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## Specialty Features

The topics discussed in this chapter include a variety of specialty features that are included in some but not all home construction plans.

### Fireplaces, Wood Stoves, and Chimneys

The installation of fireplaces, wood stoves, and the chimneys that they require for operation involves significant structural considerations relating to safety and efficiency. Basic information is provided below.

#### *Fireplaces*

From the standpoint of heating, fireplaces could be considered a luxury, their heat production efficiency being estimated to be only 10 percent. However, they are often desired as a decorative feature. As indicated in the next two sections, improved efficiency can usually be obtained by the installation of a factory-made circulating fireplace. This metal unit, enclosed by masonry, allows heated air to be circulated throughout the room in a system separate from the direct heat of the fire.

Satisfactory fireplace performance can be achieved by following several rules relating the fireplace opening size to flue area, depth of the opening, and certain other measurements.

It is generally recommended that the depth of the fireplace should be about two-thirds the height of the opening. Thus, a 30-inch-high fireplace would be 20 inches deep from the face to the rear of the opening.

The flue area (inside length times inside width) should be at least one-tenth of the area of the fireplace opening (width times height) when the chimney is 15 feet or more in height. When less than 15 feet, the flue area should be one-eighth of the area of the opening of the fireplace. This height is measured from the throat (fig. 129) to the top of the chimney. Thus, a fireplace with a 30-inch width and 24-inch height (720 in<sup>2</sup>) would require an 8- by 12-inch flue, which has an inside area of about 80 in<sup>2</sup>, when the chimney height is 15 feet or over. A 12- by 12-inch flue liner has an area of about 125 in<sup>2</sup>, and would be large enough for a 36- by 30-inch opening when the chimney height is 15 feet or over.

Steel angle iron should be used to support the brick or masonry over the fireplace opening. The bottom of the inner hearth, the sides, and the back should be built of a heat-resistant material such as firebrick. The outer hearth

should extend at least 16 inches out from the face of the fireplace and be supported by a reinforced concrete slab. This outer hearth provides protection against flying sparks and should be made of noncombustible materials such as glazed tile. Other details relating to clearance, framing of the wall, cleanout opening, and ash dump are also shown in figure 129. Hangers and brackets for fireplace screens are often built into the face of the fireplace.

The back width of the fireplace is usually 6 to 8 inches narrower than the front. This helps to guide the smoke and fumes toward the rear. A vertical back wall about 14 inches high tapers toward the upper section or throat of the fireplace (fig. 129). The area of the throat should be about 1 ¼ to 1 ⅓ times the area of the flue to promote better draft. An adjustable damper is used at this area for easy control of the opening.

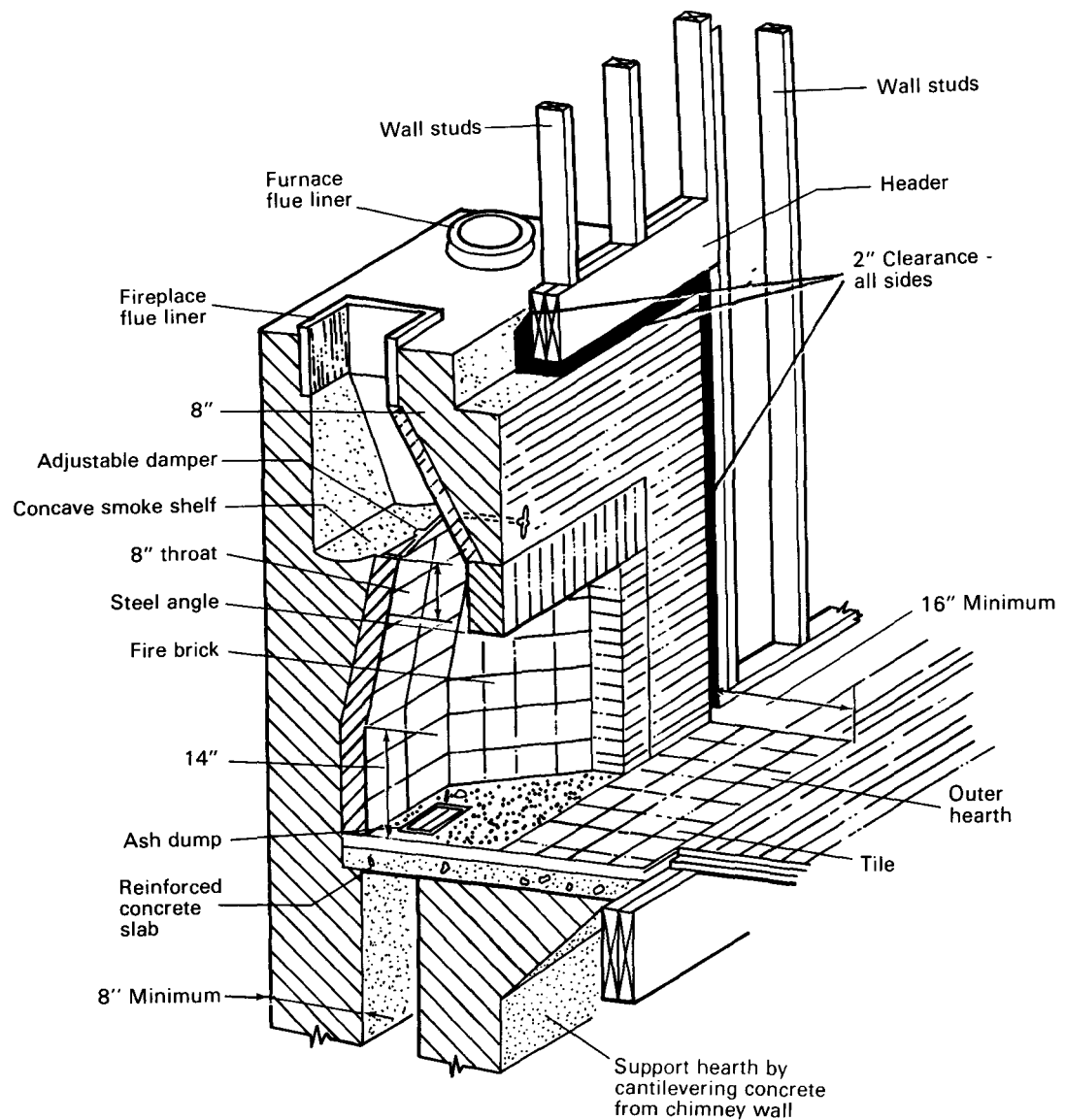
The smoke shelf (top of the throat) is necessary to prevent back drafts. The height of the smoke shelf should be 8 inches above the top of the fireplace opening (fig. 129). The smoke shelf is concave to retain any slight amount of rain that may enter.

Fireplaces with two or more openings (fig. 130) require much larger flues than conventional fireplaces. For example, a fireplace with two open adjacent faces (fig. 130A) would require a 12- by 16-inch flue for a 34- by 20- by 30-inch (width, depth, and height, respectively) opening. Local building regulations usually specify sizes for these types of fireplaces.

**Air-circulating firebox forms.** The heating capacity of a fireplace can be increased by using steel air-circulating firebox forms. These usually form the firebox sides and rear, plus the throat, damper, smoke shelf, and smoke chamber. The sides and back of the circulator are double, enclosing a space within which air is heated. Cool air is introduced into this space near the floor level and, when heated by the hot steel, rises and returns to the room through registers located at a higher level.

Air-circulating firebox forms can also prevent smoke from entering the room. The volume of air drawn up the chimney is substantial and is normally replaced by cold air infiltrating through cracks in the house. In modern tight house construction, however, the caulking and weatherstripping that reduce air infiltration also hamper the chimney draft, with the common result that smoke is drawn into the room. This problem is solved by installation of an air-circulating firebox, along with glass doors

Figure 129 – Masonry fireplace components.



across the fireplace front that prevent room air from entering the firebox.

The firebox form is set on a firebrick floor laid on reinforced concrete. The chimney flue is begun at the top of the form, and, facing the room, decorative masonry is laid around the unit opening. Small fans are often installed to increase the heating efficiency of the unit, and the inlets and outlets are covered with decorative grates.

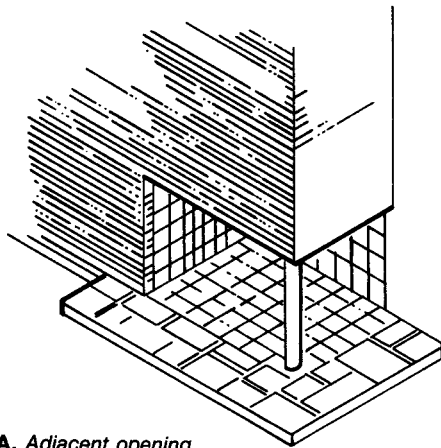
**Zero-clearance prefabricated fireboxes.** Factory-built fireplace units can be ordered that include all fireplace and chimney components from the hearth to the chimney cap. These are called “zero-clearance units” because they can be installed on wood floors and against wood framing (fig. 131). Such units must have an inspection label on them from a third-party testing agency (such as from UL,

Warnock-Hersey, or PFS Corporation) to qualify for use. The units have steel walls and include insulation that protects wood structures from excessive heat. They frequently include dampers, screens, glass doors, circulating fans, and external air supply ducts. Some are of freestanding contemporary type. Others can be placed on raised hearths and faced with stone or brick to provide a traditional appearance, or they can be covered with sheetrock and trimmed in wood. Their insulated steel chimney pipe can be housed in a wood stud chimney utilizing the same style of siding as the house.

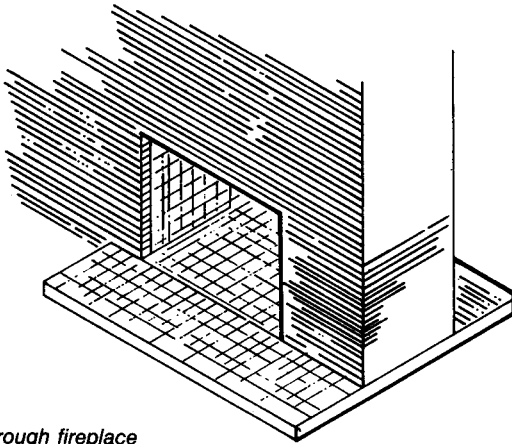
#### Wood stoves

Some types of wood stoves are freestanding; others are designed for insertion into fireplace openings. Their air intake is controlled to produce efficient, slow, and more

Figure 130 – Dual opening fireplace:



A, Adjacent opening



B, Through fireplace

complete combustion than is possible with fireplaces, with little loss of room air up the chimney. Airtight wood stoves can provide a combustion efficiency of 30 to 40 percent (a gas furnace is typically 80 percent efficient). Some models are made of steel or cast iron, which radiates heat. Others are enclosed in thin steel jackets, allowing air to circulate between the stove and the jacket. The cooler outer jacket provides a desirable safety feature. Air enters and leaves the space between stove and jacket through vents and heats the room through convection (see the technical note on heat flow and insulation). Fans are sometimes employed to improve circulation. In some systems the heated air is collected in a plenum and distributed to other rooms through ducts. To assure safe operation when properly installed, such units should have a label indicating they comply with safety standards as tested by a third-party testing agency.

