1	REV 1 7/13/23

2	REV 2 7/14/23

DICIG Marine Group	Seaborn Pile Driving Lake Washington Timber Pile Cap Analysis	Calculations Prepared For Seaborn Pile Driving 7/14/2023
Prepared By: D. Truong Reviewed By: J. Smoot	7422 East Mercer Way, Mercer Island, WA	Cover Sheet

Calculation Narrative

1

The purpose of this calculation is to determine the structural capacity of steel channels used to brace existing timber pile caps located on Mercer Island, WA. The timber caps support timber stringers and decking for a recreational private dock. Loading and structural capacity of the caps were analyzed using ASCE 7-10 and AWC NDS 2018, respectively. The pile cap with the longest span is the controlling case as all the pile caps have similar loading and structural properties. All dimensions are estimated based on photos provided by Seaborn Pile Driving. Timber is assumed to have full capacity.

A point load is applied to the end of the cantilever by a neighboring dock. Enercalc is used to evaluate the overhanging beam to determine the max shear and moment demand.

The engineer of record certifies the correctness of all calculations herein with the stamp affixed below. A thorough review of all structural components identified in the load cases on page 2 to be those critical for the performance and safety of the structure

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Federal Way
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Federal Way, WA 98003
Tel: 206.523.0024

1 REV 1 7/13/23

2 REV 2 7/14/23

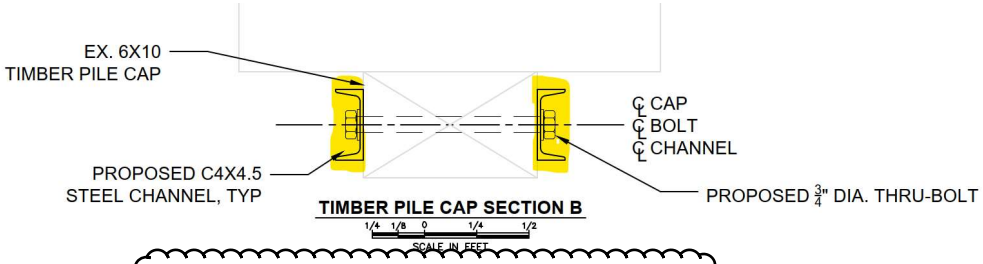
DICIG Marine Group	Seaborn Pile Driving Lake Washington Timber Pile Cap Analysis	Calculations Prepared For Seaborn Pile Driving 7/14/2023
Prepared By: D. Truong Reviewed By: J. Smoot	7422 East Mercer Way, Mercer Island, WA	Calculation Summary

Vertical Loading Summary

Structural Component	Page #	Shear Dem. (Kip)	Shear Cap. (Kip)	DCR	Mom. Dem. (Kip-ft)	Mom. Cap. (Kip-ft)	DCR	Defl. (in)	Defl. Crit. L/360 (in)	DCR
Double Channel C4x4.5, Pile Cap 1	5-8	3.4	18	OK	8.6	13	OK			
Double Channel C4x4.5, Pile Cap 2	9-12	3.4	18	OK	9.2	13	OK			
Double Channel C4x4.5, Pile Cap 3	13-16	4.2	18	OK	12.0	13	OK			
Double Channel Thru Bolt	17	0.9	1.8	OK						

2

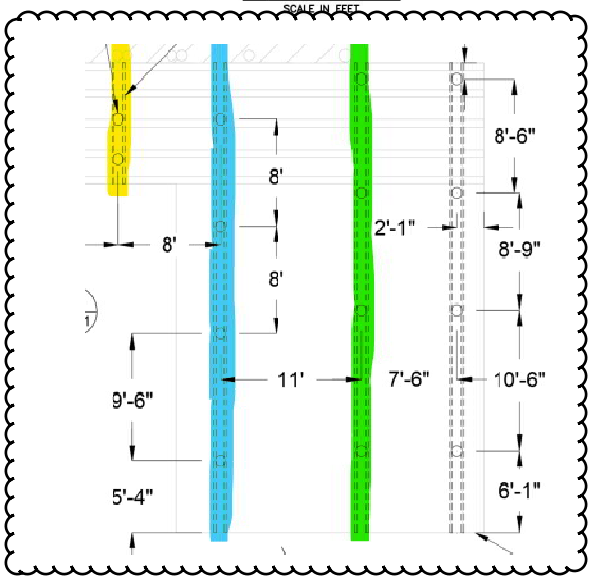
Summary	
Double Channel Design	(2) C4x4.5, Both Sides of Beam
Connection	(2) 3/4" Ø Thru Bolt



TIMBER PILE CAP SECTION B

1/4 1/8 0 1/4 1/2
SCALE IN FEET

1



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1 REV 1 7/13/23

2 REV 2 7/14/23

DICIG Marine Group	Seaborn Pile Driving Lake Washington Timber Pile Cap Analysis	Calculations Prepared For Seaborn Pile Driving 7/14/2023
Prepared By: D. Truong Reviewed By: J. Smoot	7422 East Mercer Way, Mercer Island, WA	Timber Cap Demand

6" x 10" Timber Cap Dead Load

Component	Tributary L	W	D	Unit Weight	Quant.	WEIGHT
	(ft)	(in)	(in)	(lbs/ft (SF))	(ea)	(plf)
		Distributed Dead Loads				
6" x 10" Timber Cap	13	9.5	5.5	5.3	1	68.9
2" x 8" Timber Decking	10	7.5	1.5	3	1	48.0
4" x 12" PT Timber Stringer	9	3.5	11.25	10.9	6	72.9
					Total	189.8

6" x 10" Timber Cap Live Load

Tributary Width	10 ft	
Live Load	40 psf	Mercer Island Code
Total Load	400 plf	

1

Snow Load

Ce	Exposure Factor	0.9		ASCE Table 7.3-1
Ct	Thermal Factor	1.2		ASCE Table 7.3-2
Cs	Slope Factor	1		ASCE Fig. 7.4-1
pg	Ground Snow Load	28	psf	ASCE Hazard Tool
pf	Flat Roof Snow Load	21.2	psf	ASCE 7.3-1
ps	Sloped Roof Snow Load	21.2	psf	ASCE 7.4-1
ws	Snow Line Load	212	plf	

Point Load from neighboring Dock

Dead Load	0.21	kip
Live Load	0.66	kip

NOTE: This load is set on the end of the cantilever

Load Combination (Allowable Stress Design)

1.0 D + 1.0 L	0.59	klf	ASCE Ch 2.4.1
1.0 D + 0.75 L + 0.75 S	0.65	klf	ASCE Ch 2.4.1
Max Shear, Vmax	4.2	kip	Enercalc
Max Moment, Mmax	12	kip-ft	Enercalc

2

1

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1	REV 1 7/13/23	2	REV 2 7/14/23

DICIG Marine Group	Seaborn Pile Driving Lake Washington Timber Pile Cap Analysis	Calculations Prepared For Seaborn Pile Driving 7/14/2023
Prepared By: D. Truong Reviewed By: J. Smoot	7422 East Mercer Way, Mercer Island, WA	Timber Cap Capacity

6" x 10" Timber Cap Bending Capacity

F_b	875	psi	Doug Fir No. 2
C_D	1		Live Load NDS Table 2.3.2
C_M	1		mc >16%, Table 5A
C_t	1		T<100, NDS Table 2.3.3
C_I	0.8		Cap has incising
C_L	1		d<b
C_F	1		d<12"
C_{fu}	1		Loaded on wide face
C_c	1		

Table 4.3.1 Applicability of Adjustment Factors for Sawn Lumber

		ASD only	ASD and LRFD									
		Load Duration Factor	Wet Service Factor	Temperature Factor	Beam Stability Factor	Size Factor	Flat Use Factor	Incising Factor	Repetitive Member Factor	Column Stability Factor	Buckling Stiffness Factor	Bearing Area Factor
$F_b' = F_b$	x	C_D	C_M	C_t	C_L	C_F	C_{fu}	C_i	C_r	-	-	-
$F_t' = F_t$	x	C_D	C_M	C_t	-	C_F	-	C_i	-	-	-	-
$F_v' = F_v$	x	C_D	C_M	C_t	-	-	-	C_i	-	-	-	-

Fb & Fv Reference Design Values

DOUGLAS FIR-LARCH								
Dense Select Structural	Beams and Stringers	1,900	1,100	170	730	1,300	1,700,000	620,000
Select Structural		1,600	950	170	625	1,100	1,600,000	580,000
Dense No. 1		1,550	775	170	730	1,100	1,700,000	620,000
No. 1		1,350	675	170	625	925	1,600,000	580,000
No. 2		875	425	170	625	600	1,300,000	470,000

0.50

Bending Capacity

Fb'	700	psi	
S_x	48	in^3	Section Modulus
Mn	2.8	kip-ft	

2

Bending Demand

Mmax	12	kip-ft	Moment Demand
DCR	4.3	NG	Timber Cap Alone is not Structurally Sound

1

6" x 10" Timber Cap Shear Capacity

F_v	170	psi	Doug Fir No. 2
C_D	1		Live Load NDS Table 2.3.2
C_M	0.8		mc >16%, Table 5A
C_t	1		T<100, NDS Table 2.3.3
C_I	0.8		Cap has incising

Allowable Shear Stress

F_v'	108.8	psi	
A	52.25	in^2	Cross Sectional Area
Vn	5.7	kip	

Actual Shear Stress

V_{max}	4.2	kips	Shear Demand

2

DCR	0.7	GOOD	OK

1

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Project Title:
Engineer:
Project ID:
Project Descr:

