Chapter 7

FINISHING TOUCHES

Interior Trim

A variety of moldings are available to provide a finished trim around doors and windows and at the intersection of walls with the floor or the ceiling. Typical molding patterns are shown in figures 171 to 174. Moldings that receive a natural finish are often oak or other hardwood species. The usual softwood molding is ponderosa pine. It is used where the finish is to be painted, but sometimes it is stained and given a natural finish. Molded particleboard with a wood grain vinyl overlay is also used in some cases.

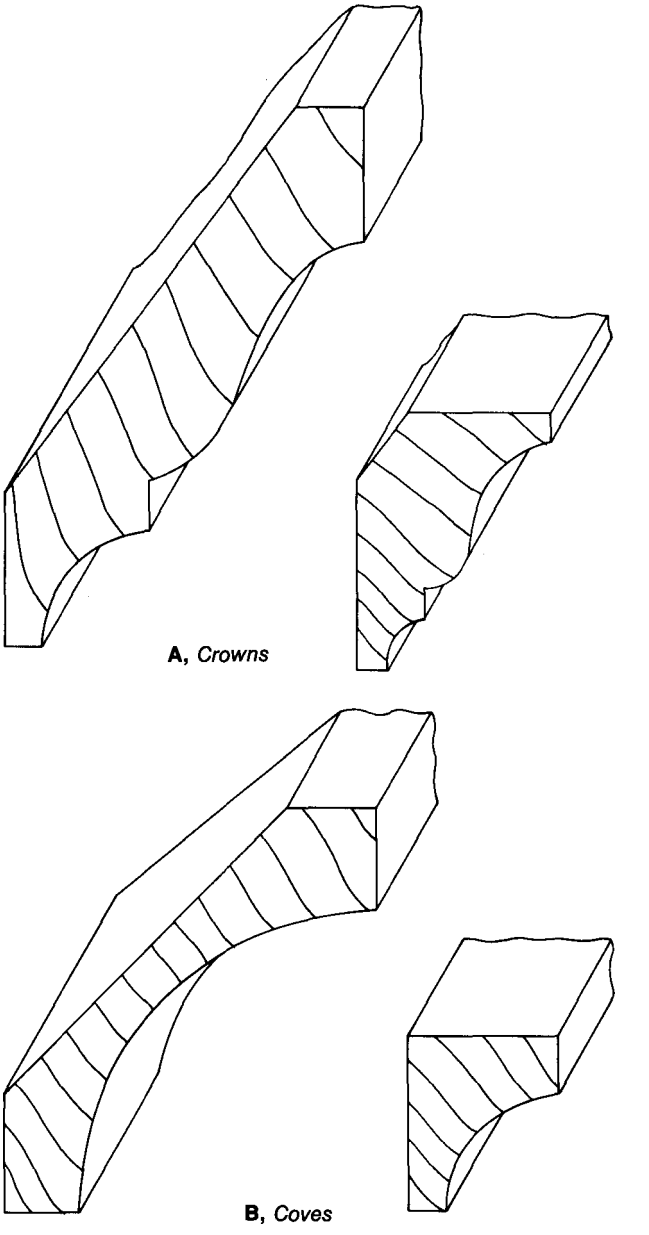
Casing

The casing is the edge trim around interior door openings and is also used to finish the room side of exterior door frames. Casing varies in width, being usually from 2¼ to 3½ inches, depending on the style. Casing may be obtained in thicknesses from ½ to ¾ inch, although $^{11}/_{16}$ inch is standard in many of the narrow-line patterns. Door casings are nailed to the jamb and to the framing studs or header, allowing about a $^{3}/_{16}$-inch edge distance from the face of the jamb (see fig. 169). Finish or casing nails, size 6d or 7d depending on the thickness of the casing, are used to nail into the stud. Finishing nails, size 4d or 5d, or 1½-inch brads are used to fasten the thinner edge of the casing to the jamb. In hardwood, it is usually advisable to predrill to prevent splitting. Nails in the casing are located in pairs (fig. 175) and spaced about 16 inches apart along the full height of the opening and at the head jamb.

Casing with any form of molded shape must have a mitered joint at the corners (fig. 175A). When casing is squared-edged, a butt joint may be made at the junction of the side and head casing (fig. 175B). If the moisture content of the casing is well above that recommended, a mitered joint may open slightly at the outer edge as the material dries. This can be minimized by using a small glued spline at the corner of the mitered joint. Actually, use of a spline joint under any moisture condition is considered good practice, and some prefitted jamb, door, and casing units are provided with splined joints. Nailing the joint after drilling aids in retaining a close fit (fig. 175).

The casing around the window frames on the interior of the house should be the same pattern as that used around the interior door frames. Other trim that is used for a double-hung window frame includes the sash stops, stool, and apron (fig. 176A). Another method of using trim around windows has the entire opening enclosed with casing (fig. 176B). The stool is then a filler member between the bottom sash rail and the bottom casing.

Figure 171–*Moldings for intersection of walls and ceilings:*



Window stool and apron

The stool is the horizontal trim member that laps the window sill and extends beyond the casing at the sides,

Figure172 – *Wall moldings:*

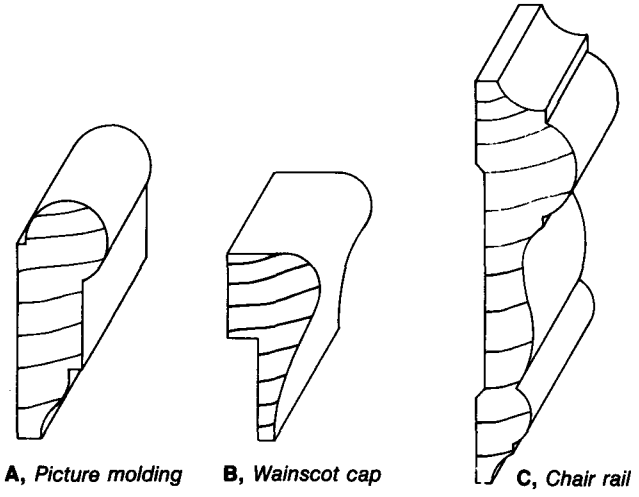
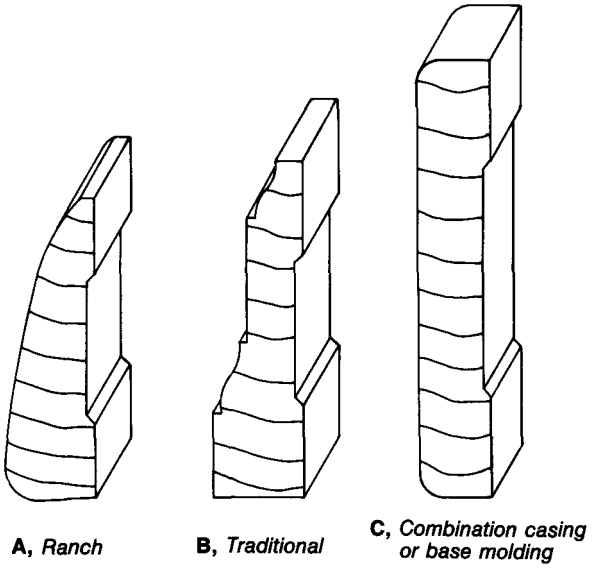


Figure 173 – *Casings:*



with each end notched against the wall. The apron serves as a finish member below the stool. The window stool is the first piece of window trim to be installed and is notched and fitted against the edge of the jamb and the gypsum board, with the outside edge flush against the bottom rail of the window sash (fig. 176A). The stool is blind-nailed at the ends so that the casing and the stop cover the nailheads. Predrilling is usually necessary to prevent splitting. The stool should also be nailed at mid-point to the sill and to the apron with finishing nails. Facenailing to the sill is sometimes used instead of, or in combination with, toenailing of the outer edge to the sill.

