



ACUTE ENGINEERING

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Structural Calculations

Project Name: Urban Industrial Brinkerhoff Duplex (Payson)
550721
Project Location: 387 N 300 E
Payson, Utah 84651
Project Number: 550721
Date: 7/12/2021

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Valid Wet Stamp In Red



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Date:	7/12/2021	Prepared by:
Project:	Urban Industrial Brinkerhoff Duplex (Payson) 550721	JRO

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1. Design Criteria

Project information

Address / location * = 387 N 300 E

Area / subdivision

Area / subdiv. No. 1 = Other

City, county = Payson (0 county)

State, Zip Code = Utah 84651

* The structural calculations report and corresponding construction documents are valid for a single use at the project location and shall not be reused, copied, or reproduced without written consent.

Jurisdiction / occupancy information

Jurisdiction = Utah

Building code = Utah Code, Title 15A

Model building code = 2015 IRC 2018 IBC 101.2 & IRC R301.1.3

Use and occupancy classification = Residential - 2-unit dwelling (R)

Risk category = Not occupancy categories I, III, IV (II)

** Building code compliance of non-structural issues is not addressed. Refer to the architect or designer for compliance.

Deferred submittals

Prefabricated metal plate wood trusses - roof (truss manufacturer)



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Environmental load parameters

Earthquake

Latitude, longitude = 40.048335, -111.728616
Mapped short period S_s = 1.7 2018 IBC Figure 1613.2.1(1)
Mapped 1-sec. period S_1 = 0.628 2018 IBC Figure 1613.2.1(2)

Wind

Basic design wind speed V = 105 mph 2018 IBC Figure 1609.3(1), 1609.3(2), 1609.3(3)
Exposure category = C 2018 IBC 1609.4.3

Soil

Geotechnical design basis †

Area / subdiv. No. 1 = Presumptive values, 2018 IBC Table 1806.2
Minimum frost cover = 30 in. 2018 IBC 1809.5
Site class = D-Default
Special requirements = None

Lateral active press. = 30 psf/ft
Lateral at-rest press. = 60 psf/ft
Lateral passive press. = 150 psf/ft
Coeff. of friction = 0.25
Allow. vert. bearing Q_a = 1500 psf
Min. cont. footing = 18 in.
Min. spot footing = 20 in.

† It is recommended that a geotechnical investigation be conducted unless satisfactory data from adjacent areas is available that demonstrates an investigation is not necessary for any of the conditions in 2018 IBC 1803.5.1-12. The structural calculations report and corresponding construction documents are only valid for the soil parameters listed herein. The design professional in responsible charge shall be notified if observations or field conditions differ.

Snow

Elevation (max) = 4635 ft

Rain

15-min. rainfall intensit = 3.98 in/hr
60-min. rainfall intensit = 1.66 in/hr

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2.1 Loads - Snow

Ground snow loads

(ASCE 7-16 Chap. 7.2)

Basis	= Utah amend. 2018 IBC 1608.1.2
Elevation	= 4635 ft
Ground snow load	Pg = 34 psf

Flat roof snow loads

(ASCE 7-16 Chap. 7.3)

Basis	= ASCE 7-16 Equation 7.3-1	
Roof exposure definition	= Not fully exposed or sheltered (ASCE 7-16 Table 7.3-1, Notes a and b).	
Roof exposure	= Partial	ASCE 7-16 Table 7.3-1 (notes a,b)
Terrain category (wind)	= C	
Exposure factor	Ce = 1	ASCE 7-16 Table 7.3-1
Roof thermal condition	= Not unheated nor a continuously heated greenhouse (ASCE 7-16 Table 7.3-2).	
Thermal factor	Ct = 1	ASCE 7-16 Table 7.3-2
Risk category	= II	
Snow importance factor	Is = 1	ASCE 7-16 Table 1.5-2
Flat roof snow load	Pf = 24 psf	ASCE 7-16 Equation 7.3-1

Sloped roof snow loads

(ASCE 7-16 Chap. 7.4)

Basis	= ASCE 7-16 Equation 7.4-1	
Roof surface	= Non-slippery (asphalt shingles, wood shingles, or shakes).	
Roof slope	= 34 deg.	
Roof slope factor	Cs = 0.91	ASCE 7-16 Chap. C7.4
Eave snow load	Peave = 22 psf	Utah amend. 2018 IBC 1608.1.1
Balanced snow load	Ps = 22 psf	ASCE 7-16 Equation 7.4-1

Unbalanced roof snow loads

(ASCE 7-16 Chap. 7.6)

Hip and gable roofs

Eave to ridge distance	W = 21.5 ft	
Roof system	= Truss	
Snow density	gamma = 18 pcf	ASCE 7-16 Equation 7.7-1
Height of balanced snow	Hb = 1 ft	ASCE 7-16 Chap. 7.7.1
Unbalanced snow load	Ps = 22 psf	ASCE 7-16 Chap. 7.6.1

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2.2 Loads - Dead / Live

Roof dead loads

(2018 IBC 1606, ASCE 7-16 Table C3.1-1a)

Asphalt shingles	= 2 psf	ASCE 7-16 Table C3.1-1a
Felt or ready roofing, roof sheathing	= 3 psf	ASCE 7-16 Table C3.1-1a
Wood trusses, misc	= 5 psf	Estimated
Insulation, gypsum sheathing	= 5 psf	ASCE 7-16 Table C3.1-1a
Roof DL No. 1	Total = 15 psf	

Floor dead loads

(2018 IBC 1606, ASCE 7-16 Table C3.1-1a)

Floor sheathing	= 2 psf	ASCE 7-16 Table C3.1-1a
Wood joists/trusses, MEP, misc	= 6 psf	ASCE 7-16 Table C3.1-1a
Gypsum sheathing	= 2 psf	ASCE 7-16 Table C3.1-1a
Interior Walls	= 2 psf	Estimated
Floor DL No. 1	Total = 12 psf	
6" composite suspended concrete slab	= 75 psf	Estimated
Floor DL No. 2	Total = 75 psf	

Wall dead loads

(2018 IBC 1606, ASCE 7-16 Table C3.1-1a)

Interior stud walls	= 10 psf	ASCE 7-16 12.14.8.1
Exterior 2x6@16"o.c., 5/8" gyp, insul., 7/16" sheath	= 12 psf	ASCE 7-16 Table C3.1-1a

Roof live loads

(2018 IBC 1607)

Occupancy or use	Unif. (psf)	Conc. (lb)	Ref.
Roofs (ordinary construction)	= 20	300	2018 IBC Table 1607.1 No. 26

