Lateral and Gravity Analysis

For

NHD AJ-532-A

Parcel #21833010000

For

Nisqually Indian Tribe

11500 25th Ave S

Olympia, WA 98513

By

N.L. Olson & Associates, Inc.

2453 Bethel Avenue

Port Orchard, WA 98336

360-876-2284

NLO #12907-23

January 2024

Dead Load Determination:

Roof:

Item	*Value*	*Unit*	*Source*
Gypsum Board (5/8-in thick)	2.75	psf	ASCE 7-16
Composition Roofing	2	psf	ASCE 7-16
Plywood (1/2-in thick)	2.4	psf	ASCE 7-16
Loose Insulation, 12-in. thick	6.0	psf	Design of Wood Structures 6th Edition, Appendix B, Insulation, Loose
2x12 Roof Rafters spaced at 16" o.c.	2.9	psf	Design of Wood Structures, 6th Edition, Appendix A
Total	16.05	psf	
Total Rounded Up	**17**	**psf**	

First Floor:

Item	*Value*	*Unit*	*Source*
Plywood (3/4-in thick)	2.4	psf	ASCE 7-16
Hardwood Flooring	4	psf	ASCE 7-16
Weight of 2x12 Joists	2.85	psf	Design of Wood Structures 6th Edition, Appendix A
Expanded Polystyrene, 9-in. thick	1.8	psf	Design of Wood Structures 6th Edition, Appendix B, Insulation, Expanded Polystyrene
Total	11.05	psf	
Total Rounded Up	**12**	**psf**	

Siding:

Item	*Value*	*Unit*	*Source*
2 x 6 @ 16-in., 5/8-in. gypsum, insulated, 3/8-in. siding	12	psf	ASCE 7-16
Subtract 1/8-in gypsum	-0.55	psf	ASCE 7-16
Add 1/8-in. plywood siding	0.4	psf	ASCE 7-16
Windows, glass, frame, and sash	8	psf	ASCE 7-16
Total	11.85	psf	
Total Rounded Up	**12**	**psf**	

Live Load Determination:

Item	*Value*	*Unit*	*Source*
First Floor Live Loads	40	psf	IBC 2018
Roof Live Load	20	psf	IBC 2018

First Floor Live Loads: 40 psf

Roof Live Load(s): 20 psf

Snow Load Determination:

Item	*Value*	*Unit*	*Source*
C_e	1.0		ASCE 7-16 “Terrain Category B, Partially Exposed”
C_t	1.0		ASCE 7-16
I_s	1.00		ASCE 7-16 “Risk Category II”
C_s	1		ASCE 7-16 Roof Slope 6 on 12
p_g	20	psf	Thurston County Website
p_f	14	psf	ASCE 7-10, Equation 7.3-1
p_s	14	psf	ASCE 7-10, Equation 7.4-1
p_m	20	psf	ASCE 7-10, Section 7.3.4

Use Flat Roof Balanced Snow Load: 25 psf

Seismic Load Determination

Seismic Load	

Dead Loads	
Roof Dead Load (psf)	17
First Floor Wall Dead Load (psf)	12
Attic Dead Load (psf)	12
First Floor Wall Height (ft)	9.000

Diaphragms	
Roof Area (sqft)	2601
Attic Area (sq ft)	0
First Floor Wall Perimeter (ft)	243.83
Roof Diaphragm Weight (lb)	57384
Total Seismic Weight (lb)	57384

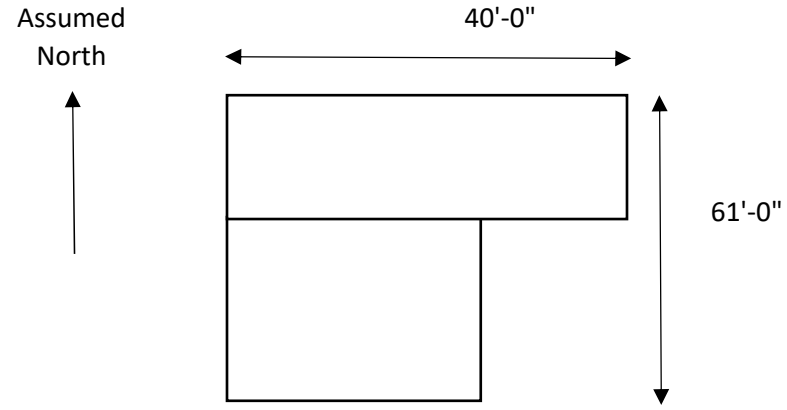
Risk Category	II
Site Class	D

I_e	1
R	6.5
S_DS	1.08
S_D1	0.49
S_1	0.49
C_t	0.02
h_x (ft)	19
x	0.75
T_a	0.182
T_L (s)	6
C_s Max	0.414
C_s Min	0.048
C_s Min	0.000
C_s Min (us	0.048
C_s	**0.166**
k	1
C_vR	**1.00**
V (lb)	**9535**
V_R (lb)	**9535**

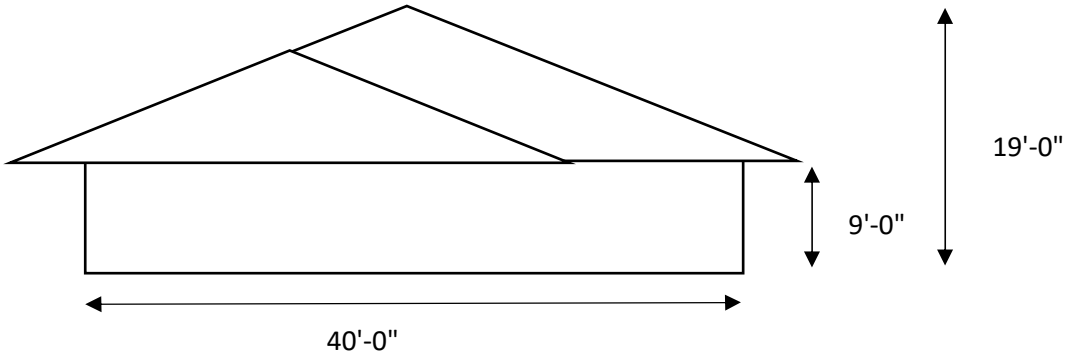
Wind Load Determination

Basic Dimensions

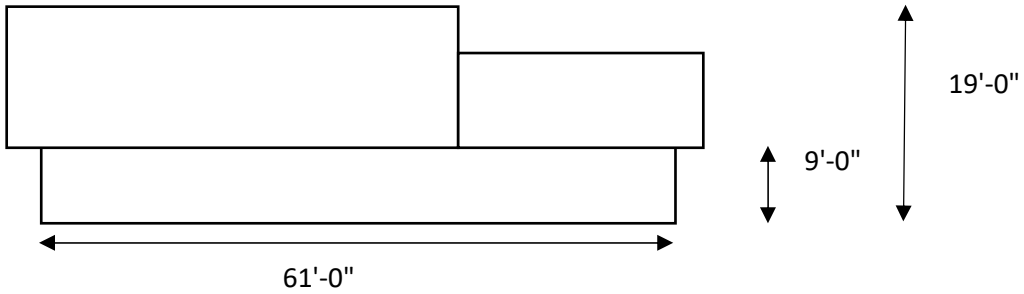
Plan View



North/South Elevation



East/West Elevation



Wind Forces		
	Exposure Category	B
Base Wind Speed V (mph)		115
Velocity Pressure Coefficient K_z		0.62
Topographic Factor K_zt		1
Coefficient C (P_net = C * C_net)		20.99

For enclosed structure:

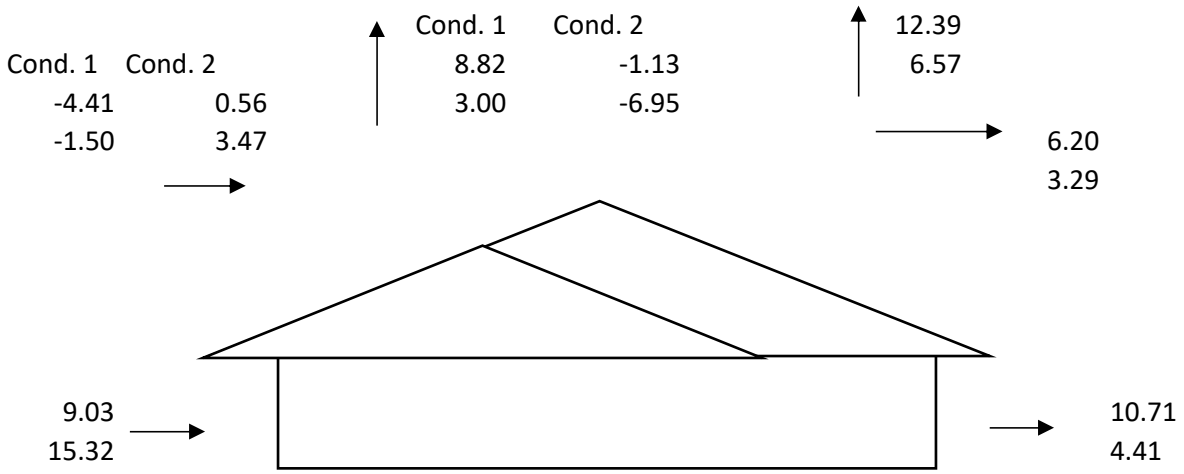
Wind Normal to West Wall			
C_net			
Walls			
		+	-
Windward Wall		0.43	0.73
Leeward Wall		-0.51	-0.21
Roofs			
		+	-
Leeward Roof		-0.66	-0.35
Windward Roof			
	Cond. 1	-0.47	-0.16
	Cond. 2	0.06	0.37

