Revised and Supplemental Structural Calculations For:

Paek Residence

2215 80th Ave SE

Mercer Island, WA 98040

8-6-19

Prepared for: MZA Architecture

Job #: 10604-2018-01-00

Date: August 5, 2019

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Criteria Sheet

Codes:

Structural:	IBC 2015
Loading:	ASCE 7-10
Wood:	NDS 2015
Steel:	AISC 360-10
Concrete:	ACI 318-14
Masonry:	TMS 402/602-13

Project Location:

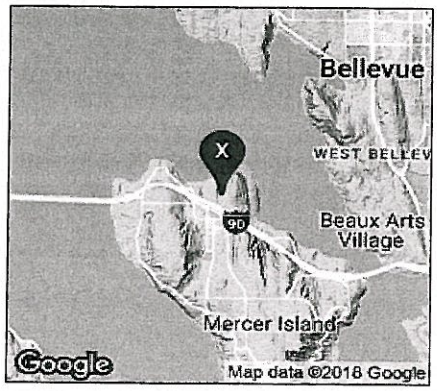
Street & Number:	2215 80th Ave SE
City:	Mercer Island WA
ZIP:	98040
Latitude:	47.5905 N
Longitude:	-122.2321 W

Occupancy Category

Risk Category: II ASCE 7 Table 1.5-1

Seismic Load Summary:

Analysis Procedure:	Equivalent Lateral Force Procedure		
Lateral System:	Wood Structural Panels Rated for Shear Resistance		
R:	6.50	C_d=	4
Base Shear V =	17.6 kips	Ω_o=	2.5
S_S=	1.365	S_1=	0.526
S_{DS}=	0.91	S_{D1}=	0.53
C_s=	0.140	I_E=	1.0



Wind Load Summary:

V=	110	K_{zt}=	1.00
Exposure =	C		

Dead Loads:

Roof		
Roofing	2.5	psf
1/2" Sheathing	1.8	psf
14" TJI 230 @ 16"oc	2.5	psf
Misc./Mech.	1.4	psf
Ceiling Finish	~~2.8~~ 1.8	psf
~~Future Solar Panels~~	~~4~~ 0	~~psf~~
	~~15~~ 10	psf
Use	~~15~~ 10	psf
Floor		
Finish Floor	1.5	psf
3/4" Sheathing	2.7	psf
Joists @ 16" oc	2.3	psf
Misc./Mech.	2.0	psf
Ceiling Finish	2.8	
	11.3	psf
Use	12	psf
Wall		
Siding	2	psf
1/2" Sheathing	1.8	psf
Wall Framing	2	psf
Insulation	1	psf
1/2" GWB	2.2	psf
	9	psf
Use	10	psf

Live Loads:

Snow	25	psf	+5 psf	Deck 60	psf
Floor	40	psf			

Soils:

Allowable Bearing 1500 psf

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Lateral Analysis

Wind:

North-South Direction:

$V_{ROOF} = (25\,ft^2)(14.39\,psf) + (113\,ft^2)(13.96\,psf) = 1.94^k$

$V_{UPPER/GARAGE} = (18\,ft^2)(13.96\,psf) + (130\,ft^2)(13.53\,psf) + (138\,ft^2)(13.00\,psf) + (177\,ft^2)(13.00\,psf) = 6.11^k$

$V_{PARAPET} = (81\,ft^2)(33.6\,psf) = 2.72^k$

$V_{MAIN} = (307\,ft^2)(13.00\,psf) = 3.99^k$

$V_{BASE} = 14.76^k$ ← N-S DIRECTION

East Direction:

$V_{ROOF} = (243\,ft^2)(16.74\,psf) + (101\,ft^2)(16.32\,psf) = 5.72^k$

$V_{UPPER} = (183\,ft^2)(16.32\,psf) + (356\,ft^2)(15.78\,psf) + (103\,ft^2)(15.78\,psf) = 10.23^k$

$V_{PARAPET} = (52\,ft^2)(33.6\,psf) = 1.75^k$

$V_{BASE} = 17.7^k$

West Direction:

$V_{ROOF} = (1416\,ft^2)(0.57\,psf) + (264\,ft^2)(17.17\,psf) + (19\,ft^2)(16.74\,psf) = 4.93^k$

