STAIR FRAMING

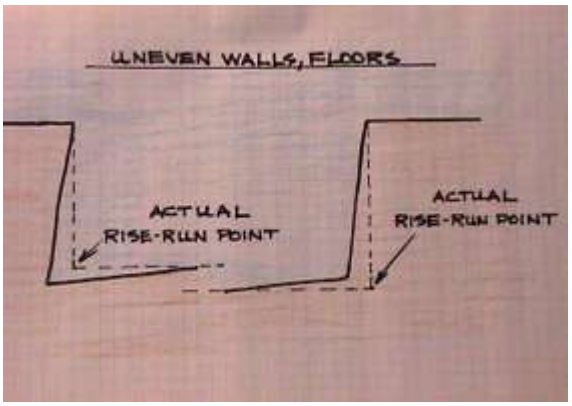
Framing a stair is one the most important things you will ever do. Not the hardest or most complicated, as everybody thinks, but it is the most important. Building something that pleases my wife or building a bentback rocking chair is probably the two most complicated procedures I have ever done. When you frame a stair, and leave it to the homeowner and their visitors to use, is something that can make you or break you. Not only in money, but in the fact that you, in my books, could become a murderer. If you build a stair, like the one I am going to describe in the mythical tread section, you know it is wrong, and someone falls down it and dies, who do you think I am going to blame for their death? You. That's who.

There is more deception and lies told about stairs than any other part of construction. Just like in the real estate business, they sell you a piece of land on a 45 degree hillside and tell you that you have bought one acre of land. They measured it and it measured one acre. Not according to the U.S. grid map. You have a lot less than an acre. Land is supposed to be measured from a vertical and level measurement. Lies and deception. Same goes for stairs. The tread measurement is a vertical read measurement, not a depth area perception measurement as most building inspectors do. Lies and deception. Only thing is that the homeowner is usually the one that pays for their incompetence and ignorance of the code, the inspector is long gone.

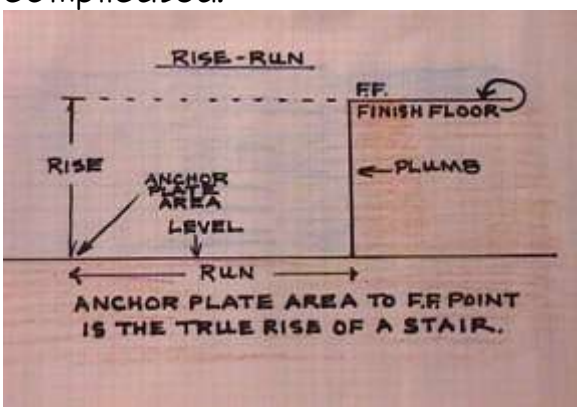
I have heard so many people say that stair building is a mystery, and that is why there are so many bad staircases. There is no mystery to it; it is just plain old carpentry techniques. Take it from a carpenter; if you will apply yourself, there is nothing you cannot build.

The Loretto stair in Santa Fe, N.M. is probably the most talked about stair in the world. I have built three stairs like this and so have a lot of other carpenters. It was not what this carpenter did in the chapel that is a mystery; it is how he did it with the tools and material he had that is a mystery to me. He didn't have the 30 or 40 thousand dollars worth of tools that I do. He carried all of his tools on a mule, a semi wouldn't haul mine. When you build a stair like this it is like you are in another world. Away from all mankind. There are few that will offer or have any advice for you. You will be in a class all by yourself and very, very few others. Sounds like I am going over the edge, doesn't it. Not yet. It would be an honor to work with this carpenter, he did something that will probably never be duplicated, with the tools, material (no plywood) and

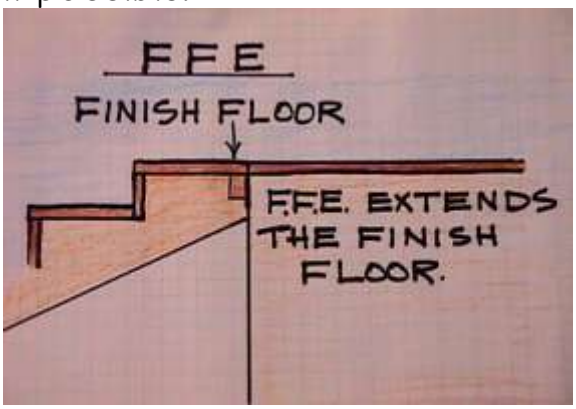
technology that he had and used. Amazing piece of work. Talking about the Loretto stair makes our little stair look like a pile of popsickle sticks.
This is a section on stair building; I hope that you realize the importance of this section. There are many brain exercises in this section. This is serious carpentry, not to be taken lightly. You won't see this stuff in other books.