Dimensions		
First Floor		
West Wall Height	9	ft
West Wall Length	61	ft

P_net			
Walls			
		+	-
Windward Wall		9.03	15.32
Leeward Wall		-10.71	-4.41
Roofs			
		+	-
Leeward Roof		-13.85	-7.35
Windward Roof			
	Cond. 1	-9.87	-3.36
	Cond. 2	1.26	7.77

Roof		
Pitch	0.5	
Angle	26.57	degrees
Height	10	ft

Roof Forces			
	Leeward		
		+	-
	Horizontal	-6.20	-3.29
	Vertical	-12.39	-6.57
	Windward		
		+	-
Cond. 1	Horizontal	-4.41	-1.50
	Vertical	-8.82	-3.00
Cond. 2	Horizontal	0.56	3.47
	Vertical	1.13	6.95



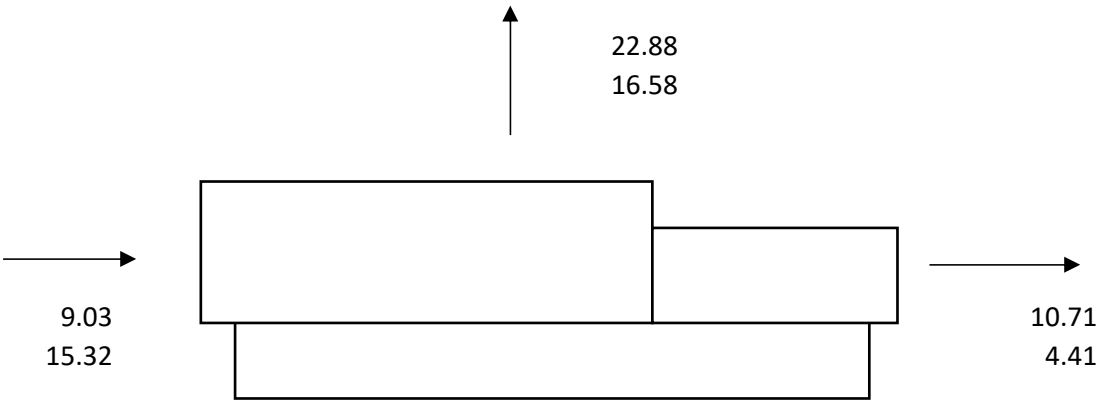
Diaphragm Forces	
East/West Roof Diaphragm Load (lb)	**9539**

Wind Normal to North Wall		
C_net		
Walls		
	+	-
Windward Wall	0.43	0.73
Leeward Wall	-0.51	-0.21
Roofs		
	+	-
Parallel to Roof	-1.09	-0.79

Dimensions		
First Floor		
North Wall Height	9	ft
North Wall Length	47	ft

P_net		
Walls		
	+	-
Windward Wall	9.03	15.32
Leeward Wall	-10.71	-4.41
Roofs		
	+	-
Leeward Roof	-22.88	-16.58

Roof		
Pitch	0.5	
Angle	26.57	degrees
Height	10	ft



Diaphragm Forces	
North/South Roof Diaphragm Load (lb)	**8810**

Comparison of Wind Loads and Seismic Loads for Diaphragms:

Roof Diaphragm:

East/West Direction:

Wind Load: 9539 lb

Seismic Load: 9535 lb

North/South Direction:

Wind Load: 8810 lb

Seismic Load: 9535 lb

Shear Wall Design

Seismic Factor(s)	
S_{DS}	1.08

Design of First Floor, North Shear Wall

Full length = 15.29 ft Wall Height = 9 ft

Σ Length of Full height wall= 9.292 ft Max Height of opening = 0 ft

% of full height walls = 61%

Shear Resistance Adjustment Factor , Co = 0.79 (2015 SDPWS Table 4.3.3.5)

V = 3383 lbs (from Seismic calcs)

Uplift Anchorage, T = Vh / CoELi = 4147 lbs (2015 SDPWS Eqn 4.3-8)

Unit shear force, v = V/CoELi = 461 plf (2015 SDPWS Eqn 4.3-9)

3/8" min w/ 8d Nails @4" edge spacing = 476.2 plf (2015 SDPWS Table 4.3A)
Adjusted for Hem Fir and LRFD

Vertical Load $(0.9-0.2S_{DS})D$ = 23.26 plf

For Smallest Segment

(0.9-0.2SDS)D + 1.0(W or E) Net

uplift = 4039 lbs

Uplift from above floor = 0 lbs

Net Uplift = 4039 lbs

Hold Downs Required

Shear capacity of 5/8 dia anchors = 1856 lbs (NDS Table 11E, LRFD)

Minimum required spacing = 4.03 ft

Use 5/8" dia Anchors at 4'-0" on center.

Area of (2) 2x6 stud is 16.5 in2; tension/compression stress is 251.4 psi

Use double Stud at Ends

Design of First Floor, Garage Shear Wall

Full length =	24.42 ft	Wall Height =	9 ft
Σ Length of Full height wall=	21.75 ft	Max Height of opening =	0 ft
% of full height walls =	89%		

Shear Resistance Adjustment Factor , Co = 0.88 (2015 SDPWS Table 4.3.3.5)

V = 4768 lbs (from Seismic calcs)

Uplift Anchorage, T = Vh / CoELi = 2242 lbs (2015 SDPWS Eqn 4.3-8)

Unit shear force, v = V/CoELi = 249 plf (2015 SDPWS Eqn 4.3-9)

3/8" min w/ 8d Nails @6" edge spacing = 327.4 plf (2015 SDPWS Table 4.3A)
Adjusted for Hem Fir and LRFD

Vertical Load $(0.9-0.2S_{DS})D$ = 0 plf

For Smallest Segment

(0.9-0.2SDS)D + 1.0(W or E) Net uplift = 2242 lbs

Uplift from above floor = 0 lbs

Net Uplift = 2242 lbs

Hold Downs Required

Shear capacity of 5/8 dia anchors = 1856 lbs (NDS Table 11E, LRFD)

Minimum required spacing = 7.45 ft

Use 5/8" dia Anchors at 4'-0" on center.

Area of (2) 2x6 stud is 16.5 in2; tension/compression stress is 135.9 psi

Use double Stud at Ends

Design of First Floor, South Shear Wall

Full length = 2.583 ft Wall Height = 7.75 ft

Σ Length of Full height wall= 2.583 ft Max Height of opening = 0 ft

% of full height walls = 100%

Shear Resistance Adjustment Factor , Co = 1 (2015 SDPWS Table 4.3.3.5)

V = 1385 lbs (from Seismic calcs)

Uplift Anchorage, T = Vh / CoELi = 4155 lbs (2015 SDPWS Eqn 4.3-8)

Unit shear force, v = V/CoELi = 536 plf (2015 SDPWS Eqn 4.3-9)

3/8" min w/ 8d Nails @4" edge spacing = 892.8 plf (2015 SDPWS Table 4.3A)
Adjusted for Hem Fir and LRFD

Vertical Load $(0.9-0.2S_{DS})D$ = 173 plf

For Smallest Segment

(0.9-0.2SDS)D + 1.0(W or E) Net uplift = 3931 lbs

Uplift from above floor = 0 lbs

Net Uplift = 3931 lbs

Hold Downs Required

Shear capacity of 5/8 dia anchors = 1856 lbs (NDS Table 11E, LRFD)

Minimum required spacing = 3.46 ft

Use 5/8" dia Anchors at 3'-6" on center.

Area of (2) 2x6 stud is 16.5 in2; tension/compression stress is 251.8 psi

Use double Stud at Ends

(1) 24"x108" portal frames will be used for lateral resistance.

Design of First Floor, West Shear Wall

Full length =	49	ft	Wall Height =	9	ft
Σ Length of Full height wall=	49	ft	Max Height of opening =	0	ft
% of full height walls =	100%				

Shear Resistance Adjustment Factor , Co = 1 (2015 SDPWS Table 4.3.3.5)

V = 4768 lbs (from Seismic calcs)

Uplift Anchorage, T = Vh / CoELi = 876 lbs (2015 SDPWS Eqn 4.3-8)

Unit shear force, v = V/CoELi = 97 plf (2015 SDPWS Eqn 4.3-9)

3/8" min w/ 8d Nails @6" edge spacing = 327.4 plf (2015 SDPWS Table 4.3A)
Adjusted for Hem Fir and LRFD

Vertical Load (0.9-0.2SDS)D = 250 plf

For Smallest Segment

(0.9-0.2SDS)D + 1.0(W or E) Net uplift = -5249 lbs

Uplift from above floor = 0 lbs

Net Uplift = -5249 lbs

No Hold Downs Required

Shear capacity of 5/8 dia anchors = 1856 lbs (NDS Table 11E, LRFD)

Minimum required spacing = 19.07 ft

Use 5/8" dia Anchors at 4' on center.

