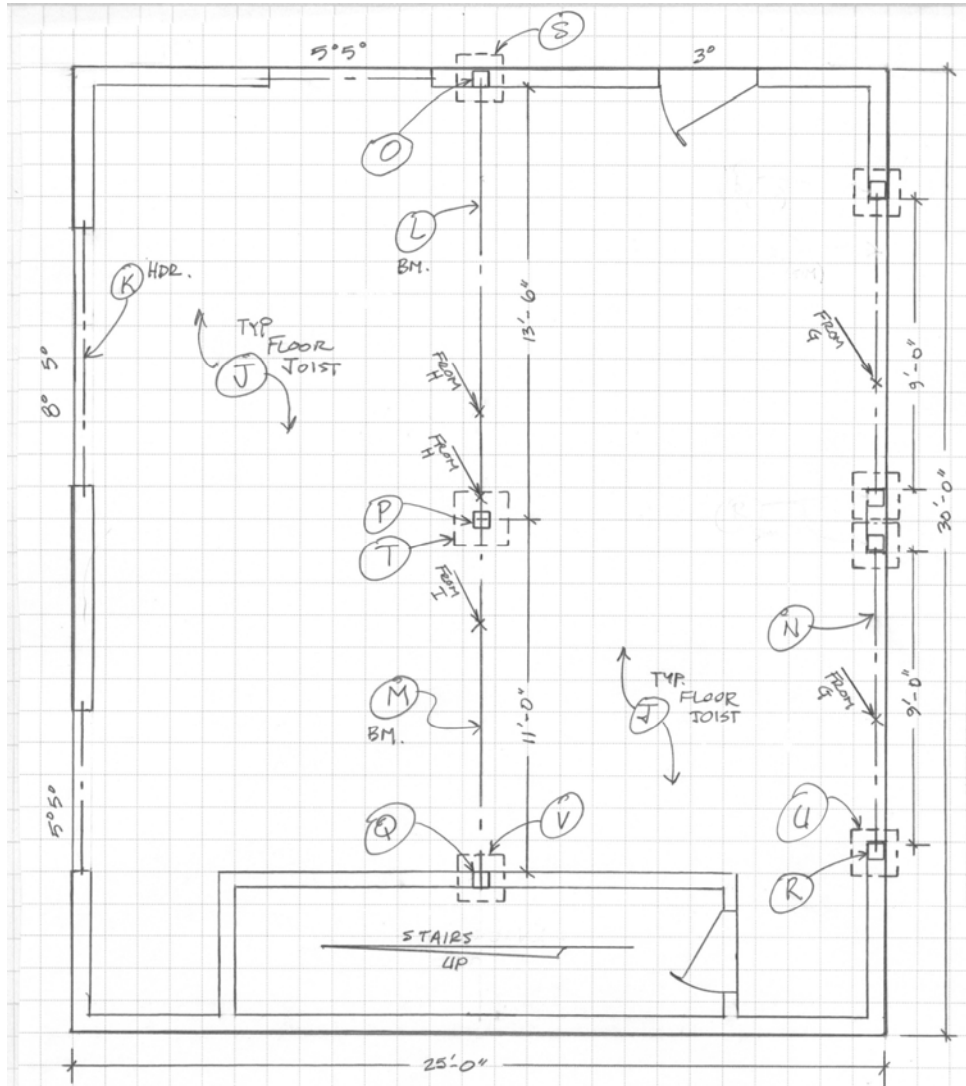


Example Floor Joist Design Using ConstructionCalc ProBeam Software

Note: The following example assumes you are a beginner. You should expect this to go slowly at first. However, with a little practice, getting solutions with ConstructionCalc is about a one minute job. Awesome.

- 1) **General.** This member is a **Floor Joist**, “J” in the below framing schematic. Since all the floor joists in this building are the same span with the same loading we only need design one typical.



- 2) Open **ConstructionCalc ProBeam** from Microsoft Excel, then File – Open.
- 3) **Part 1** – General Input.

Your Company, Inc.

