

# ***ADDENDUM STRUCTURAL CALCULATIONS***

Wu-Chang Residence  
2956 72nd Ave SE  
Mercer Island, WA

**Client:** CenterLine Architects



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Project: 2956 72nd Ave SE (Mercer Island)

By: JDA

Proj No: 248-2024

Date: 05/28/2024

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Summary

Floor plan revision on upper floor changed location of window opening in strapped shearwalls at NE and SE quadrants, but did not alter length of shearwalls or force transfer around opening (iFTAO) analysis. Revision of window openings in strapped shearwalls at east exterior resulted in change in FTAO analysis and required straps; see page 2 for updated lateral analysis and page 3 for updated FTAO analysis for east upper-to-roof strapped shearwall.



**Subject:** Calculation Overview

**Project:** Wu-Chang Residence

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R	6.5	ASCE 7-16 Table 12.2-1			
$\Omega$	2.5				
$C_d$	4				
Soil Class	CD		D	C	CD
V	18.0	= $C_w$ - ASCE 7-22 (12.8-1)			Kips
C <sub>r</sub>	0.180		0.174	0.178	0.180
		= $S_u / (R_u) - ASCE 7-22 (12.8-2) Method 1$			
	0.180	= $S_u / (R_u) - ASCE 7-22 (12.8-2) Method 2$	0.174	0.178	0.180
	0.372	= $S_u / (R_u) - ASCE 7-22 (12.8-4)$	0.454	0.296	0.372
		= $S_u / (T_u) - ASCE 7-22 (12.8-5)$			
	0.008	= $0.085 / (R_u) - ASCE 7-22 (12.8-2)$	0.008	0.008	0.008
	0.049	= $0.55 / (R_u) - ASCE 7-22 (12.8-7)$	0.049	0.049	0.049
W	100	Kips			
I <sub>e</sub>	1	ASCE 7-22 Table 1.5-2			
S <sub>s</sub>		ASCE 7 Hazard Tool			
S <sub>1</sub>	1.56	ASCE 7 Hazard Tool	1.56	1.56	1.56
S <sub>1</sub>	0.64	ASCE 7 Hazard Tool	0.64	0.64	0.64
S <sub>1st</sub>	1.75	ASCE 7 Hazard Tool	1.7	1.73	1.75
S <sub>1st</sub>	1.09	ASCE 7 Hazard Tool	1.34	0.88	1.09
S <sub>1st</sub>	1.17	= $2/3 S_{1st} - ASCE 7-22 (11.4-1)$	1.13	1.16	1.17
S <sub>1st</sub>	0.73	= $2/3 S_{1st} - ASCE 7-22 (11.4-2)$	0.89	0.58	0.73
T <sub>L</sub>	6	ASCE 7 Hazard Tool	6	6	6
PGA <sub>max</sub>	0.73	ASCE 7 Hazard Tool	0.72	0.7	0.73
V <sub>50</sub>	365	ASCE 7 Hazard Tool	260	530	365
S <sub>DC</sub>	D	ASCE 7 Hazard Tool	D	D	D
C <sub>r</sub>	0.025	ASCE 7-22 Table 12.8-2			
h <sub>n</sub>	22.50	feet			
x	0.8	ASCE 7-22 Table 12.8-2			
T	0.302	seconds = $C_u / S_u$ , ASCE 7-22 (12.8-8)			

Story	Weight (kips)	Height (ft)	Story H (ft)	Wh (ft)	C <sub>ex</sub> (ft/ΣW <sub>h</sub> )	F <sub>DE</sub> (kips)	ΣF <sub>DE</sub> (kips)	F <sub>DE</sub> (kips)	ΣF <sub>DE</sub> (kips)	F <sub>EW</sub> (kips)	ΣF <sub>EW</sub> (kips)	F <sub>NW</sub> (kips)	ΣF <sub>NW</sub> (kips)	F <sub>ps</sub> (kips)
Roof	27.63	22.50	10.00	622	0.53	9.6	9.6	6.718	6.718	3.609	3.609	4.464	4.464	6.718
Upper Floor	36.13	12.50	10.00	452	0.39	7.0	16.6	4.830	11.598	3.854	7.463	5.143	9.607	6.655
Main Floor	36.02	2.50	2.50	90	0.08	1.4	18.0	0.973	5.854	0.000	7.463	0.000	9.607	5.901
ΣW	99.78													

