Designing and Building Stairs

Stairways can be minimal or very elaborate, but they're all based on simple geometry and accurate finish work

by Bob Syvanen

Today, few people can afford the time and expense of building classical 19th-century stairways. Tastes have changed too, and as a result, stairs have become simpler. But the principles of stair design and construction are the same as they've always been, and so are the skills that the builder must bring to the task. If modern stairs aren't ornate, they still remain a focal point of a house—your work is out there for all to see.

One of the problems builders face in cutting stairs is getting rusty. Unlike the master stair-builders of the past, on-site carpenters typically build only a few stairways a year. Fortunately, designing a stair and laying out the stringers uses the same language and concepts as roof framing. Fitting treads and risers, on the other hand, is nothing more than simple, if demanding, finish work.

Basic stair types—The simplest stairway is a cleated stairway, which relies on wood or metal cleats fastened to the carriages to support the treads. You could use a cleated stairway for a back porch or cellar, but count on repairing the ever-loosening cleats. Wood cleats are typically 1x4s, and screwing them in is a big improvement over nails. But angle-iron cleats will last longer.

Another open-tread stairway—one without risers—uses dadoed carriages. The treads have ½ in. or more bearing on the inside face of the carriages, and they are either nailed or screwed in place. I use a circular saw, and set the depth of cut to half the thickness of the carriage, to make the parallel cuts. Then I clean up the bottom of the dado with a chisel. A router and a simple fixture built to the stair pitch and clamped to the carriage will also do a quick, neat job.

In the past, dadoed carriages were used mostly for utility stairs for porches, decks and the like, but more and more I'm asked to build open-tread oak stairs that have to be nearly furniture quality. One type, the stepladder stair, can be used when limited space doesn't allow any other solution (for more, see p. 62).

On finished stairs, the dado is usually stopped (that is, its length is limited to the

Stairbuilding in its highest forms requires the conceptual skills of a roof framer, and the fitting talents of a cabinetmaker. But simple open tread runs like the basement stair at left only require understanding the basics.

width of the tread), and squared up at the end with a chisel. If you begin the dado on the front of the carriage, leave the tread nosing protruding slightly. If you start the dado at the back of the carriage, the treads will be a little inset. They can look nice either way.

Other stairways use cut-out carriages. The simplest of these is a typical basement stair where the rough carriages are exposed, and risers are optional. The most complicated is a housed-stringer stairway. It is based primarily on patient and accurate work with a router. The stringer is mortised out along the outline of the treads and risers with a graduated allowance behind the riser and tread locations for driving in wedges. Adjustable commercial fixtures or wooden shop-made templates are used to guide the router. Although the first stairway that I built by myself on my own had a housed stringer, I won't try to give complete instructions here.

A finished stairway that still requires patient finish work, but is much less tedious to build, uses cut-out carriages hidden below the treads, and stringboards or skirtboards as the finish against the stairwall. The treads and risers are scribed to the skirts. The example I'll be using to describe final assembly is one of these that also has an open side, which uses a mitered stringer. This side of the stair requires a balustrade—handrail, balusters, and newel posts—but that's a separate topic.

Designing a stairway—No matter what style stairway you want to build, the design factors that you'll need to consider are comfort, code, safety and cost. Comfort gives the ideal conditions for good walking, and code dictates what you can and cannot do. Safety is largely a matter of common sense, and cost limits your grand ideas.

Although comfort is very much a subjective notion, there are three objective factors to consider in designing a stair—stair width, headroom and the relationship between the height of the riser and the width of the tread. Of the three, stair width is the easiest to deal with. Most building codes require utility stairs to be at least 2 ft. 6 in. wide and house stairs to be 3 ft. from wall finish to wall finish, but 3 ft. 6 in. feels a lot less restrictive. However, if the stairway gets beyond 44 in. in width, most building codes require a handrail on each stair wall.

Headroom is not quite as simple, although most codes agree that basement stairs need a minimum of 6 ft. 6 in., and house stairs need at least 6 ft. 8 in. This measurement is made from the nosing line (for a definition, see *headroom* in the glossary on the next page) to the lowest point on the ceiling or beam above. A lack of headroom is most noticeable when you're going down the stairs, because you are walking erect and bouncing off the balls of your feet. Ideal headroom allows you to swing an arm overhead going downstairs, but this requires a clearance of nearly 7 ft. 4 in. Headroom can be increased by enlarging the size of the stairwell, decreasing the riser height, or increasing the width of the treads (tread

width is the distance from the front to the rear of the tread).

Certain combinations of riser and tread are more comfortable than others. Most codes set limits—a maximum rise of 8¼ in. and a minimum tread width of 9 in.—but these are based on safety, not comfort. A 7-in. rise is just about ideal, but it has to be coupled with the right tread width.

The timeworn formula for getting the tread width and riser height in the right relationship is: riser + tread = 17½ (a 7-in. riser + a 10½-in. tread = 17½ in.) Another rule of thumb is: riser X tread = 75 (7 × 10½ = 73.5, which is close enough). Still another formula is: two risers + one tread = 24 in. I've always found the first formula the easiest. All of them establish an incline between 33° and 37°. This creates a stairway that is comfortable for most people.

More considerations—Each tread should project over the riser below it. This projection, or nosing, should be no more than 1¼ in. and no less than 1 in. In open-tread stairways, a tread shouldn't overlap the tread beneath it by more than ½ in. The nosing adds to the area where your foot falls, but doesn't affect the rise-run dimensions. The top of a handrail should be between 30 in. and 34 in. above this nosing, with a 1½-in. clearance between the handrail and the wall. If the top of the stairway has a door, use a landing at least as long as the door is wide.