Floor live loads

(2018 IBC 1607)

Occupancy or use	Unif. (psf)	Conc. (lb)	Ref.
Residential (1-2 unit dwelling)	= 40	0	2018 IBC Table 1607.1 No. 25
Stairs and exits (residential 1-2 unit dwelling)	= 40	300	2018 IBC Table 1607.1 No. 30
Decks	= 60	0	2018 IBC Table 1607.1 No. 5

Load sets

Live load (occupancy or use)	(psf)	Dead load	(psf)	Abbrev.
Flat roof snow load	24	Roof DL No. 1	15	S 24 15
Residential (1-2 unit dwelling)	40	Floor DL No. 1	12	L 40 12
Stairs and exits (residential 1-2 unit dwelling)	40	Floor DL No. 1	12	Ex 40 12
Decks	60	Floor DL No. 1	12	D 60 12
Residential (1-2 unit dwelling)	40	Floor DL No. 2	75	C 40 75

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Deflection limits (L/limit)

(2018 IBC 1604.3.1)

Construction		L	S or W	D+L
Roof members (supporting plaster ceiling)	=	360	360	240
Floor members (joists)	=	480		240
Floor members (beams/headers)	=	360		240
Exterior walls and interior partitions (with other brit	=		240	

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2.3 Loads - Earthquake

Seismic Design Criteria

(2018 IBC 1613.2, ASCE 7-16 Chap. 11)

Mapped acceleration parameters

Latitude	= 40.048
Longitude	= -111.729
MCE short period	Ss = 1.7 g
MCE 1.0 sec. period	S1 = 0.628 g

Design acceleration parameters

Site class	= D-Default		
Site coefficient	Fa = 1.2		
Site coefficient	Fv = 1.7		
Adjusted short period	SMS = 2.04	Design short period	SDS = 1.36
Adjusted 1.0 sec. period	SM1 = 1.07	Design 1.0 sec. period	SD1 = 0.71
Risk category	= II		
IRC Seismic design category	= E		

Dead loads

(2018 IBC 1606; ASCE 7-16 Chap. 12.7.2, Table C3.1-1a)

Effective seismic snow weight	= 0 psf	Utah Amend. 2018 IBC 1613.1.1
Roof DL No. 1	= 15 psf	
Floor DL No. 1	= 12 psf	
Interior stud walls	= 10 psf	
Exterior 2x6@16"o.c., 5/8" gyp, insul., 7/16" sheath	= 12 psf	
Exterior stud wall, synthetic (cultured) stone veneer	= 27 psf	

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Equivalent Lateral Force Procedure

(ASCE 7-16 Chap. 12.8)

	Primary LFRS
Basic structural system	= Bearing wall systems
Seismic force-resisting system	= Light-frame wood walls (wood sheath)

Structural design parameters

Response modification factor	R = 6.5	ASCE 7-16 Table 12.2-1 No. A15
System overstrength factor	Omega = 3	ASCE 7-16 Table 12.2-1 No. A15
Deflection amplification factor	Cd = 4	ASCE 7-16 Table 12.2-1 No. A15
Building height limit	= 65 ft	ASCE 7-16 Table 12.2-1 No. A15

Fundamental period

Structure type	= All other	
Approximate period parameter	Ct = 0.02	ASCE 7-16 Table 12.8-2
Approximate period parameter	x = 0.75	ASCE 7-16 Table 12.8-2
Height above base	= 10.5 ft	
Approximate fundamental period	Ta = 0.117 sec.	ASCE 7-16 Equation 12.8-7
Approximate fundamental freq.	n = 8.57 hz	
Long period transition period	TL = 8 sec.	ASCE 7-16 Figure 22-14

Seismic base shear

Seismic importance factor	Ie = 1.00	ASCE 7-16 Table 1.5-2
Seismic response coefficient	Csmin = 0.06	ASCE 7-16 Equations 12.8-5,6
Seismic response coefficient	Csmax = 0.939	ASCE 7-16 Equations 12.8-3,4
Seismic response coefficient	Cs = 0.21	ASCE 7-16 Equation 12.8-2
Seismic base shear (LRFD)	V = 16090 lb	ASCE 7-16 Equation 12.8-1

Weight Parameters

		Exterior Wall		Roof		Floor + Int Wall		Total
	Trib.	Permtr 1 (ft)	Permtr 2 (ft)	Area (sf)	Weight (psf)	Area (sf)	Weight (psf)	Weight (lb)
1	5	282	0	4,055	15	0	12	76,899
Total								76,899

Seismic Lateral Loads

(ASCE 7-16 Chap. 12.8.3)

Level	Height (ft)	Floor (in)	Hx (ft)	Cvx	Fx (lb)	Vx (Shear walls)	
						LRFD (lb)	ASD (lb)
1	9.0	12	10.50	1.0	16,090	16,090	11,263



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2.4 Loads - Wind

Design wind pressure

(2018 IBC 1609, ASCE 7-16 Chap. 26)

Terrain exposure

Surface roughness (upwind) = Open terrain with scattered obstructions having heights generally less than 30 ft.

Exposure category	= C	2018 IBC 1609.4.3
Terrain exp. constant	alpha = 9.5	ASCE 7-16 Table 26.11-1
Terrain exp. constant	Zg = 900	ASCE 7-16 Table 26.11-1
Terrain exp. constant	Zmin = 15 ft	ASCE 7-16 Table 26.11-1
Topographic factor	Kzt = 1	ASCE 7-16 Chap. 26.8.2

Basic wind pressure

Basic design wind speed	V = 105 mph	2018 IBC Figure 1609.3(1), 1609.3(2)
Structure type	= Buildings - MWFRS	
Wind directionality factor	Kd = 0.85	ASCE 7-16 Table 26.6-1
Risk category	= II	2018 IBC Table 1604.5
Approx. fundamental freq.	= 8.57 hz	
Structure type	= Rigid	ASCE 7-16 Chap. 26.2
Gust effect factor	G = 0.85	ASCE 7-16 Chap. 26.11.1
Enclosure	= Enclosed (A building having less than 4 sq ft of openings in each wall)	
Roof pitch	= 8:12	
Internal pressure coeff.	GCpi = 0.18	ASCE 7-16 Chap. 26.13, Table 26.13
Basic velocity pressure	q = 20.28 psf	ASCE 7-16 Equation 26.10-1

Directional Procedure: Components and cladding

(ASCE 7-16 Chap. 30.3)

