



April 8, 2020

STRUCTURAL CALCULATIONS
(Supplemental permit calcs)

LAI DECK TRELLIS ADDITION
7505 92nd Ave. SE
Mercer Island, WA 98040

Quantum Job Number: 19175.02

Prepared for:
JOSH ARTISAN +
ARCHITECTURE



Prepared by:
QUANTUM CONSULTING ENGINEERS
1511 Third Avenue, Suite 323
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TEL 206.957.3900
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STRUCTURAL DESIGN CRITERIA

LAI DECK ROOF ADDITION
7505 92ND AVE SE,
MERCER ISLAND, WA 98040.

QUANTUM JOB NUMBER: 19175.02

CODE CRITERIA:

BUILDING CODE 2015 INTERNATIONAL BUILDING CODE
BUILDING DEPARTMENT CITY OF MERCER ISLAND
WIND CRITERIA 110 MPH; EXPOSURE "C"
..... RISK CATEGORY = II
..... $K_{ZT} = 1.00$

SOILS CRITERIA:

ALLOWABLE BEARING PRESSURE (ASSUMED) 2,500 PSF
MINIMUM FOOTING WIDTH CONTINUOUS: 18" MIN., ISOLATED: 24" MIN.
FROST DEPTH 36" MIN.
ACTIVE SOIL PRESSURE (SLOPED SOIL CONDITION)45 PCF
SEISMIC SURCHARGE8H PSF
PASSIVE SOIL PRESSURE 300 PCF
COEFFICIENT OF FRICTION 0.35 PCF

MATERIALS CRITERIA:

CONCRETE (28 DAY STRENGTH):

FOUNDATION/S.O.G. $F'C = 2,500$ PSI

REINFORCING STEEL:

GRADE 40 (#4 BAR) $FY = 40,000$ PSI

ASSEMBLY WEIGHTS

DECK W/ 2" CONC PAVERS LOAD

DL= 34 PSF
LL= 60PSF

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 Title Block" selection.
 Title Block Line 6

Project Title:
 Engineer:
 Project ID:
 Project Descr:

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Wood Beam

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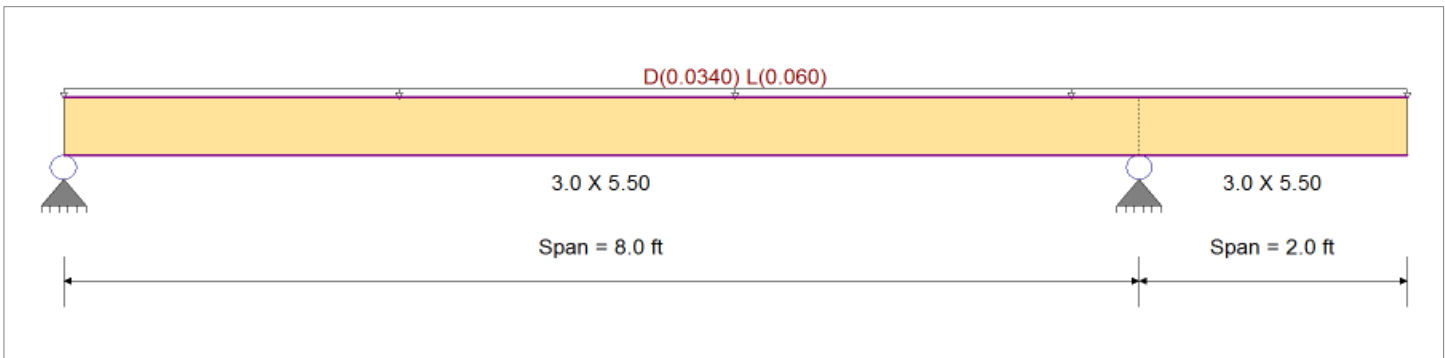
DESCRIPTION: P/t deck beams revision-long span-alt

CODE REFERENCES

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
 Load Combination Set : ASCE 7-10

