18 Stair Construction

Learning Objectives

After studying this chapter, you will be able to:

- Identify the various types of stairs.
- Define basic stair parts and terms.
- Calculate the rise-run ratio, number and size of risers, and stairwell length.
- Prepare sketches of the types of stringers.
- Lay out stringers for a given stair rise and run.
- List prefabricated stair parts that are commonly available.

Technical Vocabulary

Balusters
Balustrade
Built-up stringer
Carriages
Cut-out stringers
Handrail
Headroom
Housed stringers
Newel
Nosing
Platform
Riser
Run of stairs
Stairwell
Straight run
Total rise
Total run
Tread
Unit rise
Unit run
Wall rail
Winders
Winding stairs

A *stair* is a series of steps, each elevated a measured distance, leading from one level of a structure to another. When the series is a continuous section without breaks formed by landings or other constructions, the terms *flight of stairs* or ***run of stairs*** are often used. Other terms that can be properly used include *stairway* and *staircase.*

For a period of time, the popularity of the one-story structure in residential construction minimized the frequency of stair construction. Framing carpenters could usually handle the relatively simple task of constructing the service stairs leading from the first floor to the basement level. However, revival of traditional two-story styles along with split-level and multilevel designs has again made fine stair construction an important skill.

Because of European influence, main stairs have often been the chief architectural feature in an entrance hallway or other area, **Figure 18-1.** However, in new construction, public rooms are usually on the first floor. Due to this, there is a trend to move the stairs to a less conspicuous location.

Stair construction requires a high degree of skill. The quality of the work should compare with that found in fine cabinetwork. The parts for main stairways are usually made in millwork

Run of stairs: A series of steps that is a continuous section without breaks formed by landings or other constructions. Also called a *flight of stairs.*

Figure 18-1. An attractive main stairs is a desirable architectural feature in a residence. Stair design and construction has long been considered one of the highest forms of joinery.

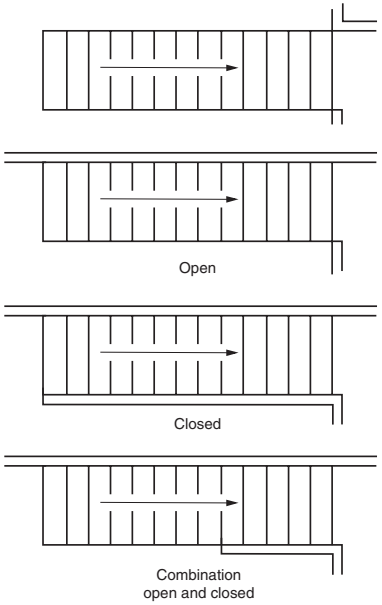

Figure 18-2. Open and closed stairways. A stair is called open even if one side is enclosed by a wall.

plants and then assembled on the job. Even so, the assembly work must be performed by a skillful carpenter who understands the basic principles of stair design and knows layout and construction procedures.

Main stairways are usually not built or installed until after interior wall surfaces are complete and finish flooring or underlayment has been laid. Basement stairs should not be installed until the concrete floor has been placed.

Carpenters build temporary stairs from framing lumber to provide access until the permanent stairs are installed. These are often designed as a detachable unit so they can be moved from one project to another. Sometimes, permanent carriages are installed during the rough framing and temporary treads are attached. ***Carriages,*** or stringers, are the inclined supports that carry the treads and risers. In this case, after the interior is finished, the temporary treads are replaced with finished parts.

18.1 Types of Stairs

Basically, there are two stair categories: service stairs and main stairs. Either of these may be closed, open, or a combination of open and closed. See **Figure 18-2.** In addition, the type of stairs may be straight run, platform, or winding.

Carriage: A sloping member that supports the risers and treads of stairs. Also called a *stringer.*

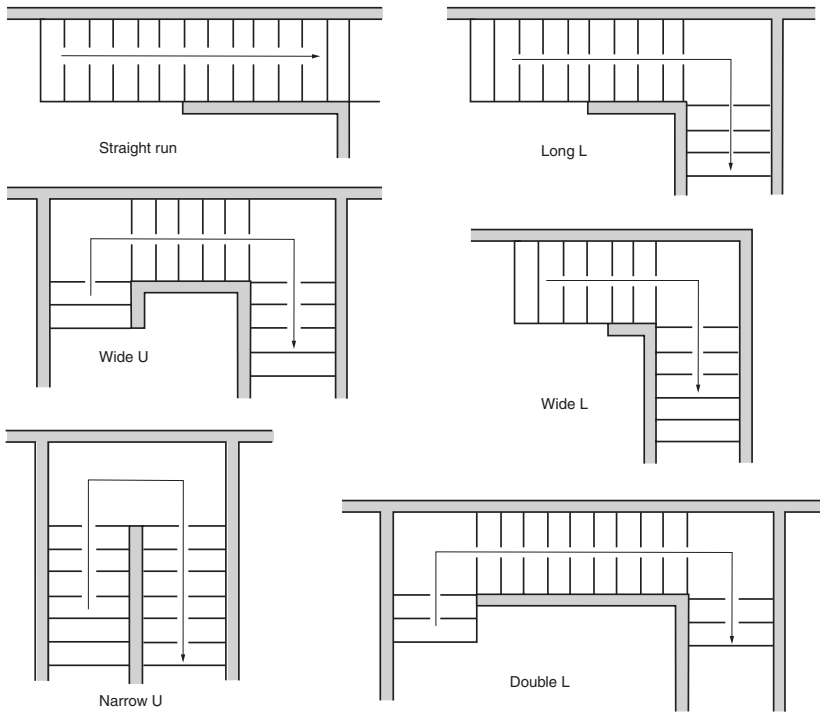

Figure 18-3. Terms used to define various stair types.

The ***platform*** type includes landings where the direction of the stair run is usually changed. Such descriptive terms as L-type (long L and wide L), double L-type, and U-type (wide U and narrow U) are commonly used. See **Figure 18-3.**

Platform: A horizontal section between two flights of stairs. Also called a *landing.*

Straight run: A stairway that does not change direction.

Stairwell: The rough opening in the floor above to provide headroom for stairs.

In split-level houses, platform stairs with short and generally straight runs are used. Usually, stair runs of this type are located so that the stair run directly above automatically provides headroom, **Figure 18-4.**

The ***straight run*** stairway is continuous from one floor level to another without landings or turns. It is the easiest to build. Standard multistory designs require a long ***stairwell*** in the floor above to provide headroom. This often presents a problem in smaller structures. A long run of 12 to 16 steps also has the disadvantage of being tiring. It offers no chance for a rest during ascent.