2 REV 2 7/14/23

Steel Beam

Project File: Liu.ec6

DESCRIPTION: C4x4.5 Pile Cap Type 1

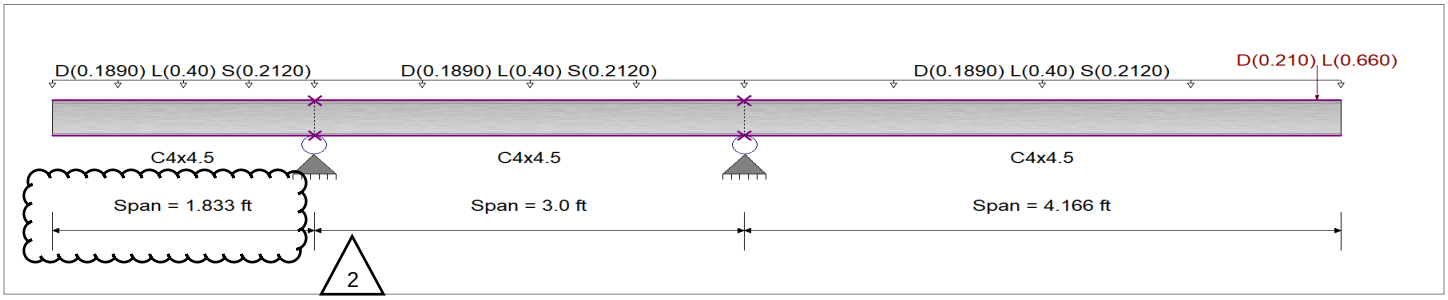
CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Strength Design
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling
Bending Axis : Major Axis Bending

Fy : Steel Yield : 50.0 ksi
E: Modulus : 29,000.0 ksi



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Load for Span Number 1
Uniform Load : D = 0.1890, L = 0.40, S = 0.2120 k/ft, Tributary Width = 1.0 ft

Load for Span Number 2
Uniform Load : D = 0.1890, L = 0.40, S = 0.2120 k/ft, Tributary Width = 1.0 ft

Load for Span Number 3
Uniform Load : D = 0.1890, L = 0.40, S = 0.2120 k/ft, Tributary Width = 1.0 ft

2

Point Load : D = 0.210, L = 0.660 k @ 4.0 ft

Timber Cap + Double Channel
DCR = 0.66

DESIGN SUMMARY

Design N.G.

Maximum Bending Stress Ratio =	1.680 : 1	Maximum Shear Stress Ratio =	0.381 : 1
Section used for this span	C4x4.5	Section used for this span	C4x4.5
Ma : Applied	8.591 k-ft	Va : Applied	3.424 k
Mn / Omega : Allowable	5.115 k-ft	Vn/Omega : Allowable	8.982 k
Load Combination	+D+L	Load Combination	+D+0.750L+0.750S
		Location of maximum on span	3.000 ft
Span # where maximum occurs	Span # 2	Span # where maximum occurs	Span # 2

Maximum Deflection

Max Downward Transient Deflection	0.926 in	Ratio =	107	>=	Span: 3 : L Only
Max Upward Transient Deflection	-0.059 in	Ratio =	609	>=	Span: 3 : L Only
Max Downward Total Deflection	1.296 in	Ratio =	77	>=	Span: 3 : +D+L
Max Upward Total Deflection	-0.083 in	Ratio =	434	>=	Span: 3 : +D+L

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	Summary of Moment Values Mmax +	Mmax -	Ma Max	Mnx Mnx/Omega Cb	Rm	Summary of Shear Values Va Max	VnxVnx/Omega
D Only										
Dsgn. L = 1.83 ft	1	0.062	0.049		-0.32	0.32	8.54 5.11	1.00 1.00	0.44	15.00 8.98
Dsgn. L = 3.00 ft	2	0.485	0.112	-0.00	-2.48	2.48	8.54 5.11	1.00 1.00	1.00	15.00 8.98
Dsgn. L = 4.17 ft	3	0.485	0.111		-2.48	2.48	8.54 5.11	1.00 1.00	1.00	15.00 8.98
+D+L										
Dsgn. L = 1.83 ft	1	0.193	0.184		-0.99	0.99	8.54 5.11	1.00 1.00	1.65	15.00 8.98
Dsgn. L = 3.00 ft	2	1.680	0.380	-0.00	-8.59	8.59	8.54 5.11	1.00 1.00	3.42	15.00 8.98
Dsgn. L = 4.17 ft	3	1.680	0.370		-8.59	8.59	8.54 5.11	1.00 1.00	3.32	15.00 8.98
+D+S										
Dsgn. L = 1.83 ft	1	0.132	0.082		-0.67	0.67	8.54 5.11	1.00 1.00	0.74	15.00 8.98
Dsgn. L = 3.00 ft	2	0.845	0.209	-0.00	-4.32	4.32	8.54 5.11	1.00 1.00	1.88	15.00 8.98

Steel Beam

Project File: Liu.ec6

LIC# : KW-06012482, Build:20.23.2.14 Davido Consulting Group

DESCRIPTION: C4x4.5 Pile Cap Type 1

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	Summary of Moment Values Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Summary of Shear Values Va Max	VnxVnx/Omega
Dsgn. L = 4.17 ft	3	0.845	0.209		-4.32	4.32	8.54	5.11	1.00	1.00	1.88	15.00 8.98
+D+0.750L												
Dsgn. L = 1.83 ft	1	0.161	0.150		-0.82	0.82	8.54	5.11	1.00	1.00	1.35	15.00 8.98
Dsgn. L = 3.00 ft	2	1.381	0.313	-0.00	-7.06	7.06	8.54	5.11	1.00	1.00	2.81	15.00 8.98
Dsgn. L = 4.17 ft	3	1.381	0.305		-7.06	7.06	8.54	5.11	1.00	1.00	2.74	15.00 8.98
+D+0.750L+0.750S												
Dsgn. L = 1.83 ft	1	0.213	0.165		-1.09	1.09	8.54	5.11	1.00	1.00	1.48	15.00 8.98
Dsgn. L = 3.00 ft	2	1.651	0.381	-0.00	-8.44	8.44	8.54	5.11	1.00	1.00	3.42	15.00 8.98
Dsgn. L = 4.17 ft	3	1.651	0.379		-8.44	8.44	8.54	5.11	1.00	1.00	3.40	15.00 8.98
+0.60D												
Dsgn. L = 1.83 ft	1	0.037	0.029		-0.19	0.19	8.54	5.11	1.00	1.00	0.26	15.00 8.98
Dsgn. L = 3.00 ft	2	0.291	0.067	-0.00	-1.49	1.49	8.54	5.11	1.00	1.00	0.60	15.00 8.98
Dsgn. L = 4.17 ft	3	0.291	0.067		-1.49	1.49	8.54	5.11	1.00	1.00	0.60	15.00 8.98

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4
Max Upward from all Load Conditions		0.212	6.828	0.972
Max Upward from Load Combinations		0.121	6.828	0.972
Max Upward from Load Cases		0.212	4.739	0.972
Max Downward from all Load Conditions (Resi		-0.571		0.972
Max Downward from Load Combinations (Resi		-0.571		0.972
Max Downward from Load Cases (Resisting U		-0.480		0.972
D Only		-0.091	2.002	0.972
+D+L		-0.571	6.741	0.972
+D+S		0.121	3.697	0.972
+D+0.750L		-0.451	5.556	0.972
+D+0.750L+0.750S		-0.292	6.828	0.972
+0.60D		-0.055	1.201	0.972
L Only		-0.480	4.739	0.972
S Only		0.212	1.696	0.972

Steel Section Properties : C4x4.5

Depth	=	4.000	in	I xx	=	3.53	in^4	J	=	0.031	in^4
Web Thick	=	0.125	in	S xx		1.77	in^3	Cw	=	0.78	in^6
Flange Width	=	1.520	in	R xx	=	1.620	in	Ro	=	1.970	in
Flange Thick	=	0.296	in	Zx	=	2.050	in^3	H	=	0.727	in
Area	=	1.340	in^2	I yy	=	0.265	in^4				
Weight	=	4.500	plf	S yy	=	0.253	in^3	Wno	=	1.550	in^2
Kdesign	=	0.750	in	R yy	=	0.445	in	Sw	=	0.193	in^4
				Zy	=	0.495	in^3	Qf	=	0.765	in^3
rts	=	0.506	in					Qw	=	1.010	in^3
Ycg	=	2.000	in					Wn2	=	0.000	
Xcg	=	0.473	in					Sw2	=	0.088	
Xp	=	0.305	in					Sw3	=	0.044	
Eo	=	0.556	in								

Project Title:
Engineer:
Project ID:
Project Descr:

2 REV 2 7/14/23

Steel Beam

Project File: Liu.ec6

DESCRIPTION: C4x4.5 Pile Cap Type 1

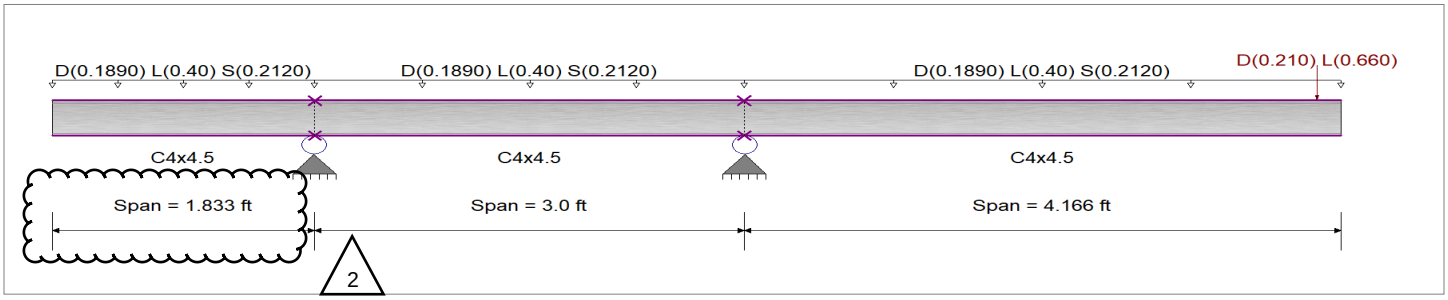
CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Strength Design
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling
Bending Axis : Major Axis Bending

Fy : Steel Yield : 50.0 ksi
E: Modulus : 29,000.0 ksi



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Load for Span Number 1
Uniform Load : D = 0.1890, L = 0.40, S = 0.2120 k/ft, Tributary Width = 1.0 ft

Load for Span Number 2
Uniform Load : D = 0.1890, L = 0.40, S = 0.2120 k/ft, Tributary Width = 1.0 ft

Load for Span Number 3
Uniform Load : D = 0.1890, L = 0.40, S = 0.2120 k/ft, Tributary Width = 1.0 ft

2

Point Load : D = 0.210, L = 0.660 k @ 4.0 ft

Timber Cap + Double Channel
DCR = 0.66

DESIGN SUMMARY

Design N.G.

