CHAPTER 5

INTERIOR FINISH OF WALLS AND CEILINGS

Builders are responsible for finishing the interior of the buildings of a construction project. Interior finish consists mainly of the coverings of the rough walls, ceilings, and floors, and installing doors and windows with trim and hardware. In this chapter, we'll discuss wall and ceiling coverings, including the closely related topics of insulation and ventilation. In the next chapter, we'll look at floor coverings, stairway construction, and interior door and wood trim installation.

DRYWALL AND OTHER COVERINGS

LEARNING OBJECTIVE: Upon completing this section, you should be able to describe drywall installation and finishing procedures, and identify various types of wall and ceiling coverings and the tools, fasteners, and accessories used in installation.

Though lath-and-plaster finish is still used in building construction today, drywall finish has become the most popular. Drywall finish saves time in construction, whereas plaster finish requires drying time before other interior work can be started. Drywall finish requires only short drying time since little, if any, water is required for application. However, a gypsum drywall demands a moderately low moisture content of the framing members to prevent "nail-pops." Nail-pops result when frame members dry out to moisture equilibrium, causing the nailhead to form small "humps" on the surface of the board. Stud alignment is also important for single-layer gypsum finish to prevent a wavy, uneven appearance. Thus, there are advantages to both plaster and gypsum drywall finishes and each should be considered along with the initial cost and maintenance.

DRYWALL

There are many types of drywall. One of the most widely used is gypsum board in 4- by 8-foot sheets. Gypsum board is also available in lengths up to 16 feet. These lengths are used in horizontal application. Plywood, hardboard, fiberboard, particleboard, wood paneling, and similar types are also used. Many of these drywall finishes come prefinished.

The use of thin sheet materials, such as gypsum board or plywood, requires that studs and ceiling joists have good alignment to provide a smooth, even surface. Wood sheathing often corrects misaligned studs on exterior walls. A strongback (fig. 5-1) provides for alignment of ceiling joists of unfinished attics. It can also be used at the center of a span when ceiling joists are uneven.

Gypsum wallboard is the most commonly used wall and ceiling covering in construction today. Because gypsum is nonflammable and durable, it is appropriate for application inmost building types. Sheets of drywall are nailed or screwed into place, and nail indentions or "dimples" are filled with joint compound. Joints between adjoining sheets are built up with special tape and several layers (usually three) of joint compound. Drywall is easily installed, though joint work can be tedious.

Drywall varies in composition, thickness, and edge shape. The most common sizes with tapered edges are 1/2 inch by 4 feet by 8 feet and 1/2 inch by 4 feet by 12 feet.

Regular gypsum board is commonly used on walls and ceilings and is available in various thicknesses. The most common thicknesses are 1/2 inch and 5/8 inch. Type X gypsum board has special additives that make it fire resistant.

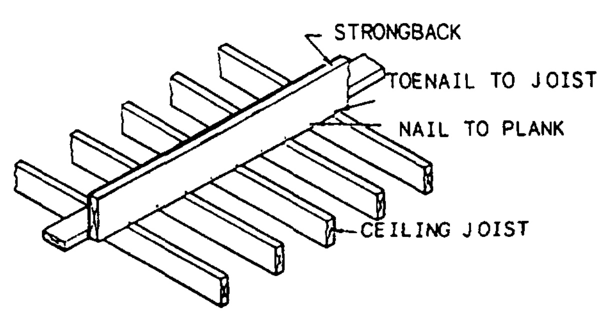

Figure 5-1.—Strongback for alignment of ceiling joists.

Types

MR (moisture resistant) or WR (water resistant) board is also called greenboard and blueboard. Being water resist ant, this board is appropriate for bathrooms, laundries, and similar areas with high moisture. It also provides a suitable base for embedding tiles in mastic. MR or WR board is commonly 1/2 inch thick.

Sound-deadening board is a sublayer used with other layers of drywall (usually type X); this board is often 1/4 inch thick

Backing board has a gray paper lining on both sides. It is used as a base sheet on multilayer applications. Backing board is not suited for finishing and decorating.

Foil-backed board serves as a vapor barrier on exterior walls. This board is available in various thicknesses.

Vinyl-surfaced board is available in a variety of colors. It is attached with special drywall finish nails and is left exposed with no joint treatment.

Plasterboard or gypsum lath is used for plaster base. It is available in thickness starting at 3/8 inch, widths 16 and 24 inches, and length is usually 48 inches. Because it comes in manageable sizes, it's widely used as a plaster base instead of metal or wood lath for both new construction and renovation. This material is not compatible with portland cement plaster.

The varying lengths of drywall allow you to lay out sheets so that the number of seams is kept to a minimum, End points can be a problem, however, since the ends of the sheets aren't shaped (only the sides are). As sheet length increases, so does weight, unwieldiness, and the need for helpers. Standard lengths are 8, 9, 10, 12, and 14 feet. Sixteen-foot lengths are also available. Use the thickness that is right for the job. One-half-inch drywall is the dimension most commonly used. That thickness, which is more than adequate for studs 16 inches on center (OC), is also considered adequate where studs are 24 inches OC. Where ceiling joists are 16 inches OC, use 1/2-inch drywall, whether it runs parallel or perpendicular to joists. Where ceiling joists are 24 inches OC, though, use 1/2-inch drywall only if the sheets are perpendicular to joists.

Drywall of 1/4- and 3/8-inch thicknesses is used effectively in renovation to cover existing finish walls with minor irregularities. Neither is adequate as a single layer for walls or ceiling, however. Two 1/4-inch-thick plies are also used to wrap curving walls.

Drywall of 5/8-inch thickness is favored for quality single-layer walls, especially where studs are 24 inches OC. Use 5/8-inch drywall for ceiling joists 24 inches OC, where sheets run parallel to joists. This thickness is widely used in multiple, fire-resistant combinations.

There are several types of edging in common use. Tapered allows joint tape to be bedded and built up to a flat surface. This is the most common edge used. Tapered round is a variation on the first type. Tapered round edges allow better joints. These edges are more easily damaged, however. Square makes an acceptable exposed edge. Beveled has an edge that, when left untapped, gives a paneled look.

Tools

Commonly used tools in drywall application include a tape measure, chalk line, level, utility and drywall knives, straightedge, and a 48-inch T square (drywall square) or framing square. Other basic tools include a keyhole saw, drywall hammer (or convex head hammer), screw gun, drywall trowel, comer trowel, and a foot lift. Some of these tools are shown in figure 5-2.

The tape measure, chalk line, and level are used for layout work. The utility and drywall knives, straightedge, and squares are used for scoring and breaking drywall. The keyhole saw is used for cutting irregular shapes and openings, such as outlet box openings. A convex head or drywall, hammer used for drywall nails will "dimple" the material without tearing the paper. The screw gun quickly sinks drywall screws to the adjusted depth and then automatically disengages.

Drywall knives have a variety of uses. The 6-inch knife is used to bed the tape in the first layer of joint compound and for filling nail or screw dimples. The 12-inch finishing knife "feathers out" the second layer of joint compound and is usually adequate for the third or "topping" layer. Knives 16 inches and wider are used for applying the topping coat. Clean and dry drywall knives after use. Use only the drywall knives for the purpose intended-to finish drywall.

The drywall trowel resembles a concrete finishing trowel and is manufactured with a 3/16-inch concave bow. This trowel, also referred to as a "flaring," "feathering," or "bow" trowel, is used when applying the finish layer of joint compound. A comer trowel is almost indispensable for making clean interior comers.

For sanding dried joint compound smooth, use 220 grit sandpaper. Sandpaper should be wrapped around a sanding block or can be used on an orbital sander. When

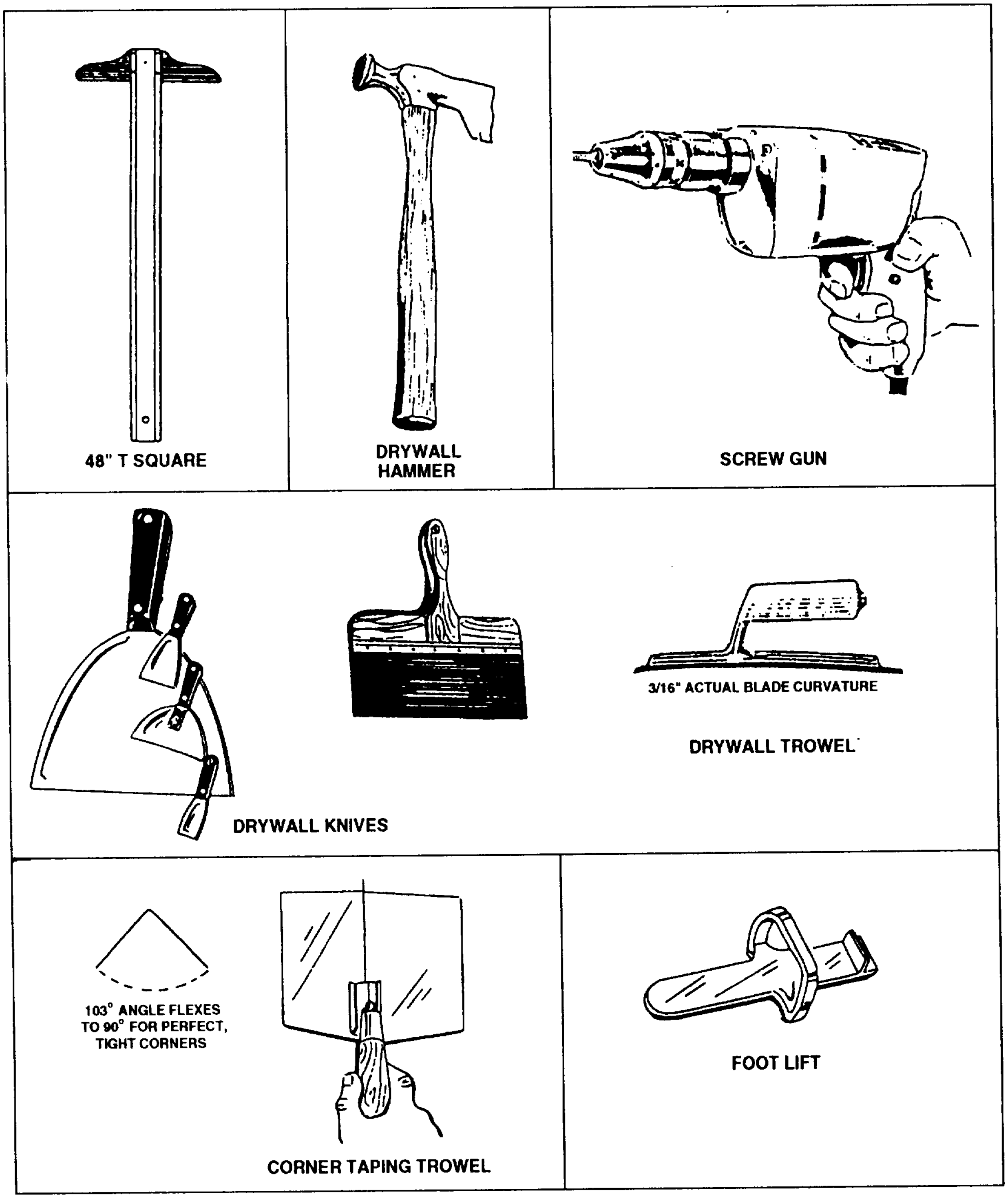

Figure 5-2.—Common tools for drywall installation.