Some models contain coils through which water circulates; the heated water can be employed for domestic uses

or for space heating. Water can be pumped to various locations or circulated through convection.

Some wood stoves have glass doors, which make them appear more like a fireplace. They can be set on brick, tile, or stone hearths and surrounded with walls of the same materials.

Wood stoves can be connected either to insulated steel or to masonry flues (fig. 132).

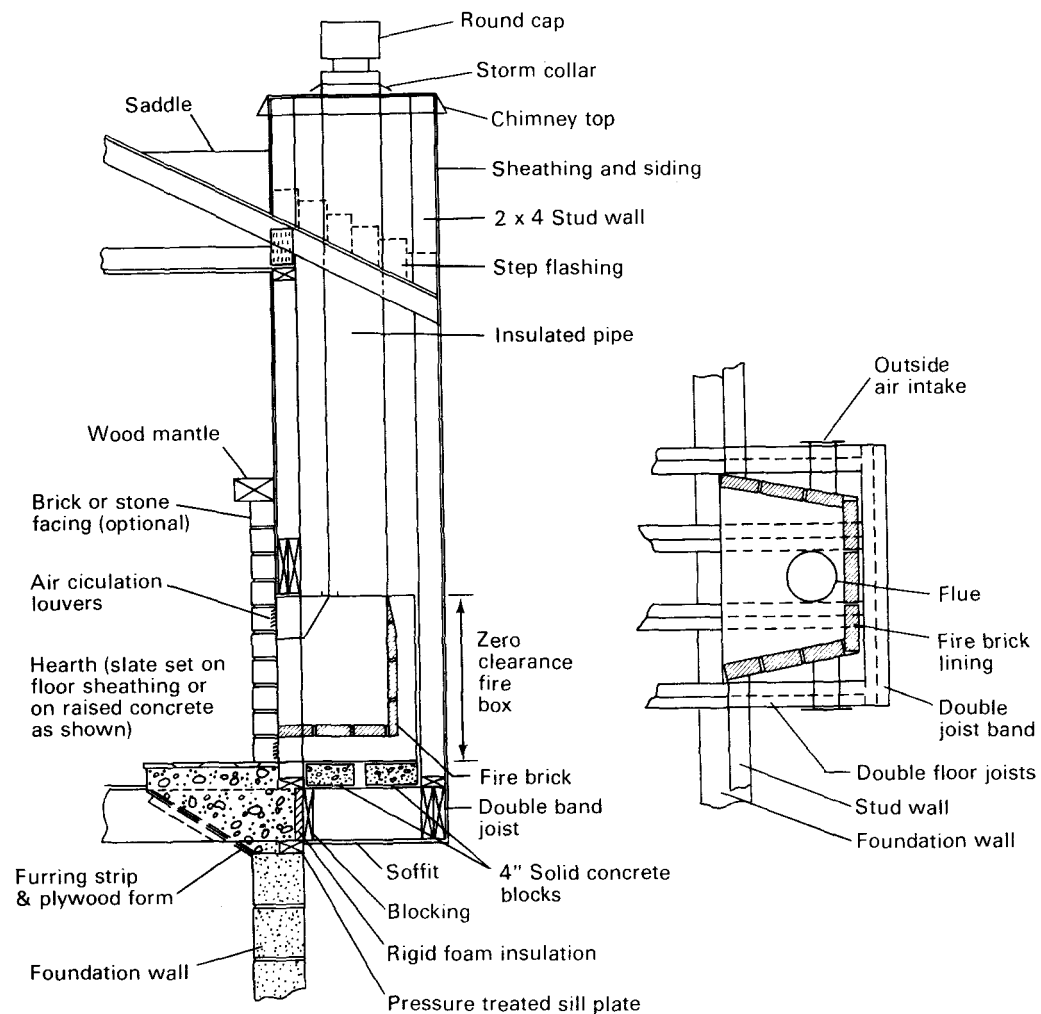
As the use of wood stoves has increased in popularity, failure to observe proper fire safety precautions in construction and installation has resulted in fires and accidents. ***In particular, it must be recalled that wood and other combustibles can be heated to the flash point without direct contact between the hot stove and such combustible material.*** Sufficient heat to ignite combustibles can be passed from the stove across air spaces through convection and radiation, or through intervening noncombustible materials such as masonry that are in contact with combustible material. The following paragraphs describe precautions that should be taken against fire.

**Pipe insulation.** When an uninsulated metal pipe or thimble passes through or comes in contact with walls, ceiling, or framing, at least 6 inches of fiberglass insulation should be packed between the pipe and such materials at all points of passage or contact. The fiberglass insulation should not have paper facings. Cement, stone, brick, or asbestos cannot serve as substitutes for such insulation, because all these materials can conduct sufficient heat to bring adjacent combustibles to the flash point.

**Clay thimbles.** Clay thimbles should not be run directly through concrete block or other nonflammable masonry. The thimble, masonry, or both, may crack, allowing heat to rise within the masonry cavities and ignite the wood sill. For passage through nonflammable block or masonry, an insulated steel pipe should be used. Alternatively, a steel pipe can be passed through the thimble, using any of a variety of techniques to maintain an air space between the two pipes. This air space should be open to the basement room.

**Safe distance from walls.** Manufacturers of various types of stoves specify the minimum distances from walls and other combustible materials judged safe for their stoves. These specifications should be carefully followed. In general, freestanding wood stoves should be kept at least 3 feet from combustibles, including wood studs covered with gypsum board and half-bricks. If a stove is placed closer to a wall or other combustible material than the minimum distance specified by the manufacturer, a steel heat shield should be placed between the stove and such materials, with air space on both sides of the shield.

Figure 131—Zero-clearance fireplace in external wood chimney.



**Safe distance from ceiling.** Uninsulated steel flue pipes should not be closer than 3 feet from ceilings.

**Hearths.** Freestanding wood stoves should be set on brick or concrete hearths. Bricks of standard  $2\frac{3}{4}$ -inch thickness or 3 inches of concrete should be used. Other hearths may be used only if specified in the stove manufacturer's installation instructions.

### Chimneys

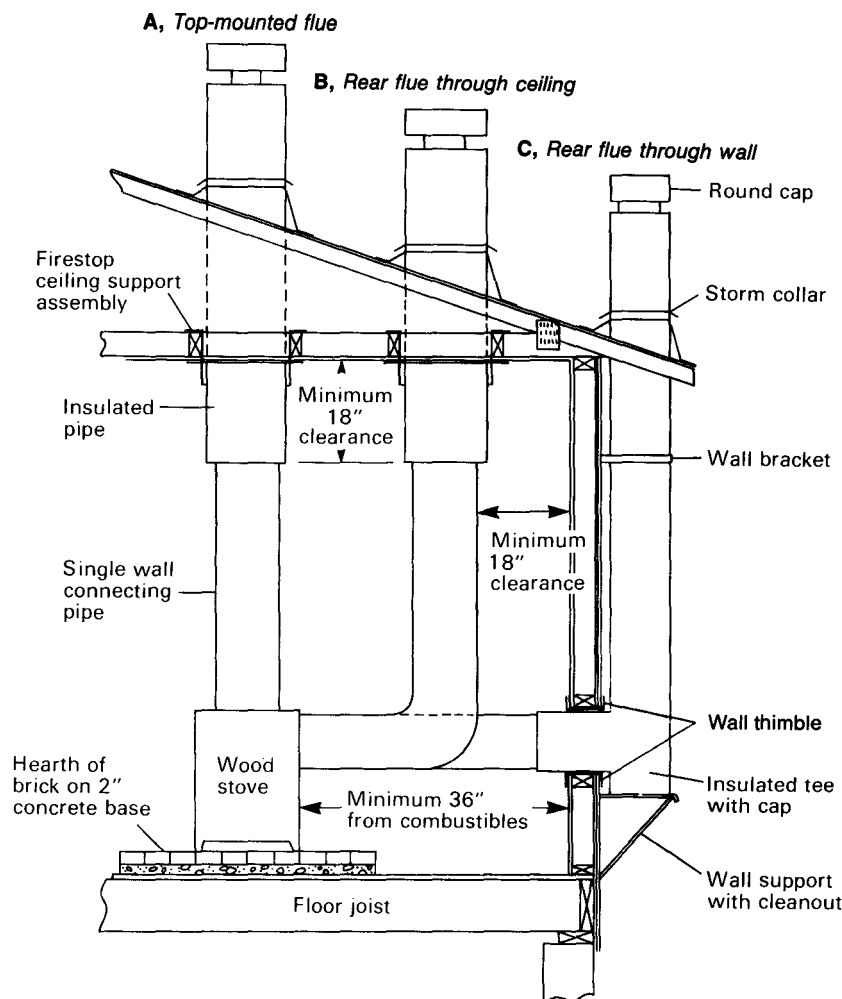
Chimneys can be constructed of masonry units supported on a suitable foundation or of lightweight insulated stainless steel pipe. They must be structurally safe and capable of producing sufficient draft for fireplaces, stoves, and/or other fuel-burning equipment. Steel flue pipe should bear a label signifying approval by Underwriters Laboratories, Inc., or other third-party testing agencies.

The chimney should be built on a concrete footing of sufficient area, depth, and strength for the imposed load. It is usually freestanding, and is constructed in such a way that it neither supports nor is supported by the structural framework of the house. The chimney footing should be below the frost line. For houses with a basement, the footings for the walls and fireplace are usually poured together and at the same elevation.

The size of the chimney depends on the number of flues, the presence or absence of fireplaces, and the design of the house. Each fireplace should have a separate flue. For best performance, flues should be separated by a 4-inch-wide brick spacer (withe) placed between them (fig. 133A).

Certain house designs include a room-wide brick or stone fireplace wall that extends through the roof. Although only two or three flues may be required for

Figure 132 – Wood stove:



heating units and fireplaces, several false flues may be added at the top for appearance.

Flue sizes conform to the width and length of a brick so that full-length bricks can be used to enclose the flue lining. Thus, an 8- by 8-inch flue lining (about 8½ in by 8½ in, outside dimensions) with the minimum 4-inch thickness of surrounding masonry will use six standard bricks for each course (fig. 134A). An 8- by 12-inch flue lining (8½ in by 13 in, outside dimensions) will be enclosed by seven bricks at each course (fig. 134B), and a 12- by 12-inch flue (13 in by 13 in, outside dimensions) by eight bricks (fig. 134C).

The height of the chimney and the size of the flue are important factors in providing sufficient draft. In addition, the greater the difference in temperature between chimney gases and outside atmosphere, the better the draft. A chimney constructed within the house framework has better draft than a chimney constructed in an exterior wall because the masonry retains heat longer.

The height of a chimney above the roofline usually depends on its location in relation to the roof ridge. If the chimney is within 10 feet of the roof ridge, the top of the flue liner must extend a minimum of 24 inches above the ridge and must be a minimum of 36 inches above the highest part of the roof next to the chimney. When the chimney is more than 10 feet from the roof ridge, the top of the chimney must extend a minimum of 24 inches above the highest point on the roof within 10 feet of the chimney and at least 36 inches above the highest point on the roof next to the chimney (fig. 133B). For flat or low-pitched roofs, the chimney should extend at least 3 feet above the highest point of the roof.

To prevent moisture from entering between the brick and flue lining, a concrete cap is usually poured over the top course of brick (fig. 133C). Precast or stone caps with a cement wash are also used.

