Lab 11: Building a Fort

This lab is about one of the most useful formulas for building things, including the rad fort shown at right.

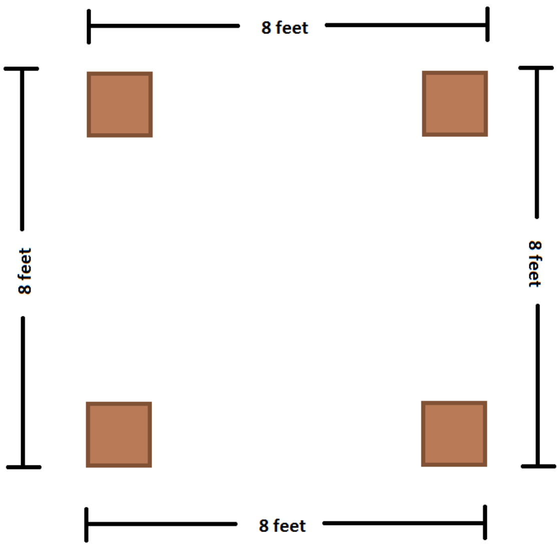
In the image below, you can see the 4 large beams that were installed to support the fort. These are big beams – 6 by 6's. Now, you'd think that a "6 by 6" beam would measure 6 inches by 6 inches. Nope!

1. **(1 point)** Do some Googling and find out the **actual** dimensions of a "6 by 6" beam. FYI: all lumber you buy at a lumber yard is like this; it has a "nominal size" (that is, the size that it's ***called***) and an "actual size" (the size it actually ***is***).

In order to start building this fort, the first job was to rent a jackhammer and drill huge holes in the ground to bury the 6 by 6 posts. Fun![1] Next, the posts needed to be stood up in the holes, which were then backfilled with some fist-sized rocks (so they were supported but could still "wiggle"). Then they needed to be squared up.

By "squared up", I mean they had to be in an arrangement where the posts were as close to the corners of a square as possible. And because of the dimensions of the fort the posts were meant to support, they needed to look like the illustration on the next page (this is a top view, looking down at the top of the posts):

[1] Actually, not even remotely. 



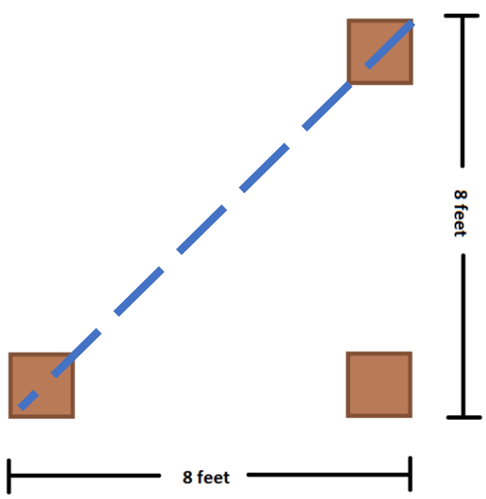
So, hopefully, you can see what's going on here–the outer edge of each post needs to be 8 feet away from the outside edge of any adjacent post. But how to check the "square"? That is, how can we be sure that the 4 posts actually make a ***square***?

2. **(3 points)** Some folks tell me, "Just run a tape measure around the outside of the four posts; so long as each side is 8 feet wide, you're good!" Draw a picture to show how you can have the exact scenario they described, but ***not*** have a square! You might want to get 4 equal-length things (pencils, forks, etc.) and make a square with them by laying them end to end. Then, still keeping them end-to-end, make something ***other*** than a square!

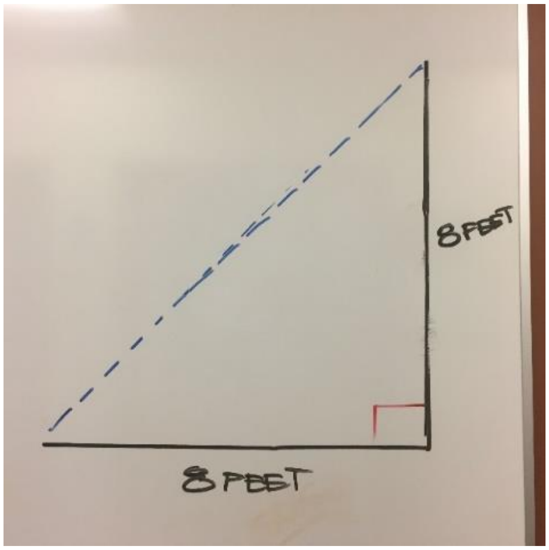
So, we need another plan. And that involves the main topic of this lab: the very useful Pythagorean Theorem! I've used this puppy to build doors on chicken coops, build shelves for our house, and yep – build our son that rad fort. ☺

3. **(2 points)** Google "The Pythagorean Theorem" and write down the formula you find here.