Assumptions: Compliant with 2003 IBC, 1997 UBC, and 2001 National Design Spec for W supports and cantilever end. Bending in strong axis only. No wet, high moisture, or high t

Disclaimer: All users of this software shall comply with State Engineering Law, which sp

Job Name: Example Floor Joist

Beam I.D.: 12'-3" span, residential loading

Other Info.: by tkg, 9/22/2005

PART 1 - General Input

Main Span, L = 12.25 ft

Main Span Max. Allowed Live Def: L / 480 = 0.31 in

Main Span Max. Allowed Total Def: L / 360 = 0.41 in

Cantilever (Overhang) Exists? No

Pitch if Sloped:

Load Duration Ten Years (Live)

Add Self Wt.? Yes No

Loads Other Than Uniform Loads? No

Getting Started. Hover Cursor Here

- a) **General.** With all ConstructionCalc programs you can type in a name of the member you're designing, job name, date, etc. in the three cells at the top. Also, you can type in your company name at the very top of the sheet.
 - b) **Span:** Main span is the horizontal distance from bearing wall to center support beam beam, in our case, 12'-3" or so. I usually use centerline to centerline distance for span, but you could also, less conservatively, use inside to inside. Note: only enter decimal numbers, no fractions, symbols, spaces, or units.
 - c) **Maximum Allowed Deflection:** This is the amount of deflection (sag) we're willing to allow (see red triangle note for more). It is also an indirect measure of how stiff or bouncy we allow our floor to be. Default is L/360 for live load deflection and L/240 for total deflection. Because our floor should be firm (not bouncy) we want more stringent deflection criteria, so we'll use L/480 and L/360. If we wanted a stiffer floor yet, we could use, say, L/600 and L/500. Increasing these "L/" numbers results in larger, stiffer (more expensive) Final Members.
 - d) **Cantilever Exists?** No. These joists are "simply supported" meaning they span between two supports with no cantilever (overhang). Simply supported also means there are **only** two supports, not three or more.
 - e) **Pitch if Sloped:** Our joists are not sloped so enter 0 or leave blank.
 - f) **Load Duration:** Since we're designing floor joists, their worst live load is from people and furniture, so we select Ten Years (Live). See popup note for more.
 - g) **Add Self-Weight?** Since the joist's self-weight will be included in the 15 psf dead load we'll use in a minute, and we don't want to add it twice, select No.
 - h) **Loads Other Than Uniform Loads?** The live loads (people, furniture) brought to our joists will be from floor sheathing over their entire length. It is common practice to assume these live loads act uniformly, so select No; no other loads (point loads, wedge, etc.).
- 4) **Part 2 – Loads Input.** Here are the loads we need. Note unused load sections are hidden via the Hide / Show Loads dropdown at the top of screen.

Uniform Loads Over Full Length of Member				Uniform Live	Reduced Live	Uniform Dead
	Live, psf	Dead, psf	Tributary Width, ft	Load, plf	Load, plf	Load, plf
Roof Loads (not including snow)						
Roof Snow (only)			0.00 ft			
Floor 3 Loads						
Floor 2 Loads						
Floor Loads	40 psf	15 psf	1.60 ft	64.0 lb/ft	64.0 lb/ft	24.0 lb/ft
Wall Dead Load						
Other 'psf' load and trib. width						
Additional 'plf' Unif. Live Loads	Description, opt!:					
Additional 'plf' Unif. Dead Loads	Description, opt!:					
	Load Subtotals			64.0 lb/ft	64.0 lb/ft	24.0 lb/ft
	Total Uniform Loads			$w_L = 64.0$ lb/ft		$w_D = 24.0$ lb/ft
	Combined Total Uniform Load			$w_U = 88.0$ lb/ft		

a) **Uniform Loads Over the Full Length of Member:** Our live loads occur over the joist's entire length (as opposed to partial loads, point loads, or wedge loads), so we need to use this section. We will use the row in the table labeled "Floor Loads" since that's what we've got. We could use any of the three floor load rows – the program doesn't care.

i) **Live Load:** Floor live load for residential applications comes from people and furniture and per code is 40 pounds per square foot. See the popup note under "Live, psf" for this and other typical live loads.

