

STRUCTURAL CALCULATION REPORT

NEWTON BARNDOMINIUM

Project Type: Single Family Residence (Barndominium)

Location: Montana (Jurisdiction: County AHJ – Site Specific Verification Required)

Occupancy: R-3 Residential

Construction Type: V-B Wood Frame

Engineer of Record: To Be Assigned

1.0 CODE BASIS

Design and analysis shall comply with the following adopted codes:

- International Residential Code (IRC) – Latest Adopted Edition
- International Building Code (IBC) – As Applicable
- ASCE 7 – Minimum Design Loads for Buildings and Other Structures (ASCE 7-22 or latest adopted)
- AWC NDS – National Design Specification for Wood Construction
- ANSI/AF&PA SDPWS – Special Design Provisions for Wind and Seismic
- Montana State Building Code Amendments
- Local County Jurisdiction Requirements

2.0 STRUCTURAL SYSTEM DESCRIPTION

The structure consists of:

- Wood framed exterior bearing walls (2x6 @ 16" O.C.)
- Interior non-bearing walls (2x4 @ 16" O.C.)
- Engineered wood roof truss system (main structure @ 24" O.C.)
- Conventional rafter framing at porch areas (2x6 @ 16" O.C.)
- Reinforced concrete continuous foundation system
- Slab-on-grade floor system

Lateral resistance is provided by:

- Wood shear walls (plywood/OSB sheathing)
 - Roof diaphragm action
 - Anchor bolt + hold-down system
 - Continuous load path to foundation
-

3.0 DESIGN LOADS (MONTANA BASIS – ASCE 7)

3.1 Gravity Loads

Load Type	Value
Dead Load (roof system)	15–20 PSF (typical truss + metal roof)
Dead Load (floor system)	10–15 PSF
Ceiling finish	5 PSF
Partition load	10 PSF
Live Load (residential)	40 PSF
Garage Live Load	50 PSF
Porch Live Load	40 PSF

3.2 Snow Loads (Critical Montana Condition)

- Ground Snow Load (Pg): **70 PSF**
- Exposure: C
- Thermal Condition: Heated Structure (Ct = 1.0 assumed)
- Importance Factor: 1.0

Roof Snow Load:

- Flat Roof Snow Load (Pf): **49 PSF (minimum design basis)**
- Drift and unbalanced conditions shall be checked per ASCE 7 Chapter 7

3.3 Wind Loads

- Ultimate Wind Speed (Vult): **115 MPH**
- Exposure Category: **C (open terrain typical Montana rural site)**
- Internal Pressure: ±0.18 to ±0.55 (enclosed structure assumed)
- Importance Factor: 1.0

Design considers:

- Main wind force resisting system (MWFRS)
- Components & cladding (C&C) pressures for siding, roof, openings

3.4 Seismic Loads

- Seismic Design Category: **D1 (site dependent)**
- Site Class: D assumed (unless geotechnical report provided)
- Seismic Importance Factor: 1.0

Base shear determined per ASCE 7 equivalent lateral force procedure.

3.5 Frost & Soil

- Frost Depth: **42 inches minimum (Montana cold region assumption)**
 - Soil Bearing Capacity (Assumed): **2,000 PSF**
 - Final bearing shall be verified by geotechnical investigation if required by AHJ
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4.0 FOUNDATION DESIGN

4.1 Foundation System

- Continuous reinforced concrete footing with stem wall
- Slab-on-grade interior floor system

Footing:

- Size: 18" x 12" continuous strip footing
- Reinforcement: (2) continuous #4 bars

Stem Wall:

- Size: 12" x 30" reinforced concrete wall
- Reinforcement: #4 vertical L-bars @ 36" O.C.