Keep in mind that people aren't the only things moved up and down stairs. I once lived in an old Cape Cod house that had a stairway with 10½-in. risers, 6½-in. treads, and not too much headroom. You could negotiate it if you exercised a little caution, but moving heavy furniture up and down was another story.
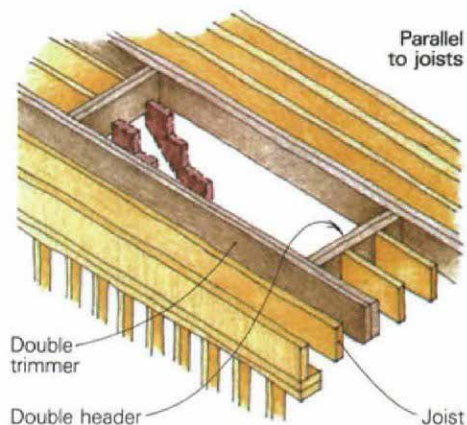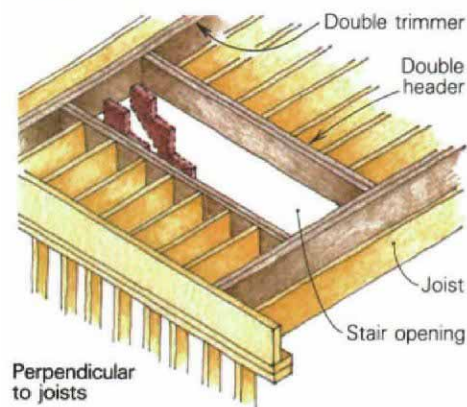
The size of a stairwell is based on the riser and tread dimensions, and on how much headroom you need. A typical basement stair can be gotten into a rough opening 9 ft. 6 in. long by 32 in. wide. A main stairwell should be a minimum of 10 ft. by 3 ft.

Framing a stairwell isn't complicated and is usually defined in the local building code. If the long dimension is parallel to the joists, the trimmer joists on each side are doubled, as are the headers. Similar framing is required if the long dimension is perpendicular to the joists (drawings, above right). If the header isn't carried by a partition below, it will have to be designed for the load.

Making the calculations—Careless measuring can get you in a lot of trouble when you're building stairs. Although the initial figuring may seem a little theoretical, you'll soon be doing some fussy finish work based on these calculations and the resulting carriages. First, check both the stair opening and the floor below for level. If either is out of level, determine how much. You'll have to compensate for it later. This problem occurs most often with basement slabs.

There are many ways to lay out stairs; the following system teamed with a pocket calcu-

Framing stair openings

Double trimmer
Double header
Joist
Stair opening
Perpendicular to joists

Parallel to joists

Double trimmer
Double header
Joist

lator works well for me, even though I have to scratch my head to recall what I did last time. Start with the measurement that has already been determined, the finished floor-to-floor height. I'll use 108 in. in this case. Then, just for a starting point to get you close, divide by 14, the average number of risers used in residential stairs. This gives a riser of 7.71 in., which is a little high. Adding another riser will reduce this measurement some: 108 in. ÷ 15 = 7.20 in. Sounds good. You now know how many risers you'll be using and how high they are.
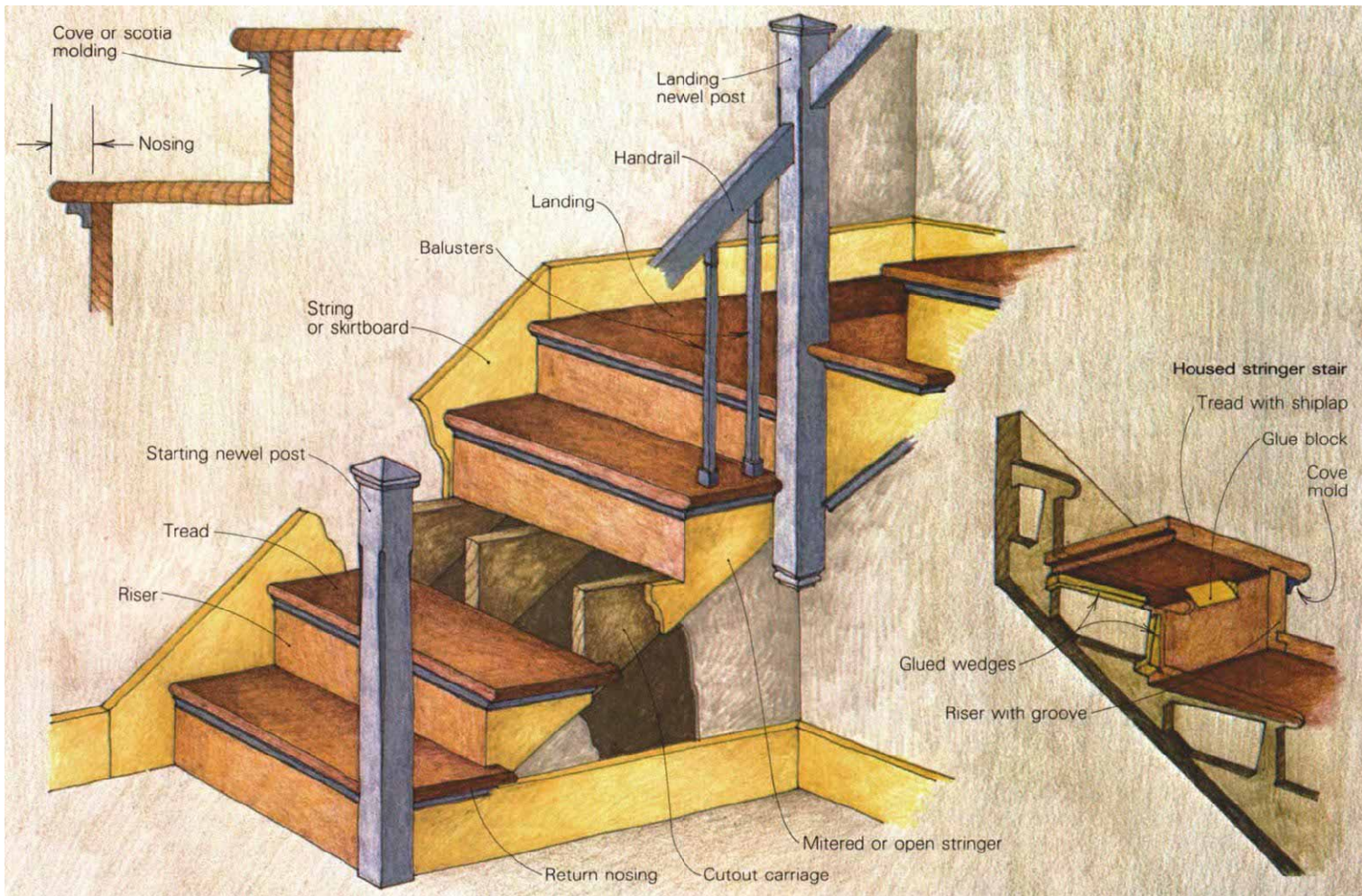
To get the width of the treads (remember, this means the front-to-back measurement of each step), use the rise-plus-tread formula in reverse: 17.5 in.-7.2 in. = 10.3 in.

