Supplementary Structural Calculations for:

Yuan Residence

3611 W Mercer Way

Mercer Island, WA 98040

Prepared for: Brandt Design Group

Job #: 01519-2019-01-00

Date: February 12, 2020

STRUCTURAL ENGINEERING

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CANOPY ROOF AREA ≈ 200 FT²

TOTAL HOUSE ROOF A = 2255 FT²

200/2255 = 0.09

HOUSE ROOF MASS = 8.6K

@ CANOPY: 0.09 (8.6K) = 0.8K

CANTILEVER DIAPHRAGM

L = 13.5' < 35'

W = 15'

L/W = 0.9 < 1.5:1

N/S: 0.8K / 13FT = 62PLF

E/W: 0.8K / 15FT = 53PLF

N/S: 62PLF

V_{MAX} = 0.8K → INTO WALL LINE

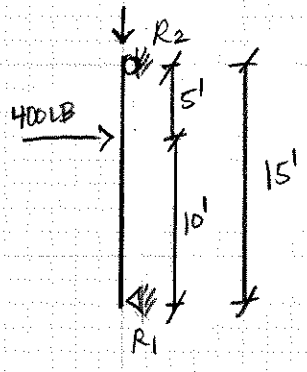
$M_{MAX} = 62(13^2)/2 = 5239$ LB FT

CHORD FORCE = 5239 LB·FT / 15FT = 350LB

E/W: 53PLF

53PLF × 15FT/2 = 398 LB ← CONTROLS

CHECK POST FOR 400 LB → IN ADDITION TO GRAVITY LOAD



SEE VA RESULTS

6X12 POST

DCR = 0.40

F/400 LB LOAD

R_1 = 267LB

R_2 = 133LB

ADD A34 TYP B OF POST

CAPACITY = 400 LB (EQ)

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STRUCTURAL ENGINEERING

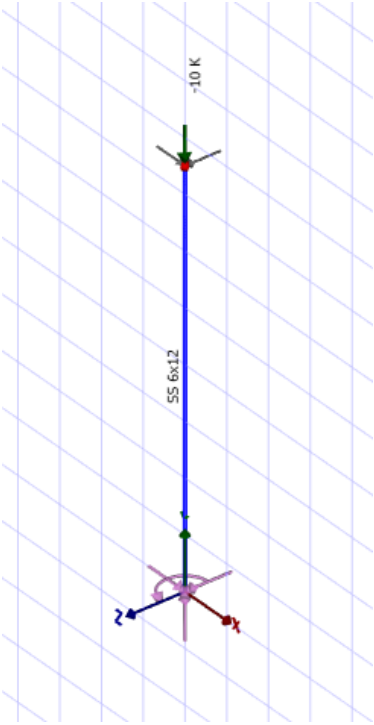
YUAN — PROJECT

2/11/2020 — DATE

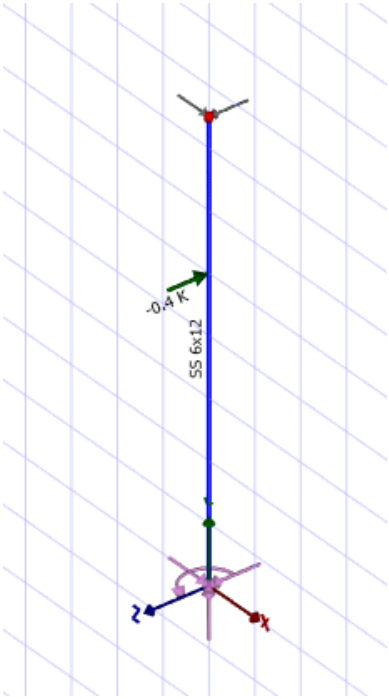
PROJ. # SRW

DESIGN

SHEET



APPLIED GRAVITY LOAD

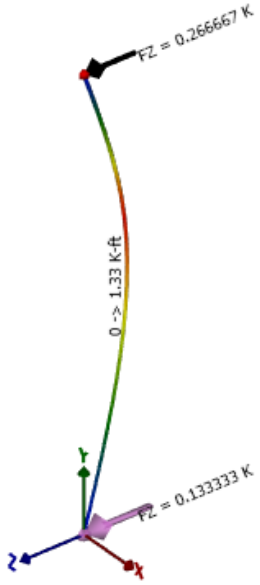


APPLIED SEISMIC LOAD

STRUCTURAL ENGINEERING

Yuan	2/11/2020
PROJECT	DATE
	PROJ. #
	SRW
	DESIGN
	SHEET

AXIAL DEMAND FROM GRAVITY LOAD



FLEXURAL DEMAND FROM SEISMIC LOAD

DCR

STRUCTURAL ENGINEERING

Yuan
PROJECT

2/11/2020
DATE

PROJ. #

SRW
DESIGN

SHEET

Nodes

Name	X ft	Y ft	Z ft	Support	Mass K	Scissor	Used By
N001	0.00000	0.00000	0.00000	DX DY DZ RY	0.00000	No	COL001
N002	0.00000	15.00000	0.00000	DX DZ	0.00000	No	COL001

Members

Name	Node 1	Node 2	Shape	Material	End Connection	Crossing Connection?	Beta, B deg	Length ft	Weight K	Offset y in	Offset z in	Framing	Action
COL001	N001	N002	SS 6x12	Douglas Fir-Larch-No.2	Rigid Connect	Yes	0.00000	15.00000	0.20048	0.00000	0.00000	Column	Normal

Member Loads, Concentrated

Member	Service Case	Direction	Magnitude	Offset ft
COL001	E+X	Force Z	-0.40000 K	10.00000

Nodal Loads

Node	Service Case	Type & Direction	Magnitude	Predefined Load
N002	L	Force Y	-10.00000 K	N.A.

Wood_Column_G 1: Results

Configuration Has Bolt Holes: False Multi-piece Lams: False	Axial Manual Kz: False Kz Sidesway?: False Manual Ky: False Ky Sidesway?: False	Beam Beam Type: Simply Supported Loading Pattern: Uniform Tension Flange On Bottom?: False Override Lbi?: False End Notch Type: No Notches
Deflections Strong (dy): Member Span Ratio 'L only': 360 'W or S only': 360 'D + L': 240 Other: 240 Weak (dz): Member Span Ratio 'L only': 360 'W or S only': 360 'D + L': 240 Other: 240	C-Factors Moisture Condition: Dry Service Condition Temp. Range: T <= 100F Wet Service Factor, CM: Calculate Temperature Factor, Ct: Calculate Incising Factor, Ci: Ignore Repetitive Member Factor, Cr: Ignore Buckling Stiffness Factor, CT: Ignore Slenderness Limit Increase: False Curvature Factor, Cc: 1 Pole/Pile Treatment: Air Dried Pole/Pile Group Count: 1	Overrides Override CF: False Override CI: False Override CL: False Override CP: False Override CV: False Override Ccs: False Override Cct: False Override Cfu: False Override Cls: False Override Cvr: False
Material Overrides Override Ft (Poles & Piles): False Neglect Size Constraints?: False		
Wood Material: Douglas Fir-Larch-No.2 Specification: NDS 2018 ASD Overstrength?: False Live Load Reduction: None Disable Checks?: False Check Level: Each Limit State	Bracing Lateral Top (+y): Unbraced Lateral Bottom (-y): Unbraced Strong (z): Unbraced	Size Constraints Limit Depth?: False Limit Width?: False

Wood_Column_G 1: Weak Deflection Check (extreme rows: max)

Member	Section	Offset ft	Result Case	Demand dz in	Capacity dz in	Code Reference	Unity Check	Details
COL001	SS 6x12	8.17500	Seismic »+X	-0.16751	0.75000	IBC 1604.3.1	**0.22335**	CM(E) = 1, Ct = 1, Ci = 1, Cfu = 1, L/Δ = 1074.55

Wood_Column_G 1: Combined Check (extreme rows: max)

