CHAPTER 4
EXTERIOR FINISH OF WALLS

In this chapter, we'll continue our discussion of exterior finishing. In chapter 3, we covered roof finishing; here, we'll examine the exterior finishing of walls, including exterior doors, windows, and glass.

EXTERIOR WALL COVERINGS

LEARNING OBJECTIVE: Upon completing this section, you should be able to identify the types of exterior wall coverings and describe procedures for installing siding.

Because siding and other types of exterior wall covering affect the appearance and the maintenance of a structure, the material and pattern should be selected carefully. Wood siding can be obtained in many different patterns and can be finished naturally, stained, or painted. Wood shingles, plywood, wood siding (paneling), fiberboard, and hardboard are some of the types of material used as exterior coverings. Masonry, veneers, metal or plastic siding, and other nonwood materials are additional choices. Many prefinished sidings are available, and the coatings and films applied to several types of base materials may eliminate the need of refinishing for many years.

WOOD SIDING

One of the materials most used for structure exteriors is wood siding. The essential properties required for siding are good painting characteristics, easy working qualities, and freedom from warp. Such properties are present to a high degree in cedar, eastern white pine, sugar pine, western white pine, cypress, and redwood; to a good degree in western hemlock, spruce, and yellow popular; and to a fair degree in Douglas fir and yellow pine.

Material

The material used for exterior siding that is to be painted should be of a high grade and free from knots, pitch. pockets, and uneven edges. Vertical grain and mixed grain (both vertical and flat) are available in some species, such as redwood and western red cedar. The moisture content at the time of application should be the same as what it will attain in service. To minimize seasonal movement due to changes in moisture content, choose vertical-grain (edge-grain) siding. While this is not as important for a stained finish, the use of edge-grain siding for a paint finish will result in longer paint life. A 3-minute dip in a water-repellent preservative before siding is installed will result in longer paint life and resist moisture entry and decay. Some manufacturers supply siding with this treatment. Freshly cut ends should be brush-treated on the job.

Patterns

Some wood siding patterns are used only horizontally and others only vertically. Some may be used in either manner if adequate nailing areas are provided. A description of each of the general types of horizontal siding follows.

PLAIN BEVEL.— Plain bevel siding (fig. 4-1) can be obtained in sizes from 1/2 by 4 inches to 1/2 by

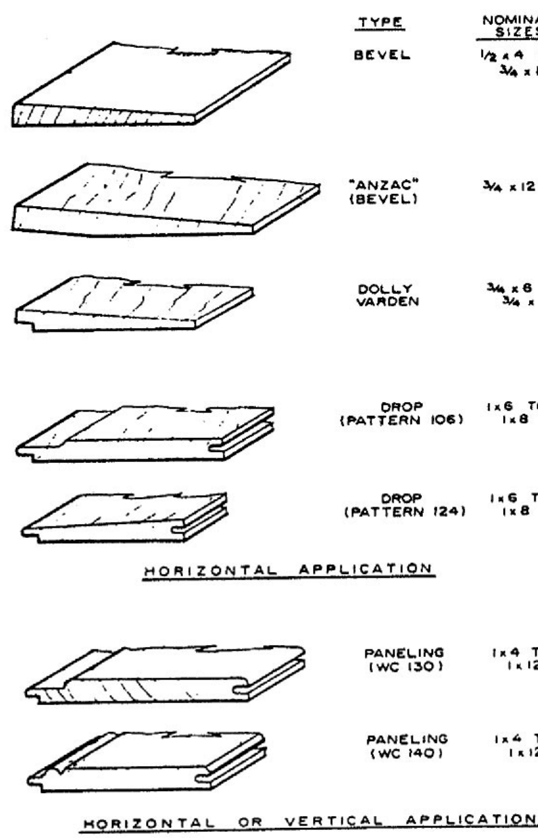


Figure 4-1.-Types of wood siding.

8 inches and also in sizes of 3/4 by 8 inches and 3/4 by 10 inches. "Anzac" siding is 3/4 by 12 inches in size. Usually, the finished width of bevel siding is about one-half inch less than the size listed. One side of beveled siding has a smooth planed surface, whereas the other has a rough resawn surface. For a stained finish, the rough or sawn side is exposed because wood stain works best and lasts longer on rough wood surfaces.

DOLLY VARDEN.— Dolly Varden siding is similar to true bevel siding except that it has shiplap edges. The shiplap edges have a constant exposure distance (fig. 4-1). Because it lays flat against the studs, it is sometimes used for garages and similar buildings without sheathing. Diagonal bracing is therefore needed to stiffen the building and help the structure withstand strong winds and other twist and strain forces.

DROP SIDING.— Regular drop siding can be obtained in several patterns, two of which are shown in figure 4-1. This siding, with matched or shiplap edges, is available in 1- by 6-inch and 1- by 8-inch sizes. It is commonly used for low-cost dwellings and for garages, usually without sheathing. Tests have shown that the tongue-and-grooved (matched) patterns have greater resistance to the penetration of wind-driven rain than the shiplap patterns, when both are treated with a water-repellent preservative.

Fiberboard and Hardboard

Fiberboard and hardboard sidings are also available in various forms. Some have a backing to provide rigidity and strength, whereas others are used directly over sheathing. Plywood horizontal lap siding, with a medium-density overlaid surface, is also available as an exterior covering material. It is usually 3/8 inch thick and 12 or 16 inches wide. It is applied in much the same manner as wood siding, except that a shingle wedge is used behind each vertical joint.

A number of siding or paneling patterns can be used horizontally or vertically (fig. 4-1). These are manufactured in nominal 1-inch thicknesses and in widths from 4 to 12 inches. Both dressed and matched and shiplapped edges are available. The narrow and medium-width patterns are usually more satisfactory under moderate moisture content changes. Wide patterns are more successful if they are vertical-grained (to keep shrinkage to a minimum). The correct moisture content is necessary in tongue-and-groove material to prevent shrinkage and tongue exposure.

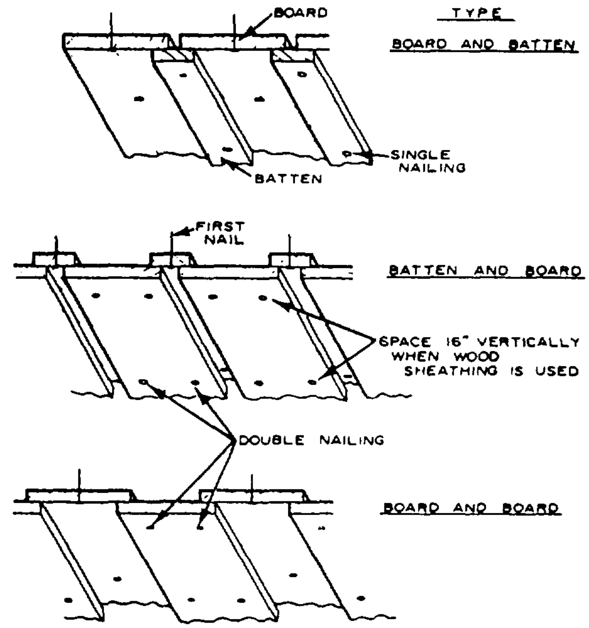


Figure 4-2.-Vertica1 board siding.

Treatment

Treating the edges of drop, matched, and shiplapped sidings with water-repellent preservative helps prevent wind-driven rain from penetrating the joints exposed to the weather. In areas under wide overhangs or in porches or other protected sections, the treatment is not as important. Some manufacturers provide siding with this treatment already applied.

Applications

A method of siding application, popular for some architectural styles, uses rough-sawn boards and battens applied vertically. These can be arranged in three ways: board and batten, batten and board, and board and board (fig. 4-2).

Sheet Materials

A number of sheet materials are now available for use as siding. These include plywood in a variety of face treatments and species, and hardboard. Plywood or paper-overlaid plywood, also known as panel siding, is sometimes used without sheathing. Paper-overlaid plywood has many of the advantages of plywood besides providing a satisfactory base for paint. A medium-density overlaid plywood is not common. Stud spacing of 16 inches requires a minimum thickness of panel siding of three-eighths inch. However, 1/2- or

5/8-inch-thick sheets perform better because of their greater thickness and strength.

Standard siding sheets are 4 by 8 feet; larger sizes are available. They must be applied vertically with intermediate and perimeter nailing to provide the desired rigidity. Most other methods of applying sheet materials require some type of sheathing beneath. Where horizontal joints are necessary, they should be protected by simple flashing.

An exterior-grade plywood should always be used for siding and can be obtained in grooved, brushed, and saw-textured surfaces. These surfaces are usually finished with stain. If shiplap or matched edges are not provided, the joints should be waterproofed. Waterproofing often consists of caulking and a batten at each joint and a batten at each stud if closer spacing is desired for appearance. An edge treatment of water-repellent preservative will also aid in reducing moisture penetration. When plywood is being installed in sheet form, allow a 1/16-inch edge and end spacing.

Exterior-grade particle board might also be considered for panel siding. Normally, a 5/8-inch thickness is required for 16-inch stud spacing and 3/4-inch thickness for 24-inch stud spacing. The finish must be an approved paint, and the stud wall behind must have corner bracing.

Medium-density fiberboards might also be used in some areas as exterior coverings over certain types of sheathing. Many of these sheet materials resist the passage of water vapor. Hence, when they are used, it is important that a good vapor barrier, well insulated, be used on the warm side of the insulated walls.

NONWOOD SIDING

Nonwood materials are used in some types of architectural design. Stucco or a cement-plaster finish, preferably over a wire mesh base, is common in the Southwest and the West Coast areas. Masonry veneers can be used effectively with wood siding in various finishes to enhance the beauty of both materials.

Some structures require an exterior covering with minimum maintenance. Although nonwood materials are often chosen for this reason, the paint industry is providing comparable long-life coatings for wood-base materials. Plastic films on wood siding and plywood are also promising because little or no refinishing is necessary for the life of the building.

Installation

Siding can be installed only after the window and doorframes are installed. In order to present a uniform appearance, the siding must line up properly with the drip caps and the bottom of the window and door sills. At the same time, it must lineup at the corners. Siding must be properly lapped to increase wind resistance and watertightness. In addition, it must be installed with the proper nails and in the correct nailing sequence.

Fasteners

One of the most important factors in the successful performance of various siding materials is the type of fasteners used. Nails are the most common, and it is poor economy to use them sparingly. Galvanized, aluminum, and stainless steel corrosive-resistant nails may cost more, but their use will ensure spot-free siding under adverse conditions. Ordinary steel-wire nails should not be used to attach siding since they tend to rust in a short time and stain the face of the siding. In some cases, the small-head rails will show rust spots through the putty and paint. Noncorrosive nails that will not cause rust are readily available.

Two types of nails are commonly used with siding: the small-head finishing nail and the moderate-size flathead siding roil.

The small-head finishing nail is set (driven with a nail set) about 1/16 inch below the face of the siding, The hole is filled with putty after the prime coat of paint has been applied. The more commonly used flathead siding nail is nailed flush with the face of the siding and the head later covered with paint.

If the siding is to be natural finished with a water-repellent preservative or stain, it should be fastened with stainless steel or aluminum nails. In some types of prefinished sidings, nails with color-matched heads are supplied.

Nails with modified shanks are available. These include the annularly (ring) threaded shank nail and the spirally threaded shank nail. Both have greater withdrawal resistance than the smooth-shank nail, and, for this reason, a shorter nail is often used.

In siding, exposed nails should be driven flush with the surface of the wood Overdriving may not only show the hammer mark, but may also cause objectionable splitting and crushing of the wood. In sidings with prefinished surfaces or overlays, the nails should be driven so as not to damage the finished surface.

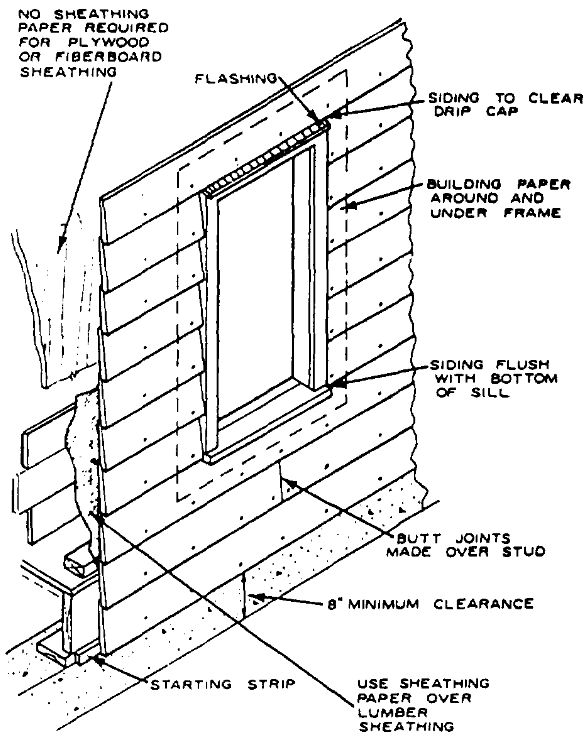


Figure 4-3.-Installation of bevel siding.

Exposure

The minimum lap for bevel siding is 1 inch. The average exposure distance is usually determined by the distance from the underside of the window sill to the top of the drip cap (fig. 4-3). From the standpoint of weather resistance and appearance, the butt edge of the first course of siding above the window should coincide with the top of the window drip cap. In many one-story structures with an overhang, this course of siding is often replaced with a frieze board It is also desirable that the bottom of a siding course be flush with the underside of the window sill. However, this may not always be possible because of varying window heights and types that might be used in a structure.

One system used to determine the siding exposure width so that it is approximately equal above and below the window sill is as follows:

1. Divide the overall height of the window frame by the approximate recommended exposure distance for the siding used (4 inches for 6-inch-wide siding, 6 inches for 8-inch-wide siding, 8 inches for 10-inch-wide siding, and 10 inches for 12-inch-wide siding). This result will be the number of courses between the top and the bottom of the window. For example, the overall height of our sample window from the top of the drip cap to the bottom of the sill is 61 inches. If 12-inch-wide siding is used, the number of courses would be 61/10 = 6.1, or six courses. To obtain the exact exposure distance, divide 61 by 6 and the result would be 10 1/6 inches.
2. Determine the exposure distance from the bottom of the sill to just below the top of the foundation wall. If this distance is 31 inches, use three courses of 10 1/3 inches each. Thus, the exposure distance above and below the window would be almost the same (fig. 4-3).

When this system is not satisfactory because of big differences in the two areas, it is preferable to use an equal exposure distance for the entire wall height and notch the siding at the window sill. The fit should be tight to prevent moisture from entering.

Installation

Siding may be installed starting with a bottom course. It is normally blocked out with a starting strip the same thickness as the top of the siding board (fig. 4-3). Each succeeding course overlaps the upper edge of the course below it. Siding should be nailed to each stud or on 16-inch centers. When plywood, wood sheathing, or spaced wood nailing strips are used over nonwood sheathing, 7d or 8d nails may be used for 3/4-inch-thick siding. However, if gypsum or fiberboard sheathing is used, 10d nails are recommended to properly penetrate the stud For 1/2-inch-thick siding, nails may be 1/4 inch shorter than those used for 3/4-inch siding.