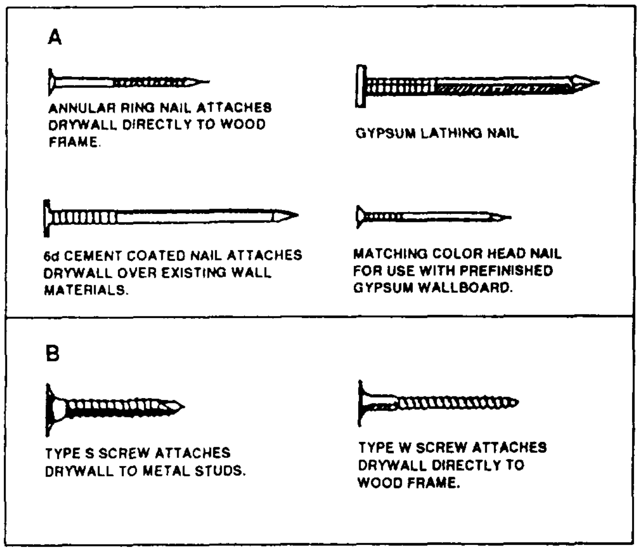

Figure 5-3.—Drywall fasteners.

sanding, ensure you're wearing the required personnel protective gear to prevent dust inhalation.

A foot lift helps you raise and lower drywall sheets while you plumb the edges. Be careful when using the foot lift—applying too much pressure to the lift can easily damage the drywall.

Fasteners

Which fasteners you use depends in part upon the material underneath. The framing is usually wood or metal studs, although gypsum is occasionally used as a base. Adhesives are normally used in tandem with screws or nails. This allows the installer to use fewer screws or nails, leaving fewer holes that require filling. For reasons noted shortly, you'll find the drywall screw the most versatile fastener for attaching drywall to framing members.

NAILS.— Drywall nails (fig. 5-3, view A) are specially designed, with oversized heads, for greater holding power. Casing or common nailheads are too small. Further, untreated nails can rust and stain a finish. The drywall nail most frequently used is the annular ring nail. This nail fastens securely into wood studs and joists. When purchasing such nails, consider the thickness of the layer or layers of drywall, and allow additional length for the nail to penetrate the underlying wood 3/4 inch. Example: 1/2-inch drywall plus 3/4-inch penetration requires a 1 1/4-inch nail. A longer nail does not fasten more securely than one properly sized, and the longer nail is subject to the expansion and contraction of a greater depth of wood.

Smooth-shank, diamond-head nails are commonly used to attach two layers of drywall; for example, when fireproofing a wall. Again, the mil length should be selected carefully. Smooth-shank nails should penetrate the base wood 1 inch. Predecorated drywall nails, which may be left exposed, have smaller heads and are color-matched to the drywall.

SCREWS.— Drywall screws (fig. 5-3, view B) are the preferred method of fastening among professional builders, cabinetmakers, and renovators. These screws are made of high-quality steel and are superior to conventional wood screws. Use a power screw gun or an electric drill to drive in the screws. Because this method requires no impact, there is little danger of jarring loose earlier connections. There are two types of drywall screws commonly used: type S and type W.

Type S.— Type S screws (fig. 5-3, view B) are designed for attachment to metal studs. The screws are self-tapping and very sharp, since metal studs can flex away. At least 3/8 inch of the threaded part of the screw should pass through a metal stud. Although other lengths are available, 1-inch type S screws are commonly used for single-ply drywall.

Type W.— Type W screws (fig. 5-3, view B) hold drywall to wood. They should penetrate studs or joists at least 5/8 inch. If you are applying two layers of drywall, the screws holding the second sheet need to penetrate the wood beneath only 1/2 inch.

TAPE.— Joint tape varies little. The major difference between tapes is whether they are perforated or not. Perforated types are somewhat easier to bed and cover. New self-sticking fiber-mesh types (resembling window screen) are becoming popular. Having the mesh design and being self-sticking eliminates the need for the first layer of bedding joint compound.

JOINT COMPOUND.— Joint compound comes ready-mixed or in powder form. The powder form must be mixed with water to a putty consistency. Ready-mixed compound is easier to work with, though its shelf life is shorter than the powdered form. Joint compounds vary according to the additive they contain. Always read and follow the manufacturer's specifications.

ADHESIVES.— Adhesives are used to bond single-ply drywall directly to the framing members, furring strips, masonry surfaces, insulation board, or other drywall. They must be used with nails or screws.

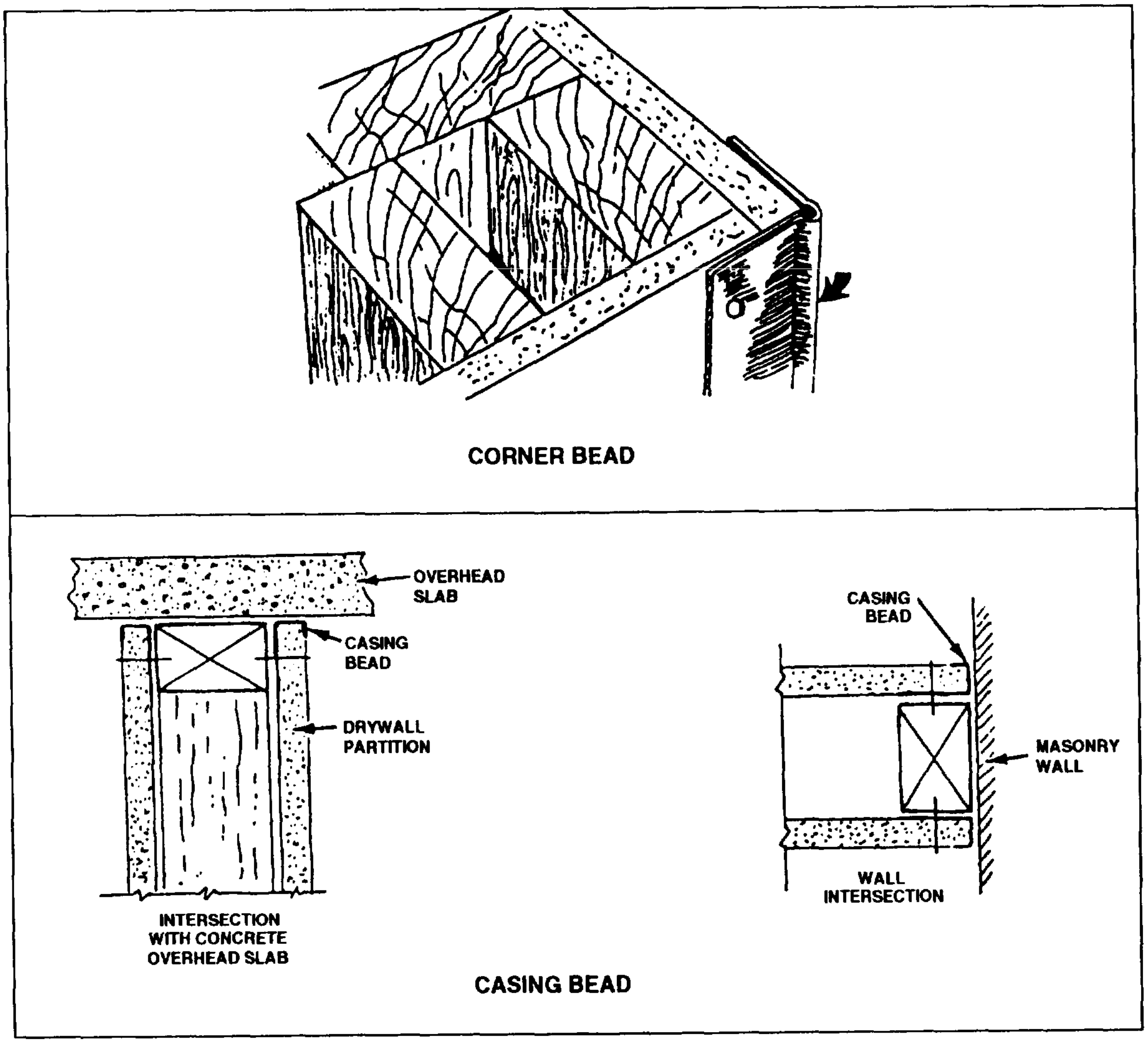

Figure 5-4.—Corner and casing beads.

Because adhesives are matched with specific materials, be sure to select the correct adhesive for the job. Read and follow the manufacturer's directions.

Accessories

A number of metal accessories have been developed to finish off or protect drywall. corner beads (fig. 5-4) are used on all exposed comers to ensure a clean finish and to protect the drywall from edge damage. corner bead is nailed or screwed every 5 inches through the drywall and into the framing members. Be sure the corner bead stays plumb as you fasten it in place. Casing beads (fig. 5-4), also called stop beads, are used where drywall sheets abut at wall intersections, wall and exposed ceiling intersections, or where otherwise specified. Casing beads are matched to the thickness of the drywall used.

Layout

When laying out a drywall job, keep in mind that each joint will require taping and sanding. You therefore should arrange the sheets so that there will be a minimum of joint work. Choose drywall boards of the maximum practical length.

Drywall can be hung with its length either parallel or perpendicular to joists or studs. Although both arrangements work sheets running perpendicular afford better attachment. In double-ply installation, run base sheets parallel and top sheets perpendicular. For walls, the height of the ceiling is an important factor. When

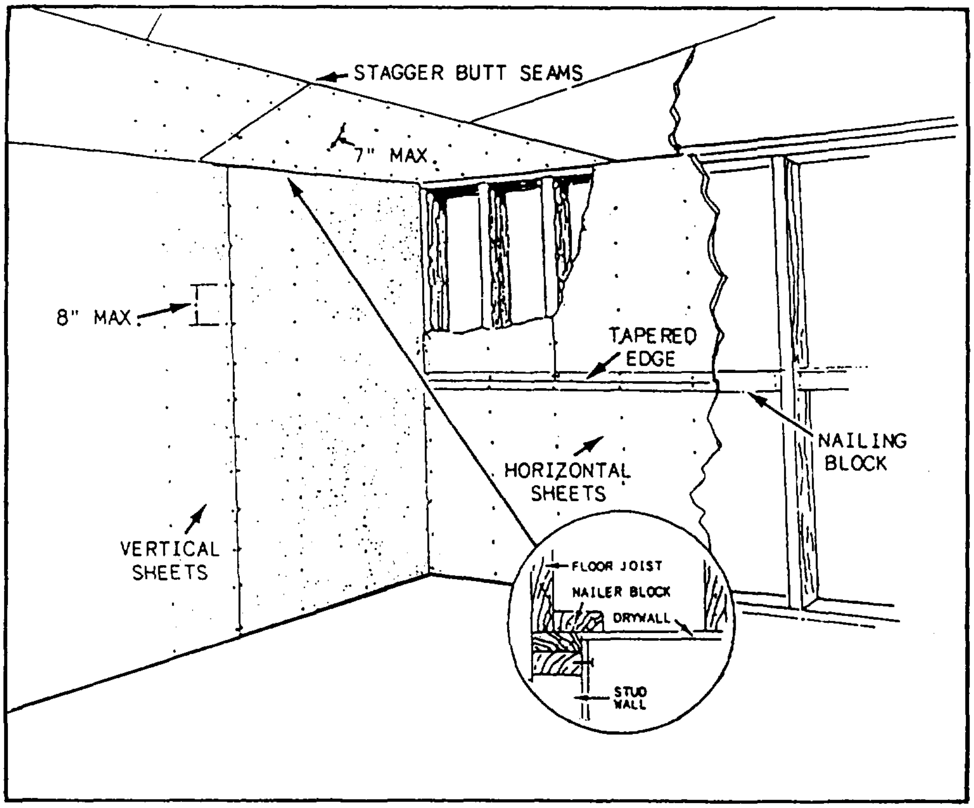

Figure 5-5.—Single-layer application of drywall.

ceilings are 8 feet 1 inch high or less, run wall sheets horizontally. Where they are higher, run wall sheets vertically, as shown in figure 5-5.