Area of (2) 2x6 stud is 16.5 in2; tension/compression stress is 53.07 psi

Use double Stud at Ends

Design of First Floor, East Shear Wall

Full length =	36	ft	Wall Height =	9	ft
Σ Length of Full height wall=	36	ft	Max Height of opening =	0	ft
% of full height walls =	100%				

Shear Resistance Adjustment Factor , Co = 1 (2015 SDPWS Table 4.3.3.5)

V = 4768 lbs (from Seismic calcs)

Uplift Anchorage, T = Vh / CoELi = 1192 lbs (2015 SDPWS Eqn 4.3-8)

Unit shear force, v = V/CoELi = 132 plf (2015 SDPWS Eqn 4.3-9)

3/8" min w/ 8d Nails @6" edge spacing = 327.4 plf (2015 SDPWS Table 4.3A)
Adjusted for Hem Fir and LRFD

Vertical Load $(0.9-0.2S_{DS})D$ = 250 plf

For Smallest Segment

(0.9-0.2SDS)D + 1.0(W or E) Net uplift = -3308 lbs

Uplift from above floor = 0 lbs

Net Uplift = -3308 lbs

No Hold Downs Required

Shear capacity of 5/8 dia anchors = 1856 lbs (NDS Table 11E, LRFD)

Minimum required spacing = 14.01 ft

Use 5/8" dia Anchors at 4'-0" on center.

Area of (2) 2x6 stud is 16.5 in2; tension/compression stress is 72.23 psi

Use double Stud at Ends

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2453 Bethel Ave.
PO Box 637
Port Orchard, WA 98366
(360) 876-2284

Project Title: NHD AJ-532-A
Engineer:
Project ID: 9454-16
Project Descr: Single Family Residence

Multiple Simple Beam

Project File: AJ-532-A.ec6

Description :

Wood Beam Design : Floor Joists

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

BEAM Size : **2x10, Sawn, Fully Braced**
Using Load Resistance Factor Design with ASCE 7-16 Load Combinations, Major Axis Bending
Wood Species : Hem Fir Wood Grade : No.2

Fb - Tension	850.0 psi	Fc - Prll	1,300.0 psi	Fv	150.0 psi	Ebend- xx	1,300.0 ksi	Density	26.830 pcf
Fb - Compr	850.0 psi	Fc - Perp	405.0 psi	Ft	525.0 psi	Eminbend - xx	470.0 ksi		

Applied Loads

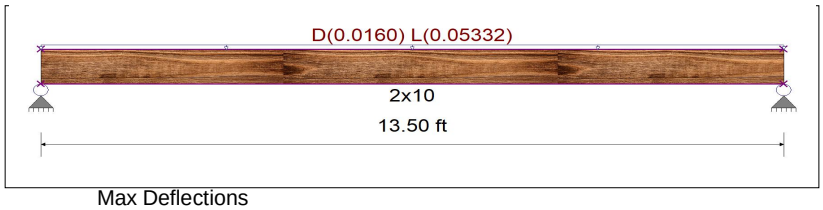
Beam self weight calculated and added to loads
Unif Load: D = 0.0120, L = 0.040 k/ft, Trib= 1.333 ft

Design Summary

Max fb/Fb Ratio = **0.740** : 1
fb : Actual : 1,375.26 psi at 6.750 ft in Span # 1
Fb : Allowable : 1,858.03 psi
Load Comb : +1.20D+1.60L

Max fv/FvRatio = **0.269** : 1
fv : Actual : 69.63 psi at 12.735 ft in Span # 1
Fv : Allowable : 259.20 psi
Load Comb : +1.20D+1.60L

Max Reactions (k)	D	Lr	L	S	W	E	H
Left Support	0.13		0.36				
Right Support	0.13		0.36				



Max Deflections

Transient Downward	0.311 in	Total Downward	0.420 in
Ratio	520	Ratio	385
	LC: L Only		LC: +D+L
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

Wood Beam Design : Typical Header

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

BEAM Size : **4x8, Sawn, Fully Unbraced**
Using Load Resistance Factor Design with ASCE 7-16 Load Combinations, Major Axis Bending
Wood Species : Hem Fir Wood Grade : No.2

Fb - Tension	850.0 psi	Fc - Prll	1,300.0 psi	Fv	150.0 psi	Ebend- xx	1,300.0 ksi	Density	26.830 pcf
Fb - Compr	850.0 psi	Fc - Perp	405.0 psi	Ft	525.0 psi	Eminbend - xx	470.0 ksi		

Applied Loads

Beam self weight calculated and added to loads
Unif Load: D = 0.0170, Lr = 0.020, S = 0.0250 k/ft, Trib= 21.50 ft

Design Summary

Max fb/Fb Ratio = **0.539** : 1
fb : Actual : 1,020.91 psi at 2.000 ft in Span # 1
Fb : Allowable : 1,895.10 psi
Load Comb : +1.20D+1.60S

Max fv/FvRatio = **0.416** : 1
fv : Actual : 107.94 psi at 0.000 ft in Span # 1
Fv : Allowable : 259.20 psi
Load Comb : +1.20D+1.60S

Max Reactions (k)	D	Lr	L	S	W	E	H
Left Support	0.74	0.86		1.08			
Right Support	0.74	0.86		1.08			

Max Deflections

Transient Downward	0.022 in	Total Downward	0.036 in
Ratio	2228	Ratio	1319
	LC: S Only		LC: +D+S
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

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Project Title: NHD AJ-532-A
Engineer:
Project ID: 9454-16
Project Descr: Single Family Residence

Multiple Simple Beam

Project File: AJ-532-A.ec6

Wood Beam Design : Entrance Beam

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

BEAM Size : **5.50 X 7.250, Sawn, Fully Braced**
Using Load Resistance Factor Design with ASCE 7-16 Load Combinations, Major Axis Bending

Wood Species :	Hem Fir				Wood Grade :	No.2			
Fb - Tension	850.0 psi	Fc - Prll	1,300.0 psi	Fv	150.0 psi	Ebend- xx	1,300.0 ksi	Density	26.830 pcf
Fb - Compr	850.0 psi	Fc - Perp	405.0 psi	Ft	525.0 psi	Eminbend - xx	470.0 ksi		

Applied Loads

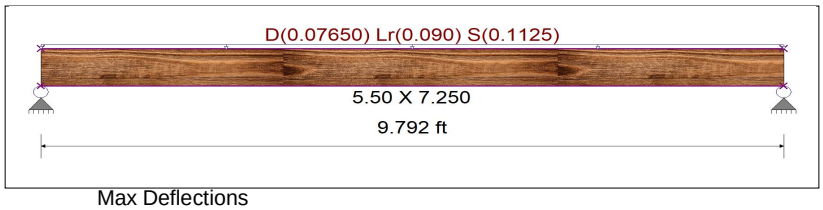
Beam self weight calculated and added to loads
Unif Load: D = 0.0170, Lr = 0.020, S = 0.0250 k/ft, Trib= 4.50 ft

Design Summary

Max fb/Fb Ratio = **0.713** : 1
fb : Actual : 837.94 psi at 4.896 ft in Span # 1
Fb : Allowable : 1,175.04 psi
Load Comb : +1.20D+1.60S

Max fv/FvRatio = **0.219** : 1
fv : Actual : 45.50 psi at 0.000 ft in Span # 1
Fv : Allowable : 207.36 psi
Load Comb : +1.20D+1.60S

Max Reactions (k)	D	Lr	L	S	W	E	H
Left Support	0.41	0.44		0.55			
Right Support	0.41	0.44		0.55			



Max Deflections

Transient Downward	0.103 in	Total Downward	0.180 in
Ratio	1140	Ratio	653
	LC: S Only		LC: +D+S
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

Wood Beam Design : 3 Car Option Garage Header

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

BEAM Size : **4x12, Sawn, Fully Unbraced**
Using Load Resistance Factor Design with ASCE 7-16 Load Combinations, Major Axis Bending

Wood Species :	Hem Fir				Wood Grade :	No.2			
Fb - Tension	850.0 psi	Fc - Prll	1,300.0 psi	Fv	150.0 psi	Ebend- xx	1,300.0 ksi	Density	26.830 pcf
Fb - Compr	850.0 psi	Fc - Perp	405.0 psi	Ft	525.0 psi	Eminbend - xx	470.0 ksi		

Applied Loads

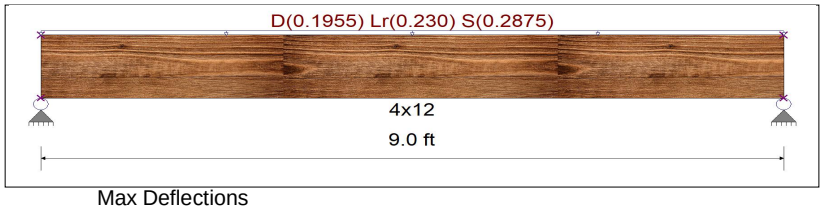
Beam self weight calculated and added to loads
Unif Load: D = 0.0170, Lr = 0.020, S = 0.0250 k/ft, Trib= 11.50 ft

Design Summary

Max fb/Fb Ratio = **0.737** : 1
fb : Actual : 1,157.60 psi at 4.500 ft in Span # 1
Fb : Allowable : 1,571.69 psi
Load Comb : +1.20D+1.60S

Max fv/FvRatio = **0.369** : 1
fv : Actual : 95.66 psi at 0.000 ft in Span # 1
Fv : Allowable : 259.20 psi
Load Comb : +1.20D+1.60S

Max Reactions (k)	D	Lr	L	S	W	E	H
Left Support	0.91	1.04		1.29			
Right Support	0.91	1.04		1.29			