The nails should be located far enough up from the butt to miss the top of the lower siding course (fig. 4-4). The clearance distance is usually 1/8 inch. This allows for slight movement of the siding because of moisture changes without causing splitting. Such an allowance is especially required for the wider (8 to 12 inch) siding.

Joints

It is good construction practice to avoid butt joints whenever possible. Use the longer sections of siding under windows and other long stretches, and use the shorter lengths for areas between windows and doors. When a butt joint is necessary, it should be made over a stud and staggered between courses.

Siding should be square cut to provide good joints. Open joints permit moisture to enter and often lead to paint deterioration. It is a good practice to brush or dip

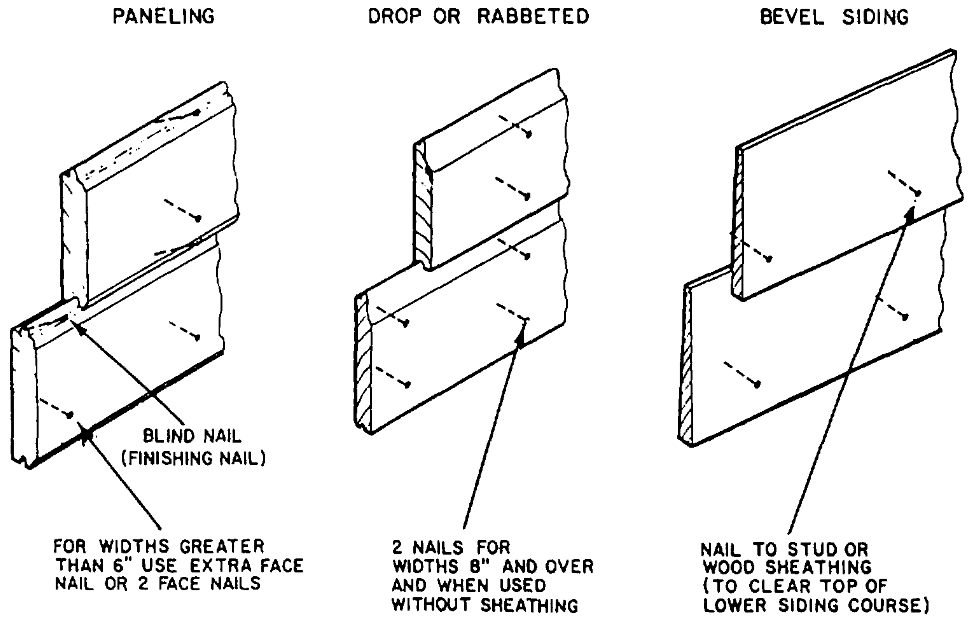


Figure 4-4.-Nailing the siding.

the fresh cut ends of the siding in a water-repellent preservative before boards are roiled in place. After the siding is in place, it is helpful to use a small finger-actuated oil can to apply the water-repellent preservative to the ends and butt joints.

Drop siding is installed in much the same way as lap siding except for spacing and nailing. Drop, Dolly Varden, and similar sidings have a constant exposure distance. The face width is normally 5 1/4 inches for 1- by 6-inch siding and 7 1/4 inches for 1- by 8-inch siding. Normally, one or two nails should be used at each stud, depending on the width (fig. 4-4). The length of the nail depends on the type of sheathing used, but penetration into the stud or through the wood backing should beat least 1 1/2 inches.

Application

There are two ways to apply nonwood siding: horizontally and vertically. Note that these are manufactured items. Make sure you follow the recommended installation procedures.

HORIZONTALLY.— Horizontally applied matched paneling in narrow widths should be blind-nailed at the tongue with a corrosion-resistant finishing nail (fig. 4-4). For widths greater than 6 inches, an additional nail should be used as shown.

Other materials, such as plywood, hardboard, or medium-density fiberboard, are used horizontally in widths up to 12 inches. They should be applied in the same manner as lap or drop siding, depending on the pattern. Prepackaged siding should be applied according to the manufacturer's directions.

VERTICALLY.— Vertically applied siding and sidings with interlapping joints should be nailed in the same manner as those applied horizontally. However, they should be nailed to blocking used between studs or to wood or plywood sheathing. Blocking should be spaced from 16 to 24 inches OC. With plywood or nominal 1-inch board sheathing, nails should be spaced on 16-inch centers only.

When the various combinations of boards and battens are used, they should also be nailed to blocking spaced from 16 to 24 inches OC between studs, or closer for wood sheathing. The first boards or battens should be fastened with nails at each blocking to provide at least 1 1/2 inches of penetration. For wide underboards, two nails spaced about 2 inches apart maybe used rather than the single row along the center (fig. 4-2). Nails of the top board or batten should always miss the underboards and should not be nailed through them (fig. 4-2). In such applications, double nails should be spaced closely to prevent splitting if the board shrinks. It is also a good practice to use sheathing paper, such as 15-pound asphalt felt, under vertical siding.

Exterior-grade plywood, paper-overlaid plywood, and similar sheet materials used for siding are usually applied vertically. The nails should be driven over the studs, and the total effective penetration into the wood should be at least 1 1/2 inches. For example, 3/8-inch plywood siding over 3/4-inch wood sheathing would require a 7d nail (which is 2 1/4 inches long). This would result in a 1 1/8-inch penetration into the stud, but a total effective penetration of 1 7/8 inches into the wood sheathing.

The joints of all types of sheet material should be caulked with mastic unless the joints are of the interlapping or matched type of battens. It is a good practice to place a strip of 15-pound asphalt felt under joints.

CORNER COVERINGS

The outside corners of a wood-framed structure can be finished in several ways. Siding boards can be miter-joined at the corners. Shingles can be edge-lapped alternately. The ends of siding boards can be butted at the corners and then covered with a metal cap.

Corner Boards

A type of corner finish that can be used with almost any kind of outside-wall covering is called a corner board. This corner board can be applied to the corner with the siding or shingles end-or-edge-butted against the board.

A corner board usually consists of two pieces of stock: one piece 3 inches wide and the other 4 inches wide if an edge-butt joint between the corner boards is used. The boards are cut to a length that will extend from the top of the water table to the bottom of the frieze. They are edge-butted and nailed together before they are nailed to the corner. This procedure ensures a good tight joint (fig. 4-5). A strip of building paper should be tacked over the corner before the corner board is nailed in position (always allow an overlap of paper to cover the subsequent crack formed where the ends of the siding butts against the corner board).

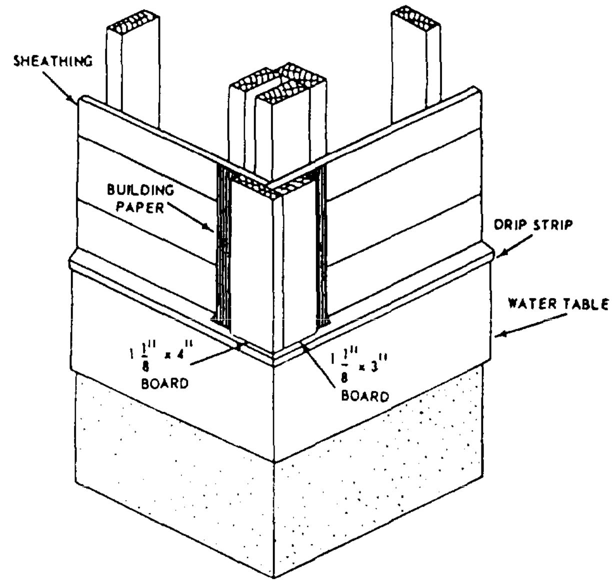


Figure 4-5.-Corner board.

Interior Corners

Interior corners (fig. 4-6, view A) are butted against a square corner board of nominal 1 1/4- or 1 3/8-inch size, depending on the thickness of the siding.

Mitered Corners

Mitering the corners (fig. 4-6, view B) of bevel and similar sidings is often not satisfactory, unless it is carefully done to prevent openings. A good joint must fit tightly the **full depth of the miter.** You should also treat the ends with a water-repellent preservative before nailing.

Metal Corners

Metal corners (fig. 4-6, view C) are perhaps more commonly used than the mitered corner and give a mitered effect. They are easily placed over each corner as the siding is installed. The metal corners should fit tightly and should be nailed on each side to the sheathing or corner stud beneath. When made of galvanized iron, they should be cleaned with a mild acid wash and primed with a metal primer before the structure is painted to prevent early peeling of the paint. Weathering of the metal will also prepare it for the prime paint coat.

corner boards (fig. 4-5) of various types and sizes may be used for horizontal sidings ofaall types. They also provide a satisfactory termination for plywood and similar sheet materials. Vertical applications of matched paneling or of boards and battens are terminated by lapping one side and nailing into the edge of this member, as well as to the nailing members beneath. corner boards are usually 1 1/8 or 1 3/8 inches wide. To give a distinctive appearance, they should be quite narrow. Plain outside casing, commonly used for window and doorframes, can be adapted for corner boards.

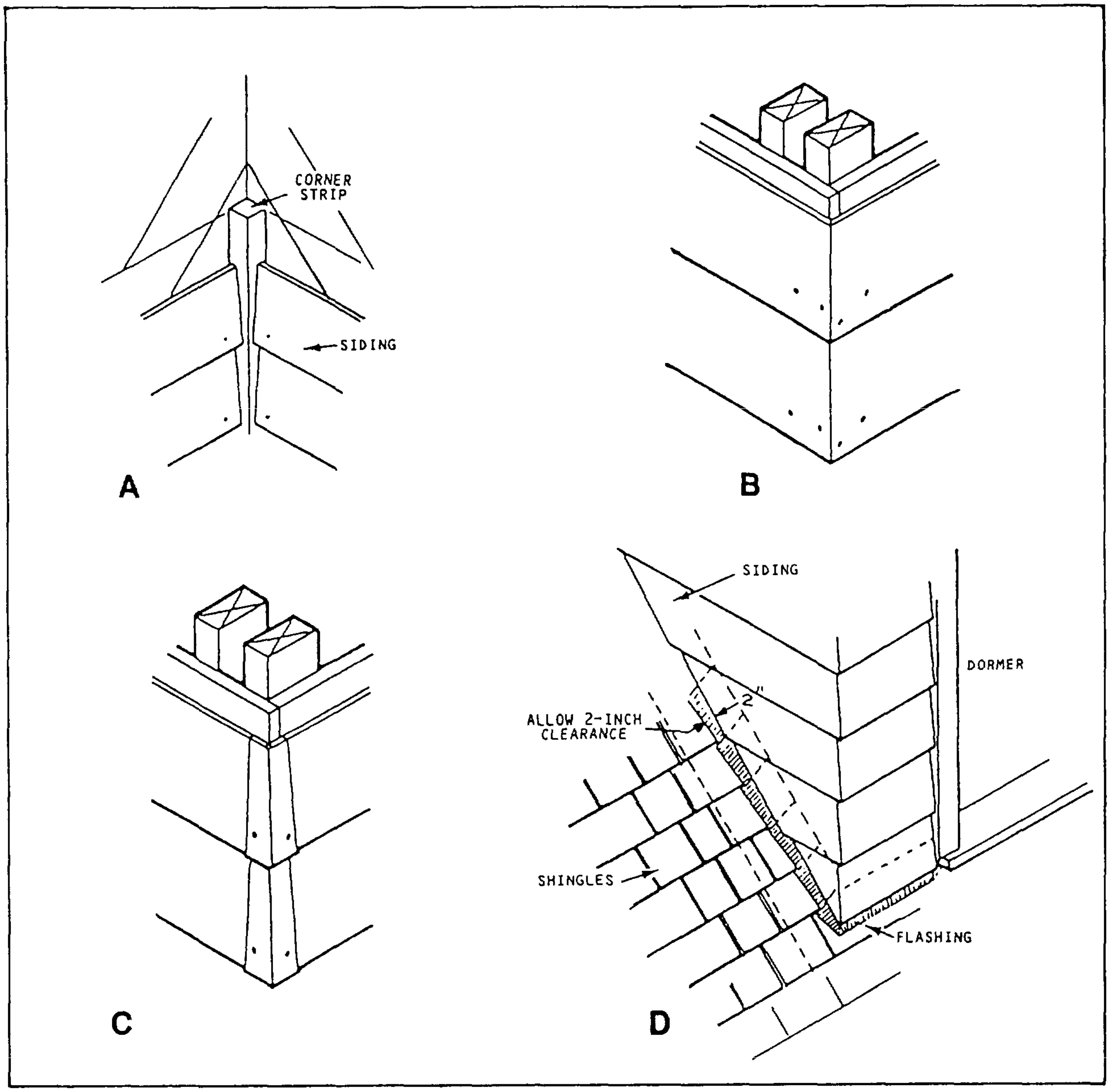


Figure 4-6.-Siding details: A. Interior corners; B. Mitered corners; C. Metal corners; D. Siding return of roof.

Shingles and Shakes

Prefinished shingle or shake exteriors are sometimes used with color-matched metal corners. They can also be lapped over the adjacent corner shingle, alternating each course. This kind of corner treatment, called lacing, usually requires that flashing be used beneath.

When siding returns against a roof surface, such as at the bottom of a dormer wall, there should be a 2-inch clearance (fig. 4-6, view D). Siding that is cut for a tight fit against the shingles retains moisture after rains and usually results in peeling paint. Shingle flashing extending well up on the dormer wall will provide the necessary resistance to entry of wind-driven rain. Here again, a water-repellent preservative should be used on the ends of the siding at the roof line.

GABLE ENDS

At times, the materials used in the gable ends and in the walls below differ in form and application. The details of construction used at the juncture of the two materials should be such that good drainage is assured. For example, when vertical boards and battens are used at the gable end and horizontal siding below, a drip cap

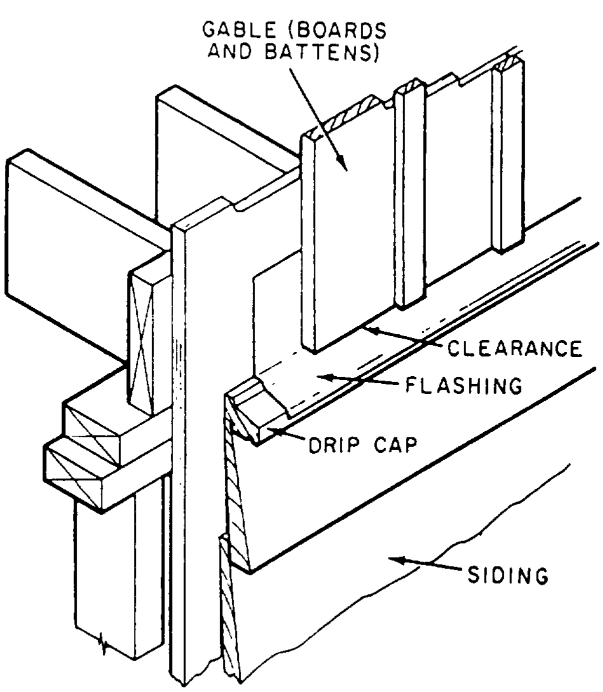


Figure 4-7.-Cable-end finish (material transition).