All stairs have one more riser than treads. This is because the floors above and below act as initial treads, but aren't a part of the stair carriage calculations. You'll have to keep reminding yourself of this when you lay out the carriages. I don't know a good way of remembering this, and I have resorted to drawing a sketch of a couple of steps and using it to count the difference. In the example we're using, then, there are 14 treads and 15 risers.

The last calculation is the total run—the length of the stairway from the face of the first riser to the face of the last riser. This is simply the total number of treads multiplied by their width: 14 in. X 10.3 in., or 144.2 in. With this figure you can check to see whether the stairway will fit in the space available. Although I now use a calculator for the math, my main tool used to be a stair table like the

A Glossary of Stair Terms

Cove or scotia molding

Nosing

Landing newel post

Handrail

Landing

Balusters

String or skirtboard

Starting newel post

Tread

Riser

Return nosing

Cutout carriage

Mitered or open stringer

Glued wedges

Riser with groove

Housed stringer stair

Tread with shiplap

Glue block

Cove mold

Balusters—The posts or other vertical members that hold up the handrail, usually two per tread.

Balustrade—The complete railing, including newel posts, balusters and a handrail. Most of these parts are available as stock finished items at lumberyards.

Carriages—Also called *stair stringers, stair horses* or *stair jacks.* They are the diagonal members that support the treads. Carriages can either be *finish stringers* or rough stringers—for an outside stairway, or for an inside stairway hidden from view. *Rough carriages,* whether they are *cut-out carriages* or just *dadoed* or *cleated stairs,* are made of 2x10 or 2x12 softwood lumber. Finish stringers are usually made of ¾-in. or 1⅛-in. stock. They either can be cut out (an *open or mitered stringer)* or routed (a *housed stringer).*

Closed stairway—Stairs with walls on both sides. In this case a *wall stringer,* whether it is a *housed stringer* or just a *stringboard,* is nailed to each wall. Closed stairways use handrails, not a balustrade.

Finished stairway—Any of several interior stair types that have risers, treads, stringers and a handrail or balustrade.

Handrail—This rail runs parallel to the pitch of the stairs. It's held by balusters or brackets.

Headroom—The vertical distance from the lowest point of the ceiling or soffit directly above the stair to the *nosing line,* an imaginary diagonal connecting the top outside corners of treads. Most codes require at least 6 ft. 8 in. for stairs in living areas, and 6 ft. 6 in. for basement utility stairs.

Housed stringer—The profile of the treads, nosing and risers is routed into a finish stringer. Extra room is left for wedges to be driven and glued in between the stringer and the treads and risers. Rabbeted and grooved risers and treads are also used.

Landing—A platform separating two sets of stairs.

Newel post—The large post at the end of the handrail. There is a *starting newel* at the base of the stairs, and a *landing newel* at turns.

Nosing—The rounded front of the tread that projects beyond the face of the riser 1 in. to 1¼ in. In the case of *open-tread stairways,* it shouldn't exceed ½ in. In most cases, the nosing is milled on the tread stock. On open stairways, a half-round molding called *return nosing* is nailed to the end of the tread.

Open or mitered stringer—This is a cut-out finish stringer used in open stairways. The treads carry over the stringer, but the vertical cut-outs on the carriage are mitered with the risers at 45°.

Open stairway—This can be open on one or both sides, requiring a balustrade. In finished stairways, the open sides will use a *mitered* or *open stringer.*

Rise—The height of each step from the surface of one tread to the next. Just as in roof framing, this measurement is sometimes called the *unit rise.* Many codes call for a maximum rise of 8¼ in. The height of the entire stair, from finished floor to finished floor, is the *total rise.*

Riser—Describes the rise of one step. It is also a stair part—the vertical board of each step that is fastened to the carriages. Risers for a *housed stringer stair* are rabbeted at the top to fit the tread above, and grooved near the bottom for the tread below. Other stairs use 1x square-edged stock. *Open-tread stairs* don't have risers.

Run—Also called *unit run,* this is the horizontal distance traveled by a single tread. A 9-in. run is the code minimum for main stairs. *Total run* is the measured distance from the beginning of the first tread to the end of the last tread—the horizontal length of the entire stairway.

Stairwell—The framed opening in the floor that incorporates the stairs. Its long dimension affects how much headroom the stair has.
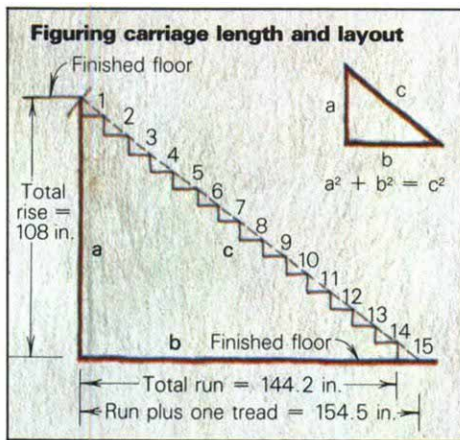
Stringboard—Diagonal trim, not used to support the treads, that is nailed to the stair walls. Finished treads and risers butt these. Often called *skirtboards, backing stringers,* or *plain stringers.*

Tread—It is both the horizontal distance from the face of one riser to the next, and the board nailed to the carriages that takes the weight of your foot. Exterior stairs typically use 2x softwood treads. Interior stairs use either 1⅛-in. hardwood stock milled with a rabbet and groove to join it to the risers, or 1³⁄₁₆-in. square-edged stock. Both are usually nosed.