Max Deflections

Transient Downward	0.079 in	Total Downward	0.135 in
Ratio	1366	Ratio	801
	LC: S Only		LC: +D+S
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

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Project Title: NHD AJ-532-A
Engineer:
Project ID: 9454-16
Project Descr: Single Family Residence

Wood Beam

Project File: AJ-532-A.ec6

DESCRIPTION: Floor Joist Collector Beam

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Load Resistance Factor D
Load Combination : ASCE 7-16

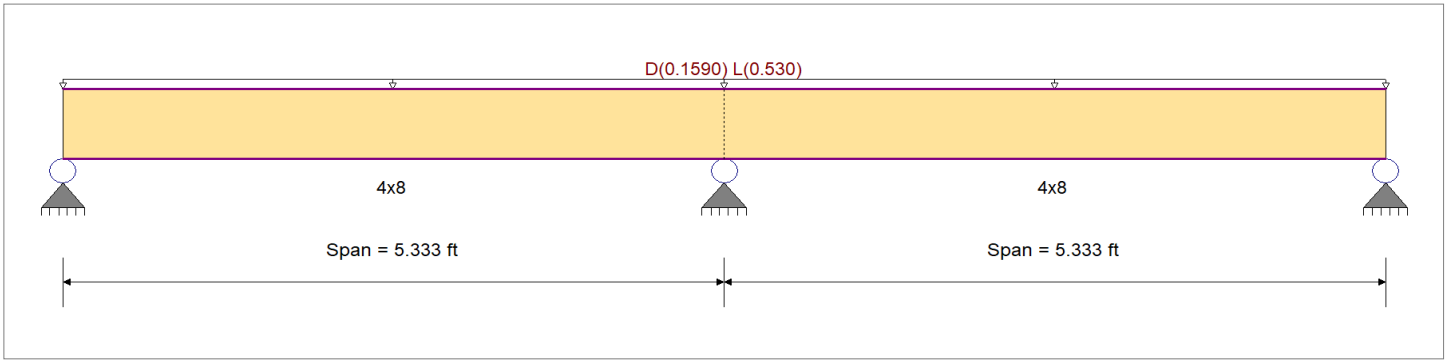
Wood Species : Hem Fir
Wood Grade : No.2

Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	850.0 psi
Fb -	850.0 psi
Fc - Prll	1,300.0 psi
Fc - Perp	405.0 psi
Fv	150.0 psi
Ft	525.0 psi

E : Modulus of Elasticity

Ebend- xx	1,300.0 ksi
Eminbend - xx	470.0 ksi
Density	26.830 pcf



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loading
Loads on all spans...
Uniform Load on ALL spans : D = 0.0120, L = 0.040 ksf, Tributary Width = 13.250 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.761 : 1	Maximum Shear Stress Ratio	=	0.652 : 1
Section used for this span		4x8	Section used for this span		4x8
fb: Actual	=	1,453.43 psi	fv: Actual	=	169.02 psi
F'b	=	1,909.44 psi	F'v	=	259.20 psi
Load Combination		+1.20D+1.60L	Load Combination		+1.20D+1.60L
Location of maximum on span	=	5.333 ft	Location of maximum on span	=	5.333 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.028 in	Ratio =	2279 >=360	Span: 2 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.037 in	Ratio =	1741 >=240	Span: 2 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	λ	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values Mu	fb	Fb	Shear Values Vu	fv	Fv
+1.40D														0.0	0.00	0.0	0.0
Length = 5.333 ft	1	0.223	0.191	0.60	1.00	1.00	1.00	1.300	1.00	1.00	1.00	0.81	319.0	1,432.1	0.63	37.1	194.4
Length = 5.333 ft	2	0.223	0.191	0.60	1.00	1.00	1.00	1.300	1.00	1.00	1.00	0.81	319.0	1,432.1	0.63	37.1	194.4
+1.20D+1.60L					1.00	1.00	1.00	1.300	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 5.333 ft	1	0.761	0.652	0.80	1.00	1.00	1.00	1.300	1.00	1.00	1.00	3.71	1,453.4	1,909.4	2.86	169.0	259.2
Length = 5.333 ft	2	0.761	0.652	0.80	1.00	1.00	1.00	1.300	1.00	1.00	1.00	3.71	1,453.4	1,909.4	2.86	169.0	259.2
+1.20D+L					1.00	1.00	1.00	1.300	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 5.333 ft	1	0.529	0.454	0.80	1.00	1.00	1.00	1.300	1.00	1.00	1.00	2.58	1,010.9	1,909.4	1.99	117.6	259.2
Length = 5.333 ft	2	0.529	0.454	0.80	1.00	1.00	1.00	1.300	1.00	1.00	1.00	2.58	1,010.9	1,909.4	1.99	117.6	259.2
+1.20D					1.00	1.00	1.00	1.300	1.00	1.00	1.00			0.0	0.00	0.0	0.0

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Project Title: NHD AJ-532-A
Engineer:
Project ID: 9454-16
Project Descr: Single Family Residence

Wood Beam

Project File: AJ-532-A.ec6

DESCRIPTION: Floor Joist Collector Beam

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	λ	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values Mu	fb	Fb	Shear Values Vu	fv	Fv
Length = 5.333 ft	**1**	0.143	0.123	0.80	1.00	1.00	1.00	1.300	1.00	1.00	1.00	0.70	273.4	1,909.4	0.54	31.8	259.2
Length = 5.333 ft	**2**	0.143	0.123	0.80	1.00	1.00	1.00	1.300	1.00	1.00	1.00	0.70	273.4	1,909.4	0.54	31.8	259.2
+0.90D					1.00	1.00	1.00	1.300	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 5.333 ft	**1**	0.086	0.074	1.00	1.00	1.00	1.00	1.300	1.00	1.00	1.00	0.52	205.1	2,386.8	0.40	23.8	324.0
Length = 5.333 ft	**2**	0.086	0.074	1.00	1.00	1.00	1.00	1.300	1.00	1.00	1.00	0.52	205.1	2,386.8	0.40	23.8	324.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0367	2.264		0.0000	0.000
+D+L	2	0.0364	3.099		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Max Upward from all Load Conditions	1.387	4.625	1.387
Max Upward from Load Combinations	1.387	4.625	1.387
Max Upward from Load Cases	1.060	3.533	1.060
D Only	0.327	1.092	0.327
+D+L	1.387	4.625	1.387
+D+0.750L	1.122	3.742	1.122
+0.60D	0.196	0.655	0.196
L Only	1.060	3.533	1.060

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Project Title: NHD AJ-532-A
Engineer:
Project ID: 9454-16
Project Descr: Single Family Residence

General Footing

Project File: AJ-532-A.ec6

DESCRIPTION: Typical Footing Pad

Code References

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : ASCE 7-16

General Information

Material Properties

f'c : Concrete 28 day strength	=	2.50	ksi
fy : Rebar Yield	=	60.0	ksi
Ec : Concrete Elastic Modulus	=	2,850.0	ksi
Concrete Density	=	145.0	pcf
φ Values Flexure	=	0.90	
Shear	=	0.750	

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	Yes
Add Pedestal Wt for Soil Pressure	:	No
Use Pedestal wt for stability, mom & shear	:	No

Soil Design Values

Allowable Soil Bearing	=	1.50	ksf
Soil Density	=	110.0	pcf
Increase Bearing By Footing Weight	=	No	
Soil Passive Resistance (for Sliding)	=	250.0	pcf
Soil/Concrete Friction Coeff.	=	0.30	

Increases based on footing Depth

Footing base depth below soil surface	=	ft
Allow press. increase per foot of depth	=	ksf
when footing base is below	=	ft

Increases based on footing plan dimension

Allowable pressure increase per foot of depth	=	ksf
when max. length or width is greater than	=	ft

Dimensions

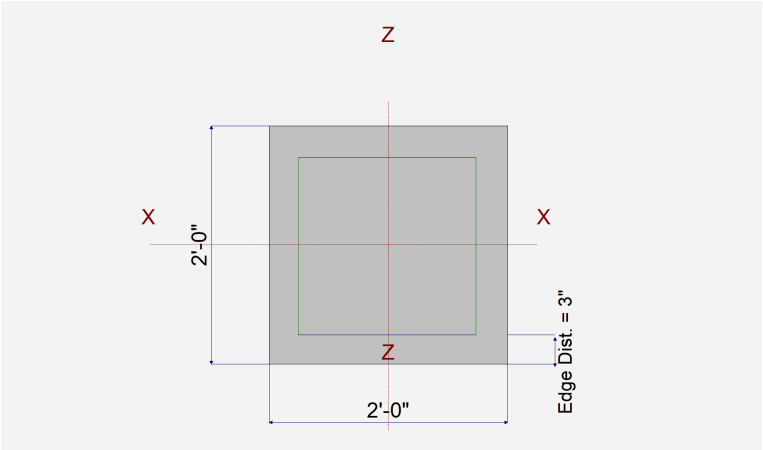
Width parallel to X-X Axis	=	2.0 ft
Length parallel to Z-Z Axis	=	2.0 ft
Footing Thickness	=	8.0 in

Pedestal dimensions...

px : parallel to X-X Axis	=	in
pz : parallel to Z-Z Axis	=	in
Height	=	in

Rebar Centerline to Edge of Concrete...