Now check out this simplified view of the previous image :



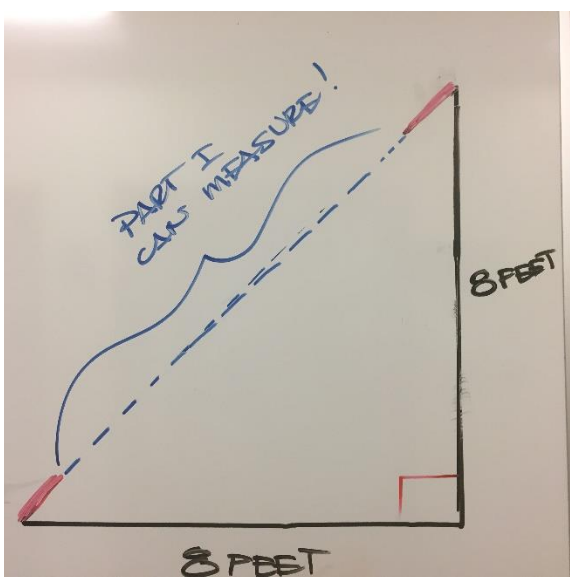
You might be wondering "What happened to the 4th post?" Well, we'll look at squaring three posts first, and then we could use the same process to place the 4th. Do you see the right triangle? If not, check out the image below.



So, that dotted line is the distance from the far corner of one post all the way to the far corner of the opposite post. Now, it's pretty easy to measure the 8-foot distances (you just run the tape measure from outside corner to next outside corner). But, because of your answer to #2, you realize that simply measuring the outside edges isn't enough. So we'd better use the Pythagorean Theorem to figure out the length of that dotted blue line!

4. **(4 points) (w)** What is it? Find the length of that blue dotted line on the previous page, assuming the angle between the 8-foot lengths is 90 degrees. Round that off to the nearest tenth of a foot. If you need a refresher on how to do the math, you might wanna look back to the radicals homework (you actually got this answer back then. 😊).

So, if you know the two perpendicular sides shown are 8 feet, and you know that the diagonal is that length you just found, then you're ***guaranteed*** to have a right angle. So all you have to do is wiggle the posts until they're that far apart, right?



Except there's one ***small*** catch: you can't measure all the way from outside corner to diagonal outside corner. You can't run a measuring tape ***through*** the posts! So we need to measure **inside** corner to inside corner. There's a more realistic version of the last image at left.

OK – we're super close now! All we have to do is figure out how long the internal diagonals of the corner posts are (marked with little red lines in the image to the left), and then subtract them from the answer we got in #4, and we'll know how far apart the inner parts of those posts should be to make sure we've got a right angle.

5. **(3 points) (w)** Using your answer from #1, how long is the inside diagonal of one of those 6 by 6's? Hint: you'll be doing almost the same math you did in #4! Again, round to the nearest tenth!

6. **(3 points) (w)** Subtract two of those (one for each post) from your answer in #4, and then you'll have the length you need to measure to ensure that the distances were square. Nearest foot is fine (for sure)[2], and make sure you include that unit!

One term, after doing this lab. A student said, "Sean – that's waaaay too much work! Just do it like ***this***!"

7. (**6 points**) (**w**) After watching that video, go ahead and find that diagonal distance again! Be sure to show me ***everything*** you do!

8. (**1 point**) Which way did you like better? Mine, or my student's?[3]

9. (**2 points**) One last thing: you likely noticed that all the measurements we used were ***feet*** (well, sometimes they were ***inches*** – but we converted them to feet). Then, we squared those units, making them ***square*** feet. How did we get the square feet back to just ***feet***? Two words will do for an answer here. 😊

[2] I was so blown away by the result of this calculation that I texted all my math buddies (who, since they're big nerds just like me, were equally pumped). 😊

[3] Honestly, I think their way is MUCH better. 😊