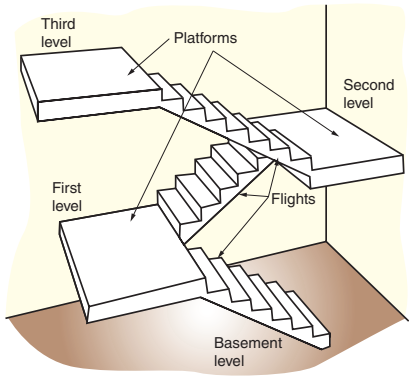

Figure 18-4. Stair runs are often made one above the other to gain headroom. This one is designed for a split-level home.

Winding stairs, also called *geometrical,* are circular or elliptical. They gradually change directions as they ascend from one level to another. These often require curved wall surfaces that are difficult to build. Because of their expense, winding stairs are usually only found in high-end homes.

18.2 Stair Parts

Stairs are basically sets of ***risers*** and ***treads*** supported by stringers, **Figure 18-5.** The relationship between the riser height (***unit rise***) and the tread width (***unit run***) determines how easily the stairs may be negotiated. Research has indicated that the ideal riser height is 7″, while the ideal tread width is 11″.

Headroom is measured from a line along the front edges of the treads to the enclosed surface or header above. This distance is usually specified in local building codes. Refer to **Figure 18-5.** The Federal Housing Administration (FHA) requires a minimum headroom of 6′-8″ for main stairs and 6′-4″ for basement or service stairs. Local codes may have other requirements.

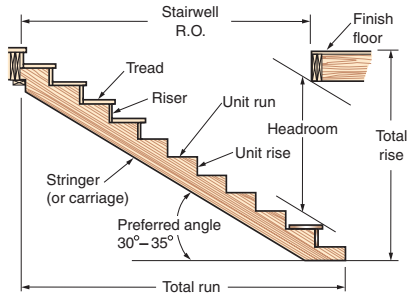

Figure 18-5. Basic stair parts and terms. The total number of risers is always one greater than the total number of treads.

18.3 Stairwell Framing

Methods of stair building differ from one locality to another. One carpenter may cut and install a carriage (stringer) during the wall and floor framing. Another may put off all stairwork until the interior finishing stages. **Figure 18-6** shows several stages of stair building.

Regardless of procedures followed, the rough openings for the stairwell must be carefully laid out and constructed. If the architectural drawings do not include dimensions and details of the stair installation, then the carpenter must calculate the sizes. Follow recognized standards and local code requirements.

Winding stairs: A curving stairway that gradually changes direction; usually circular or elliptical in shape. Also called *geometrical.*

Riser: The vertical stair member between two consecutive stair treads.

Tread: Horizontal walking surface of a stair.

Unit rise: The height of the stair riser; the vertical distance between two treads.

Unit run: The width of a stair tread minus the nosing.

Headroom: The clear space between the floor line and ceiling.

Figure 18-6. This series of photos shows various stages in building stairs. A—This carpenter is making a plumb cut on a housed (closed) stringer. Grooves are cut in the stringer to receive the treads and risers. B—This stringer is a cut-out type. The 2 × 4 spacer (arrow) gives clearance for installation of the wall finish. C—Newel post is being installed. The carpenter is checking for plumb. D—The handrail has been installed and the carpenter is cutting and placing the prefinished balusters. E—This carpenter is fastening the lower rail of a banister to the floor. Since the banister is made of oak, it is necessary to drill pilot holes for the nails. Glue is also applied to each joint. F—These stairs are completed except for the installation of carpeting.

Trimmers and headers in the rough framing should be doubled, especially when the span is greater than 4′. Headers more than 6′ long should be installed with framing anchors, unless supported by a beam, post, or partition. Tail joists over 12′ long should also be supported by framing anchors or a ledger strip. Refer to Chapter 8 for additional information on framing rough openings.

Providing adequate headroom is often a problem, especially in smaller structures. Installing an auxiliary header close to the main

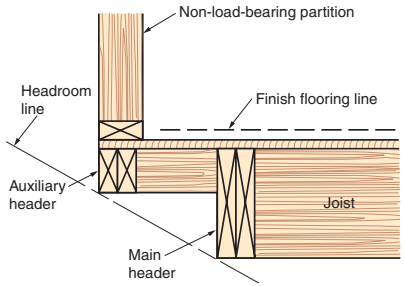

Figure 18-7. Extending the upper floor area with a shallow auxiliary header to provide headroom. The partition over the auxiliary header must not be load bearing.

header permits a slight extension in the floor area above a stairway, **Figure 18-7.** When a closet is located directly above the stairway, the closet floor is sometimes raised for additional headroom.

18.4 Stair Design

Most important in stair design is the mathematical relationship between the riser and tread. There are three generally accepted rules for calculating the rise-run or riser-tread ratio. It is wise to observe them:

- The sum of two risers and one tread should equal 24″–25″.
- The sum of one riser and one tread should equal 17″–18″.
- The height of the riser times the width of the tread should equal 70″–75″.

According to the first rule, a riser 7 1/2″ high requires a tread of 10″. A 6 1/2″ riser requires a 12″ tread.

The current edition of the International Residential Code, developed by the International Code Council, includes a change in the allowable tread width and height of risers. The previous standard for residences was an 8 1/4″ rise and a 9″ tread. Under the new code, a 7 3/4″ rise and a 10″ tread (assuming a nosing of at least 3/4″) are required. The International Residential Code, which is updated every three years, has no legal force until it is adopted by state or local governments.

In residential structures, treads (excluding nosing) are seldom less than 9″ or more than 12″. Nosing is a small extension of the tread. In a given run of stairs, it is extremely important that all of the treads be the same size. The same is true of the risers. A person tends to subconsciously measure the first few steps and will probably trip if subsequent risers are not the same.

When the rise-run combination is wrong, climbing the stairs will be tiring and cause extra strain on leg muscles. Further, the toe may kick the riser if the tread is too narrow. A unit rise of 7″–7 5/8″ with an appropriate tread width provides both comfort and safety. Main or principal stairs are usually planned to have a rise in this range. Service stairs are often steeper, but risers should be no higher than 8″. As stair rise is increased, the run must be decreased. See **Figure 18-8.**

A main stair should be wide enough to allow two people to pass without contact. Further, it should provide space so furniture can be moved up or down, **Figure 18-9.** A minimum width of 3′ is generally recommended, **Figure 18-10.** FHA permits a minimum width of 2′-8″, measured clear of the handrail. On service stairs, the requirement is reduced to 2′-6″. Furniture moving is an important consideration and extra clearance should be provided in closed stairs of the L- and U-type, especially those that include wedge-shaped treads, or ***winders.***

Stairs should have a continuous rail along the side for safety and convenience. A ***handrail*** (also called a *stair rail*) is used on open stairways that are constructed with a low partition or banister. In closed stairs, the support rail is called a ***wall rail.*** It is attached to the wall with special metal brackets. Except for very wide stairs, a rail on

Winders: Wedge-shaped treads installed where stairs turn.