Anchorage:

- 1/2" Ø anchor bolts @ 6'-0" O.C. max
 - Minimum embedment: 7"
 - Within 12" of plate ends
-

4.2 Slab-on-Grade

- Minimum thickness: 4 inches
 - Concrete strength: 3,000 PSI minimum
 - Reinforcement: welded wire mesh or fiber reinforcement
 - Vapor barrier: 6 mil minimum polyethylene under slab
 - Compacted base: engineered fill required
-

4.3 Foundation Checks

- Bearing pressure: 2,000 PSF assumed allowable
 - Footing width verified for tributary loads from walls + roof + snow
 - Sliding/overturning resisted through anchor bolt system and dead load mass
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5.0 FRAMING SYSTEM ANALYSIS

5.1 Wall Framing

- Exterior walls: 2x6 @ 16" O.C.
- Interior walls: 2x4 @ 16" O.C.
- Double top plate: YES (continuous load transfer)
- Double bottom plate: YES

Shear System:

- OSB/plywood sheathing
 - Nail schedule per SDPWS
 - Hold-downs at shear wall ends
-

5.2 Roof System

Main Structure:

- Engineered wood trusses @ 24" O.C.
- Truss span designed for 49 PSF snow load + drift conditions
- Truss bracing per BCSI

Porch Roof:

- 2x6 rafters @ 16" O.C.
 - Designed for snow + wind + dead load
 - Bearing on exterior wall + beam supports
-

5.3 Load Path

Continuous load path provided:

Roof → Truss/Rafters → Bearing Walls → Anchor Bolts → Footing → Soil

Hold-downs and straps ensure lateral load transfer to foundation.

6.0 LATERAL DESIGN (WIND + SEISMIC)

6.1 System

- Wood shear walls (OSB sheathing)
- Diaphragm action at roof and floor levels
- Anchor bolts transfer shear to foundation

6.2 Resistance Mechanism

- Shear wall panels resist racking forces
- Hold-down anchors resist overturning
- Roof diaphragm distributes wind/seismic loads

6.3 Deflection Control

- Wall deflection limited per code (H/240 typical)
 - Shear wall spacing and nailing per SDPWS
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7.0 CONNECTION DESIGN

- Simpson Strong-Tie or equivalent connectors required
 - Hurricane ties at all roof-to-wall connections
 - Straps provided at load-bearing intersections
 - Anchor bolts designed for shear + uplift
 - All connectors corrosion resistant (Montana exposure conditions)
-

8.0 ROOF LOAD COMBINATIONS

Critical load combinations per ASCE 7:

- $1.4D$
- $1.2D + 1.6L + 0.5S$
- $1.2D + 1.0W + 0.5L$
- $0.9D + 1.0W$ (uplift case)
- $1.2D + 1.0E + 0.2S$

Where:

- D = Dead Load
 - L = Live Load
 - S = Snow Load
 - W = Wind Load
 - E = Seismic Load
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9.0 CONCLUSION

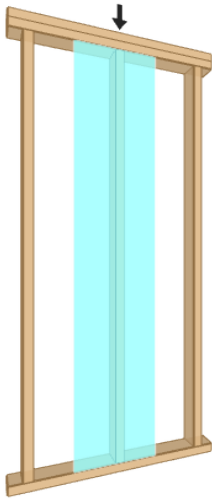
The structural system for the Newton Barndominium has been designed to comply with Montana State Building Code requirements and ASCE 7 loading criteria for:

- Heavy snow regions
- High wind exposure conditions
- Seismic Category D1 performance level
- Frost depth foundation protection

The design provides a continuous load path from roof to foundation and ensures stability under gravity, lateral, and environmental loads.

Level, Wall: Stud 2x6

Current Solution: 1 piece(s) 2 x 6 DF No.1 @ 16" OC



Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination
Slenderness	25	50	Passed (51%)	--	--
Compression (lbs)	100	5710	Passed (2%)	1.00	1.0 D + 1.0 L
Plate Bearing (lbs)	100	4383	Passed (2%)	--	1.0 D + 1.0 L
Lateral Reaction (lbs)	112	--	--	1.60	1.0 D + 0.6 W
Lateral Shear (lbs)	103	1584	Passed (7%)	1.60	1.0 D + 0.6 W
Lateral Moment (ft-lbs)	326 @ mid-span	1490	Passed (22%)	1.60	1.0 D + 0.6 W
Total Deflection (in)	0.16 @ mid-span	1.16	Passed (L/885)	--	1.0 D + 0.6 W
Bending/Compression	0.22	1	Passed (22%)	1.60	1.0 D + 0.6 W

Wall Height: 12'

Member Height: 11' 7 1/2"

O. C. Spacing: 16.00"

Member Type : Stud

Building Code : IBC 2021

Design Methodology : ASD

All Product Solutions				
Depth	Series	Plies	Spacing	Cost Index
5 1/2"	M-12 Framed Series® Lumber	1	32"	0.41 *
5 1/2"	2 x DF No.1	1	16"	0.88

The purpose of this report is for product comparison only. Load and support information necessary for professional design review is not displayed here. Please print an individual Member Report for submittal purposes.