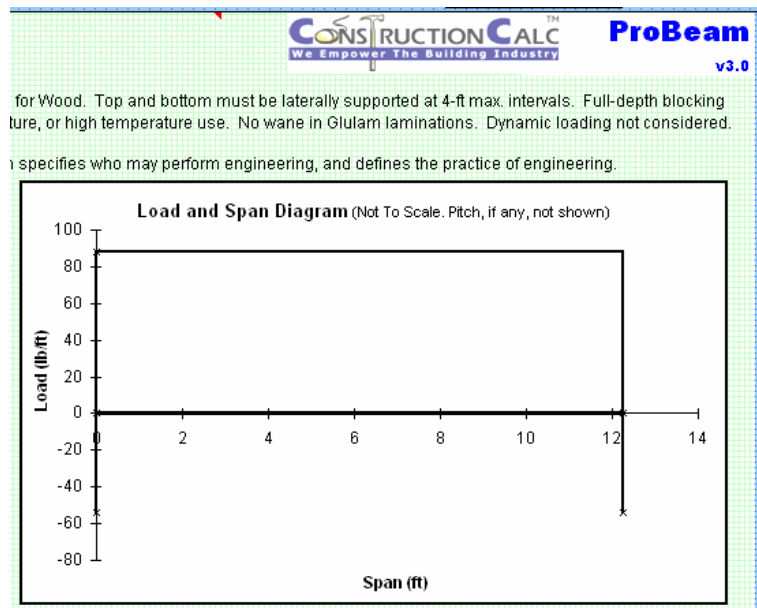
ii) **Dead Load:** Dead load for a carpet or vinyl floor system is about 15 psf (see red triangle popup note under Dead, psf).

iii) **Tributary width** (width perpendicular to the member from which load is applied) will be the joist's spacing in feet. This is always true for joists and rafters. Typical floor joist spacing is 16" or 19.2". Because our joist's span is relatively short, we'll use 19.2", which equals 1.6'. From a rigorous standpoint, tributary width is actually half the distance from one joist to the next, times 2 (load comes to our joist from each side).

Cool tip: because you're using a ConstructionCalc product, to convert feet to inches, if you enter the following: =19.2/12 and then press Tab, you'll see 1.6 displayed automatically. In other words you can do math right in the cell by starting with an equals sign. Try it. Very cool, very powerful.

b) **Done.** Click on **Calculate Now** and let's check our results.

5) **Check the span and loading:** First, we want to make sure our spans and loading were input correctly, so at the upper right of the screen is a graphic showing both. You can see the span and uniform load over entire length. Yep, it's right.



- a) **Part 3 - Allowable Solutions:** This section shows all the types and sizes of members that will work. We're only interested in 2x material and TJIs so those sections are all we'll look at. Certainly if we wanted to use a glu-lam, PSL other type of member shown we could.

4x And Smaller (Lumber)

Lumber Material: Douglas Fir-Larch
Lumber Grade: No. 2

Lumber Members

Repetitive Member Use?	2 x 10	3 x 8
Yes	(2) 2 x 8	4 x 8
	(3) 2 x 8	

5x And Larger (Timbers)

Timber Material: Douglas Fir - Larch
Timber Grade: WCLIB - No. 2

Timber Members

-	-	-
6 x 8	-	-
-	-	-
-	-	-

Glued Laminated Members

Glulam Grade: 24F-V4 (DF/DF)

2.5" x 7.5"	5.125" x 6"
3" x 7.5"	6.75" x 7.5"
3.125" x 7.5"	8.75" x 9"
5" x 6"	

2.0E Parallam PSL

1-3/4" x 9-1/4"	5-1/4" x 9-1/4"
2-11/16" x 9-1/4"	7" x 9-1/4"
3-1/2" x 9-1/4"	

Truss-Joist MacMillan 1.9E LVL-Joists

1-3/4" x 9-1/4"	(3) 1-3/4" x 5-1/2"
(2) 1-3/4" x 7-1/4"	

Truss-Joist MacMillan 1.3E LSL-Joists

3-1/2" x 7-1/4"	
-----------------	--

Truss-Joist MacMillan I-Joists

Web Stiffeners? Yes

9-1/2" TJI / Pro 150	9-1/2" TJI 110
9-1/2" TJI / Pro 250	9-1/2" TJI 210
11-7/8" TJI / Pro 350	9-1/2" TJI 230
11-7/8" TJI / Pro 550	11-7/8" TJI 360