Maximum Bending Stress Ratio =	1.680 : 1	Maximum Shear Stress Ratio =	0.381 : 1
Section used for this span	C4x4.5	Section used for this span	C4x4.5
Ma : Applied	8.591 k-ft	Va : Applied	3.424 k
Mn / Omega : Allowable	5.115 k-ft	Vn/Omega : Allowable	8.982 k
Load Combination	+D+L	Load Combination	+D+0.750L+0.750S
		Location of maximum on span	3.000 ft
Span # where maximum occurs	Span # 2	Span # where maximum occurs	Span # 2

Maximum Deflection

Max Downward Transient Deflection	0.926 in	Ratio =	107	>=	Span: 3 : L Only
Max Upward Transient Deflection	-0.059 in	Ratio =	609	>=	Span: 3 : L Only
Max Downward Total Deflection	1.296 in	Ratio =	77	>=	Span: 3 : +D+L
Max Upward Total Deflection	-0.083 in	Ratio =	434	>=	Span: 3 : +D+L

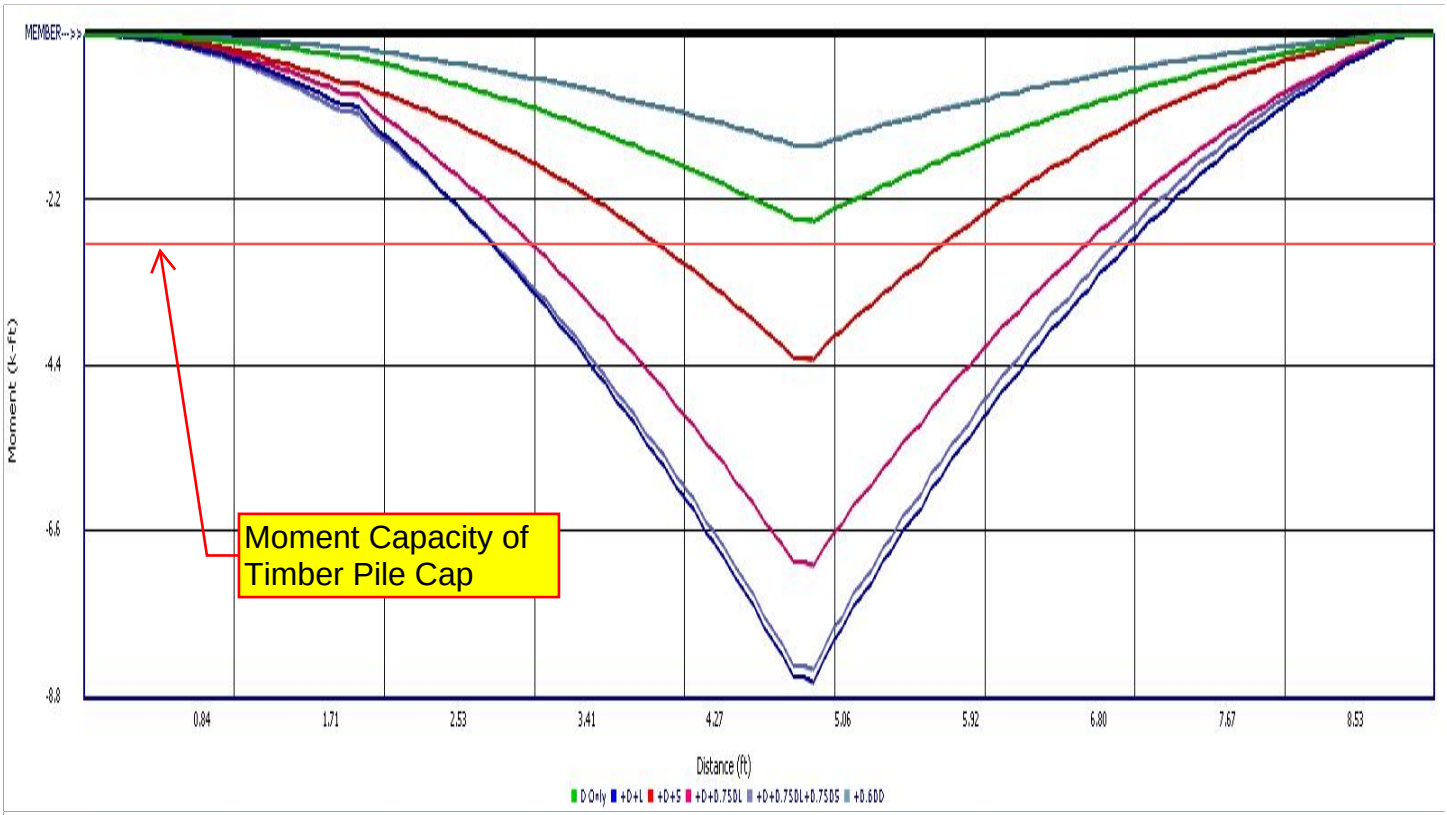
Maximum Forces & Stresses for Load Combinations

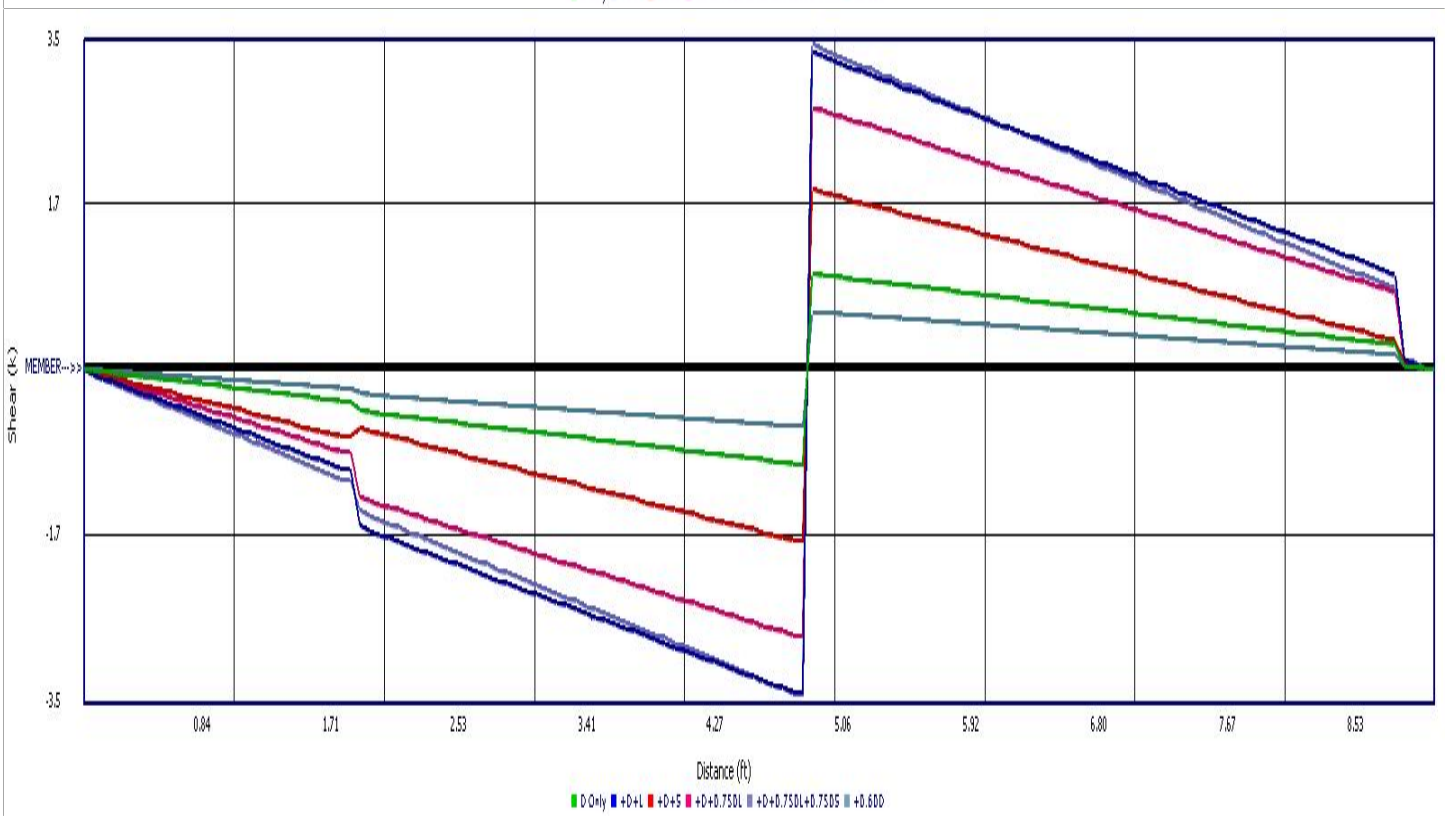
Load Combination / Segment Length	Span #	Max Stress Ratios M	V	Summary of Moment Values Mmax +	Mmax -	Ma Max	Mnx Mnx/Omega Cb	Rm	Summary of Shear Values Va Max	VnxVnx/Omega
D Only										
Dsgn. L = 1.83 ft	1	0.062	0.049		-0.32	0.32	8.54 5.11	1.00 1.00	0.44	15.00 8.98
Dsgn. L = 3.00 ft	2	0.485	0.112	-0.00	-2.48	2.48	8.54 5.11	1.00 1.00	1.00	15.00 8.98
Dsgn. L = 4.17 ft	3	0.485	0.111		-2.48	2.48	8.54 5.11	1.00 1.00	1.00	15.00 8.98
+D+L										
Dsgn. L = 1.83 ft	1	0.193	0.184		-0.99	0.99	8.54 5.11	1.00 1.00	1.65	15.00 8.98
Dsgn. L = 3.00 ft	2	1.680	0.380	-0.00	-8.59	8.59	8.54 5.11	1.00 1.00	3.42	15.00 8.98
Dsgn. L = 4.17 ft	3	1.680	0.370		-8.59	8.59	8.54 5.11	1.00 1.00	3.32	15.00 8.98
+D+S										
Dsgn. L = 1.83 ft	1	0.132	0.082		-0.67	0.67	8.54 5.11	1.00 1.00	0.74	15.00 8.98
Dsgn. L = 3.00 ft	2	0.845	0.209	-0.00	-4.32	4.32	8.54 5.11	1.00 1.00	1.88	15.00 8.98