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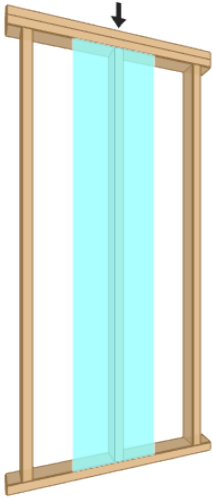
Level, Wall: Stud 2x4

1 piece(s) 2 x 4 DF No.1 @ 16" OC

Wall Height: 10'

Member Height: 9' 7 1/2"

O. C. Spacing: 16.00"



Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	33	50	Passed (66%)	--	--
Compression (lbs)	100	2300	Passed (4%)	1.00	1.0 D + 1.0 L
Plate Bearing (lbs)	100	2789	Passed (4%)	--	1.0 D + 1.0 L
Lateral Reaction (lbs)	95	--	--	1.60	1.0 D + 0.6 W
Lateral Shear (lbs)	89	1008	Passed (9%)	1.60	1.0 D + 0.6 W
Lateral Moment (ft-lbs)	229 @ mid-span	699	Passed (33%)	1.60	1.0 D + 0.6 W
Total Deflection (in)	0.29 @ mid-span	0.96	Passed (L/392)	--	1.0 D + 0.6 W
Bending/Compression	0.33	1	Passed (33%)	1.60	1.0 D + 0.6 W

- Wall deflection criteria: TL (L/120)
- Input axial load eccentricity for this design is 16.67% of applicable member side dimension.
- Applicable calculations are based on NDS.
- A bearing area factor of 1.25 has been applied to base plate bearing capacity.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.

Supports	Type	Material
Top	Dbl 2X	Spruce-Pine-Fir
Base	2X	Spruce-Pine-Fir

System : Wall
 Member Type : Stud
 Building Code : IBC 2021
 Design Methodology : ASD

Max Unbraced Length	Comments
1'	

Lateral Connections

Supports	Connector	Type/Model	Quantity	Connector Nailing
Top	Nails	8d (0.113" x 2 1/2") (Toe)	2	N/A
Base	Nails	8d (0.113" x 2 1/2") (Toe)	2	N/A

- Nailed connection at the top of the member is assumed to be nailed through the bottom 2x plate prior to placement of the top 2x of the double top plate assembly.

Vertical Load	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Point (lb)	N/A	20	80	Default Load

Lateral Load	Location	Spacing	Wind (1.60)	Comments
1 - Uniform (PSF)	Full Length	16.00"	24.7	

- ASCE/SEI 7 Sec. 30.4: Exposure Category (B), Mean Roof Height (33'), Topographic Factor (1.0), Wind Directionality Factor (0.85), Basic Wind Speed (115), Risk Category(II), Wind Zone (4), GCpi (+/- 0.18), Effective Wind Area determined using full member span and trib. width.
- IBC Table 1604.3, footnote f: Deflection checks are performed using 42% of this lateral wind load.

