BHB STRUCTURAL

Structural Calculations

BHB Project # 230396

UDOT Murrary Foundation

5823 S Commerce Way
Murray, Utah 84107

Prepared For:

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P.O. Box 517
Kaysville, Utah 84037

REVIEWED FOR CODE COMPLIANCE
Thomas W Peterson
09/25/2023
DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT

Prepared By:

KC

Rev 0
6/20/2023

PROFESSIONAL ENGINEER
No. 10881225
JORDAN PERKES
STATE OF UTAH
06/20/2023

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General Information

Site Data

Address	5823 S Commerce Way							
	Murray, Utah 84107							
County	Salt Lake							
IBC	2018							
Latitude	40	°	38	'	43.7	"	=	40.645473 °
Longitude	-111	°	54	'	4.6	"	=	-111.901289 °
Elevation	4317	ft						

Building Data

Risk Category	II	
Roof Height, h	16	ft
Plan Length, L	89.79167	ft
Plan Width, B	41.41667	ft

Soils Report

Author	GSH Geotechnical, Inc	
Dated	June 14, 2023	
Job #	1046-012-23	

Recommendations Summary

Foundation Type	Spread/Strip Footings	
Structural Fill	0	in
Soil Bearing	3000	psf
Transient Increase	50%	
Soil Site Class	D	
Frost Depth	30	in

Lateral Pressures

Active		pcf
At Rest		pcf
Passive		pcf
Coeff of Friction		

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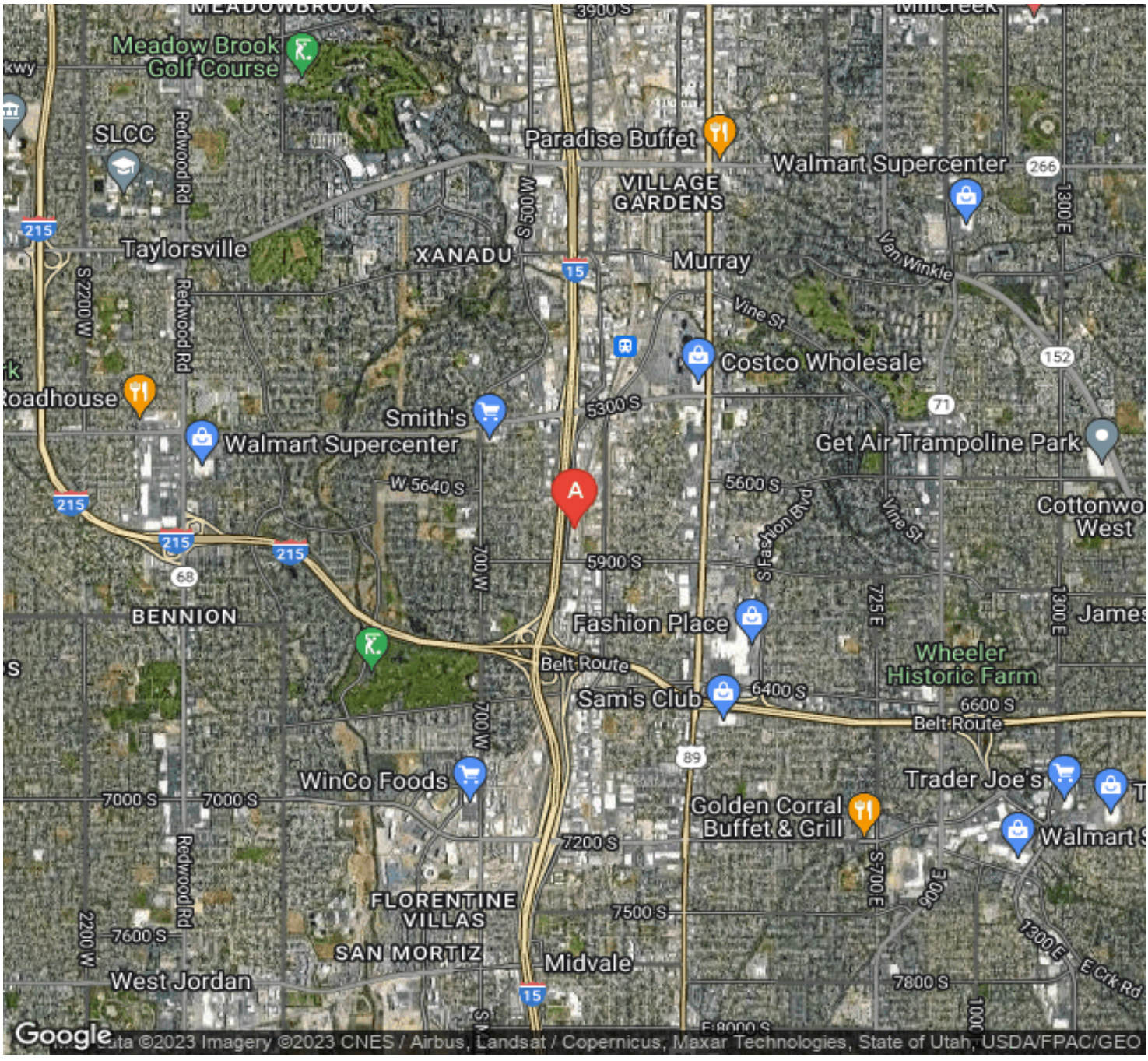
Site Mapping



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By: KC

Dead Loads

Roof	Σ =	20 psf
Deck		3
Joists/Girders		3
Ceiling		3
Roofing		2
Mech		5
Collateral		4

Live Loads

Roof Live	Σ=	20 psf
Roof Live		20

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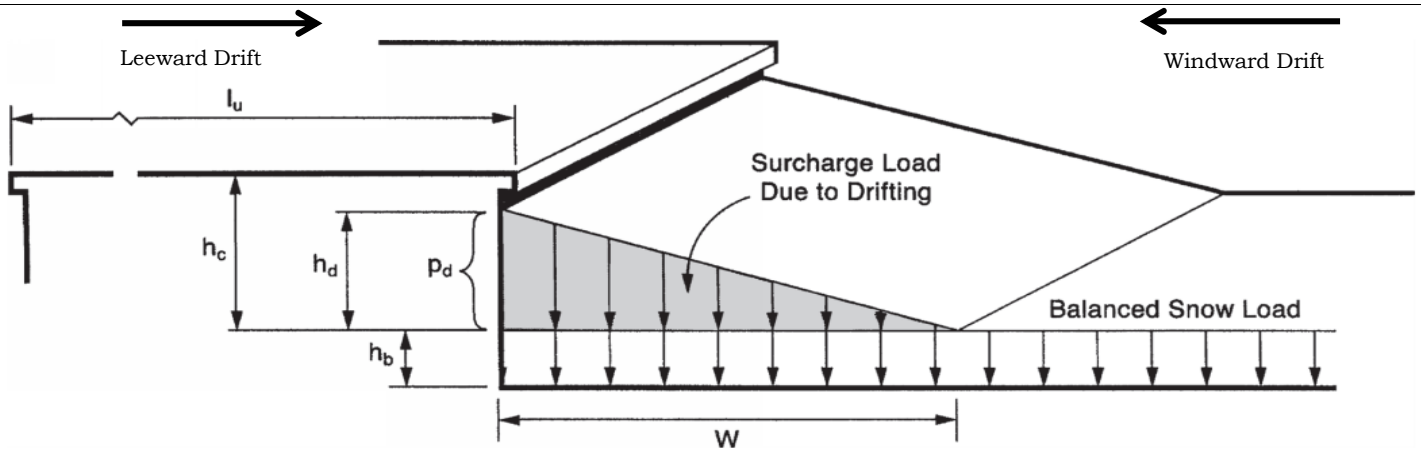
Snow Drift