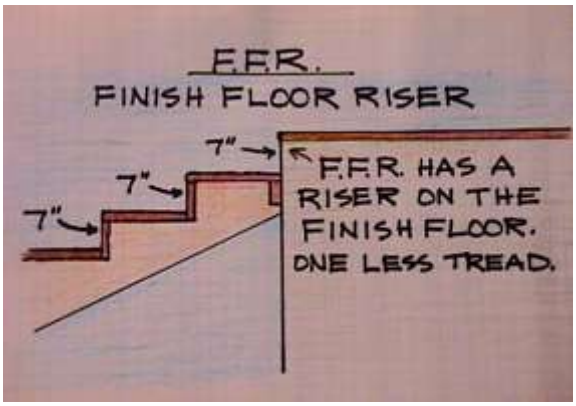
The picture above shows that the point where the rise and run meet is not always visible or even known without some calculations. Never assume that any wall or floor is plumb and level. Carpenters get a wake up call when the treads are ½" out of level in 11". This section is complicated.



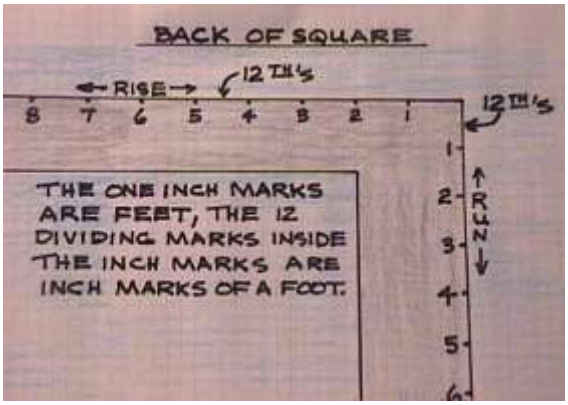
This drawing shows that the actual rise is from the upper finish floor to the anchor plate area. The actual run of the stair is from the point of the landing to the vertical point of the anchor plate point area, not to the bottom of a wall that is out of plumb. Working with a plumb and level structure is a walk in the park after reading some of these procedures of calculations.
To get the measurements of the riser and tread you have to know the total rise. We will use 112" as our rise. Maximum riser height is 8". 112 divided by 8 is 14. We have the room for more treads so try 16 risers instead of 14. 112 divided by 16 is 7". 7" is the most comfortable step. Always use an 11" or 12" tread if possible.



F.F.E. (finish floor extension) has an equal number of risers and treads. Use the E to remember equal. For a ffe stair we would have 16 treads and 16 risers. Equal.



This F.F.R (finish floor riser) stair has on less tread. It would save 11" of run, sometimes this is critical and you need every inch. These are two things you need to remember. FFE and FFR. Now we know we have 16 risers at 7" each. 16 treads at 11" each. Rise is 112" and run is 176". You can mark the run on the floor and measure from the anchor plate point to the point of the upper landing and find out how long of a stringer that you need.

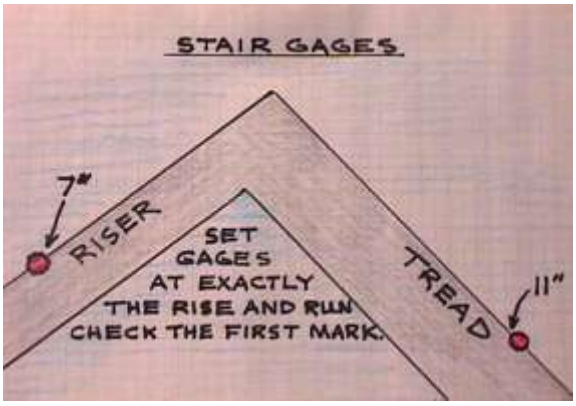


You can also, as the back of the square shows, estimate the length of the stringer.

Be very selective when you get a stringer, don't get one with a lot of knots, and as you will need three of them, get 3-2x12's with about the same crown. For this stair we will need 3-2x12x18's or 20's. Most lumber yard will have them. Microlams make the best stringers, as I wouldn't be too worried about a $100 extra for a good stair. If you are trying to save some money, go and pick up some aluminum cans and cash them in, don't skimp on the material for a staircase.