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

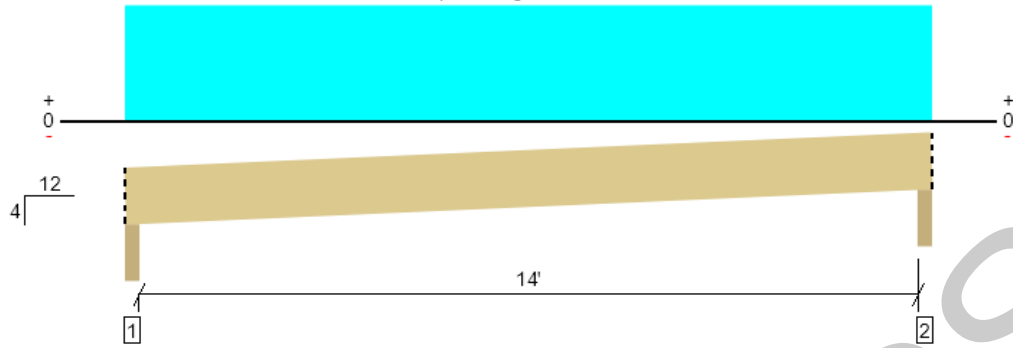
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Level, Roof: Joist

1 piece(s) 2 x 8 DF No.1 @ 16" OC

Sloped Length: 15' 4 7/16"



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	348 @ 2 1/2"	2231 (3.50")	Passed (16%)	--	1.0 D + 1.0 Lr (All Spans)
Shear (lbs)	307 @ 10 3/8"	1631	Passed (19%)	1.25	1.0 D + 1.0 Lr (All Spans)
Moment (Ft-lbs)	1198 @ 7' 3 1/2"	1889	Passed (63%)	1.25	1.0 D + 1.0 Lr (All Spans)
Live Load Defl. (in)	0.332 @ 7' 3 1/2"	0.747	Passed (L/540)	--	1.0 D + 1.0 Lr (All Spans)
Total Load Defl. (in)	0.594 @ 7' 3 1/2"	0.996	Passed (L/302)	--	1.0 D + 1.0 Lr (All Spans)

- Deflection criteria: LL (L/240) and TL (L/180).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.
- Applicable calculations are based on NDS.

Member Length : 15' 6 7/8"
System : Roof
Member Type : Joist
Building Use : Residential
Building Code : IBC 2021
Design Methodology : ASD
Member Pitch : 4/12

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Roof Live	Factored	
1 - Beveled Plate - SPF	3.50"	3.50"	1.50"	154	194	348	Blocking
2 - Beveled Plate - SPF	3.50"	3.50"	1.50"	154	194	348	Blocking

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

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	8' 10" o/c	
Bottom Edge (Lu)	15' 4" o/c	

- Maximum allowable bracing intervals based on applied load.
- Dimensions for lateral bracing intervals are measured along the length of the member for sloped conditions.

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Roof Live (1.25)	Comments
1 - Uniform (PSF)	0 to 14' 7"	16"	15.0	20.0	Default Load

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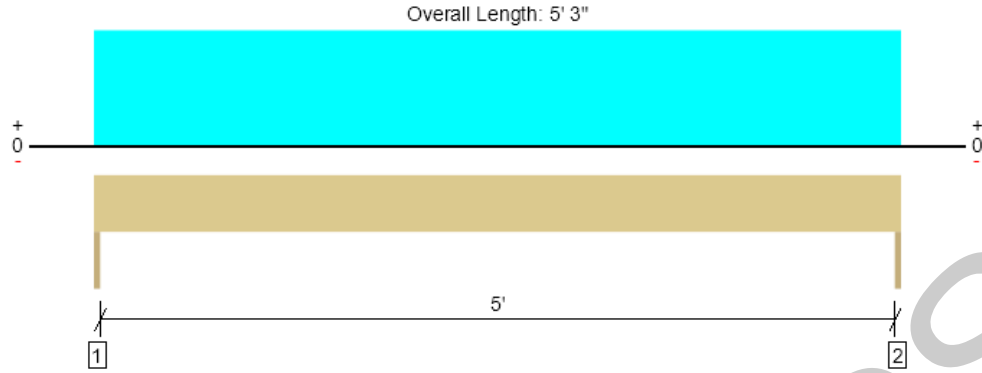
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Level, Wall: Header 2x6
2 piece(s) 2 x 6 DF No.1



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Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	147 @ 0	2813 (1.50")	Passed (5%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	115 @ 7"	1980	Passed (6%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	194 @ 2' 7 1/2"	1639	Passed (12%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.010 @ 2' 7 1/2"	0.175	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.014 @ 2' 7 1/2"	0.262	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Applicable calculations are based on NDS.