Description	

Snow Drift Data

Pg	29.0	psf	Pf	20	psf
Ce	1.0		D	18	pcf
Ct	1.0		Hb	1.1	ft
Is	1.00		Hc	-1.1	ft
Hr	0	ft			

	Lu	Hd [ft]	W [ft]	Pm [psf]	Pd [psf]
Leeward Drift		-1.5	0	-6	0
Windward Drift		-1	0	0	0
No Parapet					



Term	Definition
Pf	Minimum Roof Snow Load (psf)
Pg	Basic Ground Snow Load (psf)
Pm	Maximum Intensity of Load at the Height Change (psf)
Ce	Snow Exposure factor (Table 7-2)
Ct	Thermal Factor (Table 7-3)
Is	Imporatnce Factor (Table 7-4)
D	Density of Snow (pcf)
Hb	Height of Balanced Snow Load on Lower Roof
Hd	Maximum Height of Drift Surcharge (feet)
Hc	Height Difference Between Upper Roof and Top of Balanced Snow Load on Lower Roof
Hr	Height Difference Between Roof Elevations
Lu	Length of Roof Upward of Drift Normal to the Line of Change in Roof Level (feet) But Not Less than 25 feet For Windward Drifts, Program Takes 75% of "Hd" for Claculating Snow Drift
W	Width of Drift (feet)

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Wind Loads

Design Data					
Mean Roof Height, h	16	ft	Enclosure	Full	
Building Length, L	89.79167	ft	Gust Factor, G	0.85	
Building Width, B	41.41667	ft	Topographic Factor, Kzt	1.00	
Parapet Height, hp	0	ft	Directionality Factor, Kd	0.85	
Roof Angle	5	deg	Velocity Pressure Factor, Kz	0.86	
IBC	2018		Elevation Factor, Ke	0.86	
Basic Wind Speed, V	103	mph	Velocity Pressure, qh	17.0	
Exposure Category	C		Internal Pressure, GCPi	0.18	
Importance Factor, Iw	1				

Main Wind Force Resisting System

Surface		G	Cp	qz G Cp	qi	GCpi	qGCpi	Combined [psf]		
Windward Walls		0.85	0.80	11.6	17.0	0.18	3.1	14.6	or	8.5
Leeward Walls		0.85	-0.50	-7.2	17.0	0.18	3.1	-4.2	or	-10.3
Side Walls		0.85	-0.70	-10.1	17.0	0.18	3.1	-7.1	or	-13.2
Roof Parallel and Normal, θ < 10	0 - h/2	0.85	-0.90	-13.0	17.0	0.18	3.1	-9.9	or	-16.1
	h/2 - h	0.85	-0.90	-13.0	17.0	0.18	3.1	-9.9	or	-16.1
	h - 2h	0.85	-0.50	-7.2	17.0	0.18	3.1	-4.2	or	-10.3
	> 2h	0.85	-0.30	-4.3	17.0	0.18	3.1	-1.3	or	-7.4
Roof (Normal, θ > 10, WW)		0.85	-0.02	-0.3	17.0	0.18	3.1	2.8	or	-3.3
Roof (Normal, θ > 10, LW)		0.85	-0.70	-10.1	17.0	0.18	3.1	-7.1	or	-13.2
Windward Parapet					17.0	1.125	19.1			19.1
Leeward Parapet					17.0	-1.125	-19.1			-19.1

Components and Cladding				Roof Type	Monoslope	
Effective Trib Area	85	ft^2		'a' dimension	4.14	ft
Component Ht, z	16	ft		Velocity Pressure, qz	17.0	psf

Surace	Zone	GCp	qz G Cp	qi	GCpi	qGCpi	Combined [psf]			Maximum
Walls	Pos Zone 4 & 5	0.75	12.8	17.0	0.18	3.1	15.8	or	9.7	16.0
	Neg Zone 4	-0.84	-14.3	17.0	0.18	3.1	-11.2	or	-17.4	-17.4
	Neg Zone 5	-0.96	-16.4	17.0	0.18	3.1	-13.3	or	-19.4	-19.4
Roof	Pos Zone 1	0.21	3.5	17.0	0.18	3.1	6.6	or	0.5	16.0
	Pos Zone 2	0.21	3.5	17.0	0.18	3.1	6.6	or	0.5	16.0
	Pos Zone 3	0.21	3.5	17.0	0.18	3.1	6.6	or	0.5	16.0
	Neg Zone 1	-1.10	-18.7	17.0	0.18	3.1	-15.6	or	-21.7	-21.7
	Neg Zone 2	-1.51	-25.6	17.0	0.18	3.1	-22.5	or	-28.7	-28.7
	Neg Zone 3	-1.67	-28.4	17.0	0.18	3.1	-25.3	or	-31.4	-31.4
Parapet	WW Zone 4	(+Zone 4) - (-Zone 2)					38.4	or	38.4	38.4
	WW Zone 5	(+Zone 5) - (-Zone 3)					41.1	or	41.1	41.1
	LW Zone 4	(-Zone 4) - (+Zone 2)					-17.8	or	-17.8	-17.8
	LW Zone 5	(-Zone 5) - (+Zone 3)					-19.9	or	-19.9	-19.9

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Seismic Loads

Design Data

Lattitude	40.645	deg	Building Period, T	0.256	s
Longitude	-111.901	deg	Building Height, hn	30	ft
IBC	2018		Period Parameter, Ct	0.02	
Risk Category	II		Period Parameter, x	0.75	
Site Class	D-Default		Calculated Period, Ta	0.256	s
Importance Factor, Ie	1.00		Max Period Coefficient	1.4	
Site Specific Ground Motion	FALSE		Max Allowed Period, Tmax	0.359	s
ρ	1.0		T0 = 0.2 * SD1 / SDS	0.105	s
Seismic Design Category	D		TS = SD1 / SDS	0.523	s
			Long Period Transition, T_L	8.00	s