Truss-Joist MacMillan 1.5E LSL-Joists

1-3/4" x 9-1/4"	(3) 1-3/4" x 9-1/4"
-----------------	---------------------

- b) In the Section **4x and Smaller (Lumber)**, let's select the type of lumber we want. In my neck of the woods, Douglas-Fir Larch is standard, so select that from the dropdown. Also, we know the lumber yard has lots of No 2 grade in stock, so we'll select No 2.
- c) **Repetitive Member Use?** We're designing joists which will be spaced less than 24" apart and will share the applied load, so we want to select Yes. Note this only applies to 4x and Smaller Lumber.
- d) We see that 2x10 will work (we could also use double 2x8's and some other odd sizes that show up in the table). Remember, our joist spacing (tributary width) from above is 1.6'.
- e) In the section Truss-Joist MacMillan I-Joist, we see many options. I like 9.5" TJI-110's. Note that Web Stiffeners are selected, always a good idea.

- 6) **Part 4 - Final Selection.** We could stop at this point knowing 2x10, DF #2 and 9.5” TJI 110 works, but let’s continue and see how efficient the TJI is.

PART 4, Final Selection	Final Member: TJM I-Joist Beam Library: Choose From Min. Sizes That Calc. Final Size: 9-1/2" TJI 110 Min. Bearing Length := 1.75 in (Assuming Full-Width Bearing) Actual Member Size: 1.75" x 9.50"	Final Member: 9-1/2" TJI 110, TJM I-Joist	Final Member Results Bending Overdesign: 44.2% Shear Overdesign: 126.3% Deflection Overdesign: 32.2% Bearing / Buckling Overdsgr: 64.2% Final member makes it by: 32.2% Controlling criteria is: Deflection																																																																			
	<table border="1"> <thead> <tr> <th colspan="3">Reactions</th> </tr> <tr> <th>Maximums</th> <th>R₁ - Left</th> <th>R₂ - Right</th> </tr> </thead> <tbody> <tr> <td>Live Load:</td> <td>392 lb</td> <td>392 lb</td> </tr> <tr> <td>Dead Load:</td> <td>147 lb</td> <td>147 lb</td> </tr> <tr> <td>Total Load:</td> <td>539 lb</td> <td>539 lb</td> </tr> <tr> <td>Live Case Causing Max:</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <th>Minimums</th> <th>R₁ - Left</th> <th>R₂ - Right</th> </tr> <tr> <td>Live Load:</td> <td>0 lb</td> <td>0 lb</td> </tr> <tr> <td>0.6 or 1.0 Dead:</td> <td>88 lb</td> <td>88 lb</td> </tr> <tr> <td>Net Reaction:</td> <td>88 lb</td> <td>88 lb</td> </tr> <tr> <td>Live Case Causing Min:</td> <td>N/A</td> <td>N/A</td> </tr> </tbody> </table>	Reactions			Maximums	R ₁ - Left	R ₂ - Right	Live Load:	392 lb	392 lb	Dead Load:	147 lb	147 lb	Total Load:	539 lb	539 lb	Live Case Causing Max:	N/A	N/A	Minimums	R ₁ - Left	R ₂ - Right	Live Load:	0 lb	0 lb	0.6 or 1.0 Dead:	88 lb	88 lb	Net Reaction:	88 lb	88 lb	Live Case Causing Min:	N/A	N/A	<table border="1"> <thead> <tr> <th colspan="3">Final Member Additional Information</th> </tr> <tr> <th></th> <th>Location</th> <th>Live Case</th> </tr> </thead> <tbody> <tr> <td>Max. Positive Moment: 1,651 ft-lb</td> <td>6.13 ft</td> <td>Main Span</td> </tr> <tr> <td>Max. Negative Moment: 0 ft-lb</td> <td>0.00 ft</td> <td>Main Span</td> </tr> <tr> <td>Max. Design Shear: 539 lb</td> <td>0.00 ft</td> <td>Main Span</td> </tr> <tr> <td>Main Span Max. Downward Deflection (Live / Total): 0.232" / 0.318"</td> <td>6.13' / 6.13'</td> <td>Main / Main</td> </tr> <tr> <td>Main Span Max. Upward Deflection (Live / Total): 0.000" / 0.000"</td> <td>0.00' / 0.00'</td> <td>Main / Main</td> </tr> <tr> <td>Cant. Down. Defl. (Live / Tot): N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Cant. Up. Defl. (Live / Tot): N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Req'd EI, Not Incl. Self Wt.: 1.092E+08</td> <td>Actual EI: 1.400E+08</td> <td></td> </tr> <tr> <td>Approx. Self Weight: N/A</td> <td>Approx. Tot. Wt.: N/A</td> <td></td> </tr> <tr> <td colspan="3">Min. Calc'd Bearing Length: 1.75 in</td> </tr> </tbody> </table>	Final Member Additional Information				Location	Live Case	Max. Positive Moment: 1,651 ft-lb	6.13 ft	Main Span	Max. Negative Moment: 0 ft-lb	0.00 ft	Main Span	Max. Design Shear: 539 lb	0.00 ft	Main Span	Main Span Max. Downward Deflection (Live / Total): 0.232" / 0.318"	6.13' / 6.13'	Main / Main	Main Span Max. Upward Deflection (Live / Total): 0.000" / 0.000"	0.00' / 0.00'	Main / Main	Cant. Down. Defl. (Live / Tot): N/A	N/A	N/A	Cant. Up. Defl. (Live / Tot): N/A	N/A	N/A	Req'd EI, Not Incl. Self Wt.: 1.092E+08	Actual EI: 1.400E+08		Approx. Self Weight: N/A	Approx. Tot. Wt.: N/A		Min. Calc'd Bearing Length: 1.75 in	
Reactions																																																																						
Maximums	R ₁ - Left	R ₂ - Right																																																																				
Live Load:	392 lb	392 lb																																																																				
Dead Load:	147 lb	147 lb																																																																				
Total Load:	539 lb	539 lb																																																																				
Live Case Causing Max:	N/A	N/A																																																																				
Minimums	R ₁ - Left	R ₂ - Right																																																																				
Live Load:	0 lb	0 lb																																																																				
0.6 or 1.0 Dead:	88 lb	88 lb																																																																				
Net Reaction:	88 lb	88 lb																																																																				
Live Case Causing Min:	N/A	N/A																																																																				
Final Member Additional Information																																																																						
	Location	Live Case																																																																				
Max. Positive Moment: 1,651 ft-lb	6.13 ft	Main Span																																																																				
Max. Negative Moment: 0 ft-lb	0.00 ft	Main Span																																																																				
Max. Design Shear: 539 lb	0.00 ft	Main Span																																																																				
Main Span Max. Downward Deflection (Live / Total): 0.232" / 0.318"	6.13' / 6.13'	Main / Main																																																																				
Main Span Max. Upward Deflection (Live / Total): 0.000" / 0.000"	0.00' / 0.00'	Main / Main																																																																				
Cant. Down. Defl. (Live / Tot): N/A	N/A	N/A																																																																				
Cant. Up. Defl. (Live / Tot): N/A	N/A	N/A																																																																				
Req'd EI, Not Incl. Self Wt.: 1.092E+08	Actual EI: 1.400E+08																																																																					
Approx. Self Weight: N/A	Approx. Tot. Wt.: N/A																																																																					
Min. Calc'd Bearing Length: 1.75 in																																																																						