Handrail: A pole installed above and parallel to stair steps to act as a support for persons using the stairs. Also called a *stair rail.*

Wall rail: In closed stairs, the support rail that is attached to the wall.

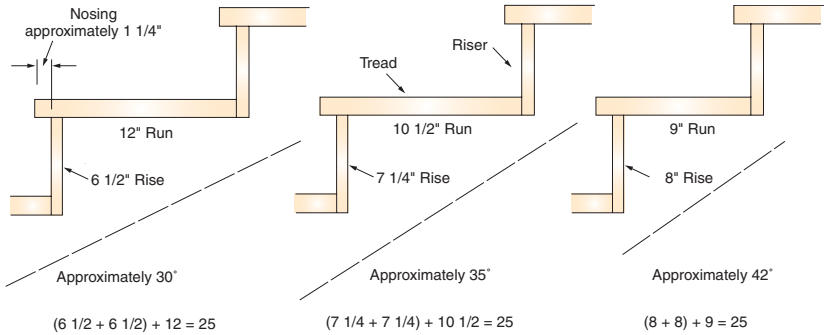

Figure 18-8. Be careful about rise-run relationships in stair design.

Figure 18-9. This L-shaped stairs is wide enough for moving furniture up and down. (C-E Morgan)

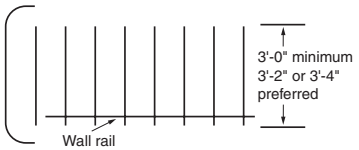

Figure 18-10. A main stair should be at least 3′ wide for easy movement of people and furniture.

only one side is sufficient. **Figure 18-11** illustrates the correct height for a rail.

A complete set of architectural plans should include detail drawings of main stairs, especially when the design includes any unusual features. For example, the stair layout in **Figure 18-12** shows a split-level entrance with open-riser stairs leading to upper and lower floors. An exact description of tread mountings, overlap, nosing requirements, and height of the handrail is not included. These items of construction are the responsibility of

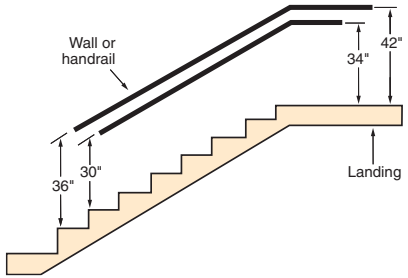

Figure 18-11. A handrail height of 30″ at the rake (slope) and 34″ at the landings has been an accepted standard. Recently, building codes in some places have been adopting heights of 36″ at the rake and 42″ at landings. (C-E Morgan)

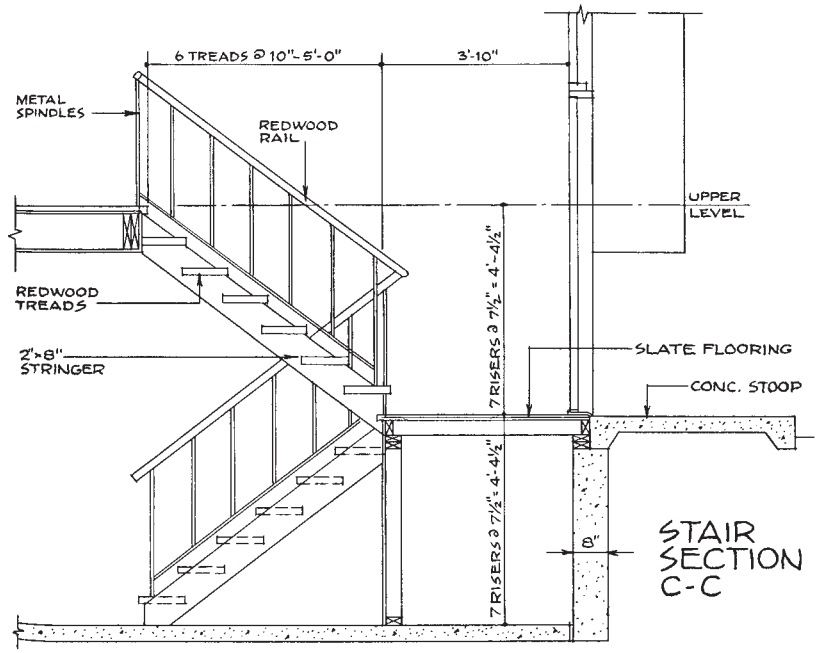

Figure 18-12. Architectural drawings show stair layouts. Note the information given for riser-tread ratios.

the carpenter, who must have a thorough understanding of basic stair design and how to lay out and make the installation.

All stairs, whether main or service, are shown on the floor plans. When details of the stair design are not included in the complete set of plans, the architect usually specifies on the plan view the number and width of the treads for each stair run. Sometimes, the number of risers and the riser height are also included.

Working Knowledge

In a given run of stairs, be sure to make all of the risers the same height and all of the treads the same width. An unequal riser, especially one that is too high, may cause a fall.

18.5 Stair Calculations

To calculate the number and size of risers and treads (less nosing) for a given stair run, first divide the ***total rise*** by 7 to determine the number of risers. Some carpenters divide by 8. Either number is accurate enough. For example, if the total rise for a basement stairway is 7′-10″ (94″), dividing by 7 yields 13.43. Since there must be a whole number of risers, round 13.43 to 13. Divide the total rise by that number to determine the unit rise:

Total rise: Vertical distance from one floor to another.

94″ ÷ 13 = 7.23 or 7 1/4″
Number of risers = 13
Riser height = 7 1/4″

In any stair run, the number of treads is one less than the number of risers. A 10 1/2″ tread is correct for this example. The ***total run*** is calculated as follows.

Number of treads = 12
Total run = 10 1/2″ × 12
= 126″
= 10′-6″

The stairs in this example will have 13 risers 7 1/4″ high, 12 treads 10 1/2″ wide, and a total run of 10′-6″.