Seismic Force Resisting System

Steel Ordinary Moment Frames		
Response Modifiction Coefficient, R	3.5	
System Overstrength Factor, Ωo	3	
Deflection Amplification Factor, Cd	3	
Cs	0.334	(12.8-2)

Response Spectrum Data (ASCE 7-16 Section 11.4.8.1 Exception is applied)

Spectral Response Paramaters

S_S	1.463	g
S_1	0.514	g

Site Coefficients

F_a	1.20
F_v	1.79

MCE Spectral Acceleration Paramaters

S_{MS}	1.756	g
S_{M1}	0.918	g

Design Spectral Acceleration Paramaters

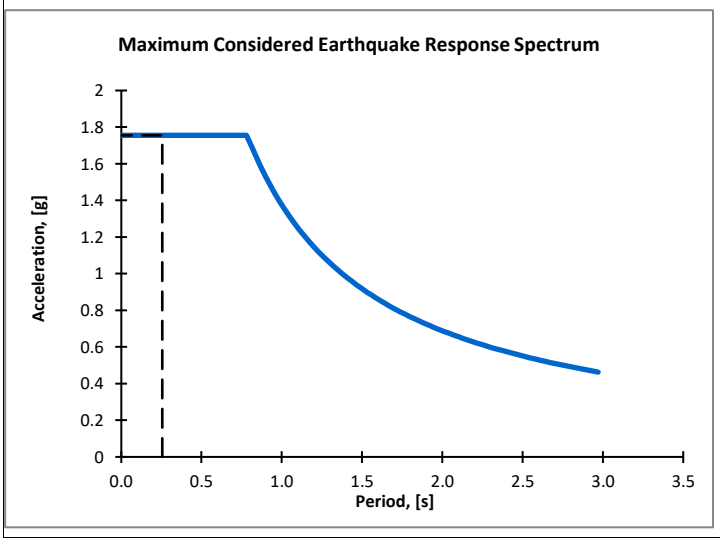
S_{DS}	1.170	g
S_{D1}	0.612	g

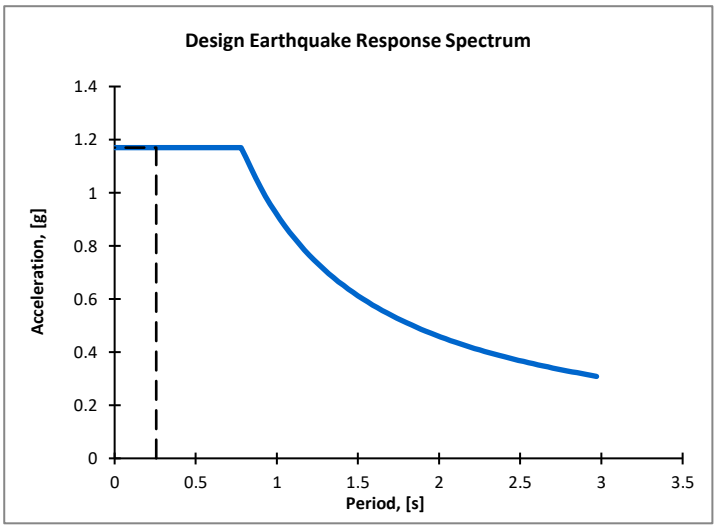
MCE Spectral Acceleration

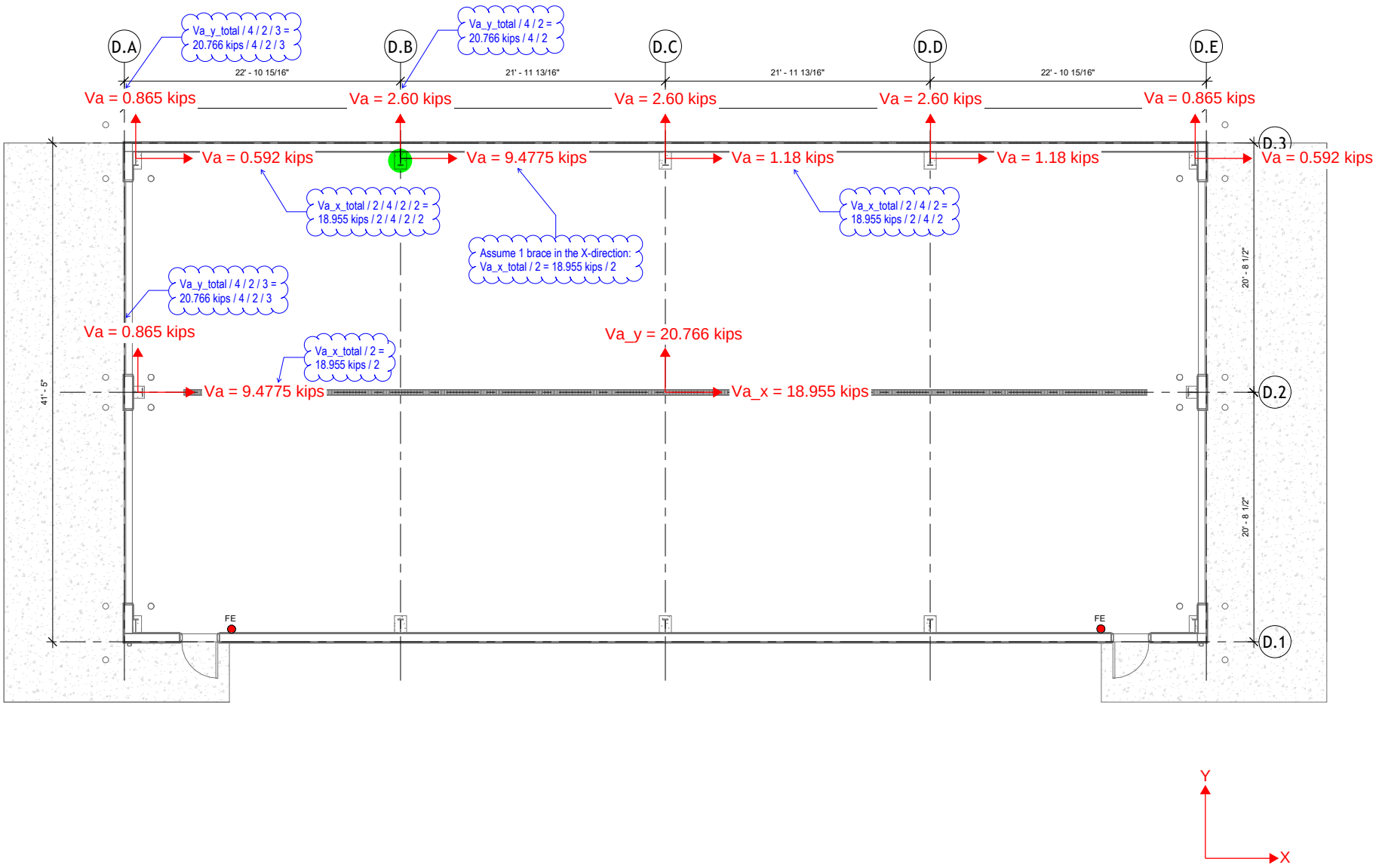
S_a	1.756	g

Design Spectral Acceleration

S_a	1.170	g






D.A
D.B
D.C
D.D
D.E
D.3
D.2
D.1
Va_y_total / 4 / 2 / 3 = 20.766 kips / 4 / 2 / 3
Va_y_total / 4 / 2 = 20.766 kips / 4 / 2
22' - 10 15/16"
21' - 11 13/16"
21' - 11 13/16"
22' - 10 15/16"
Va = 0.865 kips
Va = 2.60 kips
Va = 2.60 kips
Va = 2.60 kips
Va = 0.865 kips
Va = 0.592 kips
Va = 9.4775 kips
Va = 1.18 kips
Va = 1.18 kips
Va = 0.592 kips
Va_x_total / 2 / 4 / 2 / 2 = 18.955 kips / 2 / 4 / 2 / 2
Assume 1 brace in the X-direction: Va_x_total / 2 = 18.955 kips / 2
Va_x_total / 2 / 4 / 2 = 18.955 kips / 2 / 4 / 2
Va_y_total / 4 / 2 / 3 = 20.766 kips / 4 / 2 / 3
Va = 0.865 kips
Va_x_total / 2 = 18.955 kips / 2
Va_y = 20.766 kips
Va = 9.4775 kips
Va_x = 18.955 kips
41' - 5"
20' - 8 1/2"
20' - 8 1/2"
FE
FE
Y
X

Lateral Calculations

Design Variables

DL_{roof} = 20 psf
LL_{roof} = 20 psf
SL_{roof} = 20 psf; *Add %SL when SL > 30 psf*
DL_{wall} = 10 psf
L_x = 89 ft + 9.5 in = **89.792** ft
L_y = 41 ft + 5 in = **41.417** ft
$A = L_x * L_y$ = **3718.872** ft^2
H = 16 ft; *Deck Bearing Wall Height*
H_p = 0 ft; *Parapet Height*

Seismic Base Shear

S_{DS} = 1.170
R = 3.5
I_e = 1.0
$C_s = S_{DS} / (R / I_e)$ = **0.334**

X-Direction

$W_{roof} = DL_{roof} * A$ = **74.377** kips; *Roof Weight; (Add %SL when SL > 30 psf)*
$W_{wall} = (H / 2 + H_p) * DL_{wall} * L_y * 2$ = **6.627** kips; *Wall Weight*