The sides of drywall taper, but the ends don't, so there are some layout constraints. End joints must be staggered where they occur. Such joints are difficult to feather out correctly. Where drywall is hung vertically, avoid side joints within 6 inches of the outside edges of doors or windows. In the case of windows, the bevel on the side of the drywall interferes with the finish trim, and the bevel may be visible. To avoid this difficulty, lay out vertical joints so they meet over a cripple (shortened) stud toward the middle of a door or window opening.

When installing drywall horizontally and an impact-resistant joint is required, you should use nailing blocks (fig. 5-5).

Handling

There are several things you can do to make working with drywall easier.

First, don't order drywall too far in advance. Drywall must be stored flat to prevent damage to the edges, and it takes up a lot of space.

Second, to cut drywall (fig. 5-6), you only need to cut through the fine-paper surface (view A). Then, grasp the smaller section and snap it sharply (view B). The gypsum core breaks along the scored line. Cut through the paper on the back (view C).

Third, when cutting a piece to length, never cut too closely. One-half-inch gaps are acceptable at the top and the bottom of a wall because molding covers these gaps. If you cut too closely, you may have difficulty getting the piece into place. Also, where walls aren't square, you may have to trim anyway.

Fourth, snap chalk lines on the drywall to indicate joists or stud centers underneath attachment is much quicker. Remember: Drywall edges must be aligned over stud, joist, or rafter centers.

Fifth, when cutting out holes for outlet boxes, fixtures, and so on, measure from the nearest fixed point(s); for example, from the floor or edge of the next piece of drywall. Take two measurements from each

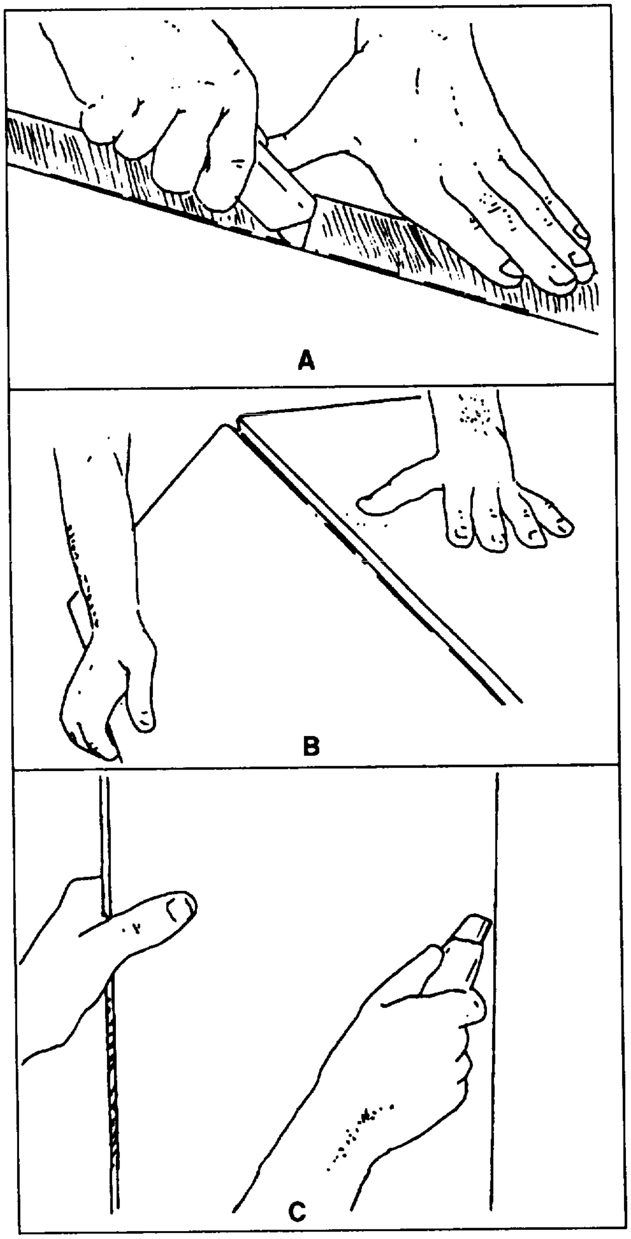

Figure 5-6.—Cutting gypsum drywall

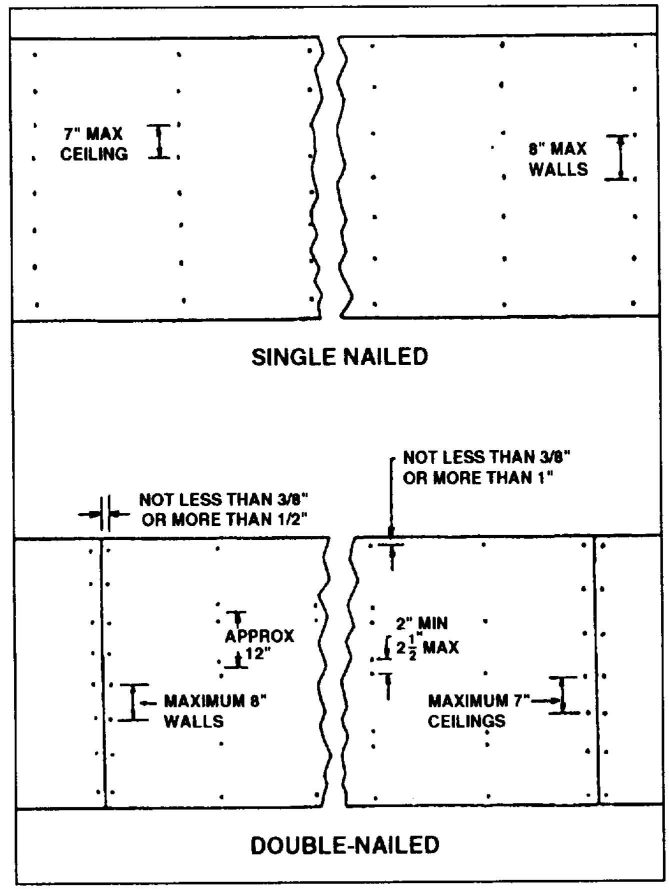

Figure 5-7.—Spacing for single and double nailing of gypsum drywall.

point, so you get the true height and width of the cutout. Locate the cutout on the finish side of the drywall. To start the cut, either drill holes at the corners or start cuts by stabbing the sharp point of the keyhole saw through the drywall and then finishing the cutting with a keyhole or compass saw. It is more difficult to cut a hole with just a utility knife, but it can be done.

Installation

When attaching drywall, hold it firmly against the framing to avoid nail-pops and other weak spots. Nails or screws must fasten securely in a framing member. If a nail misses the framing, pull it out, dimple the hole, and fill it in with compound; then try again. If you drive a nail in so deep that the drywall is crushed, drive in another reinforcing nail within 2 inches of the first.

When attaching drywall sheets, nail (or screw) from the center of the sheet outward. Where you double-nail sheets, single nail the entire sheet first and then add the second (double) nails, again beginning in the middle of the sheet and working outward.

SINGLE AND DOUBLE NAILING.— Sheets are single- or double-nailed. Single nails are spaced a maximum of 8 inches apart on walls and 7 inches apart on ceilings. Where sheets are double-nailed, the centers of nail pairs should be approximately 12 inches apart. Space each pair of nails 2 to 2 1/2 inches apart. Do not double-nail around the perimeter of a sheet. Instead, nail as shown in figure 5-7. As you nail, it is important that you dimple each nail; that is, drive each nail in slightly below the surface of the drywall without breaking the surface of the material. Dimpling creates a pocket that can be filled with joint compound. Although special

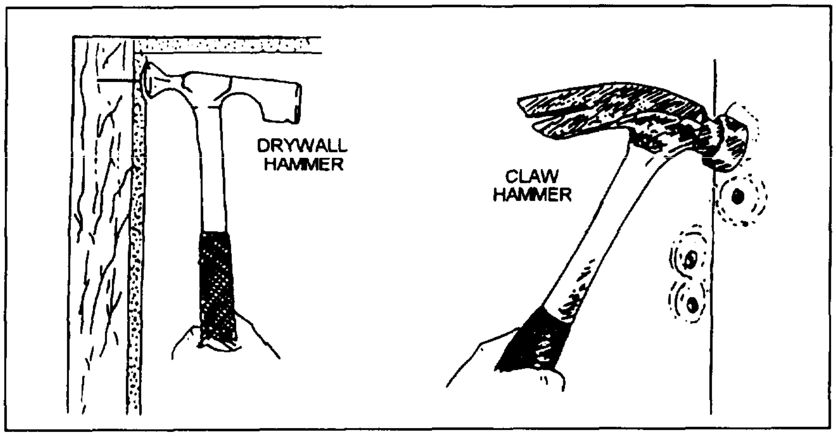

Figure 5-8.—Dimpling of gypsum drywall.

convex-headed drywall hammers are available for this operation, a conventional claw hammer also works (fig. 5-8).

SECURING WITH SCREWS.— Because screws attach more securely, fewer are needed. Screws are usually spaced 12 inches OC regardless of drywall thickness. On walls, screws maybe placed 16 inches OC for greater economy, without loss of strength. Don't double up screws except where the first screw seats poorly. Space screws around the edges the same as nails.

SECURING WITH ADHESIVES.— Adhesive applied to wood studs allows you to bridge minor irregularities along the studs and to use about half the number of nails. When using adhesives, you can space the nails 12 inches apart (without doubling up). Don't alter nail spacing along end seams, however. To attach sheets to studs, use a caulking gun and run a 3/8-inch bead down the middle of the stud. Where sheets meet over a framing member, run two parallel beads. Don't make serpentine beads, as the adhesive could ooze out onto the drywall surface. If you are laminating a second sheet of drywall over a fret, roll a liquid contact cement with a short-snap roller on the face of the sheet already in place. To keep adhesive out of your eyes, wear goggles. When the adhesive turns dark (usually within 30 minutes), it is ready to receive the second piece of drywall. Screw on the second sheet as described above.