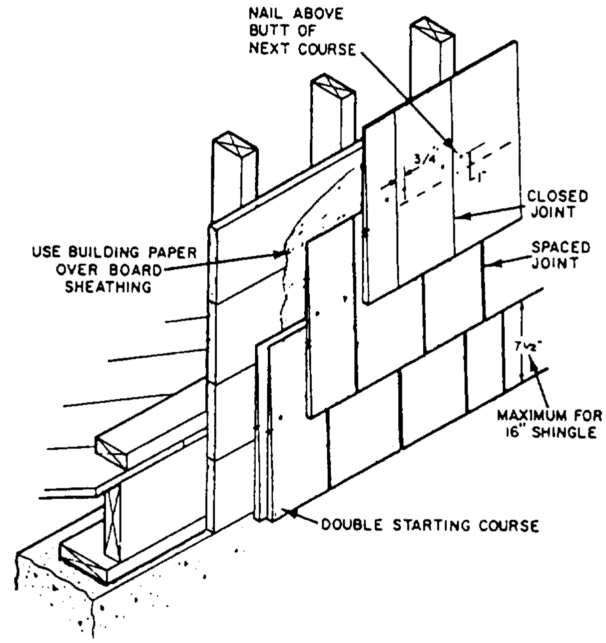


Figure 4-8.-Single coursing of sidewalls (wood shingles and shakes).

or similar molding should be used (fig. 4-7). Flashing should be used over and above the drip cap so that moisture cannot enter this transition area.

PATTERNS

Wood shingles and shakes are applied in a single- or double-course pattern. They maybe used over wood or plywood sheathing. When sheathing with 3/8-inch plywood, use threaded nails. For nonwood sheathing, 1-by 3-inch or 1- by 4-inch wood nailing strips are used as a base.

In the single-course method, one course is simply laid over the other as lap siding is applied. The shingles can be second grade because only one-half or less of the butt portion is exposed (fig. 4-8). Shingles should not be soaked before application but should usually be laid with about 1/8- to 1/4-inch space between adjacent shingles to allow for expansion during rainy weather. When a siding effect is desired, shingles should be laid so that they are in contact, but only lightly. Pre-stained or treated shingles provide the best results.

In a double-course system, the undercourse is applied over the wall, and the top course is nailed directly over a 1/4-to 1/2-inch projection of the butt (fig. 4-9). The first course should be nailed only enough to hold it in place while the outer course is being applied.

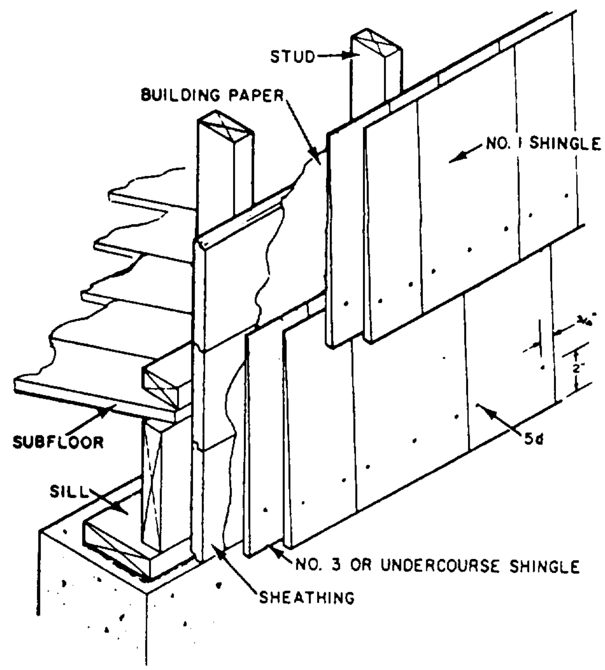


Figure 4-9.-Double coursing of side walls (wood shingles and shakes).

The first shingles can be a lower quality. Because much of the shingle length is exposed, the top course should be first-grade shingles.

Shingles and shakes should be applied with rust-resistant nails long enough to penetrate into the

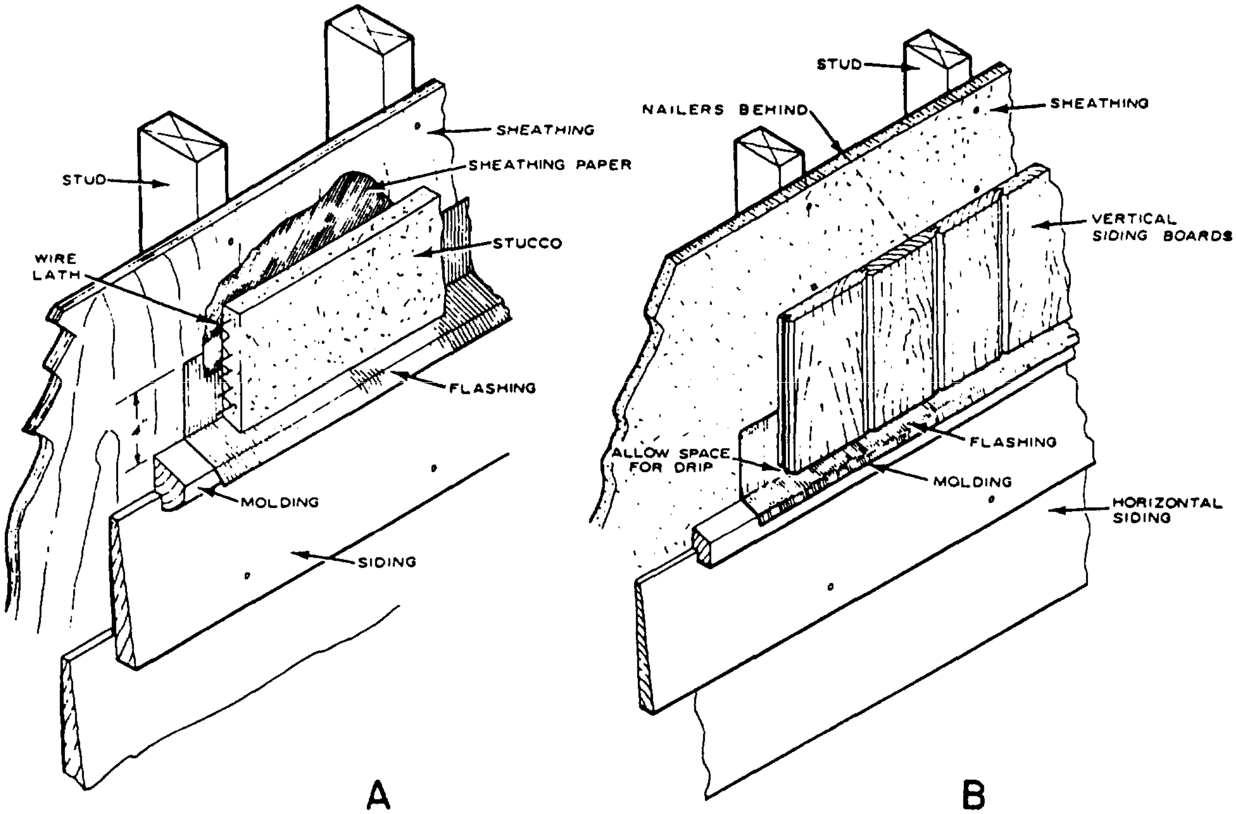


Figure 4-10.-Flashing of material changes: A. Stucco above, siding below, B. Vertical siding above, horizontal below.

wood backing strips or sheathing. In a single course, a 3d or 4d zinc-coated shingle nail is commonly used. In a double course, where nails are exposed, a 5d zinc-coated nail with a small flat head is used for the top course, and a 3d or 4d size for the undercourse. Use building paper over lumber sheathing.

FLASHING

Flashing should be installed at the junction of material changes, chimneys, and roof-wall intersections. It should also be used overexposed doors and windows, roof ridges and valleys, along the edge of a pitched roof, and any other place where rain and melted snow may penetrate.

To prevent corrosion or deterioration where unlike metals come together, use fasteners made of the same kind of metal as the flashing. For aluminum flashing, use only aluminum or stainless steel nails, screws, hangers, and clips. For copper flashing, use copper nails and fittings. Galvanized sheet metal or terneplate should be fastened with galvanized or stainless steel fasteners. (Terneplate is a steel plate coated with an alloy of lead and a small amount of tin.)

One wall area that requires flashing is at the intersection of two types of siding materials. For example, a stucco-finish gable end and a wood-siding lower wall should be flashed (fig. 4-10, view A). A wood molding, such as a drip cap, separates the two materials and is covered by the flashing, which extends at least 4 inches above the intersection. When sheathing paper is used, it should lap the flashing (fig. 4-10, view A).

When a wood-siding pattern change occurs on the same wall, the intersection should also be flashed. A vertical board-sided upper wall with horizontal siding below usually requires some type of flashing (fig. 4-10, vie w B). A small space above the molding provides a drip for rain. This will prevent paint peeling, which could occur if the boards were in tight contact with the molding. A drip cap (fig. 4-7) is sometimes used as a terminating molding.

DOOR AND WINDOW FLASHING

The same type of flashing as shown in figure 4-10, view A, should be used over door and window openings exposed to driving rain. However, window and door heads protected by wide overhangs in a single-story structure with a hip roof do not ordinarily require the

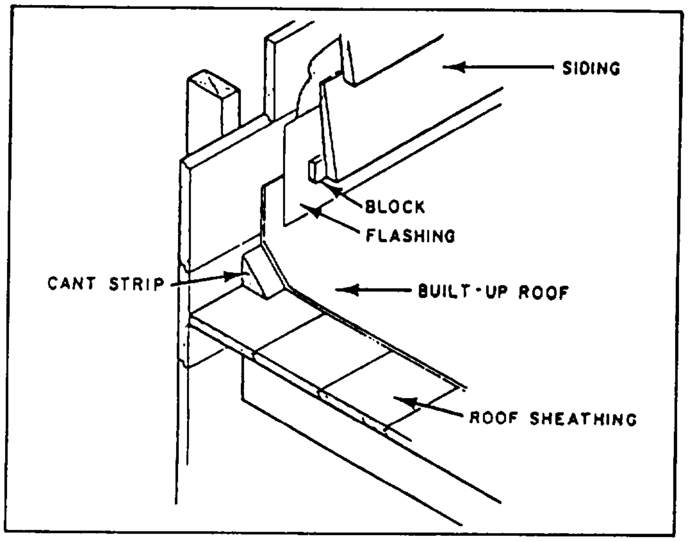


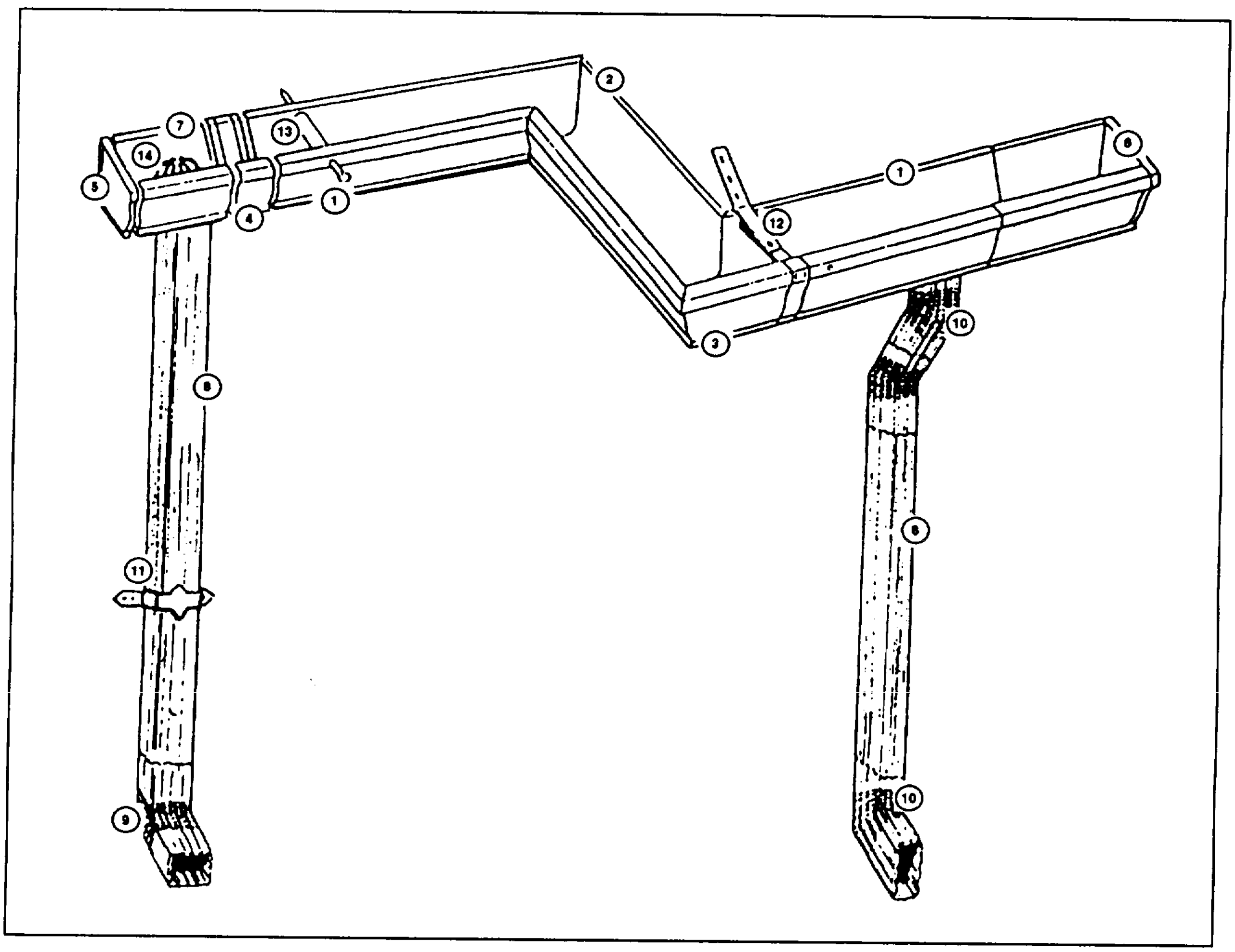
Figure 4-11-Flashing at the intersection of an exterior wall and a flat or low-pitched roof.

flashing. When building paper is used on the sidewalls, it should lap the top edge of the flashing. To protect the walls behind the window sill in a brick veneer exterior, extend the flashing under the masonry sill up the underside of the wood sill.

Flashing is also required at the junctions of an exterior wall and a flat or low-pitched built-up roof (fig. 4-11). Where a metal roof is used, the metal is turned up on the wall and covered by the siding. A clearance should be allowed at the bottom of the siding to protect against melted snow and rain.