Figure 174 – *Base moldings:*

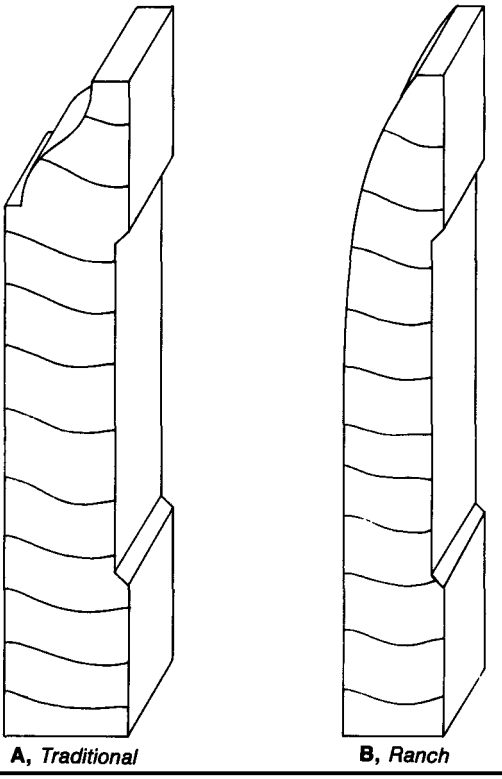


Figure 175 – *Casing joints:*

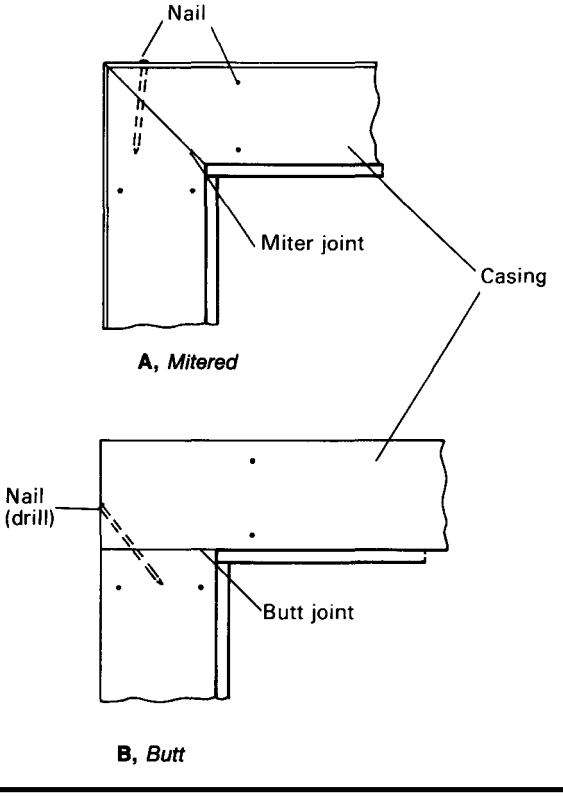
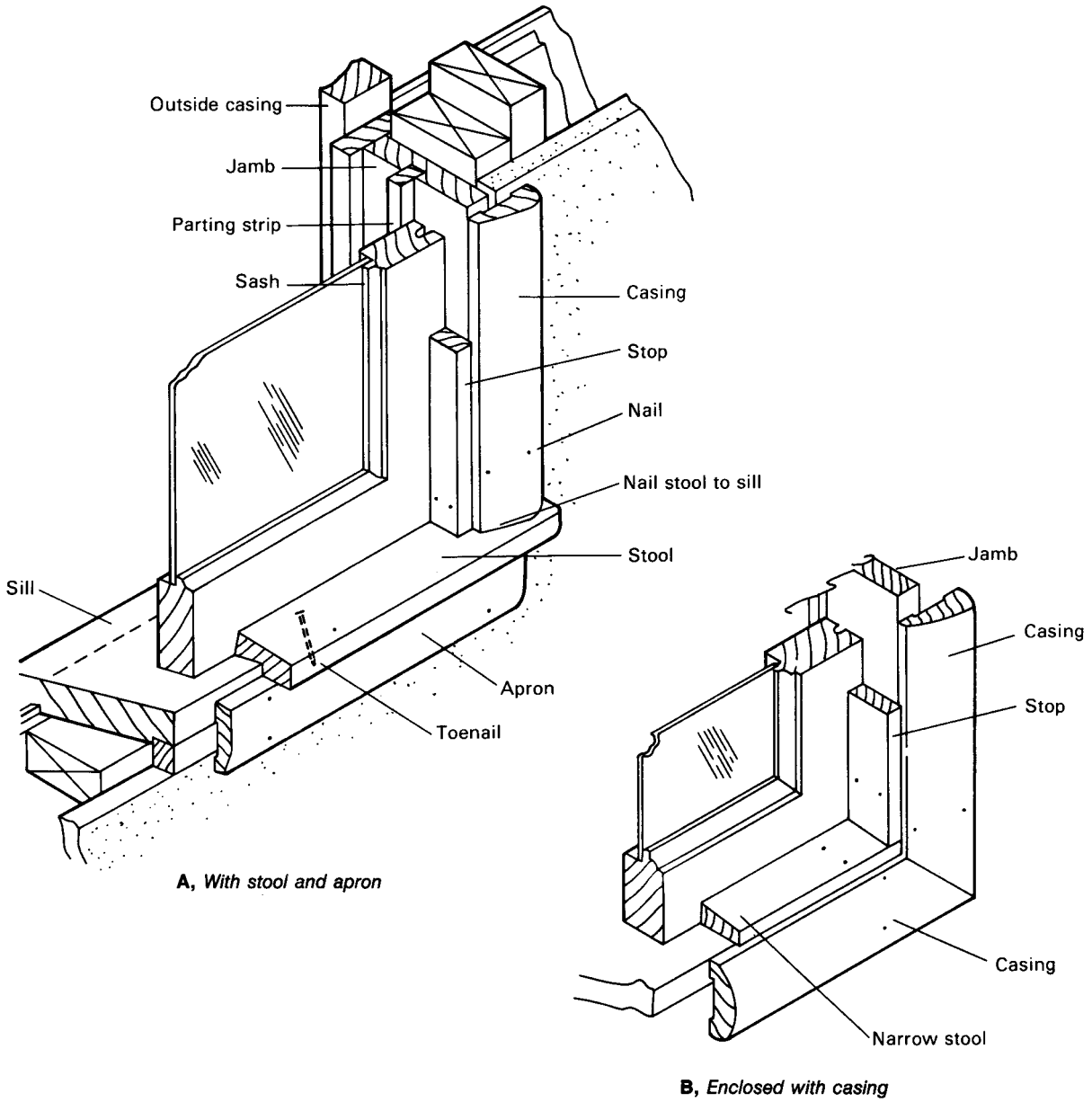


Figure 176 – *Installation of window trim:*



A, *With stool and apron*

B, *Enclosed with casing*

The casing is applied and nailed as described for door frames (fig. 175), except that the inner edge is flush with the inner face of the jambs so that the stop covers the joint between the jamb and casing. The apron is cut to a length equal to the outer width of the casing line. It is nailed to the window sill and to the 2- by 4-inch framing sill below.

When casing is used to finish the bottom of the window frame as well as the sides and top, the narrow stool butts against the side window jamb. Casing is then mitered at the bottom comers (fig. 176B) and nailed as previously described.

Base molding and base shoe

Base molding serves as a finish between the finished wall and the floor. It is available in several widths and forms. Two-piece base consists of a baseboard topped with a small base cap (fig. 177A). When the wall finish is not straight and true, the small base molding will conform more closely to the variations than will the wider base alone. A common size for this type of baseboard is $^{5}/_{8}$ by 3¼ inches or wider. One-piece base (fig. 177B and C) varies in size from $^{7}/_{16}$ by 2¼ inches to ¼ by 3¼ inches and wider. Although a wood member is desirable at the junction of the wall and carpeting to serve as a protective ‘‘bumper,’’ wood trim is sometimes eliminated entirely.

Most baseboards are finished with a base shoe ½ by ¾ inch in size (fig. 177D). A single-base molding without the shoe is sometimes placed at the wall–floorjunction, especially where carpeting might be used.

Square-edged baseboard should be installed with a butt joint at inside comers and a mitered joint at outside comers (fig. 177). It should be nailed to each stud with two 8d finishing nails. Molded single-piece base, base moldings, and base shoe should have a coped joint at inside comers and a mitered joint at outside comers. A coped joint is one in which the first piece is square-cut against the wall or base and the second molding coped. This is accomplished by sawing a 45° miter cut and with a coping saw trimming the molding along the inner line of miter (fig. 177). The base shoe should be nailed into the subfloor with long slender nails and not into the baseboard itself. Then no opening occurs under the shoe if there is a small amount of wood shrinkage.

Ceiling moldings

Ceiling moldings (fig. 171) are sometimes used at the junction of wall and ceiling for an architectural effect or to terminate paneling, gypsum board, or wood (fig. 178). As with base moldings, the inside corners should be cope jointed. This insures a tight joint and retains a good fit if there are minor moisture changes.