Winder—Wedge-shaped treads used in place of a landing when space is cramped, and a turn is required in the stairway. Many building codes state that treads should be at least the full width of the non-winder treads, 12 in. in from their narrow end; or that the narrow end be no less than 6 in. wide.

—*Paul Spring*

Figuring carriage length and layout

Finished floor

Total rise = 108 in.

$a^2 + b^2 = c^2$

Total run = 144.2 in.
Run plus one tread = 154.5 in.

Total rise*	Number of risers	Riser height	Tread width	Total run
8'0"	12	8"	9"	8'3"
	13	7⅜" +	9½"	9'6"
	13	7⅜" +	10"	10'0"
8'6"	13	7⅞"	9"	9'0"
	14	7⁷⁄₁₆" −	9½"	10'3½"
	14	7⁷⁄₁₆" −	10"	10'10"
9'0"	14	7¹¹⁄₁₆" −	9"	9'0"
	15	7³⁄₁₆" +	9½"	11'1"
	15	7³⁄₁₆" +	10"	11'8"
9'6"	15	7⅝" −	9"	10'6"
	16	7⅛"	9½"	11'10½"
	16	7⅛"	10"	12'6"

*height from finished floor to finished floor

Stair geometry. **The stair described in the text is shown above left Plugging total run and total rise into the Pythagorean theorem gives the required carriage length. Based on an ideal riser and tread, the stair chart, above right, gives the number of risers and total run for a given total rise.**

one above. I still use one for quick reference in the planning stage. If the run is too long, make the treads narrower, or eliminate a riser and a tread. Either way, you'll need to run a new set of calculations.

Layout—To lay out the carriages, you first need to know what length stock to buy. If you've got a calculator, it's easiest to use the Pythagorean theorem $(a^2 + b^2 = c^2)$. But you must add the width of an extra tread to your total run to get enough length for the bottom riser cut (drawing, above). In this case, a is the total rise of 108 in., and b is the total run of 144.2 in. plus a 10.3-in. tread. The hypotenuse, c, is 188.5 in. So you'll have to buy 16-footers to allow for cutting off end checks, and avoiding large knots with the layout.

Most cut-out carriages are 2x12s because you need at least 3½ in. of wood remaining below the cut-outs for strength; 4 in. is even better. Douglas fir is the best lumber for the job because of its strength. You will need a third, or center, carriage if the stair is wider than 3 ft. with 1½-in. thick treads, or wider than 2 ft. 6 in. with 1⅛-in. thick treads.

Once you have marked the edge of one of the carriages with the 188.5-in. measurement, you are ready to lay out. I step off equal spaces with dividers (photo top right) before marking the riser and tread lines with a square. Some carpenters simply step off the cut-out lines with a square, but I don't like the accumulated error you can get this way. A deviation of more than ¼ in. between the height of risers or the width of treads can be felt when walking a flight of stairs. For this reason, it's also a violation of code.

The dividers I use are extra long. You can improvise a pair by joining two sticks with a finish nail for a pivot, and a C-clamp to hold them tightly once they're set. The easiest way to find the spacing is to locate 7.2 in. (the riser height) and 10.3 in. (the tread width) on a framing square, and set the divider points to span the hypotenuse, which is 12.56 in. (a strong 12½ in.). No matter how careful you are in setting the dividers, it will take a few trial-and-error runs before you come out to 15 even spaces. Once you do, mark the points on

the edge of the carriage. These represent the top outside corner of each tread, less the profile of the nosing.

To draw the cut-out lines, use either a framing square or a pitchboard. Most carpenters use the square, but a pitchboard can't get out of adjustment. You can make one by cutting a right triangle from a plywood scrap. One side should be cut to the height of the riser, and the adjacent side to the tread width. A 1x4 guideboard should be nailed to the hypotenuse. Align it with the marks on the carriage and use it to scribe against.