Member	Section	Offset ft	Result Case	Demand	Capacity	Code Reference	Unity Check	Details
COL001	SS 6x12	0.07500	9. D+0.75(0.7E+L+S) »+X	0.27955	1.00000	3.9-4	**0.27955**	Fx = -7.69947 K, KLz = 15 ft, KLy = 15 ft, Lb = 15 ft, Mz = 0 K-ft, My = 0.00525 K-ft, FcE1 = 1.86234 Ksi, FcE2 = 0.445123 Ksi, FbE = 5.72052 Ksi, E'min = 580 Ksi, Fbz' = 1.55498 Ksi, Fby' = 1.7424 Ksi, CM(E) = 1, Ct = 1, Ci = 1, CT = 1, Cfu = 1, CM(Fb) = 1, CL = 0.981677, CF(Fb) = 1.1, Cr = 1, CD = 1.6, Kz = 1, Ky = 1

Wood_Column_G 1: Axial Check (extreme rows: max)

Member	Section	Offset ft	Result Case	Demand fa Ksi	Capacity Fa Ksi	Code Reference	Unity Check	Details
COL001	SS 6x12	0.00000	2. D+L	-0.16486	0.40947	3.6.3	**0.40261**	Fx = -10.2005 K, KLz = 15 ft, KLy = 15 ft, Fc* = 1.35 Ksi, FcE = 0.445123 Ksi, CM(Fc) = 1, Ct = 1, CF(Fc) = 1, Ci = 1, CP = 0.303311, CM(E) = 1, CT = 1, Cfu = 1, CD = 1, Kz = 1, Ky = 1

Wood_Column_G 1: Weak Flexure Check (extreme rows: max)

Member	Section	Offset ft	Result Case	Demand fby Ksi	Capacity Fby Ksi	Code Reference	Unity Check	Details
COL001	SS 6x12	9.97500	8. D+0.7E »+X	0.19697	1.74240	3.3-1	**0.11305**	My = 0.931 K-ft, E'min = 580 Ksi, CM(E) = 1, Ct = 1, Ci = 1, CT = 1, Cfu = 1, CM(Fb) = 1, CL = 1, CF(Fb) = 1.1, Cr = 1, CD = 1.6

Wood_Column_G 1: Weak Shear Check (extreme rows: max)

Member	Section	Offset ft	Result Case	Demand fvz Ksi	Capacity Fvz Ksi	Code Reference	Unity Check	Details
COL001	SS 6x12	15.00000	10. 0.6D+0.7E »+X	-0.00453	0.28800	3.4-1	**0.01571**	V = -0.186667 K, CM = 1, Ct = 1, Ci = 1, CD = 1.6

YUAN- BUILT UP POSTS

NDS Ch. 16

- ALL NAILS SHALL PEN. ALL LAMINATIONS PLUS 3/4 OF LAST LAMINATION
- NAILING - SPACING B/W NAILS IN A ROW:

  $20D \leq S < 6\text{in}$

  $2.7'' \leq S < 9''$ => USE 6" o.c. SPACING

COLUMN CHECKS / CHANGES

ROOF

B2 HDR → $R_1 = 6k$ => USE 4x6 POST

$R_2 = 15k$ => USE 6x8 POST

B1 BM → $R = 4182$

B12 BM → $R = 4500$

} COMB. = 8682 => 6x6 POST $f_{c\perp} = 12k$

B11 BM → $R = 2500$ => (2)2x6

B3 BM → $R = 3180 + 1680 = 4860$ => (2)2x6

B7 BM → $R = 4859 + 2000 = 6859$ => 4x6 POST

FLOOR

B12 BM → $R = 6075 + 4860 = 10935$ => 6x6 POST

B13 BM → $R = 6512 + 6859 = 13371$ => 6x6 POST W/ ABU BASE ON CONC.

B2 BM → $R = 4674$ => 4x6 braced

B14 BM → $R = 2223$ => (2)2x4 braced

B11 BM → $R = 4071$ => 4x6 braced

B10a → $R = 1500$ => (2)2x6 braced

B15 → $R = 2439$ => (2)2x6 braced

B3 → $R = 7553$ => 4x8

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Column Buckling Calculations

NDS 2015

Column Geometry Data

6X Posts Doug Fir - Larch #1		
Hem-Fir Plates		
b	5.5	in
d	7.25	in
Le_1	8.75	ft
Le_2	8.75	ft
$le_{bending}$		ft

Bracing

Braced
No Brace

Column Design Values

F_b	1200	psi
F_c	1000	psi
E'min	580	ksi
Fcperp	405	psi
cb	1.00	

Bearing Area Increase

No

Column Loading

P	16725	lbs
W_1		plf
M1	0	ft-lbs
W_2		plf
M2 (Braced)		ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C_D	1.15
Size Factor - C_F	1.00
Repetitive - C_r	1.00

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C_D	1.15
Size Factor - C_F	1.00

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
Kf	1
Column: Pinned Pinned	
Ke	1

Column Stability Factor Calculation

Strong Axis			Weak Axis		
Fce_1	2273	psi	Fce_2	400611	psi
Fc^*_1	1150	psi	Fc^*_2	1150	psi
Fce_1/Fc^*_1	1.977		Fce_2/Fc^*_2	348.357	
Cp_1	0.865		Cp_2	1.000	

Beam Stability Factor Calculation

Strong Axis			Weak Axis		
Fbe_1	15054	psi	Fbe_2	615,884	psi
Fb'_1	1380	psi	Fb'_2	1380	psi
Fbe_1/Fb'_1	10.9		Fbe_2/Fb'_2	446	
le	16.1	ft			
CL_1	1.00				

Adjusted Allowable Stresses

Strong Axis			Weak Axis		
Fc'_1	995	psi	Fc'_2	1150	psi
Fb'_1	1380	psi	Fb'_2	1380	psi

Imposed Column Stresses

Strong Axis			Weak Axis		
fc_1	419	psi	fc_2	419	psi
fb_1	0	psi	fb_2	0	psi

Perpendicular to Grain Stress Check fcp/Fcp =	***419 / 405***	**NG**
Slenderness Check le/d	**14**	**OK**
Slenderness Check le/b	**19**	**OK**

(1) $$\left(\frac{f_c}{F_c'}\right)^2+\frac{f_{b1}}{F_{b1}'\left[1-f_c/F_{cE1}\right]}+\frac{f_{b2}}{F_{b2}'\left[1-f_c/F_{cE2}-\left(f_{b1}/F_{bE1}\right)\right]}\le 1.0$$

(2) $$\frac{fc}{F_{cE2}}+\left(\frac{f_{b1}}{F_{bE}}\right)^2<1.0$$

(3) $$\frac{f_c}{F_{c'}},\frac{f_{b1}}{F_{b1}'},\frac{f_{b2}}{F_{b2}'}<1.0$$

Allowable Stress Interaction Formula	**0.42**	**OK**

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Project: YUAN ROOF B2 - CENTER POST

Date: *2/14/2020*

Project #:

Design: HAA

Sheet:

Column Buckling Calculations

NDS 2015

Column Geometry Data

6X Posts Doug Fir - Larch #1		
Hem-Fir Plates		
b	3.5	in
d	5.5	in
Le_1	8.75	ft
Le_2	8.75	ft
$le_{bending}$		ft

Bracing

Braced
No Brace

Column Design Values

F_b	1200	psi
F_c	1000	psi
E'min	580	ksi
Fcperp	405	psi
cb	1.00	

Bearing Area Increase

No

Column Loading

P	6500	lbs
W_1		plf
M1	0	ft-lbs
W_2		plf
M2 (Braced)		ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C_D	1.15
Size Factor - C_F	1.00
Repetitive - C_r	1.00

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C_D	1.15
Size Factor - C_F	1.00

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
Kf	1
Column: Pinned Pinned	
Ke	1

