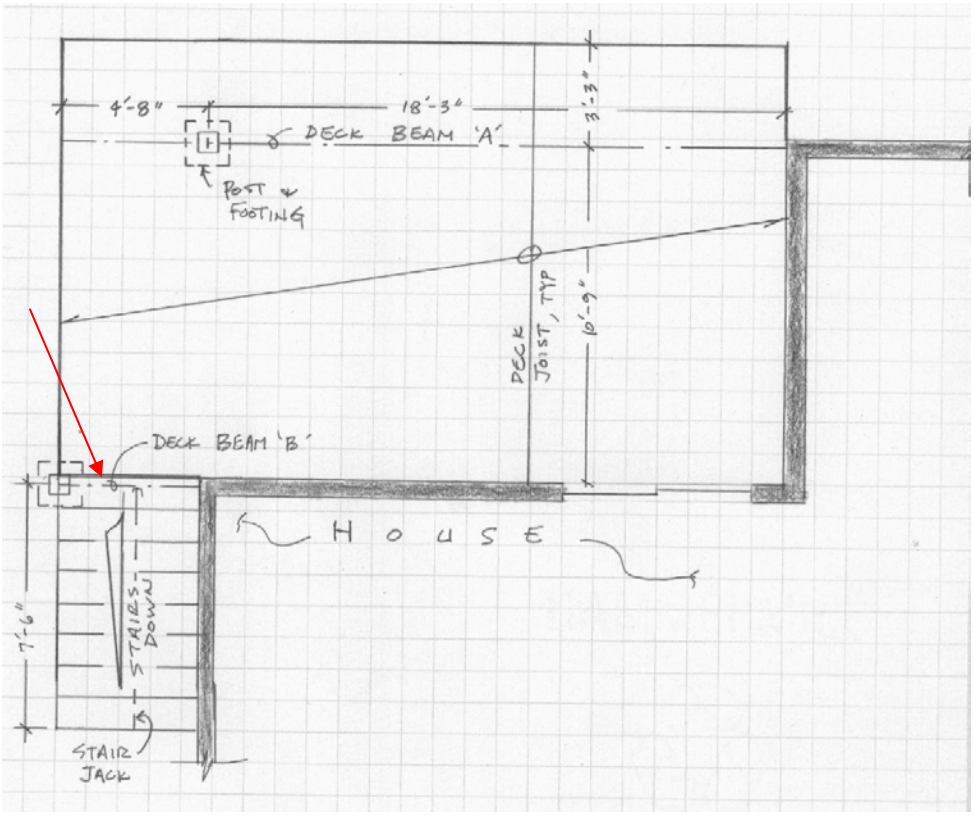
Example Deck Beam "B" Design Using ConstructionCalc Software

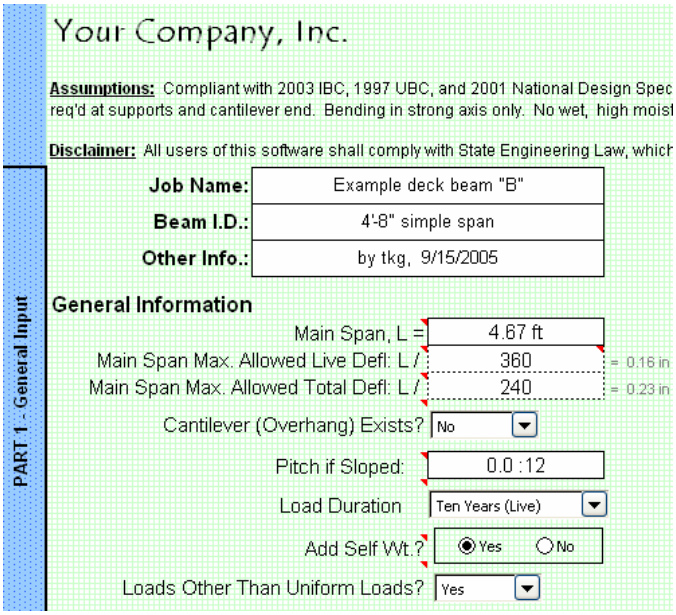
Note: The following example assumes you are a beginner. You should expect this to go slowly at first. However, with a little practice, getting solutions with ConstructionCalc is about a one minute job. Awesome.

1) **General**. This member is deck beam "B" which has no overhang (cantilever) and the loading comes from uniform and point loads (no wedge loads or partial uniform loads).



2) Open **ConstructionCalc ProBeam** from Microsoft Excel: File – Open.

3) **Part 1 –** General Input. Here is a screenshot of Part 1 input followed by a description:



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 beam's horizontal distance from bearing to bearing, in our case, 4'-8". The program doesn't allow feet and inches input, so we convert this to 4.67. Note: only enter numbers, no symbols, spaces, or units – the program does that for you.