Since this example is for basement stairs, the total run can be shortened by using a steeper angle. To do so, decrease the number of risers and shorten the treads. The calculations are:

94″ ÷ 12 = 7.83 or 7 5/6″
Number of risers = 12
Height of risers = 7 5/6″
Number of treads = 11
Tread width selected = 9″
Total run = 9″ × 11″
= 99″
= 8′-3″

Some manufacturers supply tables for determining rise and run, riser, and tread ratios. See **Figure 18-13.**

18.6 Stairwell Length

The length of the stairwell opening must be known during the rough framing operations. If not included in the architectural drawings, it can be calculated from the size of the risers and treads.

It is also necessary to know the headroom required. Add to this the thickness of the floor structure and divide this total vertical distance by the riser height. This gives the number of risers in the opening.

When counting down from the top to the tread from which the headroom is measured, there is the same number of treads as risers. Therefore, to find the total length of the rough opening, multiply the tread width by the number of risers previously determined. Some carpenters prefer to make a scaled drawing (elevation) of the stairs and floor section to check the calculations.

Well Openings Based on Minimum Head Height of 6'-8"
Dimensions Based on 2 x 10 Floor Joist

Total rise floor to floor H	Number of risers	Height of riser R	Number of treads	Width of run T	Total run L	Well opening U	Length of carriage	Use stock tread width	Dimension of nosing projection
8'-0"	12 14	8" 6 7/8"	11 13	9 1/2" 10 5/8"	8'-8 1/2" 11'-6 1/8"	9'-1" 10'-10"	11'-4 5/8" 13'-8 1/2"	10 1/2" 11 1/2"	1" 7/8"
8'-4"	13 14	7 11/16" 7 1/8"	12 13	9 13/16" 10 3/8"	9'-9 3/4" 11'-2 7/8"	10'-0" 11'-1"	12'-5 1/2" 13'-7 5/8"	10 1/2" 11 1/2"	11/16" 1 1/8"
8'-6"	13 14	7 7/8" 7 5/16"	12 13	9 5/8" 10 3/16"	9'-7 1/2" 11'-0 1/2"	9'-2" 10'-8"	12'-5 1/4" 13'-7"	10 1/2" 11 1/2"	7/8" 1 5/16"
8'-9"	14 14	7 1/2" 7 1/2"	13 13	9 1/4" 10"	10'-0 1/4" 10'-10"	9'-5" 10'-1"	12'-10 3/4" 13'-6 1/2"	10 1/2" 11 1/2"	1 1/4" 1 1/2"
8'-11"	14 14 14	7 5/8" 7 5/8" 7 5/8"	13 13 13	9 3/8" 9 1/16" 10 1/4"	10'-1 7/8" 9'-9 7/8" 11'-1 1/4"	9'-5" 9'-0" 10'-2"	13'-1 1/4" 12'-10" 13'-10 1/4"	10 1/2" 10 1/2" 11 1/2"	1 1/8" 1 7/16" 1 1/4"
9'-1"	14 15	7 13/16" 7 1/4"	13 14	9 11/16" 10 1/4"	10'-6" 11'-11 1/2"	9'-5" 10'-8"	13'-5 3/4" 14'-7 3/4"	10 1/2" 11 1/2"	13/16" 1 1/4"

Figure 18-13. A table can be used to determine the number of risers and treads and their dimensions. (C-E Morgan)

18.7 Stringer Layout

To lay out the stair stringer, first determine the riser height. Place a story pole in a plumb position from the finished floor below through the rough stair opening above. On the pole, mark the height of the top of the finished floor above.

Set a pair of dividers to the calculated riser height and step off the distances on the story pole. There will likely be a slight error in the first layout, so adjust the setting and try again. Continue adjusting the dividers and stepping off the distance on the story pole until the last space is equal to all of the others. Measure the setting of the dividers. This length is the exact riser height to use in laying out the stringers.

To create a cut-out stringer for a simple basement stair, select a straight piece of 2 × 10 or 2 × 12 stock of sufficient length. Place it on sawhorses to make the layout. Begin at the end that will be the top and hold the framing square in the position shown in **Figure 18-14.** Let the blade represent the treads and the tongue represent the risers. For example, if the risers are 7 3/4″, align that mark on the tongue with the edge of the stringer. If the treads are 10″, align that mark on the blade with the edge of the stringer.

Draw a line along the outside edge of the blade and tongue. Now move the square to the next position and repeat. The procedure is similar to that described for rafter layout in Chapter 10. Continue stepping off with the square until the required number of risers and treads have been drawn, **Figure 18-15.**

The stair begins with a riser at the bottom, so extend the last tread line to the back edge of the stringer. At the top, extend the last tread and riser line to the back edge.

One other adjustment must be made before the stringer is cut. Earlier calculations that gave the height of the riser did not take into account the thickness of the tread. Therefore the total rise of the stringer must be shortened by one tread thickness. Otherwise the top tread will be too high. The bottom of the stringer must be trimmed, as shown in **Figure 18-16.**

Working Knowledge

Extreme accuracy is required in laying out the stringer. Be sure to use a sharp pencil or knife and make the lines meet on the edge of the stock. Accuracy can be assured in this layout by using framing square clips or by clamping a strip of wood to the blade and tongue.

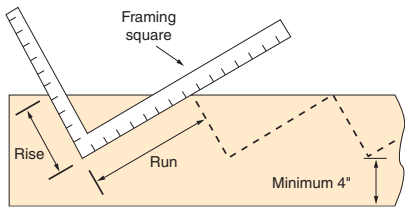

Figure 18-14. Using a framing square to lay out a stringer.

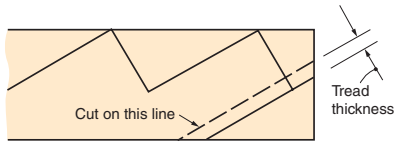

Figure 18-16. Trim the bottom end of the stringer to adjust the riser height for the tread thickness.

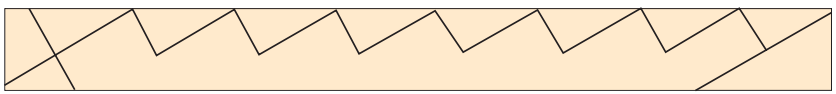

Figure 18-15. A completed stringer layout will look something like this.

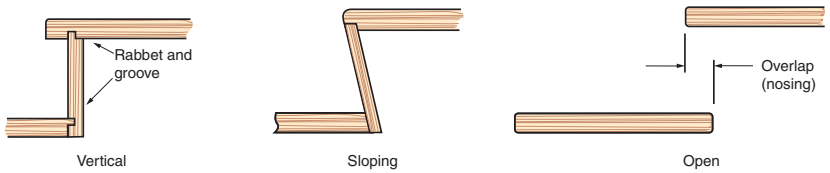

Figure 18-17. Basic stair riser shapes. For the open riser, the tread should overlap the riser at least 2″.