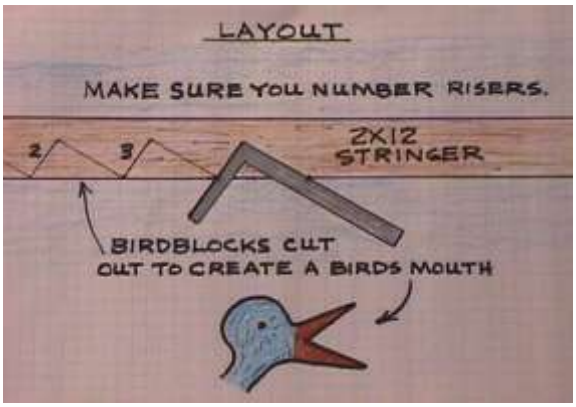
*Stepladders: You are going to be using a stepladder to build a stair. Be careful. I have seen many broken fingers and blood blisters happen while closing a stepladder. Make certain the braces are locked before going up. Try reading the instructions that come with ladders.

*The first time you go up a stepladder and all the legs are not solid to the ground, you will probably remember it, or your mother will.

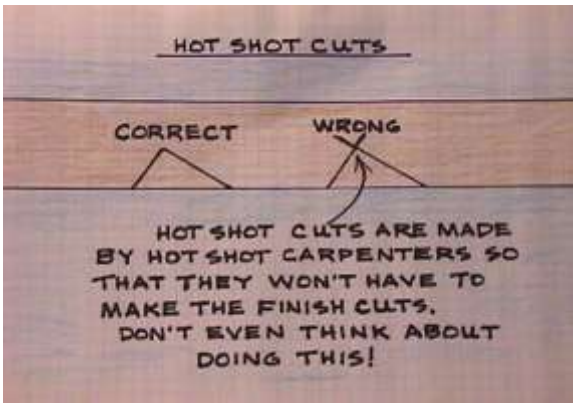


As the drawing shows, you need a good set of stair gages. Set them at 7-11, then mark a board and check them and you. I have these gages showing on the back of the square, you should remember the back of the square has 12th's of an inch on it. You should always attach them on the face of the square.

You need to pay close attention to these drawings; some of them have a lot of details in them that I am not explaining in text. I was not trying to trick you, I won't do that. I do want you to know the face and the back of a square and why they are marked this way. Doesn't matter on a 7-11 stair. Face or back.

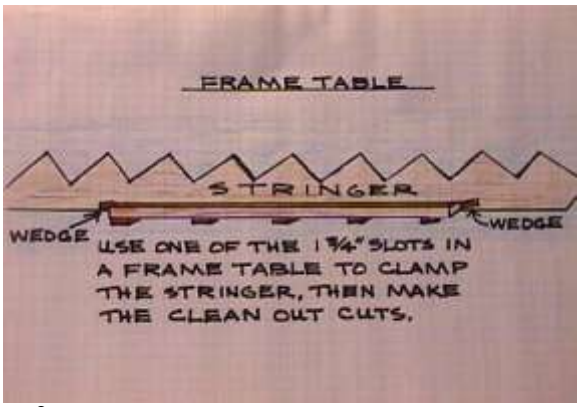


When you cut a stringer you need to have the crown to you. Cut the crown. If you cut the bow of the crown (the other side) the stringer will have sag. The crown is always up. Mark the total stringer. Be very precise making these marks.



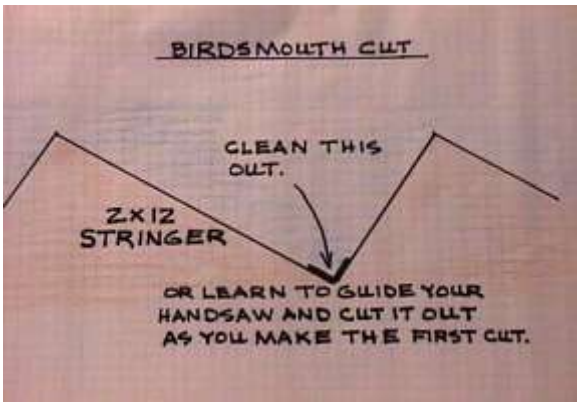
As shown, never make a hotshot cut. Leave this to the cowboys that are in a hurry. This weakens the 4 or 5" area of lumber that is going to help carry your mother- in-law up and down this stair, and we don't want it to fall with her.

Make all the cuts, using every safety precaution I have told you about. No time to get in a hurry. If you need to, put a black dot at each birdsmouth point, to keep you from making a hotshot cut by
mistake.