Flashing for chimneys is illustrated in figures 93 and 135. Masonry chimneys should be separated from wood

framing, subfloor, and other combustible materials. Framing members should have at least a 2-inch clearance and should be firestopped at each floor with a noncombustible material (fig. 136). Subfloor, roof sheathing, and wall sheathing should have a  $\frac{3}{4}$ -inch clearance.

A cleanout door is included in the bottom of chimneys for fireplaces and other solid fuel burning equipment. The cleanout door for the furnace flue is usually located just below the smokepipe thimble, with enough room for a soot pocket.

**Flue linings.** Rectangular fire-clay linings or round vitrified (glazed) tile are normally used for chimney flues. Local codes usually require vitrified tile or a stainless-steel lining for gas-burning equipment.

Rectangular flue lining is made in 2-foot lengths and in various sizes from 8 by 8 inches to 24 by 24 inches. Wall thicknesses vary with the size of the flue. Linings of a smaller size have a wall  $\frac{5}{8}$  inch thick; larger sizes vary from  $\frac{3}{4}$  inch to  $1\frac{3}{8}$  inches in thickness. Most commonly, vitrified tiles 8 inches in diameter are used for the flues

of the heating unit, although larger sizes are also available. This type of tile has a bell joint.

Flue lining should begin at least 8 inches below the thimble for a connecting smoke or vent pipe from the furnace. For fireplaces, the flue liner should start at the top of the throat and extend to the top of the chimney.

Flue liners should be installed so far ahead of the brick or masonry work, as it is carried up, that careful bedding of the mortar results in a tight and smooth joint. When diagonal offsets are necessary, the flue liners should be beveled at the directional change in order to have a tight joint. It is also good practice to stagger the joints in adjacent tile.

Standard flue blocks are available for building less expensive chimneys. These blocks are 8 inches high by 16 inches square or larger, with holes in the center sized to fit standard flue liners. Other blocks have half-circular holes on one side; two of these form a circular hole through which a thimble can be placed.

**Figure 133** – Chimney details:

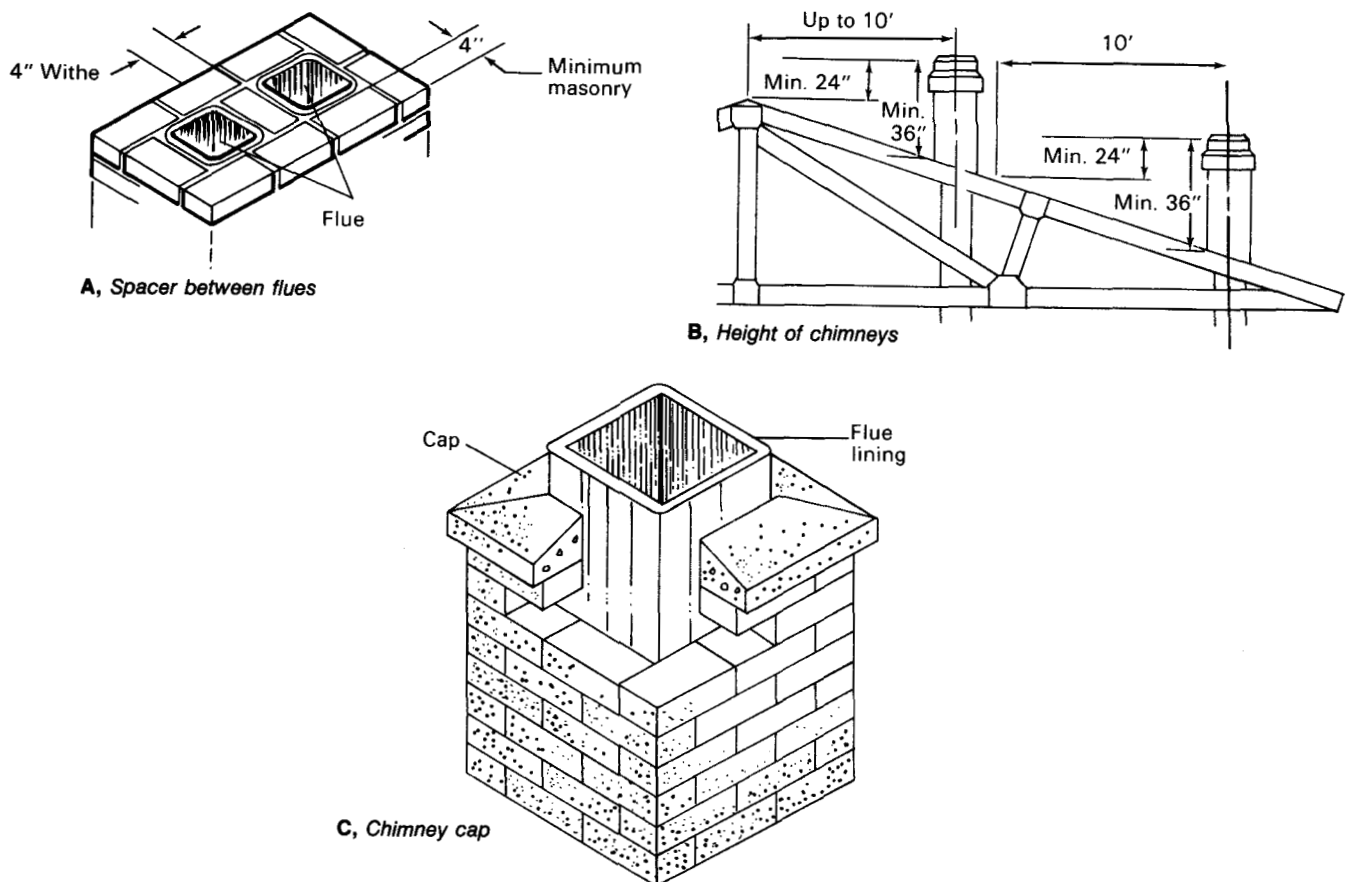
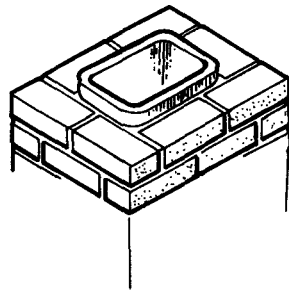
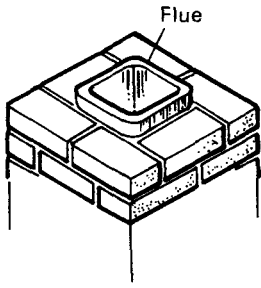
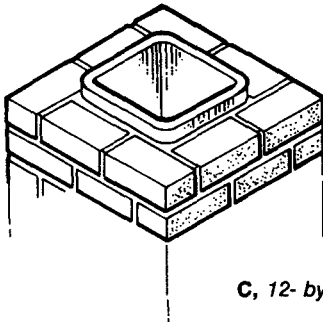


**Figure 134 – Chimney brick and flue combinations:**

**A, 8- by 8-inch flue lining**



**B, 8- by 12-inch flue lining**



**C, 12- by 12-inch flue lining**

**Insulated steel chimneys.** Insulated steel chimneys are made in tubular sections from 12 to 36 inches long. Sections are fastened together to form a long pipe. Triple-wall pipe consists of three pipes with spaces between them through which air circulates to remove heat. The inner pipe is made of stainless steel; the outer pipes are galvanized. Another type consists of double-wall stainless steel pipe with asbestos insulation between the walls.

Both types come with a full line of accessories including tees, wall supports and brackets, roof supports and flashing, storm collars, caps to keep rain from going down the flue, and spark arrestors. Both types can be fully exposed to weather or enclosed in wood chimneys. Wood chimneys normally consist of conventional stud walls covered with sheathing and siding. The entire top, 2 feet square or larger, is covered with galvanized flashing through which the last section of insulated steel pipe extends.

Unlike clay flues, which could crack in flue fires, steel chimneys do not crack when subjected to the heat of such fires. If creosote buildup is ignited in a steel flue, the fire can burn until the creosote burns off, and if the manufacturer's installation recommendations have been followed, the flue should not be damaged.

**Figure 135 – Chimney flashing.**

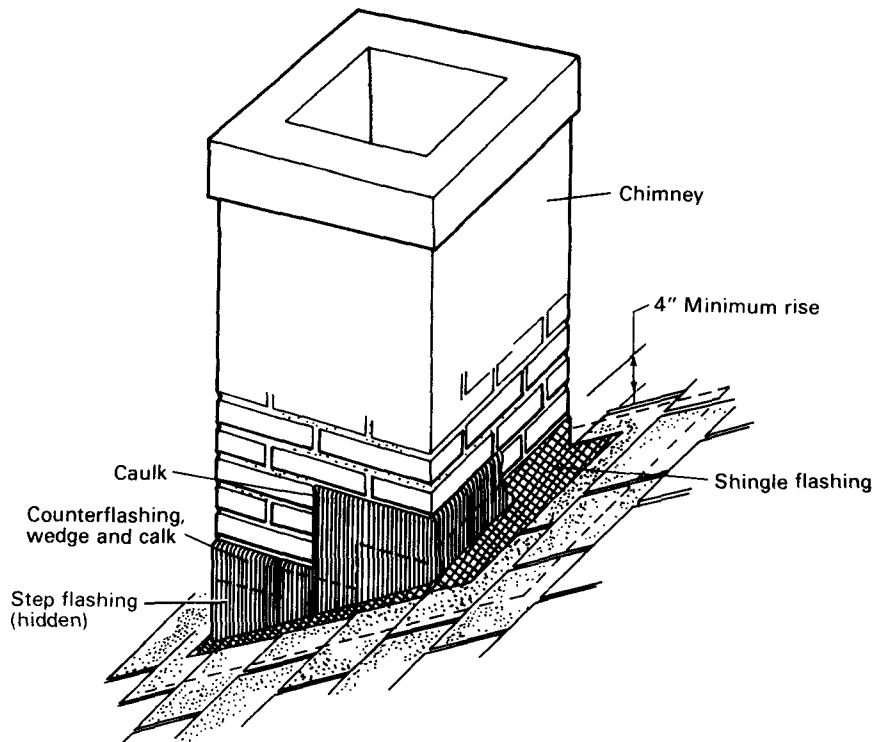
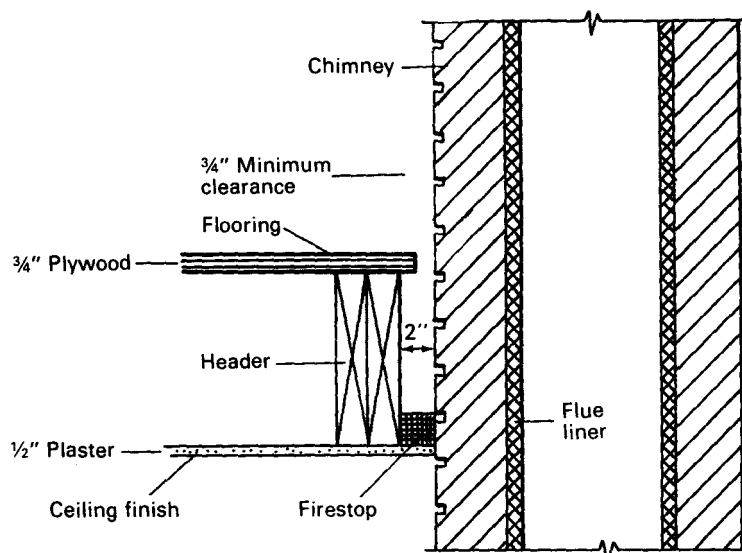


Figure 136 – Chimney clearances for wood frame construction.