GUTTERS AND DOWNSPOUTS

Several types of gutters are available to carry the rainwater to the downspouts and away from the



1. Gutter
2. Inside miter
3. Outside miter
4. Slip joint connectors
5. End cap "L"
6. End cap "R"
7. "D" end pieces
8. Downspout
9. "A" elbows
10. "B" elbows
11. Leader straps
12. Hangers
13. 7" spike, 5" ferrule
14. Strainer basket

Figure 4-12.-Parts of a metal gutter system.

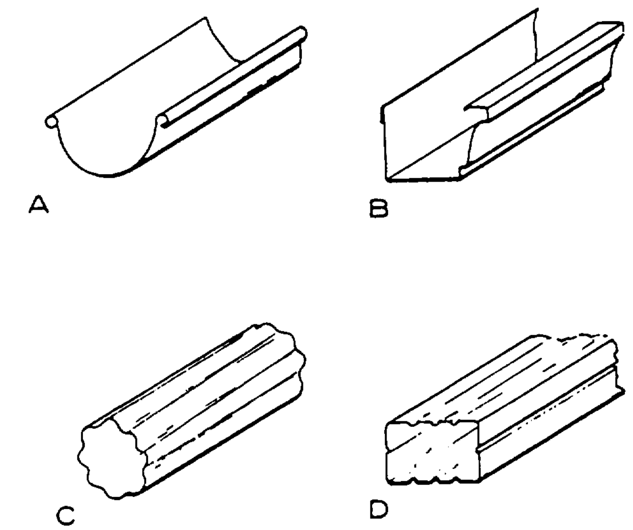


Figure 4-13.-Gutters and downspouts: A. Half-round gutter; B. "K" style gutter C. Round downspout; D. Rectangular downspout.

foundation. On flat roofs, water is often drained from one or more locations and carried through an inside wall to an underground drain. All downspouts connected to an underground drain should be fitted with basket strainers (fig. 4-1 2) at the junctions of the gutter.

Perhaps the most commonly used gutter is the type hung from the edge of the roof or fastened to the edge of the cornice fascia. Metal gutters may be the half-round (fig. 4-13, view A) or "K" style (view B) and may be made of galvanized metal, copper, or aluminum. Some have a factory-applied enamel finish.

Downspouts are round or rectangular (fig. 4-13, views C and D). The round type is used for the half-round gutters. They are usually corrugated to provide extra stiffness and strength. Corrugated patterns are less likely to burst when plugged with ice.

On long runs of gutters, such as required around a hip-roof structure, at least four downspouts are desirable. Gutters should be installed with a pitch of 1 inch per 16 feet toward the downspouts. Formed or half-round gutters are suspended with flat metal hangers (fig. 4-14, views A and B). Spike and ferrule hangers are also used with formed gutters (view C). Gutter hangers should be spaced 3 feet OC.

Gutter splices, corner joints, and downspout connections should be watertight. Downspouts should be fastened to the wall by leaderstraps (fig. 4-12) or hooks. One strap should be installed at the top, one at the bottom, and one at each intermediate joint. An elbow is used at the bottom to guide the water to a splash block

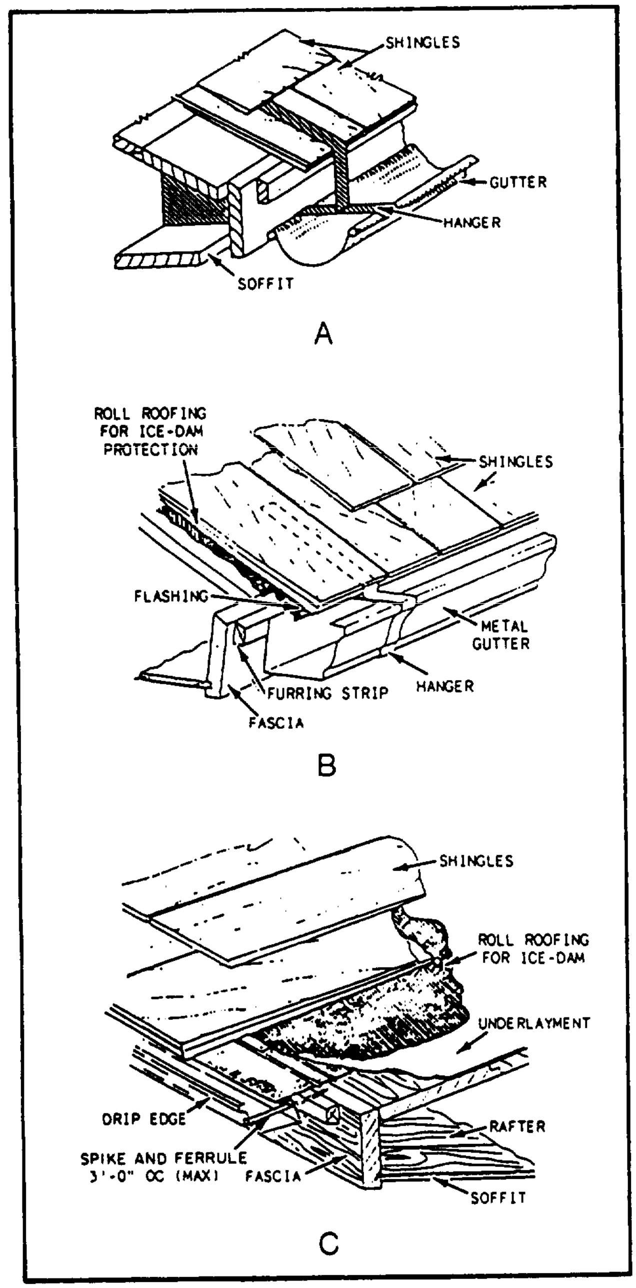


Figure 4-14.-Gutter hangers: A. Flat metal hanger with half-round gutter; B. Flat metal hanger with "K" style metal gutter; C. Spike and ferrule with formed gutter.

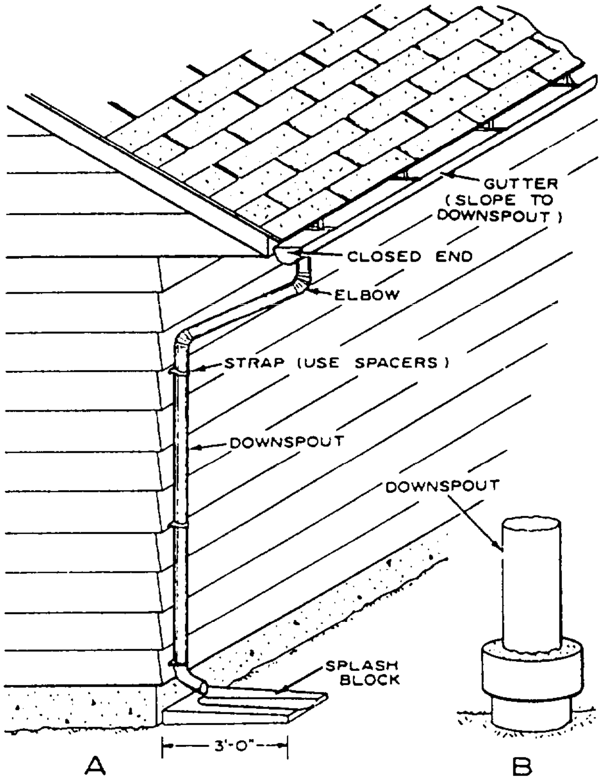


Figure 4-15.-Downspout installation: A. Downspout with splash block; B. Drain to storm sewer.

(fig. 4-15, view A), which carries the water away from the foundation. The minimum length of a splash block should be 3 feet. In some areas, the downspout drains directly into a tile line, which carries the water to a storm sewer (view B).

EXTERIOR DOORS

LEARNING OBJECTIVE: Upon completing this section, you should be able to identify the types of exterior doors and describe basic exterior doorjamb installation procedures.

Many types of exterior doors are available to provide access, protection, safety, and privacy. Wood, metal, plastic, glass, or a combination of these materials are used in the manufacture of doors. The selection of door type and material depends on the degree of protection or privacy desired, architectural compatibility, psychological effect, fire resistance, and cost.

DOOR TYPES

Better quality exterior doors are of solid-core construction. The core is usually fiberglass, or the door is metal-faced with an insulated foam core. Solid-core doors are used as exterior doors because of the heavy service and the additional fireproofing. Hollow-core doors are normally used for interior applications. Wood doors are classified by design and method of construction as panel or flush doors.

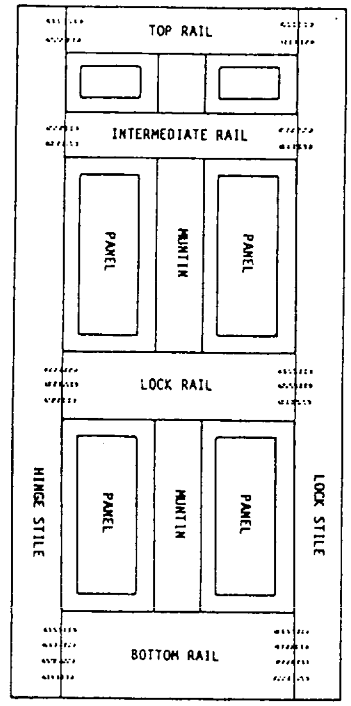


Figure 4-16.-Parts of a Six-panel door.

Panel Doors

A panel door, or stile-and-rail door, consists of vertical members called stiles and horizontal members called rails. The stiles and rails enclose panels of solid wood, plywood, louvers, or glass (fig. 4-16). The stiles extend the full height at each side of the door. The vertical member at the hinged side of the door is called the hinge, or hanging, stile, and the one to which the latch, lock, or push is attached is called the closing, or lock, stile. Three rails run across the full width of the door between the stiles: the top rail, the intermediate or lock rail, and the bottom rail. Additional vertical or horizontal members, called muntins, may divide the door into any number of panels. The rails, stiles, and muntins maybe assembled with either glued dowels or mortise-and-tenon joints.

Sash Doors

Panel doors in which one or more panels are glass are classed as sash (glazed) doors. Fully glazed panel

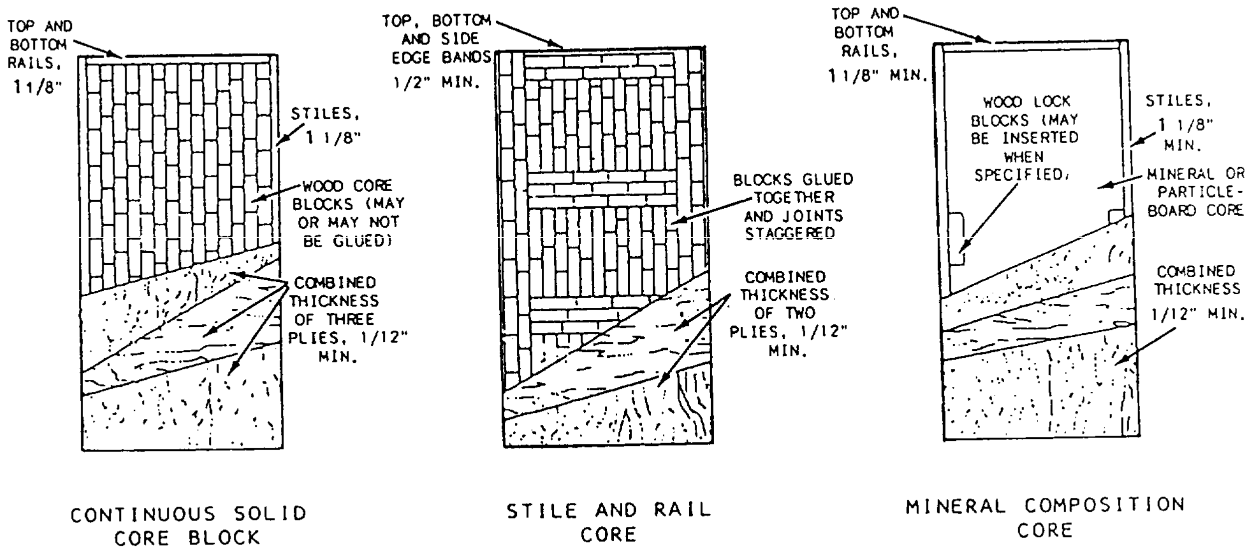


Figure 4-17.-Three types of solid-core doors.

doors with only atop and bottom rail, without horizontal or vertical muntins, are refereed to as “casement” or “French doors.” Storm doors are lightly constructed glazed doors. They are used in conjunction with exterior doors to improve weather resistance. Combination doors consist of interchangeable or hinged glass and screen panels.

Flush Doors

Flush doors are usually made up of thin sheets of veneer over a core of wood, particle board, or fiberboard. The veneer faces act as stressed-skin panels and tend to stabilize the door against warping. The face veneer may be of ungraded hardwood suitable for a plain finish or selected hardwood suitable for a natural finish. The appearance of flush doors maybe enhanced by the application of plant-on decorative panels. Both hollow-core and solid-core doors usually have solid internal rails and stiles so that hinges and other hardware may be set in solid wood.

Two types of solid wood cores are widely used in flush-door construction (fig. 4-17). The first type, called a continuous-block, strip- or wood-stave core, consists of low-density wood blocks or strips that are glued together in adjacent vertical rows, with the end joints staggered. This is the most economical type of solid core. However, it is subject to excessive expansion and contraction unless it is sealed with an impervious skin, such as a plastic laminate.

The second type is the stile-and-rail core, in which blocks are glued up as panels inside the stiles and rails. This type of core is highly resistant to warpage and is more dimensionally stable than the continuous-block core.

In addition to the solid lumber cores, there are two types of composition solid cores. Mineral cores (see fig. 4-17) consist of inert mineral fibers bonded into rigid panels. The panels are framed within the wood rails and stiles, resulting in a core that is light in weight and little affected by moisture. Because of its low density, this type of door should not be used where sound control is important.

The other type (not shown) has particleboard, flakeboard, or waferboard cores, consisting of wood chips or vegetable fibers mixed with resins or other binders, formed under heat and pressure into solid panels. This type of core requires a solid-perimeter frame. Since particleboard has no grain direction, it provides exceptional dimensional stability and freedom from warpage. Because of its low screw-holding ability, it is usually desirable to install wood blocks in the core at locations where hardware will be attached.

DOORJAMBS

The doorjamb is the part of the frame that fits inside the masonry opening or rough frame opening. Jambs may be wood or metal. The jamb has three parts: the two side jambs and the head jamb across the top. Exterior doorjambs have a stop as part of the jamb. The stop is the portion of the jamb that the face of the door closes against. The jamb is 1 1/4 inches thick with a 1/2-inch rabbet serving as a stop.