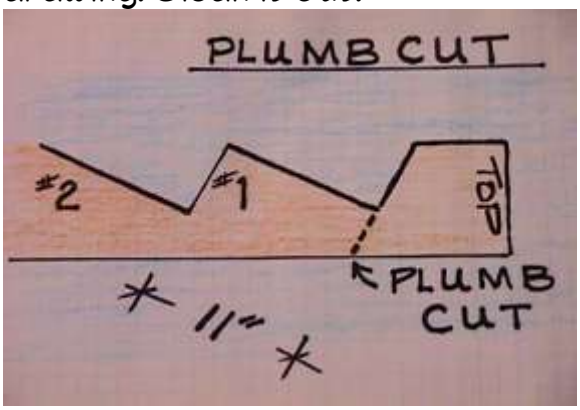
After you have made all the cuts, you can stand and clamp the stringer on a frame table to finish the birdblock cuts. If you will crowd your handsaw towards the stringer you will not have kerfwood left in your cut.

Be very precise when you cut a stringer. It is easier to do it right now than have to grind and recut the treads later.

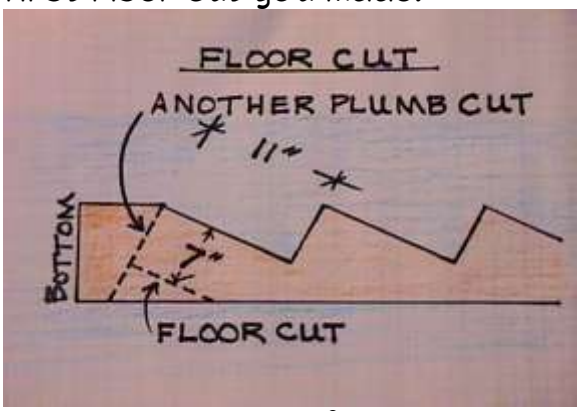


If you don't crowd your handsaw or sawsall you are going to have

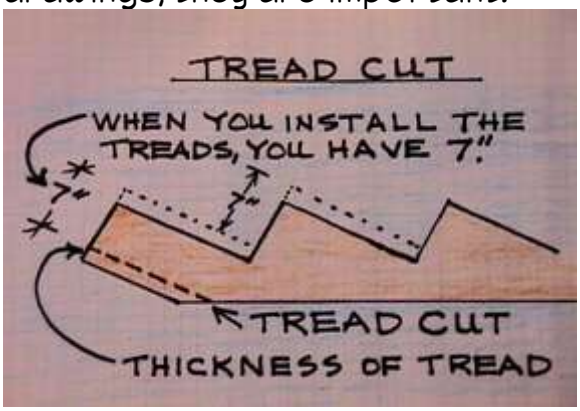
kerfwood as shown in the drawing. Clean it out.



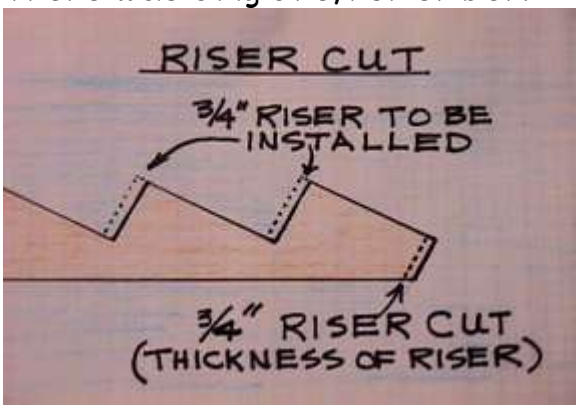
The top of the stringer has a riser cut for the first cut; make a plumb cut here, which is nothing more than an extension of the first riser cut you made.



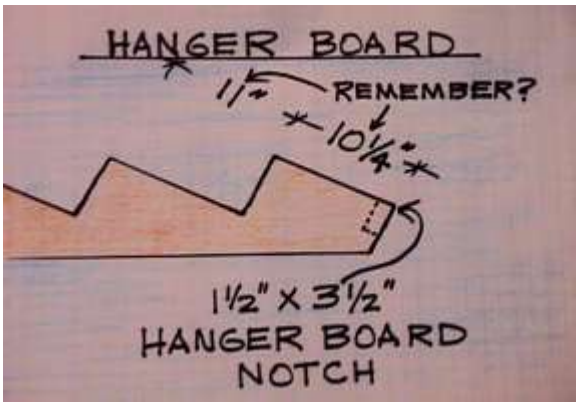
At the bottom of the stringer make another plumb cut at the end of the tread and then make the floor cut. Read these drawings, they are important.



