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Structural Calculation Report

PROJECT NAME	One-Bedroom ADU - Contemporary Style
CLIENT	Opticos Design, Inc.
PROJECT ADDRESS	Richmond, CA
ESE#	3759

January 30, 2025

Attn: Opticos Design, Inc
2100 Milvia Street, Ste #125
Berkeley, CA 94704

Project: Structural Calculation Report
One-Bedroom ADU - Contemporary Style
Richmond, CA
ESE Project # 3759

Dear Ms./Mr.,

The following structural design calculation has been prepared for the project above. The scope of work is the design of a one-story, one-bedroom Accessory Dwelling Unit (ADU) – Contemporary Style developed for the city of Richmond, California.

By using these standard calculations, the user agrees to release the City of Richmond from any and all claims, liabilities, suits, and demands on account of any injury, damage, or loss to persons or property, including injury or death, or economic losses, arising out of the use of these construction documents. The use of these plans does not eliminate or reduce the user's responsibility to verify any and all information.

These plans are for use only in the City of Richmond, California. It is understood and agreed that this ADU Master Permit Set does not include project observation or review of any contractor's performance or any other construction phaser services, and that such services will be provided for by the person or entity who has received a permit to construct the ADU (Homeowner). Any use of these documents, or modifications thereto, by the Homeowner, contractors, builders, or others (User), is performed at their own risk. The User assumes all responsibility for the use and interpretation of these documents and for construction observation and the User waives, to the fullest extent permitted by law, any claims or causes of action of any nature against the architect, its officers, directors, employees, agents, and subconsultants (collectively, Consultant), which may arise out of or that may be in any way connected thereto. In addition, the User agrees, to the fullest extent permitted by law, to defend, indemnify and hold harmless that Consultant against any and all claims, causes of action, lawsuits, damages, liabilities or costs, including reasonable attorneys' fees and defense costs (Claims), arising out of or in any way connected with the performance of such services by other persons or entities and from any and all Claims arising from use, modifications, clarifications, interpretations, adjustments, or changes made to these documents to reflect changed field or other conditions.

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Oakland, CA 94607

The plan set does not include a foundation system. Site specific foundation details are required for ADUs in the city of Richmond. The applicant must hire a general contractor or structural engineer to prepare site specific foundation details and include foundation details with the application for approval by the city of Richmond. Note this includes details and design for the hold down anchorage and bearing posts noted on the S2.1 plan.

Design criteria:

Building Code: CBC 2022

Please contact us if you have any questions concerning our structural design report.

Best Regards,

Anisa Awad, P.Eng.
Project Engineer

Digitally signed by Thuy Fontelera
Date: 2025.06.04 14:45:29-07'00'

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BASIS OF DESIGN (BOD)

Project Name: One-Bedroom ADU - Contemporary Style Date: Jan. 30, 2025

Project No.: 3759

Project Address: Richmond, California

The following structural design criteria has been prepared for the project above. The scope of work is the design of the one-story, one-bedroom accessory dwelling unit (ADU) – Contemporary Style for the city of Richmond, California.

Architect/Prime: Opticos Design Inc

Owner: City of Richmond, California

Design Criteria:

Building Code: 2022 California Building Code (CBC) with local amendments.

Construction Type: Type V-B [per Arch and CBC Ch. 6]

Occupancy Type: R-2 [per Arch and CBC Ch. 3]

Risk Category: II [CBC Table 1604.5]

Gravity System:

Roof Framing: Pitched roof: 2x8 rafters at 24” o.c. with 15/32” plywood unblocked

Wall Framing: 2x6 D.F. No 2. studs at 16" o.c. typical.

Lateral System:

The lateral system will consist of plywood wood shear wall with a hold down at each end of the wall.

Analysis Method:

Lateral Analysis: Equivalent Force Procedure or Spectral Response is used for seismic force.

Diaphragm is designed as flexible.

Seismic Design Criteria [from USGS Hazard Maps, ASCE 7-16]

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This project provides a calculation package and plans for any home owner in the city of Richmond, California to build this particular accessory dwelling unit on their land. To allow for versatility in building locations within the city, the seismic parameters of 6 locations were investigated and the highest values were used for this project design.

Mapped MCE_R Spectral Response (short period), S_S: 2.272 g
Mapped MCE_R Spectral Response (one second), S_1: 0.877 g
Design Spectral Response (short period), S_{DS}: 1.818 g
Design Spectral Response (one second), S_{D1}: 0.994 g
Seismic Design Category: E
Seismic Importance Factor, I_e: 1 [ASCE 7-16 Table 1.5-2]

Wind Design Criteria:
Basic Wind Speed: 95 MPH
Exposure Category: C

Other Design Criteria:
Rain Intensity: 1.13 in/hr

Live Loads:
Roof: 20 PSF

Special Conditions:
Solar panel weight is accounted in the total loads design.

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Wood:

All wood shall conform to the following:

Wood	
Joists and rafters	NO.1
Posts, beams and headers	NO.1
Studs, blockings, light framing and misc.	NO.2
Wall plates	NO.2
Wood sill (P.T.)	NO.2
Pressure treated (P.T.) Joist, beams and posts	NO.2

Engineered Wood (WEYERHAEUSER)	
LVL MICRO-LAMS	2.2E
LSL TIMBER STRAND	1.55E
PSL PARALLEL STRAND LUMBER (BEAMS)	2.2E
PSL PARALLEL STRAND LUMBER (POSTS)	1.8E
I JOIST PER PLAN	U.O.N.

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JOB NAME:	One-Bedroom ADU - Contemporary Style	JOB NUMBER:	3759
DESCRIPTION:	DESIGN OF ADU	DATE:	2025-01-30
	VERTICAL LOAD TABLE	BY:	AA

ROOF PITCH		5:12 slope
ROOF LEVEL		SOLAR
COMPOSITE SHINGLE		2.5
SOLAR PANELS		5.0
15/32" PLYWOOD (OSB)		1.8
INSULATION		1.0
RAFTERS 2 x 8 @ 24" O.C.		1.3
2X8 @ 16" O.C. CEILING JOISTS		1.9
5/8" GYPBOARD		2.8
MISCELLANEOUS		1.2
TOTAL	DL (psf)	17.5
ADJUSTED TOTAL	DL (psf)	**19.0**
TOTAL	RLL (psf)	**20**

WALLS		EXTERIOR	INTERIOR
STUCCO		10.0	-
PLASTER		-	2.0
15/32" PLYWOOD (OSB)		1.8	-
STUDS 2X6 @ 16" O.C.		1.4	1.4
INSULATION		1.0	1.0
5/8" GYPBOARD		2.8	5.6
MISCELLANEOUS		1.0	1.0
TOTAL	DL (psf)	**18.0**	**11.0**

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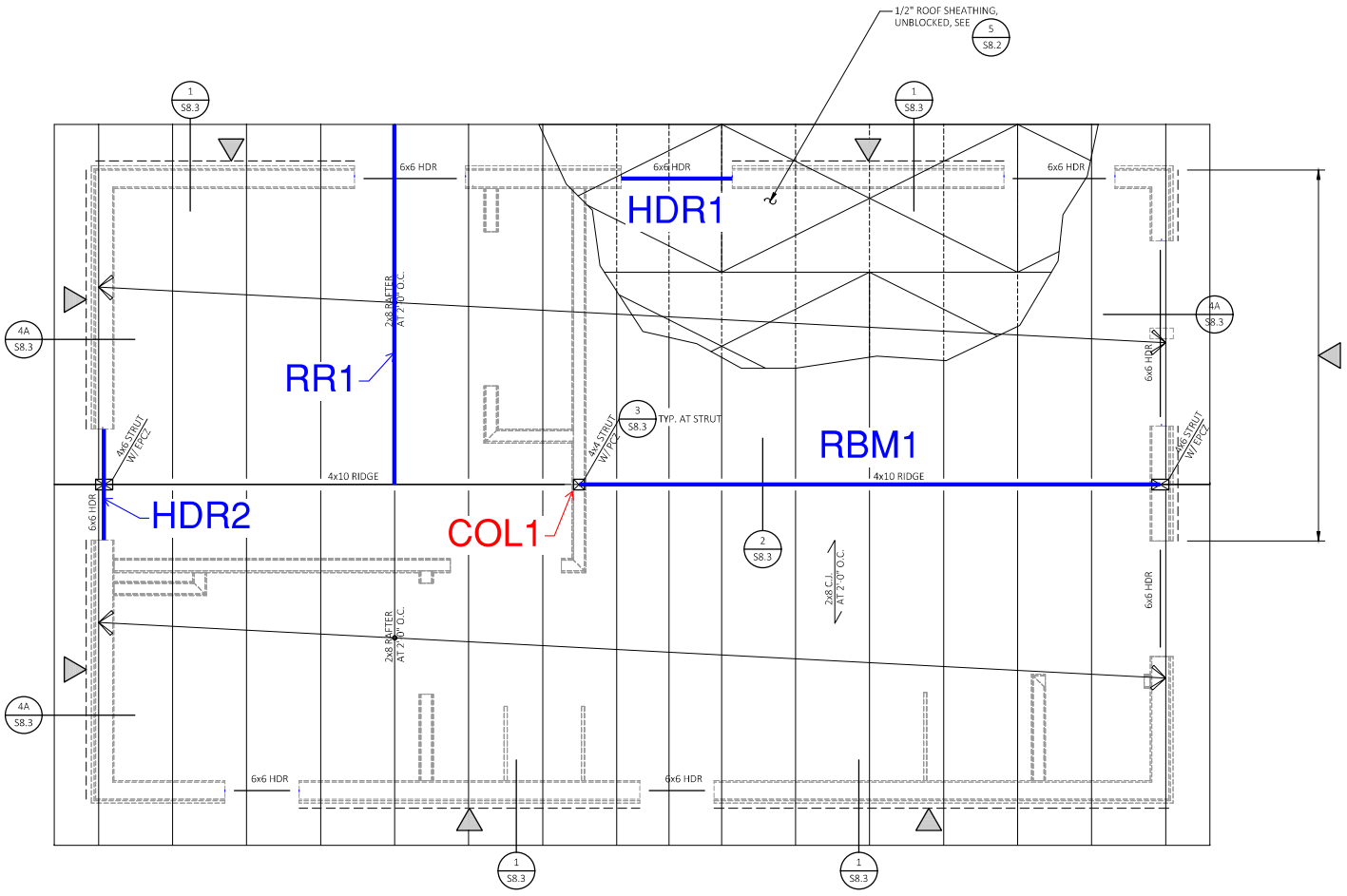
3759 - One-Bedroom ADU - Contemporary Style
DATE: 2025-01-30
BY: AA