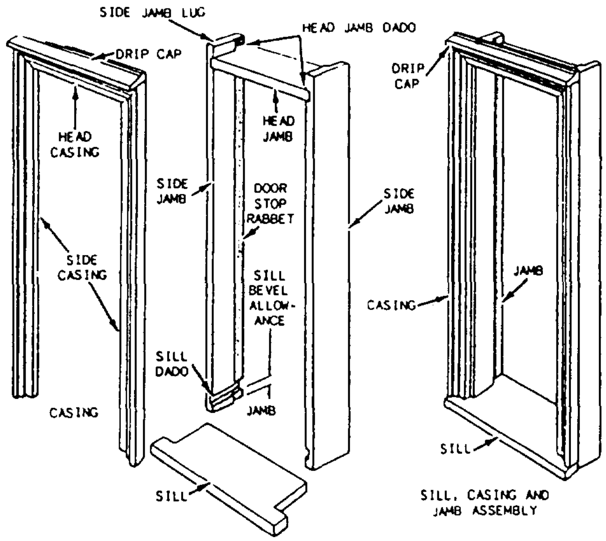


Figure 4-18.-Parts of an exterior doorframe.

Wood

Wood jambs are manufactured in two standard widths: 5 1/4 inches for lath and plaster and 4 1/2 inches for drywall. Jambs may be easily cut to fit walls of any thickness. If the jamb is not wide enough, strips of wood are nailed on the edges to form an extension. Jambs may also be custom made to accommodate various wall thicknesses.

Metal

Standard metal jambs are available for lath and plaster, concrete block, and brick veneer in 4 3/4-, 5 3/4-, 6 3/4-, and 8 3/4-inch widths. For drywall construction, the common widths available are 5 1/2 and 5 5/8 inches.

The sill is the bottom member in the doorframe. It is usually made of oak for wear resistance. When softer wood is used for the sill, a metal nosing and wear strips are generally included.

The brick mold or outside casings are designed and installed to serve as stops for the screen or combination door. The stops are provided for by the edge of the jamb and the exterior casing thickness (fig. 4-1 8).

Doorframes can be purchased knocked down (K. D.) or preassembled with just the exterior casing or brick mold applied. In some cases, they come preassembled with the door hung in the opening. When the doorframe is assembled on the job, nail the side

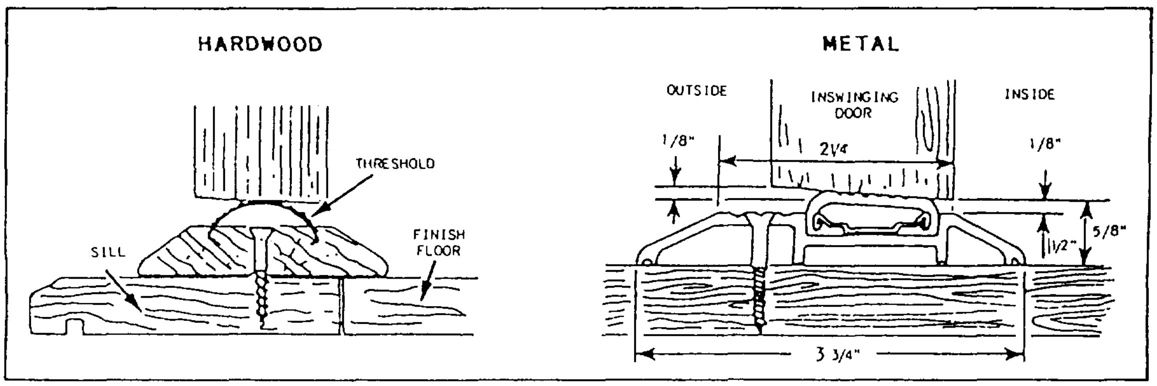


Figure 4-19.-Thresholds.

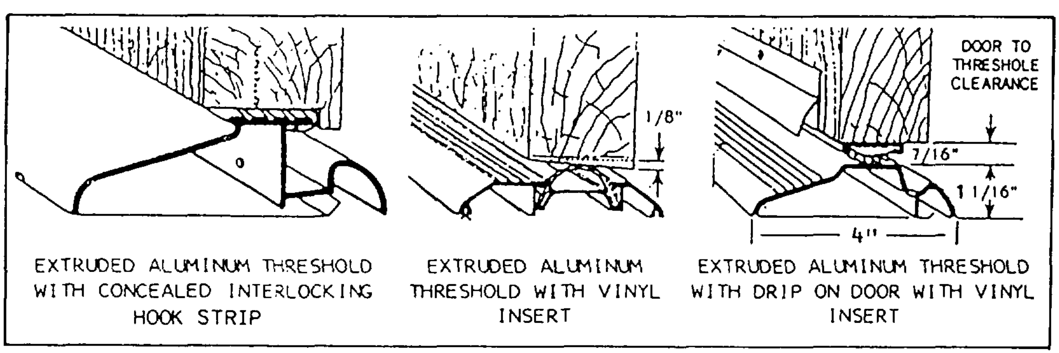


Figure 4-20.-Thresholds providing weatherproof seats.

jambs to the head jamb and sill with 10d casing nails. Then nail the casings to the front edges of the jambs with 10d casing nails spaced 16 inches OC.

Exterior doors are 1 3/4 inches thick and not less than 6 feet 8 inches high. The main entrance door is 3 feet wide, and the side or rear service door is 2 feet 8 inches wide. A hardwood or metal threshold (fig. 4- 19) covers the joint between the sill and the finished floor,

The bottom of an exterior door may be equipped with a length of hooked metal that engages with a specially shaped threshold to provide a weatherproof seal. Wood and metal thresholds are available with flexible synthetic rubber tubes that press tightly against the bottom of the door to seal out water and cold or hot air. These applications are shown in figure 4-20. Manufacturers furnish detailed instruction for installation.

DOOR SWINGS

Of the various types of doors, the swinging door is the most common (fig. 4-21). The doors are classed as either right hand or left hand, depending on which side is hinged. Stand outside the dear. If the hinges are on your left-hand side, it is a left-hand door. If the hinges are on your right, it is a right-hand door. For a door to swing freely in an opening, the vertical edge opposite the hinges must be beveled slightly. On a left-hand door that swings away from the viewer, a left-hand regular bevel is used; if the door opens toward the viewer, it has a left-hand reverse bevel. Similarly, if the hinges are on the right and the door swings toward the viewer, it has a right-hand reverse bevel.

A door that swings both ways through an opening is called a double-acting door. Two doors that are hinged on opposite sides of a doorway and open from the center are referred to as “double doors”; such doors are frequently double acting. One leaf of a double door may be equipped with an astragal— an extended lip that fits over the crack between the two doors. A Dutch door is one that is cut and hinged so that top and bottom portions open and close independently.

INSTALLING THE EXTERIOR DOORFRAME

Before installing the exterior doorframe, prepare the rough opening to receive the frame. The opening should be approximately 3 inches wider and 2 inches higher than the size of the door. The sill should rest firmly on the floor framing, which normally must be notched to accommodate the sill. The subfloor, floor joists, and stringer or header joist must be cut to a depth

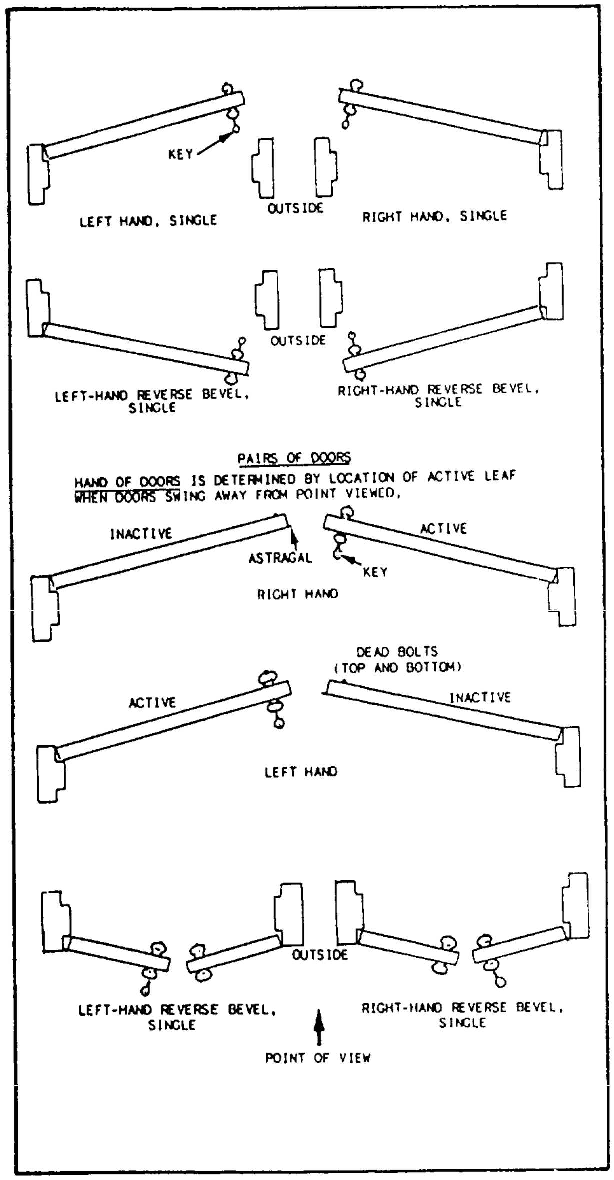


Figure 4-21.-Determining door swings.

that places the top of the sill flush with the finished floor surface.

Line the rough opening with a strip of 15-pound asphalt felt paper, 10 or 12 inches wide. In some structures, it may be necessary to install flashing over the bottom of the opening. The assembled frame is then set into the opening. Set the sill of the assembled doorframe on the trimmed-out area in the floor framing, tip the frame into place, center it horizontaly, and then secure it with temporary braces.

Using blocking and wedges, you should level the sill and bring it to the correct height (even with the finished floor). Be sure the sill is level and well supported. For masonry wall and slab floors, the sill is usually placed on a bed of mortar.

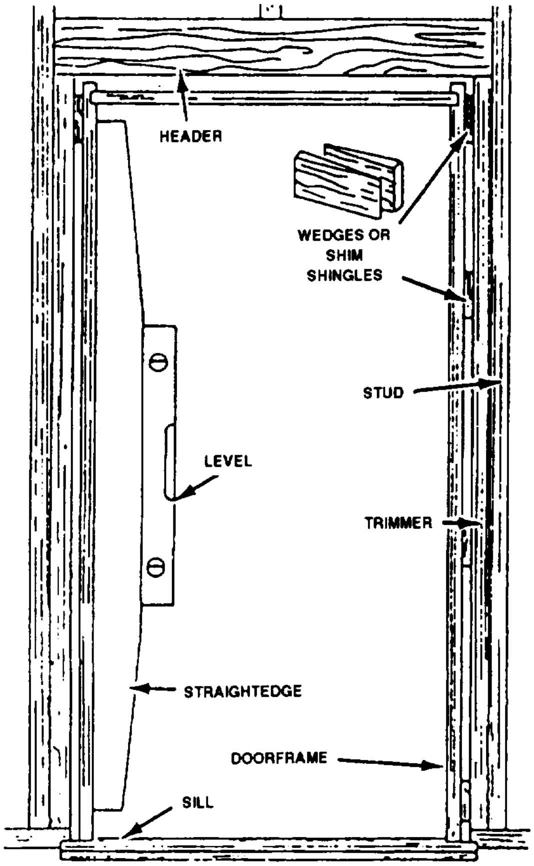


Figure 4-22.-Plumbing an exterior doorjamb.

With the sill level, drive a 16d casing nail through the side casing into the wall frame at the bottom of each side. Insert blocking or wedges between the trimmer studs and the top of the jambs. Adjust the wedges until the frame is plumb. Use a level and straightedge for this procedure (fig. 4-22).

NOTE

When setting doorframes, never drive any of the nails completely into the wood until all nails are in place and a final check has been made to make sure that no adjustments are necessary.

Place additional wedges between the jambs and stud frame in the approximate location of the lock strike plate and hinges. Adjust the wedges until the side jambs are well supported and straight. Then secure the wedges by driving a 16d casing nail through the jamb, wedge, and into the trimmer stud. Finally, nail the casing in place with 16d casing nails. These nails should be placed 3/4 inch from the outer edges of the casing and spaced 16 inches OC.

After the installation is complete, a piece of 1/4-or 3/8- inch plywood should be lightly tacked over the sill to protect it during further construction work. At this time, many Builders prefer to hang a temporary door so the interior of the structure can be secured and provide a place to store tools and materials.

Hanging the door and installing door hardware are a part of the interior finishing operation and will be described later in this TRAMAN.

PREHUNG EXTERIOR DOOR UNITS

A variety of prehung exterior door units are available. They include single doors, double doors, and doors with sidelights. Millwork plants provide detailed instructions for installing their products.

First, check the rough opening. Make sure the size is correct and that it is plumb, square, and level. Apply a double bead of caulking compound to the bottom of the opening, and set the unit in place. Spacer shims, located between the frame and door, should not be removed until the frame is firmly attached to the rough opening.

Insert shims between the side jambs and trimmer studs. They should be located at the top, bottom, and midpoint of the door. Drive 16d finishing nails through the jambs, shims, and into the structural frame members. Manufacturers usually recommend that at least two of the screws in the top hinge be replaced with 2 1/4-inch screws. Finally, adjust the threshold so that it makes smooth contact with the bottom edge of the door. After a prehung exterior door unit is installed, the door should be removed from the hinges and carefully stored. A temporary door can be used until final completion of the project.

WINDOWS

LEARNING OBJECTIVE: Upon completing this section, you should be able to identify the types of windows used in frame structures, and describe installation procedures.