If you are using a square, set it on the carriage so that the 90° intersection of the tongue and body point to the middle of the board. Along the top edge of the carriage, one leg should read the riser increment and the other, the tread increment. Use either stair-gauge fixtures (stair buttons) or a 2x4 and C-clamps to maintain the correct settings when the square is in position against the edge of the carriage. Then, holding the square precisely on the divider marks, scribe the cutlines for each 90° tread-and-riser combination (photo second from top).
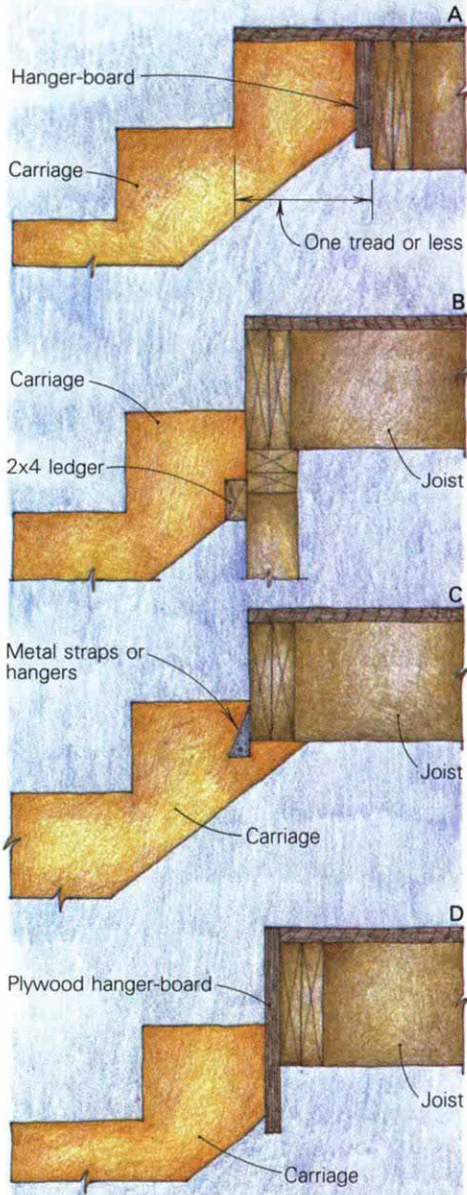
Dropping the carriages—One of the most difficult things about stairs is adjusting the carriages for the different thickness of floor finish, which can throw off the height of the bottom and top risers. Any difference should be subtracted from the layout after the tread and riser lines are marked, and carefully double-checked before you do any cutting. What you marked on the carriage is the top of the treads, but since you will be nailing treads to the carriages, you need to lower the entire member enough to make up for the difference. This is called *dropping the carriages*. If they sit on a finished floor, such as a concrete basement slab, the bottom riser will need to be cut shorter by the thickness of a tread (drawing A, next page, top right). This will lower the carriage so that when the treads and upper floor finish are added, each step will be the same height. The bottom riser will have to be ripped to a narrower width. If the treads and floor finishes are of equal thickness (B), and the carriage sits on the subfloor at the bottom,
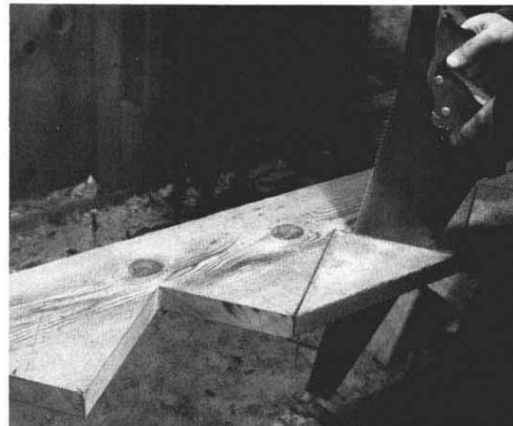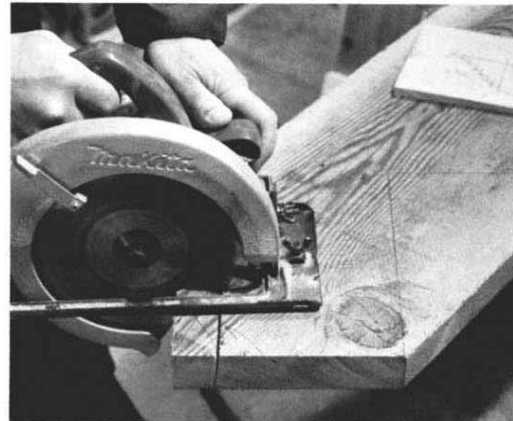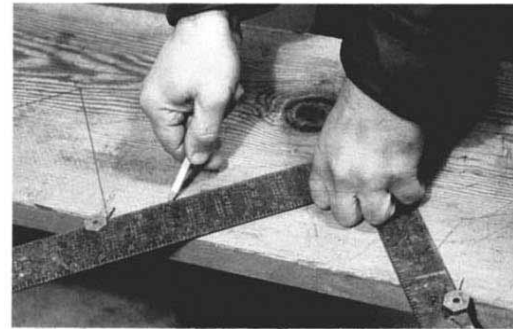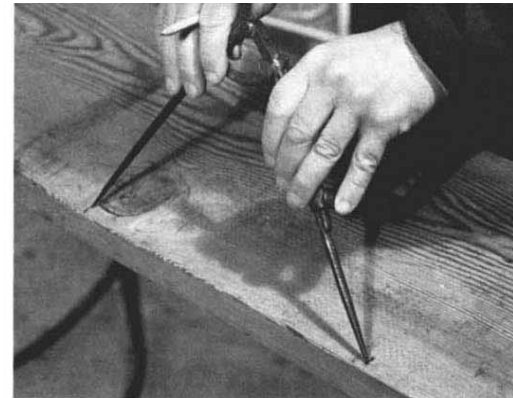
Laying out and cutting the carriages. **Starting with the top photo, Syvanen uses large dividers to mark the intersections of tread and riser lines on the front edge of the carriage. From these marks, he scribes the cut-out lines using a framing square fitted with stair-gauge fixtures. With a circular saw, he begins cutting out the carriages by notching the bottom riser for the kickplate that will anchor it to the floor. Syvanen uses a handsaw to finish the cutting. Cut-out carriages are usually made of 2x10s or 2x12s, since there should be at least 3½ in. of stock between the bottom edge of the carriage and the cutout.**