CEILINGS.— Begin attaching sheets on the ceiling, first checking to be sure extra blocking (that will receive nails or screws) is in place above the top plates of the walls. By doing the ceiling first, you have maximum exposure of blocking to nail or screw into. If there are gaps along the intersection of the ceiling and wall, it is much easier to adjust wall pieces.

Ceilings can be covered by one person using two tees made from 2 by 4s. This practice is acceptable when dealing with sheets that are 8 foot in length. Sheets over this length will require a third tee, which is very awkward for one individual to handle. Two people should be involved with the installation of drywall on ceilings.

WALLS.— Walls are easier to hang than ceilings, and it's something one person working alone can do effectively, although the job goes faster if two people work together. As you did with the ceiling, be sure the walls have sufficient blocking in corners before you begin.

Make sure the first sheet on a wall is plumb and its leading edge is centered over a stud. Then, all you have to do is align successive sheets with the first sheet. The foot lift shown earlier in figure 5-2 is useful for raising or lowering a sheet while you level its edge. After you' ve sunk two or three screws or nails, the sheet will stay in place. A gap of 1/2 inch or so along the bottom of a sheet is not critical; it is easily covered by finish flooring, baseboards, and soon. If you favor a clean, modem line without trim, manufactured metal or vinyl edges (casing beads) are available for finishing the edges.

During renovation, you may find that hanging sheets horizontally makes sense. Because studs in older buildings often are not on regular centers, the joints of vertical sheets frequently do not align with the studs. Again, using the foot lift, level the top edge of the bottom sheet. Where studs are irregular, it's even more important that you note positions and chalk line stud centers onto the drywall face before hanging the sheet.

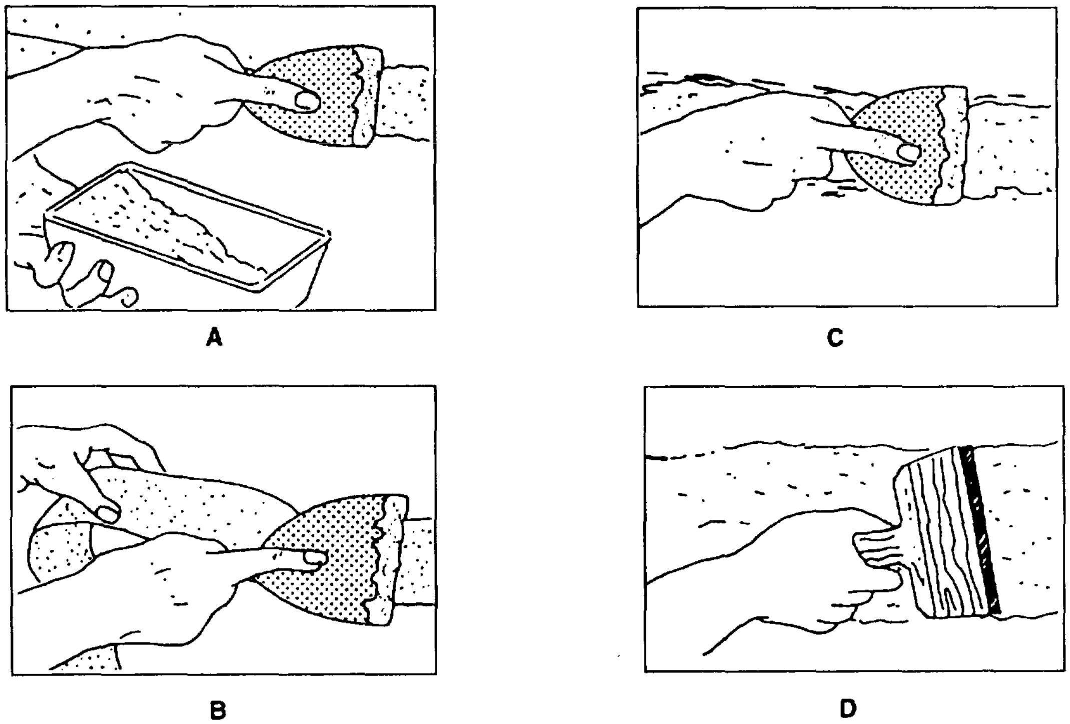

Figure 5-9.—Finishing drywall joints.

Applying drywall in older buildings yields a lot of waste because framing is not always standardized. Use the cutoffs in such out-of-the-way places as closets. Don't piece together small sections in areas where you'll notice seams. Never assume that ceilings are square with walls. Always measure from at least two points, and cut accordingly.

Drywall is quite good for creating or covering curved walls. For the best results, use two layers or 1/4-inch drywall, hung horizontally. The framing members of the curve should be placed at intervals of no more than 16 inches OC; 12 inches is better. For an 8-foot sheet applied horizontally, an arc depth of 2 to 3 feet should be no problem, but do check the manufacturer's specifications. Sharper curves may require backcutting (scoring slots into the back so that the sheet can be bent easily) or wetting (wet-sponging the front and back of the sheet to soften the gypsum). Results are not always predictable, though. When applying the second layer of 1/4-inch drywall, stagger the vertical butt joints.

Finishing

The finishing of gypsum board drywall is generally a three-coat application. Attention to drying times between coats prevents rework that has a cost involved as well as extra time.

Where sheets of drywall join, the joints are covered with joint tape and compound (fig. 5-9). The procedure is straightforward.

1. Spread a swath of bedding compound about 4 inches wide down the center of the joint (fig. 5-9, view A). Press the tape into the center of the joint with a 6-inch finish knife (fig. 5-9, view B). Apply another coat of compound over the first to bury the tape (fig. 5-9, view C). As you apply the compound over the tape, bear down so you take up any excess. Scrape clean any excess, however, as sanding it off can be tedious.

2. When the first coat is dry, sand the edges with fine-grit sand paper while wearing personal-protective equipment. Using a 12-inch knife, apply a topping of compound 2 to 4 inches wider than the first applications (view D).

3, Sand the second coat of compound when it is dry. Apply the third and final coat, feathering it out another 2 to 3 inches on each side of the joint. You should be able to do this with a 12-inch knife, Otherwise, you should use a 16-inch "feathering trowel."

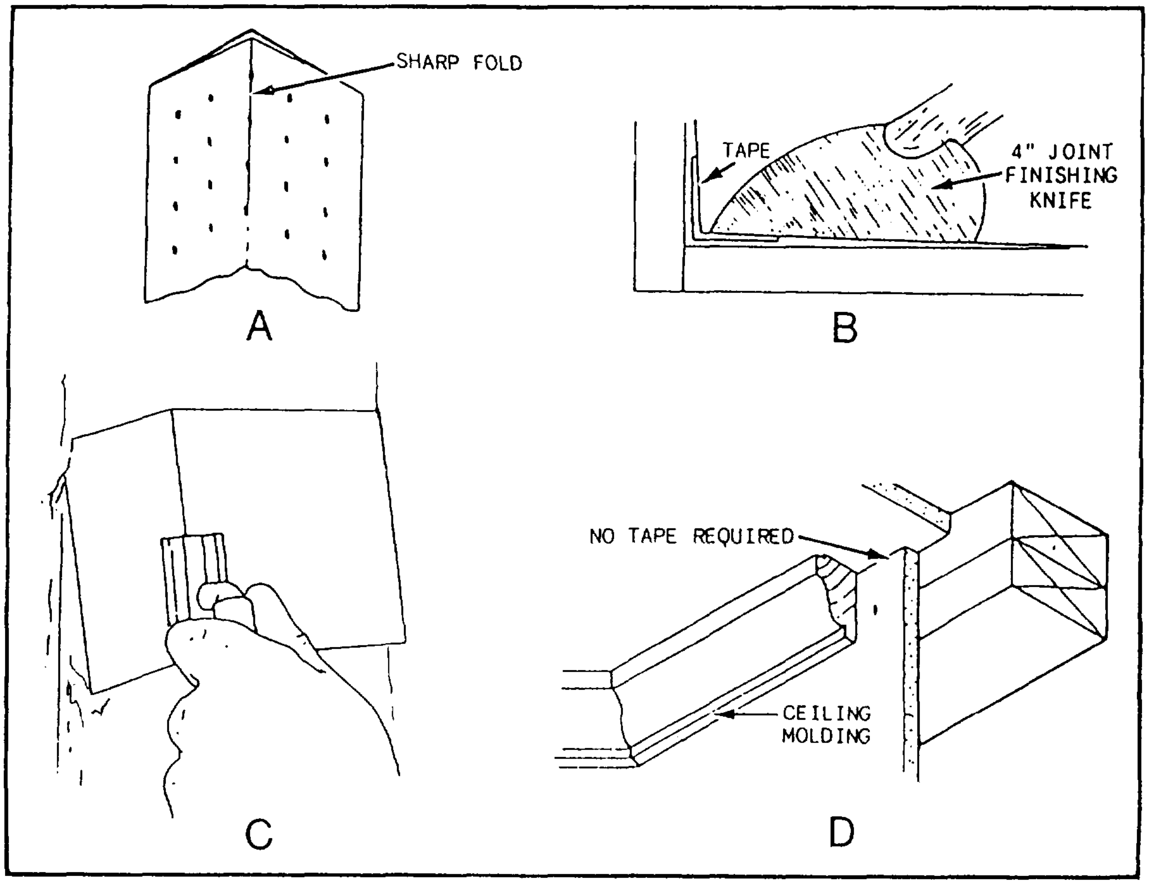

Figure 5-10.—Finishing an inside corner.

When finishing an inside corner (fig. 5-10), cut your tape the length of the corner angle you are going to finish. Apply the joint compound with a 4-inch knife evenly about 2 inches on each side of the angle. Use sufficient compound to embed the tape. Fold the tape along the center crease (view A) and firmly press it into the corner. Use enough pressure to squeeze some compound under the edges. Feather the compound 2 inches from the edge of the tape (view B). When the first coat is dry, apply a second coat. A corner trowel (view C) is almost indispensable for taping comers. Feather the edges of the compound 1 1/2 inches beyond the first coat. Apply a third coat if necessary, let it dry, and sand it to a smooth surface. Use as little compound as possible at the apex of the angle to prevent hairline cracking. When molding is installed between the wall and ceiling intersection, it is not necessary to tape the joint (view D).

When finishing an outside corner (fig. 5-1 1), be sure the corner bead is attached firmly. Using a 4-inch finishing knife, spread the joint compound 3 to 4 inches wide from the nose of the bead, covering the metal edges. When the compound is completely dry, sand lightly and apply a second coat, feathering edges 2 to 3 inches beyond the first coat. A third coat maybe needed, depending on your coverage. Feather the edges of each coat 2 or 3 inches beyond each preceding coat. Corner beads are no problem if you apply compound with care and scrape the excess clean. Nail holes and screw holes usually can be covered in two passes, though shrinkage sometimes necessitates three. A tool that works well for sanding hard-to-reach places is a sanding block on an extension pole; the block has a swivel-head joint.