18.8 Treads and Risers

The thickness of a main stair tread is generally 1 1/6″ or 1 1/8″. Hardwood or softwoods may be used. FHA requires that stair treads be hardwood, vertical-grain softwoods, or flat-grain softwoods covered with a suitable finish flooring material.

Lumber for risers is usually 3/4″ thick and should match the tread material. This is especially important when the stairs are not covered. In most construction, the riser drops behind the tread, making it possible to reinforce the joint with nails or screws driven from the back side of the stairs. **Figure 18-17** shows basic types of riser designs. A sloping riser is sometimes used in concrete steps since it provides an easy way to form a nosing.

Where the top edge of the riser meets the tread, glue blocks are sometimes used. A rabbeted edge of the riser may fit into a groove in the tread. A rabbet and groove joint may also be used where the back edge of the tread meets the riser.

Stair treads must have a ***nosing.*** This is the part of the tread that overhangs the riser. Nosings serve the same purpose as toe space along the floor line of kitchen cabinets. They provide toe room. The width of the tread nosing may vary from about 1″–1 1/2″. It should seldom be greater than 1 3/4″. In general, as the tread width is increased, the nosing can be decreased. **Figure 18-18** illustrates a number of nosing forms. Cove molding may be used under the nosing to cover the joint between riser and tread and conceal nails used to attach the riser to the stringer or carriage.

Basement stairs may be constructed with an open riser (no riser board installed). Sometimes an open riser design is built into a main stair to provide a special effect. Various methods of support or suspension may be used. Often custom-made metal brackets or other devices are needed.

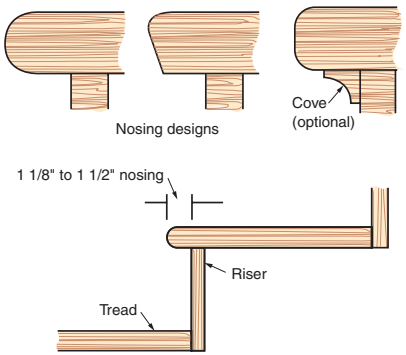

Figure 18-18. Common tread nosings.

Total run: The horizontal distance occupied by the stairs; measured from the foot of the stairs to a point directly beneath where the stairs rest on a floor or landing above.

Nosing: The part of a stair tread that projects beyond the riser.

18.9 Types of Stringers

Treads and risers are supported by stringers that are solidly fixed to the wall or framework of the building. For wide stairs, a third stringer is installed in the middle to add support.

The simplest type of stringer is the ***built-up stringer.*** It is formed by attaching cleats on which the tread can rest. Another method consists of cutting dados into which the tread will fit, **Figure 18-19.** This type is often used for basement stairs where no riser enclosure is called for.

Standard ***cut-out stringers*** are commonly constructed for either main or service stairs. This is the type created in the earlier layout description. Prefabricated treads and risers are often used with this type of stringer. An adaptation of the cut-out stringer, called *semihoused* construction, is shown in **Figure 18-20.** The cut-out stringer and backing stringer may be assembled and then installed as a unit or each part may be separately installed.

A popular type of stair construction has a stringer with tapered grooves into which the treads and risers fit. It is commonly called *housed construction.* ***Housed stringers*** can be purchased completely cut and ready to install. They can be cut on the job, using an electric router and template. Wedges with glue applied are driven into the grooves under the tread and behind the riser, **Figure 18-21.** The treads and risers are joined with rabbeted edges and grooves or glue blocks. To assemble the stairs, the housed stringer is spiked to the wall surface and into the wall frame. The treads and risers are then set into place. Work is done from the top downward.

Housed construction produces a stair that is strong and dust tight. It seldom develops

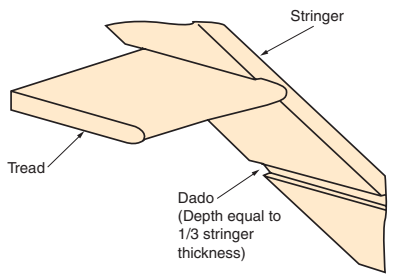

Figure 18-19. Open riser stairs. Treads are set into dados cut in the stringer.

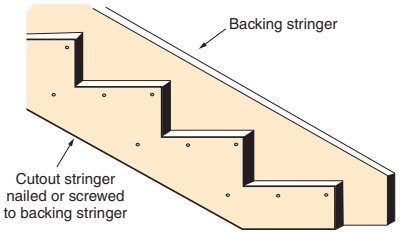

Figure 18-20. This is a semihoused stringer, an adaptation of the cut-out stringer.

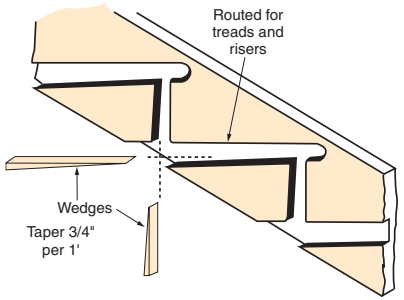

Figure 18-21. In a housed stringer, risers and treads are let into the stringer. This type of housing is difficult to make.

Built-up stringer: A stringer to which blocking has been added to form a base for adding treads and risers.

Cut-out stringer: A stair stringer into which the rise and run are cut.

Housed stringer: A stair stringer where the edges of the steps are covered with a board.

squeaks. Housed stringers show above the profiles of the treads and risers and provide a finish strip along the wall. The design should permit a smooth joint where it meets the baseboard of the upper and lower levels.

18.10 Winder Stairs

Winder stairs present stair conditions that are frequently regarded as undesirable, **Figure 18-22.** In fact, some localities do not allow them. Check local building codes to see if this type of stairs is allowed. The use of winder stairs may sometimes be necessary, however, where space is limited. When used, it is important to maintain a winder-tread width along the line of travel that is equal to the tread width in the straight run. When winders are used, it is best if they are at the bottom of a straight run.

An adaptation of the standard winder layout is illustrated in **Figure 18-23.** Here, if you extend the lines of the risers, they meet outside the stairs. This provides some tread width at the inside corner. Before starting the construction of this type of stairs, the carpenter should make a full-size or carefully scaled layout in plan view. The best radius for the line of travel can then be determined.