Column Stability Factor Calculation

	Strong Axis		Weak Axis	
Fce_1	1308	psi	Fce_2 162231	psi
Fc^*_1	1150	psi	Fc^*_2 1150	psi
Fce_1/Fc^*_1	1.137		Fce_2/Fc^*_2 141.070	
Cp_1	0.734		Cp_2 1.000	

Beam Stability Factor Calculation

	Strong Axis		Weak Axis	
Fbe_1	8261	psi	Fbe_2 556,984	psi
Fb'_1	1380	psi	Fb'_2 1380	psi
Fbe_1/Fb'_1	6.0		Fbe_2/Fb'_2 404	
le	15.6	ft		
CL_1	1.00			

Adjusted Allowable Stresses

Strong Axis			Weak Axis	
Fc'_1	844	psi	Fc'_2 1150	psi
Fb'_1	1380	psi	Fb'_2 1380	psi

Imposed Column Stresses

Strong Axis			Weak Axis	
fc_1	338	psi	fc_2 338	psi
fb_1	0	psi	fb_2 0	psi

Perpendicular to Grain Stress Check fcp/Fcp =	***338 / 405***	**OK**
Slenderness Check le/d	**19**	**OK**
Slenderness Check le/b	**30**	**OK**

(1) $$\left(\frac{f_c}{F_c'}\right)^2+\frac{f_{b1}}{F_{b1}'\left[1-f_c/F_{cE1}\right]}+\frac{f_{b2}}{F_{b2}'\left[1-f_c/F_{cE2}-\left(f_{b1}/F_{bE1}\right)\right]}\le 1.0$$

(2) $$\frac{fc}{F_{cE2}}+\left(\frac{f_{b1}}{F_{bE}}\right)^2<1.0$$

(3) $$\frac{f_c}{F_{c'}},\frac{f_{b1}}{F_{b1}'},\frac{f_{b2}}{F_{b2}'}<1.0$$

Allowable Stress Interaction Formula	**0.40**	**OK**

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Project: YUAN ROOF B2 -OUTER POST *Date:* 2/12/2020

Project #:

Design: HAA

Sheet:

Column Buckling Calculations

NDS 2015

Column Geometry Data

4X Posts Doug Fir - Larch #2		
Hem-Fir Plates		
b	5.5	in
d	5.5	in
Le_1	10.00	ft
Le_2	10.00	ft
$le_{bending}$		ft

Bracing

Braced
No Brace

Column Design Values

F_b	900	psi
F_c	1350	psi
E'min	580	ksi
Fcperp	405	psi
cb	1.00	

Bearing Area Increase

No

Column Loading

P	8682	lbs
W_1		plf
M1		ft-lbs
W_2		plf
M2 (Braced)		ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C_D	1.15
Size Factor - C_F	1.00
Repetitive - C_r	1.00

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C_D	1.15
Size Factor - C_F	1.10

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
Kf	1
Column: Pinned Pinned	
Ke	1

Column Stability Factor Calculation

Strong Axis			Weak Axis		
Fce_1	1002	psi	Fce_2	400611	psi
Fc^*_1	1708	psi	Fc^*_2	1708	psi
Fce_1/Fc^*_1	0.586		Fce_2/Fc^*_2	234.584	
Cp_1	0.491		Cp_2	1.000	

Beam Stability Factor Calculation

Strong Axis			Weak Axis		
Fbe_1	18048	psi	Fbe_2	354,444	psi
Fb'_1	1035	psi	Fb'_2	1035	psi
Fbe_1/Fb'_1	17.4		Fbe_2/Fb'_2	342	
le	17.7	ft			
CL_1	1.00				

Adjusted Allowable Stresses

Strong Axis			Weak Axis		
Fc'_1	839	psi	Fc'_2	1708	psi
Fb'_1	1035	psi	Fb'_2	1035	psi

Imposed Column Stresses

Strong Axis			Weak Axis		
fc_1	287	psi	fc_2	287	psi
fb_1	0	psi	fb_2	0	psi

Perpendicular to Grain Stress Check fcp/Fcp =	***287 / 405***	**OK**
Slenderness Check le/d	**22**	**OK**
Slenderness Check le/b	**22**	**OK**

(1) $$\left(\frac{f_c}{F_c'}\right)^2+\frac{f_{b1}}{F_{b1}'\left[1-f_c/F_{cE1}\right]}+\frac{f_{b2}}{F_{b2}'\left[1-f_c/F_{cE2}-\left(f_{b1}/F_{bE1}\right)\right]}\le 1.0$$

(2) $$\frac{fc}{F_{cE2}}+\left(\frac{f_{b1}}{F_{bE}}\right)^2<1.0$$

(3) $$\frac{f_c}{F_{c'}},\frac{f_{b1}}{F_{b1}'},\frac{f_{b2}}{F_{b2}'}<1.0$$

Allowable Stress Interaction Formula	**0.34**	**OK**

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Project: YUAN ROOF B1&12 COLUMN

Date: 2/12/2020

Project #:

Design: HAA

Sheet:

Column Buckling Calculations

NDS 2015

Column Geometry Data

4X Posts Doug Fir - Larch #2		
Hem-Fir Plates		
b	3.5	in
d	5.5	in
Le_1	13.00	ft
Le_2	9.00	ft
$le_{bending}$		ft

Bracing

Braced
No Brace

Column Design Values

F_b	900	psi
F_c	1350	psi
E'min	580	ksi
Fcperp	405	psi
cb	1.00	

Bearing Area Increase

No

Column Loading

P	6859	lbs
W_1		plf
M1		ft-lbs
W_2		plf
M2 (Braced)		ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C_D	1.15
Size Factor - C_F	1.30
Repetitive - C_r	1.00

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C_D	1.15
Size Factor - C_F	1.10

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
Kf	1
Column: Pinned Pinned	
Ke	1

Column Stability Factor Calculation

Strong Axis			Weak Axis		
Fce_1	593	psi	Fce_2	162231	psi
Fc^*_1	1708	psi	Fc^*_2	1708	psi
Fce_1/Fc^*_1	0.347		Fce_2/Fc^*_2	94.997	
Cp_1	0.317		Cp_2	1.000	

Beam Stability Factor Calculation

Strong Axis			Weak Axis		
Fbe_1	8051	psi	Fbe_2	556,984	psi
Fb'_1	1346	psi	Fb'_2	1346	psi
Fbe_1/Fb'_1	6.0		Fbe_2/Fb'_2	414	
le	16.0	ft			
CL_1	1.00				

Adjusted Allowable Stresses

Strong Axis			Weak Axis		
Fc'_1	542	psi	Fc'_2	1708	psi
Fb'_1	1346	psi	Fb'_2	1346	psi

Imposed Column Stresses

Strong Axis			Weak Axis		
fc_1	356	psi	fc_2	356	psi
fb_1	0	psi	fb_2	0	psi

Perpendicular to Grain Stress Check fcp/Fcp =	***356 / 405***	**OK**
Slenderness Check le/d	**28**	**OK**
Slenderness Check le/b	**31**	**OK**

(1) $$\left(\frac{f_c}{F_c'}\right)^2+\frac{f_{b1}}{F_{b1}'\left[1-f_c/F_{cE1}\right]}+\frac{f_{b2}}{F_{b2}'\left[1-f_c/F_{cE2}-\left(f_{b1}/F_{bE1}\right)\right]}\le 1.0$$

(2) $$\frac{fc}{F_{cE2}}+\left(\frac{f_{b1}}{F_{bE}}\right)^2<1.0$$

(3) $$\frac{f_c}{F_{c'}},\frac{f_{b1}}{F_{b1}'},\frac{f_{b2}}{F_{b2}'}<1.0$$

Allowable Stress Interaction Formula	**0.66**	**OK**

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Project: YUAN ROOF B7 COLUMN *Date:* *2/12/2020*

Project #:

Design: HAA

Sheet:

Column Buckling Calculations

NDS 2015

Column Geometry Data

4X Posts Doug Fir - Larch #2		
Hem-Fir Plates		
b	3	in
d	5.5	in
Le_1	13.00	ft
Le_2	9.00	ft
$le_{bending}$		ft

