

CK Engineering LLC.

19229 38th PL NE
Lake Forest Park, WA 98155

Phone: (206) 417-0670

STRUCTURAL CALCULATIONS
REVISIONS
22-028



7/9/2023

LIU RESIDENCE
3705 77th PL SE
Mercer Island, WA 98040
July 9, 2023

Design Criteria

Scope of Work:	REVISIONS		
Site Address:	3705 77th PL SE Mercer Island, WA 98040		
Number of Stories:	3	Engineer:	PK

Roof Loading

Roofing	Composition	3.0
Sheathing	5/8" Plywood	1.8
Insulation	Roll/Batt	3.0
Ceiling	5/8" GWB	2.8
Framing	Trusses	2.2
Miscellaneous	fixtures, mechanical, electrical, etc.	2.2
TOTAL DEAD LOAD:		15.0 psf
ROOF SNOW LOAD:		25.0 psf

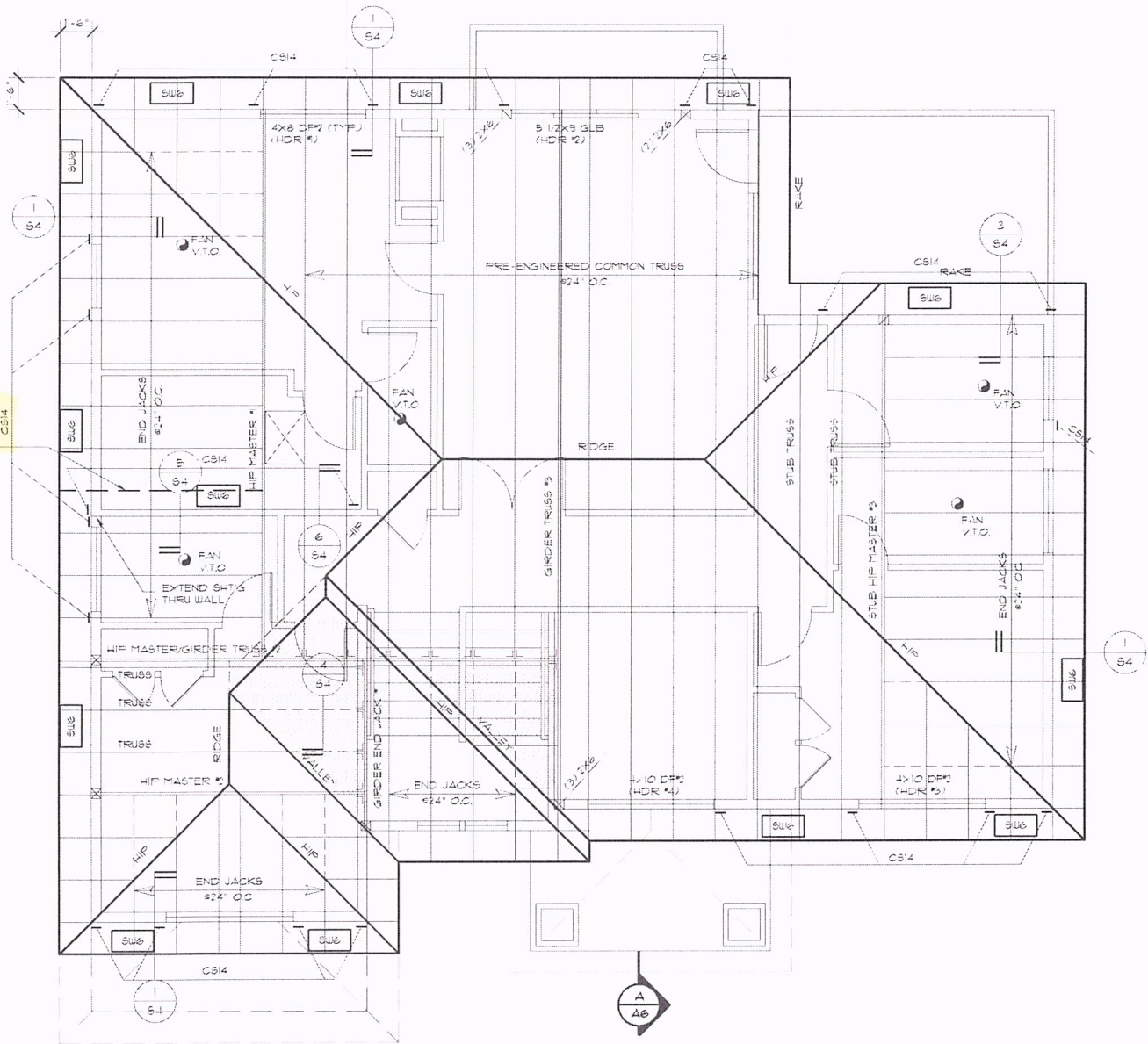
Upper Floor Loading

Floor Covering	Carpet/Hardwood/Tile	3.0
Sheathing	3/4" T&G	2.3
Ceiling	1/2" GWB	2.2
Joists	Solid Sawn @ 16" o/c	3.3
Beams		2.8
Miscellaneous	fixtures, mechanical, electrical, etc.	1.4
TOTAL DEAD LOAD:		15.0 psf
FLOOR LIVE LOAD:		40.0 psf

Main Floor Loading

Floor Covering	Carpet/Hardwood/Tile	3.0
Sheathing	3/4" T&G	2.3
Ceiling	5/8" GWB	2.8
Joists	I-Joists	2.1
Beams		4.2
Miscellaneous	fixtures, mechanical, electrical, etc.	0.6
TOTAL DEAD LOAD:		15.0 psf
FLOOR LIVE LOAD:		40.0 psf

Soil Bearing Capacity:	1500 psf
Frost Depth:	18 in



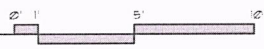
NOTE: COL TO BE (2) 2x6 HF# TYP. (UNO)
 HDR TO BE 4x8 HF# TYP. (UNO)

