Structural Calculations

for

NEW SINGLE-FAMILY DWELLING

Plummer Residence

9212 SE 33rd Pl

Mercer Island, WA 98040

FIELD REVISION 1

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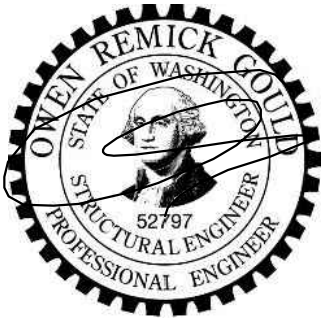
Job No. 21006

Date: 10/20/23



REAR DECK FRAMING + FOOTINGS

DJ1 DECK JOIST

SPAN = 9'-0" W = 20+60 PSF (DECK W/ PEDESTAL PAVERS) USE 1 3/8" x 7 1/4" LVL @ 16" O.C. (MIN DEPTH)
DL LL

DB2 DECK BEAM

SPAN = 7'-3" W = 20+60 PSF TRIB = 18'-1"/2 = 9'-0"
DL LL

USE 6x10

F11 DECK PAD FOOTING

$P = (20+60)(\frac{10'}{2})(7') = 1260 + 3780^{\#}$
DL LL

USE 24" SQ. PAD Cap for 12" x 250 = 18000# OK

Multiple Simple Beam

Project File: 21006_Plummer.ec6

Description : Deck Framing

Wood Beam Design : DJ1 - Deck Joists

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

BEAM Size : **1.75x7.25, Microllam LVL, Fully Braced**
Using Allowable Stress Design with IBC 2021 Load Combinations, Major Axis Bending
Wood Species : iLevel Truss Joist Wood Grade : MicroLam LVL 2.0 E

Fb - Tension	2600 psi	Fc - Prll	2510 psi	Fv	285 psi	Ebend- xx	2000 ksi	Density	42.01 pcf
Fb - Compr	2600 psi	Fc - Perp	750 psi	Ft	1555 psi	Eminbend - xx	1016.535 ksi		

Applied Loads

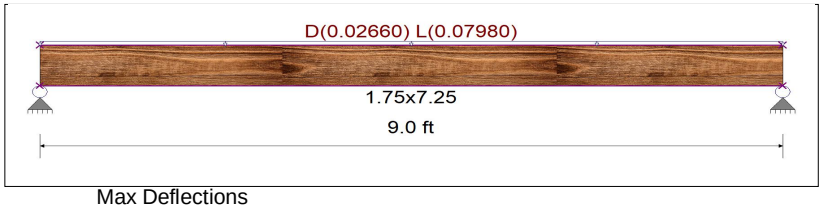
Unif Load: D = 0.020, L = 0.060 k/ft, Trib= 1.330 ft

Design Summary

Max fb/Fb Ratio = **0.291** : 1
fb : Actual : 843.25 psi at 4.500 ft in Span # 1
Fb : Allowable : 2,895.81 psi
Load Comb : +D+L

Max fv/FvRatio = **0.205** : 1
fv : Actual : 56.61 psi at 0.000 ft in Span # 1
Fv : Allowable : 276.45 psi
Load Comb : +D+L

Max Reactions (k)	D	Lr	L	S	W	E	H
Left Support	0.12		0.36				
Right Support	0.12		0.36				



Max Deflections

Transient Downward	0.118 in	Total Downward	0.158 in
Ratio	912	Ratio	684
	LC: L Only		LC: +D+L
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

Wood Beam Design : DB2 - Deck Beam

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

BEAM Size : **6x10, Sawn, Fully Braced**
Using Allowable Stress Design with IBC 2021 Load Combinations, Major Axis Bending
Wood Species : Douglas Fir-Larch Wood Grade : No.1

Fb - Tension	1,350.0 psi	Fc - Prll	925.0 psi	Fv	170.0 psi	Ebend- xx	1,600.0 ksi	Density	31.210 pcf
Fb - Compr	1,350.0 psi	Fc - Perp	625.0 psi	Ft	675.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

