Engineering

STRUCTURAL DESIGN

Owner:	Eric & Jodi Blohm

Project:	5642 E Mercer Way Mercer Island, WA

Description:	New Deck

Building Codes:	IBC/IRC 2018 ASCE 7-16

Structural Design/ EOR:	Roland Heimisch, P. E. Lic # 42479
Date	03/30/2023

Engineering

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Engineering

1. LATERAL DESIGN

Project: 5642 E Mercer Way, Mercer Island, WA

1.1 Seismic Design

The front of the roof and decks are braced with custom made steel brackets for seismic forces.

The rear grid of the decks is braced parallel to the exterior wall of the house with the ledger, and perpendicular with Simpson deck tension ties DTT1Z

For consistency of looks, steel angles and Ts 3/8x3" are used at all post/beam connections.

Section modulus	$1/6 \times 0.385 \times 3^2$	=	0.58 in^3
Allowable stress for A36 steel		=	21,600 psi

Loads at front grid:

With mapped acceleration $S_s = 1.61$ and $SD_s = 1.14$,

Seismic Response Coefficient C_s = SDs / (R/I)

= 1.14 / (6.5/1.0) = 0.185

Roof	W	=	15 x 290 sqft		=	4,350 lbs
Base Shear	V_{Base}	=	$C_s \times W = 0.18 \times 4,350$		=	800 lbs
Design Shear:	To convert from strength level to ASD, Base Shear is multiplied by 0.7					
	V_{Design}	=	0.7 x 800		=	560 lbs
Force at front grid	V		0.5 x 460		=	230 lbs
With (2) Posts, horizontal force at bottom per post is						80 lbs
			>>> bending moment at top	115 x 8 x 12	=	11,040 lb-in
Bending Stress			M / S = 11,040 / 0.58		=	19,034 < 21,600

Covered Deck	W	=	10 x 470 sqft		=	4,700 lbs
Base Shear	V_{Base}	=	$C_s \times W = 0.18 \times 4,700$		=	850 lbs
Design Shear:	To convert from strength level to ASD, Base Shear is multiplied by 0.7					
	V_{Design}	=	0.7 x 850		=	600 lbs
Force at front grid	V		0.5 x 600		=	300 lbs
With (4) Posts, horizontal force at bottom per post is						75 lbs
			>>> bending moment at top	75 x 8 x 12	=	7,200 lb-in
Bending Stress			M / S = 7,200 / 0.58		=	12,413 < 21,600

Project: 5642 E Mercer Way, Mercer Island, WA

Uncovered Deck	W	=	10 x 200 sqft		=	2,000 lbs
Base Shear	V_{Base}	=	C_s x W = 0.18 x 2,000		=	360 lbs
Design Shear:	To convert from strength level to ASD, Base Shear is multiplied by 0.7					
	V_{Design}	=	0.7 x 360		=	250 lbs
Force at front grid	V		0.5 x 250		=	125 lbs

With (3) Posts, horizontal force at bottom per post is   50 lbs

           >>> bending moment at top   50 x 8 x 12   =   4,800 lb-in

Bending Stress   M / S = 4,800 / 0.58   =   8,276 < 21,600

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Engineering

2. GRAVITY DESIGN

Project: 5642 E Mercer Way, Mercer Island, WA

2.1   Design Criteria

Dead Loads	Roof		
		Coating/Waterproofing	2.0
		Sheathing OSB/Plywood 15/32"	2.0
		Trusses / Framing	3.0
		Insulation R-38	1.2
		Gypsum Board 5/8"	2.8
		Miscellaneous (Sprinkler, HVAC etc)	1.5
		Total	12.5, say **15 psf**
	Floors Living		
		Finished Floor (carpet)	1.0
		Sheathing OSB/Plywood 3/4"	2.5
		Floor Joists / TJIs	2.5
		Insulation R-11	1.0
		Gypsum Board 5/8"	2.8
		Miscellaneous (Sprinkler, HVAC etc)	1.5
		Non bearing partitions	8.0
		Total	19.3, say **20 psf**
	Decks/Balconies		
		Decking	3.0
		Floor Joists / TJIs	2.5
		Miscellaneous (Railing/Waterproofing)	1.5
		Total	7.0 say **10 psf**
	Ext. Walls		
		Siding	3.0
		Sheathing 15/32" OSB/Plywood	2.0
		2x6" Studs @ 16" o.c.	1.5
		Insulation R-21	0.6
		Gypsum Board 5/8"	2.8
		Total	9.9, say **10 psf**
	Int. Walls		
		2x4" Studs @ 16" o.c.	1.5
		Gypsum Board (2 sides) 5/8"	5.6
		Total	7.1, say **8 psf**

Live Loads		
	Roof	**20 psf**
	Living areas	**40 psf**
	Decks/Balconies	**60 psf**

Snow Load		
	Snow Ground Load	25 psf
	Snow Roof Load (no reduction applied)	**25 psf**

Project: 5642 E Mercer Way, Mercer Island, WA

2.2   Key List

Roof

Key No. 1.1   **Rafters, HF No. 2, 2x8", @ 24" o.c.**

Key No. 1.2   **Overframing, HF No. 2, 2x6", @ 24" o.c.**

Key No. 1.3   **Ridge Beam, DF No. 2, 6x10"**

Key No. 1.4   **Beam, DF No. 2, 4x8"**

Key No. 1.5   **Glulam WS, 24F-1.8E, 5-1/2x10-1/2"**

Key No. 1.6   **Post, HF No. 2, 6x6", P.T.**

Deck

Key No. 2.1   **Deck Joists, HF No. 2, 2x10", @ 12" o.c.**

Key No. 2.2   **Deck Joists, HF No. 2, 2x10", @ 16" o.c.**

Key No. 2.3   **Beam, HF No. 2, 6x12", P.T.**

Key No. 2.4   **Beam, HF No. 2, 6x12", P.T.**

Key No. 2.5   **Post, HF No. 2, 6x6", P.T.**

Key No. 2.6   **Stair Stringers, HF No. 2, 2x12", @ 12" o.c., P.T.**

Key No. 2.7   **Landing Joists, HF No. 2, 2x6", @ 16" o.c., P.T.**

Key No. 2.8   **Exist. Header, verify min LSL, 1.55E, 2325Fb, 3-1/2x9-1/4"**

Key No. 2.9   **Exist. Header, DF No. 2, verify min 4x8"**

Key No. 2.10   **Exist. Header, DF No. 2, verify min 4x6"**

Foundation

Key No. 3.1   **Spread Footing, fc = 2,500 psi, 30x30x8"**

Key No. 3.2   **Spread Footing, fc = 2,500 psi, 24x24x8"**

Project: 5642 E Mercer Way, Mercer Island, WA

2.3 Roof

Key No. 1.1 Rafters, HF No. 2, 2x8", @ 24" o.c.

Span:	L		=	10 ft
Load:	DL		=	15 psf
	SL		=	25 psf

For calculation see design sheets

Key No. 1.2 Overframing, HF No. 2, 2x6", @ 24" o.c.

Per span tables

For calculation see design sheets

Key No. 1.3 Ridge Beam, DF No. 2, 6x10"

Span:	L cantilevered		=	11 + 2 ft
Load:	roof w/ trib 10 ft			
	DL	10 x 15	=	150 plf
	SL	10 x 25	=	250 plf

For calculation see design sheets

Key No. 1.4 Beam, DF No. 2, 4x8"

Span:	L cantilevered		=	11 + 2 ft
Load:	roof w/ trib 6 ft			
	DL	6 x 15	=	90 plf
	SL	6 x 25	=	150 plf

For calculation see design sheets

Key No. 1.5 Glulam WS, 24F-1.8E, 5-1/2x10-1/2"

Span:	L		=	20 ft
Load:	point load from ridge beam 1.3			
	PDL	at L/2	=	1,150 lbs
	PSL		=	1,920 lbs

For calculation see design sheets

Key No. 1.6 Post, HF No. 2, 6x6", P.T.

Height:	H		=	8 ft
Loads:	reaction from beams 1.4 & 1.5			
	PDL	690 + 580	=	1,270 lbs
	PSL	1,150 + 960	=	2,110 lbs

Per inspection

Project: 5642 E Mercer Way, Mercer Island, WA

2.4 Deck

Key No. 2.1   Deck Joists, HF No. 2, 2x10", @ 12" o.c., P.T.

Span:	L	cantilevered	=	12 + 5 ft
Loads:	DL		=	10 psf
	LL		=	60 psf

For calculation see design sheets

Key No. 2.2   Deck Joists, HF No. 2, 2x10", @ 16" o.c.

Span:	L	cantilevered	=	4 + 1.5 ft
Loads:	DL		=	10 psf
	LL		=	60 psf
	SL		=	25 psf

For calculation see design sheets. Depth to match 2.1

Key No. 2.3   Beam, HF No. 2, 6x12", P.T.

Span:	L	cantilevered	=	13 + 2 ft
Load:	reaction from joists 2.2 (factor 0.75 to adjust for spacing)			
	DL	0.75 x 50	=	40 plf
	LL	0.75 x 300	=	225 plf
	SL	0.75 x 125	=	95 plf

For calculation see design sheets. 2% excess in allowable stress is still within the intent of the design.

Key No. 2.4   Beam, HF No. 2, 6x12", P.T.

Span:	L	cantilevered	=	7 + 3.5 ft
Load:	reaction from joists 2.1			
	DL		=	120 plf
	LL		=	725 plf

For calculation see design sheets.

Key No. 2.5   Post, HF No. 2, 6x6", P.T.

Height:	H		=	8 ft
Loads:	reaction from beam 2.4, cantilevered end (governs over 2x interior end and reactions at beam 2.3)			
	PDL		=	945 lbs
	PLL		=	5,710 lbs

For calculation see design sheets.