Figure 177 – *Base molding:*

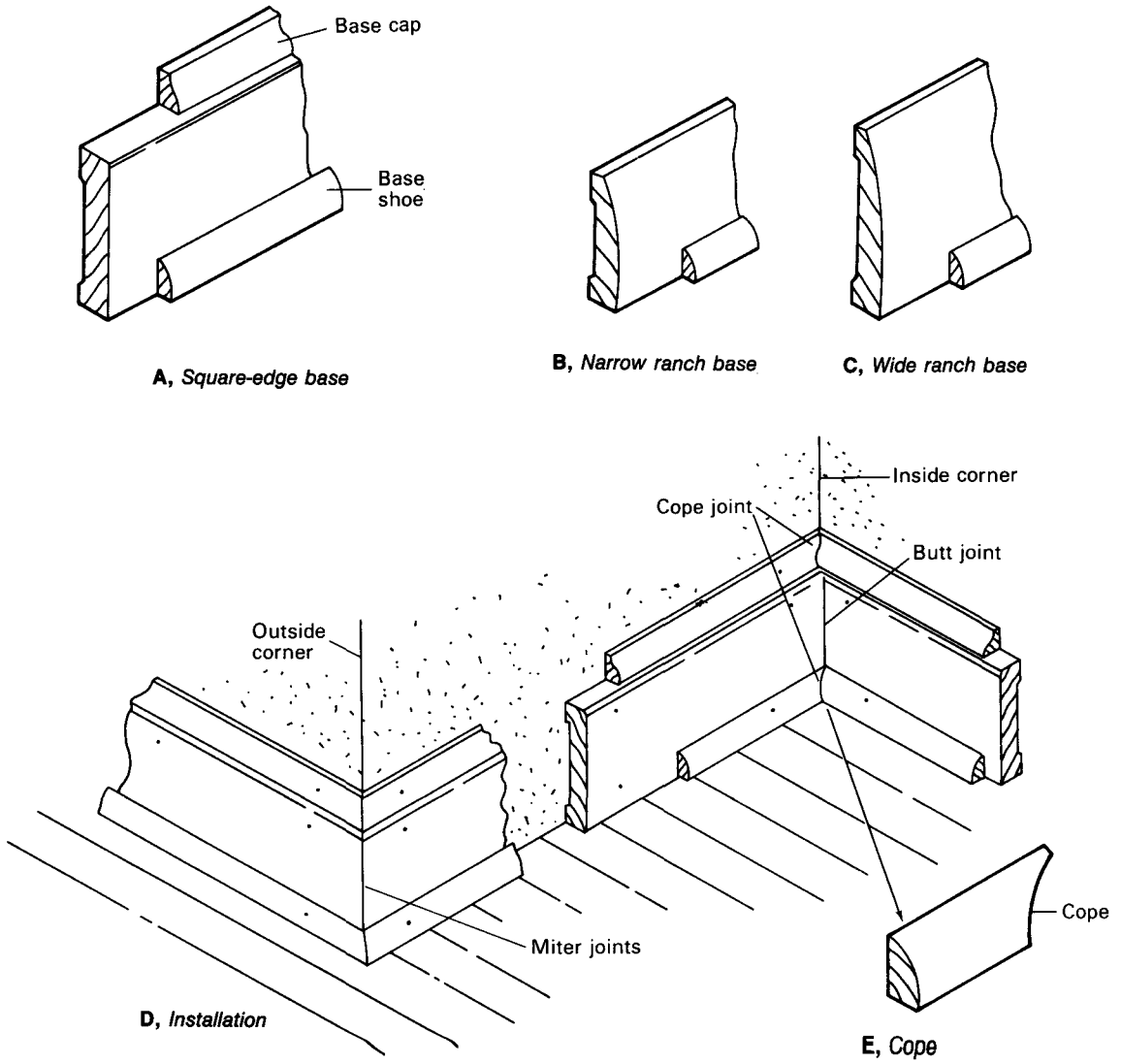
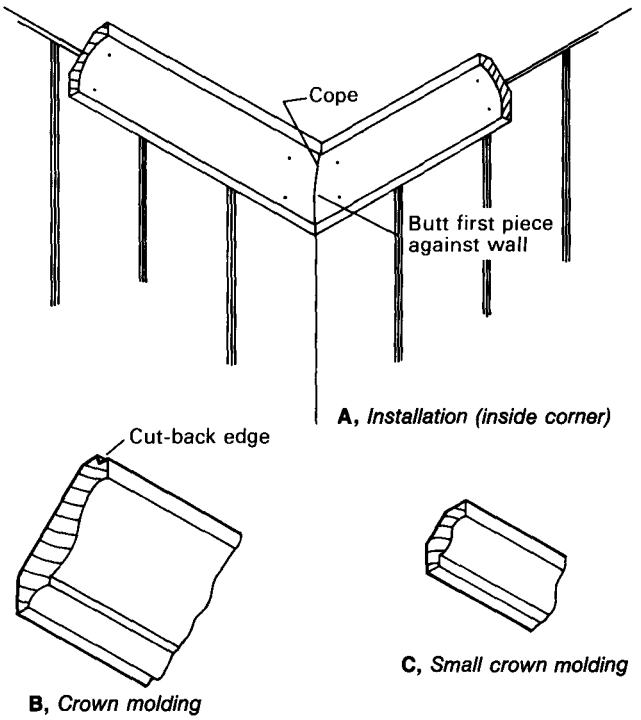


Figure 178 – *Ceiling moldings;*



A cutback edge at the outside of the molding partially conceals any unevenness of the finish and makes painting easier where there are color changes (fig. 178). Finish nails should be driven and set into the upper wall plates and, for large moldings, also into the ceiling joists, when possible.

Cabinets and Other Millwork

Millwork, as a general term, usually includes most wood materials and house components that require manufacturing. This covers not only the interior trim, doors, and other items previously described, but also such items as kitchen cabinets, fireplace mantels, built-in china cabinets, bookcases, and similar units. Most of these units are produced in a millwork manufacturing plant and are ready to install in the house. They differ from some other items because they usually require only fastening to the wall or floor.

While many units are custom made, others can be ordered directly from stock. For example, kitchen cabinets are often stock items, obtainable at widths of 12 or 15 inches and wider by 3-inch increments up to 48 inches wide.

Like interior trim, cabinets, shelving, and similar items can be made of various wood species. If the millwork is to be painted, ponderosa pine, southern pine, Douglas-fir, gum, and similar softwood species may be used. Birch, oak, redwood, and knotty pine, and other woods with attractive surface variations, are finished with varnish or sealers.

Recommended moisture content for interior millwork may vary from 6 to 11 percent in different parts of the country.

Kitchen cabinets

The kitchen usually contains more millwork than the rest of the rooms combined. This millwork is in the form of wall and base cabinets, broom closets, and other items. An efficient plan with properly arranged cabinets not only reduces work and saves steps but also often reduces costs because the area occupied is smaller. Location of the refrigerator, sink, dishwasher, and range, together with the cabinets, is important also from the standpoint of plumbing and electrical connections. In the design of a pleasant kitchen, good lighting, both natural and artificial, plays a significant part.

Kitchen cabinets, both base and wall units, should be constructed to specific standards of height and depth. Figure 179 shows common base cabinet counter heights and depths as well as clearances for wall cabinets. While the range of counter heights is from 30 to 38 inches, the standard height is 36 inches. Wall cabinets vary in height depending on the type of installation at the counter. The tops of wall cabinets are located at the same height, either free or under a 12- to 14-inch drop ceiling or storage cabinet. Wall cabinets are normally 30 inches high, but not more than 21 inches when a range or sink is located under them. Wall cabinets can also be obtained in 12-, 15-, 18-, and 24-inch heights. The shorter wall cabinets are usually placed over refrigerators.

Narrow wall cabinets are furnished with single doors and the wider ones with double doors. Base cabinets may be obtained in full-door or full-drawer units or with both drawers and doors. Sink fronts or sink-base cabinets, corner cabinets, broom closets, and desks are some of the special units that may be used in planning the ideal kitchen. Cabinets are fastened to the wall through cleats located at the back of each cabinet. It is good practice to use long screws to penetrate well into each wall stud.

Kitchen layout

Four basic layouts are commonly used in the design of a kitchen.

U-type. This layout (fig. 180A) is very efficient, having the sink at the bottom of the U and the range and refrigerator on opposite sides.

L-type. This layout (fig. 180B), with the sink and refrigerator on one leg and the range on the other, is sometimes used with a dining space in the unoccupied comer.

Galley kitchen plan. This layout (fig. 180C) is often used in narrow kitchens and can be quite efficient with a sink near the center of one side and the range and refrigerator near opposite ends of the other side.

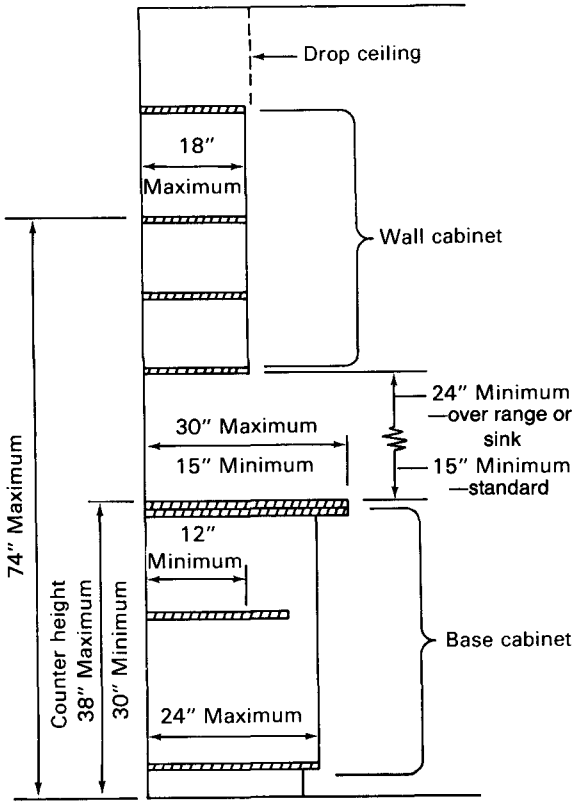
Sidewall type. This layout (fig. 180D) is usually preferred for small apartments. All cabinets, the sink, range, and refrigerator are located along one wall. Counter space is usually somewhat limited when kitchens are small.

Countertops are often plastic laminate and are available in a wide range of colors and textures. The countertop is usually purchased with the laminate already applied. Where ceramic tile is used, it must be applied on site after the top is installed. Another popular countertop is molded plastic that simulates marble.