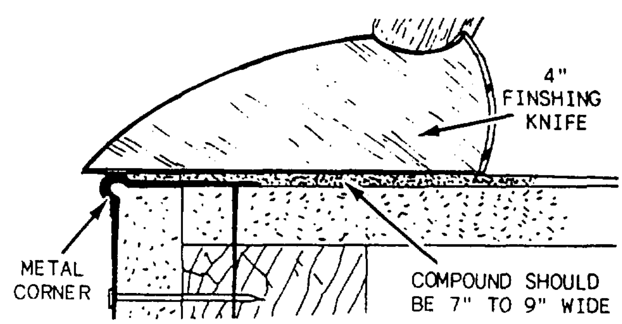

Figure 5-11.—Finishing an outside corner.

To give yourself the greatest number of decorating options in the future, paint the finished drywall surface with a coat of flat oil-base primer. Whether you intend to wallpaper or paint with latex, oil-base primer adheres best to the facing of the paper and seals it.

Renovation and Repair

For the best results, drywall should be flat against the surface to which it is being attached. How flat the nailing surface must be depends upon the desired finish effect. Smooth painted surfaces with spotlights on them require as nearly flawless a finish as you can attain. Similarly, delicate wall coverings-particularly those with close, regular patterns—accentuate pocks and lumps underneath. Textured surfaces are much more forgiving. In general, if adjacent nailing elements (studs, and so forth) vary by more than 1/4 inch, buildup low spots. Essentially, there are three ways to create a flat nailing surface:

- Frame out a new wall-a radical solution. If the studs of partition walls are buckled and warped, it's often easier to rip the walls out and replace them. Where the irregular surface is a load-bearing wall, it maybe easier to build a new wall within the old.
- Cover imperfections with a layer of 3/8-inch drywall. This thickness is flexible yet strong. Drywall of 1/4-inch thickness may suffice. Single-ply cover-up is a common renovation strategy where existing walls are ungainly but basically flat. Locate studs beforehand and use screws long enough to penetrate studs and joists at least 5/8 inch.
- Build up the surface by "furring out." In the "furring out" procedure, furring-strips 1 by 2 inches are used. Some drywall manufacturers, however, consider that size too light for attachment, favoring instead a nominal size of 2 by 2 inches. Whatever size strips you use, make sure they (and the shims underneath) are anchored solidly to the wall behind.

By stretching strings taut between diagonal comers, you can get a quick idea of any irregularities in a wall. If studs are exposed, further assess the situation with a level held against a straight 2 by 4. Hold the straightedge plumb in front of each stud and mark low spots every 12 inches or so. Using a builder's crayon, write the depth of each low spot, relative to the straightedge, on the stud. If studs aren't exposed, locate each stud by test drilling and inserting a bent coat hanger into the hole. Chalk line

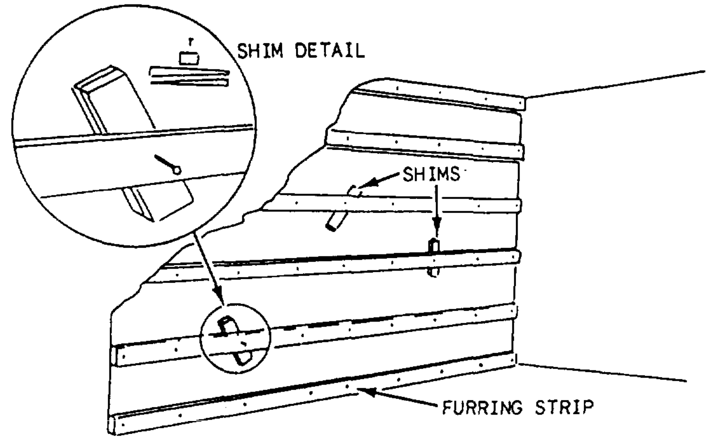

Figure 5-12.—Furring strips hacked with shims.

the center of each stud on the existing surface. Here too, mark the depth of low spots.

The objective of this process is a flat plane of furring strips over existing studs. Tack the strips in place and add shims (wood shingles are best) at each low spot marked (see fig. 5-12). To make sure a furring strip doesn't skew, use two shims, with their thin ends reversed, at each point. Tack the shims in place and plumb the furring strips again. When you are satisfied, drive the nails or screws all the way in.

When attaching the finish sheets, use screws or nails long enough to penetrate through furring strips and into the studs behind. Strips directly over studs ensure the strongest attachment. Where finish materials are not sheets—for example, single-board vertical paneling—furring should run perpendicular to the studs.

Regardless of type, finish material must be backed firmly at all nailing pints, corners, and seams. Where you cover existing finish surfaces or otherwise alter the thickness of walls, it's usually necessary to build up existing trim. Figure 5-13 shows how this might be done

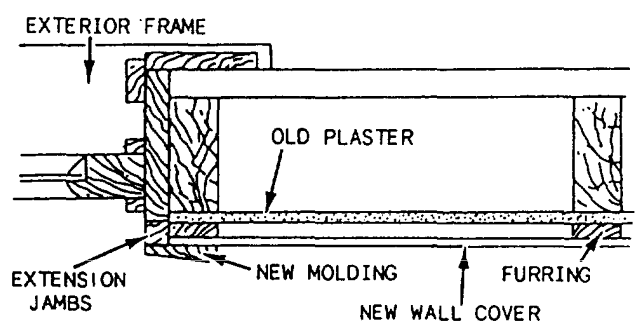

Figure 5-13.—Building up an intertor window casing.

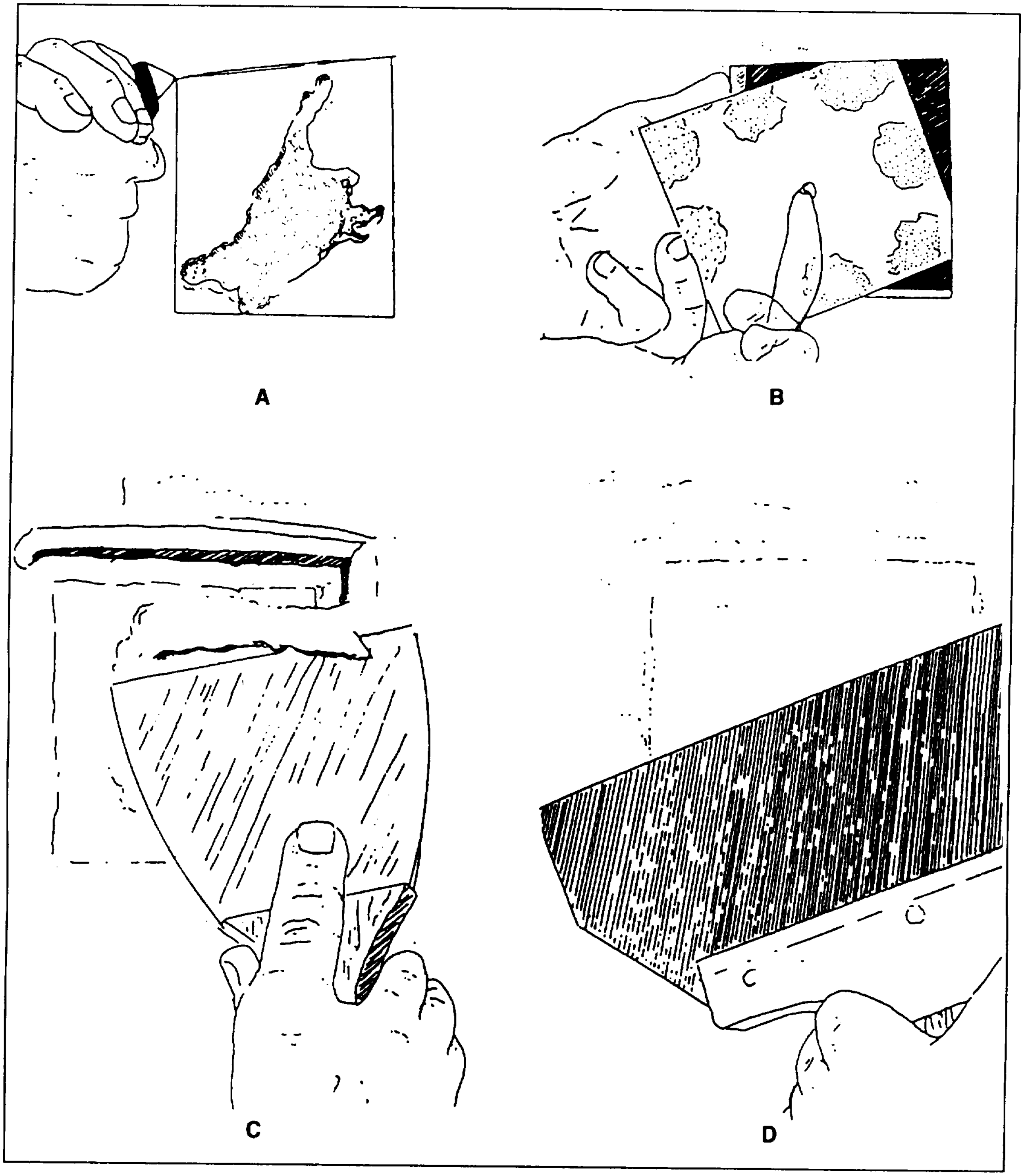

Figure 5-14.—Repairing a large hole In drywall.

for a window casing. Electrical boxes must also be extended with box extensions or plaster rings.

Masonry surfaces must be smooth, clean, and dry. Where the walls are below grade, apply a vapor barrier of polyethylene (use mastic to attach it) and install the furring strips. Use a power-actuated nail gun to attach strips to the masonry. Follow all safety procedures. If you hand nail, drive case-hardened nails into the mortar joints. Wear goggles; these nails can fragment.

Most drywall blemishes are caused by structural shifting or water damage. Correct any underlying problems before attacking the symptoms.

Popped-up nails are easily fixed by pulling them out or by dimpling them with a hammer. Test the entire wall for springiness and add roils or screws where needed. Within 2 inches of a popped-up nail, drive in another nail. Spackle both when the spots are dry, then sand and prime.

To repair cracks in drywall, cut back the edges of the crack slightly to remove any crumbly gypsum and to provide a good depression for a new filling of joint compound. Feather the edges of the compound. When dry, sand and prime them.

When a piece of drywall tape lifts, gently pull until the piece rips free from the part that's still well stuck. Sand the area affected and apply anew bed of compound for a replacement piece of tape. The self-sticking tape mentioned earlier works well here. Feather all edges.