UP-to-DOWN RUNNING WALLS															
Upper - to - Roof															
WEST	%	Length (ft)	SEISMIC			WIND			GRAVITY LOADING (plf)			Uplift	Comp	ft	
			# in Wall	PLF	Chord F (#)	# in Wall	PLF	Chord F (#)	Wall W (#)	Snow	Dead				Live
50.0%	21.66	3,359			2,232										
100.0%	24.58	3,359	137	1,366	2,232	91	908	2,950	0	0	0	723	3,083	4	OK
40.5%	8.77	1,360	155		904	103								4	OK
59.5%	12.89	1,999	155		1,328	103								4	OK
EAST	50.0%	17.58	3,359		2,232										
100.0%	32.00	3,359	105	1,050	2,232	70	697	3,840	0	0	0	212	3,284	4	OK
50.0%	8.79	1,679	191		1,116	127								4	OK
50.0%	8.79	1,679	191		1,116	127								4	OK

Main - to - Upper															
WEST	%	Length (ft)	SEISMIC			WIND			GRAVITY LOADING (plf)			Uplift	Comp	ft	
			# in Wall	PLF	Chord F (#)	# in Wall	PLF	Chord F (#)	Wall W (#)	Snow	Dead				Live
50.0%	16.86	5,799			2,232										
100.0%	24.66	5,799	235	2,352	4,803	195	1,948	5,918	0	0	0	1,061	5,795	4	OK
46.7%	7.77	2,706	348		2,241	288								4	OK
29.2%	4.86	1,694	348		1,403	288								4	OK
24.1%	4.02	1,400	348		1,160	288								4	OK
EAST	50.0%	20.83	5,799		4,803										
86.6%	23.00	5,022	218	2,184	4,160	181	1,809	5,520	0	0	0	980	5,396	4	OK
15.8%	3.29	916	278		759	231								4	OK
23.4%	4.88	1,357	278		1,124	231								4	OK
47.4%	9.88	2,749	278		2,277	231								4	OK
13.4%	2.79	777	278	2,784	644	231	2,306	670	0	0	0	2,637	3,173	4	OK

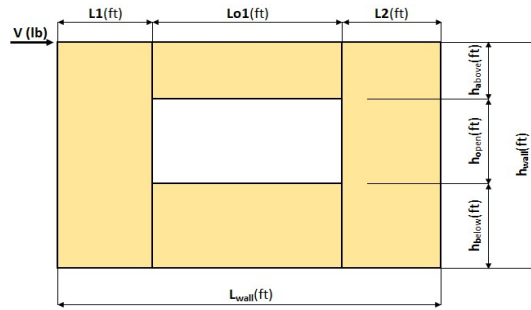
LEFT-to-RIGHT RUNNING WALLS															
Upper - to - Roof															
NORTH	%	Length (ft)	SEISMIC			WIND			GRAVITY LOADING (plf)			Uplift	Comp	ft	
			# in Wall	PLF	Chord F (#)	# in Wall	PLF	Chord F (#)	Wall W (#)	Snow	Dead				Live
50.0%	17.00	3,359			2,232										
29.4%	17.00	988	58	581	656	39	386	2,040	495	297	0	0	2,649	6	OK
16.1%	2.73	539	198		358	131								6	OK
13.4%	2.27	449	198		298	131								6	OK
11.8%	2.00	395	198	1,976	263	131	1,313	240	0	0	0	1,924	2,116	4	OK
11.8%	2.00	395	198	1,976	263	131	1,313	240	0	0	0	1,924	2,116	4	OK
47.1%	13.00	1,581	122	1,216	1,050	81	808	1,560	450	270	0	110	2,760	4	OK
22.2%	3.77	745	198		495	131								4	OK
24.9%	4.23	836	198		555	131								4	OK
SOUTH	50.0%	21.98	3,359		2,232										
37.5%	13.25	1,261	95	952	838	63	632	1,590	495	297	0	0	2,676	6	OK
10.9%	2.40	366	153		243	102								6	OK
26.6%	5.85	895	153		594	102								6	OK
26.1%	8.23	876	106	1,064	582	71	707	988	0	0	0	849	1,639	6	OK
13.0%	2.86	438	153		291	102								6	OK
13.0%	2.86	438	153		291	102								6	OK
36.4%	13.00	1,223	94	940	812	62	625	1,560	450	270	0	0	2,553	6	OK
21.7%	4.77	729	153		484	102								6	OK
14.7%	3.23	493	153		328	102								6	OK