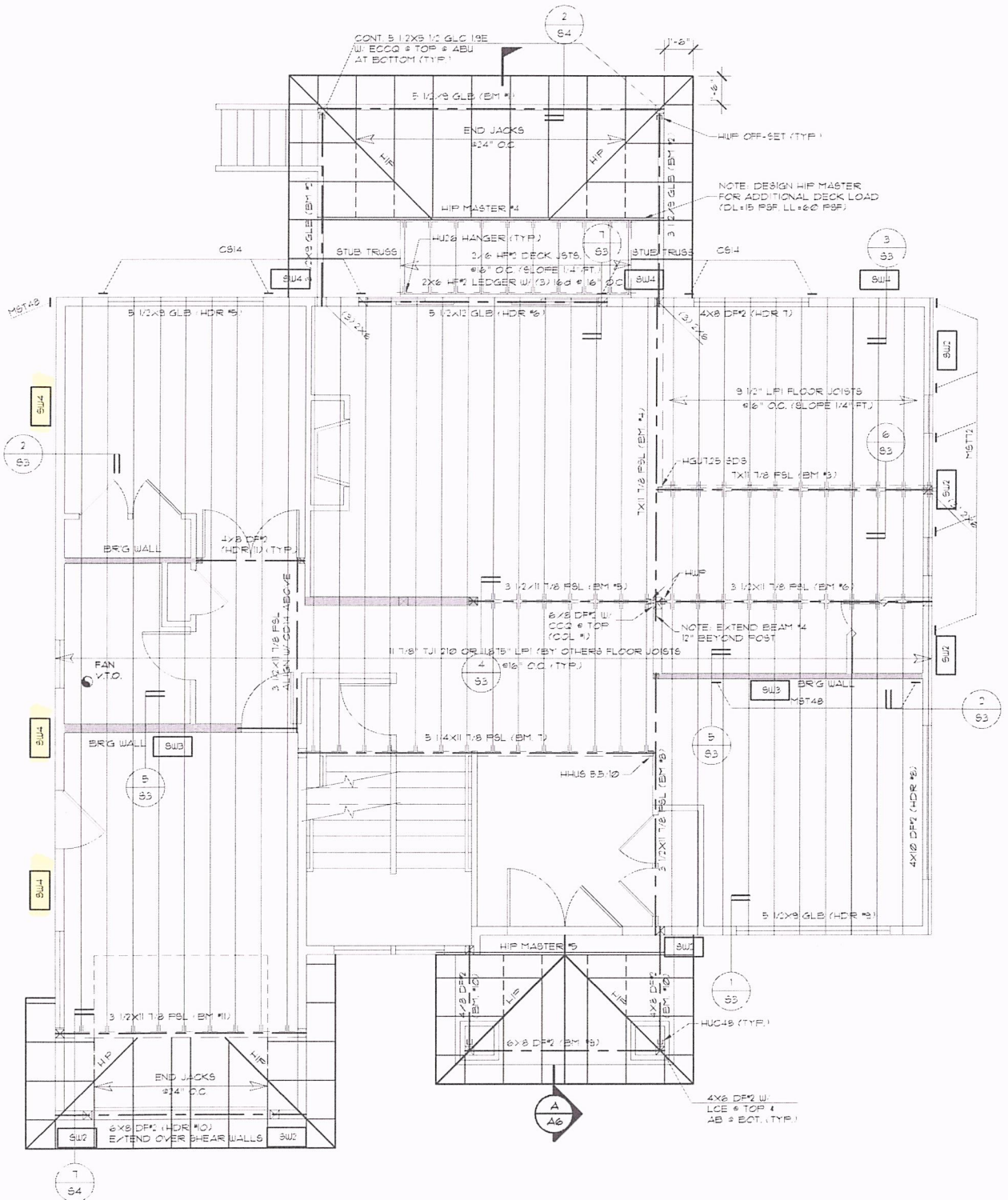
NFPA 13d FIRE SPRINKLER SYSTEM REQUIRED