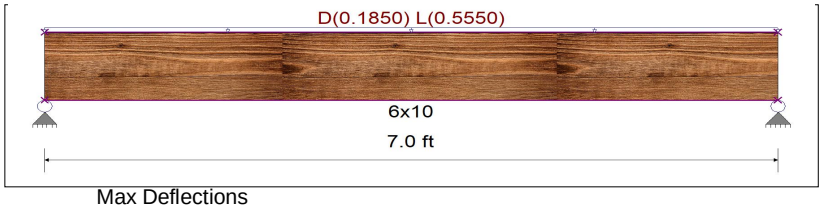
Unif Load: D = 0.020, L = 0.060 k/ft, Trib= 9.250 ft

Design Summary

Max fb/Fb Ratio = **0.487** : 1
fb : Actual : 657.45 psi at 3.500 ft in Span # 1
Fb : Allowable : 1,350.00 psi
Load Comb : +D+L

Max fv/FvRatio = **0.437** : 1
fv : Actual : 74.35 psi at 0.000 ft in Span # 1
Fv : Allowable : 170.00 psi
Load Comb : +D+L

Max Reactions (k)	D	Lr	L	S	W	E	H
Left Support	0.65		1.94				
Right Support	0.65		1.94				



Max Deflections

Transient Downward	0.048 in	Total Downward	0.064 in
Ratio	1752	Ratio	1314
	LC: L Only		LC: +D+L
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

Plywood Shear Wall Design

Refer to Shear Wall Key Plans

Story Forces - ASD Level	
Floor	F_x (psf)
Roof	6.4
Upper	4.3

Plywood Grade
CD-X

Struct 1 or CD-X

15/32" Plywood, w/ 10d nails, min. 1-1/2" penetration into framing members

R_d (Dead Load Resistance Factor) = 0.6-0.14S_{ds} = 0.44

Wall Mark Capacity (Grade Struct 1)		
Wall Mark	Edge Nailing	Capacity (plf)
1	6"o.c.	340
2	4"o.c.	510
3	3"o.c.	665
4	2"o.c.	870
Dbl 2	4"o.c. Both Sides	1020
Dbl 3	3"o.c. Both Sides	1330
Dbl 4	2"o.c. Both Sides	1740

Wall Mark Capacity (Grade CD-X)		
Wall Mark	Edge Nailing	Capacity (plf)
1	6"o.c.	310
2	4"o.c.	460
3	3"o.c.	600
4	2"o.c.	770
Dbl 2	4"o.c. Both Sides	920
Dbl 3	3"o.c. Both Sides	1200
Dbl 4	2"o.c. Both Sides	1540

Holdown Schedule	
Holdown	Capacity (lb)
HDU2	3075
HDU4	4565
HDU5	5645
HDU8	7870
MSTC28	1540
MSTC40	3080
MSTC52	4620

Notes

1) $Wall_{abv}$ = Shear wall on story above that adds shear to subject wall
2) V_{abv} = Shear demand from wall on story above
3) V_{cur} = Shear demand from current story = A_T x F_x
4) V = Total shear demand in wall = V_{abv} + V_{cur}
5) v = unit shear demand = V / L
6) Allowable shear reduction multiplier of 2xL/h for walls w/ h>2L (=1 if h<2L)
7) OTM = Wall overturning moment = V x h
8) w_{DL} = Distributed resisting dead load on top of wall
9) $P_{DL,END}$ = Minimum resisting point dead load on end of wall
10) RM = Resisting Moment from w_{DL} & $P_{DL,END}$, mulitplied by R_d above
11) T_{end} = Tension at end of wall from current story shear = (OTM - RM) / L *(negative means no uplift)*
12) T_{abv} = Tension from wall holdown on story above
13) T = T_{end} + T_{abv}

Roof Diaphragm

Walls in North-South Direction												
Wall	L (ft)	h (ft)	A_T (sf)	$Wall_{abv}$[1]	V_{abv}[2] (lbs)	V_{cur}[3] (lbs)	V[4] (lb)	v[5] (plf)	Wall Mark	h>2L?	2xL/h[6]	Capacity (plf)
UF.A.1	17	9	397	none	0	2554	2554	150	1	no	1	310
UF.B.1	10.5	9	245	none	0	1578	1578	150	1	no	1	310
UF.A.2	15.75	11	368	none	0	2366	2366	150	1	no	1	310
UF.B.2	16.25	11	380	none	0	2441	2441	150	1	no	1	310
UF.D*	27.5	9	431	none	0	2772	2772	269	1	no	1	310
UF.B9*	25.5	9	449	none	0	2888	2888	269	1	no	1	310
UF.C*	22.5	11	532	none	0	3422	3422	269	1	no	1	310