$V_{UPPER} = (271\,ft^2)(16.74\,psf) + (304\,ft^2)(16.32\,psf) + (18\,ft^2)(15.78\,psf) = 9.78^k$

$V_{MAIN} = (586\,ft^2)(15.78\,psf) = 9.25^k$

$V_{BASE} = 23.96^k$ ← WEST DIRECTION

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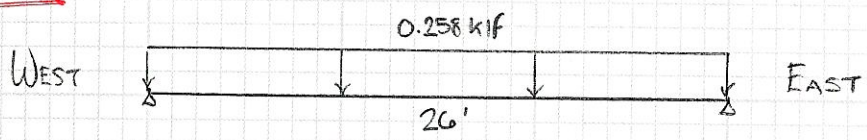
LATERAL DESIGN

NORTH - SOUTH DIRECTION SHEARWALLS: SEISMIC

ROOF DIAPHRAGM:

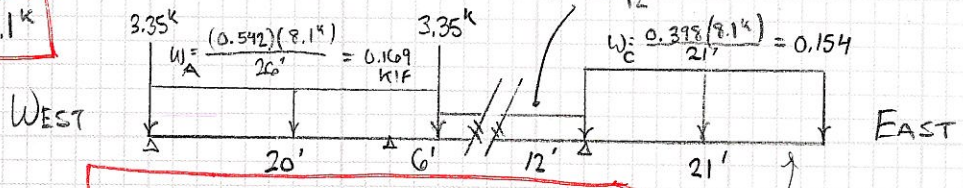
$V = 6.7^{K}$



	WEST	EAST
V (kips):	3.35	3.35
L (ft):	~~28.74~~ 22.25'	$2\times\left(\frac{2\cdot4.92}{11.58}\right)(4.92') + \left(\frac{2\cdot4.33}{11.58}\right)(4.33) + 12.5' = 24.10'$
v (plf):	~~117~~ 150	139
SW:	W6	W6
OT (kips):	~~0.99~~ 1.28 0.6DL = Ø @ 7' & 11' WALLS; 0.67K @ 3' WALL	1.61 - 0.6DL = 0.92 @ SHORT WALLS = Ø @ LONG WALL
HD:	NONE; CS16 @ 3' WALL	CS16 @ SHORT.

UPPER FLOOR / GARAGE ROOF DIAPHRAGM:

$V = 8.1^{K}$



V (kips):	5.04	6.17	3.59
L (ft):	$\left(\frac{2\cdot3.67}{10.33}\right)(3.67) + \left(\frac{2\cdot3.83}{10.33}\right)(3.83) + 12.33' = 17.77'$	12.58	16.75
v (plf):	283	491	214
SW:	W4	W2	W6
OT (kips):	2.93 + 0.99 = 3.92 - 0.6DL = 3.00	5.07 - 0.6DL	2.21 - 0.6DL
HD:	(2) CS16	HDU5	HDU2

CANTILEVERED DIAPHRAGM. SEE CALCS ATTACHED.

$\Sigma = 14.8^{K}$ N-S DIRECTION MATCHES L2 CALC

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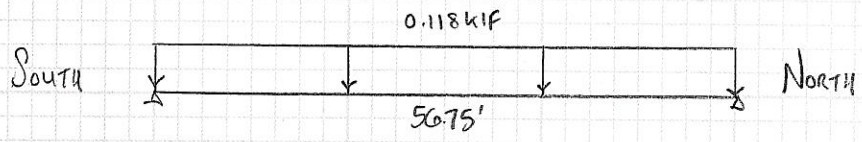
LATERAL DESIGN

EAST-WEST DIRECTION SHEARWALLS: SEISMIC

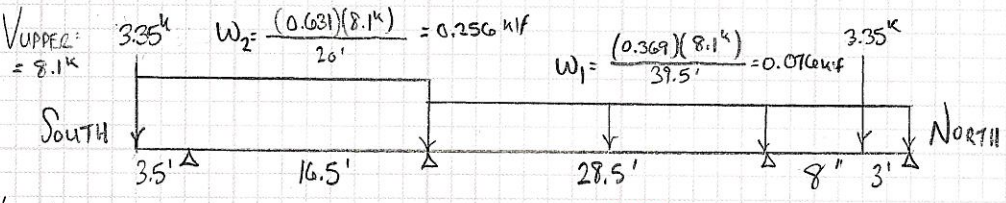
ROOF DIAPHRAGM:

$V_{ROOF} = 6.7^K$



V (kips):	3.35	3.35
L (ft):	8.67	17.33
v (plf):	386	193
SW:	W3	W6
OT (kips):	3.74 - 0.6DL = 3.36	2.17 - 0.6DL = 1.40 (11.25')
HD:	(2)CS16	CS16

UPPER FLOOR DIAPHRAGM:



V (kips):	6.35	3.19 → DIA L = 59' v_{DIA} = 54 PLF		1.39	3.77
L (ft):	48.75	21.5	GRID 1 TO 4:	14.17	20.17
v (plf):	130	148	L = 38'	98	187
SW:	W6	W6	V = 38(54) = 2052# W4 CAPACITY: 353 PLF	W6	W6
OT (kips):	1.35 + 3.74 = 5.09 - 0.6DL = 3.91	1.53 - 0.6DL = ∅	$L_{REQ'D} = \frac{2052}{353} = 5.81'$	1.01 - 0.6DL = ∅	1.93 + 2.17 = 4.10 - 0.6DL = 3.29
HD:	HDU4/(3)CS16	NONE	CS14	NONE	HDU4/(2)CS16

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PROJECT: PAEK RESIDENCE, MERCER ISLAND, WA
DATE: 08/07/18
PROJ. #: JRC
DESIGN: L12
SHEET

CONTINUOUS-SPAN BEAM ANALYSIS

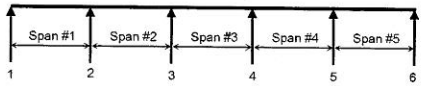
For Two (2) through Five (5) Span Beams
With Pinned or Fixed Beam Ends

Job Name:	Paek Residence	Subject:	Grid 1 multi-span beam		
Job Number:	10604-2018-01	Originator:	RJA	Checker:	RJA

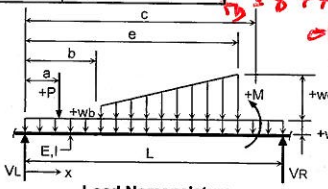
Input Data:

Beam Data:

No. Spans, N =	3	
Left End =	Pinned	Support #1
Right End =	Pinned	Support #4
Modulus, E =	1800	ksi



Span and Support Nomenclature



Load Nomenclature

Summary of Results for Entire 3-Span Beam:

Support Moments:

M1 =	0.00	ft-kips
M2 =	-37.43	ft-kips
M3 =	-38.60	ft-kips
M4 =	0.00	ft-kips
M5 =	---	ft-kips
M6 =	---	ft-kips

Support Reactions:

R1 =	-0.99	kips
R2 =	16.98	kips
R3 =	17.79	kips
R4 =	3.23	kips
R5 =	---	kips
R6 =	---	kips

Maximum Moments in Beam:

+M(max) =	28.63	ft-kips	@ x =	13.69 ft. (Span #2)
-M(max) =	-38.60	ft-kips	@ x =	27.50 ft. (Span #2)

Maximum Deflections in Beam:

-Δ(max) =	-0.251	in.	@ x =	13.70 ft. (Span #2)
+Δ(max) =	0.021	in.	@ x =	5.51 ft. (Span #1)
Δ(ratio) =	L/1315			

Span Data and Loadings:

Span Data:	Span #1	Span #2	Span #3	Span #4	Span #5
Span, L =	9.0000 ft.	27.5000 ft.	16.0000 ft.		
Inertia, I =	6336.00 in.^4	6336.00 in.^4	6336.00 in.^4		
Full Uniform:					
w =	0.7050 kpf	0.7050 kpf	0.7050 kpf		

Distributed:	Start		End		Start		End		Start		End		Start		End		Start		End	
	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)
#1:																				
#2:																				
#3:																				
#4:																				
#5:																				
#6:																				
#7:																				
#8:																				