Roof mean height	h = 17.3 ft	ASCE 7-16 Chap. 26.2
Effective wind area (component)	Aeff = 25 sf	
Velocity press. exp. coeff.	Kh = 0.87	ASCE 7-16 Table 26.10-1 Note 1.
Velocity pressure	qh = 17.73 psf	ASCE 7-16 Equation 26.10-1

Pressure coefficient		End	Interior	
Positive	GCp =	0.93	0.93	ASCE 7-16 Figure 30.3-1
Negative	GCp =	-1.26	-1.03	ASCE 7-16 Figure 30.3-1
Maximum pressure	max p =	25.53	21.45 psf	ASCE 7-16 Equation 30.3-1



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Elevation Geometry

Level	Trib. Height (ft)	Horiz. dim. (ft)		Max roof Elev. (ft)	Front Proj. A (sf)		Side Proj. A (sf)	
		Front	Side		Gable	Sloped	Gable	Sloped
1	4.8	79	50	24	400	650	275	245

Directional Procedure: MWFRS external pressure coefficients

(ASCE 7-16 Chap. 26.10, Figure 27.3-1 weighted Cp for sloped / gabled area)

Level	Front, Cp				Side, Cp			
	Windward		Leeward		Windward		Leeward	
Level	Max Cp	Min Cp	Max Cp	Min Cp	Max Cp	Min Cp	Max Cp	Min Cp
1	0.48	0.19	-0.56	-0.56	0.59	0.38	-0.49	-0.49
Walls	Windward	Leeward	Side					
	0.80	-0.50	-0.70	Windward	Leeward	Side		
	0.80	-0.50	-0.70	0.80	-0.38	-0.70		

Directional Procedure: MWFRS wind pressures

(ASCE 7-16 Chap. 26.10.1, Table 26.10-1))

Level	Elev. (ft)	Kz	qz (psf)	Front pressure (psf)			Side pressure (psf)		
				+GCpi	-GCpi	Total	+GCpi	-GCpi	Total
Walls - Leeward									
Max h	10.50	0.85	17.22	-10.42	-4.22		-8.72	-2.52	
Walls - Windward									
1	10.50	0.85	17.22	8.61	14.81	19.03	8.61	14.81	17.33
Roofs - Leeward									
1	24.00	0.94	19.01	-12.50	-5.66		-11.27	-4.43	
Roofs - Windward									
1	24.00	0.94	19.01	-0.38	11.17	16.82	2.77	12.94	17.37

Directional Procedure: Wind Lateral Loads

(ASCE 7-16 Chap. 27.2-27.3)

Level	Front				Side			
	Walls (lb)	Roof (lb)	Fx (ASD) (lb)	Vx (ASD) (lb)	Walls (lb)	Roof (lb)	Fx (ASD) (lb)	Vx (ASD) (lb)
1	4,284	10,599	14,883	14,883	2,469	5,419	7,888	7,888



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3.1 LFRS - Wood Sheathing / Diaphragms

Sheathing analysis

APA Engineered Wood Construction Guide, Form No. E30W (2016 APA)

Location	Applied loads (OOP)			Sheathing		Support spacing (in.)	Allow	Result
	Label	LL (psf)	DL (psf)	Size	Rating		LL (psf)	
Roof	S 24 15	24	15	7/16"	24/16	24	41	OK 41%
Floor	L 40 12	40	12	3/4"	48/24	16	335	OK 88%

Diaphragm parameters

Level	Seismic Fpx	Transverse (front)		Longitudinal (side)		Minimum Sheathing Thickness	Diaphragm Nailing		
		Wind	Horz.	Wind	Horz.				
		MWFRS	dim. (ft)	MWFRS	dim. (ft)		Edge 1	Edge 2	Blocking
1	7,321	7,441	39.5	7,888	50	7/16"	8d @ 6"	8d @ 6"	Unblocked

Diaphragm analysis

Level	Max Span (ft)	Reaction Load (lb)		Line L (ft)	Diaphragm Layout	Wind		Seismic	
		Wind	Seismic			v (plf)	Allow (plf)	v (plf)	Allow (plf)
Transverse (front) direction									
1	39.5	3,721	3,660	50	Case 1	74	322.5	73	230
Longitudinal (side) direction									
1	50	3,944	3,660	39.5	Case 3	100	237.5	93	170

Chord Analysis

Level	Max Span (ft)	Depth (ft)	% Total Load	Chord Force (lb)	Collector Type	Allow (lb)
Transverse (front) direction						
1	39.5	50	100%	735	TP Splice (12) 16d	2,700
Longitudinal (side) direction						
1	50	40	100%	1,248	TP Splice (12) 16d	2,700

Strut Analysis

Level	Line Length (ft)	Strut Length (ft)	% Total Load	Strut Force (lb)	Collector Type	Allow (lb)
Transverse (front) direction						
1	50	25	50%	1,860	TP Splice (12) 16d	2,700
Longitudinal (side) direction						
1	39.5	20	50%	1,972	TP Splice (12) 16d	2,700



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3.2 LFRS - Wood Shear Walls

Level 1 - Transverse LFRS (2018 IBC 2305)

Wind lateral load (ASD)	=	14,883 lb
Seismic lateral load (ASD)	=	11,263 lb

Line	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
W =	3,721	744	3,721												
E =	2,816	563	2,816												

Wall segment		Opening (ft)		LFRS						Anchorage		Hold-down	
Line	L (ft)	h (ft)	b total	h max	Type	Wind	Allow	Seismic	Allow	D (in.)	Type	T (lb)	Type
1	22.5	10	5	4.5	SW1	158	277	120	197	0.51	5/8" A.B. @ 32"	0	
1	16	9	10	2	SW1	158	365	120	260	0.45	5/8" A.B. @ 32"	317	LSTHD8
2	10	10	0	0	SW1	74	365	56	260	0.23	5/8" A.B. @ 32"	0	
3 A	14	9	0	0	SW1	266	365	201	260	0.91	5/8" A.B. @ 32"	1,812	LSTHD8
3 B	20.67	9	0	0	SW1	180	365	136	260	0.52	5/8" A.B. @ 32"	764	LSTHD8

Level 1 - Longitudinal LFRS (2018 IBC 2305)

Wind lateral load (ASD)	=	7,888 lb
Seismic lateral load (ASD)	=	11,263 lb

Line	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
W =	1,972	1,972	986												
E =	2,816	2,816	1,408												

Wall segment		Opening (ft)		LFRS						Anchorage		Hold-down	
Line	L (ft)	h (ft)	b total	h max	Type	Wind	Allow	Seismic	Allow	D (in.)	Type	T (lb)	Type
A	26	9	12	5.5	SW2	141	342	201	225	0.68	5/8" A.B. @ 32"	0	
B	22.92	9	12	5.5	SW1	181	365	258	260	0.95	5/8" A.B. @ 32"	525	LSTHD8
C	2	10	0	0	PORTA	247	906	352	563	1.28		3,430	STHD14
C	2	10	0	0	PORTA	247	906	352	563	1.28		3,430	STHD14



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4.1 VFRS - Wood Bearing Walls

Wall

Wall 1 2 X 6 DF Stud @ 16 in. o.c.