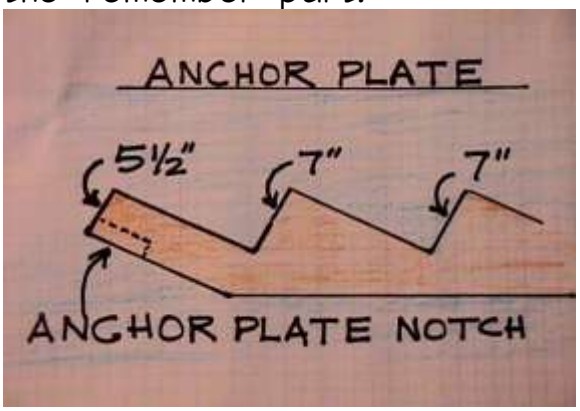
While you are at the bottom, make the tread cut. This is a cut above the floor cut, the thickness of the tread. I never make the floor cut. I just go ahead and make the tread cut, but it won't hurt you to make the floor cut until you create some confidence. I probably have more confidence in your ability than you do. Doing things builds confidence, making mistakes builds confidence. If you never made a mistake, you would be perfect, and I wouldn't want you working for me. I want someone working for me that makes some mistakes, and learns from their mistakes, they are the ones that I can teach something to. I can't teach a perfect carpenter, because I am far from perfect. There was only one, remember.



The riser cut is simple, but it is the one that you have to think about. I sometimes, in my classroom, put a stringer up and show why we have to make the riser cut. If you don't make this cut, the last tread you put on will have to be 1 1 ¾" deep.
When this will sink in, is when you build a stair without a riser cut.



Next cut is the hanger board notch. Important cut, cut it exactly the size of the hanger board you are using. Goes at the top of the stringer. Hard to hang anything off the floor. Look at the "remember" part.



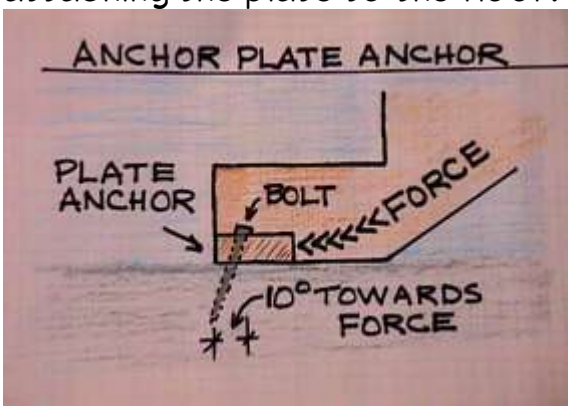
Here we are. Anchor plate. This is where I promised some action. I am going to be nice in the last chapter, but not here. Go ahead and make this cut, and then lay the template you have made on the other two stringers, mark them and cut them out. Cut the crown. Crown to you when you mark, crown to you when you cut. After this you can cut the treads, I use ¾" osb and double it, construction adhesive on every part. Construction adhesive will hold lumber together, to a degree, but as I have said in nearly every place where we have used construction adhesive, its main purpose is to hold members apart. This is the case here, it is to hold the members apart and keep squeaks to a minimum. Nails and screws hold the parts together, construction adhesive holds them apart. Construction adhesive dries to a density almost the same as pine lumber. This is one of the best building materials that has ever been invented. It is sometimes wrongly advertised and used improperly. Never depend on construction adhesive to hold a frame member up, especially where there will be a load applied. It is not designed for this. No chemical is designed for this. Frame members are.

When you finish using a tube and there is some adhesive left in the tube, pump some adhesive out and make a ball that is out of the nozzle. This will keep the adhesive in the nozzle from drying out, at least for a while. Next day you can pull the dried plug out and have fresh adhesive to use.

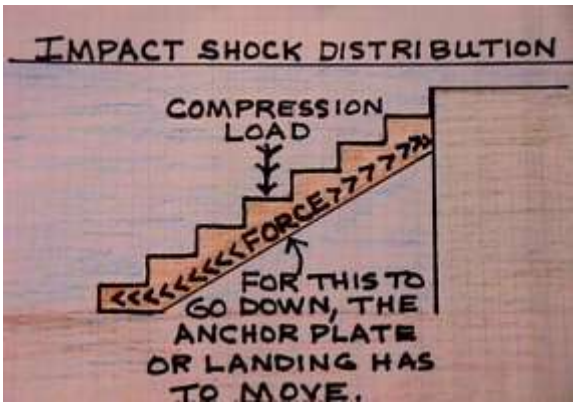
Remember this about stair building; if you can set six cinder blocks for two steps to go into a house, you are a stairbuilder. To what degree of a stairbuilder you become is up to you.