Key No. 2.6   Stair Stringers, HF No. 2, 2x12", @ 12" o.c., P.T.

Span:	L		=	12 ft
Loads:	DL		=	10 psf
	LL		=	40 psf

Per span tables

Project: 5642 E Mercer Way, Mercer Island, WA

Key No. 2.7   Landing Joists, HF No. 2, 2x6", @ 16" o.c., P.T.

Span:	L		=	3 ft
Loads:	DL		=	10 psf
	LL		=	40 psf

Per span tables

Key No. 2.8   Exist. Header, verify min LSL, 1.55E, 2325Fb, 3-1/2x9-1/4"

Span:	L		=	8 ft
Load:	floor w/ trib 8 ft, deck w/ trib 6 ft			
	DL	8 x 20 + 6 x 10	=	220 plf
	LL	8 x 40 + 6 x 60	=	600 plf

For calculation see design sheets

Key No. 2.9   Exist. Header, DF No. 2, verify min 4x8"

Span:	L		=	4 ft
Load:	floor w/ trib 8 ft, deck w/ trib 6 ft			
	DL	8 x 20 + 6 x 10	=	220 plf
	LL	8 x 40 + 6 x 60	=	600 plf

For calculation see design sheets

Key No. 2.10   Exist. Header, DF No. 2, verify min 4x6"

Span:	L		=	4 ft
Load:	floor w/ trib 8 ft, deck w/ trib 2 ft			
	DL	8 x 20 + 2 x 10	=	180 plf
	LL	8 x 40 + 2 x 60	=	360 plf

For calculation see design sheets

Project: 5642 E Mercer Way, Mercer Island, WA

2.5   Foundation

Key No. 3.1   Spread Footing, fc = 2,500 psi, 30x30x8"

Load	from post 2.5			
	P		=	6,655 lbs
Soil pressure		6,655 / 6.25	=	1,065 psf < 1,500
Rebars	# 4 @ 6" o.c. both directions			

Key No. 3.2   Spread Footing, fc = 2,500 psi, 24x24x8"

|				
Load	reaction from (2x) interior end of beam 2.3			
	P	2 x 1812	=	3,624 lbs
Soil pressure		3,624 / 4	=	906 psf < 1,500
Rebars	# 4 @ 6" o.c. both directions			

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5642 E Mercer Way
Mercer Island, WA
1_1 Rafter
Mar. 27, 2023 11:14

Design Check Calculation Sheet
WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat-tern	Location [ft] Start End	Magnitude Start End	Unit
DL	Dead	Full Area			10.00(24.0")	psf
SL	Snow	Full Area			25.00(24.0")	psf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :

10'-7.06"

0'   10'
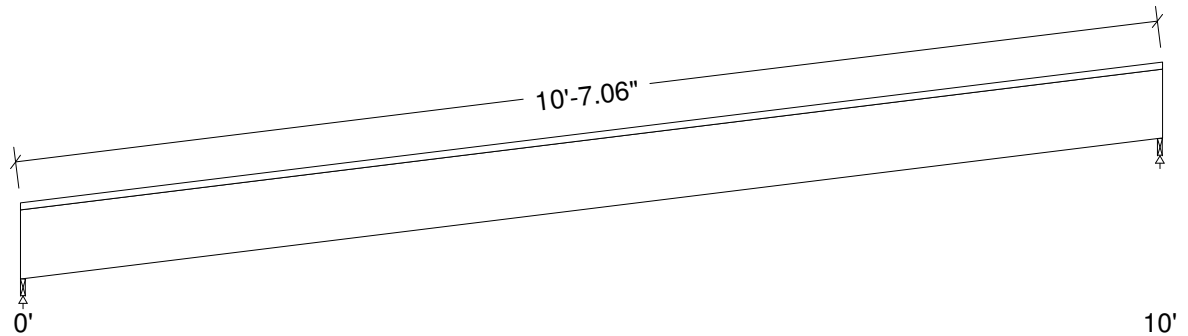
Unfactored:			
Dead	106		106
Snow	251		251
Factored:			
Total	357		357
Bearing:			
F'theta	439		439
Capacity			
Joist	357		357
Support	636		636
Des ratio			
Joist	1.00		1.00
Support	0.56		0.56
Load comb	#2		#2
Length	0.54		0.54
Min req'd	0.54		0.54
Cb	1.00		1.00
Cb min	1.00		1.00
Cb support	1.25		1.25
Fcp sup	625		625

Lumber-soft, Hem-Fir (N), No.1/No.2, 2x8 (1-1/2"x7-1/4")
Supports: All - Timber-soft Beam, D.Fir-L (N) No.2
Roof joist spaced at 24.0" c/c; Total length: 10'-9.5"; Clear span(horz): 9'-11.44"; Volume = 0.8 cu.ft.; Pitch: 4/12
Lateral support: top = continuous, bottom = at supports; Repetitive factor: applied where permitted (refer to online help);
This section PASSES the design code check.

WoodWorks® Sizer

SOFTWARE FOR WOOD DESIGN

Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 41	Fv' = 167	psi	fv/Fv' = 0.25
Bending(+)	fb = 811	Fb' = 1587	psi	fb/Fb' = 0.51
Dead Defl'n	0.07 = < L/999			
Live Defl'n	0.16 = L/771	0.53 = L/240	in	0.31
Total Defl'n	0.23 = L/542	0.70 = L/180	in	0.33

Additional Data:

FACTORS:	F/E(psi)	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	LC#
Fv'	145	1.15	1.00	1.00	–	–	–	–	1.00	1.00	2
Fb'+	1000	1.15	1.00	1.00	1.000	1.200	–	1.15	1.00	1.00	2
Fcp'	405	–	1.00	1.00	–	–	–	–	1.00	1.00	–
E'	1.6 million	1.00	1.00	–	–	–	–	–	1.00	1.00	2
Emin'	0.58 million	1.00	1.00	–	–	–	–	–	1.00	1.00	2

CRITICAL LOAD COMBINATIONS:
```
 Shear    : LC #2  = D + S
 Bending(+): LC #2  = D + S
 Deflection: LC #2  = D + S   (live)
           LC #2  = D + S   (total)
 Bearing   : Support 1 – LC #2 = D + S
           Support 2 – LC #2 = D + S
 D=dead S=snow
 All LC's are listed in the Analysis output
 Load combinations: ASD Basic from ASCE 7–16 2.4 / IBC 2018 1605.3.1
```
CALCULATIONS:
```
 V max = 337, V design = 297 lbs; M(+) = 889 lbs–ft
   EIy = 76.21 lb–in^2
 "Live" deflection is due to all non–dead loads (live, wind, snow…)
 Total deflection = 1.0 dead + "live"
 Bearing: Allowable bearing at an angle F'theta  calculated for each support
 as per NDS 3.10.3
```

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
4. SLOPED BEAMS: level bearing is required for all sloped beams.

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5642 E Mercer Way
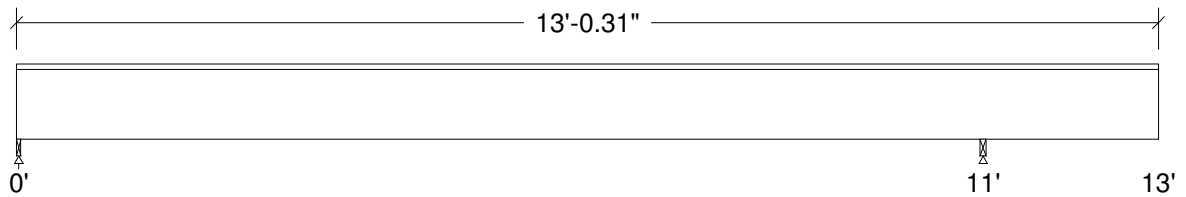Mercer Island, WA
1_3 Ridge Beam
Mar. 27, 2023 11:19

Design Check Calculation Sheet
WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat-tern	Location [ft] Start End	Magnitude Start End	Unit
DL	Dead	Full UDL	No		150.0	plf
SL	Snow	Full UDL	No		250.0	plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :

13'-0.31"

0'   11'   13'

Unfactored:			
Dead	802	1152	
Snow	1336	1920	
Factored:			
Total	2138	3073	
Bearing:			
Capacity			
Beam	2138	4166	
Support	2283	3073	
Des ratio			
Beam	1.00	0.74	
Support	0.94	1.00	
Load comb	#2	#2	
Length	0.62	0.84	
Min req'd	0.62	0.84**	
Cb	1.00	1.45	
Cb min	1.00	1.45	
Cb support	1.07	1.07	
Fcp sup	625	625	

**Minimum bearing length governed by the required width of the supporting member.

Timber-soft, D.Fir-L (N), No.2, 6x10 (5-1/2"x9-1/2")
Supports: All - Timber-soft Beam, D.Fir-L (N) No.2
Total length: 13'-0.31"; Clear span: 10'-11.25", 1'-11.56"; Volume = 4.7 cu.ft.; Beam or stringer
Lateral support: top = continuous, bottom = at supports;
This section PASSES the design code check.