Bracing

Braced
No Brace

Column Design Values

F_b	900	psi
F_c	1350	psi
E'min	580	ksi
Fcperp	405	psi
cb	1.00	

Bearing Area Increase

No

Column Loading

P	4860	lbs
W_1		plf
M1	0	ft-lbs
W_2		plf
M2 (Braced)		ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C_D	1.15
Size Factor - C_F	1.30
Repetitive - C_r	1.00

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C_D	1.15
Size Factor - C_F	1.10

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
Kf	1
Column: Pinned Pinned	
Ke	1

Column Stability Factor Calculation

Strong Axis			Weak Axis		
Fce_1	593	psi	Fce_2	119190	psi
Fc^*_1	1708	psi	Fc^*_2	1708	psi
Fce_1/Fc^*_1	0.347		Fce_2/Fc^*_2	69.794	
Cp_1	0.317		Cp_2	1.000	

Beam Stability Factor Calculation

Strong Axis			Weak Axis		
Fbe_1	5915	psi	Fbe_2	649,815	psi
Fb'_1	1346	psi	Fb'_2	1346	psi
Fbe_1/Fb'_1	4.4		Fbe_2/Fb'_2	483	
le	16.0	ft			
CL_1	1.00				

Adjusted Allowable Stresses

Strong Axis			Weak Axis		
Fc'_1	542	psi	Fc'_2	1708	psi
Fb'_1	1346	psi	Fb'_2	1346	psi

Imposed Column Stresses

Strong Axis			Weak Axis		
fc_1	295	psi	fc_2	295	psi
fb_1	0	psi	fb_2	0	psi

Perpendicular to Grain Stress Check fcp/Fcp =	***295 / 405***	**OK**
Slenderness Check le/d	**28**	**OK**
Slenderness Check le/b	**36**	**OK**

(1) $$\left(\frac{f_c}{F_c'}\right)^2+\frac{f_{b1}}{F_{b1}'\left[1-f_c/F_{cE1}\right]}+\frac{f_{b2}}{F_{b2}'\left[1-f_c/F_{cE2}-\left(f_{b1}/F_{bE1}\right)\right]}\le 1.0$$

(2) $$\frac{fc}{F_{cE2}}+\left(\frac{f_{b1}}{F_{bE}}\right)^2<1.0$$

(3) $$\frac{f_c}{F_{c'}},\frac{f_{b1}}{F_{b1}'},\frac{f_{b2}}{F_{b2}'}<1.0$$

Allowable Stress Interaction Formula	**0.54**	**OK**

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Project: YUAN ROOF B3 COLUMN *Date:* 2/12/2020

Project #:

Design: HAA

Sheet:

Column Buckling Calculations

NDS 2015

Column Geometry Data

6X Posts Doug Fir - Larch #1		
Hem-Fir Plates		
b	5.5	in
d	5.5	in
Le_1	13.00	ft
Le_2	9.00	ft
$le_{bending}$		ft

Bracing

Braced
No Brace

Column Design Values

F_b	1200	psi
F_c	1000	psi
E'min	580	ksi
Fcperp	405	psi
cb	1.00	

Bearing Area Increase

No

Column Loading

P	11000	lbs
W_1		plf
M1	0	ft-lbs
W_2		plf
M2 (Braced)		ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C_D	1.15
Size Factor - C_F	1.50
Repetitive - C_r	1.00

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C_D	1.15
Size Factor - C_F	1.15

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
Kf	1
Column: Pinned Pinned	
Ke	1

Column Stability Factor Calculation

Strong Axis			Weak Axis		
Fce_1	593	psi	Fce_2	400611	psi
Fc^*_1	1323	psi	Fc^*_2	1323	psi
Fce_1/Fc^*_1	0.448		Fce_2/Fc^*_2	302.919	
Cp_1	0.396		Cp_2	1.000	

Beam Stability Factor Calculation

Strong Axis			Weak Axis		
Fbe_1	19882	psi	Fbe_2	354,444	psi
Fb'_1	2070	psi	Fb'_2	2070	psi
Fbe_1/Fb'_1	9.6		Fbe_2/Fb'_2	171	
le	16.0	ft			
CL_1	1.00				

Adjusted Allowable Stresses

Strong Axis			Weak Axis		
Fc'_1	524	psi	Fc'_2	1323	psi
Fb'_1	2070	psi	Fb'_2	2070	psi

Imposed Column Stresses

Strong Axis			Weak Axis		
fc_1	364	psi	fc_2	364	psi
fb_1	0	psi	fb_2	0	psi

Perpendicular to Grain Stress Check fcp/Fcp =	***364 / 405***	**OK**
Slenderness Check le/d	**28**	**OK**
Slenderness Check le/b	**20**	**OK**

(1) $$\left(\frac{f_c}{F_c'}\right)^2+\frac{f_{b1}}{F_{b1}'\left[1-f_c/F_{cE1}\right]}+\frac{f_{b2}}{F_{b2}'\left[1-f_c/F_{cE2}-\left(f_{b1}/F_{bE1}\right)\right]}\le 1.0$$

(2) $$\frac{fc}{F_{cE2}}+\left(\frac{f_{b1}}{F_{bE}}\right)^2<1.0$$

(3) $$\frac{f_c}{F_{c'}},\frac{f_{b1}}{F_{b1}'},\frac{f_{b2}}{F_{b2}'}<1.0$$

Allowable Stress Interaction Formula	**0.69**	**OK**

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Project: YUAN FLR B12 COLUMN

Date: 2/12/2020

Project #:

Design: HAA

Sheet:

Column Buckling Calculations

NDS 2015

Column Geometry Data

6X Posts Doug Fir - Larch #1		
Other		
b	5.5	in
d	5.5	in
Le_1	13.00	ft
Le_2	9.00	ft
$le_{bending}$		ft

Bracing

No Brace
No Brace

Column Design Values

F_b	1200	psi
F_c	1000	psi
E'min	580	ksi
Fcperp	650	psi
cb	1.00	

Bearing
Area
Increase
No

Column Loading

P	13500	lbs
W_1		plf
M1	0	ft-lbs
W_2		plf
M2		ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C_D	1.15
Size Factor - C_F	1.00
Repetitive - C_r	1.00

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C_D	1.15
Size Factor - C_F	1.00

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
Kf	1
Column: Pinned Pinned	
Ke	1

Column Stability Factor Calculation

Strong Axis			Weak Axis		
Fce_1	593	psi	Fce_2	1236	psi
Fc^*_1	1150	psi	Fc^*_2	1150	psi
Fce_1/Fc^*_1	0.515		Fce_2/Fc^*_2	1.075	
Cp_1	0.444		Cp_2	0.715	

Beam Stability Factor Calculation

Strong Axis			Weak Axis		
Fbe_1	19882	psi	Fbe_2	19,691	psi
Fb'_1	1380	psi	Fb'_2	1380	psi
Fbe_1/Fb'_1	14.4		Fbe_2/Fb'_2	14	
le	16.0	ft			
CL_1	1.00				

Adjusted Allowable Stresses

Strong Axis			Weak Axis		
Fc'_1	511	psi	Fc'_2	823	psi
Fb'_1	1380	psi	Fb'_2	1380	psi

Imposed Column Stresses

Strong Axis			Weak Axis		
fc_1	446	psi	fc_2	446	psi
fb_1	0	psi	fb_2	0	psi

Perpendicular to Grain Stress Check fcp/Fcp =	***446 / 650***	**OK**
Slenderness Check le/d	**28**	**OK**
Slenderness Check le/b	**20**	**OK**

(1) $$\left(\frac{f_c}{F_c'}\right)^2+\frac{f_{b1}}{F_{b1}'\left[1-f_c/F_{cE1}\right]}+\frac{f_{b2}}{F_{b2}'\left[1-f_c/F_{cE2}-\left(f_{b1}/F_{bE1}\right)\right]}\le 1.0$$