The primary purpose of windows is to allow the entry of light and air, but they may also be an important part of the architectural design of a building. Windows and their frames are millwork units that are usually fully assembled at the factory, ready for use in buildings. These units often have the sash fitted and weather stripped, frame assembled, and exterior casing in place, Standard combination storms and screens or separate units can also be included. Wood components are treated with a water-repellent preservative at the factory to

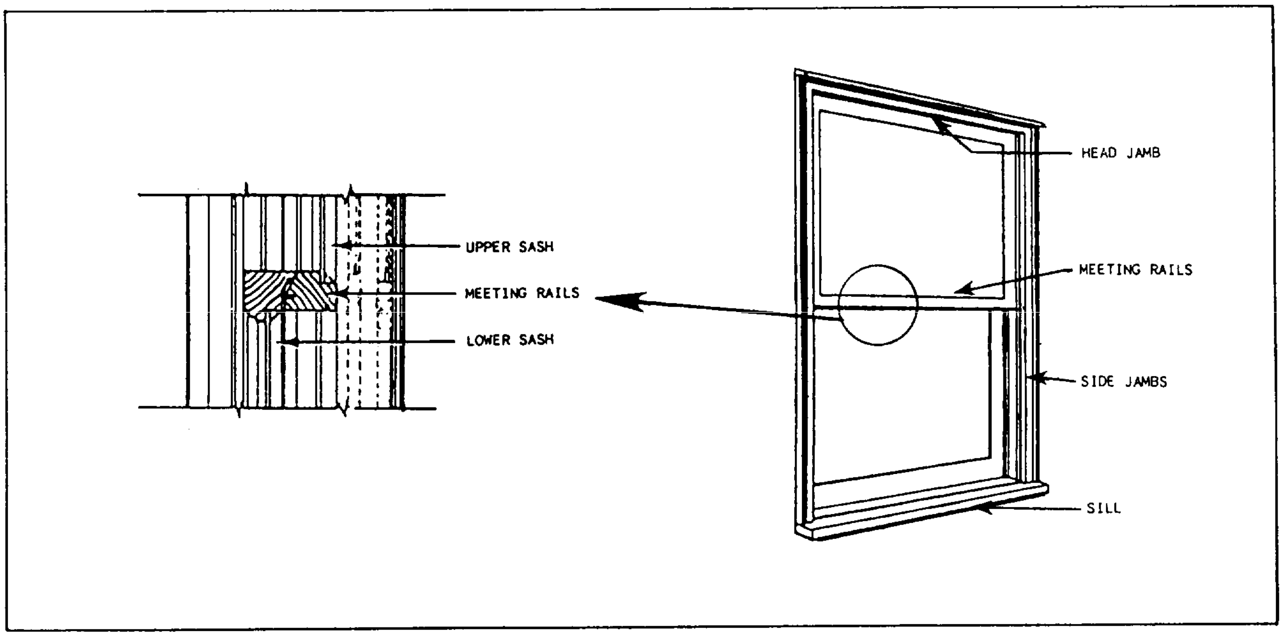


Figure 4-23.-Typical double-hung window.

provide protection before and after they are placed in the walls.

Insulated glass, used both for stationary and moveable sash, consists of two or more sheets of spaced glass with hermetically sealed edges. It resists heat loss more than a single thickness of glass and is often used without a storm sash.

Window frames and sashes should be made from a clear grade of decay-resistant heartwood stock, or from wood that has been given a preservative treatment. Examples include pine, cedar, cypress, redwood, and spruce.

Frames and sashes are also available in metal. Heat loss through metal frames and sash is much greater than through similar wood units. Glass blocks are sometimes used for admitting light in places where transparency or ventilation is not required.

Windows are available in many types. Each type has its own advantage. The principal types are double-hung, casement, stationary, awning, and horizontal sliding. In this chapter, we'll cover just the first three.

DOUBLE-HUNG WINDOWS

The double-hung window is perhaps the most familiar type of window. It consists of upper and lower sashes (fig. 4-23 detail) that slide vertically in separate grooves in the side jambs or in full-width metal weather stripping. This type of window provides a maximum face opening for ventilation of one-half the total window area. Each sash is provided with springs, balances, or compression weather stripping to hold it in place in any location. Compression weather stripping, for example, prevents air infiltration, provides tension, and acts as a counterbalance. Several types allow the sash to be removed for easy painting or repair.

The jambs (sides and top of the frames) are made of nominal 1-inch lumber; the width provides for use with drywall or plastered interior finish. Sills are made from nominal 2-inch lumber and sloped at about 3 inches in 12 inches for good drainage. Wooden sash is normally 1 3/8 inches thick. Figure 4-24 shows an assembled window stool and apron.

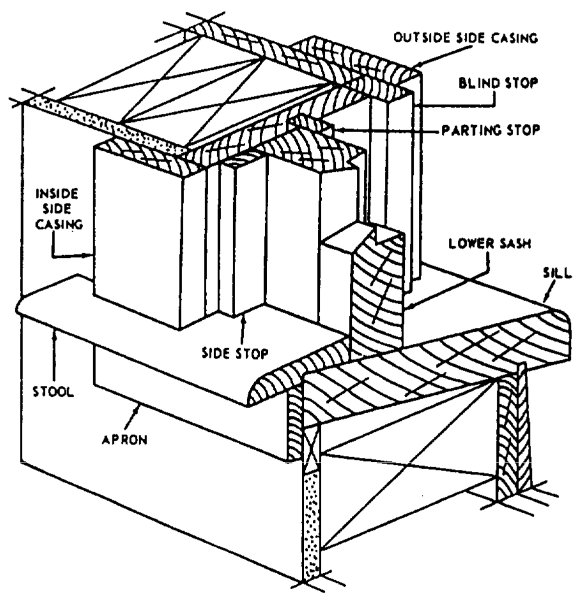


Figure 4-24.-Window stool with apron.

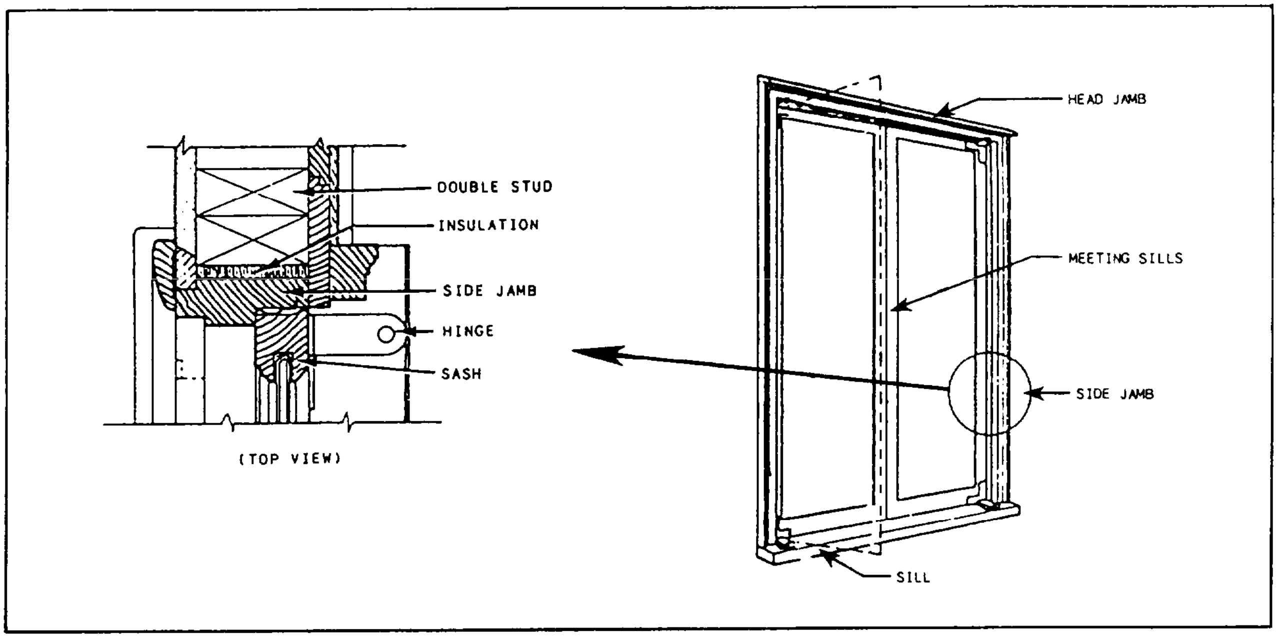


Figure 4-25.-Out-swinging casement sash.

Sash may be divided into a number of lights (glass panes or panels) by small wood members called muntins. Some manufacturers provide preassembled dividers, which snap in place over a single light, dividing it into six or eight lights. This simplifies painting and other maintenance.

Assembled frames are placed in the rough opening over strips of building paper put around the perimeter to minimize air infiltration. The frame is plumbed and nailed to side studs and header through the casings or the blind stops at the sides. Where nails are exposed, such as on the casing, use the corrosion-resistant type.

Hardware for double-hung windows includes the sash lifts that are fastened to the bottom rail. These are sometimes eliminated by providing a finger groove in the rail. Other hardware consists of sash lockss or fasteners located at the meeting rail. They lock the window and draw the sash together to provide a wind-tight fit.

Double-hung windows can be arranged in a number of ways—as a single unit, doubled (or mullion), or in groups or three or more. One or two double-hung windows on each side of a large stationary insulated window are often used to create a window wall. Such large openings must be framed with headers large enough to carry roof loads.

CASEMENT WINDOWS

Casement windows consist of side-hinged sash, usually designed to swing outward (fig. 4-25). This type can be made more weathertight than the in-swinging style. Screens are located inside these out-swinging windows, and winter protection is obtained with a storm sash or by using insulated glass in the sash. One advantage of the casement window over the double-hung type is that the entire window area can be opened for ventilation.

Weather stripping is also provided for this type of window, and units are usually received from the factory entirely assembled with hardware in place. Closing hardware consists of a rotary operator and sash lock. As in the double-hung units, casement sash can be used in a number of ways—as a pair or in combinations of two or more pairs. Style variations are achieved by divided lights. Snap-in muntins provide a small, multiple-pane appearance for traditional styling.

Metal sash is sometimes used but, because of low-insulating value, should be installed carefully to prevent condensation and frosting on the interior surfaces during cold weather. A full storm-window unit is sometimes necessary to eliminate this problem in cold climates.

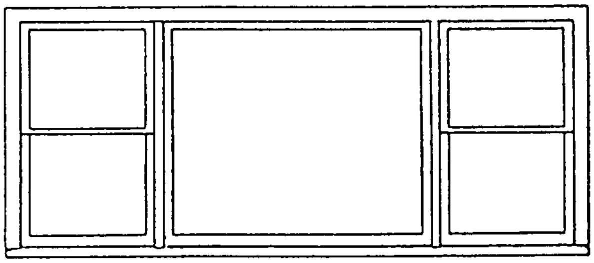


Figure 4-26.-Typical use of stationary window in combination with other types.

STATIONARY WINDOWS

Stationary windows, used alone or in combination with double-hung or casement windows (fig. 4-26), usually consist of a wood sash with a large single pane of insulated glass. They are designed to provide light, as well as be attractive, and are fastened permanently into the frame. Because of their size (sometimes 6 to 8 feet wide), stationary windows require a 1 3/4-inch-thick sash to provide strength. This thickness is required because of the thickness of the insulating glass.

Other types of stationary windows may be used without a sash. The glass is set directly into rabbeted frame members and held in place with stops. As with all window-sash units, back puttying and face puttying of the glass (with or without a stop) will assure moisture-resistance windows (fig. 4-27).

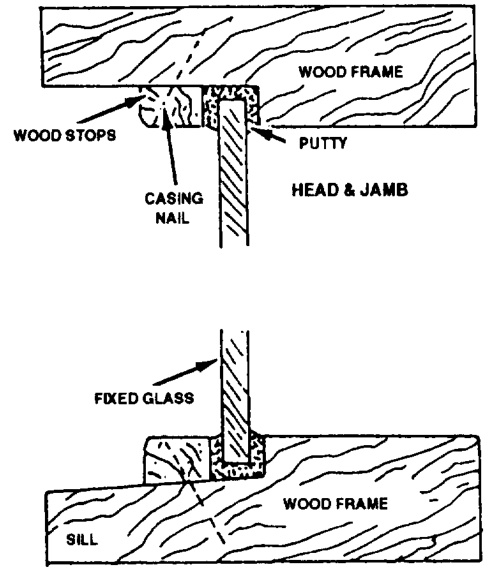


Figure 4-27.-Fixed glass in wood stops.

GLASS

LEARNING OBJECTIVE: Upon completing this section, you should be able to identify the different types of glass, glazing materials, and describe procedures for cutting, glazing, and installing glass.

It is surprising how many types of glass and glass-like materials are used in construction. Each has its own characteristics, advantages, and best uses. In this section, we'll cover the various types of glass and materials, and the methods used in assembling glass features ("glazing").

TYPES

The "Glass and Glazing" section of construction specifications contains a wide range of materials. These may include sheet glass, plate glass, heat- and glare-reducing glass, insulating glass, tempered glass, laminated glass, and various transparent or translucent plastics. Also included may be ceramic-coated, corrugated, figured, and silvered and other decorative glass. Additional materials may include glazier's points, setting pads, glazing compounds, and other installation materials.

Sheet/Window

Sheet or window glass is manufactured by the flat or vertically drawn process. Because of the manufacturing process, a wave or draw distortion runs in one direction through the sheet. The degree of distortion controls the usefulness of this type of glass. For best appearance, window glass should be drawn horizontally or parallel with the ground. To ensure this, the width dimension is given first when you are ordering.

Plate

Plate glass is similar to window and heavy-sheet glass. The surface, rather than the composition or thickness, is the distinguishing feature. Plate glass is manufactured in a continuous ribbon and then cut into large sheets. Both sides of the sheet are ground and polished to a perfectly flat plane. Polished plate glass is furnished in thicknesses or from 1/8 inch to 1 1/4 inches. Thicknesses 5/16 inch and over are termed "heavy polished plate." Regular polished plate is available in three qualities: silvering, mirror glazing, and glazing. The glazing quality is generally used where ordinary glazing is required. Heavy polished plate is generally available in commercial quality only.

Heat Absorbing

Heat-absorbing glass contains controlled quantities of a ferrous iron admixture that absorbs much of the energy of the sun. Heat-absorbing glass is available in plate, heavy plate, sheet, patterned, tempered, wired, and laminated types. Heat-absorbing glass dissipates much of the heat it absorbs, but some of the heat is retained. Thus, heat-absorbing glass may become much hotter than ordinary plate glass.

Because of its higher rate of expansion, heat-absorbing glass requires careful cutting, handling, and glazing. Sudden heating or cooling may induce edge stresses, which can result in failure if edges are improperly cut or damaged. Large lights made of heat-absorbing glass that are partially shaded or heavily draped are subject to higher working stresses and require special design consideration.

Glare Reducing

Glare-reducing glass is available in two types. The first type is transparent with a neutral gray or other color tint, which lowers light transmission but preserves true color vision. The second type is translucent, usually white, which gives wide light diffusion and reduces glare. Both types absorb some of the sun's radiant energy and therefore have heat-absorbing qualities. The physical characteristics of glare-reducing glass are quite similar to those of plate glass. Although glare-reducing glass absorbs heat, it does not require the special precautions that heat-absorbing glass does.

Insulating

Insulating glass units consist of two or more sheets of glass separated by either 3/16-, 7/32-, or 1/4-inch air space. These units are factory-sealed. The captive air is dehydrated at atmospheric pressure. The edge seal can be made either by fusing the edges together or with metal spacing strips. A mastic seal and metal edge support the glass.

Insulating glass requires special installation precautions. Openings into which insulating glass is installed must be plumb and square. Glazing must be free of paint and paper because they can cause a heat trap that may result in breakage. There must be no direct contact between insulating glass and the frame into which it is installed. The glazing compound must be a nonhardening type that does not contain any materials that will attack the metal-to-glass seal of the insulating glass. Never use putty. Resilient setting blocks and spacers should be provided for uniform clearances on all units set with face stops, Use metal glazing strips for 1/2-inch-thick sash without face stops. Use a full bed of glazing compound in the edge clearance on the bottom of the sash and enough at the sides and top to make a weathertight seal. It is essential that the metal channel at the perimeter of each unit be covered by at least 1/8 inch of compound. This ensures a lasting seal.