$W_x = W_{roof} + W_{wall}$ = **81.004** kips; *Seismic Weight*
$V_{xe\_roof} = 0.7 * W_{roof} * C_s$ = **17.404** kips
$V_{xe\_wall} = 0.7 * W_{wall} * C_s$ = **1.551** kips
$V_{xe} = 0.7 * W_x * C_s$ = **18.955** kips; *Allowable Base Shear*

Y-Direction

$W_{roof} = DL_{roof} * A$ = **74.377** kips; *Roof Weight; (Add %SL when SL > 30 psf)*
$W_{wall} = (H / 2 + H_p) * DL_{wall} * L_x * 2$ = **14.367** kips; *Wall Weight*
$W_y = W_{roof} + W_{wall}$ = **88.744** kips; *Seismic Weight*
$V_{ye\_roof} = 0.7 * W_{roof} * C_s$ = **17.404** kips
$V_{ye\_wall} = 0.7 * W_{wall} * C_s$ = **3.362** kips
$V_{ye} = 0.7 * W_y * C_s$ = **20.766** kips; *Allowable Base Shear*

Wind Base Shear

p = 18.8 psf; *Strength*

X-Direction

$V_{xw} = 0.6 * p * L_y * [(H / 2) + H_p]$ = **3.737** kips

Y-Direction

$V_{yw} = 0.6 * p * L_x * [(H / 2) + H_p]$ = **8.103** kips

Seismic Controls X-Direction
Seismic Controls Y-Direction

Footing Calculations

Design Variables

DL_{roof} = 20 psf
DL_{wall} = 10 psf
LL_{roof} = 20 psf
$SL_{uniform}$ = 20 psf
$Bearing_{soil}$ = 1500 psf

Footings

Footing – Spot Footing – SF1 (DB & D3)
Trib = [(22 ft + 10.9375 in) / 2] * [(20 ft + 8.5 in) / 2] = **118.615** ft^2

$P_{DL} = DL_{roof} * Trib$ = **2.372** kips
$P_{LL} = LL_{roof} * Trib$ = **2.372** kips
$P_{SL} = SL_{uniform} * Trib$ = **2.372** kips; Controls
$P_{TL} = P_{DL} + P_{SL}$ = **4.745** kips

Assume 1 brace in the X-direction:
$V_x = V_{xe} / 2$ = **9.477** kips; ASD
$V_y = V_{ye} / 4 / 2$ = **2.596** kips; ASD
$V_x = (V_{xe} / 0.7) / 2$ = **13.539** kips; Unfactored
$V_y = (V_{ye} / 0.7) / 4 / 2$ = **3.708** kips; Unfactored

Use FS7.0 See ENERCALC Results

Footing – Continuous Footing – CF1
Trib = (41 ft + 5 in) / 2= **20.708** ft

$W_{DL} = (DL_{roof} * Trib) + (DL_{wall} * H)$ = **574.167** plf
$W_{LL} = LL_{roof} * Trib$ = **414.167** plf
$W_{SL} = SL_{uniform} * Trib$ = **414.167** plf; Controls
$W_{TL} = W_{DL} + W_{SL}$ = **988.333** plf

$Width_{Footing} = W_{TL} / Bearing_{soil}$ = **0.659** ft

Use FC2.0 Min.