Cool tip. You could do the feet-inches conversion right in the cell without reaching for a calculator. In the Main Span input cell simply enter =4+8/12 hit tab and presto, 4.67 is displayed. The equals sign tells Excel you're entering an equation and it then does the math. You can do this in any input cell in this or any other ConstructionCalc program. Very cool.

c) **Maximum Allowed Deflection**: This is the amount of deflection (sag) we're willing to allow (see red triangle note for more). Let's use the default values of L/360 for live load deflection and L/240 for total deflection. The grey numbers to the right are the maximum deflections in inches.

d) **Cantilever Exists?** No, this beam has no overhang.

e) **Pitch if Sloped**: Our beam is horizontal, so No.

f) **Load Duration**: Since we're designing a deck beam which sees its worst live loading from people (as opposed to snow or temporary construction loads), we select Ten Years (Live).

g) **Add Self-Weight?** This beam's self weight will not be included in any uniform dead load we input later, we need to add it now, so Yes.

h) **Loads Other Than Uniform Loads?** This beam will feel the weight of the deck joists from one side (uniform load) and the stair jack (point load) from the other. So we have a uniform load over the beam's entire length plus a concentrated (point) load, thus we select Yes.

4) **Part 2 – Loads Input**. Here are the loads we need. Note unused loads are hidden via the Hide / Show Loads dropdown at the top of screen.

PART 2 - Loads Input.

Uniform Loads Over Full Length of Member

	Live, psf	Dead, psf	Tributary Width, ft	Uniform Live Load, plf	Reduced Live Load, plf	Uniform Dead Load, plf
Floor Loads	60 psf	10 psf	5.38 ft	322.5 lb/ft	322.5 lb/ft	53.8 lb/ft
Total Uniform Loads			w_L =	322.5 lb/ft	w_D =	53.8 lb/ft
Combined Total Uniform Load			w_U =	376.3 lb/ft		

Concentrated (Point) Loads

	Live Load, psf	Dead Load, psf	Trib. Width, ft.	Trib. Length, ft.	Live, lbs	Dead, lbs	Location, ft
Point Load A	60 psf	10 psf	2.33 ft	3.75 ft	525 lb	88 lb	x_A = 2.34 ft

Note: Location Measured From Left Support

a) **Uniform Loads Over the Full Length of Member**: Our beam receives load over its entire length from deck joists, thus we must use this section.

i) **Live Load**: Check the red popup note under Live, psf and you'll see "Residential balcony – 60 psf". We could probably get away with 40 psf as listed under "Residential floor, deck, and storage", but I always use 60 psf if the deck or balcony is over 3 or 4 feet above ground level.

ii) **Dead Load**: Dead load for a wood deck without ceiling is about 10 psf. See the popup note under Dead, psf. This includes the weight of the joist and the decking material, but no insulation or gyp ceiling, and it doesn't include the weight of the beam itself, which is why we selected Yes to Add Self-Weight, above.

iii) **Snow Load**: Snow load is a type of live load. It is possible, if this deck were in heavy snow country, that snow could be more than our 60 psf live load. If this were the case, we'd input

that snow load instead of our 60 in the same row. But our example is in light snow area and the weight of people will control our design, so no snow load.

iv) **Tributary width:** This is the width perpendicular to our member from which load is applied. Our beam carries half the main span of the deck joists. Because we're using a ConstructionCalc program, we can do this math right in the trib width cell. Here it is: =(10+9/12)/2. The part in parenthesis converts 10'-9" to decimal feet, then the /2 divides by 2. Try it yourself, always start an equation with an equals sign. Certainly you could have also reached for your calculator, punched in these same numbers then typed your answer in the trib width cell, but what a bother.

b) **A More Correct Uniform Load Computing Method:** The most correct way of entering this beam's uniform load is to get the joist's reactions from the previous design and input them:

PART 2 - Loads Input.

Uniform Loads Over Full Length of Member	Live, psf	Dead, psf	Tributary Width, ft	Uniform Live Load, plf	Reduced Live Load, plf	Uniform Dead Load, plf
Roof Loads (not including snow)				-	-	-
Roof Snow (only)			0.00 ft	-	-	
Floor 3 Loads				-	-	-
Floor 2 Loads				-	-	-
Floor Loads				-	-	-
Wall Dead Load						-
Other 'psf' load and trib. width				-	-	-
Additional 'plf' Unif. Live Loads	Descrip'n, opt'l:	From previous joist design		322.5 lb/ft		
Additional 'plf' Unif. Dead Loads	Descrip'n, opt'l:	From previous joist design				44.5 lb/ft
		Load Subtotals		322.5 lb/ft	322.5 lb/ft	44.5 lb/ft
		Total Uniform Loads	w_L =	322.5 lb/ft	w_D =	44.5 lb/ft
		Combined Total Uniform Load	w_U =	367.0 lb/ft		

The reactions from the joist were 645 lbs and 89 lbs for live and dead respectively from Reaction 1, Maximums (see deck joist example). However, the joists were spaced 2' apart, so to apply a "pounds per **lineal** foot (plf)" load we have to divide these reactions by 2, which equals 322.5 plf and 44.5 plf as input above.