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SOFTWARE FOR WOOD DESIGN

Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 56	Fv' = 195	psi	fv/Fv' = 0.29
Bending(+)	fb = 821	Fb' = 1006	psi	fb/Fb' = 0.82
Bending(−)	fb = 116	Fb' = 1006	psi	fb/Fb' = 0.12
Deflection:				
Interior Dead	0.09 = < L/999			
Live	0.15 = L/889	0.37 = L/360	in	0.40
Total	0.24 = L/555	0.55 = L/240	in	0.43
Cantil. Dead	−0.05 = L/501			
Live	−0.08 = L/301	0.13 = L/180	in	0.60
Total	−0.13 = L/188	0.20 = L/120	in	0.64

Additional Data:

```
FACTORS:   F/E(psi) CD    CM    Ct    CL     CF     Cfu   Cr    Cfrt  Ci    LC#
 Fv'       170     1.15  1.00  1.00   −      −      −     −     1.00  1.00  2
 Fb'+      875     1.15  1.00  1.00  1.000  1.000   −    1.00   1.00  1.00  2
 Fb'−      875     1.15  1.00  1.00  1.000  1.000   −    1.00   1.00  1.00  2
 Fcp'      625      −    1.00  1.00   −      −      −     −     1.00  1.00  −
 E'        1.3 million 1.00 1.00  −     −      −      −     −     1.00  1.00  2
```

CRITICAL LOAD COMBINATIONS:
```
 Shear     : LC #2  = D + S
 Bending(+): LC #2  = D + S
 Bending(−): LC #2  = D + S
 Deflection: LC #2  = D + S   (live)
            LC #2  = D + S   (total)
 Bearing   : Support 1 − LC #2 = D + S
            Support 2 − LC #2 = D + S
 D=dead S=snow
 All LC's are listed in the Analysis output
 Load combinations: ASD Basic from ASCE 7−16 2.4 / IBC 2018 1605.3.1
```
CALCULATIONS:
```
 V max = 2273, V design = 1942 lbs; M(+) = 5657 lbs-ft; M(−) = 800 lbs-ft
   EIy = 510.84 lb-in^2
 "Live" deflection is due to all non-dead loads (live, wind, snow…)
 Total deflection = 1.0 dead + "live"
```

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
4. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.

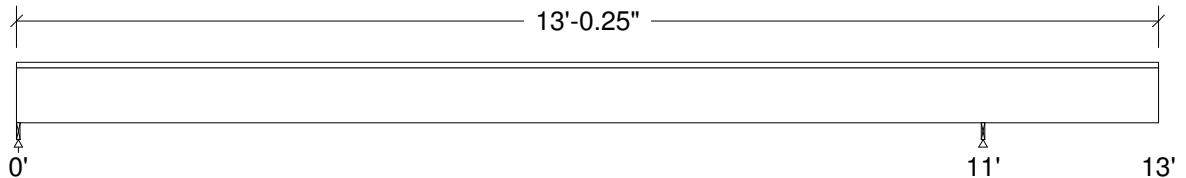| WoodWorks®		5642 E Mercer Way Mercer Island, WA 1_4 Beam Mar. 27, 2023 11:22

Design Check Calculation Sheet
WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat- tern	Location [ft] Start End	Magnitude Start End	Unit
DL	Dead	Full UDL	No		90.0	plf
SL	Snow	Full UDL	No		150.0	plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :

```
|←————————————————— 13'-0.25" —————————————————→|

  ┌─────────────────────────────────────────────────┐
  │                                                 │
  └─────────────────────────────────────────────────┘
  △                                        △
  0'                                       11'        13'
```

Unfactored:			
Dead	481	691	
Snow	801	1152	
Factored:			
Total	1281	1844	
Bearing:			
Capacity			
Beam	1719	3015	
Support	1836	1844	
Des ratio			
Beam	0.75	0.61	
Support	0.70	1.00	
Load comb	#2	#2	
Length	0.50*	0.50	
Min req'd	0.50*	0.50**	
Cb	1.00	1.75	
Cb min	1.00	1.75	
Cb support	1.07	1.07	
Fcp sup	625	625	

*Minimum bearing length setting used: 1/2" for end supports
**Minimum bearing length governed by the required width of the supporting member.

Timber-soft, D.Fir-L (N), No.2, 6x8 (5-1/2"x7-1/2")
Supports: All - Timber-soft Beam, D.Fir-L (N) No.2
Total length: 13'-0.25"; Clear span: 10'-11.5", 1'-11.75"; Volume = 3.7 cu.ft.; Post or timber
Lateral support: top = continuous, bottom = at supports;
This section PASSES the design code check.

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Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 44	Fv' = 195	psi	fv/Fv' = 0.22
Bending(+)	fb = 790	Fb' = 834	psi	fb/Fb' = 0.95
Bending(-)	fb = 112	Fb' = 834	psi	fb/Fb' = 0.13
Deflection:				
Interior Dead	0.11 = < L/999			
Live	0.18 = L/729	0.37 = L/360	in	0.49
Total	0.29 = L/455	0.55 = L/240	in	0.53
Cantil. Dead	-0.06 = L/411			
Live	-0.10 = L/246	0.13 = L/180	in	0.73
Total	-0.16 = L/154	0.20 = L/120	in	0.78

Additional Data:

```
FACTORS:   F/E(psi) CD    CM    Ct    CL    CF    Cfu   Cr    Cfrt  Ci    LC#
 Fv'       170    1.15  1.00  1.00    -     -     -     -    1.00  1.00    2
 Fb'+      725    1.15  1.00  1.00  1.000 1.000   -    1.00  1.00  1.00    2
 Fb'-      725    1.15  1.00  1.00  1.000 1.000   -    1.00  1.00  1.00    2
 Fcp'      625      -   1.00  1.00    -     -     -     -    1.00  1.00    -
 E'       1.3 million 1.00 1.00   -     -     -     -    1.00  1.00    2
```

CRITICAL LOAD COMBINATIONS:
```
 Shear      : LC #2  = D + S
 Bending(+): LC #2  = D + S
 Bending(-): LC #2  = D + S
 Deflection: LC #2  = D + S   (live)
            LC #2  = D + S   (total)
 Bearing   : Support 1 - LC #2 = D + S
             Support 2 - LC #2 = D + S
 D=dead S=snow
 All LC's are listed in the Analysis output
 Load combinations: ASD Basic from ASCE 7-16 2.4 / IBC 2018 1605.3.1
```
CALCULATIONS:
```
 V max = 1364, V design = 1209 lbs; M(+) = 3394 lbs-ft; M(-) = 480 lbs-ft
   EIy = 251.36 lb-in^2
 "Live" deflection is due to all non-dead loads (live, wind, snow…)
 Total deflection = 1.0 dead + "live"
```

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
4. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.
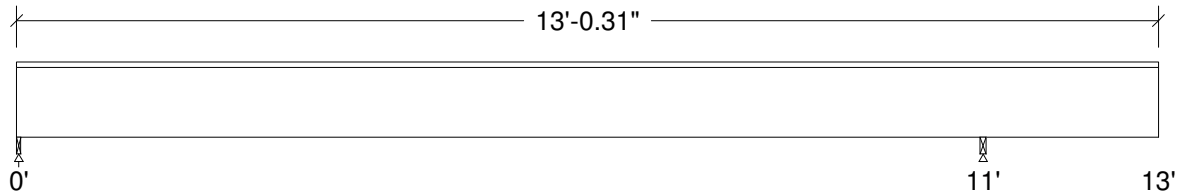
WoodWorks®
SOFTWARE FOR WOOD DESIGN

5642 E Mercer Way
Mercer Island, WA
1_3 Ridge Beam
Mar. 27, 2023 11:23

Design Check Calculation Sheet
WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat-tern	Location [ft] Start End	Magnitude Start End	Unit
DL	Dead	Full UDL	No		150.0	plf
SL	Snow	Full UDL	No		250.0	plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :

```
|←——————————————————— 13'-0.31" ———————————————————→|
```

```
0'                                            11'        13'
```

Unfactored:			
Dead	802	1152	
Snow	1336	1920	
Factored:			
Total	2138	3073	
Bearing:			
Capacity			
Beam	2138	4166	
Support	2283	3073	
Des ratio			
Beam	1.00	0.74	
Support	0.94	1.00	
Load comb	#2	#2	
Length	0.62	0.84	
Min req'd	0.62	0.84**	
Cb	1.00	1.45	
Cb min	1.00	1.45	
Cb support	1.07	1.07	
Fcp sup	625	625	

**Minimum bearing length governed by the required width of the supporting member.

Timber-soft, D.Fir-L (N), No.2, 6x10 (5-1/2"x9-1/2")
Supports: All - Timber-soft Beam, D.Fir-L (N) No.2
Total length: 13'-0.31"; Clear span: 10'-11.25", 1'-11.56"; Volume = 4.7 cu.ft.; Beam or stringer
Lateral support: top = continuous, bottom = at supports;
This section PASSES the design code check.

WoodWorks® Sizer

SOFTWARE FOR WOOD DESIGN

Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 56	Fv' = 195	psi	fv/Fv' = 0.29
Bending(+)	fb = 821	Fb' = 1006	psi	fb/Fb' = 0.82
Bending(−)	fb = 116	Fb' = 1006	psi	fb/Fb' = 0.12
Deflection:				
Interior Dead	0.09 = < L/999			
Live	0.15 = L/889	0.37 = L/360	in	0.40
Total	0.24 = L/555	0.55 = L/240	in	0.43
Cantil. Dead	−0.05 = L/501			
Live	−0.08 = L/301	0.13 = L/180	in	0.60
Total	−0.13 = L/188	0.20 = L/120	in	0.64

Additional Data:

FACTORS:	F/E(psi)	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	LC#
Fv'	170	1.15	1.00	1.00	–	–	–	–	1.00	1.00	2
Fb'+	875	1.15	1.00	1.00	1.000	1.000	–	1.00	1.00	1.00	2
Fb'–	875	1.15	1.00	1.00	1.000	1.000	–	1.00	1.00	1.00	2
Fcp'	625	–	1.00	1.00	–	–	–	–	1.00	1.00	–
E'	1.3 million	1.00	1.00	–	–	–	–	–	1.00	1.00	2

CRITICAL LOAD COMBINATIONS:
```
Shear     : LC #2  = D + S
Bending(+): LC #2  = D + S
Bending(−): LC #2  = D + S
Deflection: LC #2  = D + S  (live)
            LC #2  = D + S  (total)
Bearing   : Support 1 – LC #2 = D + S
            Support 2 – LC #2 = D + S
D=dead S=snow
All LC's are listed in the Analysis output
Load combinations: ASD Basic from ASCE 7-16 2.4 / IBC 2018 1605.3.1
```
CALCULATIONS:
```
V max = 2273, V design = 1942 lbs; M(+) = 5657 lbs-ft; M(−) = 800 lbs-ft
  EIy = 510.84 lb-in^2
"Live" deflection is due to all non-dead loads (live, wind, snow…)
Total deflection = 1.0 dead + "live"
```

Design Notes:
1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
4. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.