If a sharp object has dented the drywall, merely sand around the cavity and fill it with spackling compound. A larger hole (bigger than your fist) should have a backing. One repair method is shown in figure 5-14. First, cut the edges of the hole clean with a utility knife (view A). The piece of backing should be somewhat larger than the hole itself. Drill a small hole into the middle of the backing piece and thread a piece of wire into the hole. This wire allows you to hold the piece of backing in place. Spread mastic around the edges of the backing. When the adhesive is tacky, fit the backing diagonally into the hole (view B) and, holding onto the wire, pull the piece against the back side of the hole. When the mastic is dry, push the wire back into the wall cavity. The backing stays in place. Now, fill the hole with plaster or joint compound (view C) and finish (view D). (Note: This is just one of several options available for repairing large surface damage to gypsum board.)

Compound sags in holes that are too big. If it happens, mastic a replacement piece of drywall to the backing piece. To avoid a bulge around the filled-in hole, feather the compound approximately 16 inches, or more. If the original drywall is 1/2 inch thick use 3/8-inch plasterboard as a replacement on the backing piece.

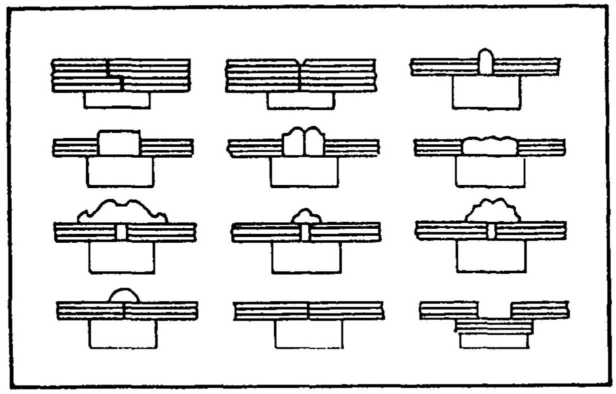

Figure 5-15.—Battens used for paneling joints.

Holes larger than 8 inches should be cut back to the centers of the nearest studs. Although you should have no problem nailing a replacement piece to the studs, the top and the bottom of the new piece must be backed. The best way to install backing is to screw drywall gussets (supports) to the back of the existing drywall. Then, put the replacement piece in the hole and screw it to the gussets.

PLYWOOD

Most of the plywood used for interior walls has a factory-applied finish that is tough and durable. Manufacturers can furnish prefinished matching trim and molding that is also easy to apply. Color-coordinated putty sticks are used to conceal nail holes.

Joints between plywood sheets can be treated in a number of ways. Some panels are fabricated with machine-shaped edges that permit almost perfect joint concealment. Usually, it is easier to accentuate the joints with grooves or use battens and strips. Some of the many different styles of battens are shown in figure 5-15.

Before installation, the panels should become adjusted (conditioned) to the temperature and humidity of the room. Carefully remove prefinished plywood from cartons and stack it horizontally. Place 1-inch spacer strips between each pair of face-to-face panels. Do this at least 48 hours before application.

Plan the layout carefully to reduce the amount of cutting and the number of joints. It is important to align panels with openings whenever possible. If finished panels are to have a grain, stand the panels around the walls and shift them until you have the most pleasing effect in color and grain patterns. To avoid mix-ups, number the panels in sequence after their position has been established.

When cutting plywood panels with a portable saw, mark the layout on the back side. Support the panel carefully and check for clearance below. Cut with the saw blade upward against the panel face. This minimizes splintering. This procedure is even more important when working with prefinished panels.

Plywood can be attached directly to the wall studs with nails or special adhesives. Use 3/8-inch plywood for this type of installation. When studs are poorly aligned or when the installation is made over an existing surface in poor condition, it is usually advisable to use furring. Nail 1- by 3- or 1- by 4-inch furring strips horizontally across the studs. Start at the floor line and continue up the wall. Spacing depends on the panel thickness. Thin panels need more support. Install vertical strips every 4 feet to support panel edges. Level uneven areas by shimmying behind the furring strips. Prefinished plywood panels can be installed with special adhesive. The adhesive is applied and the panels are simply pressed into place; no sustained pressure is required.

Begin installing panels at a corner. Scribe and trim the edges of the first panel so it is plumb. Fasten it in place before fitting the next panel. Allow approximately 1/4-inch clearance at the top and bottom. After all panels are in place, use molding to cover the space along the ceiling. Use baseboards to conceal the space at the floor line. If the molding strips, baseboards, and strips used to conceal panel joints are not prefinished, they should be spray painted or stained a color close to the tones in the paneling before installation.

On some jobs, 1/4-inch plywood is installed over a base of 1/2-inch gypsum wallboard. This backing is recommended for several reasons. It tends to bring the studs into alignment. It provides a rigid finished surface. And, it improves the fire-resistant qualities of the wall. (The plywood is bonded to the gypsum board with a compatible adhesive.)

HARDBOARD

Through special processing, hardboard (also called fiberboard) can be fabricated with a very low moisture absorption rate. This type is often scored to form a tile pattern. Panels for wall application are usually 1/4 inch thick.

Since hardboard is made from wood fibers, the panels expand and contract slightly with changes in humidity. They should be installed when they are at their maximum size. The panels tend to buckle between the studs or attachment points if installed when moisture content is low. Manufacturers of prefinished hardboard panels recommend that they be unwrapped and placed separately around the room for at least 48 hours before application.

Procedures and attachment methods for hardboard are similar to those for plywood. Special adhesives are available as well as metal or plastic molding in matching colors. You should probably drill nail holes for the harder types.

PLASTIC LAMINATES

Plastic laminates are sheets of synthetic material that are hard, smooth, and highly resistant to scratching and wear. Although basically designed for table and countertops, they are also used for wainscoting and wall paneling in buildings.

Since plastic laminate material is thin (1/32 to 1/16 inch), it must be bonded to other supporting panels. Contact bond cement is commonly used for this purpose. Manufacturers have recently developed prefabricated panels with the plastic laminate already bonded to a base or backer material. This base consists of a 1/32-inch plastic laminate mounted on 3/8-inch particleboard. Edges are tongue and grooved so that units can be blind-nailed into place. Various matching corner and trim moldings are available.

SOLID LUMBER PANELING

Solid wood paneling makes a durable and attractive interior wall surface and may be appropriately used in nearly any type of room. Several species of hardwood and softwood are available. Sometimes, grades with numerous knots are used to obtain a special appearance. Defects, such as the deep fissures in pecky cypress, can also provide a dramatic effect.

The softwood species most commonly used include pine, spruce, hemlock and western red cedar. Boards range in widths from 4 to 12 inches (nominal size) and are dressed to 3/4 inch. Board and batten or shiplap joints are sometimes used, but tongue-and-groove (T&G) joints combined with shaped edges and surfaces are more popular.

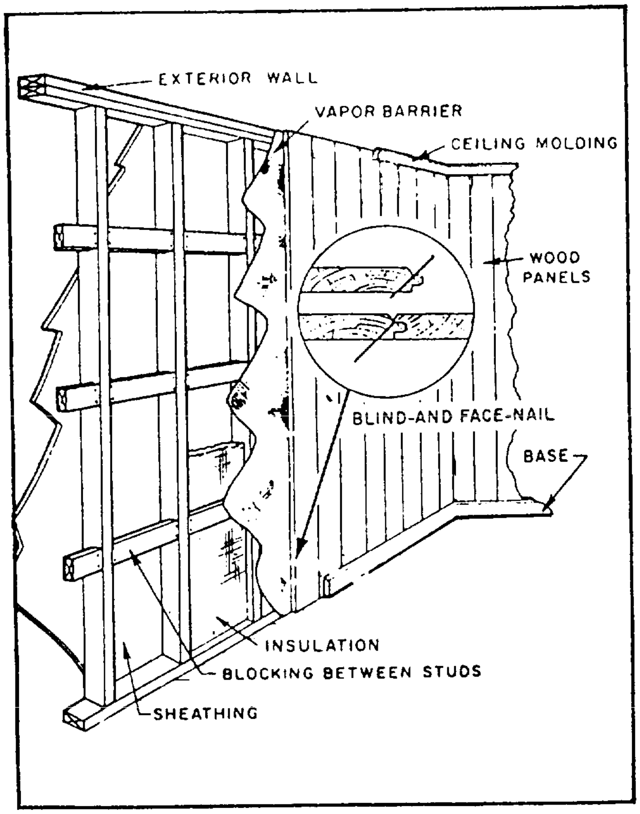

Figure 5-16.—Vertical wood paneling.

When solid wood paneling is applied horizontally, furring strips are not required-the boards are nailed directly to-the studs. Inside corners are formed by butting the paneling units flush with the other walls. If random widths are used, boards on adjacent walls must match and be accurately aligned.

Vertical installations require furring strips at the top and bottom of the wall and at various intermediate spaces. Sometimes, 2- by 4-inch blocking is installed between the studs to serve as a nailing base (see fig. 5-16). Even when heavy T&G boards are used, these nailing members should not be spaced more than 24 inches apart.

Narrow widths (4 to 6 inches) of T&G paneling are blind-nailed (see insert in fig. 5-16). The nailheads do not appear on finished surfaces, and you eliminate the need for countersinking and filling nail holes. This nailing method also provides a smooth, blemish-free surface. This is especially important when clear finishes are used. Drive 6d finishing nails at a 45° angle into the base of the tongue and on into the bearing point. Carefully plumb the first piece installed and check for the plumbness at regular intervals. For lumber paneling (not tongue and grooved), use 6d casing or finishing nails. Use two roils at each nailing member for panels 6 inches or less in width and three nails for wider panels.

Exterior wall constructions, where the interior surface consists of solid wood paneling, should include a tight application of building paper located close to the backside of the boards. This prevents the infiltration of wind and dust through the joints. In cold climates, insulation and vapor barriers are important. Base, corner and ceiling trim can be used for decorative purposes or to conceal irregularities in joints.

SUSPENDED ACOUSTIC CEILING SYSTEMS

LEARNING OBJECTIVE: Upon completing this section, you should be able to identify the materials used to install a suspended acoustical ceiling and explain the methods of installation.

Suspended acoustical ceiling systems can be installed to lower a ceiling, finish off exposed joints, cover damaged plaster, or make any room quieter and brighter. The majority of the systems available are primarily designed for acoustical control. However, many manufacturers offer systems that integrate the functions of lighting, air distribution, fire protection, and acoustical control. Individual characteristics of acoustical tiles, including sound-absorption co-efficients, noise-reduction coefficients, light-reflection values, flame resistance, and architectural applications, are available from the manufacturer.

Tiles are available in 12-to 30-inch widths, 12-to 60-inch lengths, and 3/16- to 3/4-inch thicknesses. The larger sizes are referred to as “panels.” The most commonly used panels in suspended ceiling systems are the standard 2-by 2-foot and 2- by 4-foot acoustic panels composed of mineral or cellulose fibers.

It is beyond the scope of this training manual to acquaint you with each of the suspended acoustical ceiling systems in use today. Just as the components of these systems vary according to manufacturers, so do the procedures involved in their installation. With this in mind, the following discussion is designed to acquaint you with the principles involved in the installation of a typical suspended acoustical ceiling system.