ROOF FRAMING PLAN

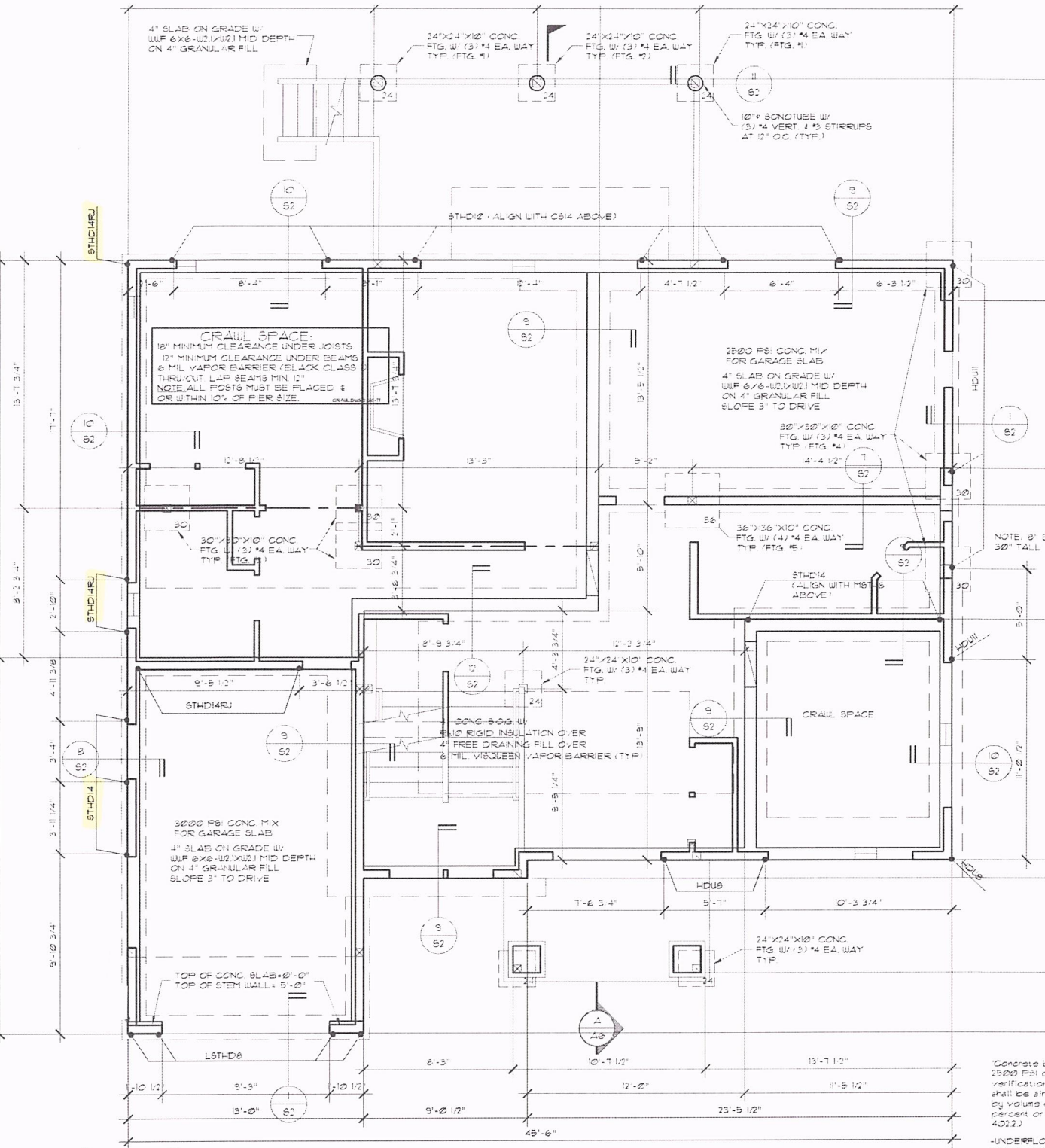
SCALE: 1/4" = 1' - 0"