- Final Member:** We’ve decided to use TJM I-Joist material, so select that.
- Beam Library:** We want to choose from members that calc (meet code). Note, this dropdown allows us to choose any member whether it calcs or not. This can be useful at times to see how close or far a particular member comes to making it.
- Final Size:** Select 9.5” TJI 110 from the dropdown. When you do it is shown in large font to the right.
- Final Member Results:** this section shows by how much the selected member calcs for the four code-required design criteria. Usually, I just look at the bold sentence that says in our case: **This member makes it by 32.2%.** A good safe design. Controlling criteria is Deflection. This means that bending strength, shear strength, and Bearing / Buckling issues are not as critical to the design as sag (bounciness).
- Reactions.** This section shows reactions, which are the downward forces brought by our Final Member to the members on which it bears – the bearing wall, left, and beam, right. Note that Maximum and Minimum reactions are shown. Minimums are only meaningful for the design of cantilever members, so we can ignore them in this case.
- Final Member Additional Information.** This section shows a bunch of additional information that may or may not be of interest to you.
- Printout.** You may want to print this design. Because this ConstructionCalc product is nothing more than a fancy Excel spreadsheet, you have lots of printing options via File, Page Setup. Also, you can hide various parts of the display via the ConstructionCalc **Hide / Show Loads and Miscellaneous** dropdowns at the top of the page.