Project Title:
Engineer:
Project ID:
Project Descr:

FN-2

General Footing

Project File: 230396 - UDOT Murray Foundations.ec6

DESCRIPTION: Footing - Spot Footing - SF1 (D.B & D.3)

Code References

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2021

General Information

Material Properties

f'c : Concrete 28 day strength	=	3.0	ksi
fy : Rebar Yield	=	60.0	ksi
Ec : Concrete Elastic Modulus	=	3,122.0	ksi
Concrete Density	=	150.0	pcf
φ Values Flexure	=	0.90	
Shear	=	0.750	

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	Yes
Add Pedestal Wt for Soil Pressure	:	No
Use Pedestal wt for stability, mom & shear	:	No

Soil Design Values

Allowable Soil Bearing	=	1.50	ksf
Soil Density	=	110.0	pcf
Increase Bearing By Footing Weight	=	Yes	
Soil Passive Resistance (for Sliding)	=	250.0	pcf
Soil/Concrete Friction Coeff.	=	0.40	

Increases based on footing Depth

Footing base depth below soil surface	=	3.083	ft
Allow press. increase per foot of depth	=		ksf
when footing base is below	=		ft

Increases based on footing plan dimension

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

Dimensions

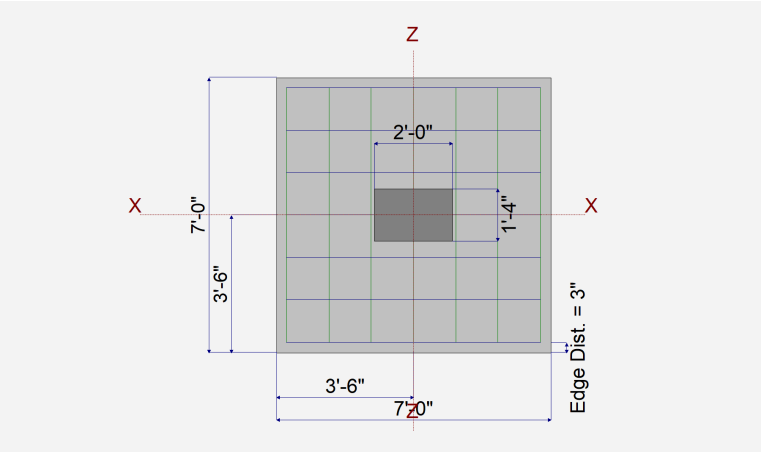
Width parallel to X-X Axis	=	7.0 ft
Length parallel to Z-Z Axis	=	7.0 ft
Footing Thickness	=	13.0 in

Pedestal dimensions...

px : parallel to X-X Axis	=	24.0 in
pz : parallel to Z-Z Axis	=	16.0 in
Height	=	16.0 in

Rebar Centerline to Edge of Concrete...

at Bottom of footing	=	3.0 in



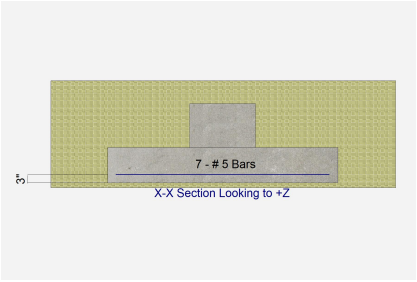
Reinforcing

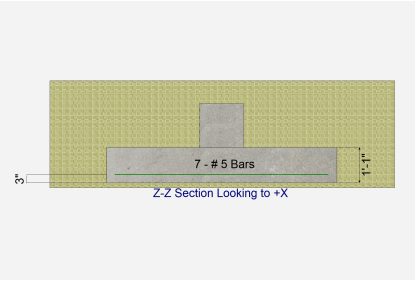
Bars parallel to X-X Axis			
Number of Bars	=		7.0
Reinforcing Bar Size	=	#	5
Bars parallel to Z-Z Axis			
Number of Bars	=		7.0
Reinforcing Bar Size	=	#	5

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation n/a

# Bars required within zone	n/a
# Bars required on each side of zone	n/a





Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	2.372	2.372		2.372				k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=								k-ft
V-x	=						3.708		k
V-z	=						13.539		k

General Footing

DESCRIPTION: Footing - Spot Footing - SF1 (D.B & D.3)

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.4905	Soil Bearing	0.8155 ksf	1.663 ksf	+D+0.70E about X-X axis
PASS	1.882	Overturning - X-X	22.903 k-ft	43.105 k-ft	+0.60D+0.70E
PASS	6.872	Overturning - Z-Z	6.273 k-ft	43.105 k-ft	+0.60D+0.70E
PASS	3.754	Sliding - X-X	2.596 k	9.744 k	+0.60D+0.70E
PASS	1.028	Sliding - Z-Z	9.477 k	9.744 k	+0.60D+0.70E
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.04552	Z Flexure (+X)	0.6157 k-ft/ft	13.526 k-ft/ft	+1.20D+0.70S+E
PASS	0.0280	Z Flexure (-X)	0.3787 k-ft/ft	13.526 k-ft/ft	+1.20D+1.60Lr
PASS	0.1472	X Flexure (+Z)	1.992 k-ft/ft	13.526 k-ft/ft	+1.20D+0.70S+E
PASS	0.1007	X Flexure (-Z)	1.362 k-ft/ft	13.526 k-ft/ft	+1.20D+0.70S+E
PASS	0.03353	1-way Shear (+X)	2.754 psi	82.158 psi	+1.20D+0.70S+E
PASS	0.02065	1-way Shear (-X)	1.696 psi	82.158 psi	+1.20D+1.60Lr
PASS	0.09980	1-way Shear (+Z)	8.199 psi	82.158 psi	+1.20D+0.70S+E
PASS	0.07041	1-way Shear (-Z)	5.785 psi	82.158 psi	+0.90D+E
PASS	0.02650	2-way Punching	4.354 psi	164.317 psi	+1.20D+1.60Lr

Top reinforcing mat required (see 'Bending' tab).

Hand check required for anchor pullout.

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc (in)	Zecc (in)	Actual Soil Bearing Stress @ Location Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, D Only	1.663	n/a	0.0	0.4189	0.4189	n/a	n/a	0.252
X-X, +D+Lr	1.663	n/a	0.0	0.4673	0.4673	n/a	n/a	0.281
X-X, +D+S	1.663	n/a	0.0	0.4673	0.4673	n/a	n/a	0.281
X-X, +D+0.750Lr	1.663	n/a	0.0	0.4552	0.4552	n/a	n/a	0.274
X-X, +D+0.750S	1.663	n/a	0.0	0.4552	0.4552	n/a	n/a	0.274
X-X, +D+0.70E	1.663	n/a	13.390	0.02226	0.8155	n/a	n/a	0.491
X-X, +D+0.750S+0.5250E	1.663	n/a	9.241	0.1577	0.7527	n/a	n/a	0.453
X-X, +0.60D	1.663	n/a	0.0	0.2513	0.2513	n/a	n/a	0.151
X-X, +0.60D+0.70E	1.663	n/a	22.316	0.0	0.710	n/a	n/a	0.427
Z-Z, D Only	1.663	0.0	n/a	n/a	n/a	0.4189	0.4189	0.252
Z-Z, +D+Lr	1.663	0.0	n/a	n/a	n/a	0.4673	0.4673	0.281
Z-Z, +D+S	1.663	0.0	n/a	n/a	n/a	0.4673	0.4673	0.281
Z-Z, +D+0.750Lr	1.663	0.0	n/a	n/a	n/a	0.4552	0.4552	0.274
Z-Z, +D+0.750S	1.663	0.0	n/a	n/a	n/a	0.4552	0.4552	0.274
Z-Z, +D+0.70E	1.663	3.667	n/a	n/a	n/a	0.3103	0.5275	0.317
Z-Z, +D+0.750S+0.5250E	1.663	2.531	n/a	n/a	n/a	0.3737	0.5367	0.323
Z-Z, +0.60D	1.663	0.0	n/a	n/a	n/a	0.2513	0.2513	0.151
Z-Z, +0.60D+0.70E	1.663	6.112	n/a	n/a	n/a	0.1427	0.360	0.217