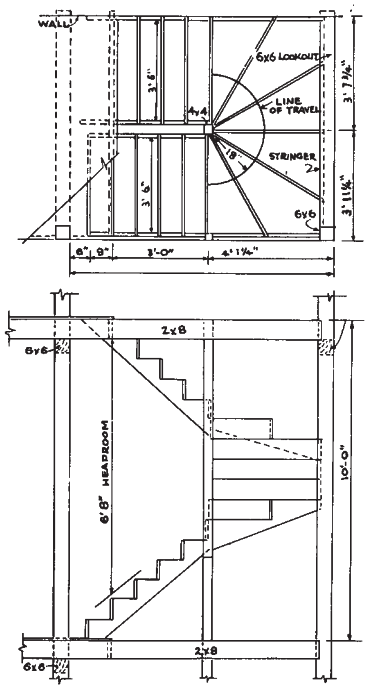

Figure 18-22. Typical drawing of a winder stairs. The tread width on the winding section should be the same at line of travel (near middle of stairs) as the tread in the straight run.

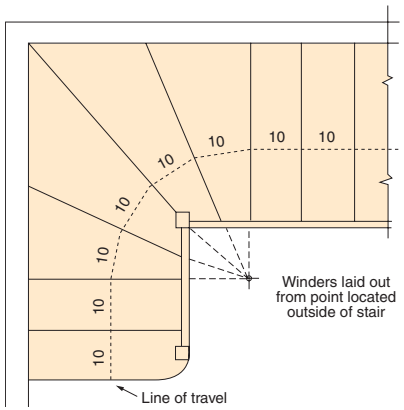

Figure 18-23. Laying out a winder stairs with lines representing the tread nosings converging outside of the construction.

PROCEDURE

Splitting angles for miter cuts

The carpenter sometimes faces odd angles that must be accurately split to make a miter cut. This can be mathematically calculated, but the following method avoids the math and assures great accuracy.

1. Select a plywood scrap about 6″ wide and 1′ long with a factory edge to use as a storyboard.
2. Draw a line near to and parallel with the factory edge.
3. Use a T-bevel to find the angle to be mitered and transfer the angle to the storyboard.
4. Draw a line along the blade of the T-bevel, as shown in **Figure 18-24A.**
5. Open a pencil compass or scribe about 3″ to 4″. Place the point of the instrument at the intersection of lines AB and AC and draw arcs of equal length across both lines, **Figure 18-24B.**
6. Swing arcs of equal distance from points B and C to create point D, **Figure 18-24C.** You may need to open up the compass or dividers somewhat more to create this point.
7. Draw a line to connect points A and D, **Figure 18-24D.** This is the miter angle.
8. Adjust the T-bevel to this angle and use it to set the miter saw.
9. Make a test cut on scraps to verify the accuracy of the angle.

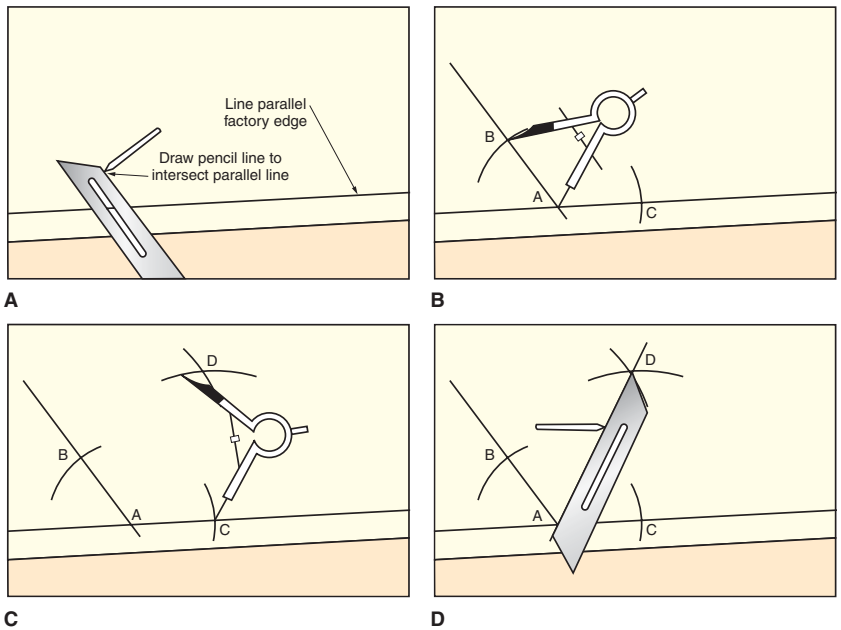

Figure 18-24. Splitting an angle for a miter cut. A—After drawing a line parallel to the factory edge, transfer the miter angle to the board. B—Draw arcs of equal lengths from the intersection of lines AB and AC. C—Swing arcs to create point D. D—Draw line AD. This is the miter angle.

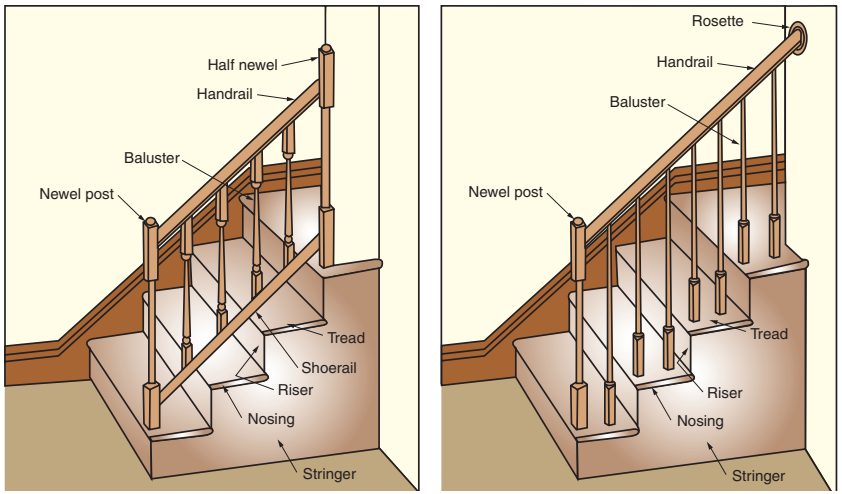

Figure 18-25. Parts of an open stair. An assembly including a newel, balusters, and rail is called a balustrade.

18.11 Open Stairs

Stairs that are open on one or both sides require some type of decorative enclosure and support for a handrail. Typical designs consist of an assembly of parts called a ***balustrade,*** **Figure 18-25.** The principal members of a balustrade are newels, balusters, and rails. They are usually made in a factory and assembled on the job by the carpenter.

The starting ***newel*** must be securely anchored either to the starter step or carried down through the floor and attached to a floor joist. ***Balusters*** are joined to the stair treads using either a round or square mortise. Two or three may be mounted on each tread.