Material Properties

Analysis Method : Allowable Stress Design	Fb +	750 psi	E : Modulus of Elasticity	
Load Combination ASCE 7-10	Fb -	750 psi	Ebend- xx	1300 ksi
	Fc - Prll	700 psi	Eminbend - xx	470 ksi
Wood Species : Douglas Fir - Larch	Fc - Perp	625 psi		
Wood Grade : No.2	Fv	170 psi		
	Ft	475 psi	Density	31.21 pcf
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling				



Applied Loads

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

Beam self weight calculated and added to loads
 Loads on all spans...

Uniform Load on ALL spans : D = 0.0340, L = 0.060 k/ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.756	1	Maximum Shear Stress Ratio	=	0.248	: 1
Section used for this span	=	3.0 X 5.50		Section used for this span	=	3.0 X 5.50	
	=	589.86 psi			=	33.74 psi	
	=	780.00 psi			=	136.00 psi	
Load Combination	=	+D+L+H, LL Comb Run (L*)		Load Combination	=	+D+L+H, LL Comb Run (LL)	
Location of maximum on span	=	3.888 ft		Location of maximum on span	=	7.553 ft	
Span # where maximum occurs	=	Span # 1		Span # where maximum occurs	=	Span # 1	
Maximum Deflection							
Max Downward Transient Deflection		0.109 in	Ratio =	883	>=	240	
Max Upward Transient Deflection		-0.086 in	Ratio =	556	>=	240	
Max Downward Total Deflection		0.058 in	Ratio =	1658	>=	180	
Max Upward Total Deflection		-0.038 in	Ratio =	1264	>=	180	

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios								Moment Values			Shear Values						
			M	V	C _d	C _{F/V}	C _i	C _r	C _m	C _t	C _L	M	fb	F'b	V	fv	F'v			
+D+H	Length = 8.0 ft	1	0.299	0.106	0.90	1.300	0.80	1.00	1.00	1.00	1.00	0.26	209.62	702.00	0.00	0.00	0.00	0.14	12.99	122.40
	Length = 2.0 ft	2	0.085	0.106	0.90	1.300	0.80	1.00	1.00	1.00	1.00	0.08	59.62	702.00	0.00	0.00	0.00	0.06	12.99	122.40
+D+L+H, LL Comb Run (L*)	Length = 8.0 ft	1	0.215	0.106	1.00	1.300	0.80	1.00	1.00	1.00	1.00	0.21	167.37	780.00	0.00	0.00	0.00	0.16	14.35	136.00
	Length = 2.0 ft	2	0.199	0.106	1.00	1.300	0.80	1.00	1.00	1.00	1.00	0.20	154.83	780.00	0.00	0.00	0.00	0.15	14.35	136.00
+D+L+H, LL Comb Run (L*)	Length = 8.0 ft	1	0.756	0.238	1.00	1.300	0.80	1.00	1.00	1.00	1.00	0.74	589.86	780.00	0.00	0.00	0.00	0.36	32.37	136.00
	Length = 2.0 ft	2	0.076	0.238	1.00	1.300	0.80	1.00	1.00	1.00	1.00	0.08	59.62	780.00	0.00	0.00	0.00	0.06	32.37	136.00
+D+L+H, LL Comb Run (LL)	Length = 8.0 ft	1	0.698	0.248	1.00	1.300	0.80	1.00	1.00	1.00	1.00	0.69	544.33	780.00	0.00	0.00	0.00	0.37	33.74	136.00
	Length = 2.0 ft	2	0.199	0.248	1.00	1.300	0.80	1.00	1.00	1.00	1.00	0.20	154.83	780.00	0.00	0.00	0.00	0.15	33.74	136.00

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Project Title:
 Engineer:
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Wood Beam

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DESCRIPTION: P/t deck beams revision-long span-alt