Bathroom cabinets

Cabinets are frequently used in the bathroom and are purchased built to a number of standard sizes just as they are for the kitchen. Countertops are similar, but where molded plastic is used, the sink may also be molded as an integral part of the countertop. While natural wood cabinets are available, plastic laminates are often used because of the severe exposure to moisture. These cabinets are usually purchased as complete units for either one or two sinks.

Figure 179 – *Kitchen cabinet dimensions.*



Closet shelving and rod

Shelving can be simple 1-inch boards supported at their ends by 1- by 2-inch cleats; however, manufactured units are often used to save installation time. Metal shelves and clothes rods that telescope allow adjustment to fit any space. Another very popular shelving is fabricated from steel rod welded to form an open mesh and in a configuration to be self supporting. The entire assembly is then coated with vinyl. These units are easy to install and have the advantage of not collecting dust as the solid shelves do.

Mantels

The type of mantel used for a fireplace depends on the style and design of the house and its interior finish. The contemporary fireplace may have no mantel at all or at best a simple wood molding used as a transition between the masonry and the wall finish. However, the colonial or formal interior usually has a well-designed mantel framing the fireplace opening. This may vary from a simple mantel to a more elaborate unit combining paneling and built-in cabinets along the entire wall. In each design, however, it is important that no wood or other combustible material be placed within 3½ inches of the edges of the fireplace opening. Furthermore, any projection more than 1½ inches in front of the fireplace, such as the mantel shelf, should be at least 12½ inches above the opening. Mantels are fastened to the header and framing studs above and on each side of the fireplace.

Finishes for Interior Walls, Ceilings, and Trim

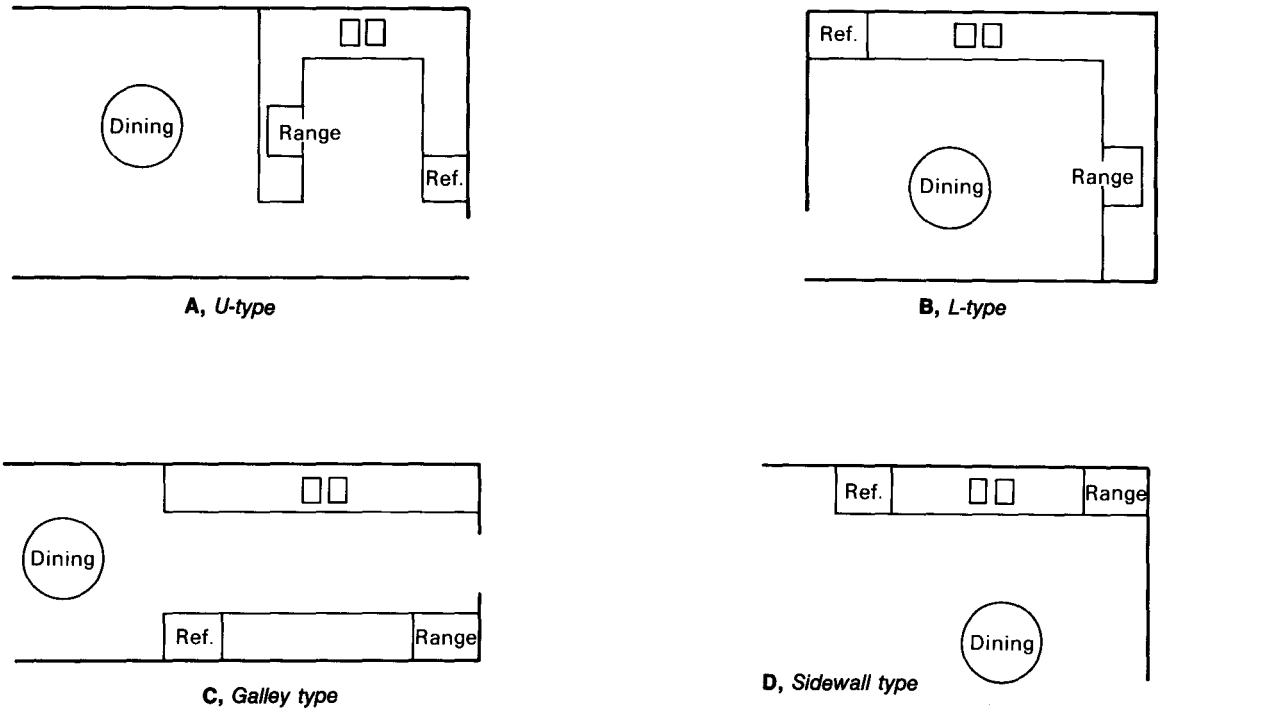
Interior wood is finished for appearance and cleanability. A wide variety of finishes can be used indoors. Veneered panels and plywood can present special finishing problems because these wood constructions may develop lathe checks.

Opaque finishes (paints)

Interior surfaces are often painted. Smooth surfaces, different colors, and a lasting sheen are often demanded for interior woodwork, especially wood trim; therefore, enamels or semigloss enamels are used rather than flat paints.

Before enameling, the wood surface should be sanded extremely smooth and the surface dust removed by a tack

Figure 180 – *Kitchen layouts:*



cloth. Imperfections such as planer marks, hammer marks, and raised grain are accentuated by enamel finish. Raised grain is especially troublesome on flat-grained surfaces of the denser softwoods because the hard bands of latewood are sometimes crushed into the softer earlywood in planing, and later expand when the wood changes moisture content. For the smoothest surface, it is helpful to sponge softwoods with water, allow them to dry thoroughly, and then sand them lightly with new sandpaper before enameling. In new buildings, woodwork should be allowed adequate time to come to its equilibrium moisture content in the heated building before finishing.

To finish hardwoods that have large pores, such as oak and ash, the pores must be filled with wood filler (see section on fillers). After filling and sanding, make successive applications of interior primer and sealer, undercoat, and enamel.

Knots in the white pines, ponderosa pine, or southern pine should be sealed with shellac or a special knot sealer before priming. A coat of pigmented shellac or a special knot sealer is also sometimes necessary over white pines and ponderosa pine to retard discoloration of light-colored enamels by colored matter present in the resin of the heartwood of these species.

One or two coats of enamel undercoat are next applied; this should completely hide the wood and also present a surface that can be easily sandpapered smooth. For best results, the surface should be sanded just before applying the finish enamel; however, this step is sometimes omitted. After the finishing enamel has been applied, it may be left with its natural gloss or rubbed to a dull finish. When wood trim and paneling are finished with a flat paint, the surface preparation need not be as exacting.

Transparentfinishes

Transparent finishes are used on most hardwood and some softwood trim and paneling, according to personal preference. Most finishing consists of some combination of the fundamental operations of sanding, staining, filling, sealing, surface coating, or waxing. Before applying the finish, planer marks and other blemishes on the wood surface that would be accentuated by the finish should be removed.

Stains. Both softwoods and hardwoods are often finished without staining, especially if the wood has a pleasing and characteristic color. When stain is used, however, it often accentuates color differences in the wood surface because of unequal absorption into different parts of the grain pattern. With hardwoods, such emphasis of the grain is usually desirable; the best stains for the purpose are dyes dissolved in either water or solvent. The water stains give the most pleasing results, but raise the grain of

the wood and require an extra sanding operation after the stain is dry.

The stains most commonly used are in solvents that dry quickly. These do not raise the grain, and often approach the water stains in clearness and uniformity of color. Stains on softwoods color the earlywood more strongly than the latewood, reversing the natural gradation in color unless the wood has been sealed first. Pigment-oil stains, which are essentially thin paints, are less subject to this problem and are therefore more suitable for softwoods. Alternatively, the softwood may be coated with penetrating clear sealer before any type of stain is applied in order to produce more nearly uniform coloring.

Fillers. In hardwoods with large pores, the pores must be filled if a smooth coating is desired. This is done usually after the wood is stained and before varnish or lacquer is applied. The filler may be transparent and without effect on the color of the finish or may be colored to contrast with the surrounding wood.

For finishing purposes, the hardwoods may be classified as follows:

Hardwoods with large pores	*Hardwoods with small pores*
Ash	Alder, red
Butternut	Aspen
Chestnut	Basswood
Elm	Beech
Hackberry	Cherry
Hickory	Cottonwood
Lauans	Gum
Mahogany	Magnolia
Mahogany, African	Maple
Oak	Sycamore
sugarberry	Yellow-popular
Walnut	

Birch has pores large enough to take wood filler effectively when desired, but small enough as a rule to be finished satisfactorily without filling.

Hardwoods with small pores may be finished with paints, enamels, or varnishes in exactly the same manner as softwoods.

A filler may be a paste or liquid, natural or colored. It is applied by brushing first across the grain and then brushing with the grain. Surplus filler must be removed immediately after the glossy wet appearance disappears. First, the filler should be packed into the pores by wiping across the grain; then wiping should be completed with a few light strokes along the grain. Filler should be allowed to dry thoroughly and be sanded lightly before the finish coats are applied.

Sealers. Sealers are thinned varnish or lacquer and are used to prevent absorption of surface coatings and also to prevent the bleeding of some stains and fillers into surface coatings, especially lacquer coatings. Lacquer sealers have the advantage of drying very rapidly.

