	408 220
29									173 95	193 106	232 124	261 139	285 151	317 167	380 198
30									161 86	180 96	216 112	244 126	266 137	296 151	355 178
31									151 78	168 87	203 101	228 114	249 124	277 137	332 161
32									142 71	158 79	190 92	214 103	233 112	259 124	311 147

Live load = 100 psf x 3' = 300 plf < 386 plf OK
Total load = 160 psf x 3' = 480 plf < 493 plf OK

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Simple Span Beam Design

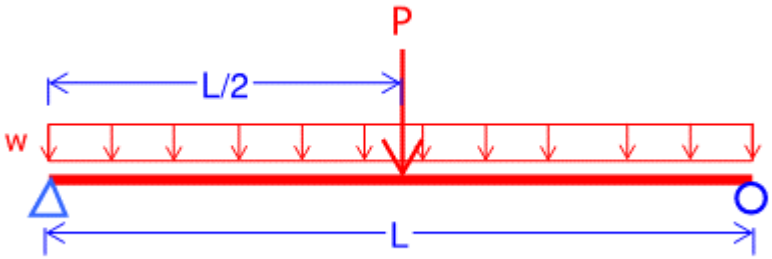
Member Designation:	**Storage Mezzanine Beam**	
Uniform Load, w:	**0.8**	klf
Point Load, P:	**0**	kips
Yield Stress, Fy:	**50**	ksi
Mod. Of Elasticity, E:	**29000**	ksi
Beam Length, L:	**16.5**	ft
Defl. Limit, L/??:	**300**	
Allowable Deflection:	**0.66**	inches
End Reactions/Shear:	**6.6**	kips

*Point Load Applied At the Center of the Span
*Buckling Not Accounted For. Beam Compression Flange Must Be Fully Braced
*Self weight is not included. Add it to the uniform load.
*Shear Assumed to Not Control

	M (k-ft)	Z or S-reqd (in^3):	I-reqd (in^4):
Uniform	**27.23**	**10.91**	**69.71**
Point	**0.00**	**0.0000**	**0.00**
Combined	**27.23**	**10.9118**	**69.71**

Actual Member Selected

Shape:	**W8x21**		
Beam Loading Direction:	**Strong Axis**		**Unity Check**
Moment of Inertia, I:	**75.3**	in^4	0.93
Plastic Section Mod., Z:	**20.40**	in^3	0.53
Elastic Section Mod., S:	**18.20**	in^3	0.60
Weight, W:	**21.0**	plf	
Area, A:	**6.16**	in^2	
Depth, d:	**8.28**	in	
Thickness of Web, tw:	**0.250**	in	
Flange Width, bf:	**5.27**	in	
Flange Thickness, tf:	**0.400**	in	



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Simple Span Beam Design

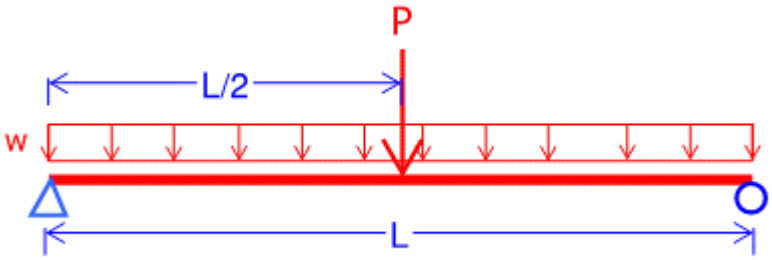
Member Designation:	**Mezzanine Tube**	
Uniform Load, w:	**0.4**	klf
Point Load, P:	**0**	kips
Yield Stress, Fy:	**42**	ksi
Mod. Of Elasticity, E:	**29000**	ksi
Beam Length, L:	**10**	ft
Defl. Limit, L/??:	**240**	
Allowable Deflection:	**0.50**	inches
End Reactions/Shear:	**2.0**	kips

*Point Load Applied At the Center of the Span
*Buckling Not Accounted For. Beam Compression Flange Must Be Fully Braced
*Self weight is not included. Add it to the uniform load.
*Shear Assumed to Not Control

	M (k-ft)	Z or S-reqd (in^3):	I-reqd (in^4):
Uniform	**5.00**	**2.39**	**6.21**
Point	**0.00**	**0.0000**	**0.00**
Combined	**5.00**	**2.3857**	**6.21**

Actual Member Selected

Shape:	**Hss3-1/2x3-1/2x3/8**		
Beam Loading Direction:	**Strong Axis**		**Unity Check**
Moment of Inertia, I:	**6.5**	in^4	0.96
Plastic Section Mod., Z:	**4.69**	in^3	0.51
Elastic Section Mod., S:	**3.71**	in^3	0.64
Weight, W:	**14.6**	plf	
Area, A:	**4.09**	in^2	
Depth, d:	**3.50**	in	
Thickness of Web, tw:	**0.000**	in	
Flange Width, bf:	**0.00**	in	
Flange Thickness, tf:	**0.000**	in	