ROOF FRAMING KEY PLAN

Note: Key plan is not representative of structural framing and is only to indicate design beam locations

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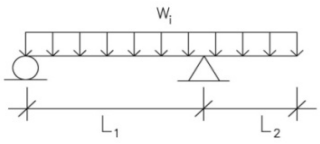
JOB NAME:	One-Bedroom ADU - Contemporary Style	JOB NUM.:	3759
DESCRIPTION:	Beam Diagrams	DATE:	2025-01-30
	VERTICAL CALCULATIONS	BY:	AA

BEAM DIAGRAMS

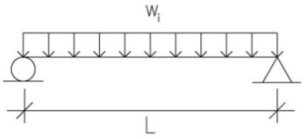
ROOF LEVEL

RR1



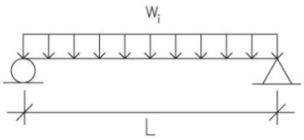
W_{DL} = 19.0 psf x 2.00 ft = 0.038 klf Roof
W_{RLL} = 20.0 psf x 2.00 ft = 0.040 klf Roof
L_1 = 8.25 ft L_2 = 1.50 ft

RBM1



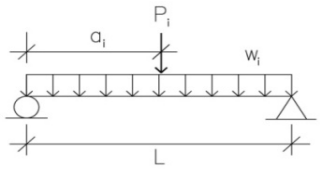
W_{DL} = 19.0 psf x 8.25 ft = 0.157 klf Roof
W_{RLL} = 20.0 psf x 8.25 ft = 0.165 klf Roof
L = 15.75 ft

HDR1



W_{DL} = 19.0 psf x 5.63 ft = 0.107 klf Roof
W_{RLL} = 20.0 psf x 5.63 ft = 0.113 klf Roof
L = 3.00 ft

HDR2



W_{1DL} = 19.0 psf x 3.00 ft = 0.057 klf Roof
W_{RLL} = 20.0 psf x 3.00 ft = 0.060 klf Roof

P_{1DL} = 1.340 kip a_1 = 1.50 ft RBM1 SIM.
P_{1RLL} = 1.300 kip a_1 = 1.50 ft RBM1 SIM.

L = 3.00 ft

Multiple Simple Beam

Project File: 3759F_Framing Design.ec6

Description :

Wood Beam Design : RR1-No. 1

Calculations per NDS 2018, IBC 2021

BEAM Size : **2x8, 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	1000 psi	Fc - Prll	1500 psi	Fv	180 psi	Ebend- xx	1700 ksi	Density	31.21 pcf
Fb - Compr	1000 psi	Fc - Perp	625 psi	Ft	675 psi	Eminbend - xx	620 ksi		

Applied Loads

Beam self weight calculated and added to loads
Unif Load: D = 0.0190, Lr = 0.020 k/ft, Trib= 2.0 ft

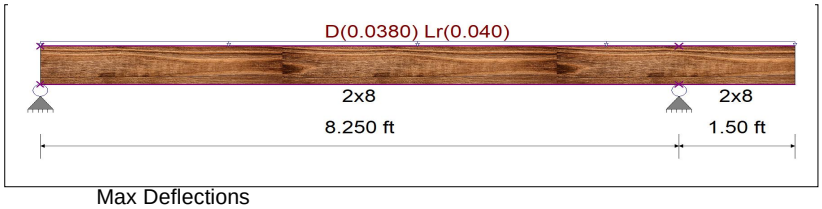
Design Summary

Max fb/Fb Ratio = **0.389** : 1
fb : Actual : 583.72 psi at 4.001 ft in Span # 1
Fb : Allowable : 1,500.00 psi
Load Comb : +D+Lr+H

Max fv/FvRatio = **0.181** : 1
fv : Actual : 40.83 psi at 7.673 ft in Span # 1
Fv : Allowable : 225.00 psi
Load Comb : +D+Lr+H

Max Reactions (k)

	D	Lr	L	S	W	E	H
Left Support	0.16	0.16					
Right Support	0.23	0.23					



Max Deflections

Transient Downward	0.048 in	Total Downward	0.096 in
Ratio	2071	Ratio	1031
	LC: Lr Only		LC: +D+Lr+H
Transient Upward	-0.025 in	Total Upward	-0.051 in
Ratio	1414	Ratio	702
	LC: Lr Only		LC: +D+Lr+H

Wood Beam Design : RBM1

Calculations per NDS 2018, IBC 2021

BEAM Size : **6x12, 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	1,000.0 psi	Fc - Prll	1,500.0 psi	Fv	180.0 psi	Ebend- xx	1,700.0 ksi	Density	31.210 pcf
Fb - Compr	1,000.0 psi	Fc - Perp	625.0 psi	Ft	675.0 psi	Eminbend - xx	620.0 ksi		

Applied Loads

Beam self weight calculated and added to loads
Unif Load: D = 0.0190, Lr = 0.020 k/ft, Trib= 8.250 ft

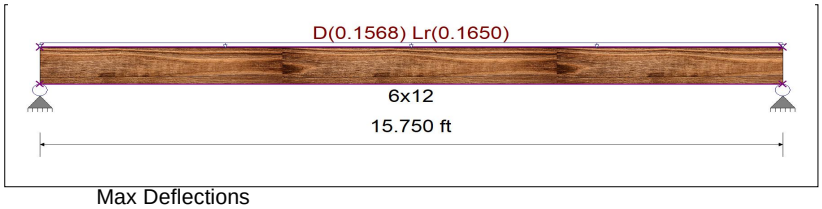
Design Summary

Max fb/Fb Ratio = **0.824** : 1
fb : Actual : 1,029.64 psi at 7.875 ft in Span # 1
Fb : Allowable : 1,250.00 psi
Load Comb : +D+Lr+H

Max fv/FvRatio = **0.245** : 1
fv : Actual : 55.13 psi at 0.000 ft in Span # 1
Fv : Allowable : 225.00 psi
Load Comb : +D+Lr+H

Max Reactions (k)

	D	Lr	L	S	W	E	H
Left Support	1.34	1.30					
Right Support	1.34	1.30					



Max Deflections

Transient Downward	0.194 in	Total Downward	0.394 in
Ratio	975	Ratio	479
	LC: Lr Only		LC: +D+Lr+H
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

Multiple Simple Beam

Wood Beam Design : HDR1

Calculations per NDS 2018, IBC 2021

BEAM Size : **6x6, Sawn, Fully Unbraced**
Using Allowable Stress Design with IBC 2021 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir-Larch				Wood Grade : No.1				
Fb - Tension	1,000.0 psi	Fc - Prll	1,500.0 psi	Fv	180.0 psi	Ebend- xx	1,700.0 ksi	Density	31.210 pcf
Fb - Compr	1,000.0 psi	Fc - Perp	625.0 psi	Ft	675.0 psi	Eminbend - xx	620.0 ksi		

Applied Loads

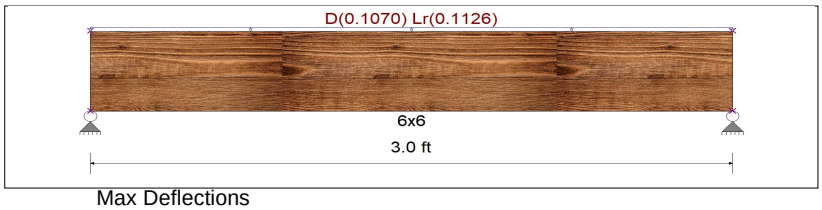
Beam self weight calculated and added to loads
Unif Load: D = 0.0190, Lr = 0.020 k/ft, Trib= 5.630 ft

Design Summary

Max fb/Fb Ratio = **0.088** : 1
fb : Actual : 110.09 psi at 1.500 ft in Span # 1
Fb : Allowable : 1,250.00 psi
Load Comb : +D+Lr+H

Max fv/FvRatio = **0.052** : 1
fv : Actual : 11.77 psi at 2.550 ft in Span # 1
Fv : Allowable : 225.00 psi
Load Comb : +D+Lr+H

Max Reactions (k)	D	Lr	L	S	W	E	H
Left Support	0.17	0.17					
Right Support	0.17	0.17					



Max Deflections

Transient Downward	0.002 in	Total Downward	0.003 in
Ratio	9999	Ratio	9999
	LC: Lr Only		LC: +D+Lr+H
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

Wood Beam Design : HDR2

Calculations per NDS 2018, IBC 2021

BEAM Size : **6x6, Sawn, Fully Unbraced**
Using Allowable Stress Design with IBC 2021 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir-Larch				Wood Grade : No.1				
Fb - Tension	1,000.0 psi	Fc - Prll	1,500.0 psi	Fv	180.0 psi	Ebend- xx	1,700.0 ksi	Density	31.210 pcf
Fb - Compr	1,000.0 psi	Fc - Perp	625.0 psi	Ft	675.0 psi	Eminbend - xx	620.0 ksi		