Methods of hanging the carriages
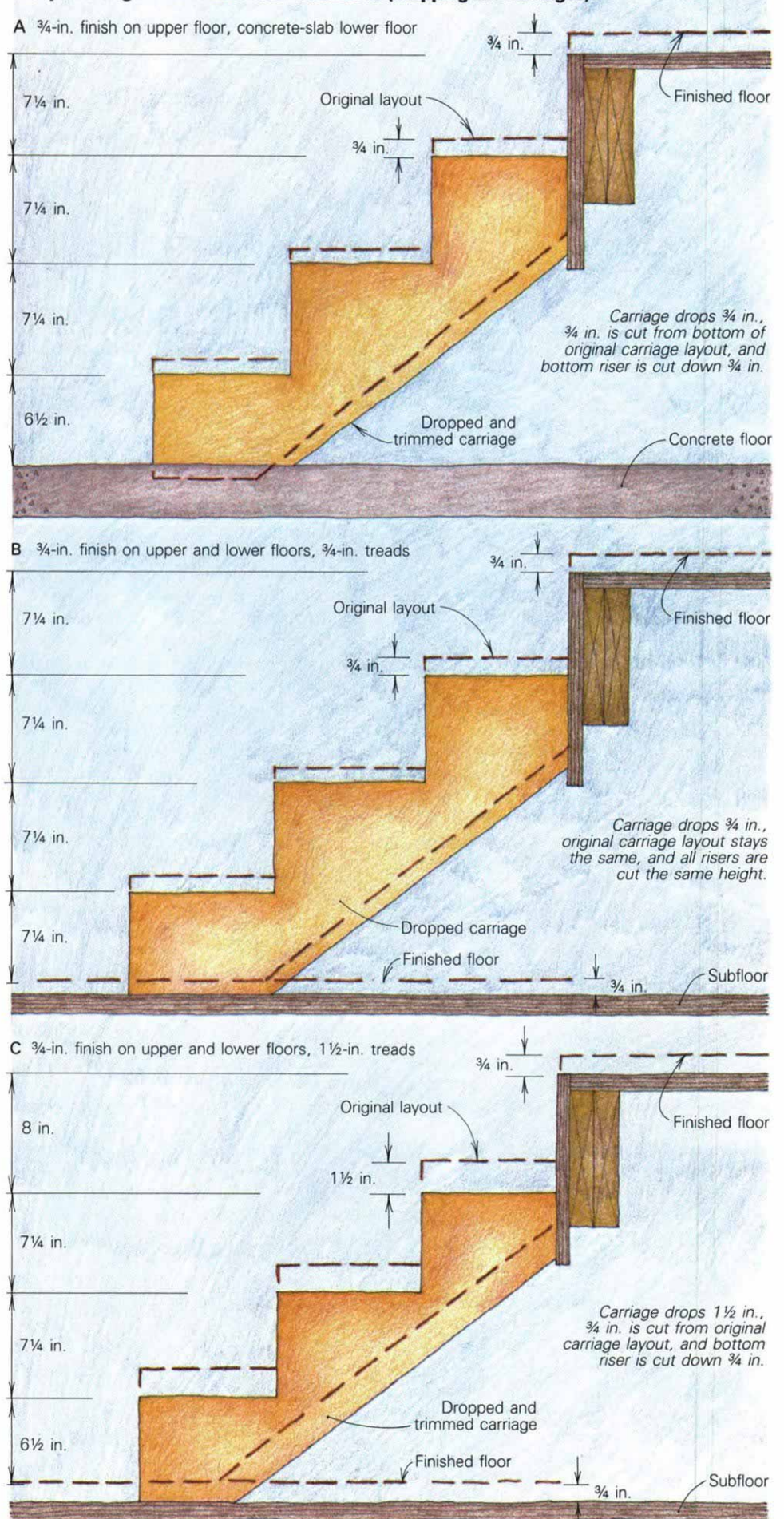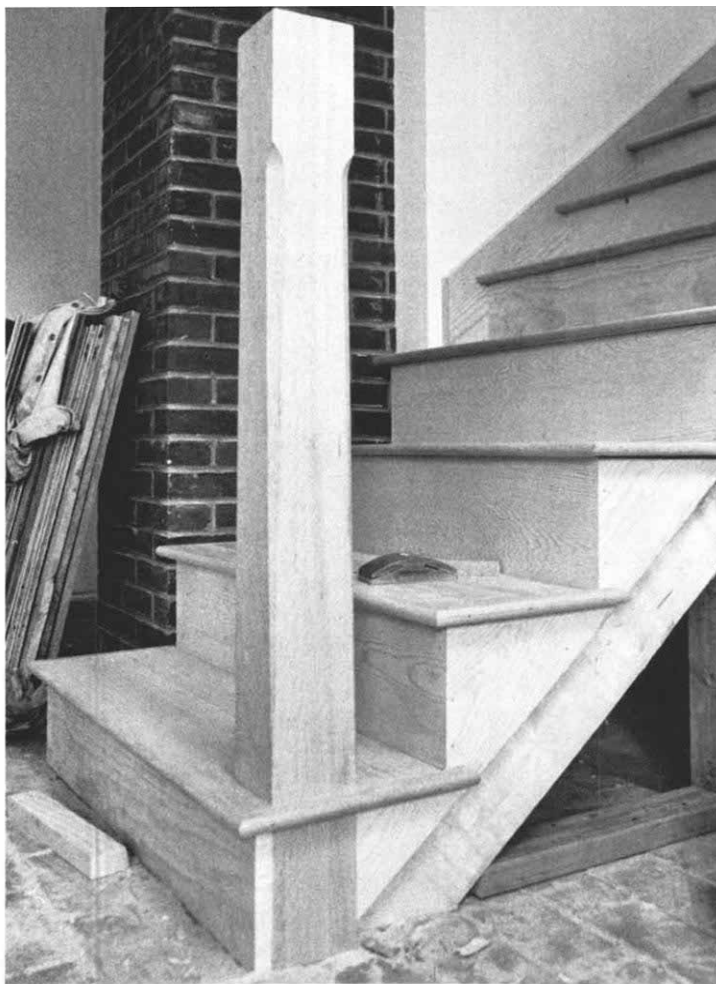
A

Hanger-board

Carriage

One tread or less

B

Carriage

2x4 ledger

Joist

C

Metal straps or hangers

Joist

Carriage

D

Plywood hanger-board

Joist

Carriage

Bottom support for carriages

A

2x4 kickboard

Carriage

2x4 blocking

Joists

B

Carriage

Doubled floor joist
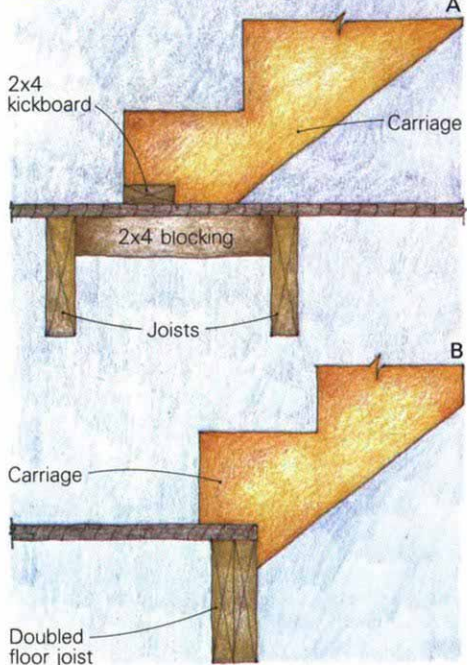
Compensating for different floor conditions (dropping the carriages)

A ¾-in. finish on upper floor, concrete-slab lower floor

¾ in.