Section	=	1
Level	=	Main
Height	=	8.71 ft
Label	=	2 X 6 DF Stud @ 16 in. o.c.
Result	=	OK Combo 5: D + (0.6W)

Vertical Load

Label	LL (psf)	DL (psf)	Trib (ft)	Line DL (plf)	Vertical Load (plf)	
					Total	Capacity
S 24 15	24	15	14.75	55	645	3,867
L 40 12	40	12	0			

Lateral out-of-plane (OOP) pressure

Seismic	=	6.5 psf			
H	=	8.71 ft	Stud Fac.	2015 SDPWS Table 3.1.1.1	= 1.35
s	=	16 in. o.c.	Wind zone		= End
Aeff	=	11.6 sf	Lateral out-of-plane (OOP) pressure		= 25 psf
Kz	=	0.84	Combined axial / bending stress factor (CSF)		= 0.21
qz	=	17.22 psf	Lateral out-of-plane deflection (L/Defl.)		= 2,287

Geometric Properties

Width	=	1.5 in.
Depth	=	5.5 in.
S	=	7.56 in.3
Area	=	8.25 in.2
I	=	20.8 in.4
Weight	=	20 lb
Slenderness Ratio Ratio		
x-x axis	=	19.0
y-y axis	=	0.0

Column Stability

CF (Fc)	=	1.00
Cd	=	1.15
Fc	=	850 psi
c	=	0.8
FcEx	=	1161 psi
FcEy	=	0 psi
Fc*	=	978 psi
Cp	=	0.74
F'c	=	730 psi
fc	=	104 psi

Combined Axial & Bending

Cd	=	1.60
CF (Fb)	=	1.00
Fc*	=	1360 psi
Cp	=	0.63
F'c	=	862 psi
fc	=	47 psi Combo 5
fc	=	90 psi Combo 6

Wind Forces Govern Design

Cr	=	1.35
M (ASD)	=	188 lb-ft
F'b	=	1512 psi
fb	=	298 psi
CSF	=	0.21 Combo 5
CSF	=	0.17 Combo 6
CSF	=	0.07 Combo 7

Wind Deflection

Deflection	=	0.05 in.
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Wall

Wall 2 2 X 6 DF Stud @ 16 in. o.c.

Section	=	2
Level	=	Garage
Height	=	9.71 ft
Label	=	2 X 6 DF Stud @ 16 in. o.c.
Result	=	OK Combo 5: D + (0.6W)

Vertical Load

Label	LL (psf)	DL (psf)	Trib (ft)	Line DL (plf)	Vertical Load (plf)	
					Total	Capacity
S 24 15	24	15	11.5	60	525	3,867
L 40 12	40	12	0			

Lateral out-of-plane (OOP) pressure

Seismic	=	6.5 psf			
H	=	9.71 ft	Stud Fac.	2015 SDPWS Table 3.1.1.1	= 1.35
s	=	16 in. o.c.	Wind zone		= End
Aeff	=	12.9 sf	Lateral out-of-plane (OOP) pressure		= 25 psf
Kz	=	0.84	Combined axial / bending stress factor (CSF)		= 0.26
qz	=	17.22 psf	Lateral out-of-plane deflection (L/Defl.)		= 1,651

Geometric Properties

Width	=	1.5 in.
Depth	=	5.5 in.
S	=	7.56 in.3
Area	=	8.25 in.2
I	=	20.8 in.4
Weight	=	22.2 lb
Slenderness Ratio Ratio		
x-x axis	=	21.2
y-y axis	=	0.0

Column Stability

CF (Fc)	=	1.00
Cd	=	1.15
Fc	=	850 psi
c	=	0.8
FcEx	=	934 psi
FcEy	=	0 psi
Fc*	=	978 psi
Cp	=	0.67
F'c	=	660 psi
fc	=	85 psi

Combined Axial & Bending

Cd	=	1.60
CF (Fb)	=	1.00
Fc*	=	1360 psi
Cp	=	0.55
F'c	=	750 psi
fc	=	40 psi Combo 5
fc	=	74 psi Combo 6

Wind Forces Govern Design

Cr	=	1.35
M (ASD)	=	234 lb-ft
F'b	=	1512 psi
fb	=	371 psi

CSF	=	0.26	Combo 5
CSF	=	0.21	Combo 6
CSF	=	0.08	Combo 7

Wind Deflection

Deflection	=	0.07 in.
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Wall

Wall 3 2 X 4 DF Stud @ 16 in. o.c.

Section	=	3
Level	=	Basemt
Height	=	8.71 ft
Label	=	2 X 4 DF Stud @ 16 in. o.c.
Result	=	OK Combo 7: D + 0.75(0.7E) + 0.75L + 0.75S

Vertical Load

Label	LL (psf)	DL (psf)	Trib (ft)	Line DL (plf)	Vertical Load (plf)	
					Total	Capacity
S 24 15	24	15	0	55	819	1,219
L 40 12	40	12	14.5			

Lateral out-of-plane (OOP) pressure

Seismic	=	6.5 psf			
H	=	8.71 ft	Stud Fac.	2015 SDPWS Table 3.1.1.1	= 1.00
s	=	16 in. o.c.	Wind zone		= 0
Aeff	=	11.6 sf	Lateral out-of-plane (OOP) pressure		= 0 psf
Kz	=	0.84	Combined axial / bending stress factor (CSF)		= 0.67
qz	=	17.22 psf	Lateral out-of-plane deflection (L/Defl.)		= 999

Geometric Properties

Width	=	1.5 in.
Depth	=	3.5 in.
S	=	3.06 in. ³
Area	=	5.25 in. ²
I	=	5.36 in. ⁴
Weight	=	12.7 lb
Slenderness Ratio Ratio		
x-x axis	=	29.9
y-y axis	=	34.8

Column Stability

CF (Fc)	=	1.05
Cd	=	1
Fc	=	850 psi
c	=	0.8
FcEx	=	470 psi
FcEy	=	346 psi
Fc*	=	893 psi
Cp	=	0.34
F'c	=	312 psi
fc	=	208 psi

Combined Axial & Bending

Cd	=	1.60
CF (Fb)	=	1.10
Fc*	=	1428 psi
Cp	=	0.30
F'c	=	433 psi
fc	=	61 psi Combo 5
fc	=	171 psi Combo 6

Seismic Forces Govern Design

Cr	=	1
M (ASD)	=	58 lb-ft
F'b	=	1232 psi
fb	=	225 psi
CSF	=	0.23 Combo 5
CSF	=	0.16 Combo 6
CSF	=	0.37 Combo 7

Seismic Deflection

Deflection	=	0.1 in.
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4.2 VFRS - Wood Joists

Summary

Mark	=	FJ 01
Center span	=	18.5 ft
Section	=	11-7/8" TJI 210 @ 16" O.C.
Result	=	Section adequate by 13%.