Applied Loads

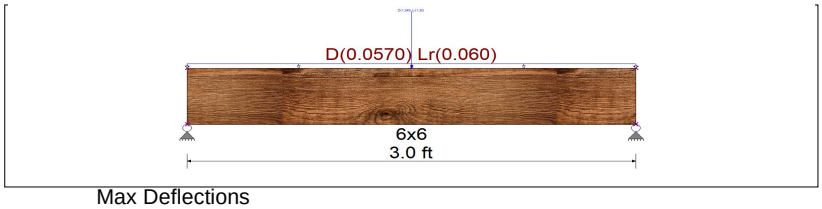
Beam self weight calculated and added to loads
Unif Load: D = 0.0190, Lr = 0.020 k/ft, Trib= 3.0 ft
1Point: D = 1.340, Lr = 1.30 k @ 1.50 ft

Design Summary

Max fb/Fb Ratio = **0.734** : 1
fb : Actual : 917.01 psi at 1.500 ft in Span # 1
Fb : Allowable : 1,250.00 psi
Load Comb : +D+Lr+H

Max fv/FvRatio = **0.320** : 1
fv : Actual : 71.89 psi at 2.550 ft in Span # 1
Fv : Allowable : 225.00 psi
Load Comb : +D+Lr+H

Max Reactions (k)	D	Lr	L	S	W	E	H
Left Support	0.77	0.74					
Right Support	0.77	0.74					



Max Deflections

Transient Downward	0.011 in	Total Downward	0.022 in
Ratio	3382	Ratio	1663
	LC: Lr Only		LC: +D+Lr+H
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

Multiple Simple Beam

Project File: 3759F_Framing Design.ec6

Wood Beam Design : RR1-No. 2

Calculations per NDS 2018, IBC 2021

BEAM Size : **2x8, Sawn, Fully Braced**
Using Allowable Stress Design with IBC 2021 Load Combinations, Major Axis Bending

Wood Species : Douglas Fir-Larch Wood Grade : No.2

Fb - Tension	900 psi	Fc - Prll	1350 psi	Fv	180 psi	Ebend- xx	1600 ksi	Density	31.21 pcf
Fb - Compr	900 psi	Fc - Perp	625 psi	Ft	575 psi	Eminbend - xx	580 ksi		

Applied Loads

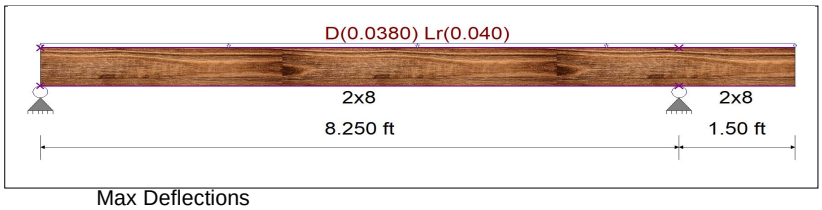
Beam self weight calculated and added to loads
Unif Load: D = 0.0190, Lr = 0.020 k/ft, Trib= 2.0 ft

Design Summary

Max fb/Fb Ratio = **0.432** : 1
fb : Actual : 583.72 psi at 4.001 ft in Span # 1
Fb : Allowable : 1,350.00 psi
Load Comb : +D+Lr+H

Max fv/FvRatio = **0.181** : 1
fv : Actual : 40.83 psi at 7.673 ft in Span # 1
Fv : Allowable : 225.00 psi
Load Comb : +D+Lr+H

Max Reactions (k)	D	Lr	L	S	W	E	H
Left Support	0.16	0.16					
Right Support	0.23	0.23					



Max Deflections

Transient Downward	0.051 in	Total Downward	0.102 in
Ratio	1949	Ratio	970
	LC: Lr Only		LC: +D+Lr+H
Transient Upward	-0.027 in	Total Upward	-0.054 in
Ratio	1330	Ratio	662
	LC: Lr Only		LC: +D+Lr+H

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JOB NAME:	One-Bedroom ADU - Contemporary Style	JOB NUMBER:	3759
DESCRIPTION:	Column Design and Capacity	DATE:	2025-01-30
	VERTICAL CALCULATIONS	BY:	AA

POST DESIGN

ASD LOAD COMBINATIONS					S_{DS}	1.818 g		Ω	2.5
1)	1.000	D +	1.000	Lr +	0.000	L +	0.000	E	
2)	1.000	D +	0.000	Lr +	1.000	L +	0.000	E	
3)	1.000	D +	0.750	Lr +	0.750	L +	0.000	E	
4)	1.255	D +	0.000	Lr +	0.000	L +	1.750	E	
5)	1.191	D +	0.000	Lr +	0.750	L +	1.313	E	
6)	0.345	D +	0.000	Lr +	0.000	L +	1.750	E	

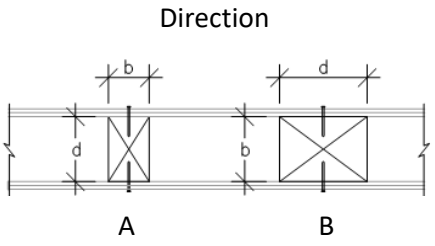
Wall Height = 9.0 ft

1ST FLOOR LEVEL

						MAX LC TOTAL (K)		Post Size (Min)				
ID	BEARING MEMBERS	D (k)	Lr (k)	L (k)	E (k)	D,L,Lr	D, L,Lr,E	D,L,Lr	D, L,Lr,E	Hardware	D/C	wall size
COL 1	(2) - RBM1	2.680	2.600	0.000	0.000	5.280		4x4		Y	**0.82**	2x4

Column Capacity

Axial	Direction	100%	Seismic	Post Base
4x4	B	6.44 K	6.74 K	7.66 K
4x6 B	B	10.13 K	10.59 K	12.03 K
4x8	B	13.35 K	13.96 K	15.86 K
4x10	B	17.03 K	17.81 K	20.23 K
4x12	B	20.71 K	21.66 K	24.61 K
4x6 A	A	19.53 K	23.09 K	12.03 K
6x6	B	23.68 K	30.43 K	18.91 K
6x8	B	32.28 K	41.49 K	25.78 K
6x10	B	40.89 K	52.55 K	32.66 K



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JOB NAME:	One-Bedroom ADU - Contemporary Style	JOB NUMBER:	3759
DESCRIPTION:	Stud Wall Calculation	DATE:	2025-01-30
	VERTICAL CALCULATIONS	BY:	AA

STUD CALCULATION: LINE A (SEE SEISMIC KP)
1st STORY LEVEL
9 FT STUDS

DATA

Member:	
Size	2x6
Stud Spacing	16 in
L_e (ft)	9.00
L_u (ft)	9.00
b (in)	1.50
d (in)	5.50
A (in^2)	8.25
S_{xx} ($in.^3$)	7.56

Wood Type:

Species	Douglas Fir-Larch
Class	2in-4in thick
Grade	No. 2
F_b (psi)	900
F_c (psi)	1350
$F_{c\perp}$ (psi)	625
E_{min} (psi)	580000
c	0.80
K_{cE}	0.30

Adjustment Factors:

C_M	1.00
C_t	1.00
C_L	1.00
C_{D1}	1.25
C_{D2}	1.60
C_{D3}	1.00
C_i	1.00
C_F	1.00
C_b	1.00
C_T	1.00
C_r	1.00

LOADING

Description	DL (psf)	LR (psf)	LL (psf)	H/TW (ft)	w_{DL} (plf)	w_{LR} (plf)	w_{LL} (plf)
Roof	19	20	0	6	107	113	0
Wall Level 1	18	0	0	9	162	0	0
-	0	0	0	0	0	0	0
-	0	0	0	0	0	0	0
-	0	0	0	0	0	0	0
-	0	0	0	0	0	0	0
-	0	0	0	0	0	0	0
-	0	0	0	0	0	0	0
				Total	269	113	0

Lateral Load:

WIND	30 psf	w_{WIND}	40 plf
LL	0 psf	w_{LL}	0.0 plf

GRAVITY + LATERAL

ASD Load Combination:	Gravity (plf)	Lat. (plf)
LC2. $w_{DL} + w_{LL}$ =	268.9	0.0
LC3. $w_{DL} + w_{Lr}$ =	381.4	0.0
LC4. $w_{DL} + 0.75*w_{LL} + 0.75*w_{Lr}$ =	353.3	0.0
LC5: $w_{DL}+0.6*w_{WIND}$ =	268.9	24.0
LC6a. $w_{DL} + 0.75*w_{LL} + 0.75*w_{Lr} + 0.75(0.6*w_{WIND})$ =	353.3	18.0

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JOB NAME:	One-Bedroom ADU - Contemporary Style	JOB NUMBER:	3759
DESCRIPTION:	Stud Wall Calculation	DATE:	2025-01-30
	VERTICAL CALCULATIONS	BY:	AA