Surface coats. Transparent surface coatings over the sealer may be gloss varnish, semigloss varnish, shellac, nitrocellulose lacquer, or wax. Wax provides protection without forming a thick coating and without greatly enhancing the natural luster of the wood. Coatings of a more resinous nature, especially lacquer and varnish, accentuate the natural luster of some hardwoods and seem to permit the observer to look down into the wood. Shellac applied by the laborious process of French polishing probably achieves this impression of depth most fully, but the coating is expensive and easily marred by water. Rubbing varnishes made with resins of high refractive index for light (ability to bend light rays) are nearly as effective as shellac. Lacquers have the advantages of drying rapidly and forming a hard surface, but require more applications than varnish to build up a lustrous coating.

Varnish and lacquer usually dry with a highly glossy surface. To reduce the gloss, the surfaces may be rubbed with pumice stone and water or with polishing oil. Waterproof sandpaper and water may be used instead of pumice stone. The final sheen varies with the fineness of the powdered pumice stone; coarse powders make a dull surface and fine powders produce a bright sheen. For very smooth surfaces with high polish, the final rubbing is done with rottenstone and oil. Varnish and lacquer made to dry to semigloss or satin finish are also available.

Flat oil finishes commonly called Danish oils are also very popular. This type of finish penetrates the wood and forms no noticeable film on the surface. Two or more coats of oil are usually applied, which may be followed by a paste wax. Such finishes are easily applied and maintained but are more subject to soiling than a film-forming type of finish. Simple boiled linseed oil or tung oil are also used extensively as wood finishes.

Finishes for Floors

The natural color and grain of wood floors make them inherently attractive and beautiful. In addition to enhancing the natural beauty of wood, floor finishes should protect the surface from excessive wear and abrasion, and make it easier to clean. As with other transparent finishes, the complete finishing process consists of four steps: sanding the surface, applying a filler for open-grain woods, applying a stain to achieve a desired color effect, and finally applying a finish. The choice of detailed procedures and specific materials depends largely on the species of wood used and individual preference in type of finish.

Careful sanding to provide a smooth surface is essential for a good finish because any irregularities or roughness in the wood surface are magnified by the finish. Development of a top-quality surface requires sanding in several steps with progressively finer sandpaper, usually with a machine unless the area is small. The final sanding is usually done with a 2/0 grade paper. When sanding is complete, all dust must be removed with a vacuum cleaner and then a tack rag. Steel wool should not be used on floors unprotected by finish because minute steel particles left in the wood may later cause staining or discoloration.

A filler is required if a smooth, glossy, varnish finish is desired on a wood that has large pores, such as oak or walnut.

Stains are sometimes used to obtain a more nearly uniform color when individual boards vary too much in their natural color. Stains may also be used to accent the grain pattern. If the natural color of the wood is acceptable, staining is omitted. The stain should be oil-based or a type that does not raise the grain. Stains penetrate wood only slightly; therefore, the finish should be carefully maintained to prevent wearing through the stained layer. It is difficult to renew the stain at worn spots in a way that matches the color of the surrounding area.

Finishes commonly used for wood floors are classified either sealers or varnishes. Sealers, which are usually thinned varnishes, are widely used in residential flooring. They penetrate the wood just enough to avoid formation of a surface coating of appreciable thickness. Wax is usually applied over the sealer; however, if greater gloss is desired, the sealed floor makes an excellent base for varnish. The thin surface coat of sealer and wax needs more frequent attention than do varnished surfaces. However, rewaxing or resealing and waxing of high-traffic areas is a relatively simple maintenance procedure—much simpler than the maintenance of varnish coatings.

Varnish may be based on phenolic, alkyd, epoxy, or polyurethane resins. Varnish forms a distinct coating over the wood and gives a lustrous finish. The kind of service expected usually determines the type of varnish, and varnishes are available especially designed for houses or for schools, gymnasiums, and other public buildings. Information on types of floor finishes can be obtained from the flooring associations or the individual flooring manufacturers.

Durability of floor finishes can be improved by keeping them waxed. Paste waxes generally give the best appearance and durability. Two coats are recommended, and if a liquid wax is used, additional coats may be necessary to get an adequate film for good performance.

Finishes for Exterior Surfaces

The primary function of any wood finish (paint, varnish, wax, stain, oil, etc.) is to protect the wood surface, help maintain appearance, and provide cleanability. Wood surfaces exposed to the weather without any finish quickly change; they need finishing both for appearance and protection.

Many different methods are effective for finishing wood and wood-based products of various species, grain patterns, textures, and colors. Selection of a particular exterior finish depends on the appearance and degree of protection desired, and on the substrates used. Because different finishes give varying degrees of protection, the type of finish, its quality, quantity, and method of application must be considered in planning the finishing or refinishing of wood and wood products used outdoors.

Finishing characteristics of wood products

Three general categories of wood products are commonly used in exterior construction: (1) lumber, (2) plywood, and (3) reconstituted wood products such as hardboard and particleboard. Each product has unique characteristics that affect the durability of any finish applied to it.

Lumber. Many older houses have wood siding. The ability of lumber to retain and hold a finish is affected by species (table 17), by smoothness, and by ring direction with respect to the surface (vertical versus flat grain). Wood shrinks less across annual rings than in the direction of the rings. For this reason, vertical- or edge-grained surfaces (fig. 181) are better than flat-grained surfaces.

The weight of wood varies tremendously between species. Some common construction woods such as southern pine are dense and heavy compared with such lighter species as redwood and cedar. The weight of wood is important because heavy woods shrink and swell more than light ones. This dimensional change in lumber occurs as the wood gains or loses moisture. Excessive dimensional change in wood constantly stresses a paint film and may result in its early failure.

Some species have wide bands of earlywood and latewood. Wide prominent bands of latewood are characteristic of southern pine and most Douglas-fir, and paint does not hold well on these species. By contrast, redwood and cedar do not have wide latewood bands, and these species are preferred when paint is to be used.

Ring direction also affects paint-holding characteristics and is determined at the time lumber is cut from a log. Most standard grades of lumber contain a high percentage

Table 17–*Characteristics of woods for painting and weathering (omissions in the table indicate inadequate data for classification)*

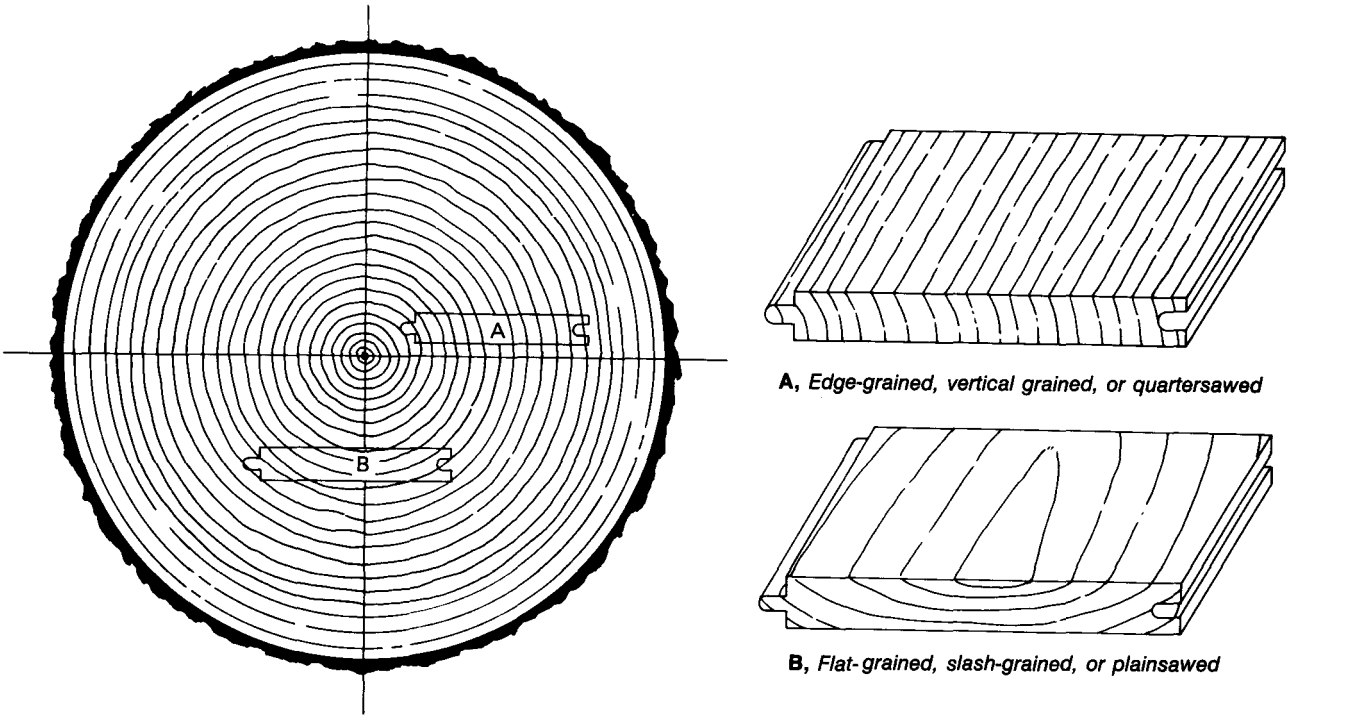
Wood	Ease of keeping well painted (I = easiest, V = most exacting[a])	Weathering: Resistance to cupping (1 = best, 4 = worst)	Weathering: Conspicuousness of checking (1 = least, 2 = most)	Appearance: Color of heartwood[b]	Appearance: Degree of figure on flat-grained surface
softwoods					
Cedars					
Alaska-cedar	I	1	1	Yellow	Faint
(California) incense-cedar	I	—	—	Brown	Faint
Port-Orford-cedar	I	—	1	Cream	Faint
Western redcedar	I	1	1	Brown	Distinct
White-cedar	I		—	Light brown	Distinct
Cypress	I	1	1	Light brown	Strong
Redwood	I	1	1	Dark brown	Distinct
Products[c] overlaid with resin-treated paper	I	—	1	—	—
Pine					
Eastern white	II	2	2	Cream	Faint
Sugar	II	2	2	Cream	Faint
Western white	II	2	2	Cream	Faint
Ponderosa	III	2	2	Cream	Distinct
Fir, commercial white	III	2	2	White	Faint
Hemlock	III	2	2	Pale brown	Faint
Spruce	III	2	2	White	Faint
Douglas-fir (lumber and plywood)	IV	2	2	Pale red	Strong
Larch	IV	2	2	Brown	Strong
Lauan (plywood)	IV	2	2	Brown	Faint
Pine					
Norway	IV	2	2	Light brown	Distinct
Southern (lumber and plywood)	IV	2	2	Light brown	Strong
Tamarack	IV	2	2	Brown	Strong
Hardwoods					
Alder	III	—	—	Pale brown	Faint
Aspen	III	2	1	Pale brown	Faint
Basswood	III	2	2	Cream	Faint
Cottonwood	III	4	2	White	Faint
Magnolia	III	2	—	Pale brown	Faint
Yellow-poplar	III	2	1	Pale brown	Faint
Beech	IV	4	2	Pale brown	Faint
Birch	IV	4	2	Light brown	Faint
Cherry	IV	—	—	Brown	Faint
Gum	IV	4	2	Brown	Faint
Maple	IV	4	2	Light brown	Faint
Sycamore	IV	—	—	Pale brown	Faint
Ash	V/III	4	2	Light brown	Distinct
Butternut	V/III	—	—	Light brown	Faint
Chestnut	V/III	3	2	Light brown	Distinct
Walnut	V/lll	3	2	Dark brown	Distinct
Elm	V/IV	4	2	Brown	Distinct
Hickory	V/IV	4	2	Light brown	Distinct
Oak, white	V/lV	4	2	Brown	Distinct
Oak, red	V/IV	4	2	Brown	Distinct