I don't care how simple a stair you build. It doesn't take long to draw it out on paper and detail the cuts you are going to make. A stringer costs $35.00, a piece of paper costs 2 cents.

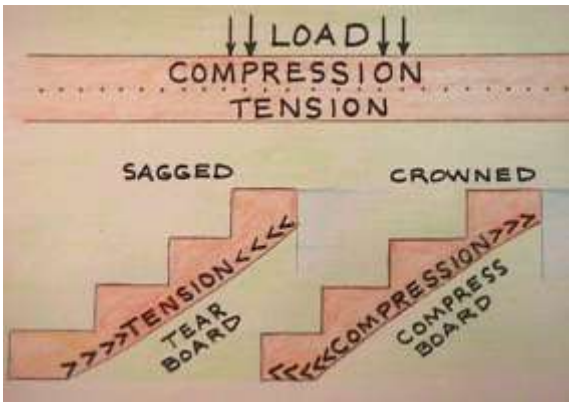
*All stringers should have at least a 1/4" crown in 16'.
The anchor plate, hanger board, and treads all are the same length. I lay the stringers against a sawhorse and stand them up to nail or screw the hanger board and the anchor plate to the stringers.
These are very important connections. Listen. The hanger board and the anchor plate are the two members of this frame that receive and distribute the impact shock of the loads that this set of stringers will support. The notches that you cut to receive these two members have to be square and the ends of the hanger board and the anchor plate should fit tightly into the notch. Be very careful when you apply construction adhesive and make sure all of the connection area has construction adhesive spread on it. Also be careful when you nail or screw them to the stringer. Both plates should be tight and secure.
The two outside stringers go flush to the end of the hanger and anchor plate boards and the center in the center. The next step after you get the anchor and hanger attached is to hang the frame onto the landing. This you should know, the top of the hanger board goes 8 ½" down from the top finish floor line. 7" rise plus 1 ½" tread. Nail or screw the hanger board to the landing exactly level. If the landing is not level, you should still nail the hanger board on level.
You have to make sure that you get the stringers square with the landing wall. Drop a plumb bob down from the end of the hanger board and get a mark. Use the 345 method to pop a square line off the wall. Now you are ready to attach the anchor plate to the floor. Drive a cut nail to hold the plate in place. On a concrete floor I use four 1/2" anchor bolts. Wood floors I use four 1/2" lag bolts or if the floor joist are open under the stair you can install four 1/2" carriage bolts. Apply 3 good beads of Liquid Nails before attaching the plate to the floor.



All of these bolts are installed at the front 1½" of the anchor plate as the drawing shows. After you have all the anchor bolts installed and hanger attached, the frames are finished and you can install the risers and treads. All of the riser boards are stair width x 7" except the one at the bottom. Its 5½". All of the treads are 11" deep and you will need 32 of these, ¾"x 11" x stair width, two per tread. Glue on all parts.



I know you remember isd. Impact shock distribution from the roof framing books. The stringers you have just installed are very much like a rafter. The stringers distribute the shock of the impact force. A doctor friend of mine told me that when you run down a stair or stand in one place and jump from one foot to the other you are creating a force 4 times greater than your body weight when your foot hits the floor. I believe it. This, he said, is the reason for so many foot and ankle problems. When I, at nearly 240#, run down this stair, I am creating nearly 1000# of force each time I land on a tread. Or think about 3 people my size going down this stair at one time, or a fireman carrying an injured person. There is absolutely no way that the bottom of the stringer boards (the 5" wide part of the 2x12 left after you cut out the treads) would even start to carry this much impact shock force. (A lot of them don't). The total wood at the bottom of the three stringers barely equals a 2x12, not near enough to carry this load.