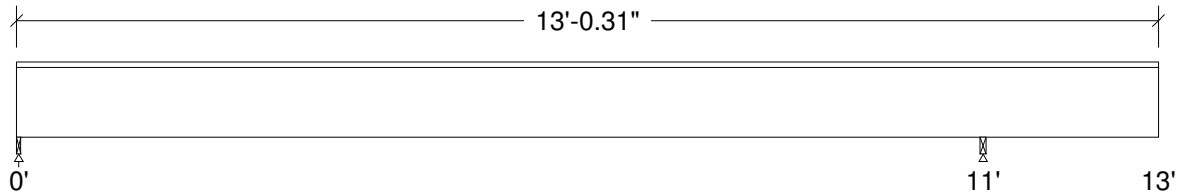|		5642 E Mercer Way
WoodWorks®		Mercer Island, WA
SOFTWARE FOR WOOD DESIGN		1_3 Ridge Beam
		Mar. 27, 2023 11:26

Design Check Calculation Sheet
WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat-tern	Location [ft] Start End	Magnitude Start End	Unit
DL	Dead	Full UDL	No		150.0	plf
SL	Snow	Full UDL	No		250.0	plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :

|← 13'-0.31" →|

0'   11'   13'

Unfactored:			
Dead	802		1152
Snow	1336		1920
Factored:			
Total	2138		3073
Bearing:			
Capacity			
Beam	2138		4166
Support	2283		3073
Des ratio			
Beam	1.00		0.74
Support	0.94		1.00
Load comb	#2		#2
Length	0.62		0.84
Min req'd	0.62		0.84**
Cb	1.00		1.45
Cb min	1.00		1.45
Cb support	1.07		1.07
Fcp sup	625		625

**Minimum bearing length governed by the required width of the supporting member.

Timber-soft, D.Fir-L (N), No.2, 6x10 (5-1/2"x9-1/2")
Supports: All - Timber-soft Beam, D.Fir-L (N) No.2
Total length: 13'-0.31"; Clear span: 10'-11.25", 1'-11.56"; Volume = 4.7 cu.ft.; Beam or stringer
Lateral support: top = continuous, bottom = at supports;
This section PASSES the design code check.

WoodWorks® Sizer

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Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 56	Fv' = 195	psi	fv/Fv' = 0.29
Bending(+)	fb = 821	Fb' = 1006	psi	fb/Fb' = 0.82
Bending(−)	fb = 116	Fb' = 1006	psi	fb/Fb' = 0.12
Deflection:				
Interior Dead	0.09 = < L/999			
Live	0.15 = L/889	0.37 = L/360	in	0.40
Total	0.24 = L/555	0.55 = L/240	in	0.43
Cantil. Dead	−0.05 = L/501			
Live	−0.08 = L/301	0.13 = L/180	in	0.60
Total	−0.13 = L/188	0.20 = L/120	in	0.64

Additional Data:

```
FACTORS:   F/E(psi) CD    CM    Ct    CL    CF    Cfu   Cr    Cfrt  Ci    LC#
 Fv'       170    1.15  1.00  1.00   −     −     −     −    1.00  1.00   2
 Fb'+      875    1.15  1.00  1.00  1.000 1.000  −    1.00  1.00  1.00   2
 Fb'−      875    1.15  1.00  1.00  1.000 1.000  −    1.00  1.00  1.00   2
 Fcp'      625     −    1.00  1.00   −     −     −     −    1.00  1.00   −
 E'       1.3 million 1.00 1.00   −     −     −     −    1.00  1.00   2
```

CRITICAL LOAD COMBINATIONS:
```
 Shear     : LC #2  = D + S
 Bending(+): LC #2  = D + S
 Bending(−): LC #2  = D + S
 Deflection: LC #2  = D + S  (live)
            LC #2  = D + S  (total)
 Bearing   : Support 1 − LC #2 = D + S
             Support 2 − LC #2 = D + S
 D=dead S=snow
 All LC's are listed in the Analysis output
 Load combinations: ASD Basic from ASCE 7−16 2.4 / IBC 2018 1605.3.1
```
CALCULATIONS:
```
 V max = 2273, V design = 1942 lbs; M(+) = 5657 lbs−ft; M(−) = 800 lbs−ft
   EIy = 510.84 lb−in^2
 "Live" deflection is due to all non−dead loads (live, wind, snow…)
 Total deflection = 1.0 dead + "live"
```

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
4. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.
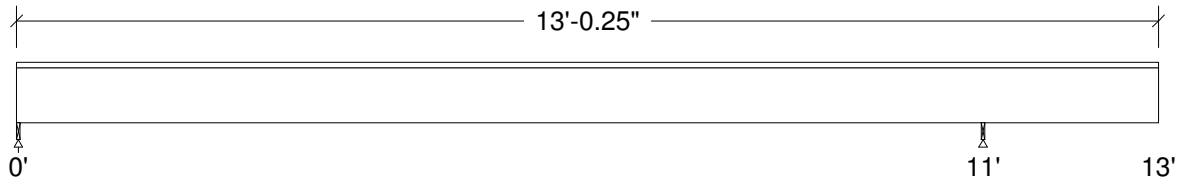
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5642 E Mercer Way
Mercer Island, WA
1_4 Beam
Mar. 27, 2023 11:26

Design Check Calculation Sheet
WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat-tern	Location [ft] Start End	Magnitude Start End	Unit
DL	Dead	Full UDL	No		90.0	plf
SL	Snow	Full UDL	No		150.0	plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :

13'-0.25"

0'   11'   13'

Unfactored:				
Dead	481		691	
Snow	801		1152	
Factored:				
Total	1281		1844	
Bearing:				
Capacity				
Beam	1719		3015	
Support	1836		1844	
Des ratio				
Beam	0.75		0.61	
Support	0.70		1.00	
Load comb	#2		#2	
Length	0.50*		0.50	
Min req'd	0.50*		0.50**	
Cb	1.00		1.75	
Cb min	1.00		1.75	
Cb support	1.07		1.07	
Fcp sup	625		625	

*Minimum bearing length setting used: 1/2" for end supports
**Minimum bearing length governed by the required width of the supporting member.

Timber-soft, D.Fir-L (N), No.2, 6x8 (5-1/2"x7-1/2")
Supports: All - Timber-soft Beam, D.Fir-L (N) No.2
Total length: 13'-0.25"; Clear span: 10'-11.5", 1'-11.75"; Volume = 3.7 cu.ft.; Post or timber
Lateral support: top = continuous, bottom = at supports;
This section PASSES the design code check.

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Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 44	Fv' = 195	psi	fv/Fv' = 0.22
Bending(+)	fb = 790	Fb' = 834	psi	fb/Fb' = 0.95
Bending(-)	fb = 112	Fb' = 834	psi	fb/Fb' = 0.13
Deflection:				
Interior Dead	0.11 = < L/999			
Live	0.18 = L/729	0.37 = L/360	in	0.49
Total	0.29 = L/455	0.55 = L/240	in	0.53
Cantil. Dead	-0.06 = L/411			
Live	-0.10 = L/246	0.13 = L/180	in	0.73
Total	-0.16 = L/154	0.20 = L/120	in	0.78

Additional Data:

```
FACTORS:   F/E(psi) CD    CM    Ct    CL     CF     Cfu   Cr    Cfrt  Ci    LC#
 Fv'        170     1.15  1.00  1.00   -      -      -     -     1.00  1.00  2
 Fb'+       725     1.15  1.00  1.00  1.000  1.000   -    1.00   1.00  1.00  2
 Fb'-       725     1.15  1.00  1.00  1.000  1.000   -    1.00   1.00  1.00  2
 Fcp'       625      -    1.00  1.00   -      -      -     -     1.00  1.00  -
 E'        1.3 million 1.00 1.00  -     -      -      -     -     1.00  1.00  2
```

CRITICAL LOAD COMBINATIONS:
```
 Shear     : LC #2  = D + S
 Bending(+): LC #2  = D + S
 Bending(-): LC #2  = D + S
 Deflection: LC #2  = D + S   (live)
             LC #2  = D + S   (total)
 Bearing   : Support 1 - LC #2 = D + S
             Support 2 - LC #2 = D + S
 D=dead S=snow
 All LC's are listed in the Analysis output
 Load combinations: ASD Basic from ASCE 7-16 2.4 / IBC 2018 1605.3.1
```
CALCULATIONS:
```
 V max = 1364, V design = 1209 lbs; M(+) = 3394 lbs-ft; M(-) = 480 lbs-ft
   EIy = 251.36 lb-in^2
 "Live" deflection is due to all non-dead loads (live, wind, snow…)
 Total deflection = 1.0 dead + "live"
```

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
4. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.