Steel Beam

LIC# : KW-06012482, Build:20.23.2.14 Davido Consulting Group

DESCRIPTION: C4x4.5 Pile Cap Type 1





Project Title:
Engineer:
Project ID:
Project Descr:

2 REV 2 7/14/23

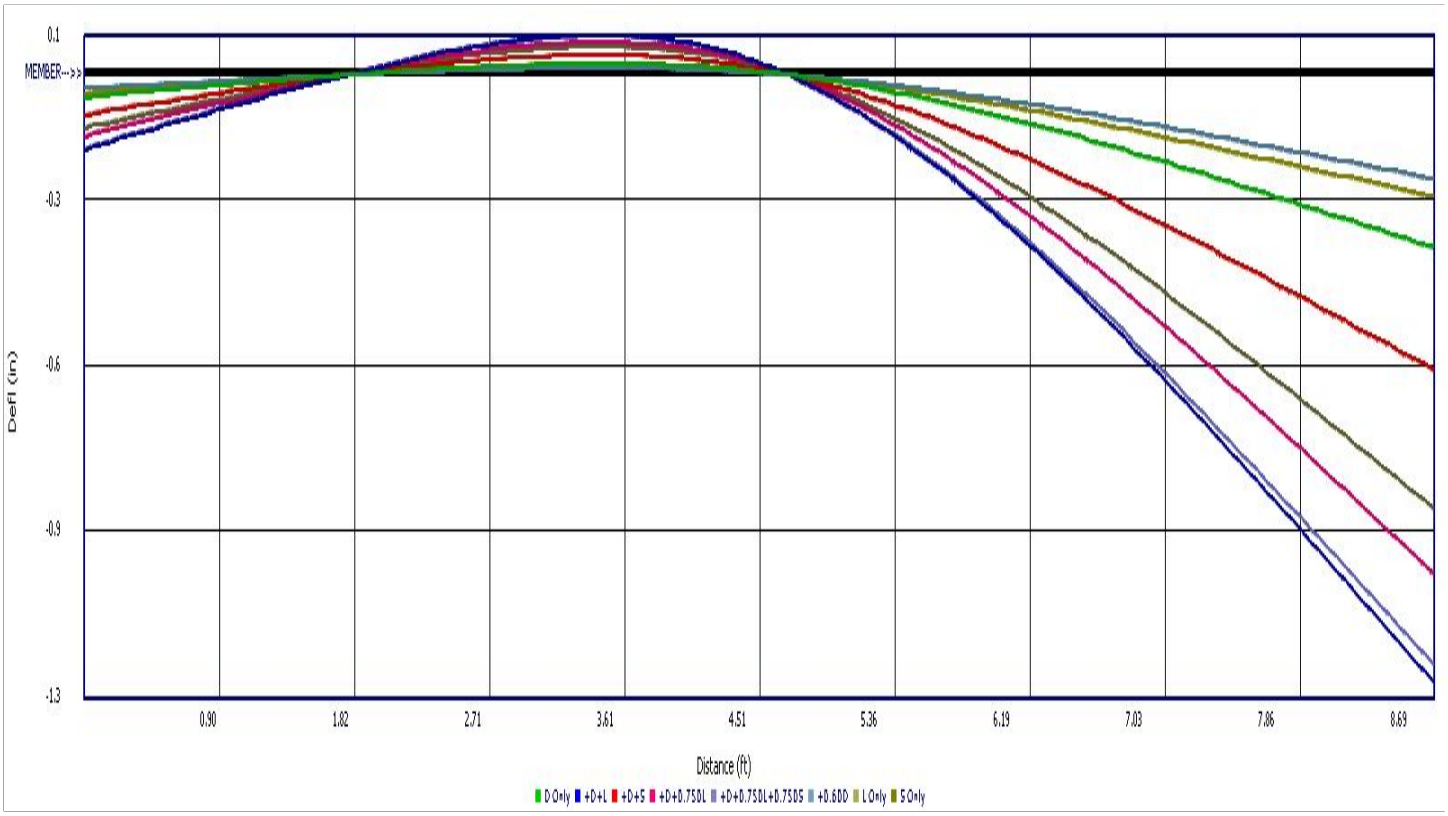
2

Steel Beam

Project File: Liu.ec6

LIC# : KW-06012482, Build:20.23.2.14 Davido Consulting Group

DESCRIPTION: C4x4.5 Pile Cap Type 1



Steel Beam

Project File: Liu.ec6

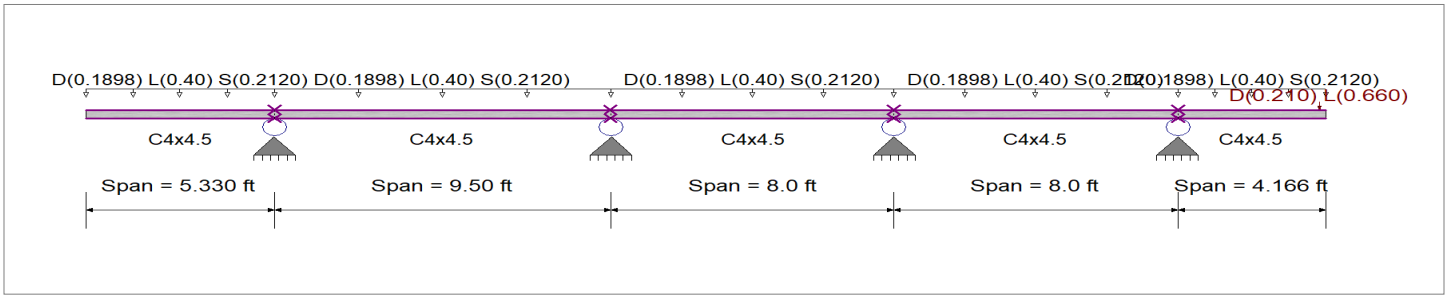
DESCRIPTION: C4x4.5 Pile Cap Type 2

CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2021

Material Properties

Analysis Method :	Allowable Strength Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added

Load for Span Number 1
Uniform Load : D = 0.1898, L = 0.40, S = 0.2120 k/ft, Tributary Width = 1.0 ft

Load for Span Number 2
Uniform Load : D = 0.1898, L = 0.40, S = 0.2120 k/ft, Tributary Width = 1.0 ft

Load for Span Number 3
Uniform Load : D = 0.1898, L = 0.40, S = 0.2120 k/ft, Tributary Width = 1.0 ft

Load for Span Number 4
Uniform Load : D = 0.1898, L = 0.40, S = 0.2120 k/ft, Tributary Width = 1.0 ft

Load for Span Number 5
Uniform Load : D = 0.1898, L = 0.40, S = 0.2120 k/ft, Tributary Width = 1.0 ft

Point Load : D = 0.210, L = 0.660 k @ 4.0 ft

Timber Cap + Double Channel
DCR = 0.707

DESIGN SUMMARY

Design N.G.

Maximum Bending Stress Ratio =	1.802 : 1	Maximum Shear Stress Ratio =	0.412 : 1
Section used for this span	C4x4.5	Section used for this span	C4x4.5
Ma : Applied	9.216 k-ft	Va : Applied	3.701 k
Mn / Omega : Allowable	5.115 k-ft	Vn/Omega : Allowable	8.982 k
Load Combination	+D+0.750L+0.750S	Load Combination	+D+0.750L+0.750S
		Location of maximum on span	5.330 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	1.157 in	Ratio =	86	>=	Span: 5 : L Only
Max Upward Transient Deflection	-0.158 in	Ratio =	608	>=	Span: 5 : L Only
Max Downward Total Deflection	2.126 in	Ratio =	60	>=	Span: 5 : +D+0.750L+0.750S
Max Upward Total Deflection	-0.211 in	Ratio =	454	>=	Span: 5 : +D+L

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	Summary of Moment Values Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Summary of Shear Values Va Max	VnxVnx/Omega
D Only												
Dsgn. L = 5.33 ft	1	0.527	0.121		-2.70	2.70	8.54	5.11	1.00	1.00	1.08	15.00	8.98
Dsgn. L = 9.50 ft	2	0.527	0.121	0.39	-2.70	2.70	8.54	5.11	1.00	1.00	1.08	15.00	8.98
Dsgn. L = 8.00 ft	3	0.191	0.089	0.71	-0.98	0.98	8.54	5.11	1.00	1.00	0.80	15.00	8.98