NOTE: GCL TO BE (2) 2x6 HF# TYP. (UNC.)
 HDR TO BE 4x8 HF#2 TYP. (UNC.)

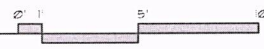
NFPA 13d FIRE SPRINKLER SYSTEM REQUIRED



NFPA 13d FIRE SPRINKLER SYSTEM REQUIRED



FOUNDATION PLAN
SCALE: 1/4" = 1' - 0"



*Concrete
2500 PSI
verification
shall be
by volume
percent of
40227

-UNDERFLO
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GROUNDING
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STRUCTURE
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NONE OF TH

Floor Info
Upper Floor Level, e.g. Upper, Main, Lower
Ft-Rr Load Direction, e.g. Left-Right, Front-Rear
 (For Left Wall, Use Front-Rear Load Direction)
CDX Sheathing type
 Values in accordance with AF&PA SDPWS-2015
Roof Resisting Dead Load
 (e.g. Roof, Upper Floor, Main Floor)
29.00 ft Total Length of Shearwalls

V(from upper) =	3875 lb	8634 lb
V(from main) =	0 lb	0 lb
V(from lower) =	0 lb	0 lb
Σ (Wind) =	3,875 lb	Σ (Smc) = 8,634 lb
v =	67 PLF	v = 149 PLF

Tributary Width (Upper Floor)
1.0 tributary width
2.0 total width
 Tributary Width (Main Floor)
1.0 tributary width
2.0 total width
 Tributary Width (Lower Floor)
1.0 tributary width
2.0 total width
 Height of Shearwall = **8.5 ft**
 Length of Shearwall = **6.0 ft**
 Aspect Ratio OK
 Use alternate R factor for seismic? **No**

Tributary Area (Upper Floor)
1.0 tributary area
2.0 total area
 Tributary Area (Main Floor)
1.0 tributary area
2.0 total area
 Tributary Area (Lower Floor)
1.0 tributary area
2.0 total area
 Weight of Shearwall = **10.0 lbs**
 Tributary width for dead load = **2.0 ft**
 Length of adjoining wall = **1.0 ft**