Load Combination	Segment Length	Span #	Max Stress Ratios								Moment Values			Shear Values				
			M	V	C _d	C _{F/V}	C _i	C _r	C _m	C _t	C _L	M	fb	F'b	V	f _v	F _v	
+D+0.750L+0.750S+0.5250E+H, LL						1.300	0.80	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00	0.00
Length = 8.0 ft	1		0.369	0.131	1.60	1.300	0.80	1.00	1.00	1.00	1.00	0.58	460.65	1248.00	0.31	28.55	217.60	
Length = 2.0 ft	2		0.105	0.131	1.60	1.300	0.80	1.00	1.00	1.00	1.00	0.17	131.03	1248.00	0.13	28.55	217.60	
+0.90D+0.60W+0.60H						1.300	0.80	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00	
Length = 8.0 ft	1		0.151	0.054	1.60	1.300	0.80	1.00	1.00	1.00	1.00	0.24	188.66	1248.00	0.13	11.69	217.60	
Length = 2.0 ft	2		0.043	0.054	1.60	1.300	0.80	1.00	1.00	1.00	1.00	0.07	53.66	1248.00	0.05	11.69	217.60	
+0.90D+0.70E+0.60H						1.300	0.80	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00	
Length = 8.0 ft	1		0.151	0.054	1.60	1.300	0.80	1.00	1.00	1.00	1.00	0.24	188.66	1248.00	0.13	11.69	217.60	
Length = 2.0 ft	2		0.043	0.054	1.60	1.300	0.80	1.00	1.00	1.00	1.00	0.07	53.66	1248.00	0.05	11.69	217.60	

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
L Only, LL Comb Run (L*)	1	0.1086	4.022		0.0000	0.000
	2	0.0000	4.022	L Only, LL Comb Run (L*)	-0.0861	2.000

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum	0.381	0.610	
Overall MINimum	0.310	0.516	
+D+H	0.141	0.235	
+D+L+H, LL Comb Run (*L)	0.126	0.370	
+D+L+H, LL Comb Run (L*)	0.381	0.475	
+D+L+H, LL Comb Run (LL)	0.366	0.610	
+D+Lr+H, LL Comb Run (*L)	0.141	0.235	
+D+Lr+H, LL Comb Run (L*)	0.141	0.235	
+D+Lr+H, LL Comb Run (LL)	0.141	0.235	
+D+S+H	0.141	0.235	
+D+0.750Lr+0.750L+H, LL Comb Run (*)	0.130	0.336	
+D+0.750Lr+0.750L+H, LL Comb Run (L)	0.321	0.415	
+D+0.750Lr+0.750L+H, LL Comb Run (LL)	0.310	0.516	
+D+0.750L+0.750S+H, LL Comb Run (*L)	0.130	0.336	
+D+0.750L+0.750S+H, LL Comb Run (L*)	0.321	0.415	
+D+0.750L+0.750S+H, LL Comb Run (LL)	0.310	0.516	
+D+0.60W+H	0.141	0.235	
+D+0.70E+H	0.141	0.235	
+D+0.750Lr+0.750L+0.450W+H, LL Comb	0.130	0.336	
+D+0.750Lr+0.750L+0.450W+H, LL Comb	0.321	0.415	
+D+0.750Lr+0.750L+0.450W+H, LL Comb	0.310	0.516	
+D+0.750L+0.750S+0.450W+H, LL Comb	0.130	0.336	
+D+0.750L+0.750S+0.450W+H, LL Comb	0.321	0.415	
+D+0.750L+0.750S+0.450W+H, LL Comb	0.310	0.516	
+D+0.750L+0.750S+0.5250E+H, LL Comb	0.130	0.336	
+D+0.750L+0.750S+0.5250E+H, LL Comb	0.321	0.415	
+D+0.750L+0.750S+0.5250E+H, LL Comb	0.310	0.516	
+0.90D+0.60W+0.60H	0.127	0.211	
+0.90D+0.70E+0.60H	0.127	0.211	
D Only	0.141	0.235	
Lr Only, LL Comb Run (*L)			
Lr Only, LL Comb Run (L*)			
Lr Only, LL Comb Run (LL)			
L Only, LL Comb Run (*L)	-0.015	0.135	
L Only, LL Comb Run (L*)	0.240	0.240	
L Only, LL Comb Run (LL)	0.225	0.375	
S Only			
W Only			
E Only			
H Only			
+D+H	0.141	0.235	
+D+L+H, LL Comb Run (*L)	0.126	0.370	
+D+L+H, LL Comb Run (L*)	0.381	0.475	