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Simple Span Beam Design

Member Designation: **Mezzanine Tube @ Stairs**

Uniform Load, w:	1.8	klf
Point Load, P:	0	kips
Yield Stress, Fy:	42	ksi
Mod. Of Elasticity, E:	29000	ksi
Beam Length, L:	5.5	ft
Defl. Limit, L/??:	240	
Allowable Deflection:	0.28	inches
End Reactions/Shear:	5.0	kips

*Point Load Applied At the Center of the Span
*Buckling Not Accounted For. Beam Compression Flange Must Be Fully Braced
*Self weight is not included. Add it to the uniform load.
*Shear Assumed to Not Control

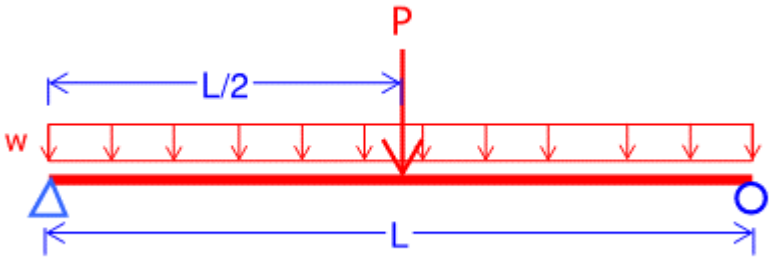
	M (k-ft)	Z or S-reqd (in^3):	I-reqd (in^4):
Uniform	6.81	3.25	4.65
Point	0.00	0.0000	0.00
Combined	6.81	3.2476	4.65

Actual Member Selected

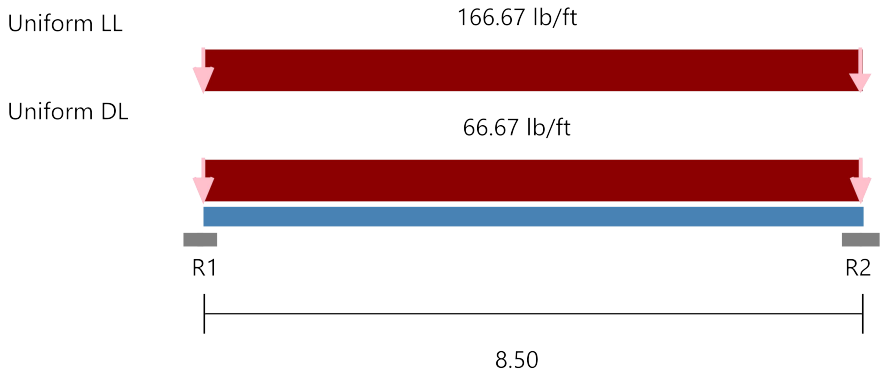
Shape: **HSS3-1/2x3-1/2x3/8**

Beam Loading Direction: **Strong Axis**

			Unity Check
Moment of Inertia, I:	6.5	in^4	0.72
Plastic Section Mod., Z:	4.69	in^3	0.69
Elastic Section Mod., S:	3.71	in^3	0.88
Weight, W:	14.6	plf	
Area, A:	4.09	in^2	
Depth, d:	3.50	in	
Thickness of Web, tw:	0.000	in	
Flange Width, bf:	0.00	in	
Flange Thickness, tf:	0.000	in	



CFS Joists on Storage Mezzanine



Section : 600S200-54 (50 ksi) @ 16 in" o.c. Single C Stud (punched)
Maxo = 2532.9 ft-lb **Va =** 2822.9 lb **I =** 3.319 in^4

Deflection Limits: Total Load - 240 Live Load - 360

Load Comb:
1. DL + LL All spans
2. DL + LL Even spans
3. DL + LL Odd spans
4. LL All spans
5. LL Even spans
6. LL Odd spans

Joist Flexural and Deflection

	Mmax (ft-lb)	K-phi (lb-in/in)	Lm (in)	Ma-dist (ft-lb)	Mmax/ Ma min	Load Comb.	TL Defl	Load Comb.	LL Defl	Load Comb.
Span	2107	0.0	102.0	2281.9	0.923	1	L/364	1	L/510	4

Joist Bending and Web Crippling

Support	Load (lb)	Load Comb.	Bearing (in)	Pa (lb)	Pn (lb)	Max Intr.	Load Comb.	Stiffeners Required
R1	991.7	1	1.00	598.9	1048.1	0.86	1	YES
R2	991.7	1	1.00	598.9	1048.1	0.86	1	YES

Joist Bending and Shear

Support	Vmax (lb)	Load Comb.	Va Factor	V/Va	M/Ma	Intr. Unstiffened	Load Comb.	Intr. Stiffened	Load Comb.
R1	991.7	1	1.000	0.35	0.00	0.35	1	N/A	N/A
R2	991.7	1	1.000	0.35	0.00	0.35	1	N/A	N/A

Joist Reaction and Connections

Support	Rx(lb)	Ry(lb)	Simpson Strong-Tie Connector	Connector Interaction	Anchor Interaction
R1	0.0	991.7	SSC4.25 (4#10) & (3) #10 to A36 steel (Joist Bearing on Support)	0.00 %	0.00 %
R2	0.0	991.7	SSC4.25 (4#10) & (3) #10 to A36 steel (Joist Bearing on Support)	0.00 %	0.00 %

* Reference catalog for connector and anchor requirement notes as well as screw placement requirements