SDPWS, Table 4.3A → 0.93 x 242 = 225 PLF

USE **SW6**

$C_{TOTAL} =$ (floor above) + (this floor) = **0**
 $T_{TOTAL} =$ (floor above) + (this floor) = **0**

Seismic controls shearwall design

+ 886 lbs	=	886 lbs	Seismic controls
+ 1062 lbs	=	1062 lbs	Load case 8 controls - Seismic

Seismic controls holddown design

USE SIMPSON DESIGNED HOLDDOWN: **CS14**

OR AT FOUNDATION / INTERIOR WALLS USE: **LSTHD8/RJ**

Where overstrength factor is applicable, use this value for E in equations 5, 6, and 8: **E = 1265 lbs**

Floor Info
Main Floor Level, e.g. Upper, Main, Lower
Ft-Rr Load Direction, e.g. Left-Right, Front-Rear
 (For Left Wall, Use Front-Rear Load Direction)
CDX Sheathing type
 Values in accordance with AF&PA SDPWS-2015
U/FL Resisting Dead Load
 (e.g. Roof, Upper Floor, Main Floor)
26.00 ft Total Length of Shearwalls

V(from upper) = 3875 lb 8634 lb
 V(from main) = 6519 lb 5147 lb
 V(from lower) = 0 lb 0 lb
 Σ (Wind) = 10,394 lb Σ (Smc) = 13,782 lb
v = 200 PLF **v = 265 PLF**

Tributary Width (Upper Floor)
1.0 tributary width
2.0 total width
 Tributary Width (Main Floor)
1.0 tributary width
2.0 total width
 Tributary Width (Lower Floor)
1.0 tributary width
2.0 total width
 Height of Shearwall = **9.0 ft**
 Length of Shearwall = **4.0 ft**
 Aspect Ratio OK
 Use alternate R factor for seismic? **No**

Tributary Area (Upper Floor)
1.0 tributary area
2.0 total area
 Tributary Area (Main Floor)
1.0 tributary area
2.0 total area
 Tributary Area (Lower Floor)
1.0 tributary area
2.0 total area
 Weight of Shearwall = **10.0 lbs**
 Tributary width for dead load = **1.0 ft**
 Length of adjoining wall = **1.0 ft**

SDPWS, Table 4.3A \rightarrow $(2w/h) \times 0.93 \times 353 = 292$ PLF

USE **SW4**

$C_{TOTAL} =$ (floor above) + (this floor) = **886**
 $T_{TOTAL} =$ (floor above) + (this floor) = **1062**

Seismic controls shearwall design

+ 1799 lbs = 2685 lbs Wind controls
 + 2246 lbs = 3308 lbs Load case 8 controls - Seismic

Seismic controls holddown design

USE SIMPSON DESIGNED HOLDDOWN: **MST48**

OR AT FOUNDATION / INTERIOR WALLS USE: **STHD14/RJ**

Where overstrength factor is applicable, use this value for E in equations 5, 6, and 8: **E = 2385 lbs**