Working Knowledge

The main purpose of balusters is to prevent anyone, children especially, from slipping under the railings and falling to the floor below. Codes usually require baluster spacing of no more than 6″, although 4″ is required in some localities.

18.12 Using Stock Stair Parts

While many parts of a main staircase could be cut and shaped on the job, the usual practice is to use factory-made parts. These are available in a wide range of stock sizes and can be selected to fill requirements for most standard stair designs. See **Figures 18-26** and **18-27.** Stair parts are ordered through lumber and millwork

Balustrade: An assembly with a railing resting on a series of balusters that, in turn, rest on a base, usually the treads.

Newel: The main post at the start of a stair and the stiffening post at the landing.

Baluster: The vertical member (spindle) supporting the handrail on open stairs.

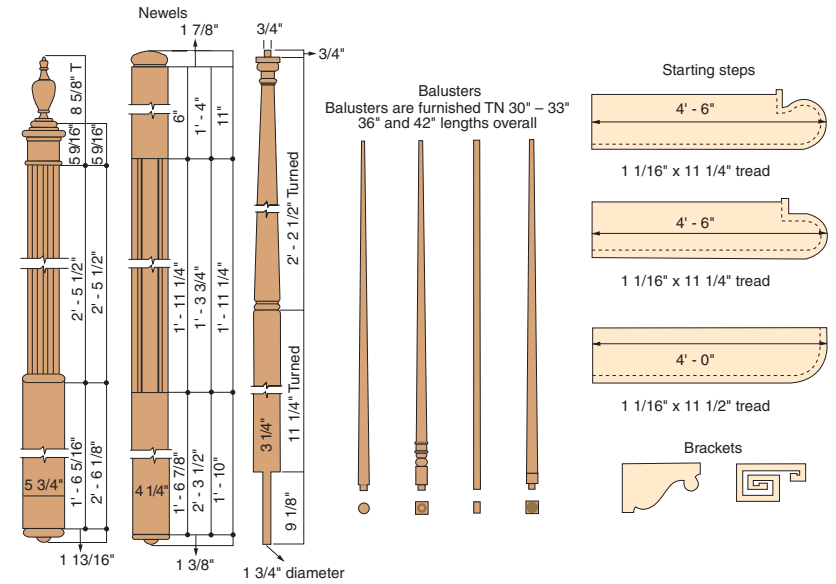

Figure 18-26. Typical stock parts commonly available for stair construction.

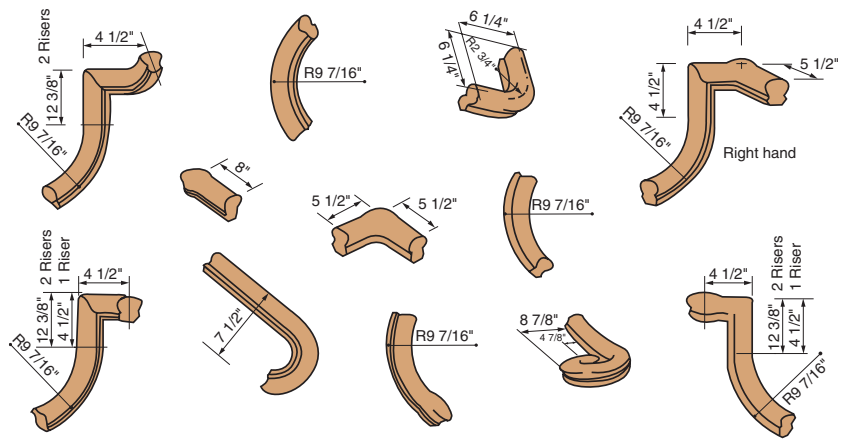

Figure 18-27. Preformed handrails and stock parts for special shapes can be purchased. (C-E Morgan)

dealers. They are shipped to the building site in heavy, protective cartons along with directions for fitting and assembly.

A completely prefabricated stairway and a factory assembly are shown in **Figure 18-28.** Stringers are made in two sections for easier shipping. The system is available in lengths up to 18 steps and widths of 36″ and 48″.

Figure 18-29 shows some suggested assemblies of balustrades using stock parts. Hardware especially designed for stair work is illustrated in **Figure 18-30.**

A B

Figure 18-28. Prefabricated stairway system. A—Parts for the system. Stringer sections lock together with a common tread. B—This installed mock-up shows the assembled section mounted on substringers. (Visador Co.)

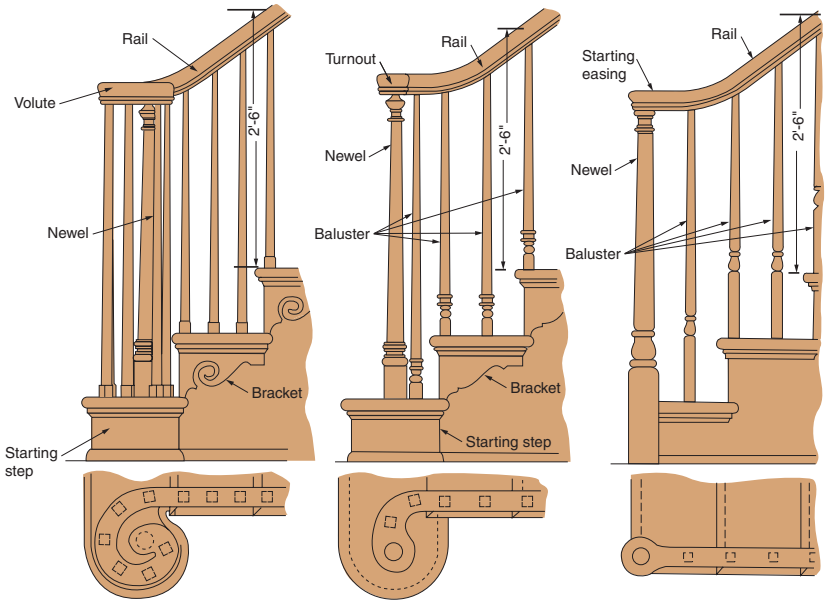

Figure 18-29. Balustrade assemblies produced from stock parts. (Colonial Stair and Woodwork Co.)

18.13 Spiral Stairways

Metal spiral stairways eliminate framing and save space. See **Figure 18-31.** Units are available in aluminum or steel in a variety of designs to fit requirements up to 30 steps and heights up to 22′-6″. Use of spiral stairs is often restricted by building codes. Some codes permit use of a spiral stairway for exits in private dwellings or

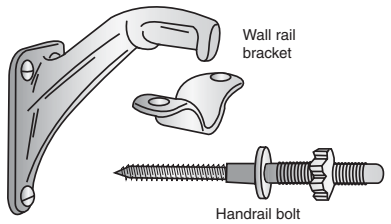

Figure 18-30. Hardware for stair rails. The handrail bolt is concealed in the center of a joint. The nut is accessible from below and can be adjusted with a screwdriver or a hammer and nail set.