at Bottom of footing	=	4.0 in

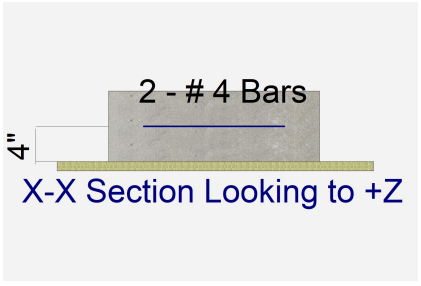


Reinforcing

Bars parallel to X-X Axis			
Number of Bars	=		2.0
Reinforcing Bar Size	=	#	4
Bars parallel to Z-Z Axis			
Number of Bars	=		2.0
Reinforcing Bar Size	=	#	4

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation	n/a
# Bars required within zone	n/a
# Bars required on each side of zone	n/a



Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	1.090		3.530					k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=								k-ft
V-x	=								k
V-z	=								k

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Project Title: NHD AJ-532-A
Engineer:
Project ID: 9454-16
Project Descr: Single Family Residence

General Footing

Project File: AJ-532-A.ec6

DESCRIPTION: Typical Footing Pad

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.8347	Soil Bearing	1.252 ksf	1.50 ksf	+D+L about Z-Z axis
PASS	n/a	Overturning - X-X	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Overturning - Z-Z	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.2566	Z Flexure (+X)	0.8695 k-ft/ft	3.388 k-ft/ft	+1.20D+1.60L
PASS	0.2566	Z Flexure (-X)	0.8695 k-ft/ft	3.388 k-ft/ft	+1.20D+1.60L
PASS	0.2566	X Flexure (+Z)	0.8695 k-ft/ft	3.388 k-ft/ft	+1.20D+1.60L
PASS	0.2566	X Flexure (-Z)	0.8695 k-ft/ft	3.388 k-ft/ft	+1.20D+1.60L
PASS	0.3188	1-way Shear (+X)	23.911 psi	75.0 psi	+1.20D+1.60L
PASS	0.3188	1-way Shear (-X)	23.911 psi	75.0 psi	+1.20D+1.60L
PASS	0.3188	1-way Shear (+Z)	23.911 psi	75.0 psi	+1.20D+1.60L
PASS	0.3188	1-way Shear (-Z)	23.911 psi	75.0 psi	+1.20D+1.60L
PASS	0.7060	2-way Punching	105.905 psi	150.0 psi	+1.20D+1.60L

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc (in)	Zecc (in)	Actual Soil Bearing Stress @ Location Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, D Only	1.50	n/a	0.0	0.3692	0.3692	n/a	n/a	0.246
X-X, +D+L	1.50	n/a	0.0	1.252	1.252	n/a	n/a	0.835
X-X, +D+0.750L	1.50	n/a	0.0	1.031	1.031	n/a	n/a	0.687
X-X, +0.60D	1.50	n/a	0.0	0.2215	0.2215	n/a	n/a	0.148
Z-Z, D Only	1.50	0.0	n/a	n/a	n/a	0.3692	0.3692	0.246
Z-Z, +D+L	1.50	0.0	n/a	n/a	n/a	1.252	1.252	0.835
Z-Z, +D+0.750L	1.50	0.0	n/a	n/a	n/a	1.031	1.031	0.687
Z-Z, +0.60D	1.50	0.0	n/a	n/a	n/a	0.2215	0.2215	0.148

All units k

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status
Footing Has NO Sliding				

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	0.1908	+Z	Bottom	0.1728	AsMin	0.20	3.388	OK
X-X, +1.40D	0.1908	-Z	Bottom	0.1728	AsMin	0.20	3.388	OK
X-X, +1.20D+1.60L	0.8695	+Z	Bottom	0.1728	AsMin	0.20	3.388	OK
X-X, +1.20D+1.60L	0.8695	-Z	Bottom	0.1728	AsMin	0.20	3.388	OK
X-X, +1.20D+L	0.6048	+Z	Bottom	0.1728	AsMin	0.20	3.388	OK
X-X, +1.20D+L	0.6048	-Z	Bottom	0.1728	AsMin	0.20	3.388	OK
X-X, +1.20D	0.1635	+Z	Bottom	0.1728	AsMin	0.20	3.388	OK
X-X, +1.20D	0.1635	-Z	Bottom	0.1728	AsMin	0.20	3.388	OK
X-X, +0.90D	0.1226	+Z	Bottom	0.1728	AsMin	0.20	3.388	OK
X-X, +0.90D	0.1226	-Z	Bottom	0.1728	AsMin	0.20	3.388	OK
Z-Z, +1.40D	0.1908	-X	Bottom	0.1728	AsMin	0.20	3.388	OK
Z-Z, +1.40D	0.1908	+X	Bottom	0.1728	AsMin	0.20	3.388	OK
Z-Z, +1.20D+1.60L	0.8695	-X	Bottom	0.1728	AsMin	0.20	3.388	OK
Z-Z, +1.20D+1.60L	0.8695	+X	Bottom	0.1728	AsMin	0.20	3.388	OK
Z-Z, +1.20D+L	0.6048	-X	Bottom	0.1728	AsMin	0.20	3.388	OK
Z-Z, +1.20D+L	0.6048	+X	Bottom	0.1728	AsMin	0.20	3.388	OK
Z-Z, +1.20D	0.1635	-X	Bottom	0.1728	AsMin	0.20	3.388	OK
Z-Z, +1.20D	0.1635	+X	Bottom	0.1728	AsMin	0.20	3.388	OK
Z-Z, +0.90D	0.1226	-X	Bottom	0.1728	AsMin	0.20	3.388	OK
Z-Z, +0.90D	0.1226	+X	Bottom	0.1728	AsMin	0.20	3.388	OK

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Project Title: NHD AJ-532-A
Engineer:
Project ID: 9454-16
Project Descr: Single Family Residence

General Footing

Project File: AJ-532-A.ec6

DESCRIPTION: Typical Footing Pad

One Way Shear

Load Combination...	Vu @ -X	Vu @ +X	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	5.25 psi	5.25 psi	5.25 psi	5.25 psi	5.25 psi	75.00 psi	0.07	OK
+1.20D+1.60L	23.91 psi	23.91 psi	23.91 psi	23.91 psi	23.91 psi	75.00 psi	0.32	OK
+1.20D+L	16.63 psi	16.63 psi	16.63 psi	16.63 psi	16.63 psi	75.00 psi	0.22	OK
+1.20D	4.50 psi	4.50 psi	4.50 psi	4.50 psi	4.50 psi	75.00 psi	0.06	OK
+0.90D	3.37 psi	3.37 psi	3.37 psi	3.37 psi	3.37 psi	75.00 psi	0.04	OK

Two-Way "Punching" Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	23.23 psi	150.00 psi	0.1549	OK
+1.20D+1.60L	105.91 psi	150.00 psi	0.706	OK
+1.20D+L	73.66 psi	150.00 psi	0.4911	OK
+1.20D	19.91 psi	150.00 psi	0.1328	OK
+0.90D	14.94 psi	150.00 psi	0.09957	OK

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Project Title: NHD AJ-532-A
Engineer:
Project ID: 9454-16
Project Descr: Single Family Residence

General Footing

Project File: AJ-532-A.ec6

DESCRIPTION: 3 Car Girder Truss Support Pad

Code References

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : ASCE 7-16

General Information

Material Properties

f'c : Concrete 28 day strength	=	2.50	ksi
fy : Rebar Yield	=	60.0	ksi
Ec : Concrete Elastic Modulus	=	2,850.0	ksi
Concrete Density	=	145.0	pcf
φ Values Flexure	=	0.90	
Shear	=	0.750	

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	Yes
Add Pedestal Wt for Soil Pressure	:	No
Use Pedestal wt for stability, mom & shear	:	No

Soil Design Values

Allowable Soil Bearing	=	1.50	ksf
Soil Density	=	110.0	pcf
Increase Bearing By Footing Weight	=	No	
Soil Passive Resistance (for Sliding)	=	250.0	pcf
Soil/Concrete Friction Coeff.	=	0.30	

Increases based on footing Depth

Footing base depth below soil surface	=	ft
Allow press. increase per foot of depth	=	ksf
when footing base is below	=	ft

Increases based on footing plan dimension

Allowable pressure increase per foot of depth	=	ksf
when max. length or width is greater than	=	ft

Dimensions

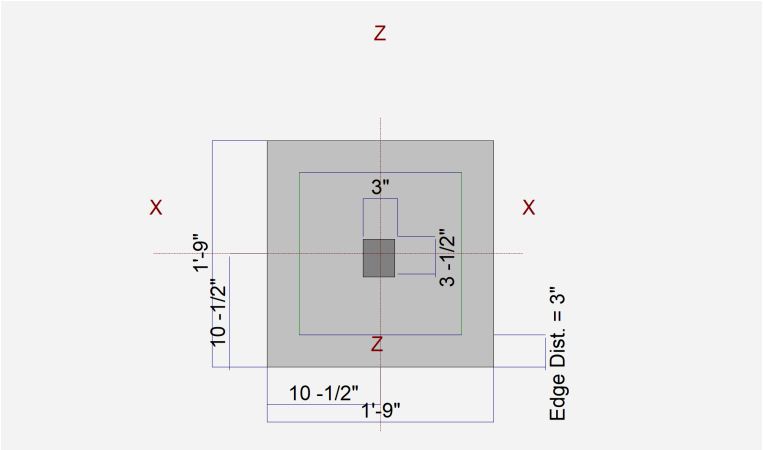
Width parallel to X-X Axis	=	1.750 ft
Length parallel to Z-Z Axis	=	1.750 ft
Footing Thickness	=	6.0 in