Overturning Stability

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
X-X, D Only	None	0.0 k-ft	Infinity	OK
X-X, +D+Lr	None	0.0 k-ft	Infinity	OK
X-X, +D+S	None	0.0 k-ft	Infinity	OK
X-X, +D+0.750Lr	None	0.0 k-ft	Infinity	OK
X-X, +D+0.750S	None	0.0 k-ft	Infinity	OK
X-X, +D+0.70E	22.903 k-ft	71.841 k-ft	3.137	OK
X-X, +D+0.750S+0.5250E	17.178 k-ft	78.068 k-ft	4.545	OK
X-X, +0.60D	None	0.0 k-ft	Infinity	OK
X-X, +0.60D+0.70E	22.903 k-ft	43.105 k-ft	1.882	OK
Z-Z, D Only	None	0.0 k-ft	Infinity	OK
Z-Z, +D+Lr	None	0.0 k-ft	Infinity	OK
Z-Z, +D+S	None	0.0 k-ft	Infinity	OK
Z-Z, +D+0.750Lr	None	0.0 k-ft	Infinity	OK
Z-Z, +D+0.750S	None	0.0 k-ft	Infinity	OK

General Footing

DESCRIPTION: Footing - Spot Footing - SF1 (D.B & D.3)

Overturning Stability

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
Z-Z, +D+0.70E	6.273 k-ft	71.841 k-ft	11.453	OK
Z-Z, +D+0.750S+0.5250E	4.705 k-ft	78.068 k-ft	16.594	OK
Z-Z, +0.60D	None	0.0 k-ft	Infinity	OK
Z-Z, +0.60D+0.70E	6.273 k-ft	43.105 k-ft	6.872	OK

All units k

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status
X-X, D Only	0.0 k	13.028 k	No Sliding	OK
X-X, +D+Lr	0.0 k	13.977 k	No Sliding	OK
X-X, +D+S	0.0 k	13.977 k	No Sliding	OK
X-X, +D+0.750Lr	0.0 k	13.740 k	No Sliding	OK
X-X, +D+0.750S	0.0 k	13.740 k	No Sliding	OK
X-X, +D+0.70E	2.596 k	13.028 k	5.019	OK
X-X, +D+0.750S+0.5250E	1.947 k	13.740 k	7.058	OK
X-X, +0.60D	0.0 k	9.744 k	No Sliding	OK
X-X, +0.60D+0.70E	2.596 k	9.744 k	3.754	OK
Z-Z, D Only	0.0 k	13.028 k	No Sliding	OK
Z-Z, +D+Lr	0.0 k	13.977 k	No Sliding	OK
Z-Z, +D+S	0.0 k	13.977 k	No Sliding	OK
Z-Z, +D+0.750Lr	0.0 k	13.740 k	No Sliding	OK
Z-Z, +D+0.750S+0.5250E	7.108 k	13.740 k	1.933	OK
Z-Z, +0.60D	0.0 k	9.744 k	No Sliding	OK
Z-Z, +0.60D+0.70E	9.477 k	9.744 k	1.028	OK
Z-Z, +D+0.750S	0.0 k	13.740 k	No Sliding	OK
Z-Z, +D+0.70E	9.477 k	13.028 k	1.375	OK

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	0.2047	+Z	Bottom	0.2808	AsMin	0.310	13.526	OK
X-X, +1.40D	0.2047	-Z	Bottom	0.2808	AsMin	0.310	13.526	OK
X-X, +1.20D+0.50Lr	0.2726	+Z	Bottom	0.2808	AsMin	0.310	13.526	OK
X-X, +1.20D+0.50Lr	0.2726	-Z	Bottom	0.2808	AsMin	0.310	13.526	OK
X-X, +1.20D+0.50S	0.2726	+Z	Bottom	0.2808	AsMin	0.310	13.526	OK
X-X, +1.20D+0.50S	0.2726	-Z	Bottom	0.2808	AsMin	0.310	13.526	OK
X-X, +1.20D+1.60Lr	0.4863	+Z	Bottom	0.2808	AsMin	0.310	13.526	OK
X-X, +1.20D+1.60Lr	0.4863	-Z	Bottom	0.2808	AsMin	0.310	13.526	OK
X-X, +1.20D+1.60S	0.4863	+Z	Bottom	0.2808	AsMin	0.310	13.526	OK
X-X, +1.20D+1.60S	0.4863	-Z	Bottom	0.2808	AsMin	0.310	13.526	OK
X-X, +1.20D+0.70S+E	1.992	+Z	Bottom	0.2808	AsMin	0.310	13.526	OK
X-X, +1.20D+0.70S+E	1.362	-Z	Top	0.2808	AsMin	0.310	13.526	OK
X-X, +0.90D	0.1316	+Z	Bottom	0.2808	AsMin	0.310	13.526	OK
X-X, +0.90D	0.1316	-Z	Bottom	0.2808	AsMin	0.310	13.526	OK
X-X, +0.90D+E	1.959	+Z	Bottom	0.2808	AsMin	0.310	13.526	OK
X-X, +0.90D+E	1.347	-Z	Top	0.2808	AsMin	0.310	13.526	OK
Z-Z, +1.40D	0.1594	-X	Bottom	0.2808	AsMin	0.310	13.526	OK
Z-Z, +1.40D	0.1594	+X	Bottom	0.2808	AsMin	0.310	13.526	OK
Z-Z, +1.20D+0.50Lr	0.2123	-X	Bottom	0.2808	AsMin	0.310	13.526	OK
Z-Z, +1.20D+0.50Lr	0.2123	+X	Bottom	0.2808	AsMin	0.310	13.526	OK
Z-Z, +1.20D+0.50S	0.2123	-X	Bottom	0.2808	AsMin	0.310	13.526	OK
Z-Z, +1.20D+0.50S	0.2123	+X	Bottom	0.2808	AsMin	0.310	13.526	OK
Z-Z, +1.20D+1.60Lr	0.3787	-X	Bottom	0.2808	AsMin	0.310	13.526	OK
Z-Z, +1.20D+1.60Lr	0.3787	+X	Bottom	0.2808	AsMin	0.310	13.526	OK
Z-Z, +1.20D+1.60S	0.3787	-X	Bottom	0.2808	AsMin	0.310	13.526	OK
Z-Z, +1.20D+1.60S	0.3787	+X	Bottom	0.2808	AsMin	0.310	13.526	OK
Z-Z, +1.20D+0.70S+E	0.1306	-X	Top	0.2808	AsMin	0.310	13.526	OK
Z-Z, +1.20D+0.70S+E	0.6157	+X	Bottom	0.2808	AsMin	0.310	13.526	OK
Z-Z, +0.90D	0.1025	-X	Bottom	0.2808	AsMin	0.310	13.526	OK
Z-Z, +0.90D	0.1025	+X	Bottom	0.2808	AsMin	0.310	13.526	OK
Z-Z, +0.90D+E	0.2707	-X	Top	0.2808	AsMin	0.310	13.526	OK
Z-Z, +0.90D+E	0.4756	+X	Bottom	0.2808	AsMin	0.310	13.526	OK