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5642 E Mercer Way
Mercer Island, WA
1_5 Beam
Mar. 27, 2023 11:31

Design Check Calculation Sheet
WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
DL	Dead	Point		10.00		1150		lbs
SL	Snow	Point		10.00		1920		lbs

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :

|← 20'-0.5" →|

0'   20'
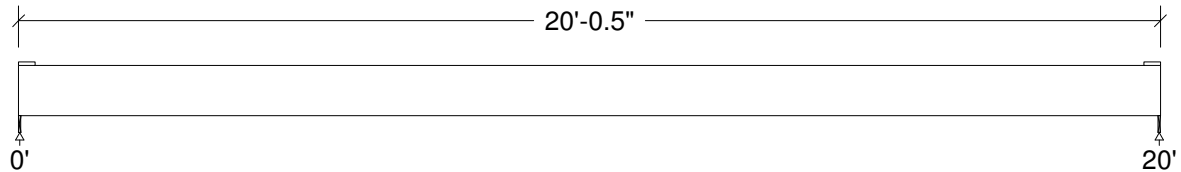
Unfactored:			
Dead	576		574
Snow	962		958
Factored:			
Total	1538		1532
Bearing:			
Capacity			
Beam	1787		1787
Support	1836		1836
Des ratio			
Beam	0.86		0.86
Support	0.84		0.83
Load comb	#2		#2
Length	0.50*		0.50*
Min req'd	0.50*		0.50*
Cb	1.00		1.00
Cb min	1.00		1.00
Cb support	1.07		1.07
Fcp sup	625		625

*Minimum bearing length setting used: 1/2" for end supports

Glulam-Unbalan., West Species, 24F-1.8E WS, 5-1/2"x10-1/2"
Supports: All - Timber-soft Beam, D.Fir-L (N) No.2
Total length: 20'-0.5"; Clear span: 19'-11.5"; Volume = 8.0 cu.ft.; 7 laminations, 5-1/2" maximum width,
Lateral support: top = at supports, bottom = at supports;
This section PASSES the design code check.

Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 40	Fv' = 305	psi	fv/Fv' = 0.13
Bending(+)	fb = 1823	Fb' = 2670	psi	fb/Fb' = 0.68
Dead Defl'n	0.35 = L/692			
Live Defl'n	0.58 = L/414	0.67 = L/360	in	0.87
Total Defl'n	0.93 = L/259	1.00 = L/240	in	0.93

WoodWorks® Sizer

SOFTWARE FOR WOOD DESIGN

Additional Data:

FACTORS:	F/E(psi)	CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Notes	Cvr	LC#
Fv'	265	1.15	1.00	1.00	–	–	–	–	1.00	1.00	1.00	2
Fb'+	2400	1.15	1.00	1.00	0.968	1.000	–	–	1.00	1.00	–	2
Fcp'	650	–	1.00	1.00	–	–	–	–	1.00	–	–	–
E'	1.8 million	1.00	1.00	–	–	–	–	–	1.00	–	–	2
Eminy'	0.85 million	1.00	1.00	–	–	–	–	–	1.00	–	–	2

CRITICAL LOAD COMBINATIONS:
```
 Shear     : LC #2  = D + S
 Bending(+): LC #2  = D + S
 Deflection: LC #2  = D + S  (live)
             LC #2  = D + S  (total)
 Bearing   : Support 1 – LC #2 = D + S
             Support 2 – LC #2 = D + S
 D=dead S=snow
 All LC's are listed in the Analysis output
 Load combinations: ASD Basic from ASCE 7–16 2.4 / IBC 2018 1605.3.1
```
CALCULATIONS:
```
 V max = 1538, V design = 1538 lbs; M(+) = 15350 lbs-ft
   EIy = 955.03 lb-in^2
 "Live" deflection is due to all non-dead loads (live, wind, snow…)
 Total deflection = 1.0 dead + "live"
 Lateral stability(+):  Lu = 20'  Le = 36'-9.63"  RB = 12.4
```

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Glulam design values are for materials conforming to ANSI 117-2015 and manufactured in accordance with ANSI A190.1-2012
4. GLULAM: bxd = actual breadth x actual depth.
5. Glulam Beams shall be laterally supported according to the provisions of NDS Clause 3.3.3.
6. GLULAM: bearing length based on smaller of Fcp(tension), Fcp(comp'n).

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5642 E Mercer Way
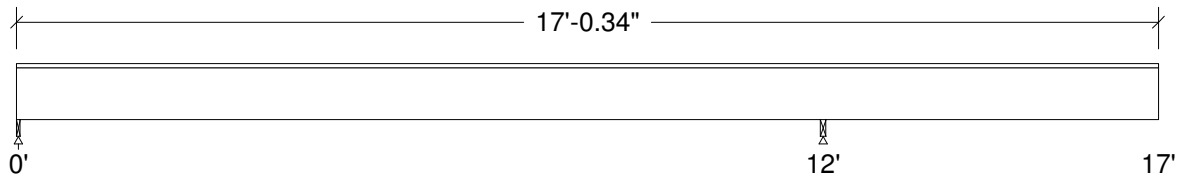Mercer Island, WA
2_1 Deck Joists
Mar. 27, 2023 13:39

Design Check Calculation Sheet
WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat-tern	Location [ft] Start End	Magnitude Start End	Unit
DL	Dead	Full Area	No		10.00(12.0")	psf
LL	Live	Full Area	Yes		60.00(12.0")	psf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :

|-------------- 17'-0.34" --------------|

0'   12'   17'

Unfactored:				
Dead	50		120	
Live	362		723	
Factored:				
Uplift	-11			
Total	412		843	
Bearing:				
Capacity				
Joist	412		843	
Support	794		1187	
Des ratio				
Joist	1.00		1.00	
Support	0.52		0.71	
Load comb	#3		#2	
Length	0.68		1.01	
Min req'd	0.68		1.01	
Cb	1.00		1.37	
Cb min	1.00		1.37	
Cb support	1.25		1.25	
Fcp sup	625		625	

Lumber-soft, Hem-Fir (N), No.1/No.2, 2x10 (1-1/2"x9-1/4")
Supports: All - Timber-soft Beam, D.Fir-L (N) No.2
Floor joist spaced at 12.0" c/c; Total length: 17'-0.31"; Clear span: 11'-11.13", 4'-11.5"; Volume = 1.6 cu.ft.
Incised; Lateral support: top = continuous, bottom = at supports; Repetitive factor: applied where permitted (refer to online help);
This section PASSES the design code check.

WoodWorks® Sizer   **SOFTWARE FOR WOOD DESIGN**

Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 47	Fv' = 116	psi	fv/Fv' = 0.41
Bending(+)	fb = 672	Fb' = 1012	psi	fb/Fb' = 0.66
Bending(-)	fb = 491	Fb' = 544	psi	fb/Fb' = 0.90
Deflection:				
Interior Dead	0.02 = < L/999			
Live	0.19 = L/773	0.40 = L/360	in	0.47
Total	0.20 = L/704	0.60 = L/240	in	0.34
Cantil. Dead	-0.00 = < L/999			
Live	-0.25 = L/241	0.33 = L/180	in	0.74
Total	-0.25 = L/238	0.50 = L/120	in	0.50

Additional Data:

FACTORS:	F/E(psi)	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	LC#
Fv'	145	1.00	1.00	1.00	–	–	–	–	1.00	0.80	2
Fb'+	1000	1.00	1.00	1.00	1.000	1.100	–	1.15	1.00	0.80	3
Fb'-	1000	1.00	1.00	1.00	0.538	1.100	–	1.15	1.00	0.80	2
Fcp'	405	–	1.00	1.00	–	–	–	–	1.00	1.00	–
E'	1.6 million	1.00	1.00	–	–	–	–	–	1.00	0.95	3
Emin'	0.58 million	1.00	1.00	–	–	–	–	–	1.00	0.95	3

CRITICAL LOAD COMBINATIONS:
```
 Shear      : LC #2  = D + L
 Bending(+): LC #3  = D + L (pattern: L_)
 Bending(-): LC #2  = D + L
 Deflection: LC #3  = D + L (pattern: L_)  (live)
             LC #3  = D + L (pattern: L_)  (total)
 Bearing   : Support 1 - LC #3 = D + L (pattern: L_)
             Support 2 - LC #2 = D + L
 Uplift    : Support 1 - LC #4 = D + L (pattern: _L)
 D=dead L=live
 All LC's are listed in the Analysis output
 Load Patterns: s=S/2,  X=L+S or L+Lr,  _=no pattern load in this span
 Load combinations: ASD Basic from ASCE 7-16 2.4 / IBC 2018 1605.3.1
```
CALCULATIONS:
```
 V max = 493, V design = 436 lbs; M(+) = 1198 lbs-ft; M(-) = 875 lbs-ft
   EIy = 158.29 lb-in^2
 "Live" deflection is due to all non-dead loads (live, wind, snow…)
 Total deflection = 0.5 dead + "live"
 Lateral stability(-):  Lu = 12'  Le = 19'-7.13"  RB = 31.1; Lu based on full span
```

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
4. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.