(2) $$\frac{fc}{F_{cE2}}+\left(\frac{f_{b1}}{F_{bE}}\right)^2<1.0$$

(3) $$\frac{f_c}{F_{c'}},\frac{f_{b1}}{F_{b1}'},\frac{f_{b2}}{F_{b2}'}<1.0$$

Allowable Stress Interaction Formula	**0.87**	**OK**

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Project: YUAN FLR B13 COLUMN

Date: 2/12/2020

Project #:

Design: HAA

Sheet:

Column Buckling Calculations

NDS 2015

Column Geometry Data

2X or 4X Doug Fir - Larch #1		
Hem-Fir Plates		
b	3.5	in
d	7.25	in
Le_1	11.50	ft
Le_2	11.50	ft
$le_{bending}$		ft

Bracing

No Brace
Braced

Column Design Values

F_b	1000	psi
F_c	1500	psi
E'min	620	ksi
Fcperp	405	psi
cb	1.00	

Bearing Area Increase

No

Column Loading

P	7553	lbs
W_1		plf
M1 (Braced)	0	ft-lbs
W_2		plf
M2		ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C_D	1.00
Size Factor - C_F	1.30
Repetitive - C_r	1.00

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C_D	1.00
Size Factor - C_F	1.05

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
Kf	1
Column: Pinned Pinned	
Ke	1

Column Stability Factor Calculation

Strong Axis			Weak Axis		
Fce_1	744110	psi	Fce_2	328	psi
Fc^*_1	1575	psi	Fc^*_2	1575	psi
Fce_1/Fc^*_1	472.451		Fce_2/Fc^*_2	0.208	
Cp_1	1.000		Cp_2	0.198	

Beam Stability Factor Calculation

Strong Axis			Weak Axis		
Fbe_1	5096	psi	Fbe_2	44,981	psi
Fb'_1	1300	psi	Fb'_2	1300	psi
Fbe_1/Fb'_1	3.9		Fbe_2/Fb'_2	35	
le	20.6	ft			
CL_1	0.98				

Adjusted Allowable Stresses

Strong Axis			Weak Axis		
Fc'_1	1575	psi	Fc'_2	312	psi
Fb'_1	1279	psi	Fb'_2	1300	psi

Imposed Column Stresses

Strong Axis			Weak Axis		
fc_1	298	psi	fc_2	298	psi
fb_1	0	psi	fb_2	0	psi

Perpendicular to Grain Stress Check fcp/Fcp =	***298 / 405***	**OK**
Slenderness Check le/d	**19**	**OK**
Slenderness Check le/b	**39**	**OK**

(1) $$\left(\frac{f_c}{F_c'}\right)^2+\frac{f_{b1}}{F_{b1}'\left[1-f_c/F_{cE1}\right]}+\frac{f_{b2}}{F_{b2}'\left[1-f_c/F_{cE2}-\left(f_{b1}/F_{bE1}\right)\right]}\le 1.0$$

(2) $$\frac{fc}{F_{cE2}}+\left(\frac{f_{b1}}{F_{bE}}\right)^2<1.0$$

(3) $$\frac{f_c}{F_{c'}},\frac{f_{b1}}{F_{b1}'},\frac{f_{b2}}{F_{b2}'}<1.0$$

Allowable Stress Interaction Formula	**0.95**	**OK**

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Project: YUAN FLR B3 COLUMN

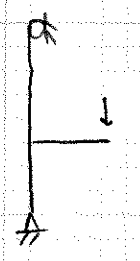
Date: 2/12/2020

Project #:

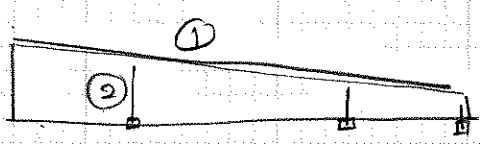
Design: HAA

Sheet:

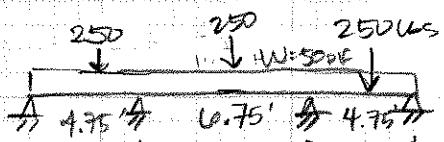
YUAN - HEARTH



KEY PLAN



① FASCIA

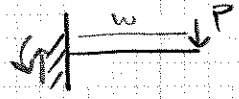


CANTILEVER TO WALL:
160 + 250 = 410
(3) SDS SCREWS ← 3 × 420 = 1260

M = 390

HSS 3½ × 3½ × ¼
Mn/Ω = 8.03 kft
Vn/Ω = 0.6 (46 ksi)(2(2.75)(¼)) = 3871.67 = 22 k
Δ = .02 L/3615

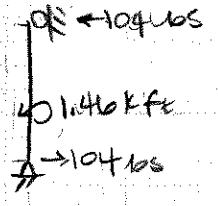
② BEAM



w = 67 PLF
P = 870
R = 980
M = 1440

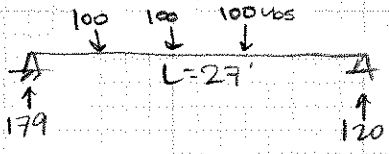
Mn/Ω = 8.03 kft VOK
Vn/Ω = 22 k VOK
Δ = 0.014 L/1338
HSS 3½ × 3½ × ¼

③ POST



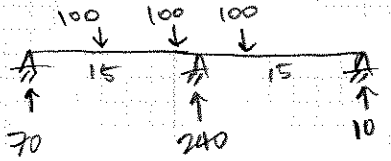
Δ = 0.209 L/803
M = 1330 k ft < 8.03 kft VOK
V = 1416 / 3.5" = 5000 lbs < 22 k VOK
HSS 2½ × 3½ × ¼

ROOF BM: (OUT-OF-PLANE)



M = 410
Δ = 0.6
L/536
f_b = 309
f_v = 4
(3) 1¾ × 11⅞ LVL

FLOOR BM: (OUT-OF-PLANE)



M = 350
Δ = 0.4
L/407
f_b = 128
f_v = 6
3.5 × 16 LSL

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SSF STRUCTURAL ENGINEERING

YUAN - FLOATING HEARTH DESIGN — PROJECT
02-12-20 — DATE
PROJ. # Yuan
DESIGN
SHEET

02-14-20 YUAN - UPDATE GREENROOF DL TO GRAVEL (DL=25PSF)
ADD WT OF STRUCTURE DL tot = 40PSF

CHECK B17 JOISTS → SEE ATTACHED REPORT [SL=30PSF AS PREV.]

B12 HDR → See below

B2 HDR → SEE ATTACHED REPORT

B12 HDR

L = 12	f_b = 1641
w_1 = 648	f_v = 99
w_2 = 370	Δ = 0.27
P = 2571	L/531
R_1 = 4754	(3) 1 3/4 x 11 7/8 LVL
R_2 = 3922	
M = 16871	

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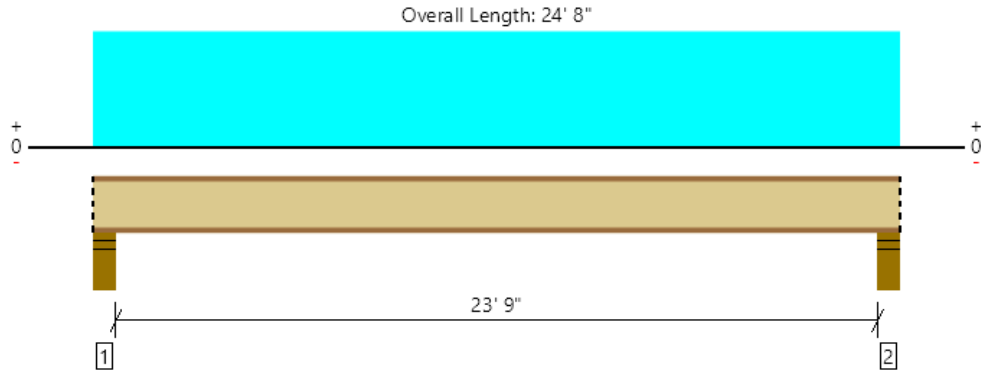
ROOF, Roof: Joist B17