Point Loads:	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)
#1:										
#2:										
#3:										
#4:										
#5:										
#6:										
#7:										
#8:										
#9:										
#10:										
#11:										
#12:										
#13:										
#14:										
#15:										

Moments:	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)
#1:										
#2:										
#3:										
#4:										

Results:

Left End Cantilever Shear = 0.00 kips Left End Cantilever Moment = 0.00 ft-kips Right End Cantilever Shear = 0.00 kips Right End Cantilever Moment = 0.00 ft-kips

End Shears:										
	-0.99 k	-7.33 k	9.65 k	-9.74 k	8.05 k	-3.23 k	---	---	---	---

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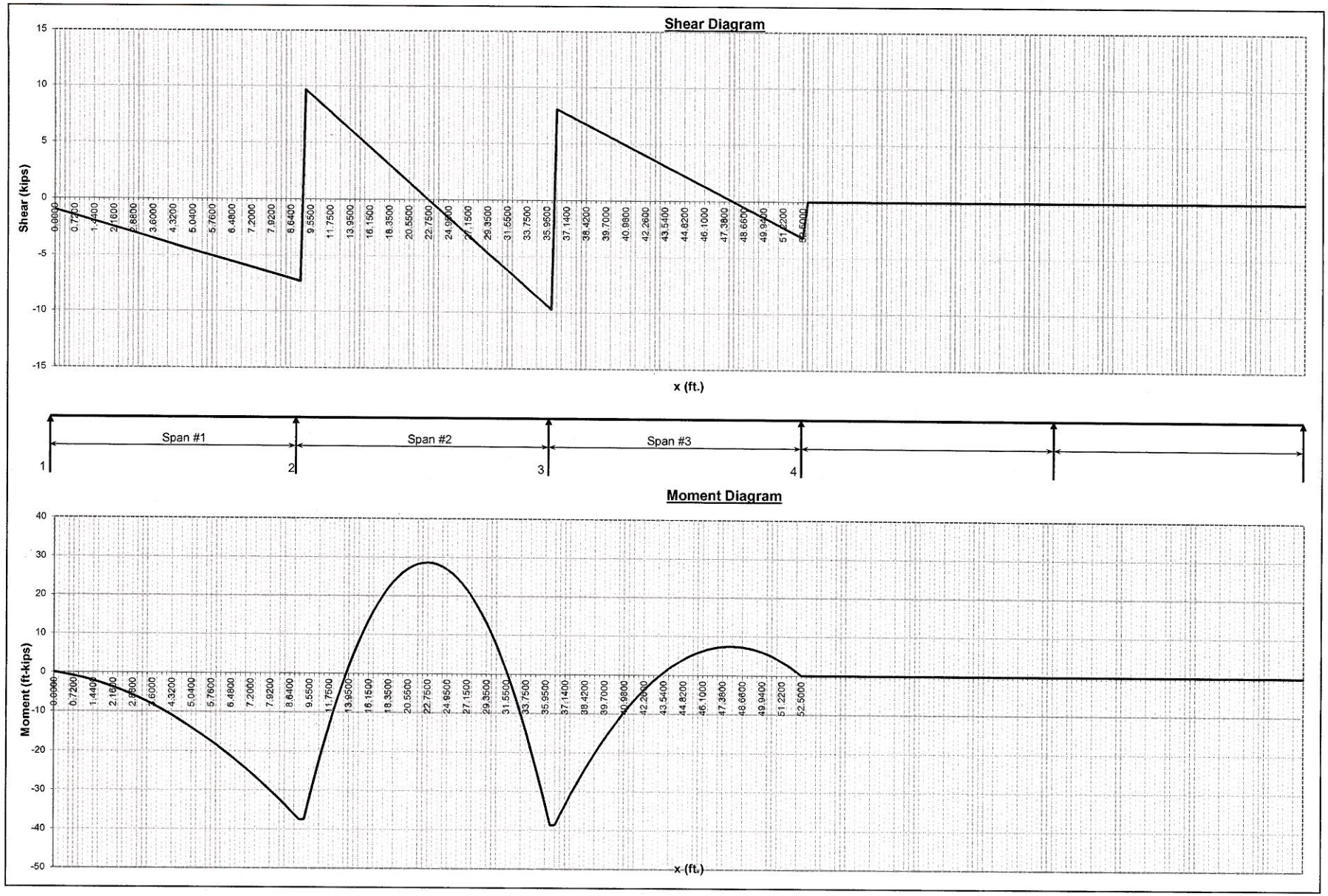

Shear Diagram
Shear (kips)
x (ft.)
Span #1
Span #2
Span #3
1
2
3
4
Moment Diagram
Moment (ft-kips)
x (ft.)