Main - to - Upper															
NORTH	%	Length (ft)	SEISMIC			WIND			GRAVITY LOADING (plf)			Uplift	Comp	ft	
			# in Wall	PLF	Chord F (#)	# in Wall	PLF	Chord F (#)	Wall W (#)	Snow	Dead				Live
50.0%	13.42	5,799			4,803										
40.4%	17.00	2,341	138	1,377	1,539	114	1,141	4,080	495	491	311	0	5,069	3	OK
20.3%	2.73	1,180	432		977	358								3	OK
20.0%	2.69	1,162	432		962	358								3	OK
59.6%	13.00	3,458	266	2,660	2,864	220	2,203	3,120	450	551	449	418	5,701	3	OK
26.9%	3.61	1,562	432		1,294	358								3	OK
32.7%	4.39	1,896	432		1,570	358								3	OK
SOUTH	50.0%	24.48	5,799		4,803										
67.3%	13.25	3,904	295	2,946	3,234	244	2,440	3,180	495	449	243	957	5,593	4	OK
9.8%	2.40	568	237		470	196								4	OK
23.9%	5.85	1,387	237		1,149	196								4	OK
33.6%	8.23	1,950	237	2,369	1,615	196	1,962	1,975	0	0	0	1,938	3,518	6	OK
32.7%	13.00	1,895	146	1,458	1,570	121	1,208	3,120	450	422	243	0	4,346	6	OK
19.5%	4.77	1,130	237		936	196								6	OK
13.2%	3.23	765	237		634	196								6	OK



**Project Information**

<b>Code:</b>	2018 IBC	<b>Date:</b>	
<b>Designer:</b>	JDA		
<b>Client:</b>	CenterLine		
<b>Project:</b>	2956 72nd Ave SE (Mercer Island)		
<b>Wall Line:</b>	East (Upper to Roof)		



**Shear Wall Calculation Variables**

V	3359 lbf	Opening 1	Adj. Factor Method =	2bs/h
L1	8.79 ft	h <sub>a</sub>	Wall Pier Aspect Ratio	Adj. Factor
L2	8.79 ft	h <sub>o</sub>	P1=h <sub>o</sub> /L1=	0.57
h <sub>wall</sub>	9.00 ft	h <sub>b</sub>	P2=h <sub>o</sub> /L2=	0.57
L <sub>wall</sub>	32.00 ft	Lo1		

**1. Hold-down forces:**  $H = Vh_{wall}/L_{wall}$  = 945 lbf

**2. Unit shear above + below opening**  
 First opening:  $va1 = vb1 = H/(h_a+h_b) = 236$  plf

**3. Total boundary force above + below openings**  
 First opening:  $O1 = va1 \times (Lo1) = 3405$  lbf

**4. Corner forces**  
 $F1 = O1(L1)/(L1+L2) = 1703$  lbf  
 $F2 = O1(L2)/(L1+L2) = 1703$  lbf

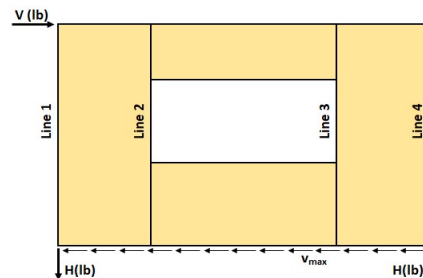
**5. Tributary length of openings**  
 $T1 = (L1 \times Lo1)/(L1+L2) = 7.21$  ft  
 $T2 = (L2 \times Lo1)/(L1+L2) = 7.21$  ft

**6. Unit shear beside opening**  
 $v1 = (V/L)(L1+T1)/L1 = 191$  plf  
 $v2 = (V/L)(T2+L2)/L2 = 191$  plf  
 Check  $v1 \times L1 + v2 \times L2 = V?$  = 3359 lbf **OK**

**7. Resistance to corner forces**  
 $R1 = v1 \times L1 = 1680$  lbf  
 $R2 = v2 \times L2 = 1680$  lbf

**8. Difference corner force + resistance**  
 $R1 - F1 = -23$  lbf  
 $R2 - F2 = -23$  lbf

**9. Unit shear in corner zones**  
 $vc1 = (R1 - F1)/L1 = -3$  plf  
 $vc2 = (R2 - F2)/L2 = -3$  plf



**Check Summary of Shear Values for One Opening**

Line 1: $vc1(h_a+h_b)+v1(h_o)=H?$		-11	955	945 lbf
Line 2: $va1(h_a+h_b)-vc1(h_a+h_b)-v1(h_o)=0?$	945	-11	955	0
Line 3: $va1(h_a+h_b)-vc2(h_a+h_b)-v1(h_o)=0?$	945	-11	955	0
Line 4: $vc2(h_a+h_b)+v2(h_o)=H?$		-11	955	945 lbf

**Design Summary\***

Req. Sheathing Capacity	236 plf	4-Term Deflection	0.357 in.	3-Term Deflection	0.400 in.
Req. Strap Force	1703 lbf	4-Term Story Drift %	0.013 %	3-Term Story Drift %	0.015 %
Req. HD Force (H)	945 lbf				
Req. Shear Wall Anchorage Force (V <sub>max</sub> )	105 plf				

\*The Design Summary assumes that the shear wall is designed as blocked.