1 piece(s) 11 7/8" TJI® 560 @ 16" OC



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1151 @ 4 1/2"	1984 (3.50")	Passed (58%)	1.15	1.0 D + 1.0 S (All Spans)
Shear (lbs)	1108 @ 5 1/2"	2358	Passed (47%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	6673 @ 12' 4"	10925	Passed (61%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.507 @ 12' 4"	0.797	Passed (L/566)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	1.183 @ 12' 4"	1.196	Passed (L/243)	--	1.0 D + 1.0 S (All Spans)

System : Roof
Member Type : Joist
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD
Member Pitch : 0/12

- Deflection criteria: LL (L/360) and TL (L/240).
- Top Edge Bracing (Lu): Top compression edge must be braced at 6' 9" o/c based on loads applied, unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 24' 8" o/c based on loads applied, unless detailed otherwise.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Total	
1 - Stud wall - HF	5.50"	5.50"	1.75"	658	493	1151	Blocking
2 - Stud wall - HF	5.50"	5.50"	1.75"	658	493	1151	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Snow (1.15)	Comments
1 - Uniform (PSF)	0 to 24' 8"	16"	40.0	30.0	Default Load

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Holly Ashford SSF Engineers (206) 956-3743 hashford@ssfengineers.com	

Weyerhaeuser

Beam Analysis

Beam:		Beam				
Load		Dead	Live	Snow	Factored	Location
Distributed (k/ft)	w_1	0.500	0.000	0.375	0.875	
	w_2				0.000	
	w_3				0.000	
	w_4				0.000	
	w_5				0.000	
	w_6				0.000	
	w_7				0.000	
	w_8				0.000	
	w_9				0.000	
	w_{10}				0.000	
Trapezoidal (k/ft/ft)	t_1				0.000	
	t_2				0.000	
	t_3				0.000	
	t_4				0.000	
	t_5				0.000	
	t_6				0.000	
Point (k)	P_1				0.000	
	P_2				0.000	
	P_3				0.000	
	P_4				0.000	
	P_5				0.000	
	P_6				0.000	
	P_7				0.000	
	P_8				0.000	
	P_9				0.000	
	P_{10}				0.000	

Support Locations and Reactions		
Number of Supports		3
Total Beam Length		28.00
Left End Condition		Pinned
Right End Condition		Pinned
R_1	1.200	0.00
R_2	16.724	9.50
R_3	6.576	28.00
R_4	0.000	28.00
R_5	0.000	28.00
R_6	0.000	28.00
R_7	0.000	28.00
R_8	0.000	28.00
R_9	0.000	28.00
R_{10}	0.000	28.00

Demand Output		
Location, ft		9.49
Shear, k	V =	-7.11
Moment, k-ft	M =	-28.03
Deflection, in	Δ =	0.00
Δ/Span		L/343997

Load Factors	
Dead	1.00
Live	1.00
Snow	1.00

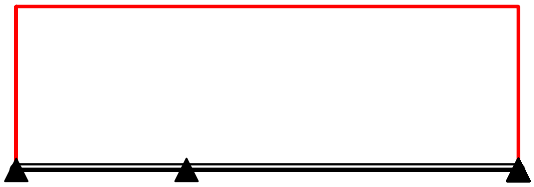
Stresses @ Input Location	
f_v (psi)	-145
f_b (psi)	-1961

Max/Min Stresses	
f_{v_MAX} (psi)	196
f_{v_MIN} (psi)	-145
f_{b_MAX} (psi)	1729
f_{b_MIN} (psi)	-1965

Beam Properties	
E (ksi)	2000
b (in)	5.25
d (in)	14
I (in^4)	1200.5
S (in^3)	171.5
A (in^2)	73.5
I (Override)	
S (Override)	
A (Override)	

Steel Beam Section	NONE

Beam Loading Diagram



Span	V_{Left} (kips)	V_{Right} (kips)	M (-) (k-ft)	M (+) (k-ft)	Δ_{TL} (in)	@ x =	L/	Δ_{LL} (in)	@ x =	L/
Span 1	1.20	-7.11	-28.08	0.82	0.055 (↑)	6.38	L/2065	0	-	L/∞
Span 2	9.61	-6.58	-28.08	24.71	-0.535 (↓)	19.66	L/415	0	-	L/∞

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PROJECT Yuan Residence - Roof Beam 2

DATE 2/14/2020

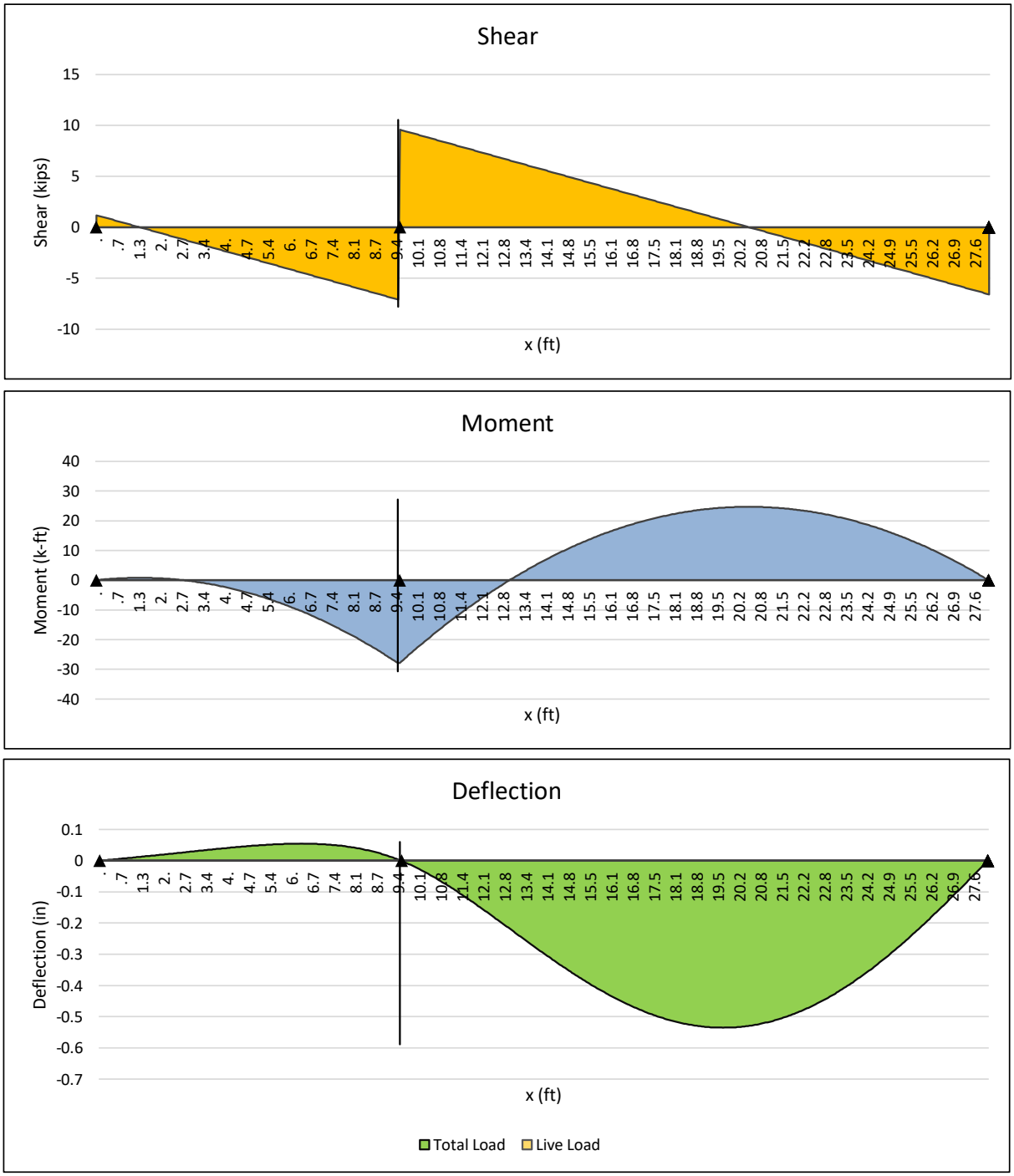
PROJ. #

DESIGN haa

SHEET

STRUCTURAL ENGINEERING

Beam Analysis



PROJECT	Yuan Residence - Roof Beam 2
DATE	*2/14/2020*
PROJ. #	
DESIGN	haa
SHEET	

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REVISED SEISMIC MASS TO ACCOUNT FOR 25PSF GRAVEL @ GARAGE

GARAGE ROOF

A = 990 FT2

W = 40PSF (INCL 25PSF GRAVEL) + 10PSF/2 = 45PSF

MASS = 44550 LB

MAIN ROOF

MASS = 45100 LB (NO CHANGE)