Holdowns for Walls in North-South Direction									
Wall	OTM[7] (lb-ft)	w_{DL}[8] (plf)	$P_{DL,END}$[9] (lb)	RM[10] (lb-ft)	T_{end}[11] (lb)	T_{abv}[12] (lb)	T[13] (lb)	Holdown	Capacity
UF.A.1	22988	340	1360	32122	-537		-537	NONE	#N/A
UF.B.1	14198	330	1320	14250	-5		-5	NONE	#N/A
UF.A.2	26030	315	1260	26194	-10		-10	NONE	#N/A
UF.B.2	26856	310	1240	27156	-18		-18	NONE	#N/A
UF.D*	24947	340	1360	73787	-1776		-1776	NONE	#N/A
UF.B9*	25989	300	1200	56970	-1215		-1215	NONE	#N/A
UF.C*	37637	290	1160	44240	-294		-294	NONE	#N/A

Walls in East-West Direction												
Wall	L (ft)	h (ft)	A_T (sf)	$Wall_{abv}$[1]	V_{abv}[2] (lbs)	V_{cur}[3] (lbs)	V[4] (lb)	v[5] (plf)	Wall Mark	h>2L?	2xL/h[6]	Capacity (plf)
UF.2*	23.5	9	410	none	0	2637	2637	305	1	no	1	310
UF.3	7.25	9	660	none	0	4245	4245	585	3	no	1	600
UF.4	7.5	9	415	none	0	2669	2669	356	2	no	1	460
UF.5	11.25	9	265	none	0	1704	1704	151	1	no	1	310
UF.6	14.75	11	375	none	0	2412	2412	164	1	no	1	310
UF.7	11.75	11	490	none	0	3151	3151	268	1	no	1	310
UF.8*	18	11	190	none	0	1222	1222	303	1	no	1	310

Holdowns for Walls in East-West Direction									
Wall	OTM[7] (lb-ft)	w_{DL}[8] (plf)	$P_{DL,END}$[9] (lb)	RM[10] (lb-ft)	T_{end}[11] (lb)	T_{abv}[12] (lb)	T[13] (lb)	Holdown	Capacity
UF.2*	23732	200	800	32912	-391		-391	NONE	#N/A
UF.3	38202	60	240	1475	5066		5066	HDU5	5645
UF.4	24021	90	360	2326	2893		2893	HDU2	3075
UF.5	15339	60	240	2889	1107		1107	HDU2	3075
UF.6	26530	80	320	5968	1394		1394	HDU2	3075
UF.7	34665	80	320	4127	2599		2599	HDU2	3075
UF.8*	13442	200	800	20807	-409		-409	NONE	#N/A

Upper Floor Diaphragm

Walls in North-South Direction												
Wall	L (ft)	h (ft)	A_T (sf)	$Wall_{abv}$[1]	V_{abv}[2] (lbs)	V_{cur}[3] (lbs)	V[4] (lb)	v[5] (plf)	Wall Mark	h>2L?	2xL/h[6]	Capacity (plf)
MF.A.1	8.25	10	240	UF.A, B	1821	1027	2848	345	2	no	1	460
MF.A.2	25.5	10	743	UF.A, B	5629	3174	8803	366	2	no	1	460
MF.B*	12.75	10	197	UF.A, B	1490	840	2330	366	2	no	1	460
MF.B6	14.25	10	1388	UF.B9,C	4086	5930	10015	703	4	no	1	770
MF.D.1/2	3.5	10	220	UF.D	1386	940	2326	665	DBL 3	yes	0.70	840
MF.E*	15.75	10	270	UF.B9	689	1151	1840	330	2	no	1	460
MF.F*	32	10	468	UF.B9,C	1534	1999	3534	247	1	no	1	310

Holdowns for Walls in North-South Direction									
Wall	OTM[7] (lb-ft)	w_{DL}[8] (plf)	$P_{DL,END}$[9] (lb)	RM[10] (lb-ft)	T_{end}[11] (lb)	T_{abv}[12] (lb)	T[13] (lb)	Holdown	Capacity
MF.A.1	28479	120	480	3576	3019		3019	HDU2	3075
MF.A.2	88026	310	620	51840	1419		1419	HDU2	3075
MF.B*	23301	180	720	10586	997		997	HDU2	3075
MF.B6	100154	170	680	11982	6188		6188	HDU8	7870
MF.D.1/2	23258	310	1240	2774	5853		5853	HDU8	7870
MF.E*	18404	180	720	14968	218		218	HDU2	3075
MF.F*	35336	210	840	59754	-763		-763	NONE	#N/A