Pedestal dimensions...

px : parallel to X-X Axis	=	3.0 in
pz : parallel to Z-Z Axis	=	3.50 in
Height	=	22.50 in

Rebar Centerline to Edge of Concrete...

at Bottom of footing	=	3.0 in



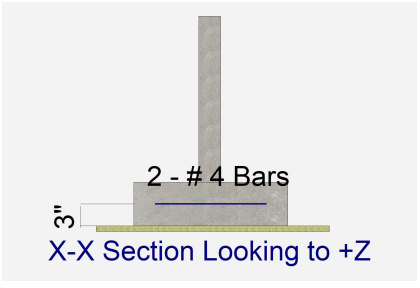
Reinforcing

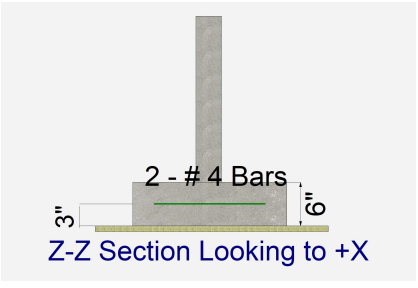
Bars parallel to X-X Axis			
Number of Bars	=		2.0
Reinforcing Bar Size	=	#	4
Bars parallel to Z-Z Axis			
Number of Bars	=		2.0
Reinforcing Bar Size	=	#	4

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation

Bars required within zone
Bars required on each side of zone





Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	1.615	1.90		2.375				k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=								k-ft
V-x	=								k
V-z	=								k

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Project Title: NHD AJ-532-A
Engineer:
Project ID: 9454-16
Project Descr: Single Family Residence

General Footing

Project File: AJ-532-A.ec6

DESCRIPTION: 3 Car Girder Truss Support Pad

DESIGN SUMMARY

Design N.G.

Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	Soil Bearing	ksf	ksf	
FAIL	Overturning - X-X	k-ft	k-ft	
FAIL	Overturning - Z-Z	k-ft	k-ft	
FAIL	Sliding - X-X	k	k	
FAIL	Sliding - Z-Z	k	k	
FAIL	Uplift	k	k	
PASS	Z Flexure (+X)	k-ft/ft	k-ft/ft	
PASS	Z Flexure (-X)	k-ft/ft	k-ft/ft	
PASS	X Flexure (+Z)	k-ft/ft	k-ft/ft	
PASS	X Flexure (-Z)	k-ft/ft	k-ft/ft	
PASS	1-way Shear (+X)	psi	psi	
PASS	1-way Shear (-X)	psi	psi	
PASS	1-way Shear (+Z)	psi	psi	
PASS	1-way Shear (-Z)	psi	psi	
PASS	2-way Punching	psi	psi	

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc (in)	Zecc (in)	Actual Soil Bearing Stress @ Location Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, D Only	1.50	n/a	0.0	0.5998	0.5998	n/a	n/a	0.400
X-X, +D+Lr	1.50	n/a	0.0	1.220	1.220	n/a	n/a	0.813
X-X, +D+S	1.50	n/a	0.0	1.375	1.375	n/a	n/a	0.917
X-X, +D+0.750Lr	1.50	n/a	0.0	1.065	1.065	n/a	n/a	0.710
X-X, +D+0.750S	1.50	n/a	0.0	1.181	1.181	n/a	n/a	0.787
X-X, +0.60D	1.50	n/a	0.0	0.3599	0.3599	n/a	n/a	0.240
Z-Z, D Only	1.50	0.0	n/a	n/a	n/a	0.5998	0.5998	0.400
Z-Z, +D+Lr	1.50	0.0	n/a	n/a	n/a	1.220	1.220	0.813
Z-Z, +D+S	1.50	0.0	n/a	n/a	n/a	1.375	1.375	0.917
Z-Z, +D+0.750Lr	1.50	0.0	n/a	n/a	n/a	1.065	1.065	0.710
Z-Z, +D+0.750S	1.50	0.0	n/a	n/a	n/a	1.181	1.181	0.787
Z-Z, +0.60D	1.50	0.0	n/a	n/a	n/a	0.3599	0.3599	0.240

All units k

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status
Footing Has NO Sliding				

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	0.1963	+Z	Bottom	0.1296	AsMin	0.2286	2.809	OK
X-X, +1.40D	0.1963	-Z	Bottom	0.1296	AsMin	0.2286	2.809	OK
X-X, +1.20D+0.50Lr	0.2507	+Z	Bottom	0.1296	AsMin	0.2286	2.809	OK
X-X, +1.20D+0.50Lr	0.2507	-Z	Bottom	0.1296	AsMin	0.2286	2.809	OK
X-X, +1.20D+0.50S	0.2713	+Z	Bottom	0.1296	AsMin	0.2286	2.809	OK
X-X, +1.20D+0.50S	0.2713	-Z	Bottom	0.1296	AsMin	0.2286	2.809	OK
X-X, +1.20D+1.60Lr	0.4321	+Z	Bottom	0.1296	AsMin	0.2286	2.809	OK
X-X, +1.20D+1.60Lr	0.4321	-Z	Bottom	0.1296	AsMin	0.2286	2.809	OK
X-X, +1.20D+1.60S	0.4981	+Z	Bottom	0.1296	AsMin	0.2286	2.809	OK
X-X, +1.20D+1.60S	0.4981	-Z	Bottom	0.1296	AsMin	0.2286	2.809	OK
X-X, +0.90D	0.1262	+Z	Bottom	0.1296	AsMin	0.2286	2.809	OK
X-X, +0.90D	0.1262	-Z	Bottom	0.1296	AsMin	0.2286	2.809	OK
X-X, +1.20D+0.20S	0.2094	+Z	Bottom	0.1296	AsMin	0.2286	2.809	OK
X-X, +1.20D+0.20S	0.2094	-Z	Bottom	0.1296	AsMin	0.2286	2.809	OK
Z-Z, +1.40D	0.2076	-X	Bottom	0.1296	AsMin	0.2286	2.809	OK
Z-Z, +1.40D	0.2076	+X	Bottom	0.1296	AsMin	0.2286	2.809	OK
Z-Z, +1.20D+0.50Lr	0.2652	-X	Bottom	0.1296	AsMin	0.2286	2.809	OK
Z-Z, +1.20D+0.50Lr	0.2652	+X	Bottom	0.1296	AsMin	0.2286	2.809	OK

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Project Title: NHD AJ-532-A
Engineer:
Project ID: 9454-16
Project Descr: Single Family Residence

General Footing

Project File: AJ-532-A.ec6

DESCRIPTION: 3 Car Girder Truss Support Pad

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
Z-Z, +1.20D+0.50S	0.2870	-X	Bottom	0.1296	AsMin	0.2286	2.809	OK
Z-Z, +1.20D+0.50S	0.2870	+X	Bottom	0.1296	AsMin	0.2286	2.809	OK
Z-Z, +1.20D+1.60Lr	0.4572	-X	Bottom	0.1296	AsMin	0.2286	2.809	OK
Z-Z, +1.20D+1.60Lr	0.4572	+X	Bottom	0.1296	AsMin	0.2286	2.809	OK
Z-Z, +1.20D+1.60S	0.5270	-X	Bottom	0.1296	AsMin	0.2286	2.809	OK
Z-Z, +1.20D+1.60S	0.5270	+X	Bottom	0.1296	AsMin	0.2286	2.809	OK
Z-Z, +0.90D	0.1335	-X	Bottom	0.1296	AsMin	0.2286	2.809	OK
Z-Z, +0.90D	0.1335	+X	Bottom	0.1296	AsMin	0.2286	2.809	OK
Z-Z, +1.20D+0.20S	0.2216	-X	Bottom	0.1296	AsMin	0.2286	2.809	OK
Z-Z, +1.20D+0.20S	0.2216	+X	Bottom	0.1296	AsMin	0.2286	2.809	OK

One Way Shear

Load Combination...	Vu @ -X	Vu @ +X	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	10.41 psi	10.41 psi	9.69 psi	9.69 psi	10.41 psi	75.00 psi	0.14	OK
+1.20D+0.50Lr	13.29 psi	13.29 psi	12.38 psi	12.38 psi	13.29 psi	75.00 psi	0.18	OK
+1.20D+0.50S	14.39 psi	14.39 psi	13.40 psi	13.40 psi	14.39 psi	75.00 psi	0.19	OK
+1.20D+1.60Lr	22.92 psi	22.92 psi	21.33 psi	21.33 psi	22.92 psi	75.00 psi	0.31	OK
+1.20D+1.60S	26.41 psi	26.41 psi	24.59 psi	24.59 psi	26.41 psi	75.00 psi	0.35	OK
+0.90D	6.69 psi	6.69 psi	6.23 psi	6.23 psi	6.69 psi	75.00 psi	0.09	OK
+1.20D+0.20S	11.11 psi	11.11 psi	10.34 psi	10.34 psi	11.11 psi	75.00 psi	0.15	OK