Steel Beam

Project File: Liu.ec6

DESCRIPTION: C4x4.5 Pile Cap Type 2

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length		Span #	Max Stress Ratios M	V	Summary of Moment Values Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Summary of Shear Values Va Max	VnxVnx/Omega	
Dsgn. L =	8.00 ft	4	0.486	0.111	0.09	-2.49	2.49	8.54	5.11	1.00	1.00	1.00	15.00	8.98
Dsgn. L =	4.17 ft	5	0.486	0.111		-2.49	2.49	8.54	5.11	1.00	1.00	1.00	15.00	8.98
+D+L														
Dsgn. L =	5.33 ft	1	1.638	0.374		-8.38	8.38	8.54	5.11	1.00	1.00	3.36	15.00	8.98
Dsgn. L =	9.50 ft	2	1.638	0.374	1.19	-8.38	8.38	8.54	5.11	1.00	1.00	3.36	15.00	8.98
Dsgn. L =	8.00 ft	3	0.603	0.281	2.30	-3.08	3.08	8.54	5.11	1.00	1.00	2.52	15.00	8.98
Dsgn. L =	8.00 ft	4	1.681	0.370	0.13	-8.60	8.60	8.54	5.11	1.00	1.00	3.33	15.00	8.98
Dsgn. L =	4.17 ft	5	1.681	0.370		-8.60	8.60	8.54	5.11	1.00	1.00	3.33	15.00	8.98
+D+S														
Dsgn. L =	5.33 ft	1	1.116	0.256		-5.71	5.71	8.54	5.11	1.00	1.00	2.30	15.00	8.98
Dsgn. L =	9.50 ft	2	1.116	0.256	0.86	-5.71	5.71	8.54	5.11	1.00	1.00	2.30	15.00	8.98
Dsgn. L =	8.00 ft	3	0.393	0.184	1.40	-2.01	2.01	8.54	5.11	1.00	1.00	1.65	15.00	8.98
Dsgn. L =	8.00 ft	4	0.846	0.216	0.38	-4.33	4.33	8.54	5.11	1.00	1.00	1.94	15.00	8.98
Dsgn. L =	4.17 ft	5	0.846	0.210		-4.33	4.33	8.54	5.11	1.00	1.00	1.88	15.00	8.98
+D+0.750L														
Dsgn. L =	5.33 ft	1	1.360	0.311		-6.96	6.96	8.54	5.11	1.00	1.00	2.79	15.00	8.98
Dsgn. L =	9.50 ft	2	1.360	0.311	0.99	-6.96	6.96	8.54	5.11	1.00	1.00	2.79	15.00	8.98
Dsgn. L =	8.00 ft	3	0.500	0.233	1.90	-2.56	2.56	8.54	5.11	1.00	1.00	2.09	15.00	8.98
Dsgn. L =	8.00 ft	4	1.382	0.306	0.12	-7.07	7.07	8.54	5.11	1.00	1.00	2.75	15.00	8.98
Dsgn. L =	4.17 ft	5	1.382	0.306		-7.07	7.07	8.54	5.11	1.00	1.00	2.75	15.00	8.98
+D+0.750L+0.750S														
Dsgn. L =	5.33 ft	1	1.802	0.412		-9.22	9.22	8.54	5.11	1.00	1.00	3.70	15.00	8.98
Dsgn. L =	9.50 ft	2	1.802	0.412	1.34	-9.22	9.22	8.54	5.11	1.00	1.00	3.70	15.00	8.98
Dsgn. L =	8.00 ft	3	0.651	0.304	2.42	-3.33	3.33	8.54	5.11	1.00	1.00	2.73	15.00	8.98
Dsgn. L =	8.00 ft	4	1.652	0.379	0.31	-8.45	8.45	8.54	5.11	1.00	1.00	3.41	15.00	8.98
Dsgn. L =	4.17 ft	5	1.652	0.379		-8.45	8.45	8.54	5.11	1.00	1.00	3.41	15.00	8.98
+0.60D														
Dsgn. L =	5.33 ft	1	0.316	0.072		-1.62	1.62	8.54	5.11	1.00	1.00	0.65	15.00	8.98
Dsgn. L =	9.50 ft	2	0.316	0.072	0.24	-1.62	1.62	8.54	5.11	1.00	1.00	0.65	15.00	8.98
Dsgn. L =	8.00 ft	3	0.114	0.053	0.43	-0.59	0.59	8.54	5.11	1.00	1.00	0.48	15.00	8.98
Dsgn. L =	8.00 ft	4	0.292	0.067	0.05	-1.49	1.49	8.54	5.11	1.00	1.00	0.60	15.00	8.98
Dsgn. L =	4.17 ft	5	0.292	0.067		-1.49	1.49	8.54	5.11	1.00	1.00	0.60	15.00	8.98

Vertical Reactions

Support notation : Far left is #: Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4	Support 5	Support 6
Max Upward from all Load Conditions		7.159	5.193	4.279	6.779	
Max Upward from Load Combinations		7.159	5.193	4.279	6.779	
Max Upward from Load Cases		4.408	3.244	2.459	4.547	
D Only		2.094	1.520	1.249	1.989	
+D+L		6.502	4.764	3.708	6.536	
+D+S		4.440	3.174	2.830	3.828	
+D+0.750L		5.400	3.953	3.093	5.400	
+D+0.750L+0.750S		7.159	5.193	4.279	6.779	
+0.60D		1.257	0.912	0.749	1.194	
L Only		4.408	3.244	2.459	4.547	
S Only		2.345	1.654	1.581	1.839	

Project Title:
Engineer:
Project ID:
Project Descr:

2 REV 2 7/14/23

2

Steel Beam

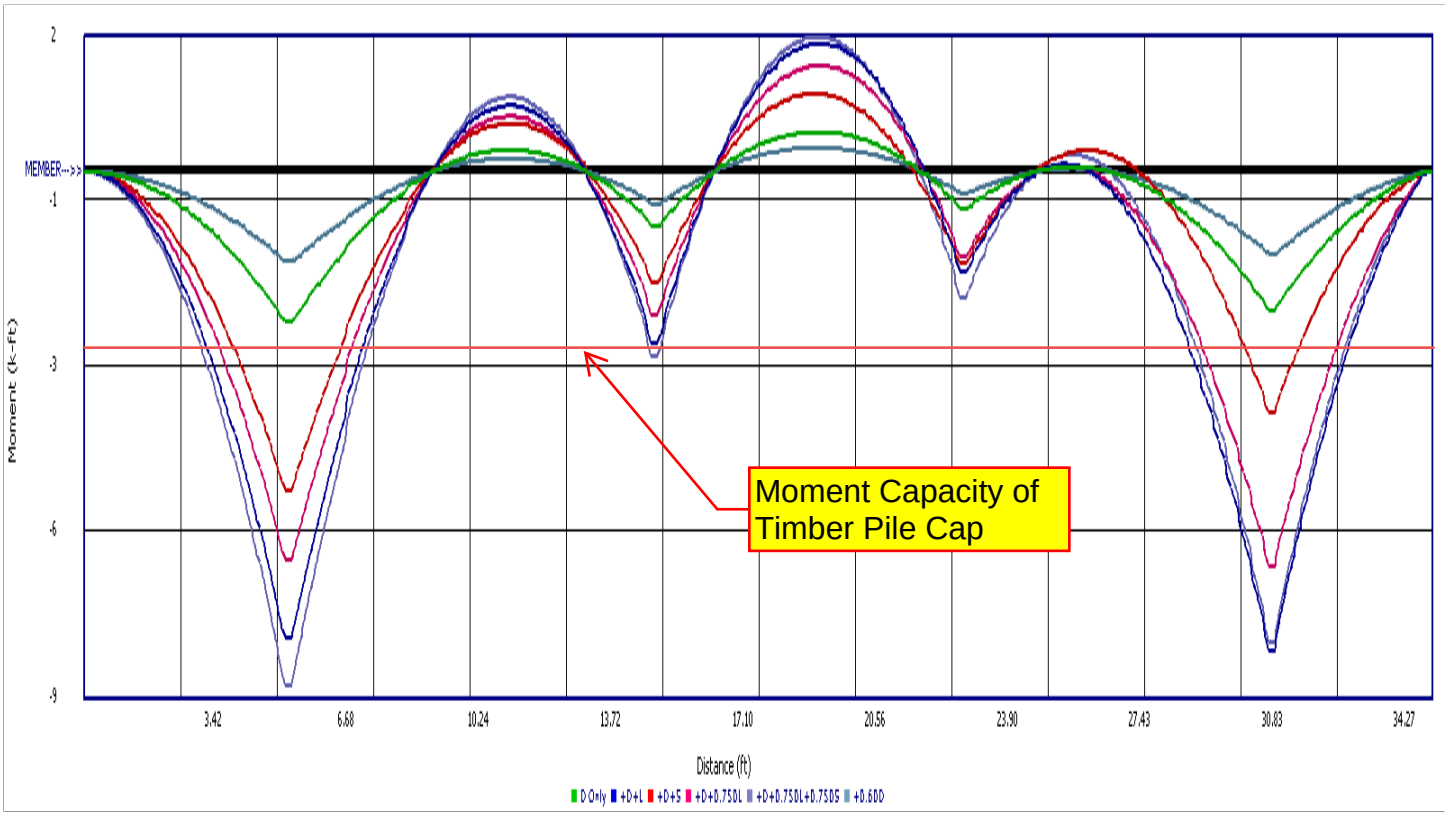
Project File: Liu.ec6

LIC# : KW-06012482, Build:20.23.2.14 Davido Consulting Group (c) ENERCALC INC 1983-2022