Load combination 2

LC2. $w_{DL} + w_{LL}$

p =		358.5 lb
$f_c = p / A$		43.5 psi
Column Capacity of Stud:		
$(L_e/d)_x^2$ =		354.12
$E'_{min} = E_{min} C_M C_t C_T C_i$		580000 psi
$F_{cE} = 0.822 E'_{min} / (L_e/d)_x^2$		1346 psi
$F^*_c = F_c C_{D3} C_M C_t C_F C_i$		1350 psi
$X = [1 + F_{cE} / F^*_c] / 2c$		1.25
$C_P = X - [X^2-((F_{cE}/F^*_c) / c)]^{1/2}$		0.69
$F'_c = F_c C_{D3} C_M C_t C_F C_i C_P$		931.5 psi
Check if $F'_c > f_c$	D/C =	0.05
Bearing Check:		
$F'_{c\perp} = F_{c\perp} C_M C_T C_b$		625 psi
$f'_{c\perp} = p/A$		43.45 psi
Check if $F'_{c\perp} > f'_{c\perp}$	D/C =	0.07
Bending:		
w_{LAT} =		0.00 plf
$M = (w x L_u^2) / 8$		0.0 in-lb
$f_b = M / S_{xx}$		0 psi
$F'_b = F_b C_{D3} C_M C_t C_L C_F C_r C_i$		900 psi
Check if $F'_b > f_b$	D/C =	0.00
Combined Stresses:		
$(f_c/F'_c)^2 + (f_{bx} /F'_{bx})*(1/(1-f_c/F_{cEx}))$ =		2.18E-03
Check if ≤ 1.0	D/C =	0.00

Use 2x6 Douglas Fir-Larch No. 2 Studs at 16 o.c. at the 1st STORY LEVEL

Load combination 3

LC3. $w_{DL} + w_{Lr}$

p =		508.50 lb
$f_c = p / A$		61.64 psi
Column Capacity of Stud:		
$(L_e/d)_x^2$ =		354.12
$E'_{min} = E_{min} C_M C_t C_T C_i$		580000 psi
$F_{cE} = 0.822 E'_{min} / (L_e/d)_x^2$		1346 psi
$F^*_c = F_c C_{D1} C_M C_t C_F C_i$		1688 psi
$X = [1 + F_{cE} / F^*_c] / 2c$		1.12
$C_P = X - [X^2-((F_{cE}/F^*_c) / c)]^{1/2}$		0.61
$F'_c = F_c C_{D1} C_M C_t C_F C_i C_P$		1027.0 psi
Check if $F'_c > f_c$	D/C =	0.06
Bearing Check:		
$F'_{c\perp} = F_{c\perp} C_M C_T C_b$		625 psi
$f'_{c\perp} = p/A$		61.64 psi
Check if $F'_{c\perp} > f'_{c\perp}$	D/C =	0.10
Bending:		
w_{LAT} =		0.00 plf
$M = (w x L_u^2) / 8$		0.0 in-lb
$f_b = M / S_{xx}$		0 psi
$F'_b = F_b C_{D1} C_M C_t C_L C_F C_r C_i$		1125 psi
Check if $F'_b > f_b$	D/C =	0.00
Combined Stresses:		
$(f_c/F'_c)^2 + (f_{bx} /F'_{bx})*(1/(1-f_c/F_{cEx}))$ =		3.60E-03
Check if ≤ 1.0	D/C =	0.00

Use 2x6 Douglas Fir-Larch No. 2 Studs at 16 o.c. at the 1st STORY LEVEL

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JOB NAME:	One-Bedroom ADU - Contemporary Style	JOB NUMBER:	3759
DESCRIPTION:	Stud Wall Calculation	DATE:	2025-01-30
	VERTICAL CALCULATIONS	BY:	AA

Load combination 4

LC4. $w_{DL} + 0.75*w_{LL} + 0.75*w_{Lr}$

p =		471.00 lb
$f_c = p / A$		57.09 psi
Column Capacity of Stud:		
$(L_e/d)_x^2$ =		354.12
$E'_{min} = E_{min}\ C_M\ C_t\ C_T\ C_i$		580000 psi
$F_{cE} = 0.822\ E'_{min} / (\ L_e/d\ )_x^2$		1346 psi
$F^*_c = F_c\ C_{D1}\ C_M\ C_t\ C_F\ C_i$		1688 psi
$X = [\ 1 + F_{cE} / F^*_c\ ] / 2c$		1.12
$C_P = X - [X^2-((\ F_{cE}/F^*_c) / c)\ ]^{1/2}$		0.61
$F'_c = F_c\ C_{D1}\ C_M\ C_t\ C_F\ C_i\ C_P$		1027.0 psi
Check if $F'_c > f_c$	D/C =	0.06
Bearing Check:		
$F'_{c\perp} = F_{c\perp}\ C_M\ C_T\ C_b$		625 psi
$f'_{c\perp} = p/A$		57.09 psi
Check if $F'_{c\perp} > f'_{c\perp}$	D/C =	0.09
Bending:		
w_{LAT} =		0.00 plf
$M = (\ w\ x\ L_u^2\ ) / 8$		0.0 in-lb
$f_b = M / S_{xx}$		0 psi
$F'_b = F_b\ C_{D2}\ C_M\ C_t\ C_L\ C_F\ C_r\ C_i$		1125 psi
Check if $F'_b > f_b$	D/C =	0.00
Combined Stresses:		
$(f_c/F'_c)^2 + (f_{bx}/F'_{bx})*(1/(1-f_c/F_{cEx}))$ =		3.09E-03
Check if ≤ 1.0	D/C =	0.00

Use 2x6 Douglas Fir-Larch No. 2 Studs at 16 o.c. at the 1st STORY LEVEL

Load combination 5

LC5: $w_{DL}+0.6*w_{WIND}$

p =		358.50 lb
$f_c = p / A$		43.45 psi
Column Capacity of Stud:		
$(L_e/d)_x^2$ =		354.12
$E'_{min} = E_{min}\ C_M\ C_t\ C_T\ C_i$		580000 psi
$F_{cE} = 0.822\ E'_{min} / (\ L_e/d\ )_x^2$		1346 psi
$F^*_c = F_c\ C_{D2}\ C_M\ C_t\ C_F\ C_i$		2160 psi
$X = [\ 1 + F_{cE} / F^*_c\ ] / 2c$		1.01
$C_P = X - [X^2-((\ F_{cE}/F^*_c) / c)\ ]^{1/2}$		0.51
$F'_c = F_c\ C_{D2}\ C_M\ C_t\ C_F\ C_i\ C_P$		1111.0 psi
Check if $F'_c > f_c$	D/C =	0.04
Bearing Check:		
$F'_{c\perp} = F_{c\perp}\ C_M\ C_T\ C_b$		625 psi
$f'_{c\perp} = p/A$		43.45 psi
Check if $F'_{c\perp} > f'_{c\perp}$	D/C =	0.07
Bending:		
w_{LAT} =		24.00 plf
$M = (\ w\ x\ L_u^2\ ) / 8$		2678.1 in-lb
$f_b = M / S_{xx}$		354 psi
$F'_b = F_b\ C_{D2}\ C_M\ C_t\ C_L\ C_F\ C_r\ C_i$		1440 psi
Check if $F'_b > f_b$	D/C =	0.25
Combined Stresses:		
$(f_c/F'_c)^2 + (f_{bx}/F'_{bx})*(1/(1-f_c/F_{cEx}))$ =		0.26
Check if ≤ 1.0	D/C =	0.26

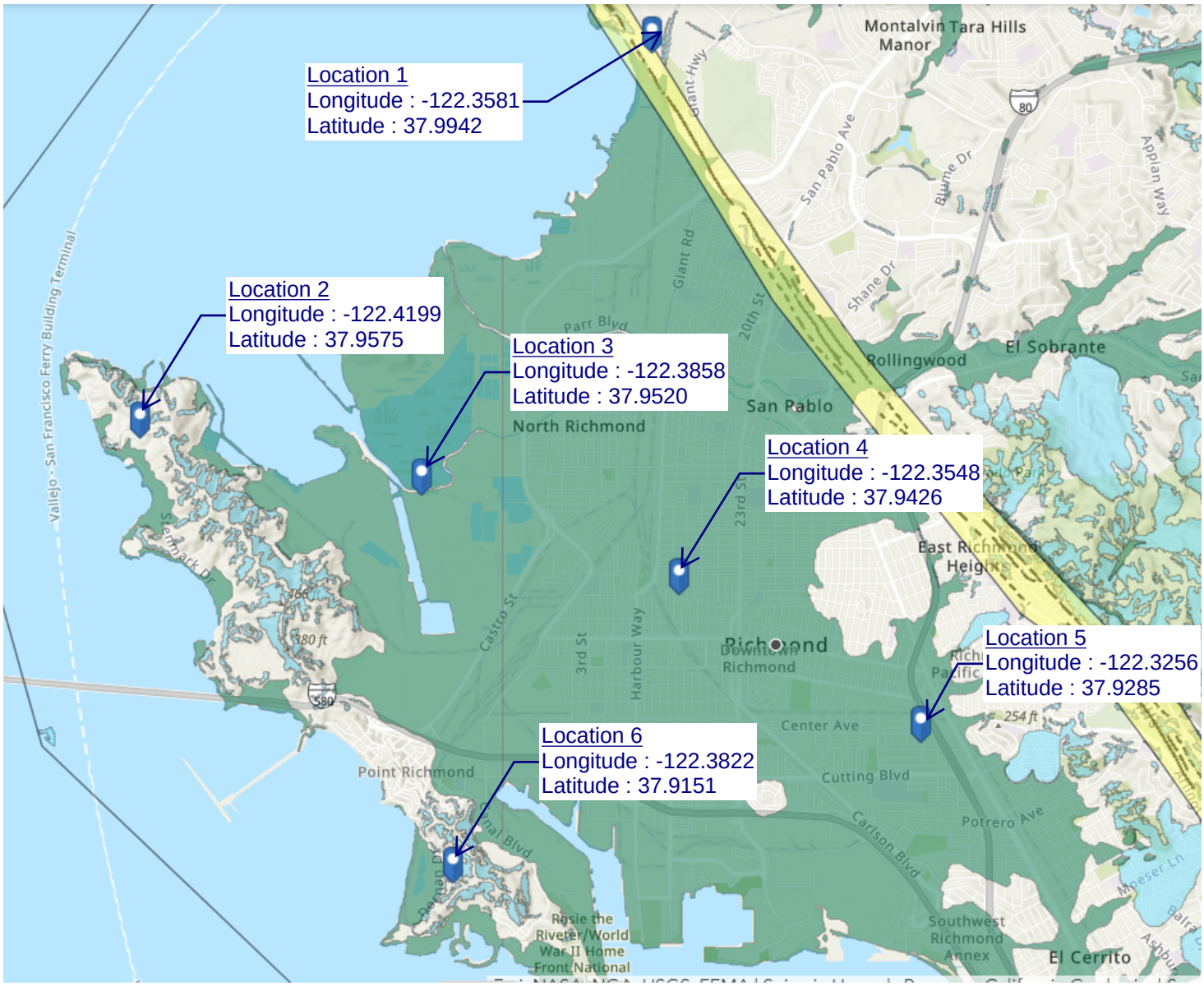
Use 2x6 Douglas Fir-Larch No. 2 Studs at 16 o.c. at the 1st STORY LEVEL