## Garages and Carports

Garages can be classified as attached, detached, or basement. A carport is a roofed, open structure for sheltering vehicles.

### Garages

An attached garage has a number of advantages. It can give better architectural lines to the house, it is warmer during cold weather, and it provides convenient space for storage. It also provides covered protection for entering or leaving vehicles and a short, direct entrance to the house. An attached garage is also less expensive to build than a detached garage because it shares one wall with the house.

Where there is considerable slope to a lot, basement garages may be desirable. Such garages generally cost less than those above grade.

Detached garages are independent structures built on a slab foundation. The specifications for the slab foundation are generally the same as those for an attached garage.

**Size.** Many car models are 215 inches long, and larger, more expensive models are usually over 230 inches—almost 20 feet—in length. While the garage need not necessarily be designed to take all sizes with adequate room around the car, it is good practice to provide a minimum distance of 21 to 22 feet between the inside faces of the front and rear walls. If additional storage or work space at the back is desired, greater depth is required.

The inside width of a single garage should never be less than 11 feet; 13 feet is more satisfactory. The recom-

mended minimum outside size for a single garage, therefore, would be 14 by 22 feet. A double garage should be not less than 22 by 22 feet in outside dimensions to provide reasonable clearance. The addition of a shop or storage area would increase these dimensions.

For an attached garage, the foundation wall should extend below the frost line and about 8 inches above the exterior final grade level. It should be not less than 6 inches thick. The sill plate should be anchored to the foundation wall with anchor bolts spaced about 8 feet apart, with at least two bolts in each sill piece. Extra anchors may be required at the sides of the main door.

If fill is required below the floor, it should be sand or gravel. If some other type of soil fill is used, it should be well compacted. If these precautions are not taken, the concrete floor may settle and crack.

The concrete floor should be not less than 4 inches thick. It should be laid with a pitch of about 2 inches from the back to the front of the garage. Welded wire mesh is often used to help control surface cracks. However, unless it is placed in the top third of the concrete, it has little value.

The garage floor should be set about 1 inch above the drive or apron level. It is desirable to have an expansion joint between the garage floor and the driveway or apron.

The framing of the side walls and roof and the application of the exterior covering material should be similar to that of the house. Interior studs can be left exposed or covered with some type of sheet material. Building codes require that the wall between the house and the attached

garage be covered with fire-resistant material. Local building regulations and fire codes should be consulted before construction is begun.

**Doors.** The overhead sectional type of garage doors are used most commonly (fig. 137). They are made in four or five horizontal hinged sections and have a track extending along the sides under the ceiling framing with a roller for each side of each section. They are opened by lifting and are adaptable to automatic electric opening with remote control devices.

The standard size for a single door is 9 feet wide by 6½ feet or 7 feet high. Doors for two-car garages are usually 16 feet wide.

In design, the door most often used is the panel type with solid stiles, rails, and panel fillers. A glazed panel section is often included; translucent fiberglass and embossed steel or aluminum are also available. Clearance from the top of the door to the ceiling must usually be about 12 inches, although low-headroom brackets are available that can reduce required clearance to 6 inches.

The header beam over garage doors should be designed for the total dead load and live load that may be imposed by the roof above. If floor loads are also carried by this header, the floor live loads must also be considered. Three 2- by 12-inch boards, 18 feet long, are often required for 16-foot doors. If a load-bearing truss is used in the gable-end wall over a garage door, no header is needed.

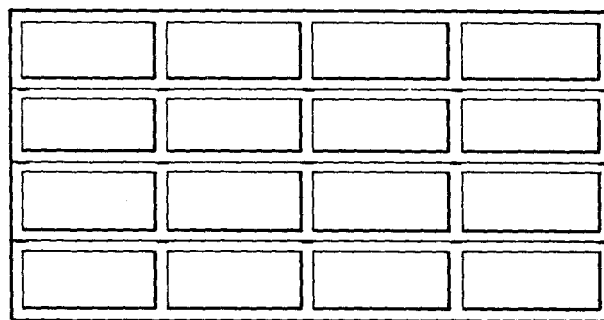
To keep the garage warmer in cold climates, overhead door units can be ordered with insulation kits and weatherstripping for the perimeter of the door. Weatherstripping is typically made of vinyl for head and side jambs and rubber or vinyl for contact with the floor.

### **Carports**

Carports are often built with 4- by 4-inch solid wood posts (6- by 6-in posts in areas with heavy snow load) at all corners and at other intermediate points determined by the size of the load-bearing headers. Typically, there are four posts (with three spaces) in the long direction. The headers that span between the posts are normally 2 by 8 inches, or 2 by 12 inches on two-car ports in heavy snow areas.

Metal post bases are often used to fasten posts to the concrete slab. The load-bearing header is either bolted or nailed to the posts. Connectors must be able to resist strong wind uplift forces. Clearances should be the same as for garages, to allow for the possibility that the carport will be closed in at a later date.

**Figure 137 – Sectional overhead garage door.**



Carports are usually attached to the house. To improve their appearance and utility, storage cabinets are often built on the open side or at the end.

### **Porches and Decks**

Porches or decks should be joined to the main house by means of the framing members and roof sheathing. Rafters, ceiling joists, and studs should be securely attached by nailing, bolting, or lag-screwing to the house framing.

When additions are made to an existing house, it may be desirable to remove siding or other exterior finish so that the framing members of the addition can be easily fastened to the house. In many instances, siding can be cut to the outline of the addition and removed only where necessary. With wood or plywood siding, metal joist hangers are sometimes applied directly to the siding, but only at points where the attachment is to be made to framing members behind the siding at the point of application. Footings should be of sufficient size, with bottoms located below the frost line, and the foundation walls should be anchored to the house foundation when possible.

All lumber used outside, especially joists, flooring, posts, and lattices, should be either pressure-treated or of a species with natural resistance to decay, such as redwood, cypress, and cedar.

### **Porches**

Some porches have roof slopes continuous with the roof of the house. Other porch roofs may have just enough pitch to provide drainage and may require continuously sealed roofing or hot-tar built-up roofing rather than shingles. Basic construction principles for porches are similar, however, and a general description can cover various types.

Figure 138 shows the construction details for the juncture of a concrete slab floor and the house foundation wall. An attached porch can be open or fully enclosed. It can be

constructed with a concrete slab floor, insulated or uninsulated, or with wood floor framing over a crawl space (fig. 139). Construction details should comply with those previously outlined for various parts of the house itself.

**Framing and floors.** Porch floors, whether wood or concrete, should have sufficient slope away from the house to provide good drainage. Weep holes or drains should be provided in any solid or fully sheathed perimeter wall. Open wood balusters with top and bottom railings should be constructed so that the bottom rail is free of the floor surface.

Wood floor framing should be at least 18 inches above the soil. It is good practice to use a soil cover of polyethylene or similar material under a partially open or a closed porch.

Lattice or grillwork around an open crawl space should be made with a removable section for entry in areas

where termites may be present (see the section on protection against decay and termites in chapter 8). A fully enclosed crawl space foundation should be vented or have an opening to the basement.

Wood for porch flooring should have good decay and wear resistance, be nonsplintering, and be resistant to warping. Species commonly used are cypress, Douglas-fir, western larch, southern pine, and redwood.

**Columns.** Roof support for enclosed porches usually consists of fully framed stud walls. Because finished coverings are used on both interior and exterior, the walls are constructed much like the walls of the house. In open or partially open porches, however, solid or built-up posts or columns are used. Solid posts, normally 4 by 4 or 6 by 6 inches, are used mainly for open porches. A more finished column can be made up of doubled 2- by 4-inch