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Wood Beam

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DESCRIPTION: P/t deck beams revision-long span-alt

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2	Support 3
+D+L+H, LL Comb Run (LL)	0.366	0.610	
+D+Lr+H, LL Comb Run (*L)	0.141	0.235	
+D+Lr+H, LL Comb Run (L*)	0.141	0.235	
+D+Lr+H, LL Comb Run (LL)	0.141	0.235	
+D+S+H	0.141	0.235	
+D+0.750Lr+0.750L+H, LL Comb Run (*)	0.130	0.336	
+D+0.750Lr+0.750L+H, LL Comb Run (L)	0.321	0.415	
+D+0.750Lr+0.750L+H, LL Comb Run (L)	0.310	0.516	
+D+0.750L+0.750S+H, LL Comb Run (*L)	0.130	0.336	
+D+0.750L+0.750S+H, LL Comb Run (L*)	0.321	0.415	
+D+0.750L+0.750S+H, LL Comb Run (LL)	0.310	0.516	
+D+0.60W+H	0.141	0.235	
+D+0.70E+H	0.141	0.235	
+D+0.750Lr+0.750L+0.450W+H, LL Comb	0.130	0.336	
+D+0.750Lr+0.750L+0.450W+H, LL Comb	0.321	0.415	
+D+0.750Lr+0.750L+0.450W+H, LL Comb	0.310	0.516	
+D+0.750L+0.750S+0.450W+H, LL Comb	0.130	0.336	
+D+0.750L+0.750S+0.450W+H, LL Comb	0.321	0.415	
+D+0.750L+0.750S+0.450W+H, LL Comb	0.310	0.516	

Title Block Line 1
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 Title Block Line 6

Project Title:
 Engineer:
 Project ID:
 Project Descr:

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QUANTUM CONSULTING ENGINEERS