Load combination 6

LC6a. $w_{DL} + 0.75*w_{LL} + 0.75*w_{Lr} + 0.75(0.6*w_{WIND})$

p =		471.00 lb
$f_c = p / A$		57.09 psi
Column Capacity of Stud:		
$(L_e/d)_x^2$ =		354.12
$E'_{min} = E_{min}\ C_M\ C_t\ C_T\ C_i$		580000 psi
$F_{cE} = 0.822\ E'_{min} / (\ L_e/d\ )_x^2$		1346 psi
$F^*_c = F_c\ C_{D2}\ C_M\ C_t\ C_F\ C_i$		2160 psi
$X = [\ 1 + F_{cE} / F^*_c\ ] / 2c$		1.01
$C_P = X - [X^2-((\ F_{cE}/F^*_c) / c)\ ]^{1/2}$		0.51
$F'_c = F_c\ C_{D2}\ C_M\ C_t\ C_F\ C_i\ C_P$		1111.0 psi
Check if $F'_c > f_c$	D/C =	0.05
Bearing Check:		
$F'_{c\perp} = F_{c\perp}\ C_M\ C_T\ C_b$		625 psi
$f'_{c\perp} = p/A$		57.09 psi
Check if $F'_{c\perp} > f'_{c\perp}$	D/C =	0.09
Bending:		
w_{LAT} =		18.00 plf
$M = (\ w\ x\ L_u^2\ ) / 8$		2008.5 in-lb
$f_b = M / S_{xx}$		266 psi
$F'_b = F_b\ C_{D2}\ C_M\ C_t\ C_L\ C_F\ C_r\ C_i$		1440 psi
Check if $F'_b > f_b$	D/C =	0.18
Combined Stresses:		
$(f_c/F'_c)^2 + (f_{bx}/F'_{bx})*(1/(1-f_c/F_{cEx}))$ =		0.20
Check if ≤ 1.0	D/C =	0.20

Use 2x6 Douglas Fir-Larch No. 2 Studs at 16 o.c. at the 1st STORY LEVEL



City of Richmond Seismic Map Points

This project provides a calculation package and plans for any home owner in the city of Richmond, CA to build this particular accessory dwelling unit on their land. To allow for versatility in building locations within the city, the seismic parameters of 6 locations were investigated.

Location 1 had the highest seismic design parameters and was used for this project design. See Appendix A for the detailed seismic parameters of all 6 locations.

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.
USGS web services are now operational so this tool should work as expected.

Richmond , CA - Location 1

Latitude, Longitude: 37.9942, -122.3581

Date	7/17/2024, 9:17:10 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Default (See Section 11.4.3)

Location 1 has the highest seismic design parameters and was used for the lateral design.

Type	Value	Description
S_S	2.272	MCE_R ground motion. (for 0.2 second period)
S_1	0.877	MCE_R ground motion. (for 1.0s period)
S_{MS}	2.726	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.817	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.954	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	1.145	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	2.574	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	2.882	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	2.272	Factored deterministic acceleration value. (0.2 second)
S1RT	0.984	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	1.109	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.877	Factored deterministic acceleration value. (1.0 second)
PGAd	0.954	Factored deterministic acceleration value. (Peak Ground Acceleration)

Type	Value	Description
PGA_{UH}	1.123	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.893	Mapped value of the risk coefficient at short periods
C_{R1}	0.887	Mapped value of the risk coefficient at a period of 1 s
C_V	1.5	Vertical coefficient

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JOB NAME:	One-Bedroom ADU - Contemporary Style	JOB NUM.:	3759
DESCRIPTION:	Seismic Weight	DATE:	2025-01-30
	LATERAL CALCULATIONS	BY:	AA

SEISMIC WEIGHT

ROOF LEVEL	WEIGHT (psf)	AREA (ft^2)	TOTAL WT (kip)	
ROOF	19	610	12	
EXTERIOR WALL	18	419	8	
INTERIOR WALL	11	203	2	
-	0	0	0	
-	0	0	0	
-	0	0	0	
-	0	0	0	Net Seismic wt
TOTAL WEIGHT			**21.4**	35 psf

JOB NAME:	One-Bedroom ADU - Contemporary Style	JOB NUM.:	3759
DESCRIPTION:	Seismic Base Shear	DATE:	2025-01-30
	LATERAL CALCULATIONS	BY:	AA

BUILDING INFORMATION

Number of stories:	1
Building height for lateral calculations:	13.71 ft

SEISMIC DESIGN CRITERIA & RESISTANCE SYSTEM COEFFICIENTS

Design Code:	2021 IBC (ASCE 7-16 Supplement 1, 2 and 3); CBC 2022
Calculation Method:	Equivalent Lateral Force Procedure

Risk Factor

All buildings and other structures except those listed in Risk Categories I, III, IV

Risk Category :	II	Table 1.5-1
Importance Factor, I_e :	1.00	Table 1.5-2

Spectral Acceleration Parameters

Site Class=	D	Default D	
Spectral Response Acceleration, S_s =	2.272 g	Mapped Spectral Acc.	
Spectral Response Acceleration, S_1 =	0.877 g	Mapped Spectral Acc.	
Site Coefficient (0.2 Sec Period), F_a =	1.2	Table 11.4-1	
Site Coefficient (1.0 Sec Period), F_v =	1.7	Table 11.4-2	
Max Considered EQ Acc., $S_{MS} = F_a S_S$ =	2.726 g	11.4-1	
Max Considered EQ Acc., $S_{M1} = F_v S_1$ =	1.491 g	11.4-2	
Design Spectral Acc., $S_{DS} = 2/3 S_{MS}$ =	1.818 g	short period	11.4-3
Design Spectral Acc., $S_{D1} = 2/3 S_{M1}$ =	0.994 g	1 sec period	11.4-4
Seismic Design Category based on S_1 :	E	Section 11.6	
Seismic Design Category based on short per.:	D	Table 11.6-1	
Seismic Design Category based on 1sec per.:	D	Table 11.6-2	
Design Seismic Design Category :	E	Per above or Geotech	

JOB NAME:	One-Bedroom ADU - Contemporary Style	JOB NUM.:	3759
DESCRIPTION:	Seismic Base Shear	DATE:	2025-01-30
	LATERAL CALCULATIONS	BY:	AA

SEISMIC DESIGN CRITERIA & RESISTANCE SYSTEM COEFFICIENTS CONTINUED

Seismic Resistance System Coefficients and Factors

System Type: Bearing wall systems

System Details: Light-frame (wood) walls sheathed with wood structural panels rated for shear resistance

Response Modification Coefficient, R =	6.5	Table 12.2-1
Overstrength Coefficient, W_0 =	2.5	Table 12.2-1
Deflection Amplification Factor, C_d =	4	Table 12.2-1
Height Limitations =	65	Table 12.2-1

Building Period

Structure Type : All other structural systems		Table 12.8-2
Approximate fundamental period, C_t =	0.02	Table 12.8-2
Approximate fundamental per. parameter, x =	0.75	Table 12.8-2
Building Height from base to highest level, h_n =	13.71 ft	
Building Period, $T = T_a = C_t h_n^x$ =	0.142 s	12.8-7
Long Period Transition, T_L =	12 s	Figure 22-14, p.225
$T_S = S_{D1} / S_{DS}$ =	0.546838 s	

Seismic Response Coefficient

$T<=1.5T_S$, $C_s = S_{DS} / (R / I_e)$ =	0.280 W	12.8-2
For $1.5T_S<T<=T_L$, $C_s = 1.5*S_{D1} / (T R / I_e)$ =	N/A	12.8-3 w/ 11.4.8 Exception
For $T>T_L$, $C_s = 1.5* S_{D1} T_L / (T^2 R / I_e)$ =	N/A	12.8-4 w/ 11.4.8 Exception
Minimum, $C_{s.min}$ =	0.080 W	12.8-5
For S_1 >= 0.6g: $C_{s.min} = 0.5 S_1 / (R / I_e)$ =	0.067 W	12.8-6

SEISMIC LOAD

Unfactored Seismic Load, $V = C_s W$ =	**0.280 W**	Section 12.8-1, 12.4-3

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JOB NAME:	One-Bedroom ADU - Contemporary Style	JOB NUM.:	3759
DESCRIPTION:	Seismic Base Shear	DATE:	2025-01-30
	LATERAL CALCULATIONS	BY:	AA