S-2

Beam Stability and Volume Factor, (C_L & C_v) 2005 NDS

Member Properties	
b (in)	5.5
d (in)	24
l_u (ft)	27.5
E (10^6 psi)	1.8
F_b (psi)	2400

Adjustment Factors	
C_D	1.15

l_e (ft)	48.12	from NDS 2005 Table 3.3.3
F_b' (psi)	2760	
E' (10^6 psi)	2.07	
R_B	21.40	< 50
F_{be} (psi)	5422	

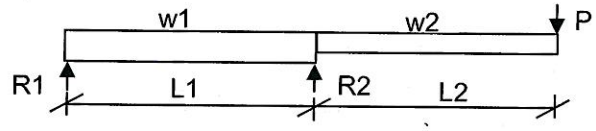
Stability Factor, C_L		
C_L	0.95	NDS 2005 3.3.3

Volume Factor, C_v		
x	10	NDS 2005 5.3.6
C_v	0.90	

Worst Case Factor	0.90

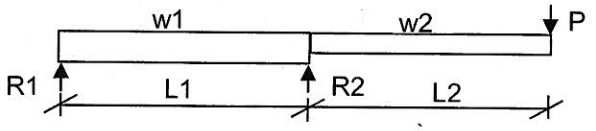
↳ 0.9 × 1.15 = 1.03 - ok

Roof TL + Flr DL		U3		GL	5 1/2 x 24	
w1=	711	plf		R1=	8893	lbs
w2=	711	plf		R2=	17,514	lbs
L1=	28	ft		M+=	55,621	lb-ft
L2=	9	ft		M-=	29,696	lb-ft
X=	14.00	ft		Fb=	1,264	psi
P=	100	lbs		Fv=	109	psi
b=	5.50	in		Δspan=	0.642	in
d=	24.00	in		l span/	524	
E=	1,800	ksi		Δcant=	(0.42)	in
Cv=	0.90			l cant/	(518)	



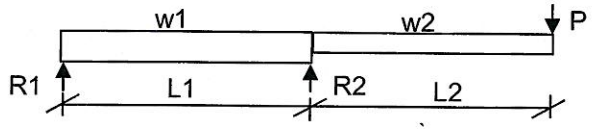
Max R1		U3		GL	5 1/2 x 24	
w1=	711	plf		R1=	9589	lbs
w2=	230	plf		R2=	12,489	lbs
L1=	28	ft		M+=	64,664	lb-ft
L2=	9	ft		M-=	10,215	lb-ft
X=	14.00	ft		Fb=	1,470	psi
P=	100	lbs		Fv=	101	psi
b=	5.50	in		Δspan=	0.786	in
d=	24.00	in		l span/	427	
E=	1,800	ksi		Δcant=	(0.72)	in
Cv=	0.90			l cant/	(298)	

R1 = 9589 + 40 * 6 * 7 = 11269 lbs



Max R1		U13		PSL	7 x 14	
w1=	1,130	plf		R1=	8942	lbs
w2=	255	plf		R2=	10,030	lbs
L1=	16	ft		M+=	35,383	lb-ft
L2=	4	ft		M-=	1,562	lb-ft
X=	8.00	ft		Fb=	1,857	psi
P=	-	lbs		Fv=	120	psi
b=	7.00	in		Δspan=	0.507	in
d=	14.00	in		l span/	379	
E=	2,000	ksi		Δcant=	(0.35)	in
Cv=	0.98			l cant/	(243)	

R1 = 8942 lbs



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Project: Paek Residence
Gridline 2.8 Beam

Date: 08/04/19
Project #:
Design: RJA
Sheet: S-4