[a]Woods ranked in group V for *ease of keeping well painted* are hardwoods with large pores that must be filled with wood filler for durable painting. When so filled before painting, the second classification in the table applies.

[b]Sapwood is always light.

[c]Plywood, lumber, and fiberboard with overlay or lowdensity surface.

Figure 181–*Wood grain in lumber:*



of flat grain. Lumber used for board-and-batten siding, drop siding, or shiplap is frequently flat-grained. Bevel siding is commonly produced in several grades. In some cases, the highest grade is required to be vertical-grained and all heartwood over most of the width for greater paint durability. Other grades may contain lumber with flat grain, or vertical grain, or mixed grain, without requirements as to heartwood.

Plywood. Exterior plywood with a rough-sawn surface is commonly used for siding. Smooth-sanded plywood is *not recommended* for siding, but it is often used in soffits. Both sanded and rough-sawn plywood develops surface checks, especially when exposed to moisture and sunlight. These surface checks can lead to early paint failure with oil-based or alkyd paint systems. Quality acrylic latex primer and topcoat paint systems generally perform better. The flat-grained pattern present in nearly all plywood can also contribute to early paint failure. Therefore, if smooth or rough-sawn plywood is to be painted, special precautions should be exercised. Penetrating stains are often more appropriate for rough-sawn exterior plywood surfaces, but good-quality acrylic latex paints also perform very well.

Reconstituted wood products. Reconstituted wood products are those made by forming small pieces of wood into large sheets, usually 4 by 8 feet or as required for a specialized use such as beveled siding. These products are classified as fiberboard or particleboard, depending upon the nature of the basic wood component.

Fiberboards are produced from mechanical pulps. Hardboard is a relatively heavy type of fiberboard, and its tempered or treated form designed for outdoor exposure is used for exterior siding. It is often sold in 4- by 8-foot sheets but is also available in narrow strips as a substitute for solid-wood beveled siding.

Particleboards are manufactured from whole wood in the form of splinters, chips, flakes, strands, or shavings. Waferboard and flakeboard are two types of particleboard made from relatively large flakes or shavings.

Some fiberboards and particleboards are manufactured for exterior use. Film-forming finishes such as paints and solid-color stains will give the most protection to these reconstituted wood products. Some reconstituted wood products may be factory-primed with paint, and some may even have a factory-applied topcoat. Also, some may be overlaid with a resin-treated paper to provide a superior surface for paint.

Types of exterior wood finishes

The outdoor finishes described in this section, their properties, treatment, and maintenance, are summarized in

table 18. The suitability and expected life of the most commonly used finishes on several wood and wood-based products are summarized in table 19. Information in tables 18 and 19 should be considered as general guidelines only. Many factors affect the performance and lifetime of wood finishes, as described earlier.

Paint. Paints are coatings commonly used on wood and provide the most protection. They come in a wide range of colors and may have either oil or latex base. Latex-based paints and stains are waterborne, and oil-based or alkyd paints are carried by organic solvents. Paints are used for esthetic purposes, to protect the wood surface from weathering, and to conceal certain defects.

Paints are applied to the wood surface and do not penetrate it deeply. The wood grain is completely obscured, and

Table 18–*Exterior wood finishes: types, treatment, and maintenance*

Finish	Initial treatment	Appearance of wood	cost of initial treatment	Maintenance procedure	Maintenance period of surface finish	Maintenance cost
Preservative oils (creosotes)	Pressure, hot and cold tank steeping	Grain visible. Brown to black in color, fading slightly with age	Medium	Brush down to remove surface dirt	5–10 yr only if original color is to be renewed; otherwise no maintenance is required	Nil to low
	Brushing	Brown to black in color, fading slightly with age	Low	Brush down to remove surface dirt	3–5 yr	Low
Waterborne preservatives	Pressure	Grain visible. Greenish in color, fading with age	Medium	Brush down to remove surface dirt	None, unless stained, painted, or varnished as below	Nil, unless stains, varnishes, or paints are used. See below
	Diffusion plus paint	Grain and natural color obsured	Low to medium	Clean and repaint	7–10 yr	Medium
Organic solvents preservatives.	Pressure, steeping, dipping, brushing	Grain visible. Colored as desired	Low to medium	Brush down and reapply	2–3 yr or when preferred	Medium
Waterrepellent†	One or two brush coats of clear material or, preferably, dip applied	Grain and natural color visible, becoming darker and rougher textured	Low	Clean and apply sufficient material	1–3 yr or when preferred	Low to medium
Stains	One or two brush coats	Grain visible. Color as desired	Low to medium	Clean and apply sufficient material	3–6 yr or when preferred	Low to medium
Clear varnish	Four coats (minimum)	Grain and natural color unchanged if adequately maintained	High	Clean and stain bleached areas, and apply two more coats	2 yr or when breakdown begins	High
Paint	Water repellent, prime, and two topcoats	Grain and natural color obscured	Medium to high	Clean and apply topcoat; or remove and repeat initial treatment if damaged	7–10 yr‡	Medium to high

Source: This table is a compilation of data from the observations of many researchers.

*Pentachlorophenol, bis (tri-n-butyltin oxide), copper naphthenate, copper-8-quinolinolate, and similar materials.

†With or without added preservatives. Addition of preservative helps control mildew growth and gives better performance.

‡Using to-pquality acrylic latex topcoats.

Table 19–*Suitability of finishing methods for exterior wood surfaces*

Type of exterior wood surfaces	Water-repellent preservative		Stains		Paints	
	Suitability	Expected life* (yr)	Suitability	Expected life† (yr)	Suitability	Expected life‡ (yr)
Siding						
Cedar and redwood						
Smooth (vertical grain)	High	1–2	Moderate	2–4	High	4–6
Rough sawn or weathered	High	2–3	Excellent	5–8	Moderate	3–5
Pine, fir, spruce, etc.						
Smooth (flat grain)	High	1–2	Low	2–3	Moderate	3–5
Rough (flat grain)	High	2–3	High	4–7	Moderate	3-5
Shingles						
Sawn	High	2–3	Excellent	4–8	Moderate	3–5
Split	High	1–2	Excellent	4–8	—	—
Plywood (Douglas-fir and southern pine)						
Sanded	Low	1–2	Moderate	2-4	Moderate	3–5
Rough sawn	Low	2–3	High	4–8	Moderate	3–5
Medium-density overlay§	—	—	—	—	Excellent	6–8
Plywood (cedar and redwood)						
Sanded	Low	1–2	Moderate	2-4	Moderate	3–5
Rough sawn	Low	2–3	Excellent	5–8	Moderate	3–5
Hardboard, medium density‖						
Smooth						
Unfinished	—	—	—	—	High	4–6
Preprimed	—	—	—	—	High	4–6
Textured						
Unfinished	—	—	—	—	High	4–6
Preprimed	—	—	—	—	High	4–6
Millwork (usually pine)						
Windows, shutters, doors, exterior trim	High¶	—	Moderate	2–3	High	3–6
Decking						
New (smooth)	High	1–2	Moderate	2–3	Low	2–3
Weathered (rough)	High	2–3	High	3–6	Low	2–3
Glued-laminated members						
Smooth	High	1–2	Moderate	3–4	Moderate	3–4
Rough	High	2–3	High	6–8	Moderate	3–4
Waferboard	—	—	Low	1–3	Moderate	2-4

Source: This table is a compilation of data from the observations of many researchers. Expected life predictions are for an average continental U.S. location; expected life will vary in extreme climates or exposure (desert, seashore, deep woods, etc.).