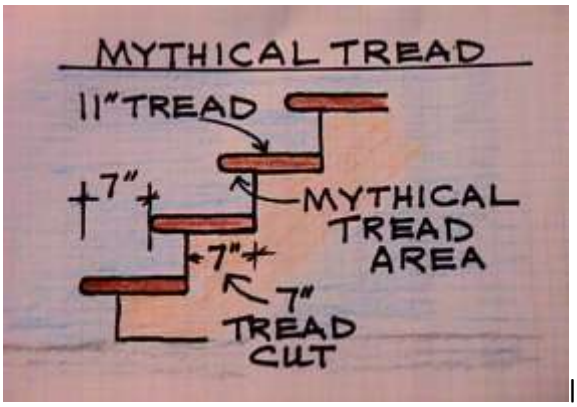
You need to study this drawing and section, over and over again. This is the most detailed, complicated procedural information in this book. When you apply a load to a board (2x12 on top of drawing) the load compresses the top half and stretches the bottom half (tension). Good, all engineers agree on this. When some so-called carpenters nail up sagging stringers, the force actually pulls on the hanger plate and anchor plate when you walk on it, eventually breaking the bottom of the stringer. When a stair builder bolts a crowned (remember, crown is always up) stringer to a landing and floor, walking on it pushes against the floor and landing creating compression (in the 5" area of 2x12 we have left) instead of tension. The dotted line (neutral line) on the top 2x12 in the drawing divides the compression from the tension area, but this imaginary line can be moved down (the neutral line has to be moved because the riser-tread cuts takes out the compression area) by proper construction, solid landings and solid bolted

anchor plates. If you don't have a solid anchor and hanger board the neutral line is moved to the middle of the 5" section of 2x12 we have left at the bottom of the stringer. No good. We want all of this 5" section to be compression area, no tension area allowed. If the anchor plate and hanger plate are solid, the tension is moved from the bottom of the 5" area to the anchor and hanger attached to the landing. Some structural engineers don't believe this, that's their problem. I am not an engineer, I am a carpenter, but I know how to build a solid staircase. When you build a stair with a sagged (or even a crowned) stringer and a nailed anchor plate it will bounce when you jump on the center of it. When you build a stair with a crowned stringer and solid bolted anchor plate and a solid hanger board and landing, it will be solid as a brick. This is also how a truss works, a bridge works, and many other structures that hold the loads. Most of the time it is not the material that prevents failures, it is the way the material is put together that holds the load.

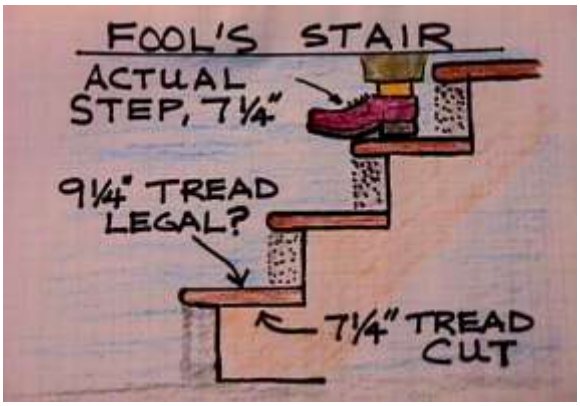
Now for those that believe this section and understand what I have been talking about. When this article came out in this magazine and told over two million readers that when you frame a stair and to attach the anchor plate all you have to do is to drive 3 or 4 nails in the anchor to hold the stair (and they never mentioned crowning the stringers) you should understand why I was a little concerned about their sources of information. The editor told me they did a "lot of research" for this article. They should have spent their "research time" trying to find a carpenter.

I have something for you. Some carpenters will not explain things to you, but I, in my gentle, soft spoken mannerism, will tell you everything I know. Take a 16' 2x4, lay it at about 30 degrees flatways against a wall that will not move and nail and secure it, where that it will not go up. Nail it to the floor. When you nail it, put a 2" bow in it. Bow up (if you bow the 2x4 down and push down on it, the 2x4 will pull the wall and floor connection, tension). This is called a springboard. Now go to the center and try to push it down. If it is solid at the top and solid at the bottom, there is no way it will go down. Instead of the force creating tension, the force is creating compression in the total 2x4. I hope this sparks an interest in you to get a degree in engineering. Now you should see how you can rack and straighten a wall. This doesn't take long and will give you some basic knowledge in engineering. It will also tell you not to believe everything you read and that the anchor plate is something you had better install correctly and not depend on 3-12p sinkers to

do the job that should have four ½" bolts. Case closed.