**Figure 138** – Porch concrete slab floor.

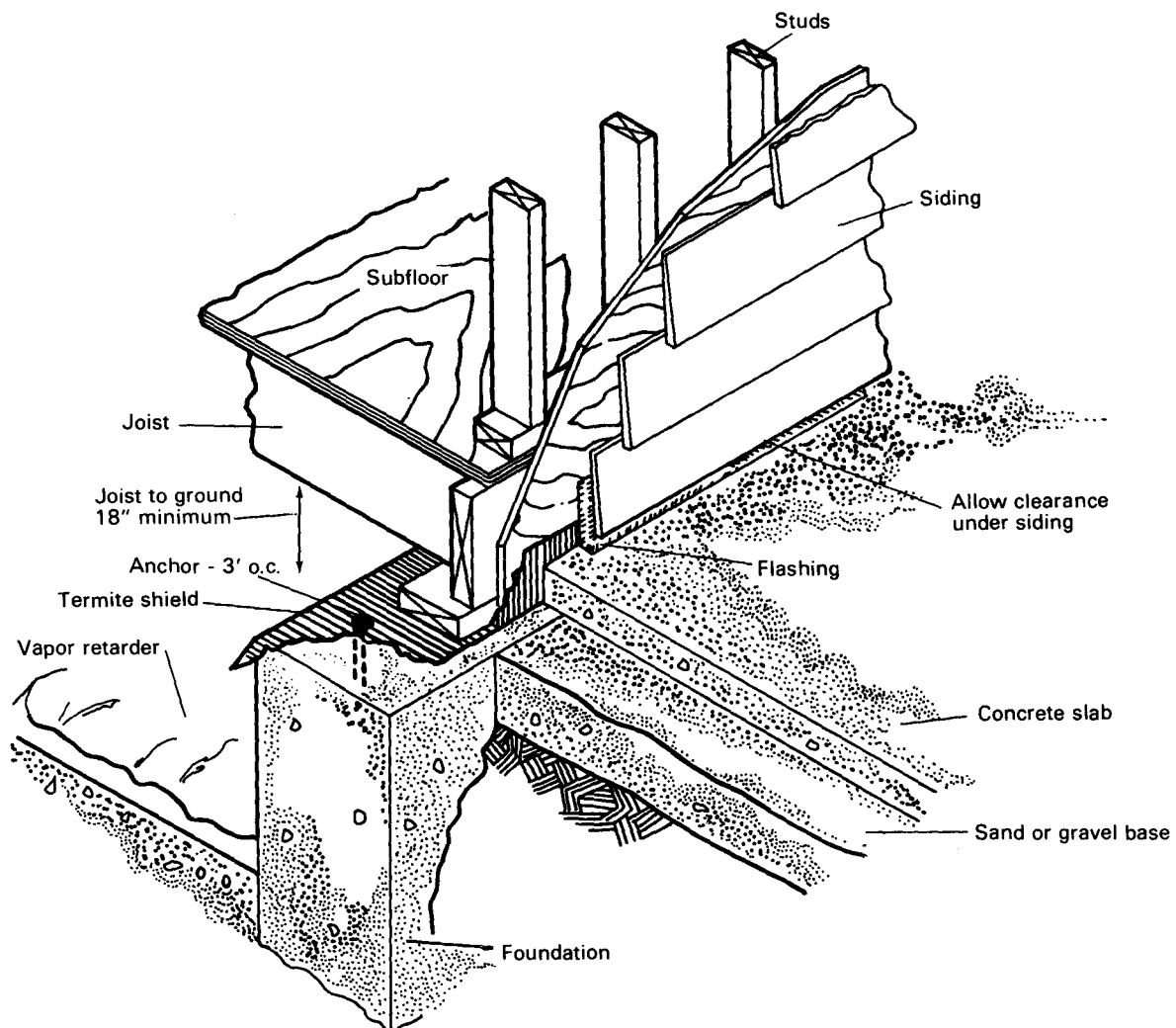
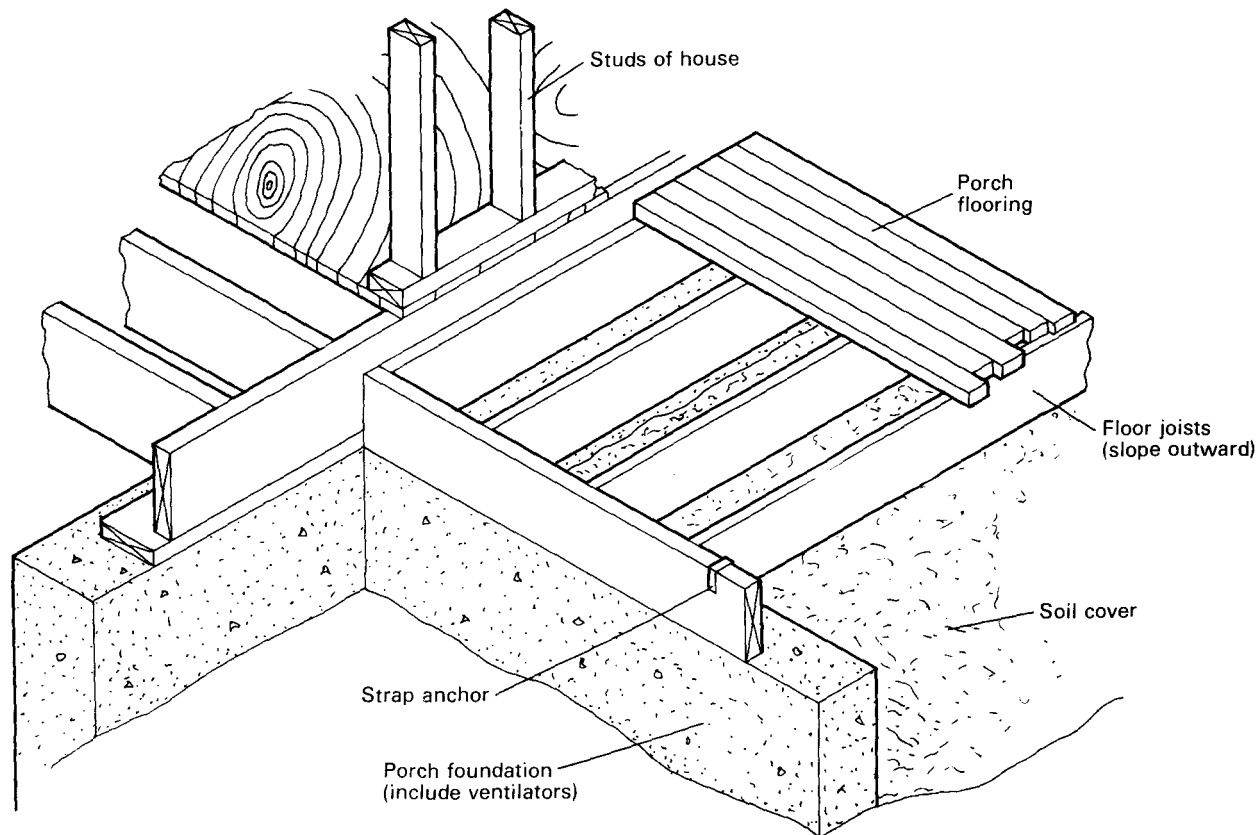


**Figure 139 – Porch crawl space floor.**



lumber covered with 1-by 4-inch boards on two opposite sides and 1-by 6-inch boards on the other sides (fig. 140A). An open railing may be used between posts.

A large house entrance often includes columns topped by capitals. These factory-made columns are ready for installation when they reach the building site.

The bases of posts or columns in open porches should be designed so that no pockets are formed that can retain moisture. In single posts, a steel pin can be used to locate the post, and a large galvanized washer or similar spacer can be used to keep the bottom of the post above the concrete or wood floor (fig. 140B). Alternatively, a variety of metal post bases are available at lumberyards. One should be selected that provides space for drainage under the end of the post (fig. 140C). The bottom of the post should be treated with water-repellent preservative (WRP) to minimize moisture penetration. Single posts of this type are often made from a decay-resistant wood species or pressure-treated wood.

**Balustrades.** Porch balustrades usually consist of one or two railings with balusters between them. A closed balustrade can be used in combination with screens or combination windows (fig. 141A). A balustrade with

decorative railings can be used for an open porch (fig. 141B). This type can also be used with full-height removable screens.

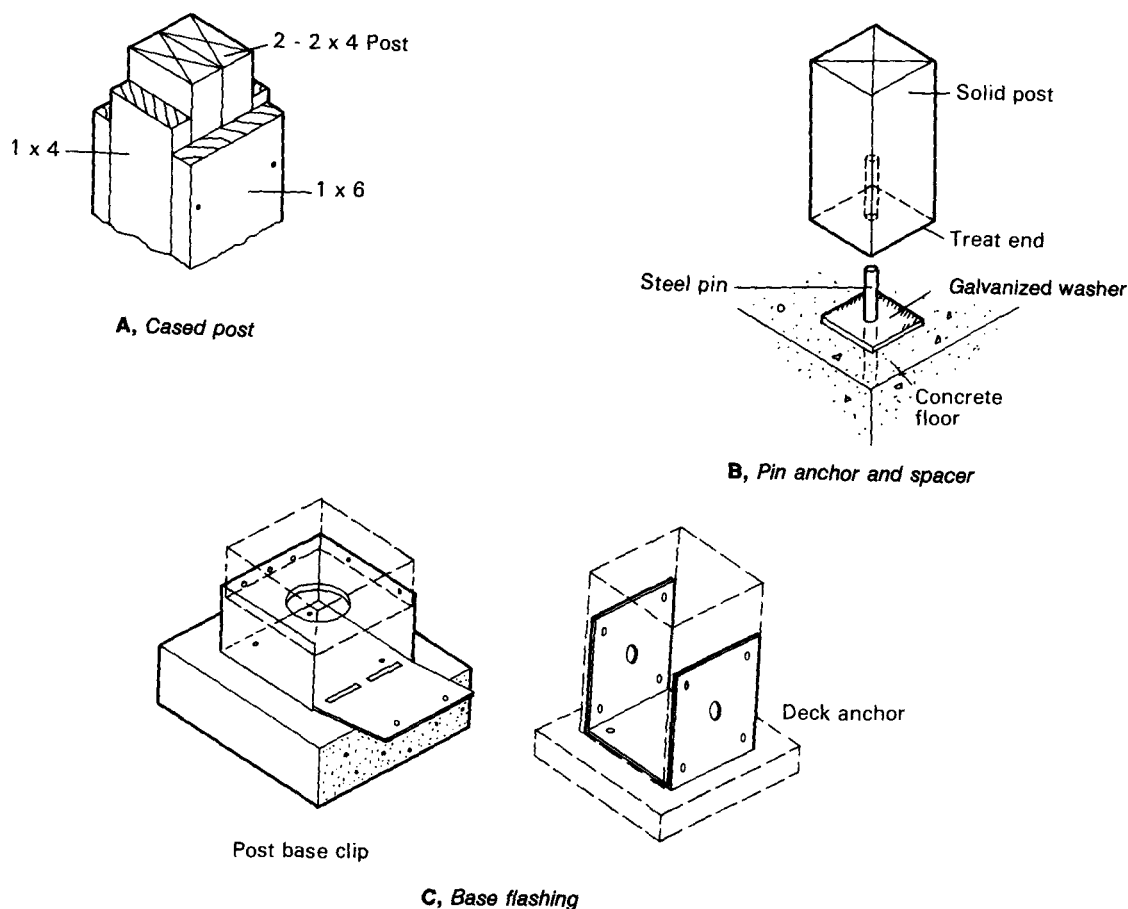
All balustrade members that are exposed to water and snow should be designed to shed water. The top of the railing should be tapered, and connections with balusters should be protected as much as possible (fig. 142A). Railings should not contact a concrete floor, but should be blocked to provide a small space beneath. When wood such as the blocks must be in contact with the concrete, it should be pressure-treated to resist decay.

Connection of the railing to a post should be made in a way that prevents moisture from being trapped. One method provides a small space between the post and the end of the railing (fig. 142B). When the railing is painted or treated with water-repellent preservative, this type of connection should provide good protection. Exposed members, such as posts, balusters, and railings, should be all heartwood stock of decay-resistant or pressure-treated wood.

### **Decks**

A variety of wood species can be used for building decks. For long life and reduced maintenance, either

Figure 140—Post details:



pressure-treated wood or wood with natural resistance to decay, such as redwood, cedar, or cypress, should be used. Some woods that are easy to work, such as hemlock, most pines, spruce, and Douglas-fir, have either low resistance or only moderate resistance to decay and insect attack. Such species can be used for deck construction if they are pressure-treated.

Decks should be designed to withstand heavy loads because they tend to be places where many people congregate. Local building codes should be checked in case they specify minimum load-bearing requirements for live load (people, snow, furniture, equipment, etc.) and dead load (the deck itself). If there are no code requirements, assume a live load of 40 pounds per square foot (lb/ft<sup>2</sup>) and a dead load of 10 lb/ft<sup>2</sup>. Spacing of posts, beams, and joists should be based on these requirements. Span tables for floor joists such as are shown in the section on floor framing should be consulted.