FJ 01**11-7/8" TJI 210 @ 16" O.C.****Uniform Load**

Label	Class	LL (psf)	DL (psf)	Partition DL (psf)	
				Center	Cantilever
L 40 12	Floor	40	12	0	0

Beam Adjustment Factors

Cd	=	1
CF / CV	=	1
Cr	=	1

Reference Allowable Loads

Moment	=	3795 lb-ft
Shear	=	1655 lb
R1	=	1005 lb
R2	=	1005 lb

Section and Material Properties

Flange		
d	=	1.375 in.
b	=	2.0625 in.
Web		
h	=	9.125 in.
Panel		
t	=	0.75 in.
C. Factor	=	0.45

Joist Properties

Joist K	=	4.5
Joist EI	=	368308531 in.2-lb
Comp. EI	=	473974018 in.2-lb
Effec. EI	=	386538308 in.2-lb

Support

	Left	Right
Left (in.)	1.75	1.75
Web stiffener	No WS	No WS

Reactions

	Left	Right
Roof LL (lb)	0	0
Floor LL (lb)	493	493
DL (lb)	148	148
Total load (lb)	641	641

Uplift

	Left
Roof LL (lb)	0
Floor LL (lb)	0
DL (lb)	0
Total uplift (lb)	0

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Summary

Mark	=	RR 01
Center span	=	3 ft
Section	=	2 X 10 @ 24" O.C.
Result	=	Section adequate by 92%.

RR 01 2 X 10 @ 24" O.C.**Uniform Load**

Label	Class	LL (psf)	DL (psf)	Partition DL (psf)	
				Center	Cantilever
S 24 15	Roof	24	15	0	0

Beam Adjustment Factors

Cd	=	1.15
CF / CV	=	1.1
Cr	=	1

Reference Allowable Loads

Moment	=	2029 lb-ft
Shear	=	1665 lb
R1	=	1640.625 lb
R2	=	1640.625 lb

Support

	Left	Right
Left (in.)	1.75	1.75
Web stiffener	No WS	No WS

Section and Material Properties**Flange**

d	=	0 in.
b	=	0 in.

Web

h	=	0 in.
---	---	-------

Panel

t	=	0 in.
C. Factor	=	0

Reactions

	Left	Right
Roof LL (lb)	72	72
Floor LL (lb)	0	0
DL (lb)	54	54
Total load (lb)	126	126

Joist Properties

Joist K	=	738.46154
Joist EI	=	0 in.2-lb
Comp. EI	=	0 in.2-lb
Effec. EI	=	158290625 in.2-lb

Uplift

	Left
Roof LL (lb)	0
Floor LL (lb)	0
DL (lb)	0
Total uplift (lb)	0

Ledger

2018 NDS Table 12

Mark	Members		Fastener		Spacing in.	Result	Summary	
	Main	Side	Rows	Type			TL lbs/fast.	Z' lbs/fast.
RR 01	2X BLCK	2 X 10	2	16d COMMON	16	OK74%	42	162



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4.3 VFRS - Beams / Posts

Summary

Mark	=	RB 01
Section	=	(2) 2 X 6 [DF #2]
Span	=	3.5 ft
Result	=	Section adequate by 79 % - Load Combo. No.3 DL + RLL - Flexure

RB 01

(2) 2 X 6 [DF #2]

Distributed Loads

Class	LL (psf)	DL (psf)	Load Start		Load End	
			Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	24	15	2.50	0.00	2.50	3.50

Dead Loads

Self Weight	BSW =	4 plf
Cont. Dead Load	W =	120 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.15
Form	CF =	1.30
Repetative	Cr / Cv =	1.00

Load Reduction Factors

Live Load	LLRF =	1.00
-----------	--------	------

Beam Section Properties

Width	b =	3 in.
Depth	d =	5.5 in.
Area	A =	17 in.2
Shear Area	As =	11 in.2
Moment of Inertia	I =	42 in.4
Section Modulus	S =	15 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	67000000 lb-in.2

Req'd bearing length = 0.21"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.01	0.00	97 %	0.01	93 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	296	2,277	87 %
Moment (lb-ft)	351	1,696	79 %

Support Reactions

	Left	Right
RLL (lb)	105	105
FLL (lb)	0	0
DL (lb)	296	296
Total (lb)	401	401
Post		Capacity

Left: 2 X 6 (1) K 5123 lb



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Summary

Mark	=	RB 02
Section	=	(3) 2 X 8 [DF #2]
Span	=	6.5 ft
Result	=	Section adequate by 24 % - Load Combo. No.3 DL + RLL - Flexure

RB 02 (3) 2 X 8 [DF #2]

Distributed Loads

Class	LL (psf)	DL (psf)	Load Start		Load End	
			Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	24	15	14.75	0.00	14.75	5.25
Roof	24	15	22.50	5.25	22.50	6.50

Dead Loads

Self Weight	BSW =	8 plf
Cont. Dead Load	W =	25 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.15
Form	CF =	1.20
Repetative	Cr / Cv =	1.15

Load Reduction Factors

Live Load	LLRF =	1.00
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Beam Section Properties

Width	b =	4.5 in.
Depth	d =	7.25 in.
Area	A =	33 in.2
Shear Area	As =	22 in.2
Moment of Inertia	I =	143 in.4
Section Modulus	S =	39 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	229000000 lb-in.2

Req'd bearing length = 0.77" 0.89"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.01	0.07	70 %	0.12	63 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	1,898	4,502	58 %
Moment (lb-ft)	3,575	4,692	24 %

Support Reactions

	Left	Right
RLL (lb)	1,173	1,361
FLL (lb)	0	0
DL (lb)	987	1,128
Total (lb)	2,160	2,489
Post		Capacity