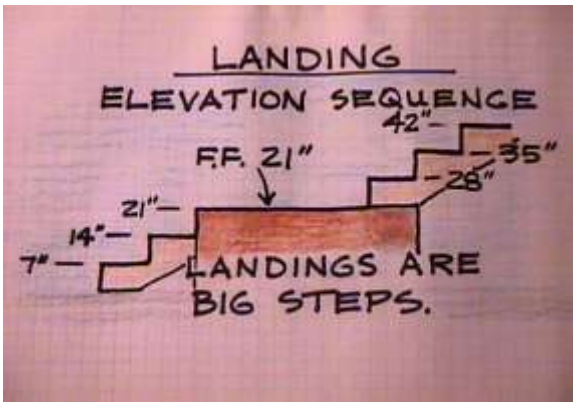


I exaggerated this stair in the drawing, surely no one has ever built one like this, but on the other hand, you can never tell. Most builders, carpenters, inspectors, homeowners would say that this stair has an 11" tread. It is 7". But I know of a lawyer in Dallas, Texas that knows the tread depth. He and some others won a $1,000,000 lawsuit over this very thing. More power to them. A woman nearly got killed on one of these so called staircases. I hate to have to get in peoples faces about this and some other things. But you know, truthfully, it doesn't bother me at all. Shouldn't you either. When you know the truth, you should speak up. If they are lying, they should admit it. Lies and deception, it is a shame we even have to mention them.



I know all about this little staircase, it is less than 3 miles from my house. It was built by a person that impersonates a carpenter for a large developer here in our area. This stair was inspected by our notorious state building inspectors. Two of them, not one, but two. They passed it, said it has a 9 ¼" tread. They tried to explain that to the homeowners. Didn't do any good. The homeowners called me and I went over and looked at it. They had already figured it out, because they have to go down the stair side-footed. This little piece of work is dangerous, and I do mean dangerous. The owners called the state and they sent another inspector to look at it and she said it had a 9¼" tread. This is absolutely absurd. This is what I have been talking about in this book and in this section, lies and deception. The sad part is that these inspectors are not responsible for their inspections. If someone gets killed on this staircase, and it could happen, the inspectors will not be involved. Long gone. The builder will be responsible, maybe,

but since it was passed by the state, the homeowners will probably lose the suit. Unless they get that Dallas lawyer. He knows, I know and you know that this stair does not have a 9 ¼" tread. Every building inspector in the USA should have to read and learn this section before they cash their next check. The code, minimum 9" tread, (should be 11", IBC code) should be enforced. It isn't. If you are ever told to build a stair like this, walk off. If you build one like this you have thrown out every principle that I have tried to instill into your head in this book. You are lying to yourself and the home owners. I don't compromise my principles, and you shouldn't either. There is no place that we should allow lies and deception to be any part of the construction industry. It happens every day. It is up to you, the carpenter, to build a safe and solid structure, not up to the inspector, engineer, architect or builder. If they tell you to do something, that you know is wrong, walk off. Be a man, not a wimp and cow down to someone that is deceiving you and the homeowner.



Landings are simple. A landing is simply a big tread. No more, no less, a big tread, remember this. I have just given you all the technology you need to build a landing. Build it big enough to support the anchor plate and the bottom of the stringer. Build it strong enough to stabilize the bottom stair and the top stair. The elevation of a landing is the same elevation of the tread it replaces. One day you might reread this and see that I have given you every detail about how to build a landing. I am not leaving you in the dark. I have given you all the tools to be a stair framer. You just have to learn to use them.

If you want to do something that will really help you, build a half scale stair, with four steps in it, out of 1x6's and 1x4's. Think, the 1x6 is 5 ½" (half of 11) and the 1x4 is 3 ½" (half of 7). Practice won't make you perfect, but it will build that important tool, confidence.

You can lose confidence by making too many mistakes. Take your time and remember the basics.

MORE STAIR TALK

There will come a day that I will write a stair book, not now, but soon. Stair building is something I did for 15 years. When an architect and engineer gives you a set of drawings for a 9'x18' geometric staircase (Elliptical spiral), and it is only a drawing, and tells you to build it. Now that is a challenge. A geometric stair is shaped like an egg. An elliptical staircase. All of the magazines rave about the stair builders in England and abroad. Let me tell you something, we have some of the best stair builders in the world in the U.S.A. I have built a few hundred stairs but some of the work they do rivals the person that built the Loretto stair. I have given you only a small part of stair knowledge. But it is solid, basic knowledge that you can use as a foundation to becoming a stair builder, if that is what you choose.

There is one thing I want you to remember, the actual tread depth (the part of the tread that you put your foot on) is the distance of the tread cut. No more....If you set your stair gages at 7" rise and 8" run and cut a stringer out, you are going to have an 8" tread. I don't care if you cantilever the treads 6". You still have an 8" tread. Period.