7¼ in.

Original layout

¾ in.

Finished floor

7¼ in.

7¼ in.

Carriage drops ¾ in., ¾ in. is cut from bottom of original carriage layout, and bottom riser is cut down ¾ in.

6½ in.

Dropped and trimmed carriage

Concrete floor

B ¾-in. finish on upper and lower floors, ¾-in. treads

¾ in.

7¼ in.

Original layout

¾ in.

Finished floor

7¼ in.

7¼ in.

Carriage drops ¾ in., original carriage layout stays the same, and all risers are cut the same height.

7¼ in.

Dropped carriage

Finished floor

¾ in.

Subfloor

C ¾-in. finish on upper and lower floors, 1½-in. treads

¾ in.

8 in.

Original layout

1½ in.

Finished floor

7¼ in.

Carriage drops 1½ in., ¾ in. is cut from original carriage layout, and bottom riser is cut down ¾ in.

6½ in.

Dropped and trimmed carriage

Finished floor

¾ in.

Subfloor

Nearly complete, the finish stair at left is missing only its balusters, handrail, and molding under the nosing. The newel post is mortised into the first tread for stability. This stair uses both an open stringer and treads and risers that butt-join the skirtboards or stringboards that are nailed to the wall. Above, kraft paper protects the completed oak treads from construction traffic. The open stringer is mitered to the riser, and the treads overhang the stringer by the depth of the return nosing with its scotia molding beneath. The cut-out carriage that actually supports the treads is hidden behind the finish stringer and drywall blocking.

no change will have to be made for the risers to be equal.

A more confusing condition is when the treads are thicker than the finished floor (C). At this point, I usually draw a four-riser layout, at any scale, on graph paper to figure how much of a drop I need to make, and if the bottom riser needs to be narrower.

How the cut-out carriages are attached once they are raised in the stairwell also may require adjustment at the top and bottom of the carriages (drawings, opposite page, bottom left. At the bottom, I like to use a 2x4 kickboard nailed to the floor at the front edge of the riser (A). If there is a stair opening below, the carriages can be cut to fit around the upper corner of the framing (B). Stairs take a beating, and should be well secured.

At the top, the header joist usually acts as the uppermost riser, but sometimes, the floor will extend a full or partial tread width from the framing (drawing A, opposite page, top left). A 1x4 or 2x4 ledger board can be nailed to the framing (B), and if so, the carriages must be notched to fit it. Metal angles or straps can be used if the carriages aren't exposed (C). I like a hanger board because it is quick, neat and strong. I nail the carriages to a line on a piece of plywood, a riser's distance from the top. I then raise the whole business as a unit and nail it in place (D).

Give the carriage a trial fit before sawing it out. I make only the horizontal cut that rests on the floor and the vertical cut that leans against the framing at the top before trying

the carriage in the stairwell. If you are really unsure, use a 1x10 trial board. With the carriage in place, you can easily check your layout. The treads should be level from front to back, and the carriage should fit on both sides of the opening. Also make sure that the risers will all be the same height once the treads and finish floor are installed.

If everything checks out, what's left is just cutting and fitting. With this basic layout you can produce the cut-out carriages that are needed for the stairway shown above, you can dado the carriages for let-in treads, or you can just nail cleats to the layout lines. For cut-out carriages, use a circular saw as far as you can, and finish them off with a handsaw held vertically so as not to overcut the line and weaken the cut. You can nail the triangular cutouts to a 2x6 for a third stringer if the budget is tight. Use the completed carriage as a pattern to trace onto the other 2x12, and then cut the pencil line to get an exact duplicate.

Treads and risers—On a closed stairway, the cut-out carriages sit inside the finish wall stringers, which are called skirtboards, or strings. These are usually 1x10, and should be nailed hard against the wall so that the snug fit of previously installed risers and treads isn't spoiled by the skirtboards spreading when newly scribed boards are tapped into place. They should be installed parallel to the nosing line, and as high as possible without exposing any wall where the riser and tread meet. Don't nail the cut-out carriages to the

skirtboards on a closed stairway, or the mitered stringer to the outside carriage on an open stair. Instead, hold the carriages about 3 in. away from the walls, so that they are bearing only at their tops and bottoms. This keeps the treads and risers from splitting as a result of nailing too close to their ends. Skirtboards and risers can be made of pine to ease the budget, but the best treads are oak. The standard thicknesses for treads are 1⅛ in. and 1³⁄₁₆ in.

1 like to rip all of my treads and risers to width before beginning the assembly. Keep the risers a hair narrower than what's called for. Crosscut both risers and treads to 1 in. longer than the inside dimension between the skirt boards. This allows them to fit at a low enough angle to get a good scribe and still have a little extra to cut off. If the stair is open on one side, the treads will have to be roughcut long enough to leave a ½-in. scribing allowance on the closed side, and some overhang on the open side, which gets a return nosing. The risers will need at least a 45° miter to mate with the open stringer. Use a radial arm saw or handsaw for this.