You will note the Total Uniform Loads are slightly less using this method than using the tributary width method above (367 plf vs. 376.3 plf Combined Total Uniform Load). This is because the joists are **continuous** over beam "A" – a structural concept that is beyond this example. Suffice to say, if you really want to be correct in applying loads to beams, girders, posts, and footings, you have to calculate the members bringing their load first, then apply those reactions as loads to the supporting members. However, most engineers and designers cheat and use the simpler tributary area method – which still yields decent results.

c) **Concentrated (Point) Load**. The middle stair jack bears on our beam, bringing it's concentrated load with it. Here is the input:

i) Live Load: Check the popup note under Live Load, psf and you'll see "One and two family residential stairs – 40 psf".

ii) Dead Load: The stairs themselves weight about the same as the deck, 10 psf.

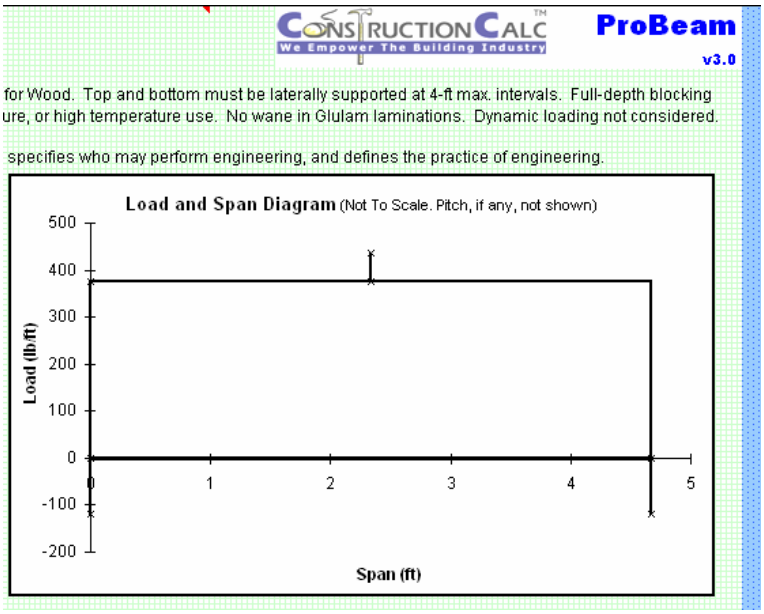
iii) Tributary Width, ft: Since we entered live and dead load in pounds per square foot (psf) we need a width and length over which they act to derive a point load. Width is half the distance between our stair jack and the outside jack, plus half the distance between our stair jack and the jack nailed to the house: Both distances are the same so our trib width is half of 4'-8". We could enter =4.67/2 and Excel would do our math for us, pasting 2.33 in the cell.

iv) Tributary Length, ft: The other part of our tributary area comes from half the length of the stair jack, which we could enter as =7.5/2 which will paste 3.75 in the cell.

v) Location: The program needs to know where along the length of our beam the point load is located, starting from the left support. The middle stair jack is connected to our beam at our beam's midpoint, which is 2.34' from the left support.

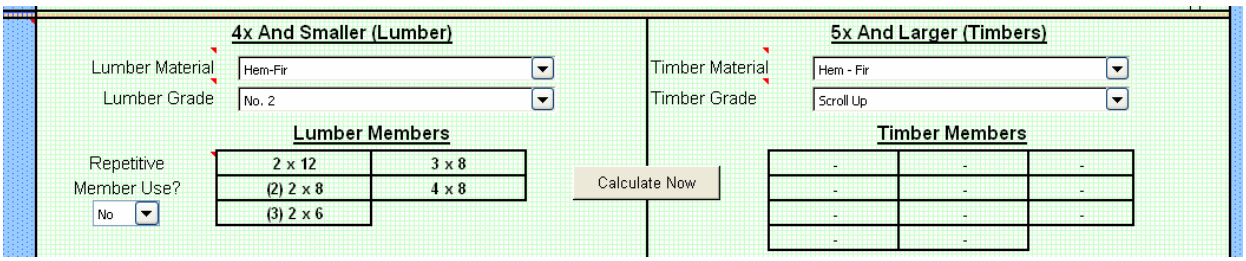
d) **Done**. We'll finish this example using the tributary method loads from 4a above. Click on **Calculate Now** and let's check our results.

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 main span, cantilever, uniform load, and point load at mid-span. Yep, it's right.