DESCRIPTION: P/t deck beams revision-short span

Load Combination Segment Length	Span #	Max Stress Ratios		C _d	C _{F/V}	C _i	C _r	C _m	C _t	C _L	Moment Values			Shear Values		
		M	V								M	fb	F'b	V	fv	F'v
+D+0.60W+H Length = 5.90 ft	1	0.219	0.089	1.60	1.300	0.80	1.00	1.00	1.00	1.00	0.21	273.67	1248.00	0.00	0.00	0.00
+D+0.70E+H Length = 5.90 ft	1	0.219	0.089	1.60	1.300	0.80	1.00	1.00	1.00	1.00	0.21	273.67	1248.00	0.00	0.00	0.00
+D+0.750Lr+0.750L+0.450W+H Length = 5.90 ft	1	0.498	0.201	1.60	1.300	0.80	1.00	1.00	1.00	1.00	0.47	620.90	1248.00	0.00	0.00	0.00
+D+0.750L+0.750S+0.450W+H Length = 5.90 ft	1	0.498	0.201	1.60	1.300	0.80	1.00	1.00	1.00	1.00	0.47	620.90	1248.00	0.00	0.00	0.00
+D+0.750L+0.750S+0.5250E+H Length = 5.90 ft	1	0.498	0.201	1.60	1.300	0.80	1.00	1.00	1.00	1.00	0.47	620.90	1248.00	0.00	0.00	0.00
+0.90D+0.60W+0.60H Length = 5.90 ft	1	0.197	0.080	1.60	1.300	0.80	1.00	1.00	1.00	1.00	0.18	246.30	1248.00	0.00	0.00	0.00
+0.90D+0.70E+0.60H Length = 5.90 ft	1	0.197	0.080	1.60	1.300	0.80	1.00	1.00	1.00	1.00	0.18	246.30	1248.00	0.00	0.00	0.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
L Only	1	0.0656	2.972		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.375	0.375
Overall MINimum	0.316	0.316
+D+H	0.139	0.139
+D+L+H	0.375	0.375
+D+Lr+H	0.139	0.139
+D+S+H	0.139	0.139
+D+0.750Lr+0.750L+H	0.316	0.316
+D+0.750L+0.750S+H	0.316	0.316
+D+0.60W+H	0.139	0.139
+D+0.70E+H	0.139	0.139
+D+0.750Lr+0.750L+0.450W+H	0.316	0.316
+D+0.750L+0.750S+0.450W+H	0.316	0.316
+D+0.750L+0.750S+0.5250E+H	0.316	0.316
+0.90D+0.60W+0.60H	0.125	0.125
+0.90D+0.70E+0.60H	0.125	0.125
D Only	0.139	0.139
Lr Only		
L Only	0.235	0.235
S Only		
W Only		
E Only		
H Only		
+D+H	0.139	0.139
+D+L+H	0.375	0.375
+D+Lr+H	0.139	0.139
+D+S+H	0.139	0.139
+D+0.750Lr+0.750L+H	0.316	0.316
+D+0.750L+0.750S+H	0.316	0.316
+D+0.60W+H	0.139	0.139
+D+0.70E+H	0.139	0.139
+D+0.750Lr+0.750L+0.450W+H	0.316	0.316
+D+0.750L+0.750S+0.450W+H	0.316	0.316

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Wood Beam

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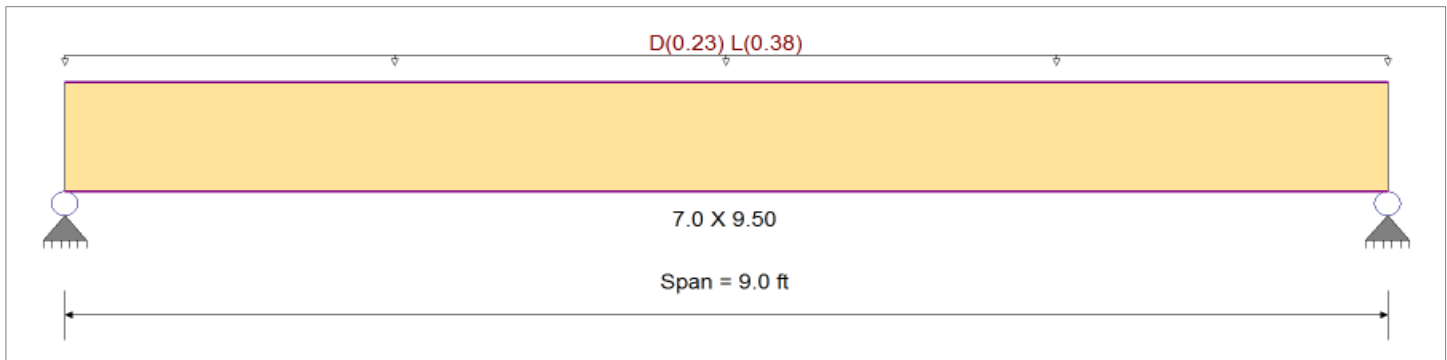
DESCRIPTION: garage header- alt

CODE REFERENCES

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
 Load Combination Set : ASCE 7-10

Material Properties

Analysis Method : Allowable Stress Design	Fb +	750 psi	E : Modulus of Elasticity	
Load Combination ASCE 7-10	Fb -	750 psi	Ebend- xx	1300 ksi
	Fc - Prll	700 psi	Eminbend - xx	470 ksi
Wood Species : Douglas Fir - Larch	Fc - Perp	625 psi		
Wood Grade : No.2	Fv	170 psi		
	Ft	475 psi	Density	31.21 pcf
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling				