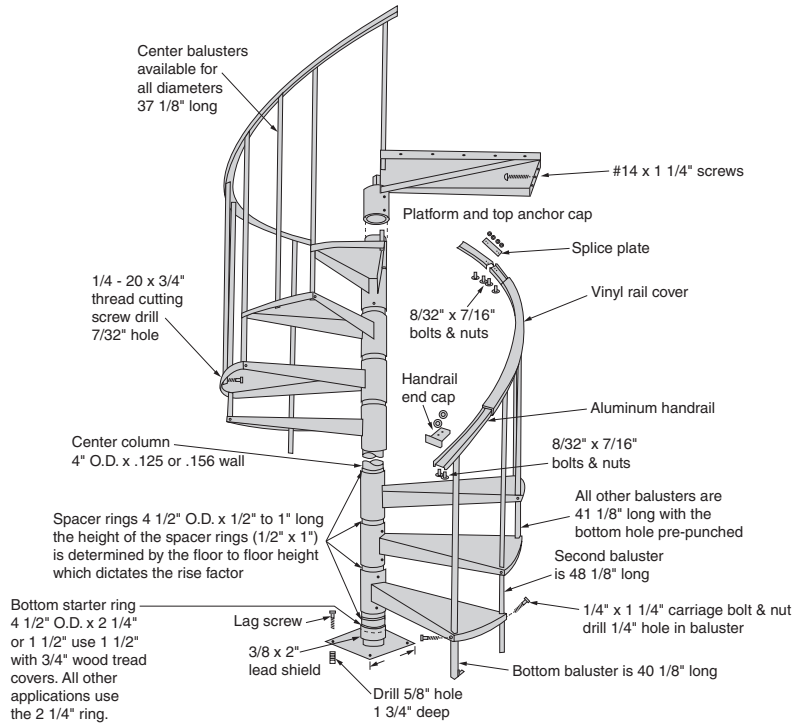

Figure 18-31. Assembly drawing of a spiral stairway.

in some other situations when the area served is not more than 400 square feet.

18.14 Disappearing Stair Units

Where attics are used primarily for storage and where space for a fixed stairway is not available, hinged or disappearing stairs are often used. Such stairways may be purchased ready to install. They operate through an opening in the ceiling and swing up into the attic space when not in use, **Figure 18-32.** Where such stairs are to be provided, the attic floor should be designed for regular floor loading and the rough opening should be constructed at the time the ceiling is framed.

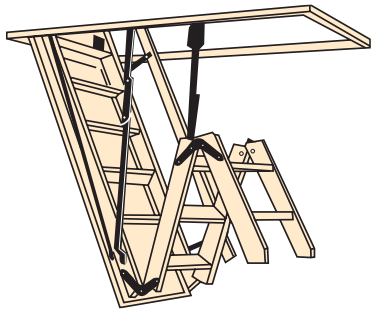

Figure 18-32. This disappearing stair unit is designed to fold into the ceiling. The ceiling opening should be framed as the ceiling joists are installed. (Rock Island Millwork)

Summary

A stairway is a series of steps, each elevated a measured distance, leading from one level of a structure to another. Main stairways are often constructed in a factory, then assembled on-site by the carpenter. Stairways are either straight run or winding (circular or elliptical). Stairway components include the stringers that support risers and treads, vertical risers between treads, and the horizontal treads (steps). In a given run of stairs, all treads must be the same size to assure safe use. Risers must also be the same size. A main stair should be wide enough for two people to pass each other without contact. The number of steps and risers is calculated using the total rise (vertical height) and total run (horizontal distance) occupied by the stairs. Stairways that are open on one side require use of a decorative enclosure that also supports a handrail. This enclosure is called a balustrade and consists of newels, horizontal rails, and balusters. Balustrades are typically factory made and shipped to the job site for installation by the carpenter. Metal spiral stairways are available. They are usually installed to save space. Disappearing stair units fold into the ceiling. They provide access to attic areas without consuming space in the room below.

Test Your Knowledge

Answer the following questions on a separate piece of paper. Do not write in this book.

1. The platform type of stairway includes _____ where the direction of the stair run is usually changed.
2. The minimum headroom for a main stairway, as specified by FHA, is _____.
3. One of the rules used to calculate riser-tread relationship states that the sum of two risers and one tread should be _____.
4. The front edge of the tread that overhangs the riser is called the _____.
5. A stairs in a split-level home has six risers with a tread width of 11". The total run of the stairs is _____.
6. A semihoused stair stringer is formed by attaching a(n) _____ stringer to a backing stringer.
7. *True or False?* Winder stairs are allowed by all building codes.
8. _____ are glued and driven into the stringer to assemble risers and treads in housed stringers.
9. The three principal members of a balustrade are the newels, rails, and _____.
10. When a disappearing stair unit is used to provide attic access, the attic floor should be designed for _____ floor loading.

Curricular Connections

Social Studies. The Dutch artist M.C. Escher created a number of drawings featuring stairways that were optical illusions—they led nowhere but back to themselves. Use the library or Internet to view several Escher stairway prints. Try to determine how he achieved the optical illusion. Also, search for ways that other artists have featured stairways in their paintings or photographs. See how many different kinds of stairways you can find depicted. If possible, determine why the artist made the stairway the focal point of the work.

Outside Assignments

1. Obtain a set of architectural plans where the main or service stairway is not drawn in detail. Carefully study the stair requirements and then prepare a detail drawing similar to **Figure 18-12.** Use a scale of 1/2" equals 1'. Carefully select and calculate the riser-tread ratio. Be sure the number and size of risers is correct for the distance between the two levels. Check the headroom requirements against your local building codes and determine the stairwell sizes. Submit the completed drawing and size specifications to your instructor.

2. Study a millwork catalog and become familiar with the stock parts shown for a main stairway. Working from a set of architectural plans or a stair detail that you may have drawn, prepare a list of all of the stair parts needed to construct the stairway. Include the number of each part and its size, quality, material, and catalog number. Take the list to a building supply dealer and obtain a cost estimate for the materials. Be prepared to discuss the materials and costs with your instructor and class.

This freestanding curved stair was completely fabricated in a manufacturing plant and then disassembled and shipped to the building site. (L.J. Smith, Inc.)