Unfactored Vertical Seismic Load Distribution

***Below Force is unfactored and does not include rho**

Seismic Load, $F_x = C_{vx} V$ — Section 12.8.3

Story Coefficient, $C_{vx} = (w_x h^k_x) / (\sum w_i h^k_i)$ — 12.8-11

Exponent related to structure period, k = 1.00 — Section 12.8.3

Level	w_x (k)	h_x (ft)	$w_x h_x^k$	C_{vx}	$F_x = C_{vx} V$	$F_x = C_{vx} V S w_x$
ROOF	21.40	11.35	242.89	1.000	0.280 W	5.98 k
	0.00	0.00	0.00	0.000	0.000 W	0.00 k
	0.00	0.00	0.00	0.000	0.000 W	0.00 k
	0.00	0.00	0.00	0.000	0.000 W	0.00 k
Total =	21.40		242.89	1.000	0.280 W	5.98 k

Diaphragm Seismic Forces

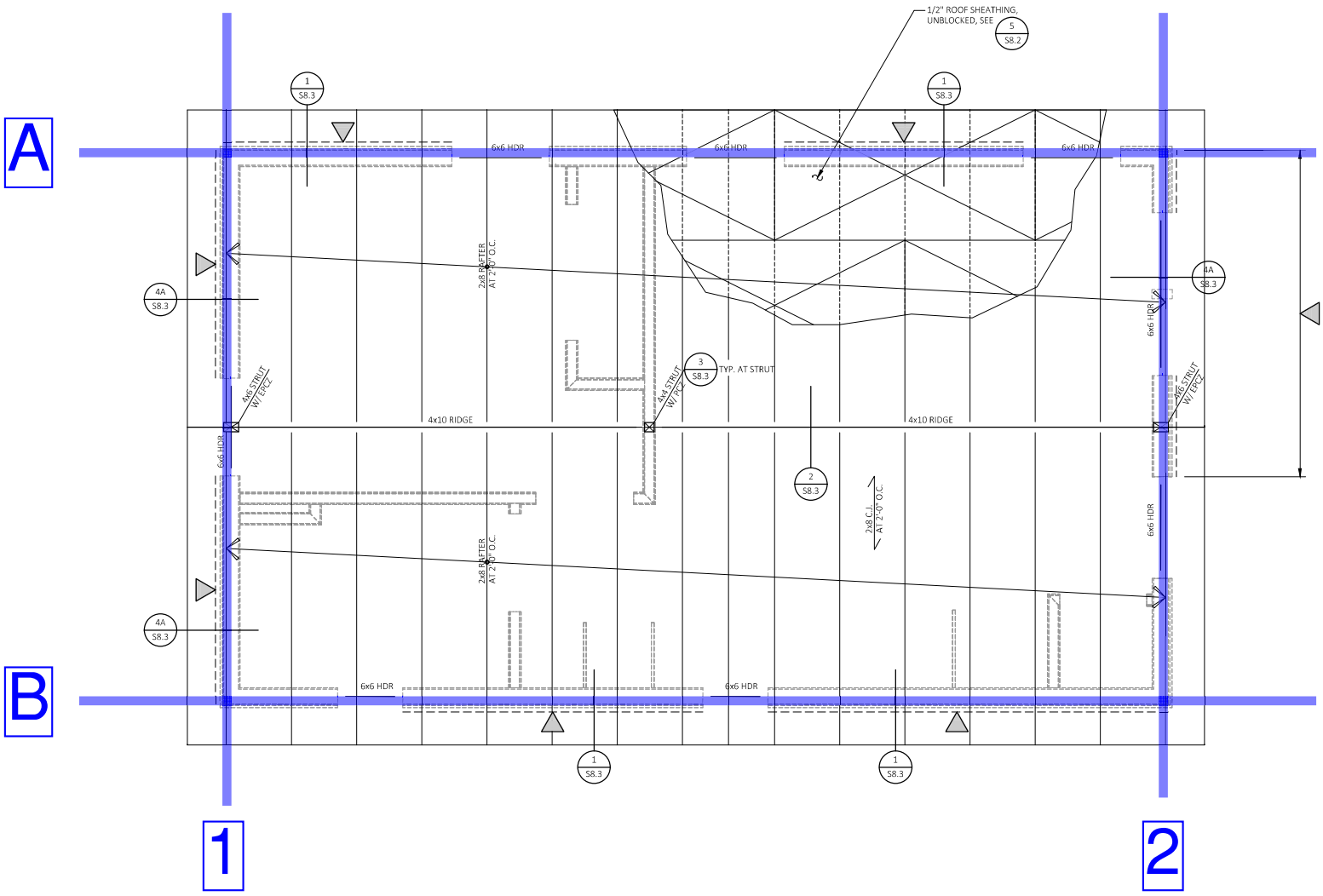
Diaphragm Design Force, $F_{px} = SF_x w_x / Sw_x$ — 12.10.1

Maximum Diaphragm Design Force, $F_{px\,max} = 0.4 S_{DS} I w_x$ — Section 12.10.1

Minimum Diaphragm Design Force, $F_{px\,min} = 0.2 S_{DS} I w_x$ — Section 12.10.2

Level	w_x (k)	F_x	F_{px}	$F_{px\,max}$	$F_{px\,min}$	$F_{px\,design}$
ROOF	21.40 k	5.98 k	5.98 k	15.56 k	7.78 k	7.78 k
	0.00 k	0.00 k	0.00 k	0.00 k	0.00 k	0.00 k
	0.00 k	0.00 k	0.00 k	0.00 k	0.00 k	0.00 k
	0.00 k	0.00 k	0.00 k	0.00 k	0.00 k	0.00 k

3759 - One-Bedroom ADU - Contemporary Style
DATE: 2025-01-30
BY: AA



SEISMIC GRIDLINES KEY PLAN

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JOB NAME:	One-Bedroom ADU - Contemporary Style	JOB NUM.:	3759
DESCRIPTION:	ShearWall Design	DATE:	2025-01-30
	LATERAL CALCULATIONS	BY:	AA

SHEARWALL AND UPLIFT CALCULATION NOTES

STORY SHEAR DISTRIBUTION AND SHEAR WALL DESIGN:

Forces distributed by tributary area. See Lateral Key Plan for shear line definition.
See previous lateral calculations for force distribution.

TABLE 1. SHEAR WALL SCHEDULE PER NDS 2021: SPECIAL DESIGN PROVISIONS FOR WIND AND SEISMIC, TABLE 4.3A

STRUCTURAL 1	
ALLOWABLE SHEAR	NAIL SPACING
312 plf	6
469 plf	4
611 plf	3
800 plf	2
625 plf	6DBL
938 plf	4DBL
1223 plf	3DBL
1600 plf	2DBL

- Nail spacing specified according to capacities in table above unless noted otherwise.
- FACTOR = % tributary width of shear line
- FORCE = Story shear adjusted for tributary width = Story Shear x FACTOR
- For multi-story shear walls, forces from shear lines above will be distributed by tributary area into shear lines below.
- Wall aspect ratio = h/L , has been considered for each shear wall.
- For walls with h/L between 2-3.5, a reduction Factor = 1.25-0.125*h/w will be applied to the shear capacity.
- For walls with h/L > 3.5, prefabricated shear wall panels will be specified.
- **HF** Denotes Hardy Frame shearwall panel and anchorage will be specified.
- ***STRP*** Denotes strapped shear wall. See Strapped Shear Wall Calculations for further details.
- ***MF*** Denotes Moment Frame. See Moment Frame Calculations for further details.
- Tabulated allowable shear value has been multiplied by 0.92 per NDS 2021: SDPWS table 4.3A footnote 10

PROJECT SPECIFIC NOTES:

- Shear walls designed using 15/32" plywood with 10d nail.
- Posts at hold downs will be specified according to manufacturer's recommendation.

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JOB NAME:	One-Bedroom ADU - Contemporary Style	JOB NUM.:	3759
DESCRIPTION:	ShearWall Design	DATE:	2025-01-30
	LATERAL CALCULATIONS	BY:	AA

SHEARWALL AND UPLIFT CALCULATION NOTES

UPLIFT CALCULATIONS AND TIE-DOWN ANCHORAGE:

TABLE 2. HOLD DOWN SCHEDULE PER SIMPSON CATALOG C-C-2021 (Pg.53)

ALLOWABLE TENSION LOADS	HOLDOWN TYPE	POST SIZE
3.075 kip	HDU2	4x4
4.565 kip	HDU4	4x4
5.645 kip	HDU5	4x4
6.97 kip	HDU8	4x4
7.87 kip	HDU8	4x6
9.535 kip	HDU11	4x6
11.175 kip	HDU11	4x8
10.77 kip	HDU14	4x6
14.39 kip	HDU14	4x8
14.445 kip	HDU14	6x6

TABLE 3. STRAP SCHEDULE PER SIMPSON CATALOG C-C-2021 (Pg. 273)

ALLOWABLE TENSION LOADS	STRAP TYPE	POST SIZE
4.69 kip	CMSTC16	4x4
1.705 kip	CS16	4x4

- Tie-downs will be specified according to capacities listed in tables above unless otherwise noted.
- Worst case tie-down anchorage will be specified on plan.
- Designed anchorages may be upsized when specified on plan.
- L' is conservative wall length. Reduction considers tie-downs offset from end of shear wall.
  L' = L - 1 ft
- Resistant moment from dead loads may not be considered if demand does
  not exceed minimum hardware capacity.