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5642 E Mercer Way
Mercer Island, WA
2_2 Deck Joists
Mar. 27, 2023 13:58

Design Check Calculation Sheet
WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat-tern	Location [ft] Start End	Magnitude Start End	Unit
DL	Dead	Full Area	No		10.00(16.0")	psf
LL	Live	Full Area	Yes		60.00(16.0")	psf
SL	Snow	Full Area	No		25.00(16.0")	psf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :

5'-6.25"

0'   4'   5'-6"
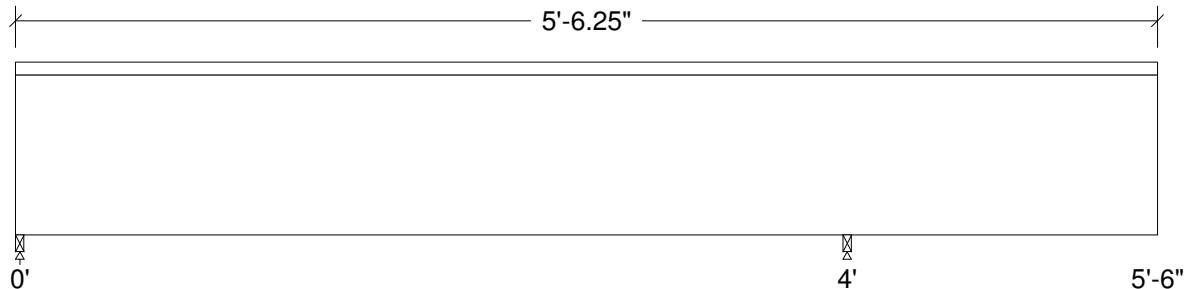
Unfactored:				
Dead	23		50	
Live	162		303	
Snow	58		126	
Factored:				
Total	188		372	
Bearing:				
Capacity				
Joist	304		532	
Support	586		586	
Des ratio				
Joist	0.62		0.70	
Support	0.32		0.63	
Load comb	#8		#3	
Length	0.50*		0.50*	
Min req'd	0.50*		0.35	
Cb	1.00		1.75	
Cb min	1.00		1.75	
Cb support	1.25		1.25	
Fcp sup	625		625	

*Minimum bearing length setting used: 1/2" for end supports and 1/2" for interior supports

Lumber-soft, Hem-Fir (N), No.1/No.2, 2x10 (1-1/2"x9-1/4")
Supports: All - Timber-soft Beam, D.Fir-L (N) No.2
Floor joist spaced at 16.0" c/c; Total length: 5'-6.25"; Clear span: 3'-11.5", 1'-5.75"; Volume = 0.5 cu.ft.
Lateral support: top = continuous, bottom = at supports; Repetitive factor: applied where permitted (refer to online help);
This section PASSES the design code check.

WoodWorks® Sizer

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Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 15	Fv' = 145	psi	fv/Fv' = 0.10
Bending(+)	fb = 101	Fb' = 1265	psi	fb/Fb' = 0.08
Bending(-)	fb = 59	Fb' = 1170	psi	fb/Fb' = 0.05
Deflection:				
Interior Dead	negligible			
Live	0.00 = < L/999	0.13 = L/360	in	0.02
Total	0.00 = < L/999	0.20 = L/240	in	0.02
Cantil. Dead	negligible			
Live	-0.00 = < L/999	0.10 = L/180	in	0.03
Total	-0.00 = < L/999	0.15 = L/120	in	0.02

Additional Data:

FACTORS:	F/E(psi)	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	LC#
Fv'	145	1.00	1.00	1.00	–	–	–	–	1.00	1.00	2
Fb'+	1000	1.00	1.00	1.00	1.000	1.100	–	1.15	1.00	1.00	5
Fb'-	1000	1.00	1.00	1.00	0.925	1.100	–	1.15	1.00	1.00	2
Fcp'	405	–	1.00	1.00	–	–	–	–	1.00	1.00	–
E'	1.6 million	1.00	1.00	–	–	–	–	–	1.00	1.00	5
Emin'	0.58 million	1.00	1.00	–	–	–	–	–	1.00	1.00	5

CRITICAL LOAD COMBINATIONS:
 Shear   : LC #2 = D + L
 Bending(+): LC #5 = D + L (pattern: L_)
 Bending(-): LC #2 = D + L
 Deflection: LC #5 = D + L (pattern: L_) (live)
            LC #5 = D + L (pattern: L_) (total)
 Bearing   : Support 1 - LC #8 = D + 0.75(L + S) (pattern: L_)
            Support 2 - LC #3 = D + 0.75(L + S)
 D=dead L=live S=snow
 All LC's are listed in the Analysis output
 Load Patterns: s=S/2, X=L+S or L+Lr, _=no pattern load in this span
 Load combinations: ASD Basic from ASCE 7-16 2.4 / IBC 2018 1605.3.1
CALCULATIONS:
 V max = 213, V design = 139 lbs; M(+) = 179 lbs-ft; M(-) = 105 lbs-ft
   EIy = 158.29 lb-in^2
 "Live" deflection is due to all non-dead loads (live, wind, snow…)
 Total deflection = 0.5 dead + "live"
 Lateral stability(-): Lu = 4' Le = 7'-5.75" RB = 19.2; Lu based on full span

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
4. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.

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5642 E Mercer Way
Mercer Island, WA
2_3 Beam
Mar. 27, 2023 13:57

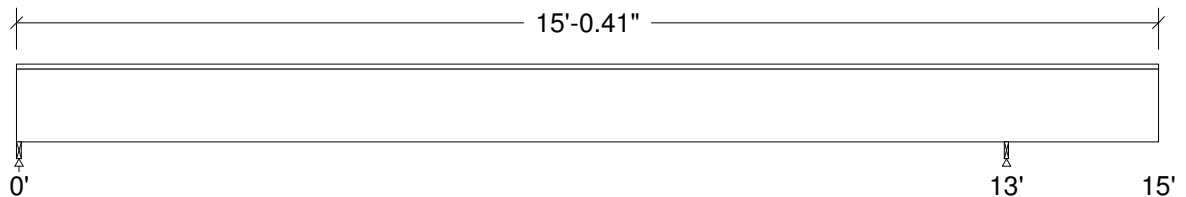## Design Check Calculation Sheet
WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat- tern	Location [ft] Start End	Magnitude Start End	Unit
DL	Dead	Full UDL	No		40.0	plf
LL	Live	Full UDL	Yes		225.0	plf
SL	Snow	Full UDL	No		95.0	plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :

|— 15'-0.41" —|

0'   13'   15'

Unfactored:		
Dead	255	346
Live	1470	1947
Snow	606	822
Factored:		
Total	1812	2423
Bearing:		
Capacity		
Beam	1812	2423
Support	2988	2617
Des ratio		
Beam	1.00	1.00
Support	0.61	0.93
Load comb	#8	#3
Length	0.81	0.71
Min req'd	0.81	0.71
Cb	1.00	1.53
Cb min	1.00	1.53
Cb support	1.07	1.07
Fcp sup	625	625

Timber-soft, Hem-Fir (N), No.2, 6x12 (5-1/2"x11-1/2")
Supports: All - Timber-soft Beam, D.Fir-L (N) No.2
Total length: 15'-0.44"; Clear span: 12'-11.25", 1'-11.63"; Volume = 6.6 cu.ft.; Beam or stringer
Incised; Lateral support: top = continuous, bottom = at supports;

This section FAILS the design check
WARNING: This section violates the following design criteria: Bending

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Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 36	Fv' = 108	psi	fv/Fv' = 0.33
Bending(+)	fb = 550	Fb' = 540	psi	fb/Fb' = 1.02
Bending(−)	fb = 52	Fb' = 536	psi	fb/Fb' = 0.10
Deflection:				
Interior Dead	0.03 = < L/999			
Live	0.21 = L/749	0.43 = L/360	in	0.48
Total	0.24 = L/646	0.65 = L/240	in	0.37
Cantil. Dead	−0.02 = < L/999			
Live	−0.10 = L/237	0.13 = L/180	in	0.76
Total	−0.12 = L/205	0.20 = L/120	in	0.58

Additional Data:

FACTORS:	F/E(psi)	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	LC#
Fv'	135	1.00	1.00	1.00	−	−	−	−	1.00	0.80	2
Fb'+	675	1.00	1.00	1.00	1.000	1.000	−	1.00	1.00	0.80	5
Fb'−	675	1.00	1.00	1.00	0.992	1.000	−	1.00	1.00	0.80	2
Fcp'	405	−	1.00	1.00	−	−	−	−	1.00	1.00	−
E'	1.1 million	1.00	1.00	−	−	−	−	−	1.00	0.95	8
Emin'	0.40 million	1.00	1.00	−	−	−	−	−	1.00	0.95	8

CRITICAL LOAD COMBINATIONS:
```
 Shear     : LC #2  = D + L
 Bending(+): LC #5  = D + L (pattern: L_)
 Bending(−): LC #2  = D + L
 Deflection: LC #8  = D + 0.75(L + S) (pattern: L_)  (live)
             LC #8  = D + 0.75(L + S) (pattern: L_)  (total)
 Bearing   : Support 1 − LC #8 = D + 0.75(L + S) (pattern: L_)
             Support 2 − LC #3 = D + 0.75(L + S)
 D=dead L=live S=snow
 All LC's are listed in the Analysis output
 Load Patterns: s=S/2,  X=L+S or L+Lr,  _=no pattern load in this span
 Load combinations: ASD Basic from ASCE 7−16 2.4 / IBC 2018 1605.3.1
```
CALCULATIONS:
```
 V max = 1763, V design = 1501 lbs; M(+) = 5558 lbs-ft; M(−) = 530 lbs-ft
   EIy = 766.76 lb-in^2
 "Live" deflection is due to all non-dead loads (live, wind, snow…)
 Total deflection = 0.5 dead + "live"
 Lateral stability(−):  Lu = 13'  Le = 21'-7.13"  RB = 9.9; Lu based on full span
```

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
4. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.
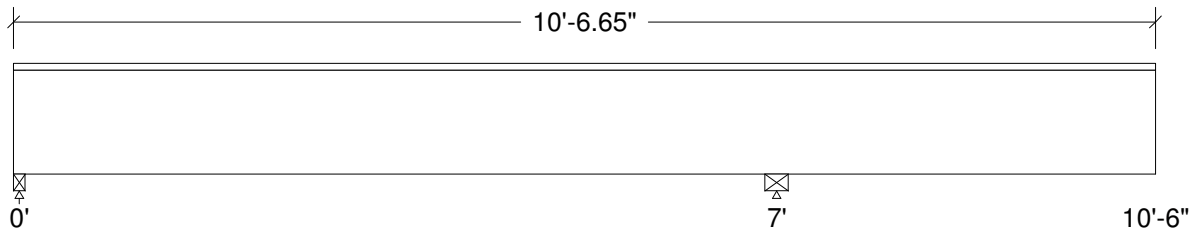
WoodWorks® SOFTWARE FOR WOOD DESIGN

Design Check Calculation Sheet
WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat-tern	Location [ft] Start End	Magnitude Start End	Unit
DL	Dead	Full UDL	No		120.0	plf
LL	Live	Full UDL	Yes		725.0	plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :

10'-6.65"

0'   7'   10'-6"

Unfactored:				
Dead	322		945	
Live	2577		5709	
Factored:				
Uplift	−274			
Total	2898		6654	
Bearing:				
Capacity				
Beam	2898		6654	
Support	4778		9592	
Des ratio				
Beam	1.00		1.00	
Support	0.61		0.69	
Load comb	#3		#2	
Length	1.30		2.61	
Min req'd	1.30		2.61	
Cb	1.00		1.14	
Cb min	1.00		1.14	
Cb support	1.07		1.07	
Fcp sup	625		625	

Timber-soft, Hem-Fir (N), No.2, 6x12 (5-1/2"x11-1/2")
Supports: All - Timber-soft Beam, D.Fir-L (N) No.2
Total length: 10'-6.63"; Clear span: 6'-10.06", 3'-4.69"; Volume = 4.6 cu.ft.; Beam or stringer
Incised; Lateral support: top = continuous, bottom = at supports;
This section PASSES the design code check.