Member Length : 5' 3"
System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2021
Design Methodology : ASD

Supports	Bearing Length			Loads to Supports (lbs)			
	Total	Available	Required	Dead	Floor Live	Factored	Accessories
1 - Trimmer - SPF	1.50"	1.50"	1.50"	42	105	147	None
2 - Trimmer - SPF	1.50"	1.50"	1.50"	42	105	147	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	5' 3" o/c	
Bottom Edge (Lu)	5' 3" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 5' 3"	N/A	4.2	--	
1 - Uniform (PSF)	0 to 5' 3"	1'	12.0	40.0	Default Load

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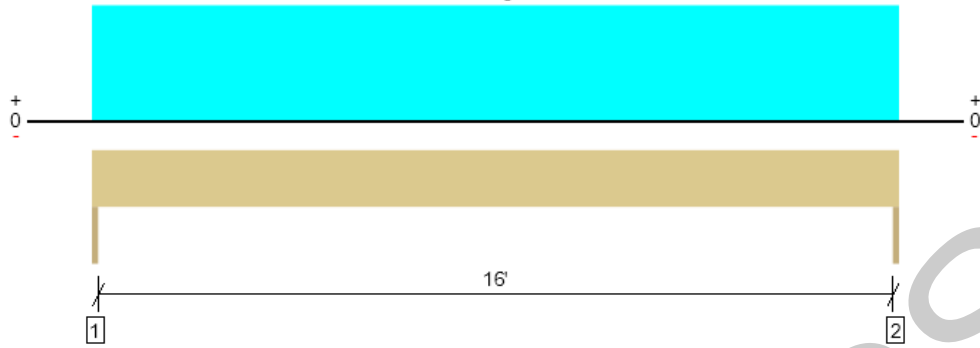


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Level, Wall: Header Back Door

2 piece(s) 1 3/4" x 9 1/4" 2.0E Microllam® LVL

Overall Length: 16' 3"



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	499 @ 0	3806 (1.50")	Passed (13%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	444 @ 10 3/4"	6151	Passed (7%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	2028 @ 8' 1 1/2"	11204	Passed (18%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.141 @ 8' 1 1/2"	0.542	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.216 @ 8' 1 1/2"	0.813	Passed (L/903)	--	1.0 D + 1.0 L (All Spans)

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Member Length : 16' 3"
System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2021
Design Methodology : ASD

Supports	Bearing Length			Loads to Supports (lbs)			
	Total	Available	Required	Dead	Floor Live	Factored	Accessories
1 - Trimmer - SPF	1.50"	1.50"	1.50"	174	325	499	None
2 - Trimmer - SPF	1.50"	1.50"	1.50"	174	325	499	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	16' 3" o/c	
Bottom Edge (Lu)	16' 3" o/c	

Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 16' 3"	N/A	9.4	--	
1 - Uniform (PSF)	0 to 16' 3"	1'	12.0	40.0	Default Load

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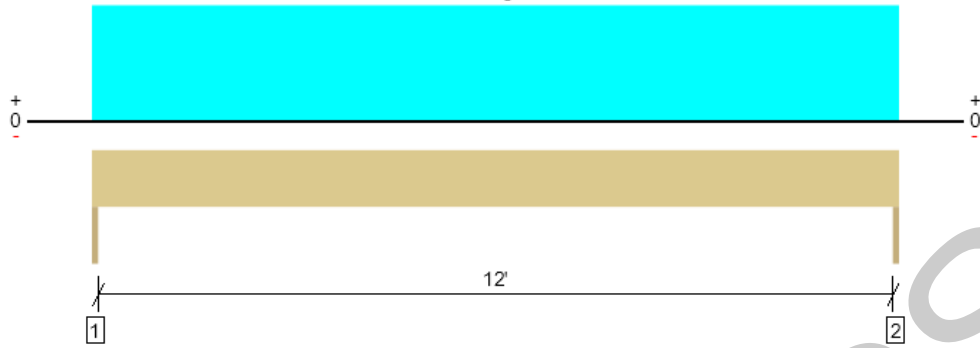


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File Name: Newton Barndominium Calclations

Level, Wall: Header Garage Door

2 piece(s) 1 3/4" x 7 1/4" 2.0E Microllam® LVL

Overall Length: 12' 3"



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	364 @ 0	3806 (1.50")	Passed (10%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	321 @ 8 3/4"	4821	Passed (7%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	1114 @ 6' 1 1/2"	7115	Passed (16%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.095 @ 6' 1 1/2"	0.408	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.140 @ 6' 1 1/2"	0.313	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)

- Deflection criteria: LL (L/360) and TL (5/16").
- Allowed moment does not reflect the adjustment for the beam stability factor.

