Introduction:

Stair building is one of the most complex aspects of carpentry. My experience is that a good and accurate design is the only way to approach any complex geometry problem. I made these drawings on an inexpensive computer-aided drafting program called QuickCAD, which I bought for $60 several years ago. At first I hated QuickCAD because it was bass-ackwards from all the CAD programs I had used years before. I ignored the program for a couple of years, and eventually I took the time to struggle with it and (most importantly) read the manual for solutions to problems that kept arising. Eventually I figured out the darned thing, and now I can't live without QuickCAD.

Without CAD software, stairs can be laid out on paper, using ordinary drafting tools. When complete, you can use a ruler to take measurements from the drawing, measurements that would be difficult and time-consuming to calculate. But... care needs to be taken to create precise linework. I would recommend using as large a sheet of paper as possible, even using poster board, which can be bought at OfficeMax, Staples, Wal-Mart, etc. The larger the scale used (say... 3 inches on paper equals one foot in real life), the more accurate your results will be.

Another alternative is a specialty spreadsheet for stair stringers at www.Shalla.net. This spreadsheet calculates all the necessary dimensions for stair stringers, and lets you
1. Determine heights of finished floor, deck, or sidewalk surfaces. This determines the **rise** of each step.

The distance from the deck surface to the floor, sidewalk or deck surface below is called the **total rise**.

![Diagram](https://via.placeholder.com/150)

**Measuring Height From Deck To Sidewalk**

Then some **math** must be done. If a certain riser height is preferred (say 6 inches), then divide the total run by the preferred riser height. Or... use the riser height of the pre-cut stair treads, otherwise use a good starting number like 7 inches.

This gives the number of risers (steps) needed. Let's use an example of 27 inch total rise. 27" divided by 6" gives us 4½ steps. Oops... you can't have **half a step**. We can have either 4 or 5 risers.

27" divided by 4 gives a riser height of 6.75 inches.
27" divided by 5 gives a riser height of 5.4 inches, which is kinda short. So 4 risers will be our choice.

Note that the **number of risers** is not necessarily the same as the **number of steps**. *You always get one free riser.* Suppose a house has one room that is 7 inches lower than the next room, you don't need any stairs... you just have a step down to the next platform. A deck could be built this way, with several different levels, each 6 to 8 inches lower than the previous. That's a lot of trouble to avoid building stairs, though.

### 2. Determine the thickness of stair tread material.

On most decks this is simply **one inch**, the thickness of standard 5/4x6 deck boards.

But... there are extra-thick deck boards available (I keep running into these darned things), and there are synthetic decking materials that can be any thickness the manufacturer wants.

### 3. Lay out the heights of the **UPPER SURFACES** of the stair treads.

These are the surfaces you walk on, and the surfaces that the building inspector measures from.
**First...** We subtract the riser height from the finished deck surface, which gives the location of the top of the upper tread.

**Then...** Then we subtract the riser height again from that first line (the top surface line) to get the top surface of the second tread. And so on...

Laying this out is much easier on paper (or a CAD system) than trying to create layout lines on the actual project. I suppose you could draw layout lines on the deck support posts, or you could drive some stakes into the ground and mark them.

4. Subtract the thickness of the stair treads to determine the horizontal cut lines that will be marked on the stair stringers.
If using pre-cut stringers, hold the stringers in a position so the highest horizontal cut meets this line. Of course, the stringer must be held with the horizontal cuts level, or else your stairs will suck.

5. Determine a starting point for the outer (front) surface of the risers.

On many decks and porches, the top riser will determine the starting point, because the top riser is often the outer joist of the deck structure.
6. **Determine the final position of the top tread:**

The important geometry is the location of the **front edge** of the first tread.

Common tread materials for exterior decks are:

- Two 5/4x6 deck boards, which gives a tread width of about 11 inches.
- Two 2x6's which gives a tread width of about 11 inches.
- 2x12, which gives a tread width of about 11¼ inches.
- 2x10, which gives a tread width of about 9¼ inches. This certainly works for indoor treads but may not be acceptable for deck stairs.