Tempered

Tempered glass is plate or patterned glass that has been reheated to just below its melting point and then cooled very quickly by subjecting both sides to jets of air. This leaves the outside surfaces, which cool faster, in a state of compression. The inner portions of the glass are in tension. As a result, fully tempered glass has three to five times the strength against impact forces and temperature changes than untempered glass has. Tempered glass chipped or punctured on any edge or surface will shatter and disintegrate into small blunt pieces. Because of this, it cannot be cut or drilled.

Heat Strengthened

Heat-strengthened glass is plate glass or patterned glass with a ceramic glaze fused to one side. Preheating the glass to apply the ceramic glaze strengthens the glass considerably, giving it characteristics similar to tempered glass. Heat-strengthened glass is about twice as strong as plate glass. Like tempered glass, it cannot be cut or drilled.

Heat-strengthened glass is available in thicknesses of 1/4 and 5/16 inch and in limited standard sizes. It is opaque and is most often used for spandrel glazing in curtain wall systems. Framing members must be sturdy and rigid enough to support the perimeter of the tempered glass panels. Each panel should rest on resilient setting blocks. When used in operating doors and windows, it must not be handled or opened until the glazing compound has set.

Wired

Wired glass is produced by feeding wire mesh into the center of molten glass as it is passed through a pair of rollers. A hexagonal, diamond-shaped square, or rectangular pattern weld or twisted wire mesh may be used. To be given afire rating, the mesh must be at least 25 gauge, with openings no larger than 1 1/8 inches. Also, the glass must be no less than 1/4 inch thick. Wired glass may be etched or sandblasted on one or both sides to soften the light or provide privacy. It may be obtained with a pattern on one or both sides.

Patterned

Patterned glass has the same composition as window and plate glass. It is semitransparent with distinctive geometric or linear designs on one or both sides. The pattern can be impressed during the rolling process or sandblasted or etched later. Some patterns are also available as wired glass. pattern glass allows entry of light while maintaining privacy. It is also used for decorative screens and windows. Patterned glass must be installed with the smooth side to the face of the putty.

Laminated

Laminated glass is composed of two or more layers of either sheet or polished plate glass with one or more layers of transparent or pigmented plastic sandwiched between the layers. A vinyl plastic, such as plasticized polyvinyl resin butyl 0.015 to 0.025 inch thick, is generally used. Only the highest quality sheet or polished plate glass is used in making laminated glass. When this type of glass breaks, the plastic holds the pieces of glass and prevents the sharp fragments from shattering. When four or more layers of glass are laminated with three or more layers of plastic, the product is known as bullet-resisting glass. Safety glass has only two layers of glass and one of plastic.

Safety

Safety glass is available with clear or pigmented plastic, and either clear or heat-absorbing and glare-reducing glass. Safety glass is used where strong impact may be encountered and the hazard of flying glass must be avoided. Exterior doors with a pane area greater than 6 square feet and shower tubs and enclosures are typical applications.

Glazing compounds must be compatible with the layers of laminated plastic. Some compounds cause deterioration of the plastic in safety glass.

Mirrors

Mimers are made with polished plate, window, sheet, and picture glass. The reflecting surface is a thin coat of metal, generally silver, gold, copper, bronze, or chromium, applied to one side of the glass. For special mirrors, lead, aluminum, platinum, rhodium, or other metals may be used. The metal film can be semi-transparent or opaque and can be left unprotected or protected with a coat of shellac, varnish, paint, or metal (usually copper). Mirrors used in building construction are usually either polished plate glass or tempered plate glass.

Proper installation requires that the weight of the mirror be supported at the bottom. Mastic installation is not recommended because it may cause silver spoilage.

Plexiglas®

Sheets made of thermoplastic acrylic resin (Plexiglas®and Luciteo, both trade names) are available in flat and corrugated sheets. This material is readily formed into curved shapes and, therefore, is often used in place of glass. Compared with glass, its surface is more readily scratched; hence, it should be installed in out-of-reach locations. This acrylic plastic is obtainable in transparent, translucent, or opaque sheets and in a wide variety of colors.

GLAZING MATERIALS

In this section, we'll discuss the various types of sealers you'll need to install, hold fast, and seal a window in its setting.

Wood-Sash Putty

Wood-sash putty is a cement composed of fine powdered chalk (whiting) or lead oxide (white lead) mixed with boiled or raw linseed oil. Putty may contain other drying oils, such as soybean or perilla. As the oil oxides, the putty hardens. Litharge (an oxide of lead) or special driers may be added if rapid hardening is required. Putty is used in glazing to set sheets of glass into frames. Special putty mixtures are available for interior and exterior glazing of aluminum and steel window sash.

A good grade of wood-sash putty resists sticking to the putty knife or glazier's hands, yet it should not be too dry to apply to the sash. In wood sash, apply a suitable primer, such as priming paints or boiled linseed oil.

Putty should not be painted until it has thoroughly set. Painting forms an airtight film, which slows the drying. This may cause the surface of the paint to crack All putty should be painted for proper protection.

Metal-Sash Putty

Metal-sash putty differs from wood putty in that it is formulated to adhere to nonporous surfaces. It is used for glazing aluminum and steel sash either inside or outside. It should be applied as recommended by the manufacturer. Metal-sash putty should be painted within 2 weeks after application, but should be thoroughly set and hard before painting begins.

There are two grades of metal-sash putty: one for interior and one for exterior glazing. Both wood-sash putty and metal-sash putty are known as oleoresinous caulking compounds. The advantage of these materials is their low cost; their disadvantages include high shrinkage, little adhesion, and an exposed life expectancy of less than 5 years.

Elastic Compounds

Elastic glazing compounds are specially formulated from selected processed oils and pigments, which remain plastic and resilient over a longer period than the common hard putties. Butyl and acrylic compounds are the most common elastics. Butyl compounds tend to stain masonry and have a high shrinkage factor. Acrylic-based materials require heating to 110°F before application. Some shrinkage occurs during curing. At high temperatures, these materials sag considerably in vertical joints. At low temperatures, acrylic-based materials become hard and brittle. The y are available in a wide range of colors and have good adhesion qualities.

Polybutane Tape

Polybutane tape is a nondrying mastic, which is available in extruded ribbon shapes. It has good adhesion qualities, but should not be used as a substitute or replacement for spacers. It can be used as a continuous bed material in conjunction with a polysulfide sealer compound. This tape must be pressure applied for proper adhesion.

Polysulfide Compounds

Polysulfide-base products are two-part synthetic rubber compounds based on a polysulfide polymer. The consistency of these compounds after mixing is similar to that of a caulking compound. The activator must be thoroughly mixed with the base compound at the job. The mixed compound is applied with either a caulking gun or spatula. The sealing surfaces must be extremely clean. Surrounding areas of glass should be protected before glazing. Excess and spilled material must be removed and the surfaces cleaned promptly. Once polysulfide elastomer glazing compound has cured, it is very difficult to remove. Any excess material left on the surfaces after glazing should be cleaned during the working time of the material (2 to 3 hours). Toluene and xylene are good solvents for this purpose.

Rubber Materials

Rubber compression materials are molded in various shapes. They are used as continuous gaskets and as intermittent spacer shims. A weathertight joint requires that the gasket be compressed at least 15 percent. Preformed materials reduce costs because careful cleaning of the glass is not necessary, and there is no waste of material.

MEASURING AND CUTTING GLASS

Always measure the length and width of the opening in which the glass is to fit at more than one place. Windows are often not absolutely square. If there is a difference between two measurements, use the smaller and then deduct 1/8 inch from the width and length to allow for expansion and contraction. Otherwise, the glass may crack with changes of temperature. This is especially true with steel casement windows.

Cutting glass is a matter of confidence-and experience. You can gain both by practicing on scrap glass before trying to cut window glass to size. Equipment required for glass cutting consists of a glass cutter, a flat, solid table, a tape measure, and a wood or metal T-square or straightedge. Look at figure 4-28. You should lightly oil the cutting wheel (view A) with a thin machine oil or lubricating fluid. Hold the cutter by resting your index finger on the flat part of the handle, as shown in view B.

To cut a piece of glass, lay a straightedge along the proposed cut, as shown in view C. Hold it down firmly with one hand and with the glass cutter in the other, make one continuous smooth stroke along the surface of the glass with the side of the cutter pressed against the straightedge (view D). The objective is to score the glass, not cut through it. You should be able to hear the cutter bite into the glass as it moves along. Make sure the cut is continuous and that you have not skipped any section. Going over a cut is a poor practice as the glass is sure to break away at that point. Snap the glass immediately after cutting by placing a pencil or long dowel under the score line and pressing with your hands on each side of the cut (view E). Frosted or patterned glass should be cut on the smooth side. Wire-reinforced glass can be cut the same as ordinary glass, except that you will have to separate the wires by flexing the two pieces up and down until the wire breaks or by cutting the wires with side-cutting pliers.

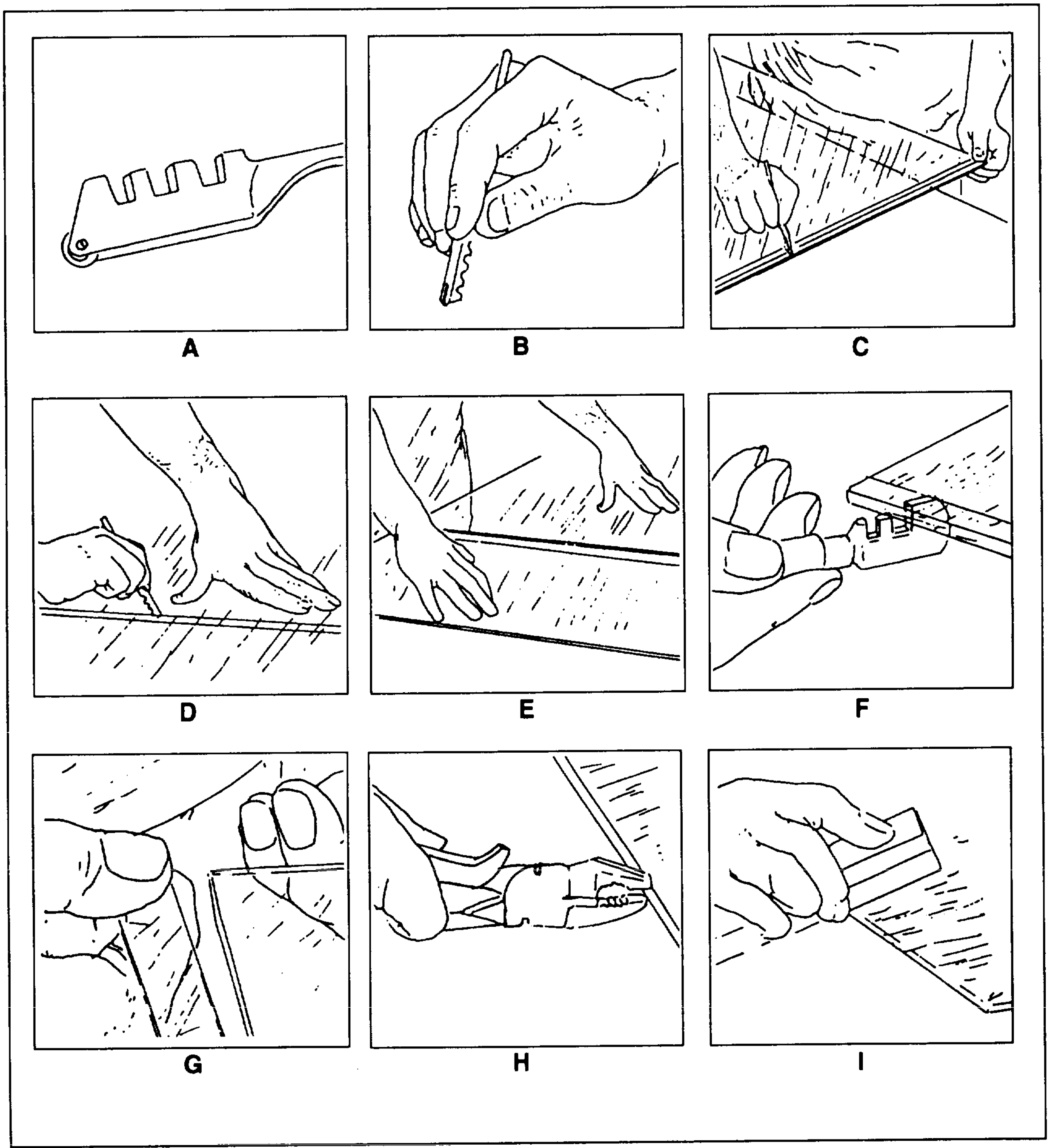


Figure 4-28.-Glass cutting.

To cut a narrow strip from a large piece of glass, score a line and then tap gently underneath the score line with the cutter to open up an inch or so of the score line (view F). Next, grasp the glass on each side of the line and gently snap off the waste piece (view G). Press downward away from the score mark. If the strip does not break off cleanly, nibble it off with the pliers (view H) or the notches in the cutter. Slivers less than 1/2 inch wide are cut off by scoring the line and then nibbling off the waste. Do not nibble without first scoring a line. You can smooth off the edges of glass intended for shelving or tabletops with an oilstone dipped in water, as shown in view I. Rub the stone back and forth from end to end with the stone at a 45° angle to the glass. Rub the stone side to side only, not up and down.

No attempt should be made to change the size of heat-strengthened, tempered, or doubled-glazed units, since any such effort will result in permanent damage.

Table 4-1.-Weight and Maximum Sizes of Sheet Glass

THICKNESS (in.)	THICKNESS (mm)	WEIGHT (oz/sq ft)	WEIGHT (kg/m^2)	MAX. SIZE (in.)	MAX. SIZE (mm)
Window Glass					
SS 3/32	2.4	19	5.8	40 × 50	1,020 × 1,270
DS 1/8	3.2	26	7.9	60 × 80	1,520 × 2,030
Thick Sheet Glass					
3/16	4.8	40	12.2	120 × 84	3,050 × 2,130
7/32	5.6	45	13.7	120 × 84	3,050 × 2,130
1/4	6.3	52	15.9	120 × 84	3,050 × 2,130
3/8	9.5	77	23.5	160 × 84	4,060 × 2,130
7/16*	11.1	86	26.2	60 × 84	1,520 × 2,130
*Used for glass shelving and table tops					

Table 4-2.-Grades of Sheet Glass

GRADE	USE
AA	For uses where superior quality is required
A	For selected glazing
B	For general glazing
Silvering quality A	For silvering mirror applications; seldom used for glazing
Silvering quality B	For mirror applications; seldom used for glazing
Greenhouse quality	For greenhouse glazing or similar applications where appearance is not critical

All heat-absobing glass must be clean cut. Nibbling to remove flares or to reduce oversized dimensions of heat-absorbing glass is not permitted.