* Development of mildew on the surface indicates a need for refinishing.

†Smooth. unweathered surfaces are generally finished with only one coat of stain, but rough-sawn or weathered surfaces, being more absorptive, can be finished with two coats, with the second coat applied while the first coat is still wet.

‡Expected life of two coats, one primer and one topcoat. Applying a second topcoat (three-coat job) will approximately double the life. Top-quality acrylic latex paints will have best durability.

§ Mediumdensity overlay is generally painted.

‖ Semitransparent stains are not suitable for hardboard. Solidcolor stains (acrylic latex) will perform like paints. Paints are preferred.

¶ Exterior millwork. such as windows, should be factory treated according to Industry Standard IS4-81. Other trim should be liberally treated by brushing before painting.

a surface film is formed. Paints perform best on smooth, edge-grained lumber of lightweight species. The surface film can blister or peel if the wood is wetted or if inside water vapor moves through the house wall and wood siding because of the absence of a vapor-retarding material.

Latex paints are generally easier to use because water is used in cleanup. They are also porous and allow some moisture movement. In comparison, oil-based paints require organic solvent for cleanup, and some are resistant to moisture movement.

Of all the finishes, paints provide wood with the most protection against surface erosion and offer the widest selection of colors. A nonporous paint film retards penetration of moisture and reduces the problem of discoloration by wood extractives and warping of the wood. However, *paint is not a preservative. It will not prevent decay if conditions are favorable for fungal growth.* Original and maintenance costs are often higher for a paint finish than for a water-repellent preservative or penetrating stain finish.

Solid-color stains. Solid-color stains are opaque finishes (also called hiding or heavybodied); they come in a wide range of colors and are made with a much higher concentration of pigment than the semitransparent penetrating stains. As a result, they totally obscure the natural wood color and grain. Oil-based solid-color stains tend to form a film much like paint and as a result may also peel loose from the substrate. Latex-based solid-color stains are also available, and like the oil-based solid-color stains, they form a surface film. Both these stains are similar to thinned paints and can usually be applied over old paint or stain.

Semitransparent penetrating stains. Semitransparent penetrating stains are only moderately pigmented and do not totally hide the wood grain. These stains penetrate the wood surface, are porous, and do not form a surface film like paints. As a result, they do not blister or peel even if moisture moves through the wood. Penetrating stains have alkyd or oil base, and some may contain a fungicide as well as a water repellent. Moderately pigmented latex-based (waterborne) stains are also available, but they do not penetrate the wood surface like oil-based stains.

Stains are most effective on rough lumber or rough-sawn plywood surfaces, but they also provide satisfactory performance on smooth surfaces, although they require frequent renewal. They are available in a variety of colors and are especially popular in the brown or red earth tones because they give a "natural" or rustic wood appearance. They make an excellent finish for weathered wood. *Semitransparent stains are not effective when applied over a solid color stain or over old paint.*

Water repellents and water-repellent preservatives. A water-repellent preservative may be used as a natural finish. It contains a fungicide or mildewcide, a small amount of wax as a water repellent, a resin or drying oil, and a solvent such as turpentine or mineral spirits. Water-repellent preservatives do not contain any coloring pigments. Therefore, the resulting finish varies in color depending upon the wood itself. The preservative also prevents wood from darkening (graying) as a result of mildew and mold growth.

The initial application to smooth surfaces is usually short-lived. When a surface starts to show a blotchy discoloration caused by extractives or mildew, it should be cleaned with liquid household bleach and detergent solution and retreated after drying. During the first few years, the finish may have to be applied every year or so. After the wood has gradually weathered to a uniform color, the treatments are more durable and need refinishing only when fungi start to make the surface color uneven.

Caution: *Because of the toxicity of some fungicides in water-repellent preservative solutions and some semitransparent stains, care should be exercised to avoid excessive contact with the solution or its vapor or with the treated wood. Shrubs and plants should also be protected from accidental contamination.*

Water-repellent preservatives may also be used as a treatment for bare wood before priming and painting or in areas where old paint has peeled, exposing bare wood, particularly around butt joints or in comers. This treatment keeps rain or dew from penetrating into the wood, especially at joints and end grain, and thus decreases the shrinking and swelling of wood. The fungicide inhibits decay.

Water repellents are also available. These are water-repellent preservatives with the preservative left out. Water repellents are not effective natural finishes by themselves because they do not control mildew. They can be used as a stabilizing treatment before priming and painting.

Transparent coatings. Clear coatings of conventional spar, urethane, or marine varnishes, which are film-forming finishes, are not generally recommended for exterior use on wood. Such coatings embrittle by exposure to sunlight and develop severe cracking and peeling, often in less than 2 years. Areas that are protected from direct sunlight by overhang or which are on the north side of the structure can be finished with exterior-grade varnishes. Even in protected areas, however, a minimum of three coats of varnish is recommended, and the wood should be treated with water-repellent preservative before finishing. The use of pigmented stains and sealers as undercoats also contributes to longer life of the clear finish. For best performance in marine exposures, six coats of varnish should be used.

Application of exterior finishes

Paint. Proper surface care and preparation before applying paint to wood is essential for good performance. Wood and wood-based products should be protected from the weather and wetting, both on the jobsite and after they are installed. Surface contamination from dirt, oil, and other foreign substances must be eliminated. *It is most important to paint wood surfaces within 1 week after installation, weather permitting.* To achieve maximum paint life, follow these steps:

Treat wood siding and trim. Brush or dip exterior wood with a *paintable* water-repellent preservative or water repellent to protect the wood against the entrance of rain and dew and minimize swelling and shrinking. Treat lap and butt joints especially well and the edges of panel products such as plywood, hardboard, and particleboard,

because paint normally fails first in these areas. Allow at least 2 warm, sunny days for adequate drying before painting the treated surface. If the wood has been dip treated with a water repellent or water-repellent preservative, allow at least 1 week of favorable weather.

Prime bare wood. The primer coat is very important because it forms a base for all succeeding paint coats. For woods with water-soluble extractives such as redwood and cedar, the best primers are good-quality oil-based and alkyd-based paints or stain-blocking acrylic latex-based paints. The primer seals in the extractives so that they will not bleed through the topcoat. A primer should be used whether the topcoat is oil-based or latex-based. For species such as pine that are predominantly sapwood and free of extractives, a high-quality acrylic latex topcoat paint may be used both as primer and topcoat. Apply enough primer to obscure the wood grain and do not spread too thinly. Follow the application rates recommended by the manufacturer. A primer coat that is uniform and of the proper thickness distributes the swelling stresses resulting from moisture content changes in wood and thus helps to prevent premature paint failure. Brush application is always superior to roller or spray application, especially for the first coat.

Apply paint. Two coats of a good-quality acrylic latex house paint should be applied over the primer. Other paints that are used include the oil based, alkyd based, and vinyl acrylic. The quality of paint is usually, but not always, related to price. If it is not practical to apply two topcoats to the entire house, consider two topcoats for fully exposed areas on the south and west sides as a minimum for good protection. Areas fully exposed to sunshine and rain are the first to deteriorate and therefore should receive two coats. On those wood surfaces best suited for painting, one coat of a good house paint over a properly applied primer (a conventional two-coat paint system) should last 4 to 5 years, but two coats over the primer can last up to 10 years (table 19).

Coverage. One gallon of paint covers about 400 ft^2 of smooth wood surface area. However, coverage varies with different paints, surface characteristics, and application procedures. Research indicates that the optimum thickness for the total dry paint coat (primer and two topcoats) is 4 to 5 mils or about the thickness of a sheet of newspaper.

Time between coats. To avoid future separation between paint coats, apply the first topcoat within 2 weeks after the primer, and the second topcoat within 2 weeks of the first. As certain paints weather, they form a soaplike substance on their surface that may prevent proper adhesion of new paint coats. If more than 2 weeks elapse before applying another paint coat, scrub the old surface with water using a bristle brush or sponge. If necessary, use a mild detergent to remove all dirt and deteriorated paint. Then rinse well with water, and allow the surfaces to dry before painting.

Temperature blistering. To avoid blistering, oil-based paints should not be applied on a cool surface that will be heated by the sun within a few hours. Temperature blistering is most common with thick coats of paint of dark colors applied in cool weather. The blisters usually show up in the last coat of paint and occur within a few hours or perhaps as much as 1 or 2 days after painting.