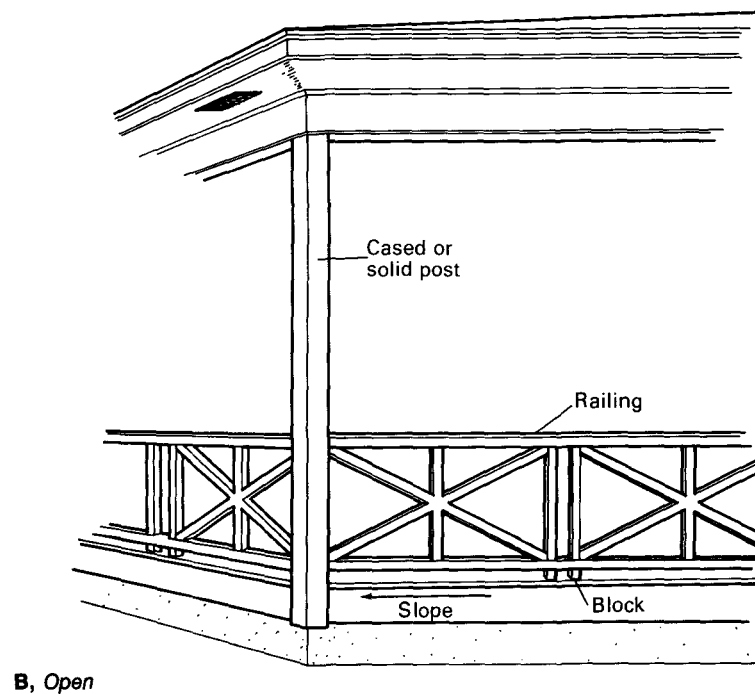
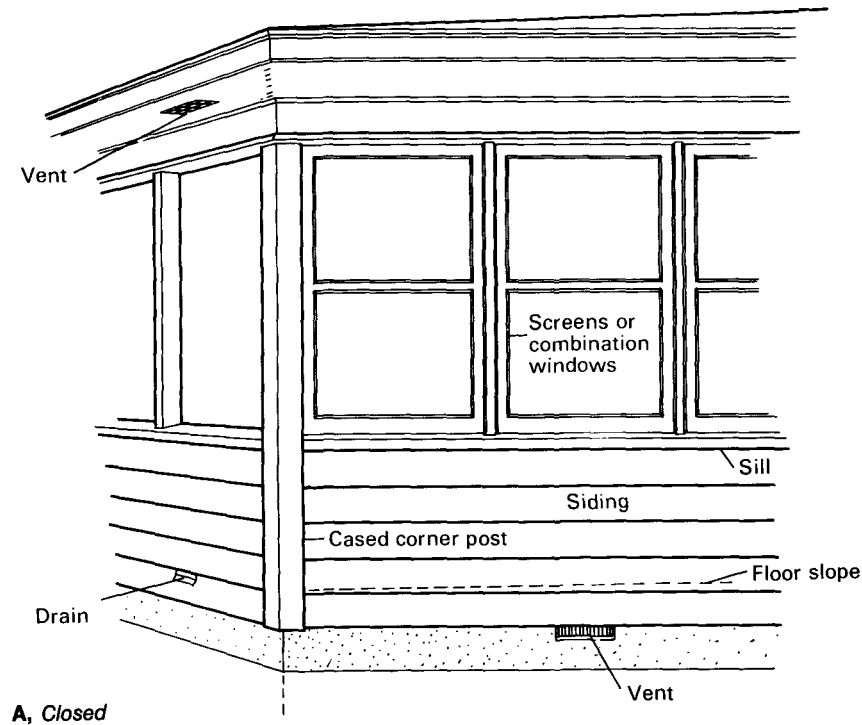
**Layout.** Most decks are attached to the house, although some are freestanding. For those that are attached to the house, the top of decking should be located 1 inch below the inside floor level. If no doorway

is in place and measurements cannot easily be made, some other point of reference should be used that can be transferred to the outside. For example, the measurement from the top of the inside floor to the bottom of a window sash can be transferred to the outside from the bottom of the same window sash. One inch should be added to this measurement to locate the top of the decking.

Next, a measurement should be made down from the top of the deck to a distance equal to the thickness of the deck flooring plus the height of the deck joists. This point represents the bottom of the deck joists. The bottom of the deck joists can be located in this manner at both ends of the proposed deck, and a chalk-line string snapped through the points.

Joist spacing should be marked along the length of the chalk line. The outside face of the first floor joist will be in line with the end of the deck. Beginning with the outside face of the first-floor joist, a distance of 15¼ inches should be measured to mark the beginning face of the second joist. Thereafter, the beginning faces of the floor joists should be marked at 16-inch intervals. The final mark at the end of the deck marks the outside face of the final floor joist.

Figure 141—Types of balustrades:



Several methods can be used to attach the deck floor joists to the house along the chalk line. The simplest method is to attach joist hangers directly to the siding with lag screws (fig. 143). The lag screws must penetrate either the floor framing members or the wall studs of the house. The bottoms of the joist hangers are aligned with

the chalk line, and the sides of the hangers are aligned with the marks indicating deck floor joist spacing.

Another method is to attach a header joist to the side of the house with lag screws that are long enough to penetrate the floor framing or wall studs of the house

(fig. 144). The bottom of the header joist should be aligned with the chalk line; its height is the same as the deck floor joists. Metal joist hangers should be nailed to the header joist with their bottoms aligned with the bottom edge of the joist. The sides of the joist hangers should be aligned with the marks indicating deck floor joist spacing.

A third method is to attach a 2- by 4-inch or 2- by 6-inch wood ledger to the side of the house with lag screws (fig. 145). The top of the ledger should be aligned with the chalk line. No joist hangers are required since the deck floor joists rest on top of the ledger.

If either the header joist method or the ledger method is chosen for use against wood siding, flashing must be installed. A circular saw should be used to cut through the siding at the top and along the entire length of the header or ledger. The siding should be pried out with a flat bar, and Z-flashing installed to prevent water accumulation between the wood siding and the header or ledger (figs. 144 and 145).

If the deck floor framing is attached to a brick or block wall, lead anchors and expansion bolts should be used in place of lag screws.

The deck floor framing should be assembled on the ground by nailing a header joist to the ends of the floor joists on the side of the deck away from the house, using 16d hot-dipped galvanized nails, three per joist. A second header joist should then be nailed to the first. The floor joists should be lifted and the ends placed into the joist hangers or onto the ledger. The header joist should be

**Figure 142 – Railings:**

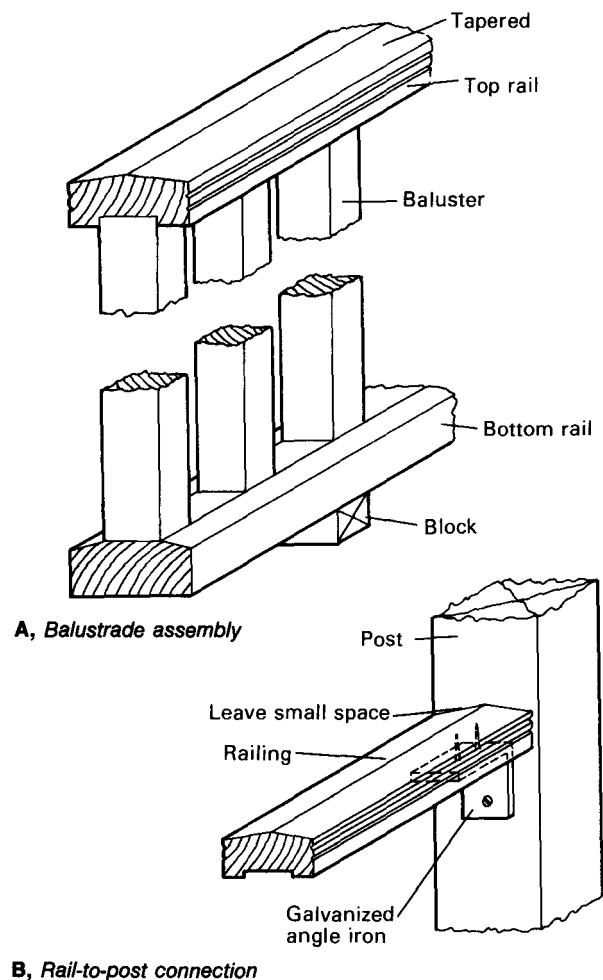


**Figure 143 – Deck attachment to house with joist hangers.**

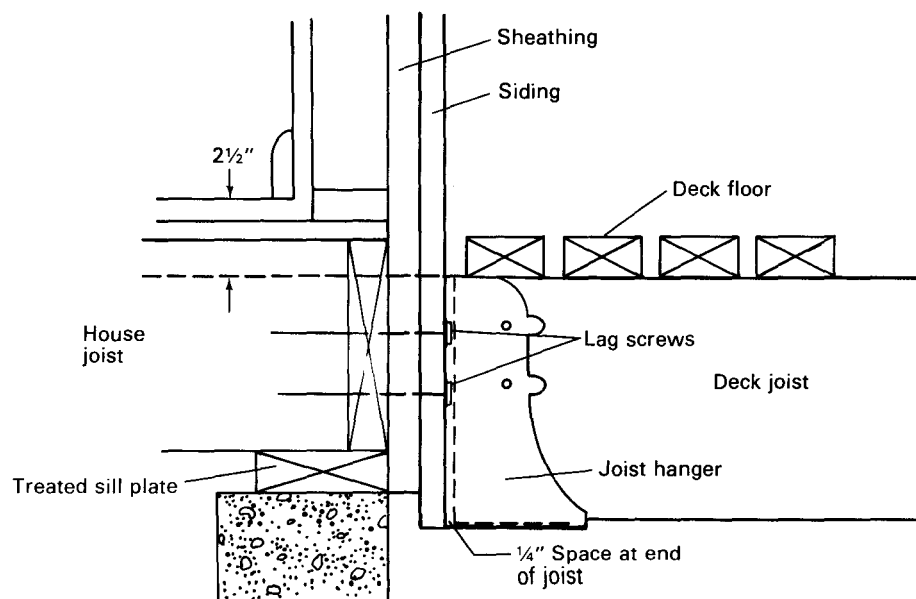


Figure 144—Deck attachment to house with header joist.

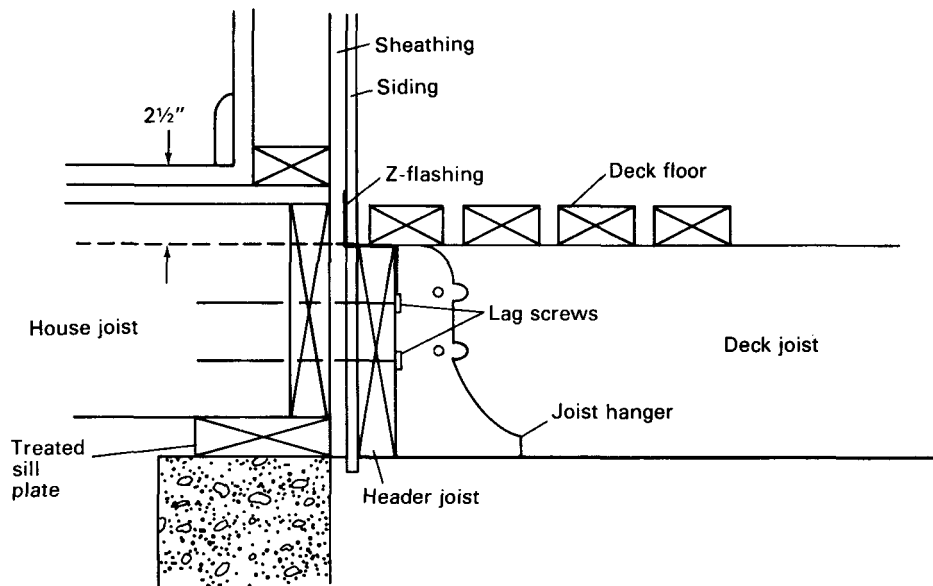
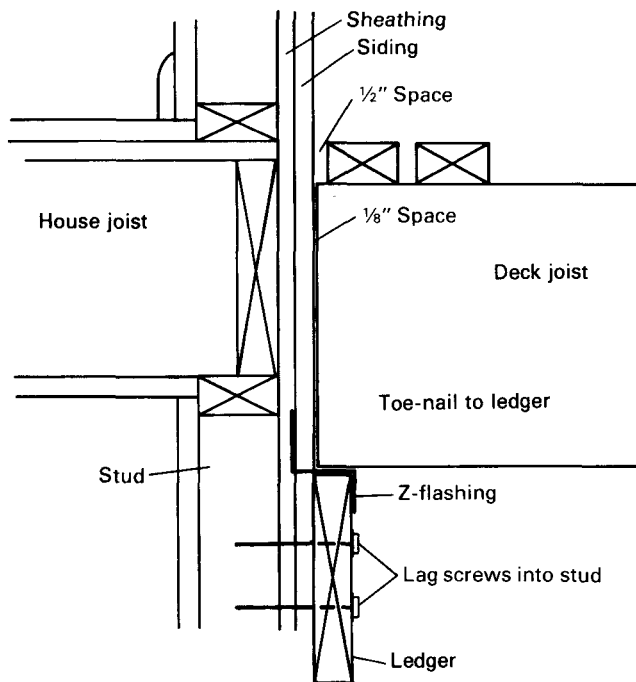


Figure 145—Deck attachment to house using ledger.



raised until the deck floor framing is level, and temporarily braced with 2 by 4 posts.