WoodWorks® Sizer

SOFTWARE FOR WOOD DESIGN

Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 66	Fv' = 108	psi	fv/Fv' = 0.62
Bending(+)	fb = 477	Fb' = 540	psi	fb/Fb' = 0.88
Bending(−)	fb = 512	Fb' = 538	psi	fb/Fb' = 0.95
Deflection:				
Interior Dead	0.00 = < L/999			
Live	0.05 = < L/999	0.23 = L/360	in	0.23
Total	0.06 = < L/999	0.35 = L/240	in	0.16
Cantil. Dead	0.01 = < L/999			
Live	0.12 = L/355	0.23 = L/180	in	0.51
Total	0.12 = L/339	0.35 = L/120	in	0.35

Additional Data:

```
FACTORS:   F/E(psi) CD    CM    Ct    CL     CF     Cfu   Cr    Cfrt  Ci    LC#
 Fv'        135     1.00  1.00  1.00   –      –      –     –     1.00  0.80  2
 Fb'+       675     1.00  1.00  1.00  1.000  1.000   –    1.00   1.00  0.80  3
 Fb'–       675     1.00  1.00  1.00  0.996  1.000   –    1.00   1.00  0.80  2
 Fcp'       405      –    1.00  1.00   –      –      –     –     1.00  1.00   –
 E'        1.1 million 1.00 1.00  –    –      –      –     –     1.00  0.95  3
 Emin'     0.40 million 1.00 1.00  –   –      –      –     –     1.00  0.95  3
```

CRITICAL LOAD COMBINATIONS:
```
 Shear     : LC #2  = D + L
 Bending(+): LC #3  = D + L (pattern: L_)
 Bending(−): LC #2  = D + L
 Deflection: LC #3  = D + L (pattern: L_)  (live)
             LC #3  = D + L (pattern: L_)  (total)
 Bearing   : Support 1 – LC #3 = D + L (pattern: L_)
             Support 2 – LC #2 = D + L
 Uplift    : Support 1 – LC #4 = D + L (pattern: _L)
 D=dead L=live
 All LC's are listed in the Analysis output
 Load Patterns: s=S/2,  X=L+S or L+Lr,  _=no pattern load in this span
 Load combinations: ASD Basic from ASCE 7-16 2.4 / IBC 2018 1605.3.1
```
CALCULATIONS:
```
 V max = 3697, V design = 2802 lbs; M(+) = 4815 lbs-ft; M(−) = 5176 lbs-ft
   EIy = 766.76 lb-in^2
 "Live" deflection is due to all non-dead loads (live, wind, snow…)
 Total deflection = 0.5 dead + "live"
 Lateral stability(−):  Lu = 7'  Le = 12'-11.44"  RB = 7.7; Lu based on full span
```

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
4. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.

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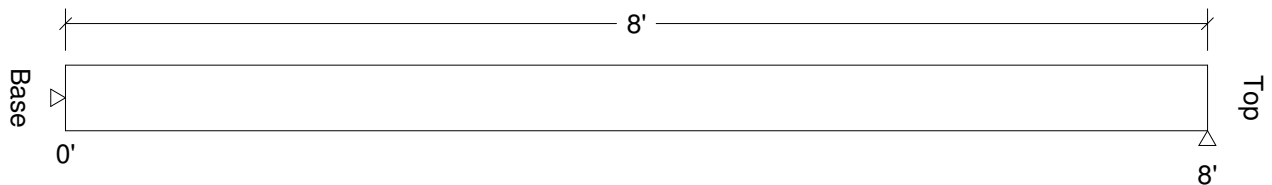
2_5 Post
Mar. 27, 2023 14:13

Design Check Calculation Sheet
WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Location [ft] Start End	Magnitude Start End	Unit
PDL	Dead	Axial	(Ecc. = 0.00")	945	lbs
PLL	Live	Axial	(Ecc. = 0.00")	5710	lbs

Reactions (lbs):

Unfactored:			
Lateral:			
Dead			
Live			
Axial:			
Dead	945		945
Live	5710		5710
Factored:			
L->R			
Load comb	#1		#1

Timber-soft, Hem-Fir (N), No.2, 6x6 (5-1/2"x5-1/2")
Support: Non-wood
Total length: 8'; Volume = 1.7 cu.ft.; Post or timber
Pinned base; Incised; Ke x Lb: 1.0 x 8.0 = 8.0 ft; Ke x Ld: 1.0 x 8.0 = 8.0 ft;
This section PASSES the design code check.

Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Axial	fc = 220	Fc' = 394	psi	fc/Fc' = 0.56
Axial Bearing	fc = 220	Fc* = 460	psi	fc/Fc* = 0.48

Additional Data:
```
FACTORS:  F/E(psi) CD    CM    Ct    CL/CP   CF    Cfu    Cr   Cfrt   Ci    LC#
 Fc'       575    1.00  1.00  1.00  0.856  1.000   -      -    1.00  0.80   2
 Fc*       575    1.00  1.00  1.00    -    1.000   -      -    1.00  0.80   2
CRITICAL LOAD COMBINATIONS:
 Axial    : LC #2  = D + L
 D=dead L=live
 All LC's are listed in the Analysis output
 Load combinations: ASD Basic from ASCE 7-16 2.4 / IBC 2018 1605.3.1
```

Design Notes:
1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.

WoodWorks® SOFTWARE FOR WOOD DESIGN		5642 E Mercer Way Mercer Island, WA 2_8 Exist Header Mar. 29, 2023 13:47

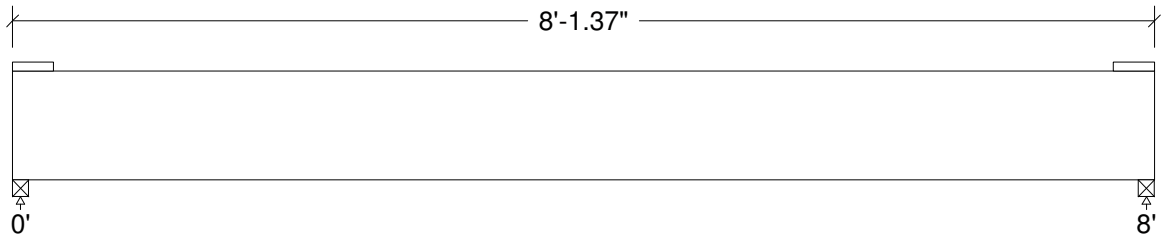## Design Check Calculation Sheet
WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat- tern	Location [ft] Start End	Magnitude Start End	Unit
DL	Dead	Full UDL			220.0	plf
LL	Live	Full UDL			600.0	plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :

```
|←—————————————————— 8'-1.37" ——————————————————→|

 ⌐                                                              ⌐
 |                                                              |

 ⊠                                                              ⊠
 0'                                                             8'
```

Unfactored:			
Dead	893		893
Live	2434		2434
Factored:			
Total	3327		3327
Bearing:			
Capacity			
Beam	9857		9857
Support	3327		3327
Des ratio			
Beam	0.34		0.34
Support	1.00		1.00
Load comb	#2		#2
Length	1.37		1.37
Min req'd	1.37**		1.37**
Cb	1.00		1.00
Cb min	1.00		1.00
Cb support	1.11		1.11
Fcp sup	625		625

**Minimum bearing length governed by the required width of the supporting member.

LSL, 1.55E, 2325Fb, 3-1/2"x9-1/4"
Supports: All - Timber-soft Beam, D.Fir-L (N) No.2
Total length: 8'-1.38"; Clear span: 7'-10.63"; Volume = 1.8 cu.ft.
Lateral support: top = at supports, bottom = at supports;
This section PASSES the design code check.