Member Length : 12' 3"
System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2021
Design Methodology : ASD

Supports	Bearing Length			Loads to Supports (lbs)			
	Total	Available	Required	Dead	Floor Live	Factored	Accessories
1 - Trimmer - SPF	1.50"	1.50"	1.50"	119	245	364	None
2 - Trimmer - SPF	1.50"	1.50"	1.50"	119	245	364	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	12' 3" o/c	
Bottom Edge (Lu)	12' 3" o/c	

Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 12' 3"	N/A	7.4	--	
1 - Uniform (PSF)	0 to 12' 3"	1'	12.0	40.0	Default Load

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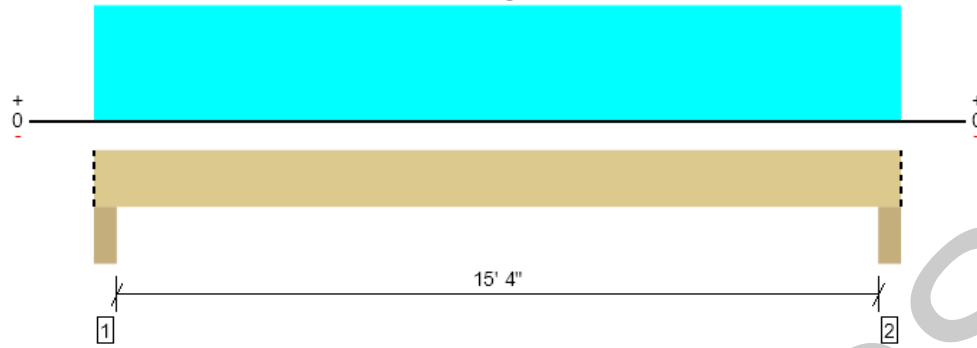


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File Name: Newton Barndominium Calclations

Level, Floor: Drop Beam

3 piece(s) 1 3/4" x 9 1/4" 2.0E Microllam® LVL

Overall Length: 16' 3"



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	538 @ 4"	20934 (5.50")	Passed (3%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	456 @ 1' 2 3/4"	9227	Passed (5%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	2008 @ 8' 1 1/2"	16806	Passed (12%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.080 @ 8' 1 1/2"	0.519	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.132 @ 8' 1 1/2"	0.779	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			
	Total	Available	Required	Dead	Floor Live	Factored	Accessories
1 - Column - SPF	5.50"	5.50"	1.50"	213	325	538	Blocking
2 - Column - SPF	5.50"	5.50"	1.50"	213	325	538	Blocking

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

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	16' 3" o/c	
Bottom Edge (Lu)	16' 3" o/c	

- Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 16' 3"	N/A	14.2	--	
1 - Uniform (PSF)	0 to 16' 3" (Front)	1'	12.0	40.0	Default Load

- Side loads are assumed to not induce cross-grain tension.

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

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Level, Free Standing Post 6x6

1 piece(s) 6 x 6 DF No.1

Post Height: 10'



Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	22	50	Passed (44%)	--	--
Compression (lbs)	100	20918	Passed (0%)	1.00	1.0 D + 1.0 L
Base Bearing (lbs)	100	898425	Passed (0%)	--	1.0 D + 1.0 L
Bending/Compression	0.00	1	Passed (0%)	1.00	1.0 D + 1.0 L

- Input axial load eccentricity for this design is 16.67% of applicable member side dimension.
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

 Member Type : Free Standing Post
 Building Code : IBC 2021
 Design Methodology : ASD

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Vertical Load	Dead (0.90)	Floor Live (1.00)	Comments
1 - Point (lb)	20	80	Default Load

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