TOTAL ROOF

89 650 LB

% GARAGE = 0.50

% HOUSE = 0.50

SEISMIC LOADS

HOUSE

$F_{x,ROOF} = 0.5(17K) = 8.5K$

$F_{x,MAIN} = 11.7K$

* LESS THAN ORIG. DESIGN.
ORIG. DESIGN STILL VALID.

GARAGE

$F_{x,ROOF} = 0.5(17K) = 8.5K$

N/S

$V_{EQ,ROOF} = 8.5K/31' = 274PLF$

E/W

$V_{EQ,ROOF} = 9.5/25' = 340PLF$

NO CHANGE TO WIND LOADS

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YUAN
PROJECT

2/14/2020
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PROJ. # SRW
DESIGN

SHEET

Vertical Distribution ASD ρ= 1.3 ☐ Meets ASCE 7-10 12.3.4.2.a for levels resisting < 0.35V?

Level	h_x (ft)	W_x (k)	h_x^k (ft)	$W_x h_x^k$	Story Shear ASD C_{vx} (%)	Story Shear ASD F_x (k)	Story Shear ASD SV (k)	Diaphragm Force (ρ not included) $F_{px,calc}$	$F_{px,min}$	$F_{px,max}$	$F_{px,design}$	$\gamma=F_{px}/F_x$
Roof	29.8	89.65	29.8	2674	0.591	17.0	**17.0**	13.1	11.7	23.5	**13.1**	0.77
Main	14.3	130	14.3	1849	0.409	11.7	**28.7**	13.1	17.0	33.9	**17.0**	1.45
Σ		219.4		4523		**28.7**						

STRUCTURAL ENGINEERING

Yuan Residence

Seismic Criteria

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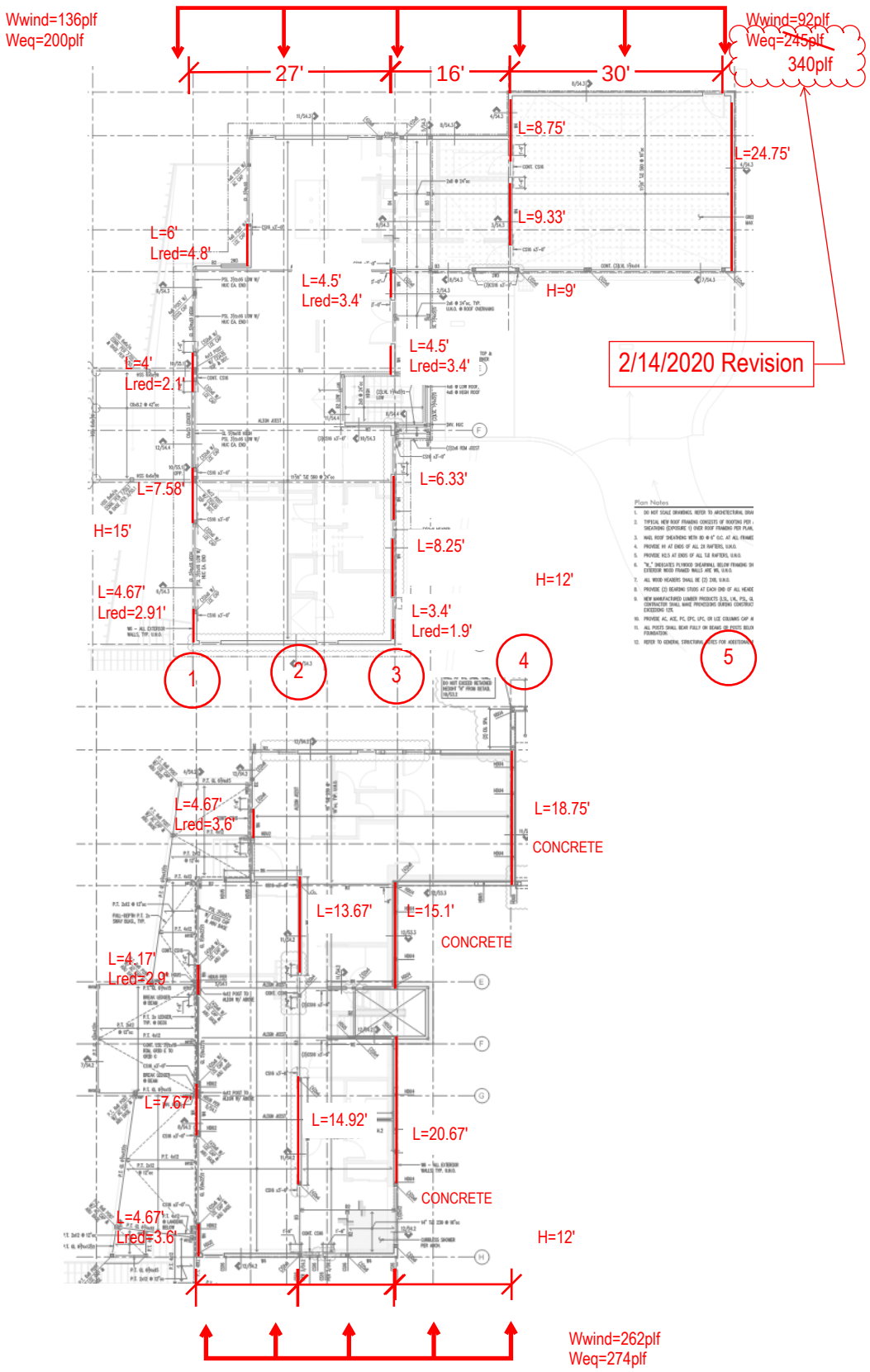
NORTH-SOUTH

ROOF



STRUCTURAL ENGINEERING

PROJECT: Yuan Residence	DATE: 2019-06-14
Lateral Design - Revised	PROJ. #:
	DESIGN: SRW
	SHEET:

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North-South

Level	Roof - Main				Roof - Main/Garage		Roof - Main/Garage		Roof - Garage	
Wall Line	1		2		3		4		5	
Lateral Force	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic
V (k)	1.836	2.7			2.924	4.3	2.468	5.71	1.38	4.11
L (ft)	22.25	22.25	8.5	8.5	26.98	26.98	18.08	18.08	24.75	24.75
L red (ft)	19.15	19.15	8.5	8.5	23.28	23.28	18.08	18.08	24.75	24.75
V (plf)	96	141	0	0	126	185	137	316	56	166
SW	W6		W6		W6		W4		W6	
H (ft)	15	15	0	0	12	12	9	9	9	9
OT (lb)	1238	1820	0	0	1301	1913	1229	2842	502	1495
Design OT (lb)	1820		0		1913		2842		1495	
Holdown	HDU2		NA		HDU2		HDU4		HDU2	