General Footing

Project File: 230396 - UDOT Murray Foundations.ec6

DESCRIPTION: Footing - Spot Footing - SF1 (D.B & D.3)

One Way Shear

Load Combination...	Vu @ -X	Vu @ +X	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	0.71 psi	0.71 psi	0.86 psi	0.86 psi	0.86 psi	82.16 psi	0.01	OK
+1.20D+0.50Lr	0.95 psi	0.95 psi	1.15 psi	1.15 psi	1.15 psi	82.16 psi	0.01	OK
+1.20D+0.50S	0.95 psi	0.95 psi	1.15 psi	1.15 psi	1.15 psi	82.16 psi	0.01	OK
+1.20D+1.60Lr	1.70 psi	1.70 psi	2.05 psi	2.05 psi	2.05 psi	82.16 psi	0.02	OK
+1.20D+1.60S	1.70 psi	1.70 psi	2.05 psi	2.05 psi	2.05 psi	82.16 psi	0.02	OK
+1.20D+0.70S+E	0.58 psi	2.75 psi	5.56 psi	8.20 psi	8.20 psi	82.16 psi	0.10	OK
+0.90D	0.46 psi	0.46 psi	0.55 psi	0.55 psi	0.55 psi	82.16 psi	0.01	OK
+0.90D+E	1.21 psi	2.13 psi	5.79 psi	8.02 psi	8.02 psi	82.16 psi	0.10	OK

Two-Way "Punching" Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	1.83 psi	164.32 psi	0.01116	OK
+1.20D+0.50Lr	2.44 psi	164.32 psi	0.01486	OK
+1.20D+0.50S	2.44 psi	164.32 psi	0.01486	OK
+1.20D+1.60Lr	4.35 psi	164.32 psi	0.0265	OK
+1.20D+1.60S	4.35 psi	164.32 psi	0.0265	OK
+1.20D+0.70S+E	2.79 psi	164.32 psi	0.01699	OK
+0.90D	1.18 psi	164.32 psi	0.007171	OK
+0.90D+E	1.40 psi	164.32 psi	0.008546	OK

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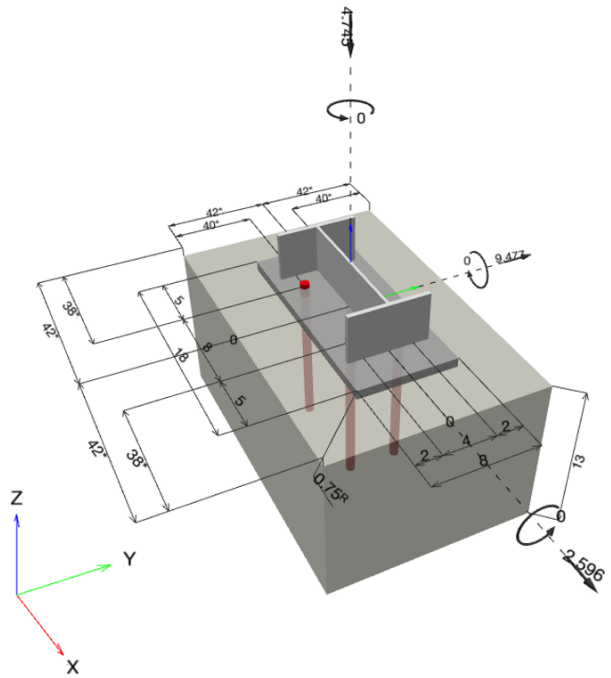
Specifier's comments:

1 Input data

Anchor type and diameter:	**Heavy Hex Head ASTM F 1554 GR. 36 3/4**
Item number:	not available
Effective embedment depth:	h_{ef} = 12.000 in.
Material:	ASTM F 1554
Evaluation Service Report:	Hilti Technical Data
Issued I Valid:	- | -
Proof:	Design Method ACI 318-19 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.750 in.
Anchor plate[R]:	l_x x l_y x t = 18.000 in. x 8.000 in. x 0.750 in.; (Recommended plate thickness: not calculated)
Profile:	W shape (AISC), W12X26; (L x W x T x FT) = 12.200 in. x 6.490 in. x 0.230 in. x 0.380 in.
Base material:	cracked concrete, 3000, f_c' = 3,000 psi; h = 13.000 in.
Reinforcement:	tension: present, shear: present; anchor reinforcement: shear
	edge reinforcement: none or < No. 4 bar

[R] - The anchor calculation is based on a rigid anchor plate assumption.

Geometry [in.] & Loading [kip, ft.kip]



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1.1 Design results

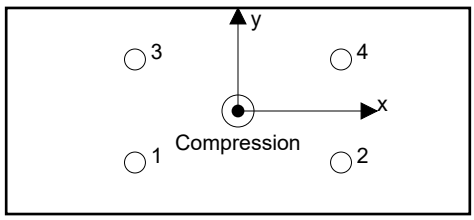
Case	Description	Forces [kip] / Moments [ft.kip]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = -4.745; V_x = 2.596; V_y = 9.477; M_x = 0.00000; M_y = 0.00000; M_z = 0.00000;	no	33

2 Load case/Resulting anchor forces

Anchor reactions [kip]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0.000	2.457	0.649	2.369
2	0.000	2.457	0.649	2.369
3	0.000	2.457	0.649	2.369
4	0.000	2.457	0.649	2.369



max. concrete compressive strain: 0.01 [‰]
max. concrete compressive stress: 33 [psi]
resulting tension force in (x/y)=(0.000/0.000): 0.000 [kip]
resulting compression force in (x/y)=(0.000/-0.000): 4.745 [kip]

Anchor forces are calculated based on the assumption of a rigid anchor plate.