Applied Loads

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

Beam self weight calculated and added to loads
 Uniform Load : D = 0.230, L = 0.380 , Tributary Width = 1.0 ft, (deck joist)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.961 : 1	Maximum Shear Stress Ratio	=	0.308 : 1
Section used for this span	=	7.0 X 9.50	Section used for this span	=	7.0 X 9.50
	=	720.53 psi		=	52.28 psi
	=	750.00 psi		=	170.00 psi
Load Combination	=	+D+L	Load Combination	=	+D+L
Location of maximum on span	=	4.500ft	Location of maximum on span	=	8.212 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection		0.087 in	Ratio =		1244 >=360
Max Upward Transient Deflection		0.000 in	Ratio =		0 <360
Max Downward Total Deflection		0.056 in	Ratio =		1934 >=180
Max Upward Total Deflection		0.000 in	Ratio =		0 <180

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values								
			M	V	C _d	C _{F/V}	C _i	C _r	C _m	C _t	C _L	M	fb	F'b	V	fv	F'v						
D Only	Length = 9.0 ft	1	0.418	0.134	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.47	282.04	675.00	0.00	0.00	0.00	0.00	0.00	153.00	
+D+L	Length = 9.0 ft	1	0.961	0.308	1.00	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	6.32	720.53	750.00	0.00	0.00	0.00	0.00	0.00	0.00	170.00
+D+0.750L	Length = 9.0 ft	1	0.652	0.209	1.25	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	5.36	610.91	937.50	0.00	0.00	0.00	0.00	0.00	0.00	212.50
+0.90D	Length = 9.0 ft	1	0.212	0.068	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.23	253.83	1200.00	0.00	0.00	0.00	0.00	0.00	0.00	272.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
L Only	1	0.0868	4.533		0.0000	0.000

Title Block Line 1
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QUANTUM CONSULTING ENGINEERS

DESCRIPTION: garage header- alt

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	2.810	2.810
Overall MINimum	1.710	1.710
D Only	1.100	1.100
+D+L	2.810	2.810
+D+0.750L	2.382	2.382
+0.90D	0.990	0.990
L Only	1.710	1.710

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Cantilevered Retaining Wall

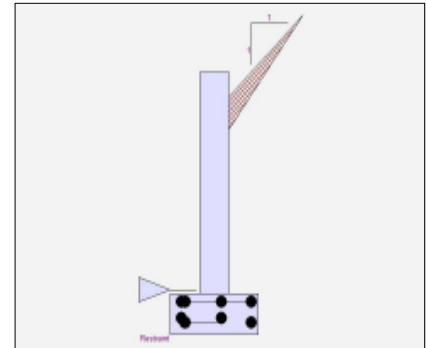
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	1.00
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	45.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing Soil Friction	=	0.350
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	50.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method : Uniform		
Multiplier Used	=	8.000
(Multiplier used on soil density)		

Uniform Seismic Force	=	38.667
Total Seismic Force	=	186.889

Design Summary

Wall Stability Ratios		
Overturning	=	1.70 OK
Slab Resists All Sliding !		
Total Bearing Load	=	1,760 lbs
...resultant ecc.	=	4.58 in
Soil Pressure @ Toe	=	1,899 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,500 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,631 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	1.8 psi OK
Footing Shear @ Heel	=	15.5 psi OK
Allowable	=	75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	811.4 lbs

Stem Construction

Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	12.00
Rebar Placed at	=	6 in

Design Data		
fb/FB + fa/Fa	=	0.307

Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	730.7

Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	1,077.3
Moment.....Allowable	=	3,505.6

Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	10.1
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.00

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD

Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	40,000.0

Vertical component of active lateral soil pressure IS considered in the calculation of soil bearing pressures.