Wood Beam

Project File: 22-028.ec6

LIC# : KW-06016495, Build:20.23.05.25

CK Engineering LLC

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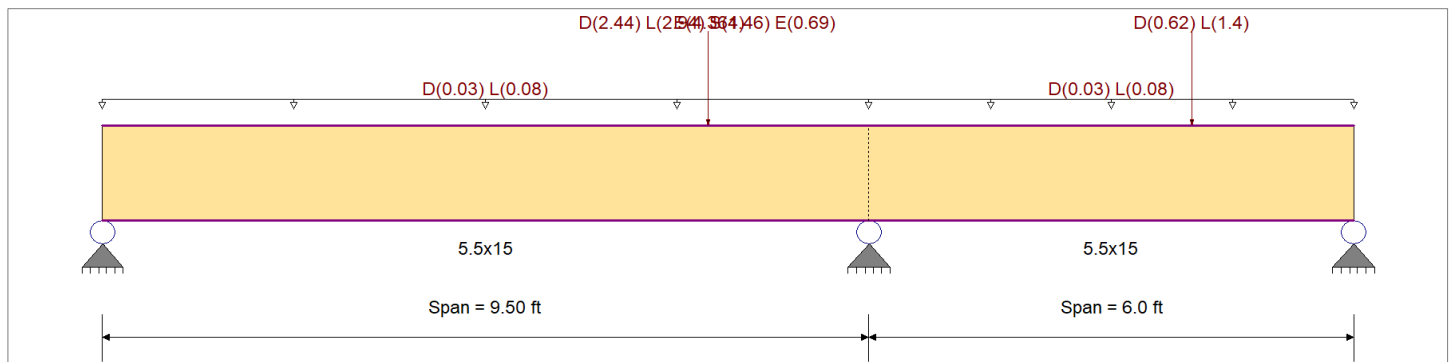
DESCRIPTION: HDR#12 6-7-2023

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
 Load Combination Set : IBC 2018

Material Properties

Analysis Method : Allowable Stress Design	Fb +	2400 psi	<i>E : Modulus of Elasticity</i>	
Load Combination : IBC 2018	Fb -	1850 psi	Ebend- xx	1800ksi
	Fc - Prll	1650 psi	Eminbend - xx	950ksi
Wood Species : DF/DF	Fc - Perp	650 psi	Ebend- yy	1600ksi
Wood Grade : 24F-V4	Fv	265 psi	Eminbend - yy	850ksi
	Ft	1100 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 loading

Load for Span Number 1

Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 2.0 ft, (FLOOR)
 Point Load : D = 2.440, L = 2.940, S = 1.460, E = 0.690 k @ 7.50 ft, (BM#3)
 Point Load : E = 4.364 k @ 7.50 ft, (SW2)

Load for Span Number 2

Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 2.0 ft, (FLOOR)
 Point Load : D = 0.620, L = 1.40 k @ 4.0 ft, (BM#6)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.454 : 1	Maximum Shear Stress Ratio	=	0.987 : 1
Section used for this span		5.5x15	Section used for this span		5.5x15
fb: Actual	=	1,343.15psi	fv: Actual	=	418.39 psi
F'b	=	2,960.00psi	F'v	=	424.00 psi
Load Combination	=	+1.158D+4.550E	Load Combination	=	+1.158D+4.550E
Location of maximum on span	=	9.500ft	Location of maximum on span	=	8.279 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection		0.018 in Ratio = 6207 >=360	Span: 1 : E Only		
Max Upward Transient Deflection		-0.006 in Ratio = 11314 >=360	Span: 2 : E Only		
Max Downward Total Deflection		0.032 in Ratio = 3545 >=240	Span: 1 : +D+0.750L+0.750S+0.5250E		
Max Upward Total Deflection		-0.008 in Ratio = 8926 >=240	Span: 2 : +D+0.750L+0.750S+0.5250E		

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values				
			M	V	CD	CM	C _t	CLx	C _v	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v	
D Only																			
	Length = 9.50 ft	1	0.096	0.182	0.90	1.00	1.00	1.00	1.000	1.00	1.00	1.00	2.74	159.4	1,665.0	0.0	2.38	43.3	238.5
	Length = 6.0 ft	2	0.096	0.182	0.90	1.00	1.00	1.00	1.000	1.00	1.00	1.00	2.74	159.4	1,665.0	0.75	0.75	43.3	238.5
+D+L																			
	Length = 9.50 ft	1	0.203	0.369	1.00	1.00	1.00	1.00	1.000	1.00	1.00	1.00	6.46	375.9	1,850.0	5.38	5.38	97.8	265.0

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Wood Beam

Project File: 22-028.ec6

LIC# : KW-06016495, Build:20.23.05.25

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DESCRIPTION: HDR#12 6-7-2023