6) **Part 3 - Allowable Solutions:** This section shows all the types and sizes of members that will work.

a) Because this is an exterior application, our preference is a pressure treated hem fir beam, 4x and smaller. So we select Hem Fir from the Lumber Material dropdown and No. 2 from Lumber Grade (we know our lumber yard stocks lots of No. 2). Now we see many choices.

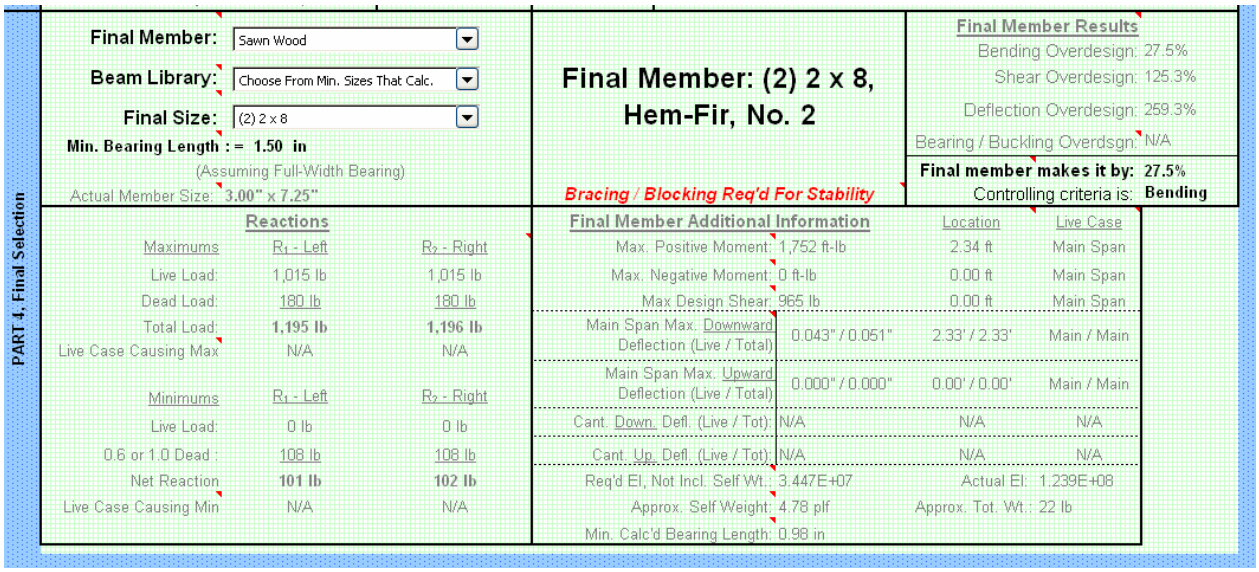


b) **Repetitive Member Use**. Our beam gets no help from adjacent beams – it acts alone (unlike joists or rafters). So we chose No. Note, if we use (3) 2x6's, technically, we should get repetitive member credit because the three 2x6's are working together sharing load. The program recognizes this and automatically makes the adjustment – you still chose No and don't worry about it.

c) Depending what I've got laying around the jobsite, I'd either use (2) 2x8's nailed together or a 4x8, but anything shown will work.

d) We could select a glu-lam or something else shown in one of the other Part 3 sections, but for this exterior application, Hem Fir is the ticket.

7) **Part 4 - Final Selection**. We could stop at this point knowing any of the above works, but let's continue and see how efficient our (2) 2x8's are.



a) **Final Member**: Select Sawn Wood.

b) **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.

c) **Final Size**: Select (2) 2x8 from the dropdown. When you do, it is shown in large font to the right.

d) **Min Bearing Length**: We see that our beam could bear on anything at least 1.5" by the full width of our 2, 2x8s (3 inches). A hanger would work nicely.

e) **Bracing / Blocking Req'd For Stability**. This red note appears when you're designing a cantilever or any beam with a large point load. It is just a reminder that blocking is particularly important in these cases (see Assumptions at top of screen).

f) **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 27.5%.** A good safe design.

g) **Pressure Treated**: Nothing in the printout indicates pressure treatment is included in the design, and it is not. Wood preservative by itself does not diminish the strength of sawn wood – no worry there. However, in the pressure treatment process, small perforations are sometimes made to enhance absorption of chemicals. These can diminish strength up to 15%. Our double 2x8 is 27% overdesigned, so even if perforated pressure treated material is used, we're still okay.

h) **Reactions**. This section shows reactions, which are the downward forces brought by our Final Member to the members on which it bears – the wall at the right and the post at the left. When we get around to designing the post and footing, we could use the reactions shown since they will be a portion of the true load (we'd also have to include the load from the outer stair jack and the outermost deck joist).

i) **Final Member Additional Information**. This section shows a bunch of engineering information that may or may not be of interest to you.

j) **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.