Load Factors		
Building Code		IBC 2015,ACI
Dead Load		1.200
Live Load		1.600
Earth, H		1.600
Wind, W		1.000
Seismic, E		1.000

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Title **Lai deck addition-Retain wall**
Job # : Dsgnr: **MDA**
Description....
4 ft retain wall

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0632 in ² /ft		
(4/3) * As :	0.0843 in ² /ft	Min Stem T&S Reinf Area 0.864 in ²	
200bd/fy : 200(12)(6)/40000 :	0.36 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in ² /ft	Horizontal Reinforcing Options :	
	=====	One layer of :	Two layers of :
Required Area :	0.1728 in ² /ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2 in ² /ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	1.2192 in ² /ft	#6@ 27.50 in	#6@ 55.00 in

Footing Dimensions & Strengths

Toe Width	=	0.67 ft
Heel Width	=	1.33
Total Footing Width	=	2.00
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
f_c =	2,500 psi	F_y = 40,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm.= 3.00 in

Footing Design Results

	Toe	Heel
Factored Pressure	= 1,631	0 psf
μ_u : Upward	= 319	21 ft-#
μ_u : Downward	= 51	901 ft-#
μ_u : Design	= 268	880 ft-#
Actual 1-Way Shear	= 1.75	15.46 psi
Allow 1-Way Shear	= 40.00	40.00 psi
Toe Reinforcing	= # 4 @ 12.00 in	
Heel Reinforcing	= # 4 @ 12.00 in	
Key Reinforcing	= None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not req'd: $\mu_u < \phi * 5 * \lambda * \sqrt{f_c} * S_m$
Heel: Not req'd: $\mu_u < \phi * 5 * \lambda * \sqrt{f_c} * S_m$
Key: No key defined

Min footing T&S reinf Area	0.43	in ²
Min footing T&S reinf Area per foot	0.22	in ² /ft
If one layer of horizontal bars:		If two layers of horizontal bars:
#4@ 11.11 in		#4@ 22.22 in
#5@ 17.22 in		#5@ 34.44 in
#6@ 24.44 in		#6@ 48.89 in

Summary of Overturning & Resisting Forces & Moments

ItemOVERTURNING.....		RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 680.6	1.83	1,247.7	Soil Over Heel	= 319.9	1.67	533.1
Surcharge over Heel	=			Sloped Soil Over Heel	= 26.7	1.78	47.4
Surcharge Over Toe	=			Surcharge Over Heel	=		
Adjacent Footing Load	=			Adjacent Footing Load	=		
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	=			* Axial Live Load on Stem	=		
Seismic Earth Load	= 130.8	2.42	316.2	Soil Over Toe	=		
	=			Surcharge Over Toe	= 33.3	0.33	11.1
Total	811.4	O.T.M.	1,563.9	Stem Weight(s)	= 450.0	1.00	449.9
	=	=		Earth @ Stem Transitions	=		
Resisting/Overturning Ratio		=	1.70	Footing Weight	= 250.0	1.00	249.9
Vertical Loads used for Soil Pressure =		1,759.8	lbs	Key Weight	=		
				Vert. Component	= 679.9	2.00	1,359.7
				Total =	1,759.8	lbs	R.M.= 2,651.1

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS considered in the calculation of Overturning Resistance.

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Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.119	in