DESCRIPTION: C4x4.5 Pile Cap Type 2

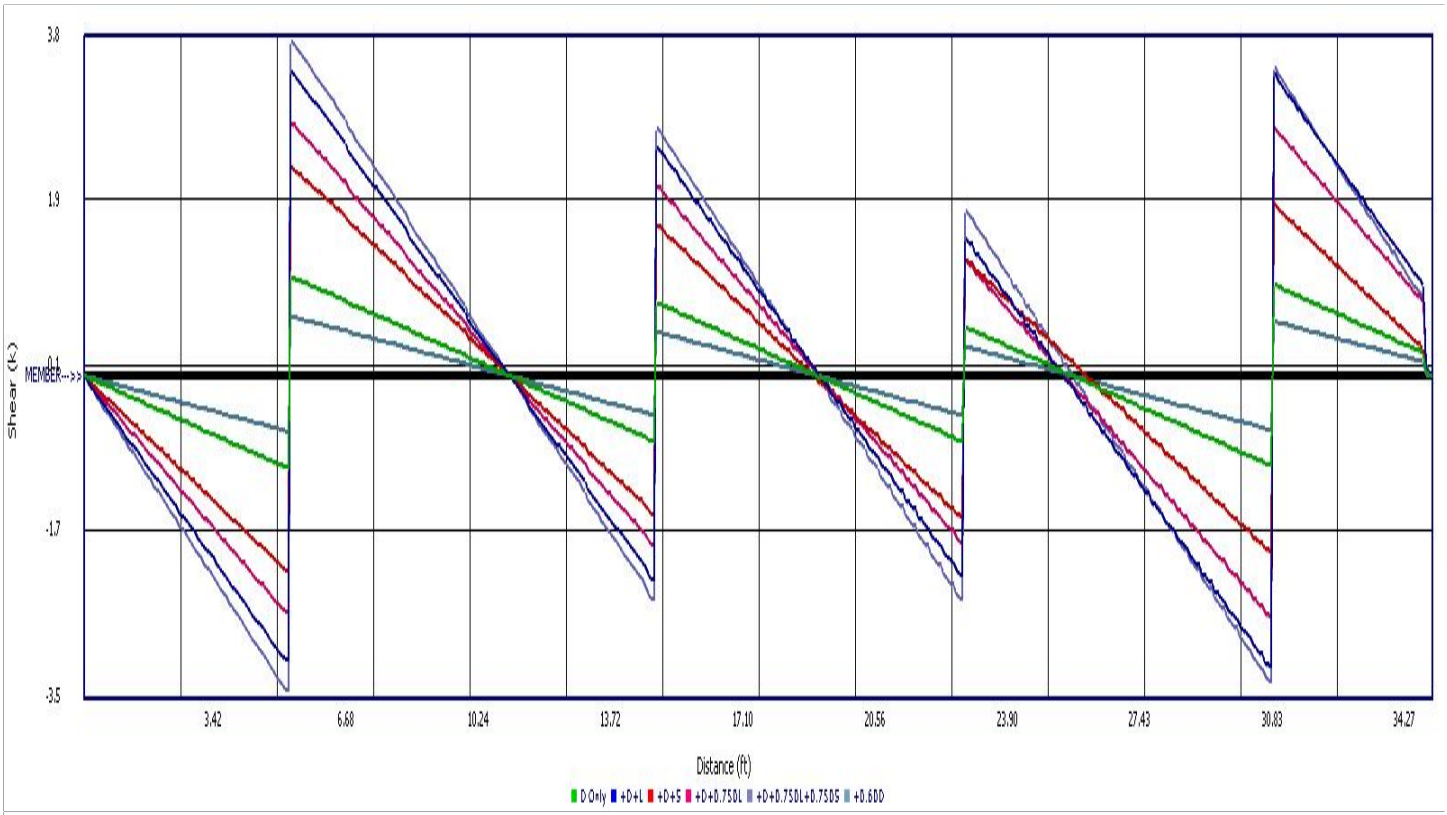
Steel Section Properties : C4x4.5

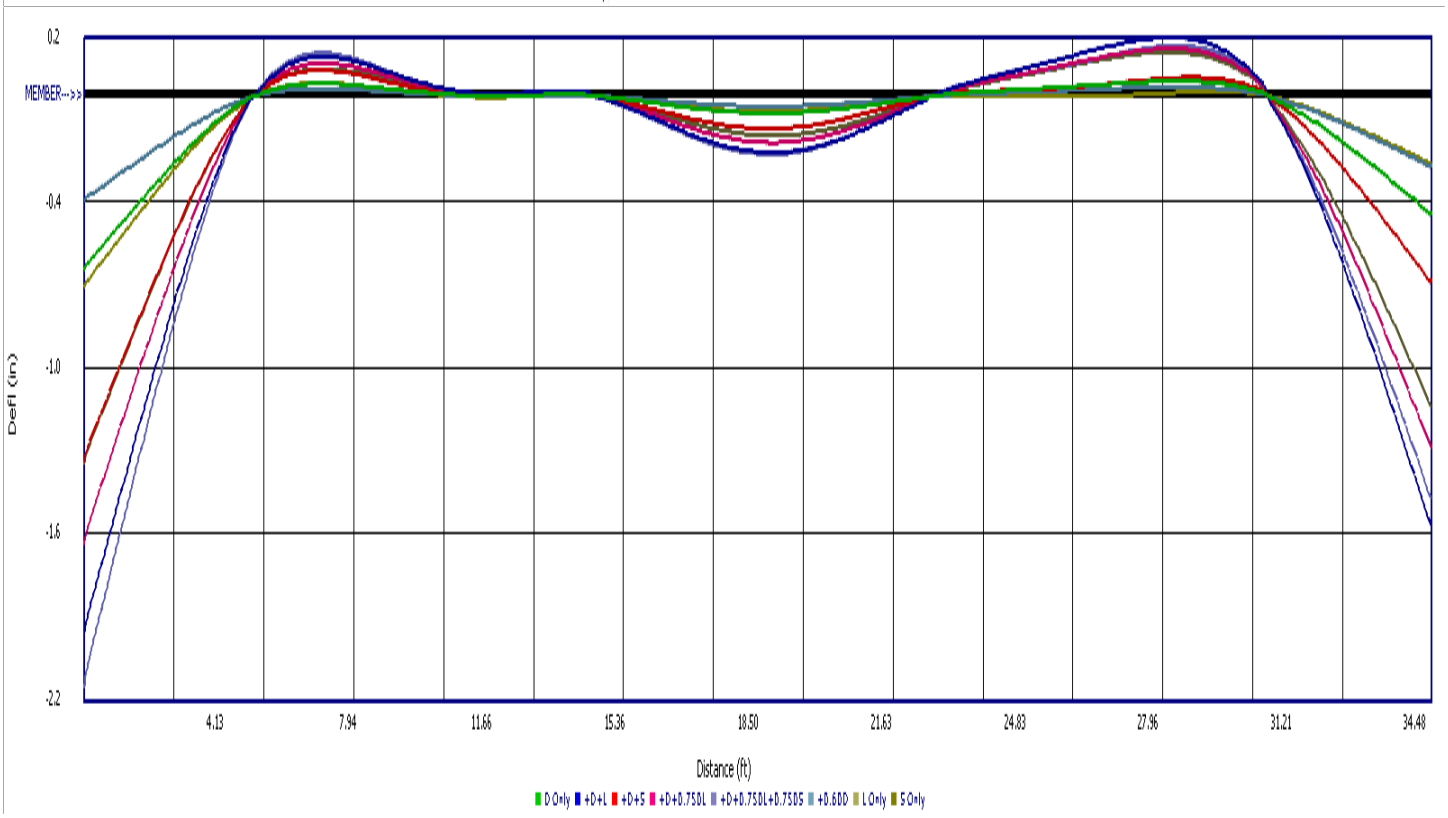
Depth	=	4.000	in	I xx	=	3.53	in^4	J	=	0.031	in^4
Web Thick	=	0.125	in	S xx		1.77	in^3	Cw	=	0.78	in^6
Flange Width	=	1.520	in	R xx	=	1.620	in	Ro	=	1.970	in
Flange Thick	=	0.296	in	Zx	=	2.050	in^3	H	=	0.727	in
Area	=	1.340	in^2	I yy	=	0.265	in^4				
Weight	=	4.500	plf	S yy	=	0.253	in^3	Wno	=	1.550	in^2
Kdesign	=	0.750	in	R yy	=	0.445	in	Sw	=	0.193	in^4
				Zy	=	0.495	in^3	Qf	=	0.765	in^3
rts	=	0.506	in					Qw	=	1.010	in^3
Ycg	=	2.000	in					Wn2	=	0.000	
Xcg	=	0.473	in					Sw2	=	0.088	
Xp	=	0.305	in					Sw3	=	0.044	
Eo	=	0.556	in								



Steel Beam

DESCRIPTION: C4x4.5 Pile Cap Type 2





Project Title:
Engineer:
Project ID:
Project Descr:

2 REV 2 7/14/23

2

Steel Beam

Project File: Liu.ec6

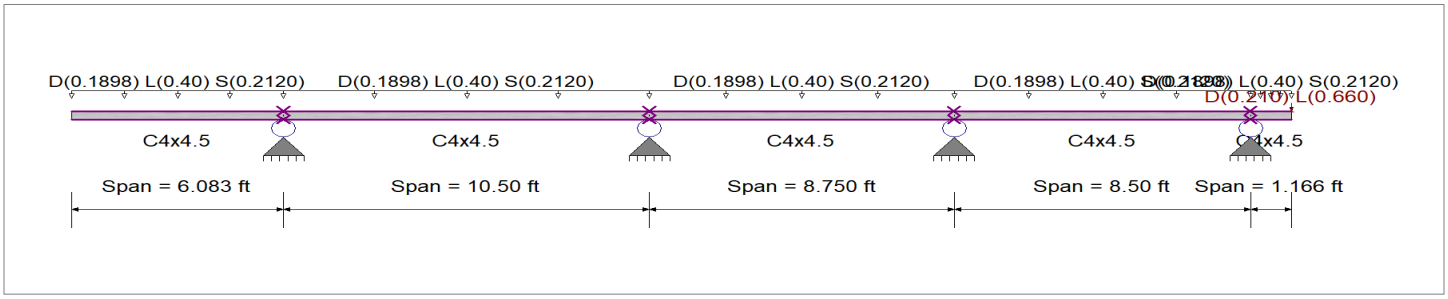
DESCRIPTION: C4x4.5 Pile Cap Type 3

CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2021

Material Properties

Analysis Method :	Allowable Strength Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added

Load for Span Number 1
Uniform Load : D = 0.1898, L = 0.40, S = 0.2120 k/ft, Tributary Width = 1.0 ft

Load for Span Number 2
Uniform Load : D = 0.1898, L = 0.40, S = 0.2120 k/ft, Tributary Width = 1.0 ft

Load for Span Number 3
Uniform Load : D = 0.1898, L = 0.40, S = 0.2120 k/ft, Tributary Width = 1.0 ft

Load for Span Number 4
Uniform Load : D = 0.1898, L = 0.40, S = 0.2120 k/ft, Tributary Width = 1.0 ft

Load for Span Number 5
Uniform Load : D = 0.1898, L = 0.40, S = 0.2120 k/ft, Tributary Width = 1.0 ft

Point Load : D = 0.210, L = 0.660 k @ 1.166 ft

Timber Cap + Double Channel
DCR = 0.923

DESIGN SUMMARY

Design N.G.