Minimum temperatures. Oil-based paint may be applied when the temperature is 40 °F or above. A minimum of 50 °F is desirable for applying latex-based waterborne paints. For proper curing of latex paint films, the temperature should not drop below 50 °F for at least 24 hours after paint is applied. Low temperatures result in poor coalescence of the paint film and early paint failure.

Avoid dewfall. To avoid wrinkling, fading, or loss of gloss of oil-based paints and streaking of latex paints, the paint should not be applied in the evenings of cool spring and fall days when heavy dews form during the night before the surface of the paint has thoroughly dried. Serious water absorption problems and major finish failure can also occur with some latex paints when applied under these conditions.

Solid-color stains. Solid-color stains may be applied to a smooth surface by brush, spray, or roller application, but brush application is best. These stains act much like paint. One coat of solid-color stain is considered adequate for siding, but two coats provide significantly better protection and longer service. These stains are not generally recommended for horizontal wood surfaces such as decks and window sills.

With a solid-color stain, in contrast to paint, lap marks may form. Latex-based stains are particularly fast-drying and are more likely to show lap marks than those with an oil base. To prevent lap marks, follow the procedures suggested under application of semitransparent penetrating stains.

Semitransparent penetrating stains. Semitransparent penetrating oil-based stains may be brushed, sprayed, or rolled on. Brushing gives the best penetration and performance. The stains are generally thin and runny, so application can be messy. Lap marks may form if stains are improperly applied but can be prevented by staining only a small number of boards or one panel at a time. This method prevents the front edge of the stained area from drying out before a logical stopping place is reached. It is desirable to work in the shade because the drying rate is slower. One gallon usually covers about 200 to 400 ft^2 of

smooth wood surface and from 100 to 200 ft² of rough or weathered surface.

For long life with penetrating oil-based stain on rough-sawn or weathered lumber, use two coats and apply the second coat before the first is dry. (If the first coat dries completely, it may seal the wood surface so that the second coat cannot penetrate into the wood.) Apply the first coat to a panel or area in a manner to prevent lap marks. Then work on another area so that the first coat can soak into the wood for 20 to 60 minutes. About an hour after applying the second coat, use a cloth, sponge, or dry brush lightly wetted with stain to wipe off the excess stain that has not penetrated into the wood. Otherwise areas of stain that did not penetrate may form an unsightly surface film and glossy spots will appear. Avoid intermixing different brands or batches of stain. Stir stain occasionally and thoroughly during application to prevent settling and color change.

CAUTION: *Sponges or cloths that are wet with oil-based stain are particularly susceptible to spontaneous combustion. To prevent fires, bury them, immerse them in water, or seal them in an airtight metal container immediately after use.*

A two-coat system on rough wood may last as long as 6 to 8 years in certain exposures because of the large amount of stain absorbed. By comparison, if only one coat of penetrating stain is used on new smooth wood, its life expectancy is 2 to 4 years; however, succeeding coats will last longer.

Water repellents and water-repellent preservatives. The most effective method of applying a water repellent or water-repellent preservative is to dip the entire board into the solution. However, brush treatment is also effective. When wood is treated in place, liberal amounts of the solution should be applied to all lap and butt joints, edges and ends of boards, and edges of panels where end grain occurs. Other areas especially vulnerable to moisture, such as the bottoms of doors and window frames, should not be overlooked. One gallon covers about 250 ft² of smooth surface or 150 ft² of rough surface. The life expectancy is only 1 to 2 years as a natural finish, depending upon the wood and exposure. Treatments on rough surfaces are generally longer lived than those on smooth surfaces. Repeated brush treatment to the point of refusal will enhance durability and performance. Treated wood that is painted will not need retreating unless the protective paint layer weathers away.

Special applications

Finishing porches and decks. Exposed flooring on porches and decks is sometimes painted. The recommended procedure for treating with water-repellent preservative and primer is the same as for wood siding. After the primer, an undercoat (first topcoat) and matching second topcoat of porch and deck enamel should be applied. These paints are especially formulated to resist abrasion and wear.

Many fully-exposed decks are more effectively finished with a water-repellent preservative or a penetrating-type semitransparent pigmented stain alone. These finishes need more frequent refinishing than painted surfaces, but are easy to refinish because no such laborious surface preparation is needed as when painted surfaces start to peel. Solid-color stains should not be used on any horizontal surface such as decks because early failure may occur.

Finishing treated wood. Wood pressure-treated with waterborne chemicals that react with the wood or form an insoluble residue, for example, copper, chromium, and arsenic salts (CCA-treated wood), presents no major problem in finishing if the wood is properly redried and thoroughly cleaned after treating. Wood treated with solventborne or oilborne preservative chemicals, such as pentachlorophenol, is not considered paintable until all the solvents have evaporated. Solvents such as methylene chloride or liquified petroleum gas evaporate readily. Successful painting is usually impossible, however, when heavy oil solvents with low volatility are used to treat wood under pressure. Even special drying procedures for wood pressure-treated with the water-repellent preservative formulas that employ highly volatile solvents do not restore complete paintability.

Woods that have been pressure-treated for decay or fire resistance sometimes have special finishing requirements. None of the common *pressure* preservative treatments (creosote, pentachlorophenol, water-repellent preservatives, and waterborne) significantly change the weathering characteristics of woods. Certain treatments such as waterborne treatments containing chromium reduce the degrading effects of weathering. Except for esthetic or visual reasons, there is generally no need to apply a finish to most preservative-treated woods. If needed, oil-based, semitransparent penetrating stains can be used, but only after the preservative-treated wood has weathered for 1 to 2 years depending on exposure. The only preservative-treated woods that can be painted or stained immediately after treatment and without further exposure are CCA-treated woods, but only if they are dry and clean. Since CCA is waterborne, the wood must be dried after treatment. Manufacturers generally have specific recommendations for good painting and finishing practices for fire-retardant and preservative-treated woods.

Maintenance of Finishes

Exterior wood surfaces need to be refinished only when the old finish has worn thin and no longer protects the wood. In repainting with oil-based paint, one coat may be adequate if the old paint surface is in good condition. Dirty paint can often be freshened by washing with detergent. Repainting too frequently with oil-based systems produces an excessively thick film that is likely to crack abnormally across the grain of the wood. Complete paint removal and repainting is the only cure for cross-grain cracking.

Paint and solid-color stains

In refinishing an old paint coat (or solid-color stain), proper surface preparation is essential if the new coat is to give the expected performance. First, all loose paint should be scraped away. Any remaining paint should be sanded to feather the edges smooth with the bare wood. Any remaining old paint should be scrubbed with a brush or sponge and water. The scrubbed surface should be rinsed with clean water. If the surface is still dirty or chalky, it needs to be scrubbed again using a detergent. Mildew should be removed with a dilute liquid household bleach solution. After rinsing the cleaned surface thoroughly with fresh water, it should be allowed to dry before repainting. Areas of exposed wood should be treated with a water-repellent preservative, or water repellent, and allowed to dry for at least 2 days, and then primed. Topcoats can then be applied.

It is particularly important to clean areas protected from sun and rain such as porches, soffits, and side walls protected by overhangs. These areas tend to collect dirt and water-soluble materials that interfere with adhesion of the new paint. It is probably adequate to repaint these protected areas every other time the house is painted.

Latex paint can be applied over freshly primed surfaces and on weathered paint surfaces if the old paint is clean and sound. Where old sound paint surfaces are to be repainted with latex paint, a simple test should be conducted first. After cleaning the surface, a small, inconspicuous area is repainted with latex paint and allowed to dry at least overnight. Then, to test for adhesion, one end of an adhesive bandage is pressed firmly onto the painted surface and pulled off with a snapping action. If the tape comes away free of paint, the latex paint is well bonded and the old surface does not need priming or additional cleaning. If the new latex paint adheres to the tape, the old surface is too chalky and needs more cleaning or the use of an oil-based primer. If both the latex paint and the old paint coat adhere to the tape, the old paint is not well bonded to the wood and must be removed before repainting.

Semitransparent penetrating stains

Semitransparent penetrating oil-based stains are relatively easy to refinish. Heavy scraping and sanding are generally not required. Simply use a stiff-bristle brush to remove all surface dirt, dust, and loose wood fibers, and then apply a new coat of stain. The second coat of penetrating stain often lasts longer than the first because it penetrates into small surface checks that open up as wood weathers.

Water-repellent preservatives

Water-repellent preservatives used for natural finishes can be renewed by a simple cleaning of the old surface with a bristle brush and an application of a new coat of finish. For determining if a water-repellent preservative has lost its effectiveness, a small quantity of water is splashed against the wood surface. If the water beads up and runs off the surface, the treatment is still effective. If the water soaks in, the wood needs to be refinished. Refinishing is also required when the wood surface shows signs of graying. Gray discoloration can be removed by using liquid household bleach.

NOTE: Steel wool and wire brushes should not be used to clean surfaces to be finished with semitransparent stains or water-repellent preservatives because small iron deposits may be left behind. The small iron deposits can react with certain water-soluble extractives in woods like western redcedar, redwood, Douglas-fir, and the oaks to yield dark blue-black stains on the surface.