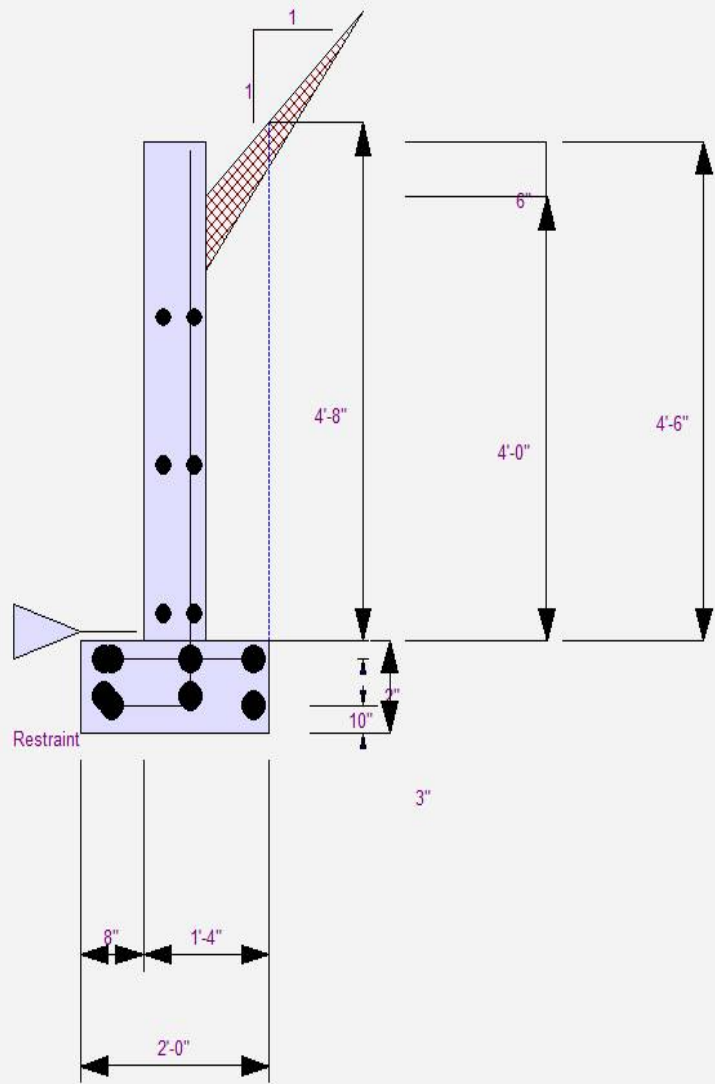
The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,
because the wall would then tend to rotate into the retained soil.

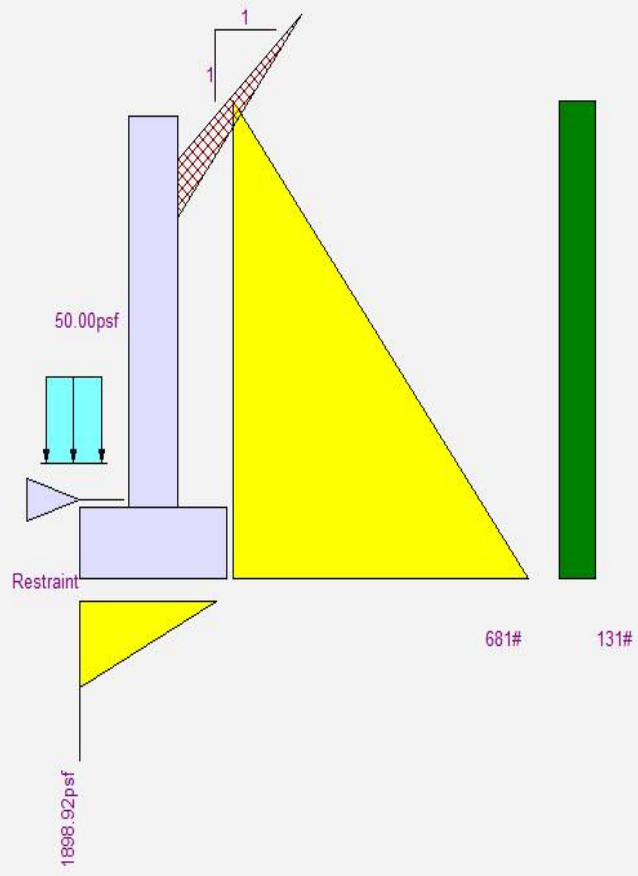
8" w/ #4 @ 12"

#4@12.in
@ Toe

#4@12"

@ Heel





■ Seismic lateral earth pressure