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JOB NAME:	One-Bedroom ADU - Contemporary Style	JOB NUM.:	3759
DESCRIPTION:	ShearWall Design	DATE:	2025-01-30
	LATERAL CALCULATIONS	BY:	AA

SHEAR WALL DESIGN

UNFACTORED STORY FORCE (Fi): 5.98 K LEVEL: ROOF RHO: 1.0 Design: ASD

DESIGN STORY FORCE: 4.19 K DIRECTION: EAST - WEST SDS: 1.818

SHEAR WALL NAILING

WALL LINE	AREA (sq ft)	FACTOR	FORCE K		TOTAL FORCE	WALL HT (ft)	WALL SEGMENT LENGTHS (ft) W1	W2	W3	W4	W5	W6	∑ WALL LENGTH	DEMAND plf	H/W (MIN.)	REDUCTION	NAIL SPACING	CAPACITY plf	D/C RATIO
A	0.5	0.50	2.09		2.09	9	6.5	7.0					13.50	155	OKAY	1.00	6	312	0.50
B	0.5	0.50	2.09		2.09	9	9.0	12.0					21.00	100	OKAY	1.00	6	312	0.32
C		0.00	0.00		0.00								-	-	-	-		-	-
D		0.00	0.00		0.00								-	-	-	-		-	-
E		0.00	0.00		0.00								-	-	-	-		-	-
F		0.00	0.00		0.00								-	-	-	-		-	-
G		0.00	0.00		0.00								-	-	-	-		-	-
H		0.00	0.00		0.00								-	-	-	-		-	-
I		0.00	0.00		0.00								-	-	-	-		-	-
J		0.00	0.00		0.00								-	-	-	-		-	-
K		0.00	0.00		0.00								-	-	-	-		-	-
L		0.00	0.00		0.00								-	-	-	-		-	-
M		0.00	0.00		0.00								-	-	-	-		-	-
N		0.00	0.00		0.00								-	-	-	-		-	-
O		0.00	0.00		0.00								-	-	-	-		-	-
P		0.00	0.00		0.00								-	-	-	-		-	-
Q		0.00	0.00		0.00								-	-	-	-		-	-
TOTAL	1	1.00	4.19																
TOTAL STORY SHEAR			4.19																

JOB NAME:	One-Bedroom ADU - Contemporary Style	JOB NUM.:	3759
DESCRIPTION:	ShearWall Design	DATE:	2025-01-30
	LATERAL CALCULATIONS	BY:	AA

SHEAR WALL DESIGN

LEVEL: ROOF

DIRECTION: EAST - WEST

(1) Refer to "Resisting Moment From Dead Load Calculator" for uplift resistance

HOLD DOWNS										
Required Tie-Down (Worst Case Wall Segment)						Required Tie-Down (User Selected Wall Segment)				
Wall Line	Wall Length		Uplift (K)(1)	Tie-Downs	D/C	Wall Length		Uplift (K)(1)	Tie-Downs	D/C
A	6.50		1.65	HDU2 W/ 4X4	0.54			0.00		#N/A
B	9.00		1.01	HDU2 W/ 4X4	0.33			0.00		#N/A
C	-		-		-			-		-
D	-		-		-			-		-
E	-		-		-			-		-
F	-		-		-			-		-
G	-		-		-			-		-
H	-		-		-			-		-
I	-		-		-			-		-
J	-		-		-			-		-
K	-		-		-			-		-
L	-		-		-			-		-
M	-		-		-			-		-
N	-		-		-			-		-
O	-		-		-			-		-
P	-		-		-			-		-
Q	-		-		-			-		-

element
structural engineers, inc.

JOB NAME:	One-Bedroom ADU - Contemporary Style	JOB NUM.:	3759
DESCRIPTION:	ShearWall Design	DATE:	2025-01-30
	LATERAL CALCULATIONS	BY:	AA

SHEAR WALL DESIGN

UNFACTORED STORY FORCE (Fi): 5.98 K LEVEL: ROOF RHO: 1.0 Design: ASD

DESIGN STORY FORCE: 4.19 K DIRECTION: NORTH-SOUTH SDS: 1.818

SHEAR WALL NAILING

WALL LINE	AREA (sq ft)	FACTOR	FORCE K		TOTAL FORCE	WALL HT (ft)	WALL SEGMENT LENGTHS (ft) W1	W2	W3	W4	W5	W6	∑ WALL LENGTH	DEMAND plf	H/W (MIN.)	REDUCTION	NAIL SPACING	CAPACITY plf	D/C RATIO
1	0.5	0.50	2.09		2.09	9	7.0	7.0					14.00	150	OKAY	1.00	6	312	0.48
2	0.5	0.50	2.09		2.09	9	3.5	3.0					6.50	322	REDUCE	0.88	4	410	0.78
3		0.00	0.00		0.00								-	-	-	-		-	-
4		0.00	0.00		0.00								-	-	-	-		-	-
5		0.00	0.00		0.00								-	-	-	-		-	-
6		0.00	0.00		0.00								-	-	-	-		-	-
7		0.00	0.00		0.00								-	-	-	-		-	-
8		0.00	0.00		0.00								-	-	-	-		-	-
9		0.00	0.00		0.00								-	-	-	-		-	-
10		0.00	0.00		0.00								-	-	-	-		-	-
11		0.00	0.00		0.00								-	-	-	-		-	-
12		0.00	0.00		0.00								-	-	-	-		-	-
13		0.00	0.00		0.00								-	-	-	-		-	-
14		0.00	0.00		0.00								-	-	-	-		-	-
15		0.00	0.00		0.00								-	-	-	-		-	-
16		0.00	0.00		0.00								-	-	-	-		-	-
17		0.00	0.00		0.00								-	-	-	-		-	-
TOTAL	1	1.00	4.19																
TOTAL STORY SHEAR			4.19																

JOB NAME:	One-Bedroom ADU - Contemporary Style	JOB NUM.:	3759
DESCRIPTION:	ShearWall Design	DATE:	2025-01-30
	LATERAL CALCULATIONS	BY:	AA

SHEAR WALL DESIGN

LEVEL: ROOF

DIRECTION: NORTH-SOUTH

(1) Refer to "Resisting Moment From Dead Load Calculator" for uplift resistance

HOLD DOWNS										
Required Tie-Down (Worst Case Wall Segment)						Required Tie-Down (User Selected Wall Segment)				
Wall Line	Wall Length		Uplift (K)(1)	Tie-Downs	D/C	Wall Length		Uplift (K)(1)	Tie-Downs	D/C
1	7.00		1.57	HDU2 W/ 4X4	0.51			0.00		#N/A
2	3.00		4.35	HDU4 W/ 4X4	0.95			0.00		#N/A
3	-		-		-			-		-
4	-		-		-			-		-
5	-		-		-			-		-
6	-		-		-			-		-
7	-		-		-			-		-
8	-		-		-			-		-
9	-		-		-			-		-
10	-		-		-			-		-
11	-		-		-			-		-
12	-		-		-			-		-
13	-		-		-			-		-
14	-		-		-			-		-
15	-		-		-			-		-
16	-		-		-			-		-
17	-		-		-			-		-

element
structural engineers, inc.

JOB NAME:	One-Bedroom ADU - Contemporary Style	JOB NUM.:	3759
DESCRIPTION:	Diaphragm Design	DATE:	2025-01-30
	LATERAL CALCULATIONS	BY:	AA

DIAPHRAGM DESIGN

LEVEL: ROOF
DIRECTION: E-W
UNFACTORED DIAPHRAGM FORCES: 7.78 K
DIAPHRAGM: 15/32" PLYWOOD W/ 8d NAIL
APPLY ASCE SECTION 12.3.3.4: Y (1.25*STRAP LOAD)
ASD DIAPHRAGM FORCES: 5.45 K

WALL LINE ID	FACTOR	FORCE K	DIAPHRAGM LENGTH , ft	SHEAR, V plf	BLK'G (Y/N)	CASE 1/3	NAIL SPACE	V_A plf	D/C	COLLECTOR LENGTH, ft	COLLECTOR FORCE, LBS	REQUIRED STRAP
A	0.50	2.72	31.25	87	N	3	6	180	0.48		0	CS16
B	0.50	2.72	31.25	87	N	3	6	180	0.48		0	CS16
C		0.00		0			6	180	0.00		0	CS16
D		0.00		0			6	180	0.00		0	CS16
E		0.00		0			6	180	0.00		0	CS16
F		0.00		0			6	180	0.00		0	CS16
G		0.00		0			6	180	0.00		0	CS16
H		0.00		0			6	180	0.00		0	CS16
I		0.00		0			6	180	0.00		0	CS16
J		0.00		0			6	180	0.00		0	CS16
TOTAL	1.00	5.45										

LEVEL: ROOF
DIRECTION: N-S
UNFACTORED DIAPHRAGM FORCES: 7.78 K
DIAPHRAGM: 15/32" PLYWOOD W/ 8d NAIL
APPLY ASCE SECTION 12.3.3.4: Y (1.25*STRAP LOAD)
ASD DIAPHRAGM FORCES: 5.45 K

WALL LINE ID	FACTOR	FORCE K	DIAPHRAGM LENGTH , ft	SHEAR, V plf	BLK'G (Y/N)	CASE 1/3	NAIL SPACE	V_A plf	D/C	COLLECTOR LENGTH, ft	COLLECTOR FORCE, LBS	REQUIRED STRAP
1	0.50	2.72	19.50	140	N	1	6	240	0.58		0	CS16
2	0.50	2.72	19.50	140	N	1	6	240	0.58		0	CS16
3		0.00		0			6	180	0.00		0	CS16
4		0.00		0			6	180	0.00		0	CS16
5		0.00		0			6	180	0.00		0	CS16
6		0.00		0			6	180	0.00		0	CS16
7		0.00		0			6	180	0.00		0	CS16
8		0.00		0			6	180	0.00		0	CS16
9		0.00		0			6	180	0.00		0	CS16
10		0.00		0			6	180	0.00		0	CS16
TOTAL	1.00	5.45										

Appendix A:
Seismic Parameters

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.
USGS web services are now operational so this tool should work as expected.

Richmond , CA - Location 1

Latitude, Longitude: 37.9942, -122.3581

Date	7/17/2024, 9:17:10 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Default (See Section 11.4.3)

Highest seismic design parameters used for design.