Two-Way "Punching" Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	27.61 psi	150.00 psi	0.1841	OK
+1.20D+0.50Lr	35.27 psi	150.00 psi	0.2351	OK
+1.20D+0.50S	38.17 psi	150.00 psi	0.2545	OK
+1.20D+1.60Lr	60.80 psi	150.00 psi	0.4053	OK
+1.20D+1.60S	70.08 psi	150.00 psi	0.4672	OK
+0.90D	17.75 psi	150.00 psi	0.1183	OK
+1.20D+0.20S	29.47 psi	150.00 psi	0.1965	OK

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Project Title: NHD AJ-532-A
Engineer:
Project ID: 9454-16
Project Descr: Single Family Residence

Beam on Elastic Foundation

Project File: AJ-532-A.ec6

DESCRIPTION: 3 Car Girder Truss Support Footing

CODE REFERENCES

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : ASCE 7-16

Material Properties

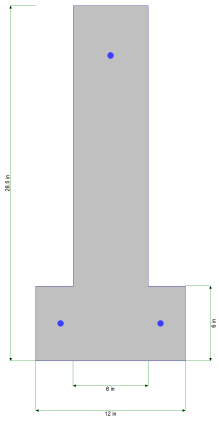
f'c	=	2.50 ksi	ϕ Phi Values	Flexure :	0.90
fr = f'c^1/2 *7.50	=	375.0 psi		Shear :	0.750
ψ Density	=	145.0 pcf	β 1	=	0.850
λ Lt Wt Factor	=	1.0			
Elastic Modulus	=	2,850.0 ksi			

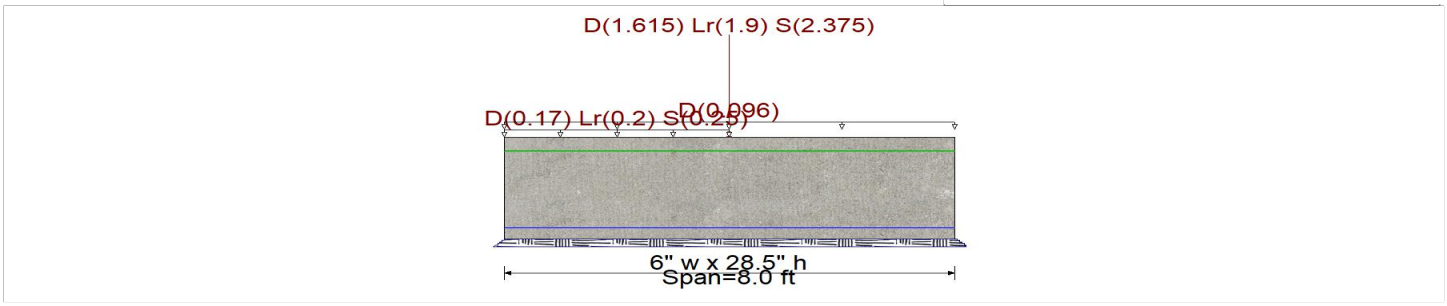
Soil Subgrade Modulus = 250.0 psi / (inch deflection)

Load Combination ASCE 7-16

fy - Main Rebar	=	60.0 ksi	Fy - Stirrups	=	40.0 ksi
E - Main Rebar	=	29,000.0 ksi	E - Stirrups	=	29,000.0 ksi
			Stirrup Bar Size #	=	# 3
			Number of Resisting Legs Per Stirrup		1.0

Beam is supported on an elastic foundation.





Cross Section & Reinforcing Details

Inverted Tee Section, Stem Width = 6.0 in, Total Height = 28.50 in, Top Flange Width = 12.0 in, Flange Thickness = 6.0 in
Span #1 Reinforcing....
2-#4 at 3.0 in from Bottom, from 0.0 to 8.0 ft in this span
1-#4 at 4.0 in from Top, from 0.0 to 8.0 ft in this span

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Point Load : D = 1.615, Lr = 1.90, S = 2.375 k @ 4.0 ft
Uniform Load : D = 0.0170, Lr = 0.020, S = 0.0250 ksf, Extent = 0.0 -->> 4.0 ft, Tributary Width = 10.0 ft
Uniform Load : D = 0.0960 k/ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.123 : 1		Maximum Deflection	
Section used for this span	Typical Section		Max Downward L+Lr+S Deflection	0.000 in
Mu : Applied	5.572 k-ft		Max Upward L+Lr+S Deflection	0.000 in
Mn * Phi : Allowable	45.169 k-ft		Max Downward Total Deflection	0.037 in
Load Combination	+1.20D+1.60S		Max Upward Total Deflection	0.006 in
Location of maximum on span	3.953 ft			
Span # where maximum occurs	Span # 1			
Maximum Soil Pressure =	1.314 ksf	at 0.00 ft	LdComb: +D+S	
Allowable Soil Pressure =	1.50 ksf	OK		

Shear Stirrup Requirements

Entire Beam Span Length : Vu < PhiVc/2, Req'd Vs = Not Reqd, use stirrups spaced at 0.000 in

Maximum Forces & Stresses for Load Combinatior

Load Combination / Segment Length	Span #	Location (ft) in Span	Bending Stress Results (k-ft Mu : Max	Phi*Mnx	Stress Ratio
MAXimum Bending Envelope					
Span # 1	1	3.953	5.57	45.17	0.12
+1.40D					
Span # 1	1	3.953	2.20	45.17	0.05

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Project Descr: Single Family Residence

Beam on Elastic Foundation

Project File: AJ-532-A.ec6

DESCRIPTION: 3 Car Girder Truss Support Footing

Load Combination / Segment Length	Span #	Location (ft) in Span	Bending Stress Results (k-ft) Mu : Max	Phi*Mnx	Stress Ratio
+1.20D+0.50Lr					
Span # 1	1	3.953	2.80	45.17	0.06
+1.20D+0.50S					
Span # 1	1	3.953	3.04	45.17	0.07
+1.20D+1.60Lr					
Span # 1	1	3.953	4.83	45.17	0.11
+1.20D+1.60S					
Span # 1	1	3.953	5.57	45.17	0.12
+0.90D					
Span # 1	1	3.953	1.41	45.17	0.03
+1.20D+0.20S					
Span # 1	1	3.953	2.34	45.17	0.05

Overall Maximum Deflections - Unfactored Lo

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
Span 1	1	0.0365	0.000		0.0000	0.000

Detailed Shear Information

Load Combination	Span Number	Distance 'd' (ft)	(in)	Vu (k) Actual	Design	Mu (k-ft)	d*Vu/Mu	Phi*Vc (k)	Comment	Phi*Vs (k)	Spacing (in) Req'd	Suggest
+1.20D+1.60S	1	0.00	25.50	0.08	0.08	0.00	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	0.09	25.50	0.16	0.16	0.00	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	0.19	25.50	0.24	0.24	0.01	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	0.28	25.50	0.32	0.32	0.03	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	0.38	25.50	0.39	0.39	0.06	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	0.47	25.50	0.47	0.47	0.09	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	0.56	25.50	0.54	0.54	0.13	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	0.66	25.50	0.62	0.62	0.18	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	0.75	25.50	0.69	0.69	0.23	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	0.85	25.50	0.76	0.76	0.29	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	0.94	25.50	0.83	0.83	0.36	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	1.04	25.50	0.90	0.90	0.44	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	1.13	25.50	0.97	0.97	0.52	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	1.22	25.50	1.04	1.04	0.60	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	1.32	25.50	1.11	1.11	0.70	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	1.41	25.50	1.17	1.17	0.80	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	1.51	25.50	1.24	1.24	0.90	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	1.60	25.50	1.30	1.30	1.02	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	1.69	25.50	1.37	1.37	1.14	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	1.79	25.50	1.43	1.43	1.26	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	1.88	25.50	1.49	1.49	1.39	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	1.98	25.50	1.55	1.55	1.53	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	2.07	25.50	1.61	1.61	1.67	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	2.16	25.50	1.67	1.67	1.82	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	2.26	25.50	1.73	1.73	1.97	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	2.35	25.50	1.79	1.79	2.13	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	2.45	25.50	1.84	1.84	2.29	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	2.54	25.50	1.90	1.90	2.46	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	2.64	25.50	1.95	1.95	2.63	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	2.73	25.50	2.00	2.00	2.81	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	2.82	25.50	2.06	2.06	3.00	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	2.92	25.50	2.11	2.11	3.19	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	3.01	25.50	2.16	2.16	3.38	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	3.11	25.50	2.21	2.21	3.58	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	3.20	25.50	2.26	2.26	3.79	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	3.29	25.50	2.30	2.30	3.99	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	3.39	25.50	2.35	2.35	4.21	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	3.48	25.50	2.40	2.40	4.42	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	3.58	25.50	2.44	2.44	4.64	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	3.67	25.50	2.49	2.49	4.87	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	3.76	25.50	2.53	2.53	5.10	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	3.86	25.50	2.57	2.57	5.33	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	3.95	25.50	2.61	2.61	5.57	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	4.05	25.50	-3.06	3.06	5.54	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	4.14	25.50	-2.96	2.96	5.25	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	4.24	25.50	-2.87	2.87	4.97	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	4.33	25.50	-2.78	2.78	4.70	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	4.42	25.50	-2.68	2.68	4.44	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	4.52	25.50	-2.59	2.59	4.19	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00

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Project Descr: Single Family Residence