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values			
			M	V	CD	CM	C _t	CLx	C _v	C _{fu}	C _i	C _r	M	fb	F _b	V	f _v	F _v
Length = 6.0 ft	2		0.203	0.369	1.00	1.00	1.00	1.00	1.000	1.00	1.00	1.00	6.46	375.9	1,850.0	1.98	97.8	265.0
+D+S									1.00	1.00	1.00	1.000			0.0	0.00	0.0	0.0
Length = 9.50 ft	1		0.110	0.219	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.00	4.00	233.0	2,127.5	3.67	66.7	304.8
Length = 6.0 ft	2		0.110	0.219	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.00	4.00	233.0	2,127.5	0.96	66.7	304.8
+D+0.750L									1.00	1.00	1.00	1.000			0.0	0.00	0.0	0.0
Length = 9.50 ft	1		0.139	0.254	1.25	1.00	1.00	1.00	1.000	1.00	1.00	1.00	5.53	321.8	2,312.5	4.63	84.2	331.3
Length = 6.0 ft	2		0.139	0.254	1.25	1.00	1.00	1.00	1.000	1.00	1.00	1.00	5.53	321.8	2,312.5	1.67	84.2	331.3
+D+0.750L+0.750S									1.00	1.00	1.00	1.000			0.0	0.00	0.0	0.0
Length = 9.50 ft	1		0.177	0.334	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.00	6.48	376.9	2,127.5	5.59	101.7	304.8
Length = 6.0 ft	2		0.177	0.334	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.00	6.48	376.9	2,127.5	1.83	101.7	304.8
+1.158D+4.550E									1.00	1.00	1.00	1.000			0.0	0.00	0.0	0.0
Length = 9.50 ft	1		0.454	0.987	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	23.09	1,343.2	2,960.0	23.01	418.4	424.0
Length = 6.0 ft	2		0.454	0.987	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	23.09	1,343.2	2,960.0	4.18	418.4	424.0
+1.119D+0.750L+0.750S+3.4									1.00	1.00	1.00	1.000			0.0	0.00	0.0	0.0
Length = 9.50 ft	1		0.427	0.903	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	21.74	1,264.7	2,960.0	21.06	383.0	424.0
Length = 6.0 ft	2		0.427	0.903	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	21.74	1,264.7	2,960.0	4.40	383.0	424.0
+0.60D									1.00	1.00	1.00	1.000			0.0	0.00	0.0	0.0
Length = 9.50 ft	1		0.032	0.061	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	1.64	95.7	2,960.0	1.43	26.0	424.0
Length = 6.0 ft	2		0.032	0.061	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	1.64	95.7	2,960.0	0.45	26.0	424.0
+0.4418D+4.550E									1.00	1.00	1.00	1.000			0.0	0.00	0.0	0.0
Length = 9.50 ft	1		0.325	0.914	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	21.45	1,247.9	3,840.0	21.30	387.3	424.0
Length = 6.0 ft	2		0.415	0.914	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	21.12	1,228.9	2,960.0	3.65	387.3	424.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S+0.5250E	1	0.0322	5.148		0.0000	0.000
	2	0.0000	5.148	+D+0.750L+0.750S+0.5250E	-0.0081	2.145

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Max Upward from all Load Conditions	1.356	10.406	0.654
Max Upward from Load Combinations	1.356	10.406	0.654
Max Upward from Load Cases	0.607	5.180	0.553
Max Downward from all Load Conditions			-0.729
Max Downward from Load Combinations			-0.450
Max Downward from Load Cases (Resis)			-0.729
D Only	0.453	3.249	0.100
+D+L	1.060	7.669	0.654
+D+S	0.627	4.746	-0.110
+D+0.750L	0.908	6.564	0.515
+D+0.750L+0.750S	1.039	7.686	0.357
+D+0.70E	0.875	6.875	-0.410
+D+0.750L+0.750S+0.5250E	1.356	10.406	-0.026
+0.60D	0.272	1.950	0.060
+0.60D+0.70E	0.694	5.576	-0.450
L Only	0.607	4.419	0.553
S Only	0.174	1.496	-0.211
E Only	0.603	5.180	-0.729