Type	Value	Description
S_S	2.272	MCE_R ground motion. (for 0.2 second period)
S_1	0.877	MCE_R ground motion. (for 1.0s period)
S_{MS}	2.726	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.817	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.954	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	1.145	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	2.574	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	2.882	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	2.272	Factored deterministic acceleration value. (0.2 second)
S1RT	0.984	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	1.109	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.877	Factored deterministic acceleration value. (1.0 second)
PGAd	0.954	Factored deterministic acceleration value. (Peak Ground Acceleration)

Type	Value	Description
PGA_{UH}	1.123	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.893	Mapped value of the risk coefficient at short periods
C_{R1}	0.887	Mapped value of the risk coefficient at a period of 1 s
C_V	1.5	Vertical coefficient

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.
USGS web services are now operational so this tool should work as expected.

Richmond , CA - Location 2

Latitude, Longitude: 37.9575, -122.4199

Date	7/17/2024, 9:18:57 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Default (See Section 11.4.3)

Type	Value	Description
S_S	1.579	MCE_R ground motion. (for 0.2 second period)
S_1	0.6	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.895	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.263	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

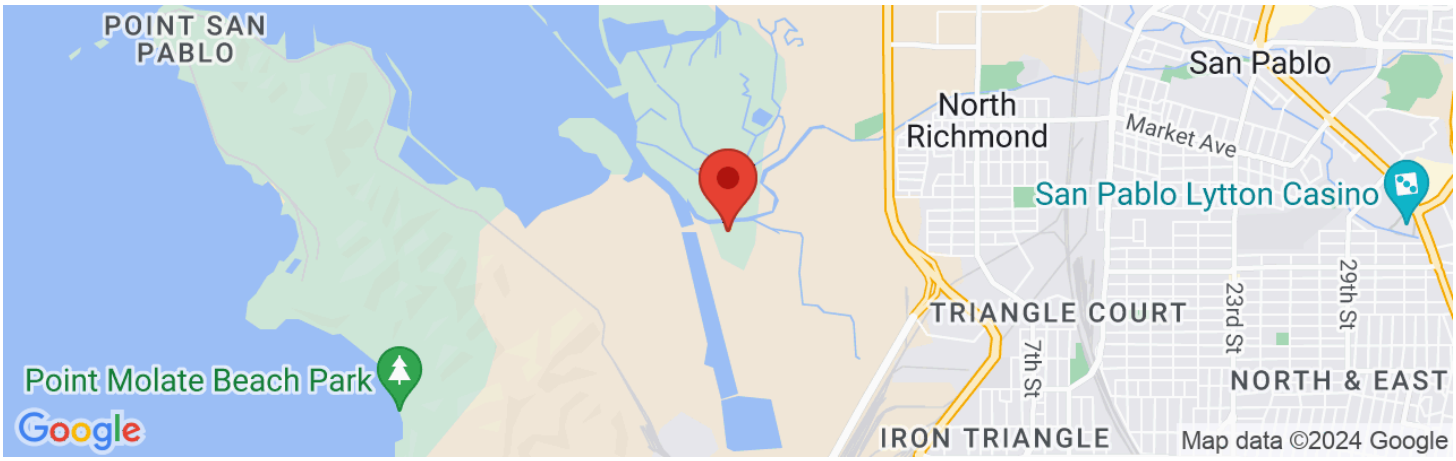
Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.665	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.798	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.959	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	2.141	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.579	Factored deterministic acceleration value. (0.2 second)
S1RT	0.753	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.833	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.665	Factored deterministic acceleration value. (Peak Ground Acceleration)

Type	Value	Description
PGA_{UH}	0.832	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.915	Mapped value of the risk coefficient at short periods
C_{R1}	0.904	Mapped value of the risk coefficient at a period of 1 s
C_V	1.416	Vertical coefficient

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.
USGS web services are now operational so this tool should work as expected.

Richmond , CA - Location 3

Latitude, Longitude: 37.9520, -122.3858



Date	7/17/2024, 9:19:54 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Default (See Section 11.4.3)

Type	Value	Description
S_S	1.8	MCE_R ground motion. (for 0.2 second period)
S_1	0.685	MCE_R ground motion. (for 1.0s period)
S_{MS}	2.16	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.44	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.757	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.908	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	2.134	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	2.352	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.8	Factored deterministic acceleration value. (0.2 second)
S1RT	0.817	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.909	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.685	Factored deterministic acceleration value. (1.0 second)
PGAd	0.757	Factored deterministic acceleration value. (Peak Ground Acceleration)

Type	Value	Description
PGA_{UH}	0.912	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.907	Mapped value of the risk coefficient at short periods
C_{R1}	0.898	Mapped value of the risk coefficient at a period of 1 s
C_V	1.46	Vertical coefficient

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.
USGS web services are now operational so this tool should work as expected.

Richmond , CA - Location 4

Latitude, Longitude: 37.9426, -122.3548

Date	7/17/2024, 9:20:37 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Default (See Section 11.4.3)

Type	Value	Description
S_S	1.988	MCE_R ground motion. (for 0.2 second period)
S_1	0.762	MCE_R ground motion. (for 1.0s period)
S_{MS}	2.386	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.591	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.835	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	1.003	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	2.318	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	2.571	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.988	Factored deterministic acceleration value. (0.2 second)
S1RT	0.886	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.992	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.762	Factored deterministic acceleration value. (1.0 second)
PGAd	0.835	Factored deterministic acceleration value. (Peak Ground Acceleration)

Type	Value	Description
PGA_{UH}	0.999	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.902	Mapped value of the risk coefficient at short periods
C_{R1}	0.893	Mapped value of the risk coefficient at a period of 1 s
C_V	1.498	Vertical coefficient

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.
USGS web services are now operational so this tool should work as expected.

Richmond , CA - Location 5

Latitude, Longitude: 37.9285, -122.3256

Date	7/17/2024, 9:21:16 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Default (See Section 11.4.3)

Type	Value	Description
S_S	2.122	MCE_R ground motion. (for 0.2 second period)
S_1	0.817	MCE_R ground motion. (for 1.0s period)
S_{MS}	2.547	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.698	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

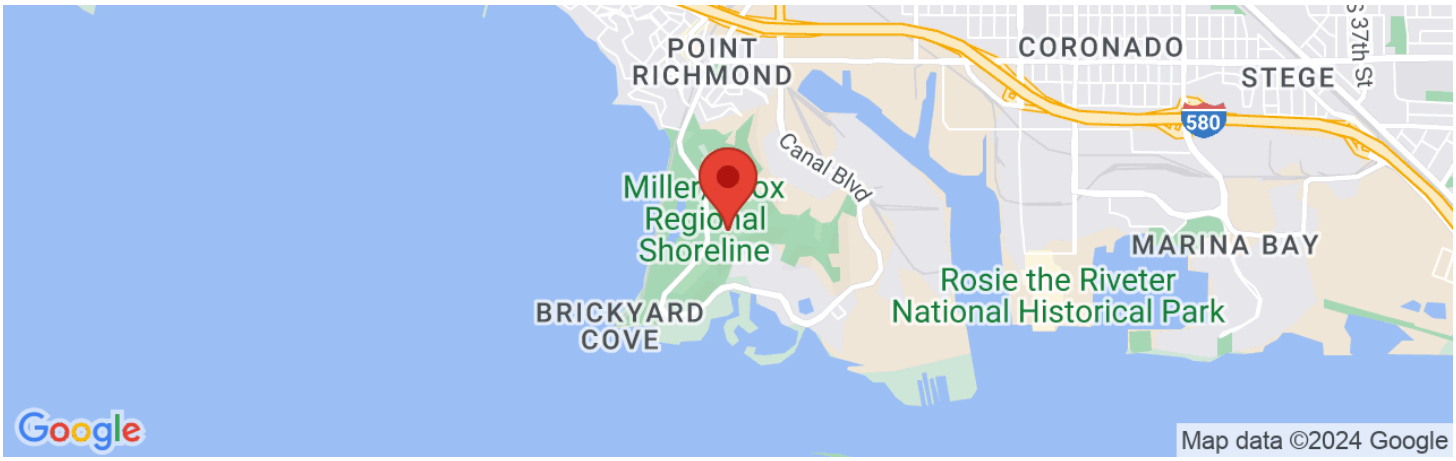
Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.892	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	1.07	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	2.431	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	2.699	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	2.122	Factored deterministic acceleration value. (0.2 second)
S1RT	0.925	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	1.037	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.817	Factored deterministic acceleration value. (1.0 second)
PGAd	0.892	Factored deterministic acceleration value. (Peak Ground Acceleration)

Type	Value	Description
PGA_{UH}	1.049	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.901	Mapped value of the risk coefficient at short periods
C_{R1}	0.892	Mapped value of the risk coefficient at a period of 1 s
C_V	1.5	Vertical coefficient

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.
USGS web services are now operational so this tool should work as expected.

Richmond , CA - Location 6

Latitude, Longitude: 37.9151, -122.3822



Date	7/17/2024, 9:22:14 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Default (See Section 11.4.3)

Type	Value	Description
S_S	1.575	MCE_R ground motion. (for 0.2 second period)
S_1	0.6	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.89	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.26	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.663	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.796	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.98	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	2.156	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.575	Factored deterministic acceleration value. (0.2 second)
S1RT	0.755	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.833	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.663	Factored deterministic acceleration value. (Peak Ground Acceleration)

Type	Value	Description
PGA_{UH}	0.839	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.918	Mapped value of the risk coefficient at short periods
C_{R1}	0.907	Mapped value of the risk coefficient at a period of 1 s
C_V	1.415	Vertical coefficient