Maximum Bending Stress Ratio =	2.347 : 1	Maximum Shear Stress Ratio =	0.471 : 1
Section used for this span	C4x4.5	Section used for this span	C4x4.5
Ma : Applied	12.005 k-ft	Va : Applied	4.234 k
Mn / Omega : Allowable	5.115 k-ft	Vn/Omega : Allowable	8.982 k
Load Combination	+D+0.750L+0.750S	Load Combination	+D+0.750L+0.750S
		Location of maximum on span	6.083 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	2.211 in	Ratio =	66	>=	Span: 5 : L Only
Max Upward Transient Deflection	-0.054 in	Ratio =	519	>=	Span: 5 : L Only
Max Downward Total Deflection	3.582 in	Ratio =	41	>=	Span: 5 : +D+0.750L+0.750S
Max Upward Total Deflection	-0.111 in	Ratio =	251	>=	Span: 5 : +D+0.750L+0.750S

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	Summary of Moment Values Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Summary of Shear Values Va Max	VnxVnx/Omega
D Only												
Dsgn. L = 6.08 ft	1	0.687	0.138		-3.51	3.51	8.54	5.11	1.00	1.00	1.24	15.00	8.98
Dsgn. L = 10.50 ft	2	0.687	0.138	0.53	-3.51	3.51	8.54	5.11	1.00	1.00	1.24	15.00	8.98
Dsgn. L = 8.75 ft	3	0.279	0.104	0.62	-1.43	1.43	8.54	5.11	1.00	1.00	0.93	15.00	8.98

Project Title:
Engineer:
Project ID:
Project Descr:

2 REV 2 7/14/23

2

Steel Beam

Project File: Liu.ec6

DESCRIPTION: C4x4.5 Pile Cap Type 3

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	Summary of Moment Values Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Summary of Shear Values Va Max	VnxVnx/Omega
Dsgn. L = 8.50 ft	4	0.279	0.104	0.85	-1.43	1.43	8.54	5.11	1.00	1.00	0.93	15.00 8.98
Dsgn. L = 1.17 ft	5	0.073	0.048		-0.37	0.37	8.54	5.11	1.00	1.00	0.43	15.00 8.98
+D+L												
Dsgn. L = 6.08 ft	1	2.134	0.428		-10.91	10.91	8.54	5.11	1.00	1.00	3.85	15.00 8.98
Dsgn. L = 10.50 ft	2	2.134	0.428	1.63	-10.91	10.91	8.54	5.11	1.00	1.00	3.85	15.00 8.98
Dsgn. L = 8.75 ft	3	0.855	0.318	1.96	-4.37	4.37	8.54	5.11	1.00	1.00	2.85	15.00 8.98
Dsgn. L = 8.50 ft	4	0.855	0.318	2.54	-4.37	4.37	8.54	5.11	1.00	1.00	2.85	15.00 8.98
Dsgn. L = 1.17 ft	5	0.277	0.173		-1.42	1.42	8.54	5.11	1.00	1.00	1.56	15.00 8.98
+D+S												
Dsgn. L = 6.08 ft	1	1.454	0.292		-7.43	7.43	8.54	5.11	1.00	1.00	2.62	15.00 8.98
Dsgn. L = 10.50 ft	2	1.454	0.292	1.13	-7.43	7.43	8.54	5.11	1.00	1.00	2.62	15.00 8.98
Dsgn. L = 8.75 ft	3	0.605	0.224	1.30	-3.09	3.09	8.54	5.11	1.00	1.00	2.01	15.00 8.98
Dsgn. L = 8.50 ft	4	0.605	0.224	1.94	-3.09	3.09	8.54	5.11	1.00	1.00	2.01	15.00 8.98
Dsgn. L = 1.17 ft	5	0.101	0.076		-0.52	0.52	8.54	5.11	1.00	1.00	0.68	15.00 8.98
+D+0.750L												
Dsgn. L = 6.08 ft	1	1.772	0.356		-9.06	9.06	8.54	5.11	1.00	1.00	3.20	15.00 8.98
Dsgn. L = 10.50 ft	2	1.772	0.356	1.36	-9.06	9.06	8.54	5.11	1.00	1.00	3.20	15.00 8.98
Dsgn. L = 8.75 ft	3	0.711	0.264	1.63	-3.64	3.64	8.54	5.11	1.00	1.00	2.37	15.00 8.98
Dsgn. L = 8.50 ft	4	0.711	0.264	2.12	-3.64	3.64	8.54	5.11	1.00	1.00	2.37	15.00 8.98
Dsgn. L = 1.17 ft	5	0.226	0.142		-1.15	1.15	8.54	5.11	1.00	1.00	1.28	15.00 8.98
+D+0.750L+0.750S												
Dsgn. L = 6.08 ft	1	2.347	0.471		-12.00	12.00	8.54	5.11	1.00	1.00	4.23	15.00 8.98
Dsgn. L = 10.50 ft	2	2.347	0.471	1.81	-12.00	12.00	8.54	5.11	1.00	1.00	4.23	15.00 8.98
Dsgn. L = 8.75 ft	3	0.955	0.354	2.13	-4.88	4.88	8.54	5.11	1.00	1.00	3.18	15.00 8.98
Dsgn. L = 8.50 ft	4	0.955	0.354	2.93	-4.88	4.88	8.54	5.11	1.00	1.00	3.18	15.00 8.98
Dsgn. L = 1.17 ft	5	0.247	0.163		-1.26	1.26	8.54	5.11	1.00	1.00	1.46	15.00 8.98
+0.60D												
Dsgn. L = 6.08 ft	1	0.412	0.083		-2.11	2.11	8.54	5.11	1.00	1.00	0.74	15.00 8.98
Dsgn. L = 10.50 ft	2	0.412	0.083	0.32	-2.11	2.11	8.54	5.11	1.00	1.00	0.74	15.00 8.98
Dsgn. L = 8.75 ft	3	0.168	0.062	0.37	-0.86	0.86	8.54	5.11	1.00	1.00	0.56	15.00 8.98
Dsgn. L = 8.50 ft	4	0.168	0.062	0.51	-0.86	0.86	8.54	5.11	1.00	1.00	0.56	15.00 8.98
Dsgn. L = 1.17 ft	5	0.044	0.029		-0.22	0.22	8.54	5.11	1.00	1.00	0.26	15.00 8.98

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4	Support 5	Support 6
Max Upward from all Load Conditions		8.181	5.238	6.201	3.793	
Max Upward from Load Combinations		8.181	5.238	6.201	3.793	
Max Upward from Load Cases		5.042	3.240	3.775	2.603	
D Only		2.393	1.532	1.813	1.114	
+D+L		7.435	4.773	5.588	3.717	
+D+S		5.068	3.233	3.889	2.083	
+D+0.750L		6.175	3.963	4.644	3.066	
+D+0.750L+0.750S		8.181	5.238	6.201	3.793	
+0.60D		1.436	0.919	1.088	0.668	
L Only		5.042	3.240	3.775	2.603	
S Only		2.675	1.700	2.076	0.969	

Project Title:
Engineer:
Project ID:
Project Descr:

2 REV 2 7/14/23

2

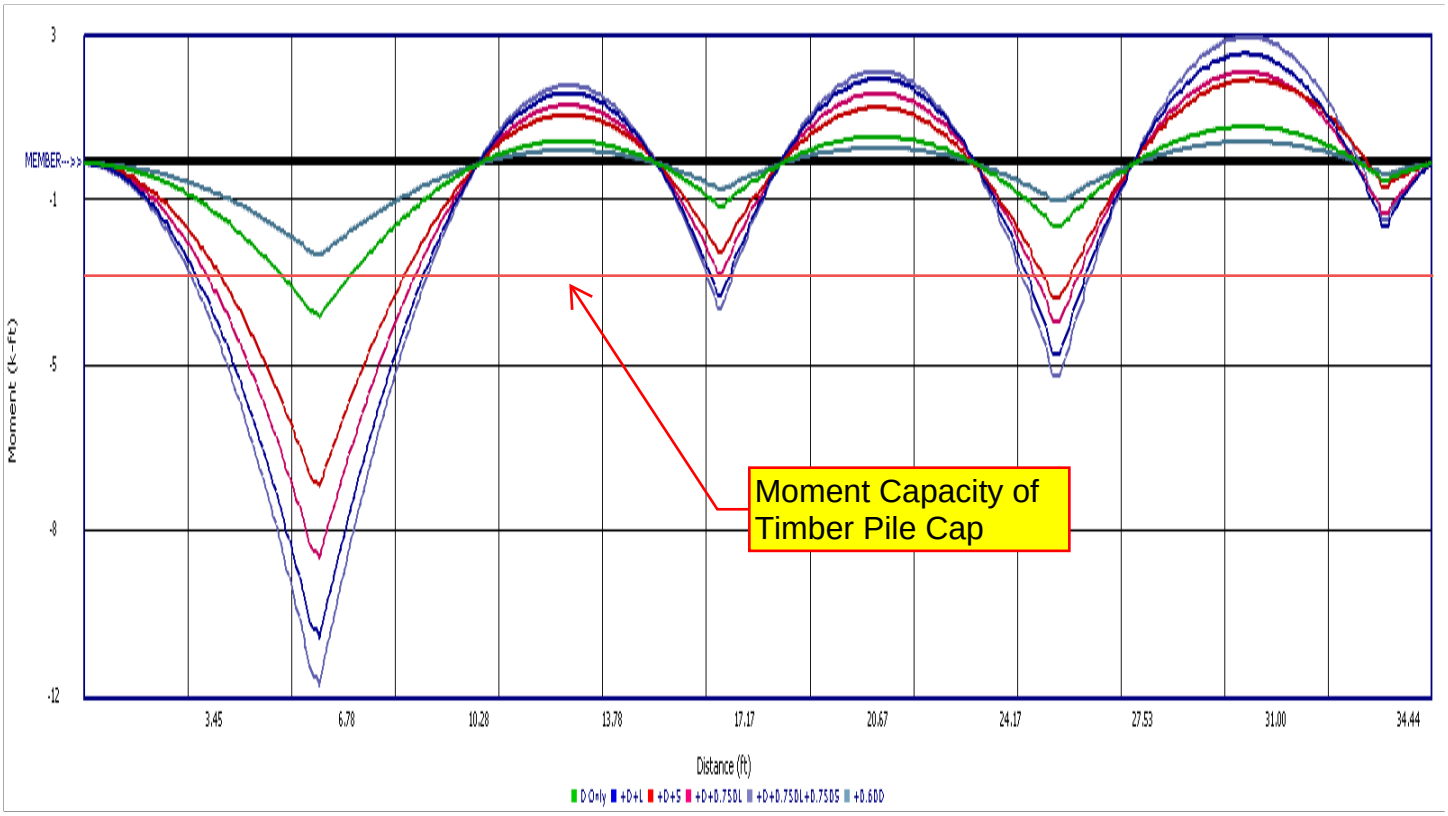
Steel Beam

Project File: Liu.ec6

DESCRIPTION: C4x4.5 Pile Cap Type 3

Steel Section Properties : C4x4.5

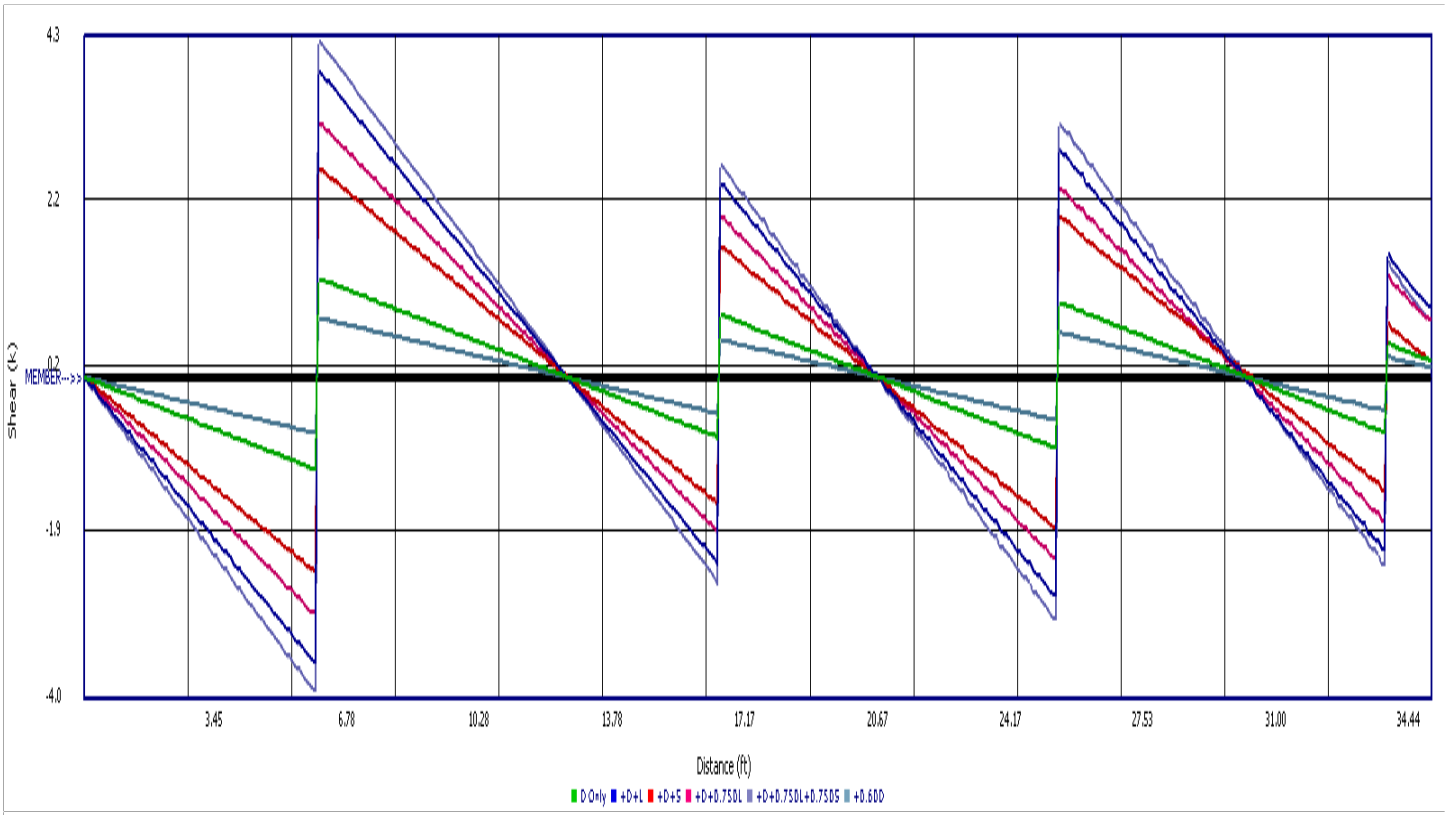
Depth	=	4.000	in	I xx	=	3.53	in^4	J	=	0.031	in^4
Web Thick	=	0.125	in	S xx		1.77	in^3	Cw	=	0.78	in^6
Flange Width	=	1.520	in	R xx	=	1.620	in	Ro	=	1.970	in
Flange Thick	=	0.296	in	Zx	=	2.050	in^3	H	=	0.727	in
Area	=	1.340	in^2	I yy	=	0.265	in^4				
Weight	=	4.500	plf	S yy	=	0.253	in^3	Wno	=	1.550	in^2
Kdesign	=	0.750	in	R yy	=	0.445	in	Sw	=	0.193	in^4
				Zy	=	0.495	in^3	Qf	=	0.765	in^3
rts	=	0.506	in					Qw	=	1.010	in^3
Ycg	=	2.000	in					Wn2	=	0.000	
Xcg	=	0.473	in					Sw2	=	0.088	
Xp	=	0.305	in					Sw3	=	0.044	
Eo	=	0.556	in								

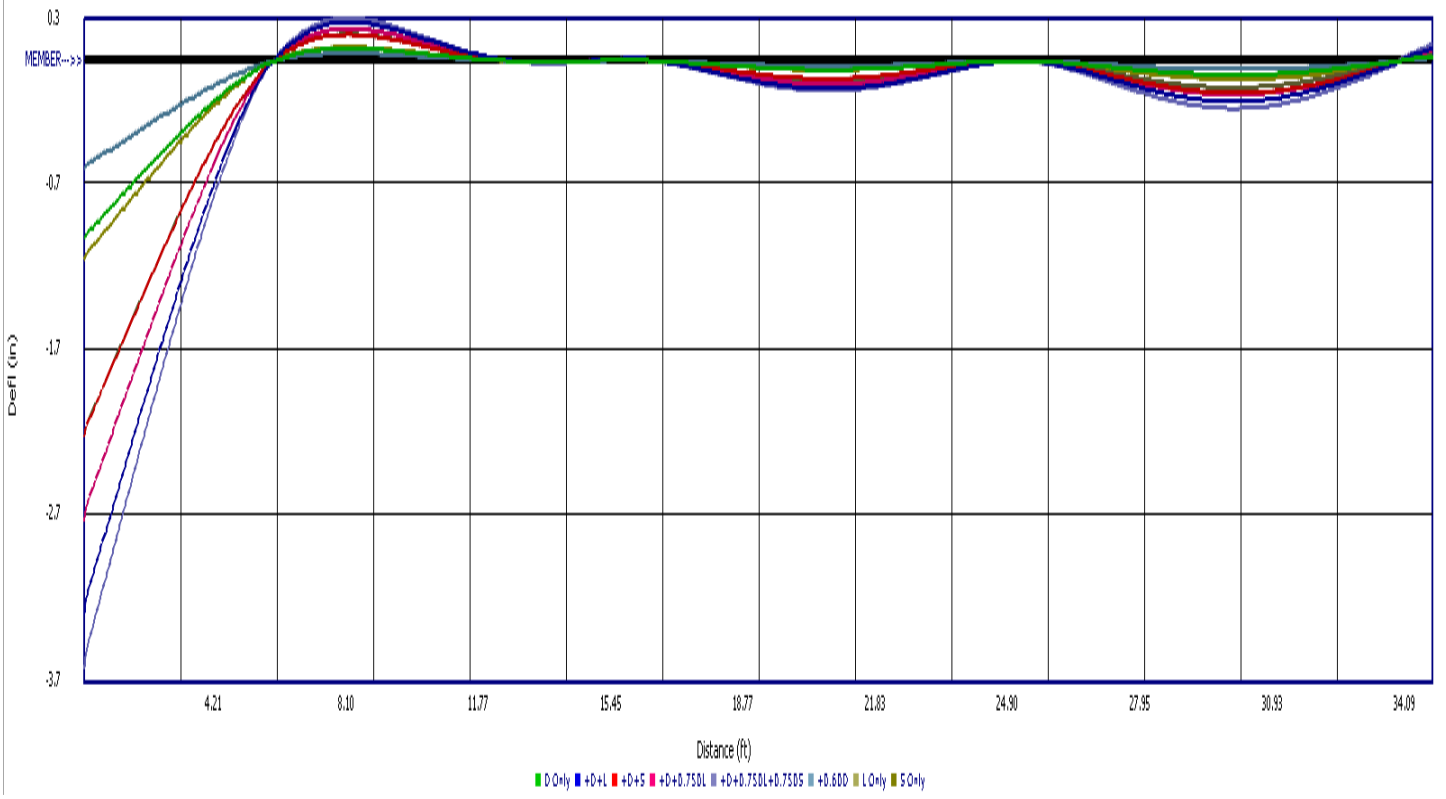


Steel Beam

LIC# : KW-06012482, Build:20.23.2.14 Davido Consulting Group

DESCRIPTION: C4x4.5 Pile Cap Type 3





1 REV 1 7/13/23

DICIG Marine Group	Seaborn Pile Driving Lake Washington Timber Pile Cap Analysis	Calculations Prepared For Seaborn Pile Driving 7/14/2023
Prepared By: D. Truong Reviewed By: J. Smoot	7422 East Mercer Way, Mercer Island, WA	Double Channel Connection

3/4" Thru-Bolt Shear Capacity (NDS 2015)

Z⊥	NDS Table 12G G=0.46	1780	lbs
CD	Live Load NDS Table 2.3.2	1	
CM	NDS Table 11.3.3	1	
Ct	T<100, NDS Table 11.3.4	1	

Cg and CΔ Calculation

n	number of bolts	1		s	Spacing	24	in
Em	Main Member Elasticity	1300	ksi	D	Bolt Diameter	0.75	in
ES	Steel Elasticity	29000	ksi	ɣ	Load/Slip Modulus	175370	
Am	Main Member Area	53.8	in²	u		176.22	
tsteel	Steel Member Thickness	0.125	in	m		0.00	
hsteel	Height of Member	4.0	in	REA		0.21	
As	Area of Steel Member	0.50	in²				

CΔ	Geometry Factor	1
Cg	Group Action Factor	1.00

End Distance Table 12.5.1A Load ⊥ to grain

End Distance	3.5	in	
Min. End Dist. CΔ=1	3	in	4D
Min. End Dist. CΔ=0.5	1.5	in	2D

Spacing Table 12.5.1B Load ⊥ to grain

Bolt Spacing	24	in	
Min Spacing	2.25	in	
			3D

***** Edge Distance Table 12.5.1C Load ⊥ to grain *****

Edge Distance	2	in
Min. Edge Distance, 1.5D Unloaded Edge	1.125	in

Ceg	End Grain Factor	1	
Cdi	Diaphragm Factor	1	
Ctn	Toe Nail Factor	1	
Z'	Capacity of Single Fastener	1.78	kips
Z''	Total Capacity	1.78	kips
	Line Load from Uniform and Point Load	0.9	klf
Zu	Load on Bolt Connection	0.9	kip
DCR	Demand to Capacity Ratio	0.49	

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****For Bolt Demand, take uniform load from all load sources and multiply by bolt spacing, divide by 2 for two channels**

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