Walls in East-West Direction												
Wall	L (ft)	h (ft)	A_T (sf)	$Wall_{abv}$[1]	V_{abv}[2] (lbs)	V_{cur}[3] (lbs)	V[4] (lb)	v[5] (plf)	Wall Mark	h>2L?	2xL/h[6]	Capacity (plf)
MF.1*	20.5	10	459	UF.2	2461	1959	4420	520	3	no	1	600
MF.3.1	10.25	10	549	UF.2-4	3423	2344	5766	563	3	no	1	600
MF.3.2	7.5	10	401	UF.2-4	2504	1715	4219	563	3	no	1	600
MF.5.1	7.5	10	259	UF.4,5	1303	1107	2410	321	2	no	1	460
MF.5.2	9	10	311	UF.4,5	1564	1328	2892	321	2	no	1	460
MF.56	8	10	510	UF.6	2144	2179	4323	540	3	no	1	600
MF.7.1/2	3.25	8	320	UF.6-8	1774	1367	3141	966	DBL 3	yes	0.81	975
MF.8	5.5	10	330	UF.8	1093	1410	2503	455	2	no	1	460

Note: Seismic load from full-height concrete wall added to MF.1, 3.1 & 3.2 Vabv

Holdowns for Walls in East-West Direction									
Wall	OTM[7] (lb-ft)	w_{DL}[8] (plf)	$P_{DL,END}$[9] (lb)	RM[10] (lb-ft)	T_{end}[11] (lb)	T_{abv}[12] (lb)	T[13] (lb)	Holdown	Capacity
MF.1*	44198	100	400	12988	1522		1522	HDU2	3075
MF.3.1	57664	70	280	2911	5342		5342	HDU5	5645
MF.3.2	42193	70	280	1809	5385		5385	HDU5	5645
MF.5.1	24099	70	280	1809	2972	1107	4079	HDU4	4565
MF.5.2	28918	70	280	2381	2949		2949	HDU4	4565
MF.56	43225	70	280	1992	5154		5154	HDU5	5645
MF.7.1/2	25128	100	400	813	7482		7482	HDU8	7870
MF.8	25031	100	400	1651	4251		4251	HDU4	4565

Lower Deck Diaphragm

Walls in North-South Direction												
Wall	L (ft)	h (ft)	A_T (sf)	$Wall_{abv}$[1]	V_{abv}[2] (lbs)	V_{cur}[3] (lbs)	V[4] (lb)	v[5] (plf)	Wall Mark	h>2L?	2xL/h[6]	Capacity (plf)
D.B	10.75	4	290	NONE	0	693	693	64	1	no	1	310
D.F	18.75	4	290	NONE	0	693	693	37	1	no	1	310

Holdowns for Walls in North-South Direction									
Wall	OTM[7] (lb-ft)	w_{DL}[8] (plf)	$P_{DL,END}$[9] (lb)	RM[10] (lb-ft)	T_{end}[11] (lb)	T_{abv}[12] (lb)	T[13] (lb)	Holdown	Capacity
D.B	2773	40	160	1792	91		91	NONE	#N/A
D.F	2773	40	160	4460	-90		-90	NONE	#N/A

Close enough

Walls in East-West Direction												
Wall	L (ft)	h (ft)	A_T (sf)	$Wall_{abv}$[1]	V_{abv}[2] (lbs)	V_{cur}[3] (lbs)	V[4] (lb)	v[5] (plf)	Wall Mark	h>2L?	2xL/h[6]	Capacity (plf)
D.8	30.75	4	290	MF.8	2503	693	3196	104	1	no	1	310

Holdowns for Walls in East-West Direction									
Wall	OTM[7] (lb-ft)	w_{DL}[8] (plf)	$P_{DL,END}$[9] (lb)	RM[10] (lb-ft)	T_{end}[11] (lb)	T_{abv}[12] (lb)	T[13] (lb)	Holdown	Capacity
D.8	12786	130	520	34435	-704		-704	NONE	#N/A

**Shear wall with force-transfer around openings; see additional spreadsheet to follow*