Stair assembly usually begins at the bottom. The first two risers are fit and nailed, and then the first tread is pushed tightly against the bottom edge of the riser for scribing. For the stair pictured above, I first had to cut the open, or mitered, stringer. It was pine, and was laid out like the carriages with the exception of the vertical cuts, which extend beyond by the thickness of the riser material to form
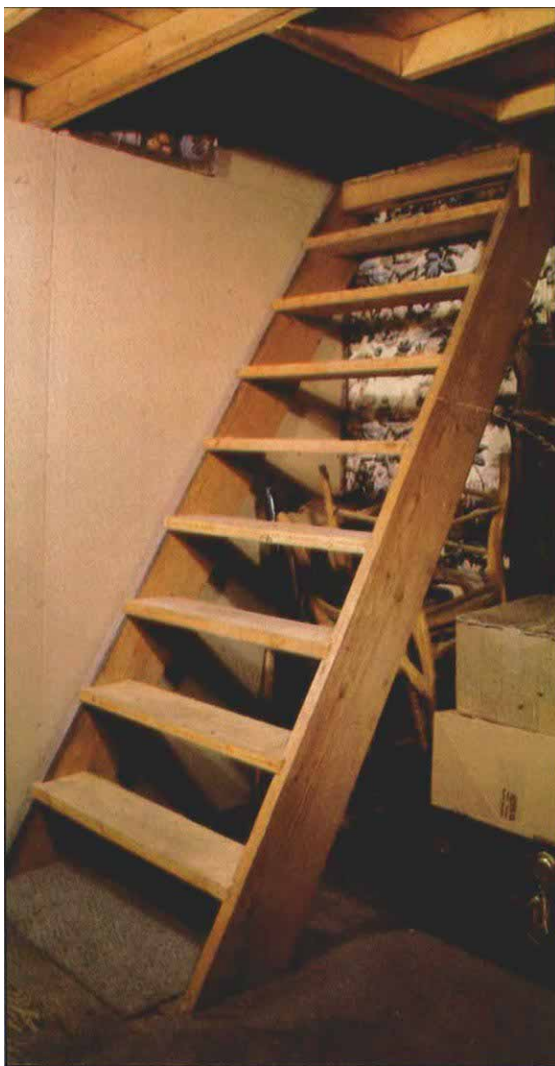
Stepladder stairway

A cleated or dadoed stairway at an angle of from 50° to 75° is considered a stepladder stairway, or ships's stairway. The rise on these ladders can be from 9 in. to 12 in. As the angle of the carriages increases, the rise increases. A 50° angle should have about a 9-in. rise. A 75° angle should have about a 12-in. rise.

As with all other stairs, the relationship between the height of the riser and the width of the tread is important. But in this case, their relationship is reversed. The tread width on stepladder stairs will always be less than the riser height.

If you know what riser height you'll be using, the easy formula for calculating the tread width is this: tread width = 20 - 4/3 riser height. If you use a 12-in. rise, then the tread will be 4 in. You can also rearrange this formula to solve for riser height (riser height = 15 - 3/4 tread width) if you know what tread width you want. This is useful if you are limited in how far out into a room the base of the stair can come.

A simple way to lay out a stepladder stairway is to lean a 2x6 or 2x8 carriage at about 75° in the stair opening. Lay a 2x4 on edge on the floor, and scribe a pencil line across its top edge to transfer a level line from the floor onto the carriage. Mark the vertical cut, at the top, in a similar manner.

Make these cuts and set the carriage back in place. Measure the floor-to-floor height and divide by 12 in. to get the number of risers. You'll end up with a whole number and a fraction. For instance, if your total rise is 106 in., the number of risers will be 8.83. That's close enough to call it 9 risers. Divide this back into the total rise of 106 in. to get an accurate riser dimension of 11.77 in., or about 11¾ in.

The easiest way to lay out the carriages is to make a story pole using dividers set at about 11¾ in. to step off nine equal segments within the 106 in. It might take a few tries adjusting the dividers to get it to come out just right. You can even find the riser dimension without the math by making a few divider runs up and down the story pole.

With the carriage in place, mark each tread from the story pole. A level line at each mark locates the treads. A bevel square set at the correct angle will also work. The treads can be cleated or let in with a dado.   —*B.S.*

an outside miter. I'm most comfortable making these cuts with a handsaw. Keeping this angle slightly steeper than 45° allows the faces to meet in an unbroken line, without any interference at the back of the joint. The miters were predrilled, glued and nailed with 8d finish nails (photo previous page, right).

The treads are initially cut to overhang the open stringer, by the same dimension as the nosing. Then a cross-grain section is cut out so that a mitered corner is left at the outer edge. This accommodates a return nosing. I also like to put a piece of nosing at the rear of the tread where it overhangs, although you can just round off the back end of the return nosing. If the mitered stringer doesn't snug up perfectly under each tread, don't worry. The crack will be covered by the cove or scotia molding that runs under the nosing. It's more important to get good bearing for the tread on the cut-out carriage, and a little shimming or block-planing will help here.

Once beyond the open side of the stair, you will be fitting treads and risers on a closed stairway, scribing to the skirtboard on each side. With a 1-in. allowance for scribing, set the scribers at ½ in. for the first side. Set the tread or riser with the side you are going to scribe down in place on the carriage and against the skirtboard. The other end will ride high on the other skirt. If you are working on a tread, make sure it is snug to the riser along its entire length. Risers should sit firmly on the carriages to get an accurate scribe. I use a handsaw to back-bevel the cut on risers, but I keep the cut square at the front of the treads where the nosing protrudes, and then angle it the rest of the way. If necessary, use a block plane to make sure the cut fits.

Next, get the inside dimension at the back of the tread or lower edge of the riser, depending on which you are fitting. A wood ruler with a brass slide works well here. Transfer this dimension to the board you're working on, set the scriber to the remaining stock, and mark the board. Cut the boards the same way you did the first time. Cut carefully, remembering that you can always plane it off, but you can't stretch it. However, don't make the cut too strong either. Trust your measure.

Careful cutting and fitting are important with this kind of stair, and a little glue, and some nails and wedges in the right place work wonders as time goes on. Risers and treads are nailed to the carriages with 8d finish nails through predrilled holes. A sharpened de-headed 8d finish nail chucked tightly into an electric drill makes a snug hole every time.

Stairs that aren't made from rabbeted stock (like housed-stringer stairs) can be kept together if you drive three or four 6d common nails through the bottom of the riser into the back of the tread. This should be done as you fit your way up the stair. Two 1x1 blocks, 2 in. long, glued behind each step at the intersection of the upper edge of the riser and the front of the tread will cut down a lot on movement too. Any gaps between the carriage and treads should be shimmed from behind with wood wedges to eliminate squeaks. □

Locating and marking treads on a stepladder stair

Finished floor

Carriage

Bevel square adjusted for a level line

Top of tread

Story pole

Finished floor