Left: 2 X 6 (1) K 5123 lb
Right: 2 X 6 (1) K 5123 lb

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Summary

Mark	=	RB 03
Section	=	(3) 2 X 6 [DF #2]
Span	=	3.83 ft
Result	=	Section adequate by 39 % - Load Combo. No.3 DL + RLL - Flexure

RB 03 (3) 2 X 6 [DF #2]**Distributed Loads**

Class	LL (psf)	DL (psf)	Load Start		Load End	
			Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	24	15	22.50	0.00	22.50	3.83

Dead Loads

Self Weight	BSW =	6 plf
Cont. Dead Load	W =	25 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.15
Form	CF =	1.30
Repetative	Cr / Cv =	1.15

Load Reduction Factors

Live Load	LLRF =	1.00
-----------	--------	------

Beam Section Properties

Width	b =	4.5 in.
Depth	d =	5.5 in.
Area	A =	25 in.2
Shear Area	As =	17 in.2
Moment of Inertia	I =	62 in.4
Section Modulus	S =	23 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	100000000 lb-in.2

Req'd bearing length = 0.66"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.01	0.03	79 %	0.05	75 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	1,422	3,416	58 %
Moment (lb-ft)	1,791	2,925	39 %

Support Reactions

	Left	Right
RLL (lb)	1,034	1,034
FLL (lb)	0	0
DL (lb)	836	836
Total (lb)	1,870	1,870
Post	Capacity	

Left: 2 X 6 (1) K 5123 lb

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Summary

Mark	=	RB 04
Section	=	(3) 2 X 6 [DF #2]
Span	=	5.5 ft
Result	=	Section adequate by 31 % - Load Combo. No.3 DL + RLL - Flexure

RB 04 (3) 2 X 6 [DF #2]**Distributed Loads**

Class	LL (psf)	DL (psf)	Load Start		Load End	
			Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	24	15	12.00	0.00	12.00	5.50

Dead Loads

Self Weight	BSW =	6 plf
Cont. Dead Load	W =	25 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.15
Form	CF =	1.30
Repetative	Cr / Cv =	1.15

Load Reduction Factors

Live Load	LLRF =	1.00
-----------	--------	------

Beam Section Properties

Width	b =	4.5 in.
Depth	d =	5.5 in.
Area	A =	25 in.2
Shear Area	As =	17 in.2
Moment of Inertia	I =	62 in.4
Section Modulus	S =	23 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	100000000 lb-in.2

Req'd bearing length = 0.52"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.01	0.06	68 %	0.11	60 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	1,227	3,416	64 %
Moment (lb-ft)	2,024	2,925	31 %

Support Reactions

	Left	Right
RLL (lb)	792	792
FLL (lb)	0	0
DL (lb)	680	680
Total (lb)	1,472	1,472
Post	Capacity	

Left: 2 X 6 (1) K 5119 lb

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Summary

Mark	=	RB 05
Section	=	(2) 1-3/4 X 11-7/8 LVL [LVL (2.0E)]
Span	=	16.75 ft
Result	=	Section adequate by 49 % - Load Combo. No.3 DL + RLL - Total Load Deflection

Distributed Loads

Class	LL (psf)	DL (psf)	Load Start		Load End	
			Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	24	15	2.50	0.00	2.50	16.75

Dead Loads

Self Weight	BSW =	12 plf
Cont. Dead Load	W =	120 plf

Allowable Stress

Shear Stress	Fv =	285 psi
Bending Stress	Fb =	2600 psi

Beam Adjustment Factors

Load Duration	Cd =	1.15
Form	CF =	1.00
Repetative	Cr / Cv =	1.00

Load Reduction Factors

Live Load	LLRF =	1.00
-----------	--------	------

Beam Section Properties

Width	b =	3.5 in.
Depth	d =	11.875 in.
Area	A =	42 in.2
Shear Area	As =	28 in.2
Moment of Inertia	I =	488 in.4
Section Modulus	S =	82 in.3

Beam Material Properties

Modulus of Elasticity	E =	2000000 psi
Flexure Stiffness	EI =	977000000 lb-in.2

Req'd bearing length = 0.76"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.01	0.11	81 %	0.43	49 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	1,752	9,081	81 %
Moment (lb-ft)	8,318	20,525	59 %

Support Reactions

	Left	Right
RLL (lb)	503	503
FLL (lb)	0	0
DL (lb)	1,484	1,484
Total (lb)	1,986	1,986
Post	Capacity	

Left: (2) 2 X 6 7506 lb

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Summary

Mark	=	RB 06
Section	=	(2) 2 X 6 [DF #2]
Span	=	3.75 ft
Result	=	Section adequate by 3 % - Load Combo. No.3 DL + RLL - Flexure

RB 06 (2) 2 X 6 [DF #2]**Distributed Loads**

Class	LL (psf)	DL (psf)	Load Start		Load End	
			Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	24	15	21.50	0.00	21.50	3.75

Dead Loads

Self Weight	BSW =	4 plf
Cont. Dead Load	W =	25 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.15
Form	CF =	1.30
Repetative	Cr / Cv =	1.00

Load Reduction Factors

Live Load	LLRF =	1.00
-----------	--------	------

Beam Section Properties

Width	b =	3 in.
Depth	d =	5.5 in.
Area	A =	17 in.2
Shear Area	As =	11 in.2
Moment of Inertia	I =	42 in.4
Section Modulus	S =	15 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	67000000 lb-in.2

Req'd bearing length = 0.93"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.01	0.03	72 %	0.06	67 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	1,321	2,277	42 %
Moment (lb-ft)	1,639	1,696	3 %

Support Reactions

	Left	Right
RLL (lb)	968	968
FLL (lb)	0	0
DL (lb)	781	781
Total (lb)	1,748	1,748
Post	Capacity	

Left: 2 X 6 (1) K 5123 lb

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Summary

Mark	=	RB 07
Section	=	(2) 2 X 8 [DF #2]
Left Cantilever	=	2 ft
Center Span	=	6.25 ft
Result	=	Section adequate by 68 % - Load Combo. No.3 DL + RLL - Flexure

RB 07 (2) 2 X 8 [DF #2]**Distributed Loads**

Class	LL (psf)	DL (psf)	Load Start		Load End	
			Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	24	15	4.50	0.00	4.50	8.25