PREPARATION FOR INSTALLATION

The success of a suspended ceiling project, as with any other construction project, is as dependent on planning as it is on construction methods and procedures. Planning, in this case, involves the selection of a grid system (either steel or aluminum), the selection and layout of a grid pattern, and the determination of

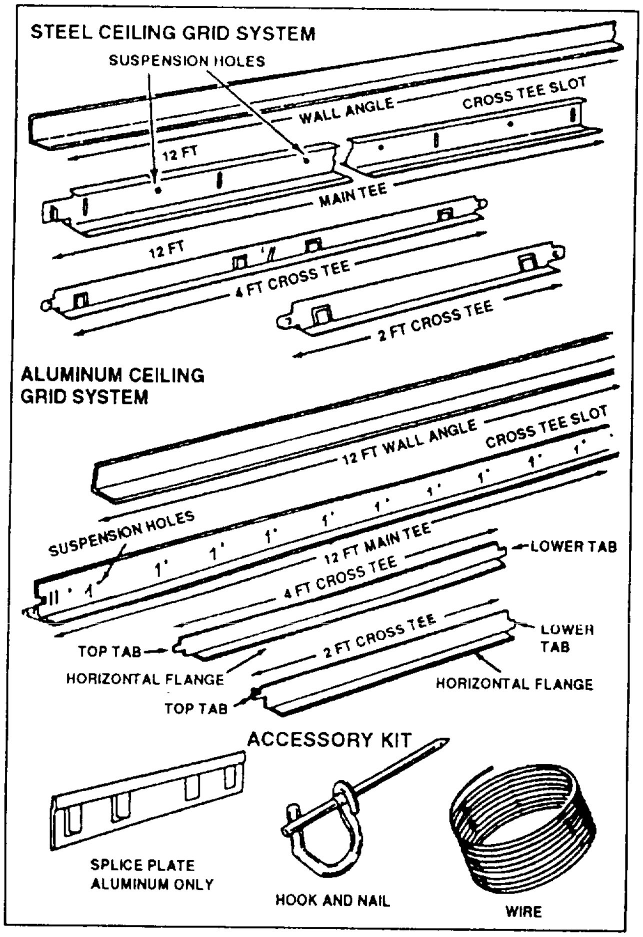

Figure 5-17.—Grid system components.

material requirements. Figure 5-17 shows the major components of a steel and aluminum ceiling grid system used for the 2- by 2-foot or 2- by 4-foot grid patterns shown in figure 5-18.

Pattern Layout

The layout of a grid pattern and the material requirements are based on the ceiling measurements and the length and width of the room at the new ceiling height. If the ceiling length or width is not divisible by 2 (that is, 2 feet), increase those dimensions to the next higher dimension divisible by 2. For example, if a ceiling measures 13 feet 7 inches by 10 feet 4 inches, the dimensions should be increased to 14 by 12 feet for material and layout purposes. Next, draw a layout on graph paper. Make sure the main tees run perpendicular to the joists. Position the main tees on your drawing so the border panels at room edges are equal and as large as possible. Try several layouts to see which looks best with the main tees. Draw in cross tees so the border panels at the room ends are equal and as large as possible. Try several combinations to determine the best. For 2- by 4-foot patterns, space cross tees 4 feet apart. For 2- by 2-foot patterns, space cross tees 2 feet apart. For smaller areas, the 2- by 2-foot pattern is recommended

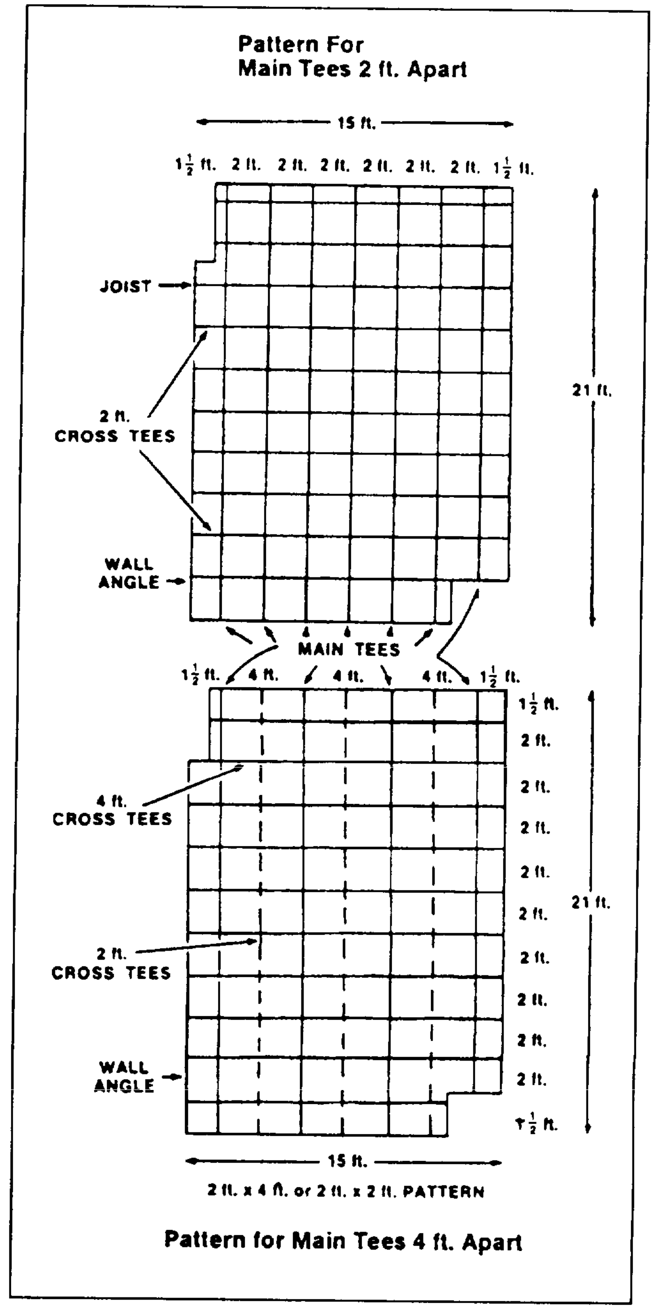

Figure 5-18.—Grid layout for main tees.

Material Requirements

As indicated in figure 5-17, wall angles and main tees come in 12-foot pieces. Using the perimeter of a room at suspended ceiling height, you cart determine the number of pieces of wall angle by dividing the perimeter by 12 and adding 1 additional piece for any fraction. Determine the number of 12-foot main tees and 2-foot or 4-foot cross tees by counting them on the grid pattern

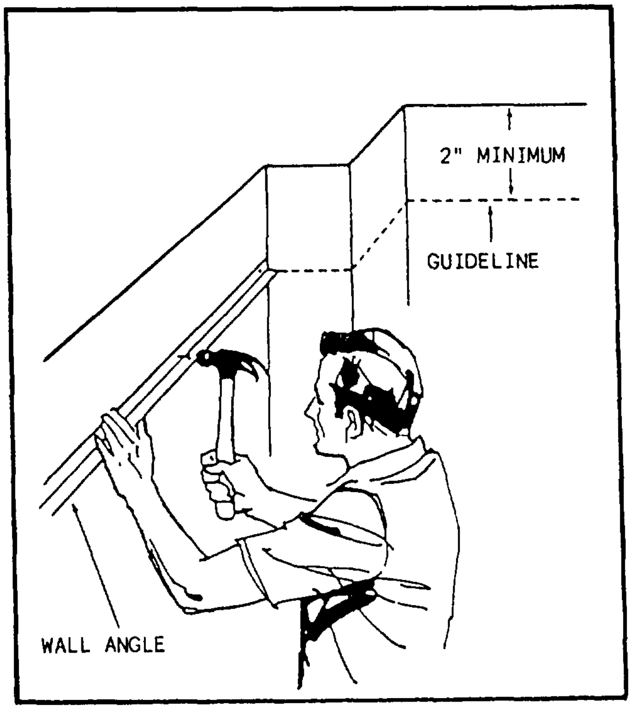

Figure 5-19.—Wall angle installation.

layout. In determining the number of 2-foot or 4-foot cross tees for border panels, you must remember that no more than 2 border tees can be cut from one cross tee.

INSTALLATION

The tools normally used to install a grid system include a hammer, chalk or pencil, pliers, tape measure, screwdriver, hacksaw, knife, and tin snips. With these, you begin by installing the wall angles, then the suspension wires, followed by the main tees, cross tees, and acoustical panels.

Wall Angles

The first step is to install the wall angles at the new ceiling height. This can be as close as 2 inches below the existing ceiling. Begin by marking a line around the entire room to indicate wall angle height and to serve as a level reference. Mark continuously to ensure that the lines at intersecting walls meet. On gypsum board, plaster, or paneled walls, install wall angles (fig. 5-19) with nails, screws, or toggle bolts. On masonry walls, use anchors or concrete nails spaced 24 inches apart. **Make sure the wall angle is level.** Overlap or miter the wall angle at corners (fig. 5-20). After the wall angles are installed the next step is to attach the suspension wires.

Suspension Wires

Suspension wires are required every 4 feet along main tees and on each side of all splices (see fig. 5-21). Attach wires to the existing ceiling with nails or screw

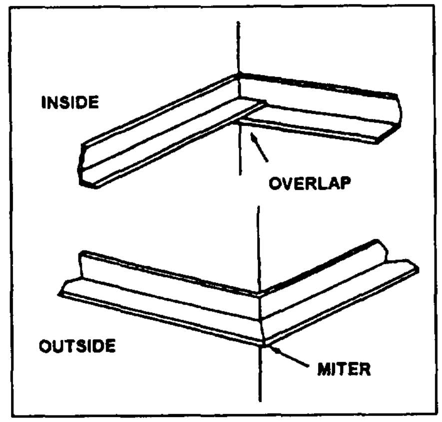

Figure 5-20.—Corner treatment.

eyelets. Before attaching the first wire, measure the distance from the wall to the first main tee. Then, stretch a guideline from an opposite wall angle to show the correct position of the first nail tee. Position suspension wires for the first tee along the guide. Wires should be cut to proper length, at least 2 inches longer than the distance between the old and new ceiling, Attach additional wires at 4-foot intervals. Pull wires to remove kinks and make 90° bends in the wires where they intersect the guideline. Move the guideline, as required, for each row. After the suspension wires are attached, the next step is to install the main tees.

Tees

In an acoustical ceiling, the panels rest on metal members called tees. The tees are suspended by wires.

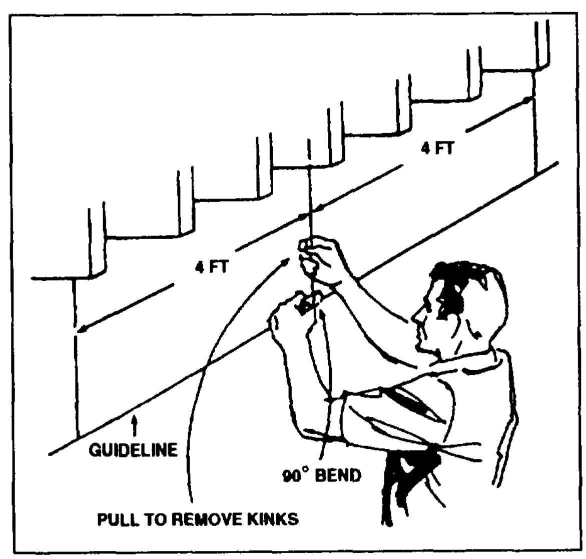

Figure 5-21.—Suspenslon wire installation.