Beam on Elastic Foundation

Project File: AJ-532-A.ec6

DESCRIPTION: 3 Car Girder Truss Support Footing

Detailed Shear Information

Load Combination	Span Number	Distance (ft)	'd' (in)	Vu Actual	(k) Design	Mu (k-ft)	d*Vu/Mu	Phi*Vc (k)	Comment	Phi*Vs (k)	Spacing (in) Req'd	Suggest
+1.20D+1.60S	1	4.61	25.50	-2.50	2.50	3.94	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	4.71	25.50	-2.41	2.41	3.70	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	4.80	25.50	-2.32	2.32	3.48	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	4.89	25.50	-2.24	2.24	3.26	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	4.99	25.50	-2.15	2.15	3.04	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	5.08	25.50	-2.06	2.06	2.84	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	5.18	25.50	-1.98	1.98	2.64	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	5.27	25.50	-1.90	1.90	2.46	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	5.36	25.50	-1.81	1.81	2.28	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	5.46	25.50	-1.73	1.73	2.10	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	5.55	25.50	-1.65	1.65	1.94	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	5.65	25.50	-1.58	1.58	1.78	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	5.74	25.50	-1.50	1.50	1.63	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	5.84	25.50	-1.42	1.42	1.49	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	5.93	25.50	-1.35	1.35	1.36	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	6.02	25.50	-1.27	1.27	1.23	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	6.12	25.50	-1.20	1.20	1.11	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	6.21	25.50	-1.13	1.13	0.99	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	6.31	25.50	-1.05	1.05	0.89	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	6.40	25.50	-0.98	0.98	0.78	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	6.49	25.50	-0.91	0.91	0.69	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	6.59	25.50	-0.85	0.85	0.60	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	6.68	25.50	-0.78	0.78	0.52	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	6.78	25.50	-0.71	0.71	0.45	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	6.87	25.50	-0.65	0.65	0.38	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	6.96	25.50	-0.59	0.59	0.32	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	7.06	25.50	-0.52	0.52	0.26	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	7.15	25.50	-0.46	0.46	0.21	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	7.25	25.50	-0.40	0.40	0.16	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	7.34	25.50	-0.34	0.34	0.12	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	7.44	25.50	-0.28	0.28	0.09	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	7.53	25.50	-0.23	0.23	0.06	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	7.62	25.50	-0.17	0.17	0.04	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	7.72	25.50	-0.12	0.12	0.02	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	7.81	25.50	-0.06	0.06	0.01	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00
+1.20D+1.60S	1	7.91	25.50	-0.01	0.01	0.00	1.00	12.03	Vu < PhiVc/2	Not Reqd	0.00	0.00

APPENDIX

APA

Technical Topics

TT-100H MAY 2020

A Portal Frame with Hold Downs for Engineered Applications

The APA portal-frame design, as shown in Figure 1, was envisioned primarily for use as bracing in conventional light-frame construction. However, it can also be used in engineered applications, as described in this technical topic. The portal frame is not actually a narrow shear wall because it transfers shear by means of a semi-rigid, moment-resisting frame. The extended header is integral in the function of the portal frame, thus, the effective frame width is more than just the wall segment, but includes the header length that extends beyond the wall segment. For this shear transfer mechanism, the wall aspect ratio requirements of the code do not apply to the wall segment of the APA portal frame.

FIGURE 1

CONSTRUCTION DETAILS FOR APA PORTAL-FRAME DESIGN WITH HOLD DOWNS

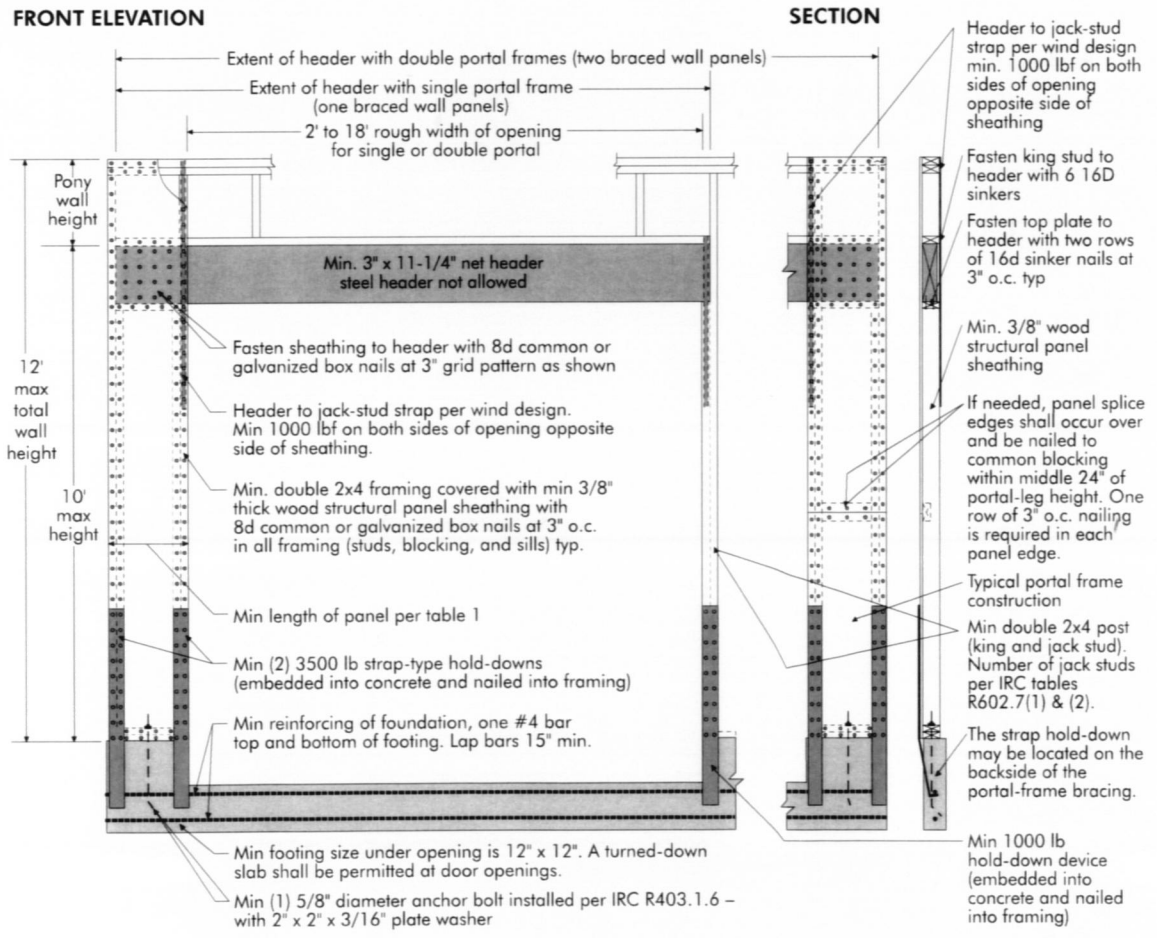

TABLE 1

RECOMMENDED ALLOWABLE DESIGN VALUES FOR A SINGLE LEG OF AN APA PORTAL FRAME USED ON A RIGID-BASE FOUNDATION FOR WIND OR SEISMIC LOADING[a,b,c,d]

Minimum Portal Width (in.)	Maximum Portal Height (ft)	Allowable Design (ASD) Values per Frame Segment		Load Factor
		Shear[e,f] (lbf)	Deflection (in.)	
16	8	850	0.33	3.09
	10	625	0.44	2.97
24	8	1,675	0.38	2.88
	10	1,125	0.51	3.42

a. Design values are based on the use of Douglas-fir or Southern pine framing. For other species of framing, multiply the above shear design value by the specific gravity adjustment factor = (1 – (0.5 – SG)), where SG = specific gravity of the actual framing. This adjustment shall not be greater than 1.0.

b. For construction as shown in Figure 1.

c. Values are for a single portal-frame segment (one vertical leg and a portion of the header). For multiple portal-frame segments, the allowable shear design values are permitted to be multiplied by the number of frame segments.

d. Interpolation of design values for heights between 8 and 10 feet, and for portal widths between 16 and 24 inches, is permitted.

e. The allowable shear design value is permitted to be multiplied by a factor of 1.4 for wind design.

f. If story drift is not a design consideration, the tabulated design shear values are permitted to be multiplied by a factor of 1.15. This factor is permitted to be used cumulatively with the wind-design adjustment factor in Footnote (e) above.

Recommended design values for engineered use of the portal frames are provided in Table 1 considering both strength and stiffness. The Table 1 values were developed using the CUREE cyclic test protocol (ASTM E2126) with a flexible load head to ensure that the code (IBC) drift limit, ductility and safety factor are maintained. For seismic design, APA recommends using the design coefficients and factors for light-frame (wood) walls sheathed with wood structural panels rated for shear resistance (Item 15 of Table 12.2-1 of ASCE 7-16). See APA Report T2004-59 for more details.

Since cyclic testing was conducted with the portal frame attached to a rigid test frame using embedded strap-type hold downs, design values provided in Table 1 of this document should be limited to portal frames constructed on similar rigid-base foundations, such as a concrete foundation, stem wall or slab, and using a similar embedded strap-type hold down.

References

APA. 2004. *Confirmation of Seismic Design Coefficients for the APA Portal Frame.* APA Report T2004-59. Tacoma, WA.

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American Society of Civil Engineers. 2016. *Minimum Design Load and Associated Criteria for Buildings and Other Structures.* ASCE 7. Reston, VA.

ASTM International. 2001. *Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings.* ASTM E2126. West Conshohocken, PA.

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