3 Tension load

	Load N_{ua} [kip]	Capacity ϕ N_n [kip]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	N/A	N/A	N/A	N/A
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	N/A	N/A	N/A	N/A
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

* highest loaded anchor **anchor group (anchors in tension)

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4 Shear load

	Load V_{ua} [kip]	Capacity ϕ V_n [kip]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	2.457	7.555	33	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	9.826	104.798	10	OK
Concrete edge failure in direction **[1]	N/A	N/A	N/A	N/A

* highest loaded anchor **anchor group (relevant anchors)

[1] Shear Anchor Reinforcement has been selected!

4.1 Steel Strength

$V_{sa} = 0.6\ A_{se,V}\ f_{uta}$ ACI 318-19 Eq. (17.7.1.2b)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
0.33	58,000

Calculations

V_{sa} [kip]
11.623

Results

V_{sa} [kip]	ϕ_{steel}	$\phi\ V_{sa}$ [kip]	V_{ua} [kip]
11.623	0.650	7.555	2.457

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4.2 Pryout Strength

$V_{cpg} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \right]$ ACI 318-19 Eq. (17.7.3.1b)

$\phi V_{cpg} \geq V_{ua}$ ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9 h_{ef}^2$ ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e'_N}{3 h_{ef}}} \right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.3.1)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = 16 \lambda_a \sqrt{f'_c} h_{ef}^{5/3}$ ACI 318-19 Eq. (17.6.2.2.3)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	12.000	0.000	0.000	38.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
1.000	∞	16	1.000	3,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [kip]
1,760.00	1,296.00	1.000	1.000	1.000	1.000	55.121

Results

V_{cpg} [kip]	$\phi_{concrete}$	ϕV_{cpg} [kip]	V_{ua} [kip]
149.711	0.700	104.798	9.826

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!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- The design of Anchor Reinforcement is beyond the scope of PROFIS Engineering. Refer to ACI 318-19, Section 17.5.2.1 (b) for information about Anchor Reinforcement.
- Anchor Reinforcement has been selected as a design option, calculations should be compared with PROFIS Engineering calculations.

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Fastening meets the design criteria!

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6 Installation data

Profile: W shape (AISC), W12X26; (L x W x T x FT) = 12.200 in. x 6.490 in. x 0.230 in. x 0.380 in.

Hole diameter in the fixture: d_f = 0.812 in.

Plate thickness (input): 0.750 in.

Recommended plate thickness: not calculated

Anchor type and diameter: Heavy Hex Head ASTM F 1554 GR. 36 3/4

Item number: not available

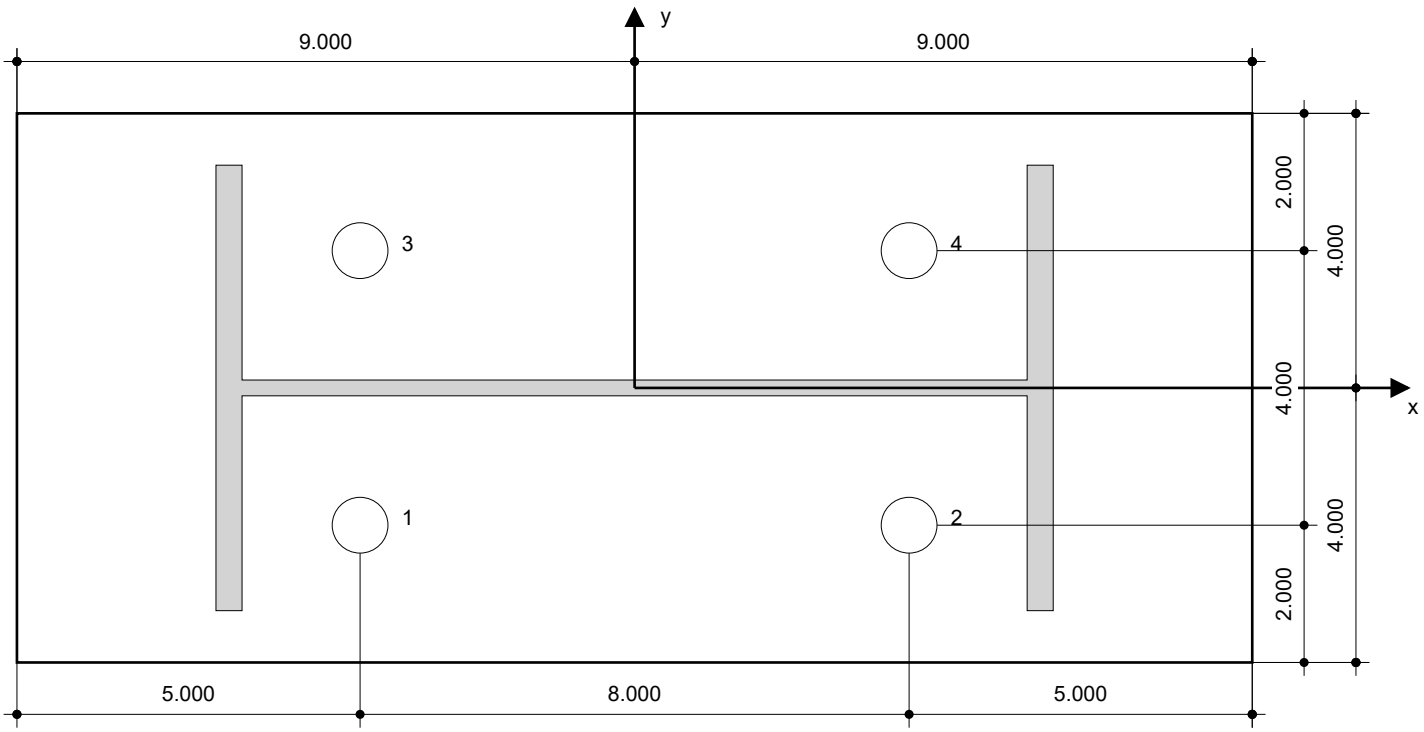
Maximum installation torque: -

Hole diameter in the base material: - in.

Hole depth in the base material: 12.000 in.

Minimum thickness of the base material: 13.000 in.

Hilti Heavy Hex Head headed stud anchor with 12 in embedment, 3/4, Steel galvanized, installation per instruction for use



Coordinates Anchor [in.]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.000	-2.000	38.000	46.000	40.000	44.000
2	4.000	-2.000	46.000	38.000	40.000	44.000
3	-4.000	2.000	38.000	46.000	44.000	40.000
4	4.000	2.000	46.000	38.000	44.000	40.000

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7 Remarks; Your Cooperation Duties

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