The deck should be squared with diagonal measurements and a temporary brace placed across the framing to maintain squareness. From a ladder, a plumb line should be dropped to locate footings and posts, and stakes should be driven at these points. The deck should be set on the ground while post holes are being dug.

Footings for the deck support posts should be deep enough to extend to undisturbed soil below frost line (fig. 146). One method of digging footing holes is to use a post-hole digger. A 6-foot steel bar may be useful for loosening the soil. An 8-inch-diameter hole is sufficient for 4- by 4-inch posts.

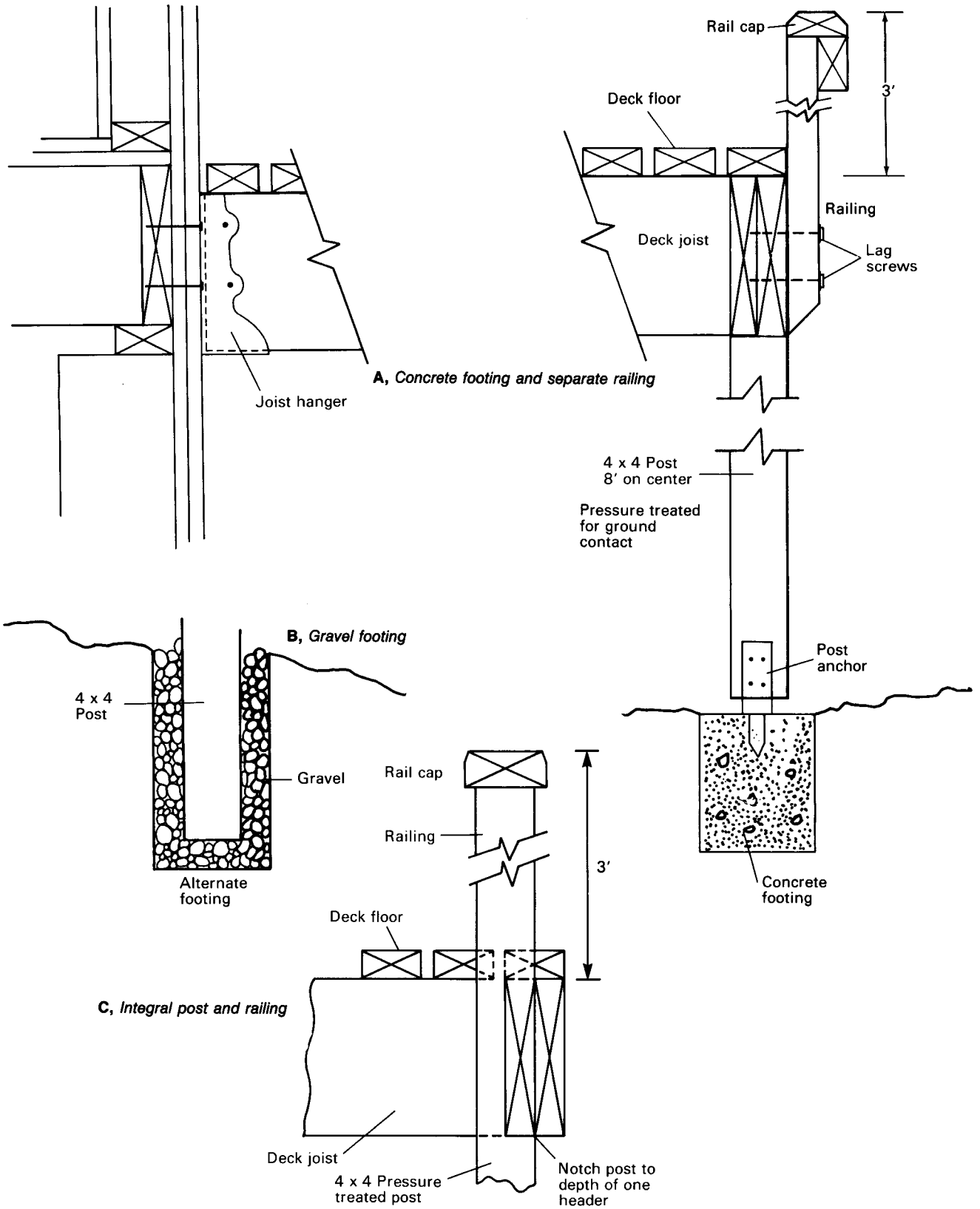
When the post footing holes have been dug, the deck should again be raised, leveled, and temporarily braced. The joist ends at the house should then be permanently nailed to the hangers or ledger.

If concrete footings are used, the holes should be filled with concrete and post anchors fastened in the concrete. It may be worthwhile to check the location of the anchor with the plumb line. It should be remembered that the plumb line will probably be at the outside corner of the post, and the anchor should be positioned accordingly. Four- by four-inch pressure-treated posts should be cut to fit between the anchor and the deck joists, and nailed to the joists (fig. 146A).

Curing of the footings requires about 7 days. When they have been cured, the temporary deck bracing can be removed and the support posts set on and nailed to the anchors.

As an alternative to the use of a concrete footing, about 4 inches of gravel can be placed in the bottom of the hole, its depth measured, and the post cut, set in the hole on top of the gravel, and nailed to the deck floor framing. The hole should then be backfilled with gravel, and the gravel tamped (fig. 146B).

Figure 146 – Deck posts and footing:



**Flooring.** Starting from the house, chalk-line string should be snapped for placement of deck flooring. If 2- by 4-inch lumber is used, marks should be made every 4 inches; if 2- by 6-inch lumber is used, marks should be made every 6 inches. For a 12-foot-deep deck, 36 2 by 4's or 24 2 by 6's are needed. The marking provides a ½-inch space between boards. The first ½-inch space should be adjacent to the house. This allows rainwater to drain past the decking.

Corrosion-resistant nails should be used. Two 16d nails should be driven at each deck-joint intersection. If nails are driven at about a 30° angle, they are less likely to loosen. Three 16d nails should be used at butt joints.

Decking boards should be inspected visually for straightness as they are being placed. Any boards having a slight edgewise crook can be straightened somewhat by nailing one end and bending the board into place as it is nailed. Occasionally, a pry bar may be needed to straighten difficult boards. Boards that are slightly bowed should be laid with the crown up to prevent the accumulation of water. It may sometimes be necessary to discard boards that are badly deformed.

**Railings.** Railings must be sturdy enough to withstand the weight of people leaning against them. They should also be designed to prevent children from falling through. Local codes may specify minimal height and maximal space between rails.

In an extended post deck, the posts extend 36 inches up through the deck flooring and serve as the major rail posts.

Many builders use 2- by 2-inch rail posts, spaced 6 inches on center and lag-screwed to the deck header or to an edge joist. A vertical 2- by 4-inch board at the top of the 2 by 2's and a horizontal cap board complete the top of the railings. Edges of the cap board can be routed to give the board a more finished look and to minimize splinters (fig 146).

### Driveways and Walkways

Driveways and walks should be installed prior to such landscaping as final grading, planting of shrubs and trees, and seeding or sodding of lawn areas.

Concrete and bituminous pavement are most commonly used in the construction of walks and drives, especially in areas where snow removal is important. In some areas of the country, a gravel driveway and a flagstone or precast concrete walk may be satisfactory, thereby reducing cost.

#### Driveways

The grade, width, and radius of curve in a driveway are important in establishing a safe entry to the garage.

When attached garages are located near the street on relatively level property, driveway width is the basic consideration. Driveways that are long and require an area for turnaround require careful planning and design. Figure 147 shows a driveway and turnaround that allow the driver to back out of a single or double garage into the turnaround, and proceed to the street or highway in a forward direction. This is much safer than having to back onto the street or roadway, particularly in areas of heavy traffic. As shown in figure 147, a double garage should be serviced by a wider entry and turnaround.

Driveways that must be steep should have a near-level area 12 to 16 feet long in front of the garage for safety. Driveways that have a grade more than 7 percent (7-ft rise in 100 ft of length) should have some type of pavement to prevent erosion.

Two types of paved driveways are the slab or full-width type, which is more common, and the ribbon type (fig. 148). When driveways are fairly long or steep, the full-width type is the most practical. The ribbon driveway is cheaper and perhaps less conspicuous because of the grass center strip between the two concrete runners. However, it is not practical if there is a curve or turn involved or if the driveway is long.

The width of the slab driveway should be 9 feet, although 8 feet is often considered acceptable (fig. 148A). When the driveway is also used as a walk, it should be at least