In this example we'll use a pair of 5/4x6 deck boards, which creates treads one inch thick and 11 inches wide.

7. **Subtract the nose overhang distance to get the location of the front of the next riser.**

The nose is usually **one inch**. Nose distances of 3/4" to 1¼" are usually acceptable.
8. Subtract the riser material thickness to get the **vertical cut line** for the stair stringers.

Riser materials are usually:

- 1x6 or double 1x4 treated wood (3/4" thick)
- 5/4x6 deck boards (1" thick or more)
- Sometimes 2x lumber is used (1½" thick)

See the next drawing for this...

9. Repeat steps 6, 7 and 8 for all the other treads.

In other words, now that the first riser outer surface has been determined, the tread width can be laid out in front:
- This gives us the location of the front edge of the second tread.
- Back off the nose overhang to get the outer surface of the next riser.
- Back off the riser thickness to get the vertical cut line on the stringer.
10. **Convert stair layout to stringer cutting layout:**

Draw a line to connect all the points on the stair stringers. Note that this is **parallel** to the "nose line" of the finished stairs, but is **not** the same as the nose line.

Make another line parallel to the first line, 11.25 inches apart. This denotes the width of a 2x12, the standard material used for stair stringers.

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**Subtract Nose Overhang And Subtract Riser Thickness To Determine Vertical Cut Lines On Stringer**

**Repeating Steps 6, 7 & 8 To Determine Remaining Tread & Riser Locations**
Convert Stair Layout To Stringer Cutting Layout
Draw Line Parallel To "Point Line",
11.25" Away
In the drawing below, note some interesting patterns:

- The 7.75" top vertical dimension is **not** part of the stringer... this is a dimension that locates the position of the top of the stringer relative to the deck surface.
- The middle vertical dimensions (6.75") are the riser heights.
- The lower vertical dimension (5.75") is just the riser height **minus** the tread thickness.
- The 10.00" horizontal dimensions are the "**effective tread width**". This is the actual tread width **minus** the nose overhang distance. If you took a "bird's eye view" of the steps from above, you would see only 10 inches of the 11 inch treads.
- The 9.25" horizontal dimension is the effective tread width **minus** the 0.75" thickness of the riser. When the risers are nailed onto the front edges, the effective tread width will return to 10 inches. And all the remaining tread supporting areas will simply "shift forward" by 0.75", if that makes any sense.
One benefit of a simple 2-dimensional CAD program is that you get easy (and very accurate) measurements of the overall length, and the angle between the stringer bottom and horizontal. Note that some of the tread cut-out angles are the same 34 degree angle, and the other lines are the complement of that angle, 56 degrees. You remember the Complementary Angle Theorem from high school math, don't you?

It's kinda intuitive... if a line is 34 degrees above horizontal, then the angle between that line and vertical is just 90-34, or 56 degrees.
A really powerful benefit of CAD software is the ability to quickly get distances from the end of the board to the stair "points" on the stringer. From these points the angled cuts can be laid out, and inaccuracies are held to a minimum.

This is NOT how most carpenters lay out stair stringers. The traditional practice has been to use a rafter framing square with little hexagonal brass buttons (sold separately) that are clamped onto the framing square to establish fixed dimensions. I'm not sure I can explain this process... you can read about it in the book Basic Stairbuilding by Scott Schuttner, from Taunton Press, which should be available at Home Depot.
11. Build Stairs

Note that many decks are not built with the decking overhanging the edge by one inch, so stairs built against such a deck may have a missing nose at the top. This is not normally a problem.

The procedure for building stairs is typically:

- Install the stringers. Stringers would be fastened at the top, to the deck. It may also be desirable (or required by code) to fasten the lower end of the stringers to posts in the ground.
- Install the riser boards.
- Install the treads.

For more information on building stairs