SHEET GLASS SIZES AND GRADES

Sheet glass is produced in a number of thicknesses, but only 3/32- and 1/8-inch sheets are commonly used as a window glass. These thicknesses are designated, respectively, as single strength (SS) and double strength (DS). Thick sheet glass, manufactured by the same method as window glass, is used in openings that exceed window-glass-size recommendations. Table 4-1 lists the thicknesses, weights, and recommended maximum sizes. Sheet glass comes in six grades (table 4-2).

The maximum size glass that may be used in a particular location is governed to a great extent by wind load. Wind velocities, and consequently wind pressures, increase with height above the ground. Various building codes or project specifications determine the maximum allowable glass area for wind load.

SASH PREPARATION

Attach the sash so that it will withstand the design load and comply with the specifications. Adjust, plumb, and square the sash to within 1/8 inch of nominal dimensions on shop drawings. Remove all rivets, screws, bolts, nail heads, welding fillets, and other projections from specified clearances. Seal all sash corners and fabrication intersections to make the sash watertight. Put a coat of primer paint on all sealing surfaces of wood sash and carbon steel sash. Use appropriate solvents to remove grease, lacquers, and other organic-protecting finishes from sealing surfaces of aluminum sash.

Wood

On old wood sashes, you must clean all putty runs of broken glass fragments and glazier's points—triangular pieces of zinc or galvanized steel driven into the rabbet. Remove loose paint and putty by scraping. Wipe the surface clean with a cloth saturated in mineral spirits or turpentine; prime the putty runs and allow them to dry.

On new wood sashes, you should remove the dust, prime the putty runs, and allow them to dry. All new wood sashes should be pressure treated for decay protection.

Metal

On old metal sashes, you must remove loose paint or putty by scraping. Use steel wool or sandpaper to remove rust. Clean the surfaces thoroughly with a cloth saturated in mineral spirits or turpentine. Prime bare metal and allow it to dry thoroughly.

On new metal sashes, you should wipe the sash thoroughly with a cloth saturated in mineral spirits or turpentine to remove dust, dirt, oil, or grease. Remove any rust with steel wool or sandpaper. If the sash is not already factory-primed, prime it with rust-inhibitive paint and allow it to dry thoroughly.

GLAZING

"Glazing" refers to the installation of glass in prepared openings of windows, doors, partitions, and curtain walls. Glass may be held in place with glazier's points, spring clips, or flexible glazing beads. Glass is kept from contact with the frame with various types of shims. Putty, sealants, or various types of caulking compounds are applied to make a weathertight joint between the glass and the frame.

Wood Sash

Most wood sash is face-glazed. The glass is installed in rabbets, consisting of L-shaped recesses cut into the sash or frame to receive and support panes of glass. The glass is held tightly against the frame by glazier's points. The rabbet is then filled with putty. The putty is pressed firmly against the glass and beveled back against the wood frame with a putty knife. A priming paint is essential in glazing wood sash. The priming seals the pores of the wood, preventing the loss of oil from the putty. Wood frames are usually glazed from the outside (fig. 4-29).

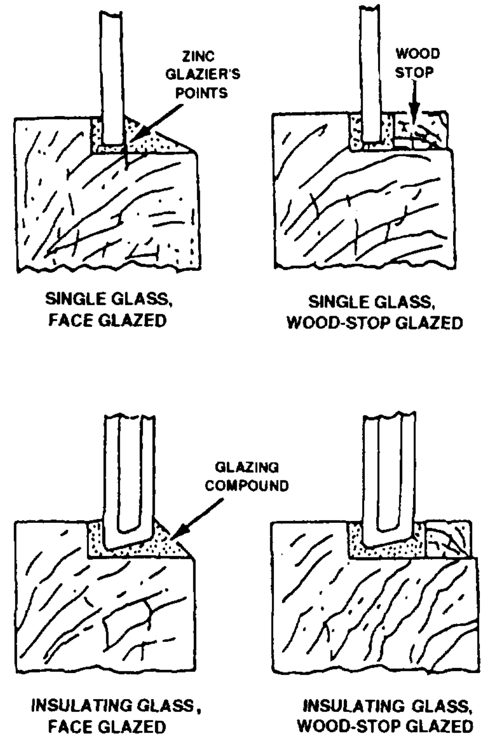


Figure 4-29.-Types of wood-sash glazing.

As we noted earlier, wood-sash putty is generally made with linseed oil and a pigment. Some putties contain soybean oil as a drying agent. Putty should not be painted until it is thoroughly set. A bead of putty or glazing compound is applied between the glass and the frame as a bedding. The bedding is usually applied to the frame before the glass is set. Back puttying is then used to force putty into spaces that may have been left between the frame and the glass.

Metal Windows and Doors

Glass set in metal frames must be prevented from making contact with metal. This may be accomplished by first applying a setting bed of metal-sash putty or glazing compound. Metal-sash putty differs from wood-sash putty in that it is formulated to adhere to a

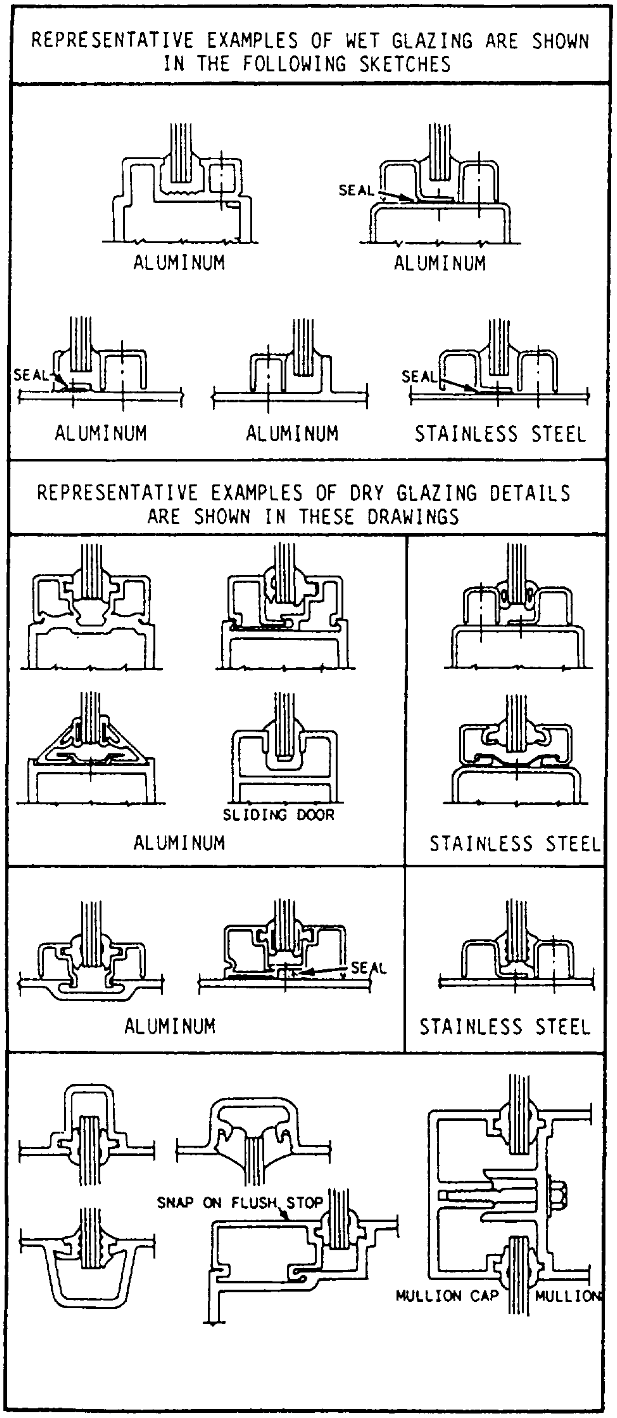


Figure 4-30.-Types of metal-sash glazing.

nonporous surface. Figure 4-30 shows examples of the types of metal-sash putty. Elastic glazing compounds may be used in place of putty. These compounds are produced from processed oils and pigments and will remain plastic and resilient over a longer period than will putty. A skin quickly forms over the outside of the compound after it is placed, while the interior remains soft. This type of glazing compound is used in windows or doors subject to twisting or vibration. It may be painted as soon as the surface has formed.

For large panes of glass, setting blocks may be placed between the glass edges and the frame to maintain proper spacing of the glass in the openings. The blocks may be of wood, lead, neoprene, or some flexible material. For large openings, flexible shims must be set between the face of the glass and the glazing channel to allow for movement. Plastics and heat-absorbing or reflective glass require more clearance to allow for greater expansion. The shims may be in the form of a continuous tape of a butyl-rubber-based compound, which has been extruded into soft, tacky, ready-to-use tape that adheres to any clean, dry surface. The tape is applied to the frame and the glass-holding stop before the glass is placed in a frame. Under compression, the tape also serves as a sealant.

Glass may be held in place in the frame by spring clips inserted in holes in the metal frame or by continuous angles or stops attached to the frame with screws or snap-on spring clips. The frames of metal windows are shaped either for outside or inside glazing.

SETTING GLASS IN WOOD AND METAL SASHES

Do not glaze or reglaze exterior sash when the temperature is 40°F or lower unless absolutely necessary. Sash and door members must be thoroughly cleaned of dust with a brush or cloth dampened with turpentine or mineral spirits. Lay a continuous 1/6-inch-thick bed of putty or compound in the putty run (fig. 4-31). The glazed face of the sash can be recognized as the size on which the glass was cut. If the glass has a bowed surface, it should be set with the concave side in. Wire glass is set with the twist vertical. Press the glass firmly into place so that the bed putty will fill all irregularities.

When glazing wood sash, insert two glazier's points per side for small lights and about 8 inches apart on all sides for large lights. When glazing metal sash, use wire clips or metal glazing beads.

After the glass has been bedded, lay a continuous bead of putty against the perimeter of the glass-face putty run. Press the putty with a putty knife or glazing tool with sufficient pressure to ensure its complete adhesion to the glass and sash. Finish with full, smooth, accurately formed bevels with clean-cut miters. Trim up

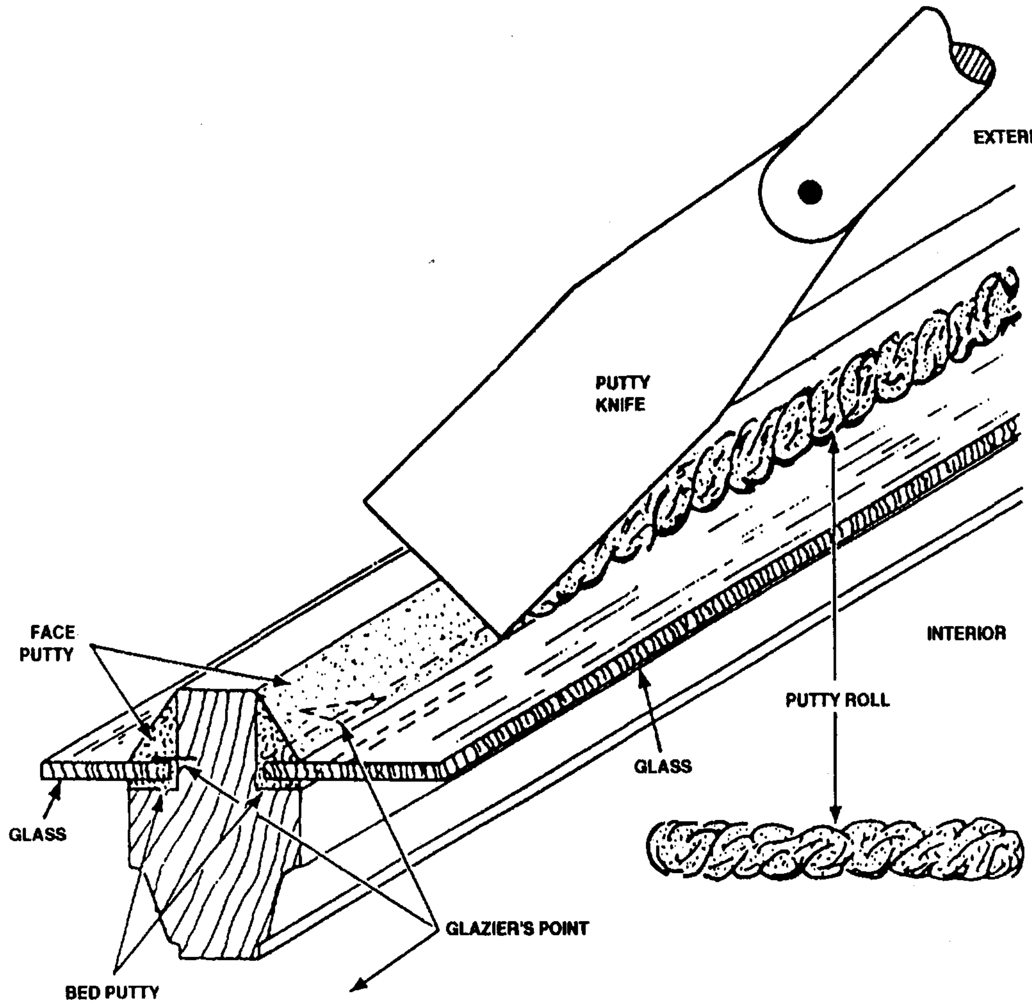


Figure 4-31.—Setting glass with glazier's points and putty.

the bed putty on the reverse side of the glass. When glazing or reglazing interior sash and transoms and interior doors, you should use wood or metal glazing beads. Exterior doors and hinged transoms should have glass secured in place with inside wood or metal glazing beads bedded in putty. In setting wired glass for security purposes, set wood or metal glazing beads, and secure with screws on the side facing the area to be protected.

Weed-sash putty should be painted as soon as it has surface-hardened. Do not wait longer than 2 months after glazing. When painting the glazing compound, overlap the glass 1/16 inch as a seal against moisture.

For metal sashes, use type 1 metal sash elastic compound. Metal-sash putty should be painted immediatel y after a firm skin has formed on the surface. Depending on weather conditions, the time for skinning over may be 2 to 10 days. Type II metal-sash putty can usually be painted within 2 weeks after placing. This putty should not be painted before it has hardened because early painting may retard the set.

Clean the glass on both sides after painting. A cloth moistened with mineral spirits will remove putty stains. When scrapers are used, care should be exercised to avoid breaking the paint seal at the putty edge.

After installing large glass units in buildings under construction, it is considered good practice to place a large "X" on the glass. Use masking tape or washable paint. This will alert workers so they will not walk into the glass or damage it with tools and materials.

RECOMMENDED READING LIST

NOTE

Although the following references were current when this TRAMAN was published, their continued currency cannot be assured. You therefore need to ensure that you are studying the latest revisions.

Basic Roof Framing, Benjamin Barnow, Tab Books, Inc., Blue Ridge Summit, Pa., 1986.

Design of Wood Frame Structures for Permanence, National Forest Products Association, Washington, D.C., 1988.

Exterior and Interior Trim, John E. Ball, Delmar Pub., Albany, N.Y., 1975.

Modern Carpentry, Willis H. Wagner, Goodheart-WILCOX Co., South Holland, Ill., 1983.