**Figure 147 – Driveway with turnaround.**

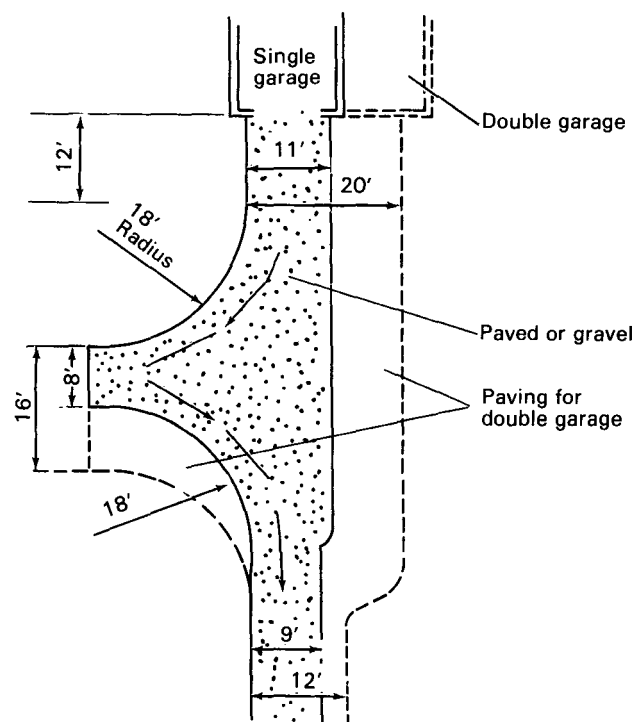
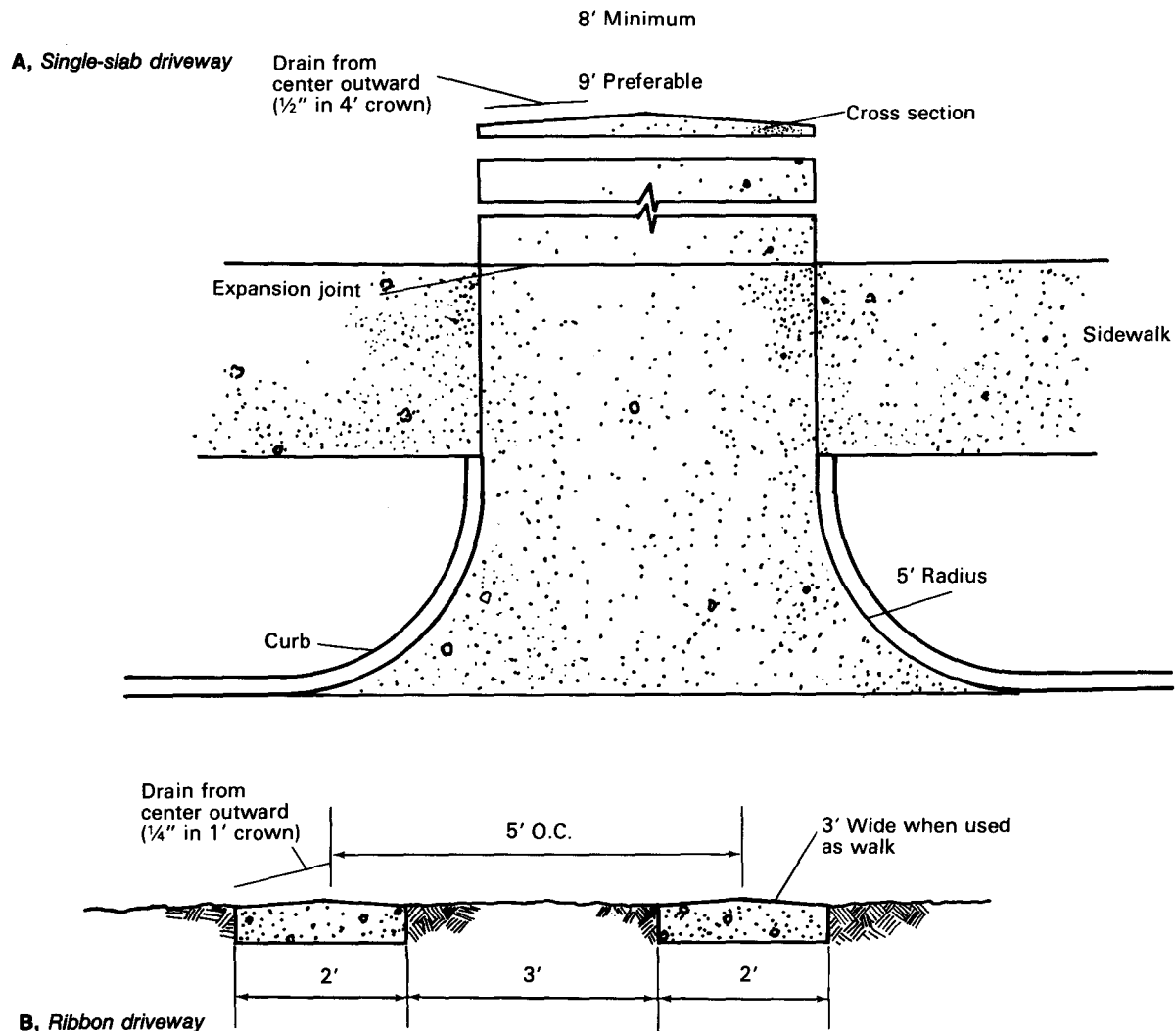


**Figure 148 – Driveway details:**



10 feet wide to allow for a parked car as well as a walkway. The width should be increased by at least 1 foot at curves. The radius of the drive at the curb should be at least 5 feet (fig. 148A). Relatively short double driveways should be at least 18 feet wide, and 2 feet wider when they are also to be used as a walk from the street.

The concrete strips in a ribbon driveway should be at least 2 feet in width and located so that they are 5 feet on center (fig. 148B). When the ribbon is also used as a walk, the width of strips should be increased to at least 3 feet.

A 5-bag or 5½-bag commercial concrete mix is ordinarily used for driveways. However, a 5½-bag to 6-bag mix containing an air-entraining mixture should be used in areas having severe winter climates. Pouring a concrete driveway over an area that has been recently filled is poor practice unless the fill, preferably gravel, has settled and is well tamped. A gravel base is not

ordinarily required on sandy undisturbed soil but should be used in all other conditions. Concrete should be about 4 inches thick. Lengths of 2 by 4 are often used for side forms to produce a 3½-inch-thick slab. The side forms establish the elevation and alignment of the driveway and are used for finishing the top surface of the concrete.

Under most conditions, the use of steel reinforcing is good practice. Steel mesh, 6 by 6 inches in size and installed in the upper one-third of the poured concrete, normally prevents or minimizes cracking.

Isolation joints, sometimes called expansion joints, should be used (a) at the junction of the driveway with the public walk or curb, (b) at the junction with the garage slab, and (c) about every 40 feet on long driveways. The purpose of the isolation joint is to separate two adjacent concrete sections that may move relative to each other. The isolation joint should be filled with a material

such as asphalt-impregnated fiber sheathing. The joint filler material should be set  $\frac{1}{2}$  inch below the concrete surface to allow placing of a sealant at the top to make the joint watertight.

Control joints should be provided at 10- to 12-foot intervals. These crosswise grooves, cut into the partially set concrete, predispose the concrete to crack in a controlled fashion along these lines during the cold weather rather than to form irregular cracks in other areas. In order to be effective, the control-joint depth should be approximately one-quarter of the concrete thickness.

Blacktop driveways, normally constructed by paving contractors, should also have a well-tamped gravel or crushed rock base. The top should be slightly crowned for drainage.

### Walkways

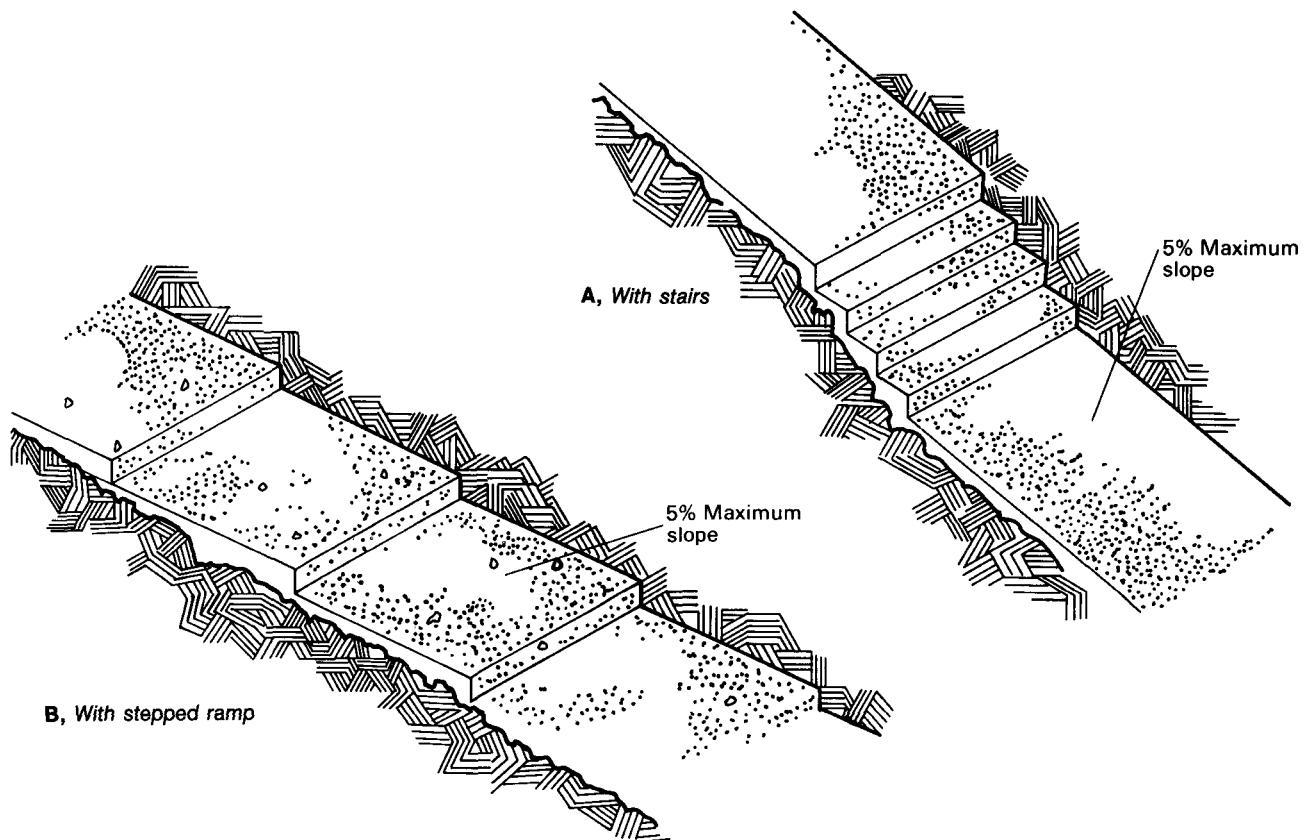
Main walkways generally extend from the front entry to the street or front sidewalk, or to a driveway leading to the street. A 5-percent grade is considered maximum for sidewalks; any greater slope usually requires steps. Walks should be at least 3 feet wide.

Concrete walkways should be constructed in the same general manner as concrete driveways. They should not be poured over filled areas unless such areas have settled and are very well tamped. This is especially true of the areas near the house after basement excavation backfill has been completed.

The thickness of the concrete over normal undisturbed soil should be about 4 inches. A 2 by 4 is commonly used as a side form. As described for concrete driveways, control joints should be used and spaced on 4-foot centers. Isolation joints should be used to separate the walkways from steps, driveway, and the public sidewalk.

When slopes to the house are greater than a 5-percent grade, stairs or steps should be used. This may be accomplished with a flight of stairs at a terrace, a continuing sidewalk (fig. 149A), or a ramp sidewalk (fig. 149B). Such stairs should have 11-inch treads and 7-inch risers when the total stair size is 30 inches or less. When the rise is more than 30 inches, the tread should be 12 inches and the riser 6 inches.

Figure 149 – Sidewalks on slopes:



For a moderately uniform slope, a stepped ramp may be satisfactory (fig. 149B). Generally, the rise should be about 6 inches to 6½ inches and the length between risers sufficient for two or three normal paces.

Walks can also be made of brick, flagstone, or other types of stone. Brick and stone are often placed directly over a well-tamped sand base. However, this system is not completely satisfactory where freezing of the soil is possible. For a more durable walk in cold climates, the brick or stone topping should be embedded in a freshly laid reinforced concrete base (fig. 150).

As with all concrete sidewalks and curbed or uncurbed driveways, a slight crown should be included in the walk for drainage. Joints between brick or stone may be filled with a cement mortar mix or with sand.

Walkways made of pressure-treated wood can be used in conjunction with decks. Two 2- by 4-inch boards can be fastened to the ground, 24 inches on center, with steel rebar stakes, to which 2 by 6 decking is attached. Such a walkway can lead to the wood steps of the deck.

**Figure 150** – *Offer sidewalks:*