OT-DL

Level	Upper									
Wall Line	1		2		3		4		5	
Lateral Force	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic
V (k)	1.834	1.918	3.537	3.699	3.799	3.973	2.096	2.192		
V above (k)	1.836	2.7	0	0	2.924	4.3	2.468	5.71		
Total V (k)	3.67	4.618	3.537	3.699	6.723	8.273	4.564	7.902		
L (ft)	21.18	21.18	28.59	28.59	35.75	35.75	18.75	18.75		
L red (ft)	17.77	17.77	28.59	28.59	35.75	35.75	18.75	18.75		
V (plf)	207	260	124	129	188	231	243	421		
SW	W4		W6		W6		NA			
H (ft)	12	12	12	12	12	12	12	12		
OT (lb)	2079	2616	1485	1553	2257	2777	2921	5057		
Total OT (lb)	3317	4437	1485	1553	3557	4689	4149	7900		
Design OT (lb)	4437		1553		4689		7900			
Holdown	HDU4		HDU2		NA		NA			
					Concrete		Concrete			

STRUCTURAL ENGINEERING

Yuan Residence
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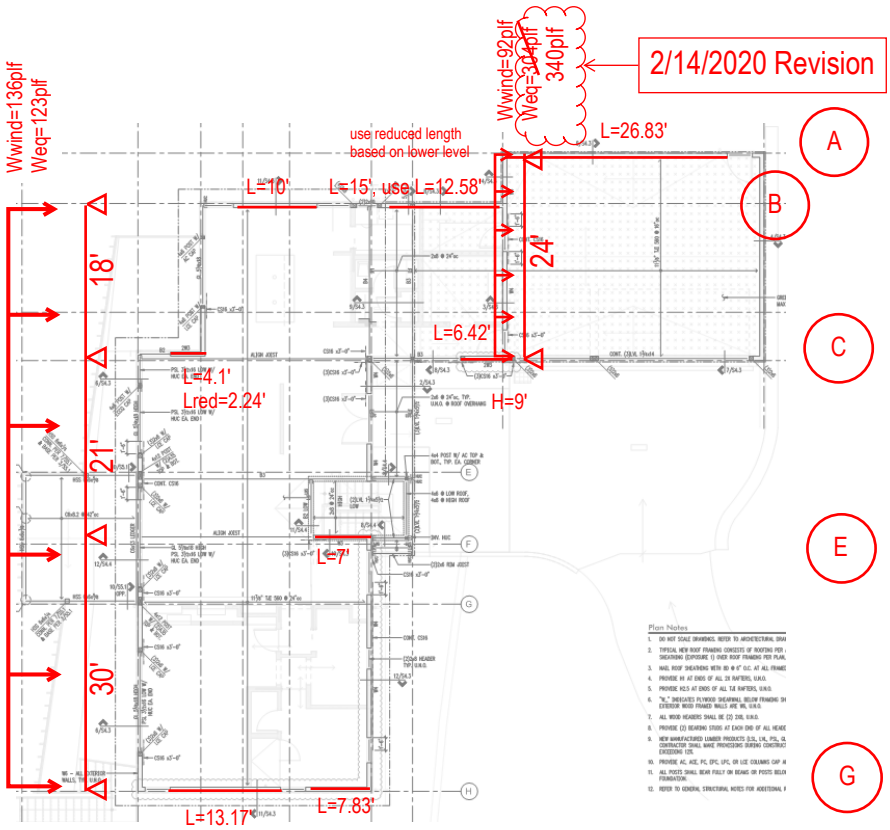
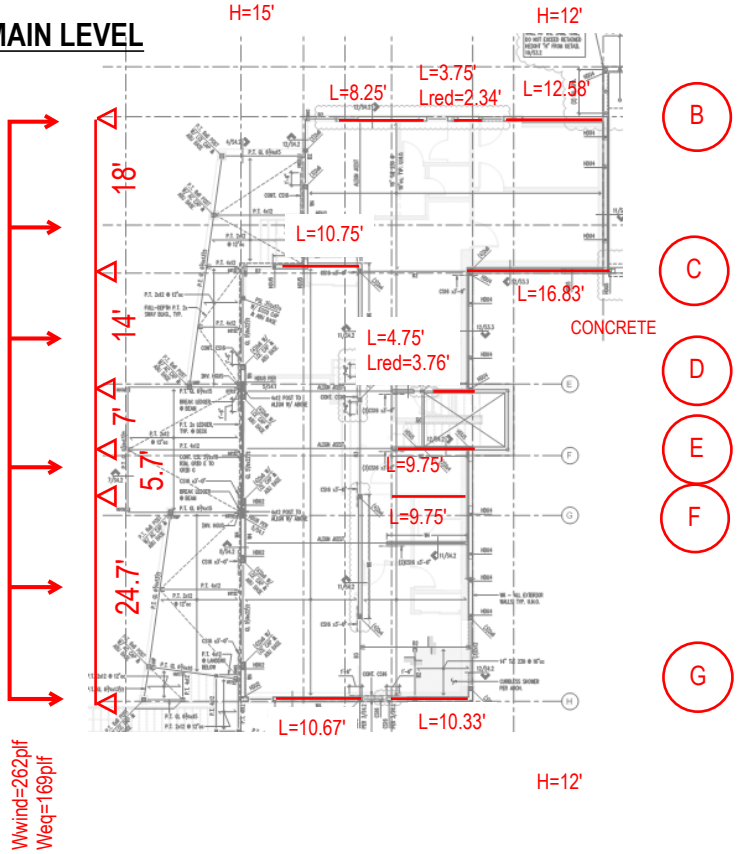
EAST-WEST

ROOF



MAIN LEVEL



PROJECT	Yuan Residence
	Lateral Design - Revised
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SSF STRUCTURAL ENGINEERING

2/14/2020 Revision

East-West

Level	Roof - Garage								Roof - Main							
Wall Line	A		B		C		D		E		F		G			
Lateral Force	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic			Wind	Seismic		
V (k)	1.104	4.08	1.224	1.107	3.756	6.4785			3.468	3.1365			2.04	1.845		
L (ft)	26.83	26.83	22.58	22.58	10.52	10.52			7	7			21	21		
L red (ft)	26.83	26.83	22.58	22.58	8.66	8.66			7	7			21	21		
V (plf)	41	152	54	49	434	748			495	448			97	88		
SW	W6		W6		2W3				W3				W6			
H (ft)	9	9	9	9	9	9			12	12			15	15		
OT (lb)	370	1369	488	441	3213	5542			5945	5377			1457	1318		
Design OT (lb)	1369		488		5542				5945				1457			
Holdown	HDU2		NA		HDU5				HDU5				CS16			

OT-DL

Level	Upper													
Wall Line	A		B		C		D		E		F		G	
Lateral Force	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic
V (k)			2.36	1.52	4.19	2.70	2.75	1.77	1.66	1.07	3.98	2.57	3.24	2.09
V above (k)			1.22	1.11	3.76	6.48	0	0	3.468	3.1365	0	0	2.04	1.845
Total V (k)			3.58	2.63	7.95	9.18	2.75	1.77	5.13	4.21	3.98	2.57	5.28	3.93
L (ft)			24.58	24.58	27.58	27.58	4.75	4.75	9.75	9.75	9.75	9.75	21	21
L red (ft)			23.17	23.17	27.58	27.58	3.76	3.76	9.75	9.75	9.75	9.75	21	21
V (plf)			155	113	288	333	732	472	526	432	408	263	251	187
SW			W6		W4		W2		W3		W3		W6	
H (ft)			12	12	12	12	12	12	12	12	12	12	12	12
OT (lb)			1749	1283	3458	3995	6950	4483	6316	5181	4901	3162	3015	2247
Total OT (lb)			2237	1724	6671	9538	6950	4483	12261	10558	4901	3162	4472	3565
Design OT (lb)			2237		9538		6950		12261		4901		4472	
Holdown			HDU4		HDU11		HDU8		HDU14		HDU5		HDU4	

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Yuan Residence
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