Dead Loads

Self Weight BSW = 5 plf

Allowable Stress

Shear Stress Fv = 180 psi
Bending Stress Fb = 900 psi

Beam Adjustment Factors

Load Duration Cd = 1.15
Form CF = 1.20
Repetative Cr / Cv = 1.00

Load Reduction Factors

Live Load LLRF = 1.00

Beam Section Properties

Width b = 3 in.
Depth d = 7.25 in.
Area A = 22 in.²
Shear Area As = 15 in.²
Moment of Inertia I = 95 in.⁴
Section Modulus S = 26 in.³

Beam Material Properties

Modulus of Elasticity E = 1600000 psi
Flexure Stiffness EI = 152000000 lb-in.²

Req'd bearing length = 0.56" 0.31"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.01	0.02	88 %	0.04	88 %
Cantilever		0.00	81 %	0.01	83 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	552	3,002	82 %
Moment (lb-ft)	864	2,720	68 %

Support Reactions

	Left	Right
RLL (lb)	588	338
FLL (lb)	0	0
DL (lb)	470	242
Total (lb)	1,058	580
Post		Capacity

Left: 4 X 4 5714 lb
Right: (2) 2 X 6 7512 lb

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Summary

Mark	=	RB 08
Section	=	(3) 2 X 10 [DF #2]
Span	=	6.5 ft
Result	=	Section adequate by 26 % - Load Combo. No.3 DL + RLL - Flexure

RB 08 (3) 2 X 10 [DF #2]**Distributed Loads**

Class	LL (psf)	DL (psf)	Load Start		Load End	
			Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	24	15	22.50	0.00	22.50	6.50

Dead Loads

Self Weight	BSW =	10 plf
Cont. Dead Load	W =	25 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.15
Form	CF =	1.10
Repetative	Cr / Cv =	1.15

Load Reduction Factors

Live Load	LLRF =	1.00
-----------	--------	------

Beam Section Properties

Width	b =	4.5 in.
Depth	d =	9.25 in.
Area	A =	42 in.2
Shear Area	As =	28 in.2
Moment of Inertia	I =	297 in.4
Section Modulus	S =	64 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	475000000 lb-in.2

Req'd bearing length = 1.13"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.01	0.05	79 %	0.08	74 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	2,431	5,744	58 %
Moment (lb-ft)	5,178	7,002	26 %

Support Reactions

	Left	Right
RLL (lb)	1,755	1,755
FLL (lb)	0	0
DL (lb)	1,432	1,432
Total (lb)	3,187	3,187
Post	Capacity	

Left: 2 X 6 (1) K 5124 lb

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Summary

Mark	=	RB 09
Section	=	(2) 2 X 6 [DF #2]
Span	=	3.83 ft
Result	=	Section adequate by 45 % - Load Combo. No.3 DL + RLL - Flexure

RB 09 (2) 2 X 6 [DF #2]**Distributed Loads**

Class	LL (psf)	DL (psf)	Load Start		Load End	
			Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	24	15	11.50	0.00	11.50	3.83

Dead Loads

Self Weight	BSW =	4 plf
Cont. Dead Load	W =	25 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.15
Form	CF =	1.30
Repetative	Cr / Cv =	1.00

Load Reduction Factors

Live Load	LLRF =	1.00
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Beam Section Properties

Width	b =	3 in.
Depth	d =	5.5 in.
Area	A =	17 in.2
Shear Area	As =	11 in.2
Moment of Inertia	I =	42 in.4
Section Modulus	S =	15 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	67000000 lb-in.2

Req'd bearing length = 0.52" 0.52"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.01	0.02	84 %	0.04	81 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	746	2,277	67 %
Moment (lb-ft)	939	1,696	45 %

Support Reactions

	Left	Right
RLL (lb)	529	4,187
FLL (lb)	0	0
DL (lb)	452	3,252
Total (lb)	981	7,439
Post		Capacity

Left: 2 X 6 (1) K 5119 lb
Right: (2) 2 X 6 (1) K 10256 lb

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Summary

Mark	=	RB 10
Section	=	(3) 2 X 10 [DF #2]
Span	=	6.5 ft
Result	=	Section adequate by 26 % - Load Combo. No.3 DL + RLL - Flexure

RB 10 (3) 2 X 10 [DF #2]**Distributed Loads**

Class	LL (psf)	DL (psf)	Load Start		Load End	
			Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Roof	24	15	22.50	0.00	22.50	6.50

Dead Loads

Self Weight	BSW =	10 plf
Cont. Dead Load	W =	25 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.15
Form	CF =	1.10
Repetative	Cr / Cv =	1.15

Load Reduction Factors

Live Load	LLRF =	1.00
-----------	--------	------

Beam Section Properties

Width	b =	4.5 in.
Depth	d =	9.25 in.
Area	A =	42 in.2
Shear Area	As =	28 in.2
Moment of Inertia	I =	297 in.4
Section Modulus	S =	64 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	475000000 lb-in.2

Req'd bearing length = 1.13"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.01	0.05	79 %	0.08	74 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	2,431	5,744	58 %
Moment (lb-ft)	5,178	7,002	26 %

Support Reactions

	Left	Right
RLL (lb)	1,755	1,755
FLL (lb)	0	0
DL (lb)	1,432	1,432
Total (lb)	3,187	3,187
Post	Capacity	

Left: 2 X 6 (1) K 5124 lb



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Summary

Mark	=	MB 01
Section	=	(2) 1-3/4 X 11-7/8 LVL [LVL (2.0E)]
Span	=	12.25 ft
Result	=	Section adequate by 43 % - Load Combo. No.2 DL + FLL - Flexure

MB 01 (2) 1-3/4 X 11-7/8 LVL [LVL (2.0E)]

Distributed Loads

Class	LL (psf)	DL (psf)	Load Start		Load End	
			Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Floor	40	12	9.75	0.00	9.75	7.75
Floor	40	12	11.50	7.75	11.50	12.25

Dead Loads

Self Weight BSW = 12 plf

Allowable Stress

Shear Stress $F_v = 285$ psi
Bending Stress $F_b = 2600$ psi

Beam Adjustment Factors

Load Duration $C_d = 1.00$
Form $CF = 1.00$
Repetative $Cr / Cv = 1.00$

Load Reduction Factors

Live Load LLRF = 1.00

Beam Section Properties

Width $b = 3.5$ in.
Depth $d = 11.875$ in.
Area $A = 42$ in.²
Shear Area $A_s = 28$ in.²
Moment of Inertia $I = 488$ in.⁴
Section Modulus $S = 82$ in.³

Beam Material Properties

Modulus of Elasticity $E = 2000000$ psi
Flexure Stiffness $EI = 977000000$ lb-in.²