WoodWorks® Sizer

SOFTWARE FOR WOOD DESIGN

Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 121	Fv' = 310	psi	fv/Fv' = 0.39
Bending(+)	fb = 1577	Fb' = 2270	psi	fb/Fb' = 0.69
Dead Defl'n	0.03 = < L/999			
Live Defl'n	0.15 = L/621	0.27 = L/360	in	0.58
Total Defl'n	0.18 = L/524	0.40 = L/240	in	0.46

Additional Data:

```
FACTORS:   F/E(psi) CD    CM    Ct    CL    CV    Cfu   Cr    Cfrt  Ci    LC#
 Fv'        310    1.00   -    1.00   -     -     -     -    1.00   -     2
 Fb'+      2325    1.00   -    1.00  0.976 1.000  -    1.00  1.00   -     2
 Fcp'      2050     -     -    1.00   -     -     -     -    1.00   -     -
 E'        1.5 million -  -    1.00   -     -     -     -    1.00   -     2
 Eminy'   0.80 million -  -    1.00   -     -     -     -    1.00   -     2
```

CRITICAL LOAD COMBINATIONS:
```
 Shear    : LC #2  = D + L
 Bending(+): LC #2  = D + L
 Deflection: LC #2  = D + L   (live)
            LC #2  = D + L   (total)
 Bearing   : Support 1 - LC #2 = D + L
             Support 2 - LC #2 = D + L
 D=dead L=live
 All LC's are listed in the Analysis output
 Load combinations: ASD Basic from ASCE 7-16 2.4 / IBC 2018 1605.3.1
```
CALCULATIONS:
```
 V max = 3280, V design = 2601 lbs; M(+) = 6560 lbs-ft
   EIy = 357.80 lb-in^2 Apparent E approximates the effect of shear deflection.
 "Live" deflection is due to all non-dead loads (live, wind, snow…)
 Total deflection = 0.5 dead + "live"
 Lateral stability(+):  Lu = 8'  Le = 15'-4.25"  RB = 11.8
```

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. FIRE RATING: LVL, PSL and LSL are not rated for fire endurance.
4. SCL: Structural composite lumber design has assumed: - dry service conditions - no preservative or fire-retardant treatment - no notches
5. SCL: Deflection is calculated using an apparent modulus of elasticity E that incorporates the effect of shear deflection.

WoodWorks®
SOFTWARE FOR WOOD DESIGN

5642 E Mercer Way
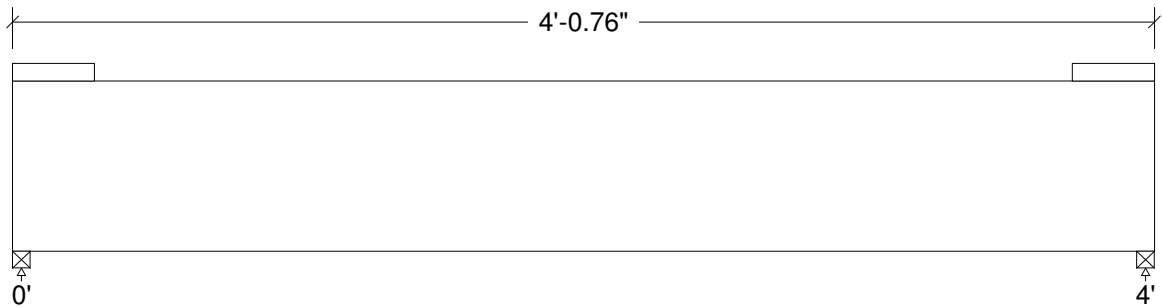Mercer Island, WA
2_9 Exist Header
Mar. 29, 2023 13:44

Design Check Calculation Sheet
WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat-tern	Location [ft] Start End	Magnitude Start End	Unit
DL	Dead	Full UDL			220.0	plf
LL	Live	Full UDL			600.0	plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :

4'-0.76"

0'   4'

Unfactored:			
Dead	447		447
Live	1219		1219
Factored:			
Total	1666		1666
Bearing:			
Capacity			
Beam	1666		1666
Support	1845		1845
Des ratio			
Beam	1.00		1.00
Support	0.90		0.90
Load comb	#2		#2
Length	0.76		0.76
Min req'd	0.76		0.76
Cb	1.00		1.00
Cb min	1.00		1.00
Cb support	1.11		1.11
Fcp sup	625		625

Lumber-soft, D.Fir-L (N), No.1/No.2, 4x8 (3-1/2"x7-1/4")
Supports: All - Timber-soft Beam, D.Fir-L (N) No.2
Total length: 4'-0.75"; Clear span: 3'-11.25"; Volume = 0.7 cu.ft.
Incised; Lateral support: top = at supports, bottom = at supports;
This section PASSES the design code check.

WoodWorks® Sizer   SOFTWARE FOR WOOD DESIGN

Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 66	Fv' = 144	psi	fv/Fv' = 0.46
Bending(+)	fb = 642	Fb' = 880	psi	fb/Fb' = 0.73
Dead Defl'n	0.00 = < L/999			
Live Defl'n	0.02 = < L/999	0.13 = L/360	in	0.15
Total Defl'n	0.02 = < L/999	0.20 = L/240	in	0.12

Additional Data:

FACTORS:	F/E(psi)	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	LC#
Fv'	180	1.00	1.00	1.00	–	–	–	–	1.00	0.80	2
Fb'+	850	1.00	1.00	1.00	0.995	1.300	–	1.00	1.00	0.80	2
Fcp'	625	–	1.00	1.00	–	–	–	–	1.00	1.00	–
E'	1.6 million	1.00	1.00	–	–	–	–	–	1.00	0.95	2
Emin'	0.58 million	1.00	1.00	–	–	–	–	–	1.00	0.95	2

CRITICAL LOAD COMBINATIONS:
```
 Shear     : LC #2  = D + L
 Bending(+): LC #2  = D + L
 Deflection: LC #2  = D + L  (live)
             LC #2  = D + L  (total)
 Bearing   : Support 1 – LC #2 = D + L
             Support 2 – LC #2 = D + L
 D=dead L=live
 All LC's are listed in the Analysis output
 Load combinations: ASD Basic from ASCE 7–16 2.4 / IBC 2018 1605.3.1
```
CALCULATIONS:
```
 V max = 1640, V design = 1119 lbs; M(+) = 1640 lbs-ft
   EIy = 177.83 lb-in^2
 "Live" deflection is due to all non-dead loads (live, wind, snow…)
 Total deflection = 0.5 dead + "live"
 Lateral stability(+):  Lu = 4'  Le = 8'-2.88"  RB = 7.6
```

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.

Design Check Calculation Sheet
WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat-tern	Location [ft] Start End	Magnitude Start End	Unit
DL	Dead	Full UDL			180.0	plf
LL	Live	Full UDL			360.0	plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :

4'-0.5"
0'   4'
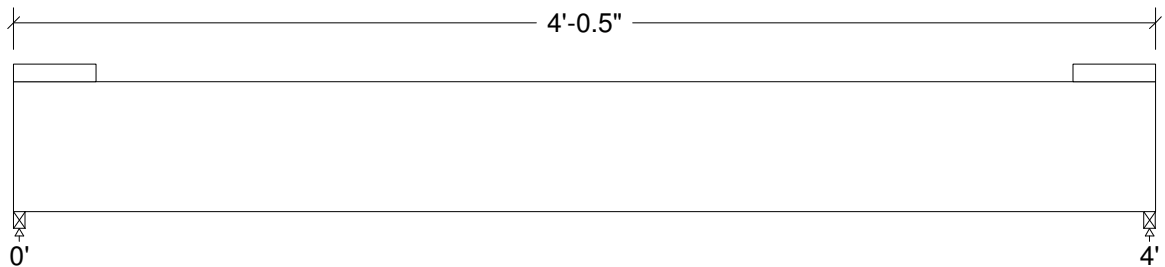
Unfactored:			
Dead	364		364
Live	728		728
Factored:			
Total	1091		1091
Bearing:			
Capacity			
Beam	1094		1094
Support	1211		1211
Des ratio			
Beam	1.00		1.00
Support	0.90		0.90
Load comb	#2		#2
Length	0.50*		0.50*
Min req'd	0.50*		0.50*
Cb	1.00		1.00
Cb min	1.00		1.00
Cb support	1.11		1.11
Fcp sup	625		625

*Minimum bearing length setting used: 1/2" for end supports

Lumber-soft, D.Fir-L (N), No.1/No.2, 4x6 (3-1/2"x5-1/2")
Supports: All - Timber-soft Beam, D.Fir-L (N) No.2
Total length: 4'-0.5"; Clear span: 3'-11.5"; Volume = 0.5 cu.ft.
Incised; Lateral support: top = at supports, bottom = at supports;
This section PASSES the design code check.

WoodWorks® Sizer   **SOFTWARE FOR WOOD DESIGN**

Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design	Value	Unit	Analysis/Design
Shear	fv = 64	Fv' =	144	psi	fv/Fv' = 0.44
Bending(+)	fb = 734	Fb' =	884	psi	fb/Fb' = 0.83
Dead Defl'n	0.01 = < L/999				
Live Defl'n	0.03 = < L/999	0.13 =	L/360	in	0.21
Total Defl'n	0.04 = < L/999	0.20 =	L/240	in	0.18

Additional Data:

FACTORS:	F/E(psi)	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	LC#
Fv'	180	1.00	1.00	1.00	–	–	–	–	1.00	0.80	2
Fb'+	850	1.00	1.00	1.00	1.000	1.300	–	1.00	1.00	0.80	2
Fcp'	625	–	1.00	1.00	–	–	–	–	1.00	1.00	–
E'	1.6 million	1.00	1.00	–	–	–	–	–	1.00	0.95	2

CRITICAL LOAD COMBINATIONS:
```
 Shear     : LC #2  = D + L
 Bending(+): LC #2  = D + L
 Deflection: LC #2  = D + L   (live)
             LC #2  = D + L   (total)
 Bearing   : Support 1 – LC #2 = D + L
             Support 2 – LC #2 = D + L
 D=dead L=live
 All LC's are listed in the Analysis output
 Load combinations: ASD Basic from ASCE 7–16 2.4 / IBC 2018 1605.3.1
```
CALCULATIONS:
```
 V max = 1080, V design = 821 lbs; M(+) = 1080 lbs-ft
   EIy = 77.64 lb-in^2
 "Live" deflection is due to all non–dead loads (live, wind, snow…)
 Total deflection = 0.5 dead + "live"
```

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.