Req'd bearing length = 1.24" 1.34"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.07	0.21	48 %	0.28	54 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	2,910	7,897	63 %
Moment (lb-ft)	10,203	17,848	43 %

Support Reactions

	Left	Right
RLL (lb)	0	0
FLL (lb)	2,447	2,646
DL (lb)	808	868
Total (lb)	3,255	3,514
Post		Capacity

Left: (2) 2 X 4 4008 lb
Right: (2) 2 X 4 4008 lb

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Summary

Mark	=	MB 02
Section	=	(2) 1-3/4 X 11-7/8 LVL [LVL (2.0E)]
Span	=	4.75 ft
Result	=	Section adequate by 87 % - Load Combo. No.2 DL + FLL - Shear

MB 02 (2) 1-3/4 X 11-7/8 LVL [LVL (2.0E)]**Distributed Loads**

Class	LL (psf)	DL (psf)	Load Start		Load End	
			Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Floor	40	12	13.50	0.00	13.50	4.75

Dead Loads

Self Weight BSW = 12 plf

Allowable Stress

Shear Stress Fv = 285 psi
Bending Stress Fb = 2600 psi

Beam Adjustment Factors

Load Duration Cd = 1.00
Form CF = 1.00
Repetative Cr / Cv = 1.00

Load Reduction Factors

Live Load LLRF = 1.00

Beam Section Properties

Width b = 3.5 in.
Depth d = 11.875 in.
Area A = 42 in.2
Shear Area As = 28 in.2
Moment of Inertia I = 488 in.4
Section Modulus S = 82 in.3

Beam Material Properties

Modulus of Elasticity E = 2000000 psi
Flexure Stiffness EI = 977000000 lb-in.2

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.07	0.01	96 %	0.01	96 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	989	7,897	87 %
Moment (lb-ft)	2,014	17,848	89 %

Req'd bearing length = 0.65" 0.65"

Support Reactions

	Left	Right
RLL (lb)	0	0
FLL (lb)	1,283	1,283
DL (lb)	414	414
Total (lb)	1,696	1,696
Post		Capacity

Right: (2) 2 X 4 4008 lb

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Summary

Mark	=	MB 03
Section	=	1-3/4 X 11-7/8 LVL [LVL (2.0E)]
Span	=	3.33 ft
Result	=	Section adequate by 97 % - Load Combo. No.2 DL + FLL - Shear

MB 03**1-3/4 X 11-7/8 LVL [LVL (2.0E)]****Distributed Loads**

Class	LL (psf)	DL (psf)	Load Start		Load End	
			Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Floor	40	12	0.67	0.00	0.67	3.33
Floor	40	12	3.00	0.00	3.00	3.33

Dead Loads

Self Weight BSW = 6 plf

Allowable Stress

Shear Stress Fv = 285 psi
Bending Stress Fb = 2600 psi

Beam Adjustment Factors

Load Duration Cd = 1.00
Form CF = 1.00
Repetative Cr / Cv = 1.00

Load Reduction Factors

Live Load LLRF = 1.00

Beam Section Properties

Width b = 1.75 in.
Depth d = 11.875 in.
Area A = 21 in.²
Shear Area As = 14 in.²
Moment of Inertia I = 244 in.⁴
Section Modulus S = 41 in.³

Beam Material Properties

Modulus of Elasticity E = 2000000 psi
Flexure Stiffness EI = 488000000 lb-in.²

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.07	0.00	99 %	0.00	99 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	133	3,948	97 %
Moment (lb-ft)	273	8,924	97 %

Req'd bearing length = 0.25" 0.25"

Support Reactions

	Left	Right
RLL (lb)	0	0
FLL (lb)	244	1,527
DL (lb)	83	497
Total (lb)	328	2,024
Post		Capacity

Right: (2) 2 X 4

4008 lb

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Summary

Mark	=	MB 04
Section	=	(2) 2 X 6 [DF #2]
Span	=	4.33 ft
Result	=	Section adequate by 65 % - Load Combo. No.2 DL + FLL - Flexure

MB 04 (2) 2 X 6 [DF #2]**Distributed Loads**

Class	LL (psf)	DL (psf)	Load Start		Load End	
			Trib (ft)	x1 (ft)	Trib (ft)	x2 (ft)
Floor	40	12	0.67	0.00	0.67	4.33
Floor	40	12	3.00	0.00	3.00	4.33

Dead Loads

Self Weight	BSW =	4 plf
Cont. Dead Load	W =	25 plf

Allowable Stress

Shear Stress	Fv =	180 psi
Bending Stress	Fb =	900 psi

Beam Adjustment Factors

Load Duration	Cd =	1.00
Form	CF =	1.30
Repetative	Cr / Cv =	1.00

Load Reduction Factors

Live Load	LLRF =	1.00
-----------	--------	------

Beam Section Properties

Width	b =	3 in.
Depth	d =	5.5 in.
Area	A =	17 in.2
Shear Area	As =	11 in.2
Moment of Inertia	I =	42 in.4
Section Modulus	S =	15 in.3

Beam Material Properties

Modulus of Elasticity	E =	1600000 psi
Flexure Stiffness	EI =	67000000 lb-in.2

Req'd bearing length = 0.25"

Deflection Criteria

Span	DLD (in.)	LLD (in.)	Result	TLD (in.)	Result
Center	0.07	0.02	88 %	0.03	88 %

Strength Criteria

Condition	Maximum	Allowable	Result
Shear (lb)	375	1,980	81 %
Moment (lb-ft)	515	1,475	65 %

Support Reactions

	Left	Right
RLL (lb)	0	0
FLL (lb)	318	318
DL (lb)	158	158
Total (lb)	476	476

Post	Capacity
Left: 2 X 4 (1) K	3260 lb

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5.1 Foundation - Concrete Walls / Footings

Foundation Walls and Footings

ACI 318-14 Section 14 and Utah Amendment to IBC Table 1807.1.6.4

Foundation Wall				Line Loads			Point Loads			Continuous Footing			Spot Footing		
		Soil		RLL	FLL	DL	RLL	FLL	DL	Brg. Press.			Brg. Press.		
Section	Mark	(ft)	Result	(plf)	(plf)	(plf)	(plf)	(plf)	(plf)	Mark	(psf)	Result	Mark	(psf)	Result
1	FW9	8.5	100%	540	430	1,628	0	0	0	FT20	1,413	6%			
2	FW3	2.5	100%	276	0	593	305	0	233	FT20	844	44%			
3				0	460	248	0	794	260	FT18	1,175	22%			
4	FW9B	8.5	7%	48	0	1,275	0	0	0	FT20	794	47%			