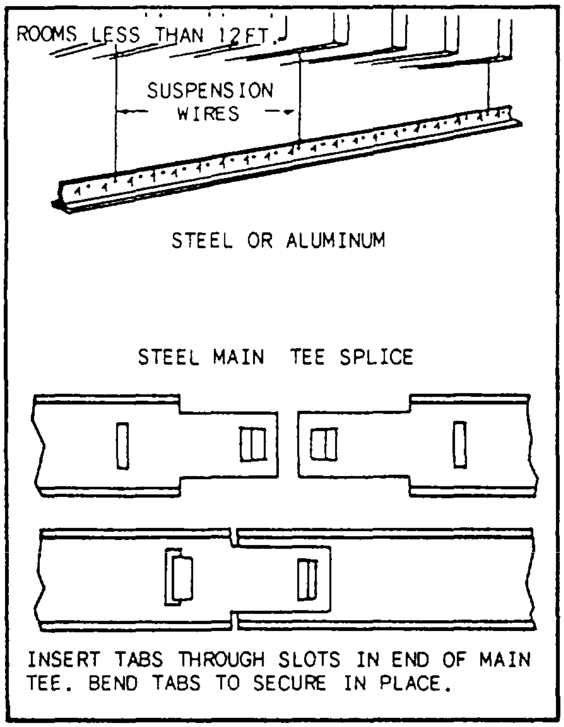

Figure 5-22.—Main tee suspension and steel splice.

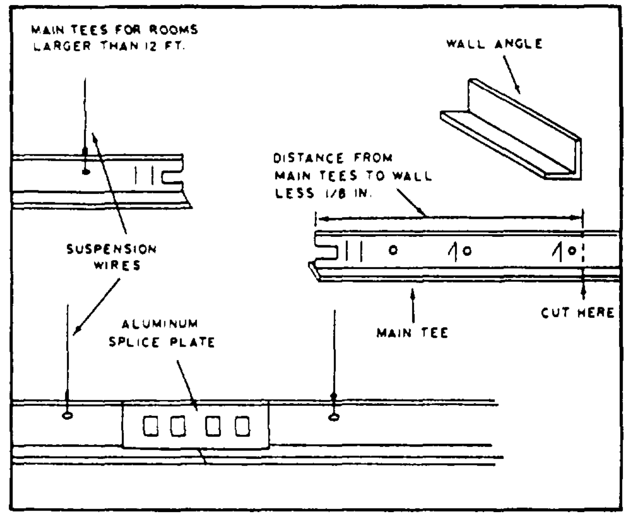

Figure 5-23.—Main tee and aluminum tee splice.

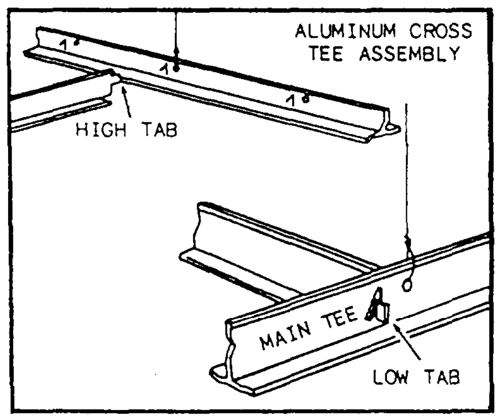

Figure 5-24.—Aluminum cross tee assembly.

MAIN TEES.— Install maintees of 12 feet or less by resting the ends on opposite wall angles and inserting the suspension wires (top view of fig. 5-22). Hang one wire near the middle of the main tee, level and adjust the wire length, then secure all wires by making the necessary turns in the wire.

For main tees over 12 feet, cut them so the cross tees do not intersect the main tee at a splice joint. Begin the installation by resting the cut end on the wall angle and attaching the suspension wire closest to the opposite end. Attach the remaining suspension wires, making sure the main tee is level before securing. The remaining tees are installed by making the necessary splices (steel splices are shown in fig. 5-22 and those for aluminum in 5-23) and resting the end on the opposite wall angle. After the main tees are installed, leveled, and secured, install the cross tees.

CROSS TEES.— Aluminum cross tees have "high" and 'low" tab ends that provide easy positive installation without tools. Installation begins by cutting border tees (when necessary) to fit between the first main tee and the wall angle. Cut off the high tab end and rest this end in the main tee slot. Repeat this procedure until all border tees are installed on one side of the room. Continue across the room, installing the remaining cross tees according to your grid pattern layout. An aluminum cross tee assembly is shown in figure 5-24. At the opposite wall angle, cut off the low tab of the border tee and rest the cut end on the wall angle. If the border edge is less than half the length of the cross tee, use the remaining portion of the border of the previously cut tee.

Steel cross tees have the same tab on both ends and, like the aluminum tees, do not require tools for installation. The procedures used in their installation are the same as those just described for aluminum. A steel cross tee assembly is shown in figure 5-25. The final step after completion of the grid system is the installation of the acoustical panels.

Acoustical Panels

Panel installation is started by inserting all full ceiling panels. Border panels should be installed last, after they have been cut to proper size. To cut a panel, turn the finish side up, scribe with a sharp utility knife, and saw with a 12- or 14-point handsaw.

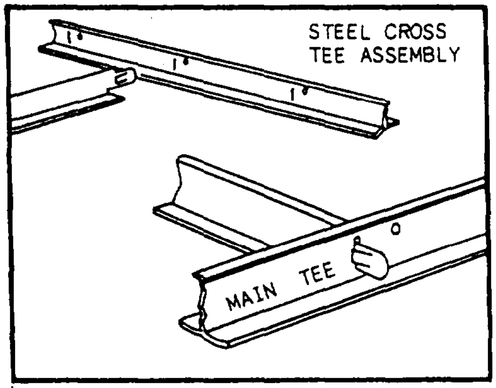

Figure 5-25.—Steel cross tee assembly.

Most ceiling panel patterns are random and do not require orientation. However, some fissured panels are designed to be installed in a specific direction and are so marked on the back with directional arrows. When installing panels on a large project, you should work from several cartons. The reason for this is that the color, pattern, or texture might vary slightly; and by working from several cartons, you avoid a noticeable change in uniformity.

Since ceiling panels are prefinished, handle them with care. Keep their surfaces clean by using talcum powder on your hands or by wearing clean canvas gloves. If panels do become soiled, use an art gum eraser to remove spots, smudges, and fingerprints. Some panels can be lightly washed with a sponge dampened with a mild detergent solution. However, before washing or performing other maintenance services, such as painting, refer to the manufacturer's instructions.

Ceiling Tile

Ceiling tile can be installed in several ways, depending on the type of ceiling or roof construction. When a flat-surfaced backing is present, such as between beams of a beamed ceiling in a low-slope roof, tiles are fastened with adhesive as recommended by the manufacturer. A small spot of a mastic type of construction adhesive at each corner of a 12-by 12-inch tile is usually sufficient. When tile is edge-matched, stapling is also satisfactory.

Perhaps the most common method of installing ceiling tile uses wood strips nailed across the ceiling joists or roof trusses (fig. 5-26, view A). These are

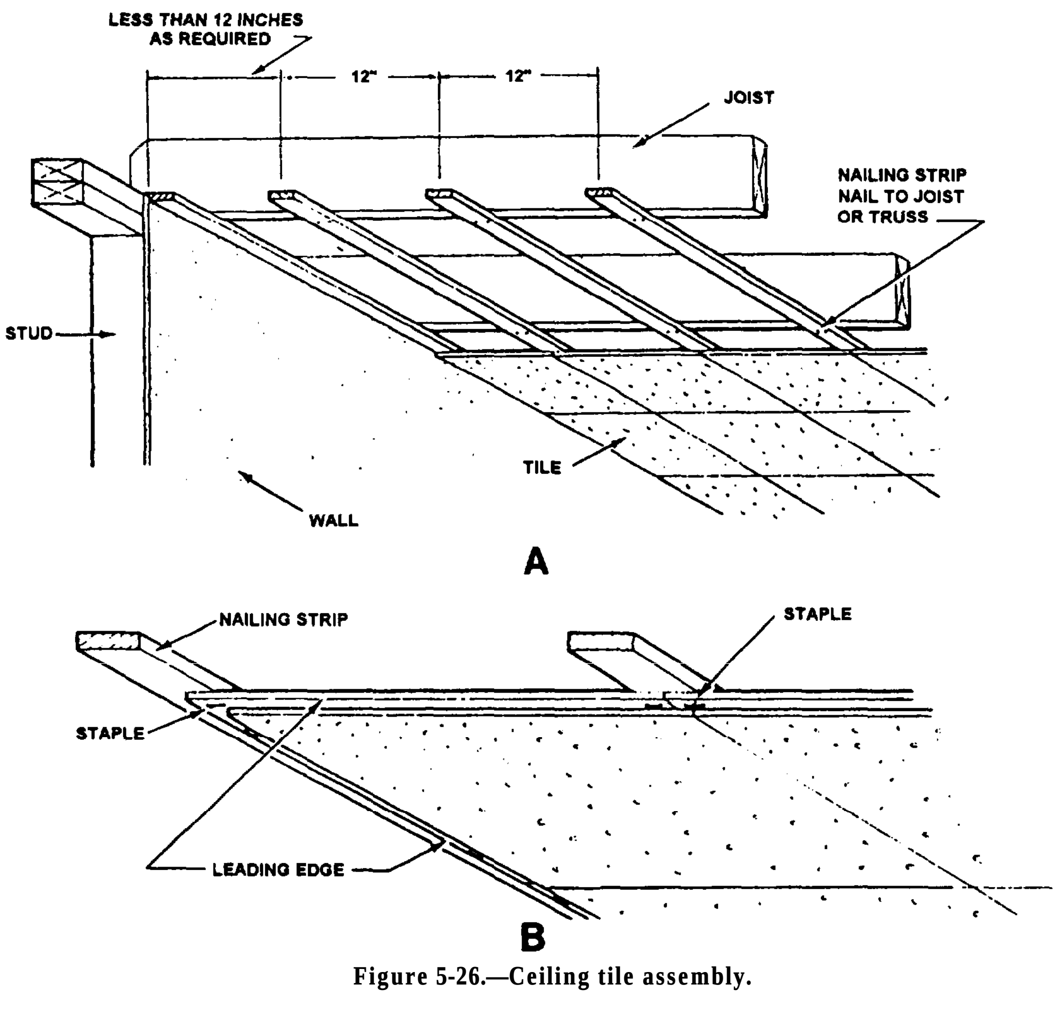

Figure 5-26.—Ceiling tile assembly.

spaced a minimum of 12 inches OC. A nominal 1- by 3-inch or 1- by 4-inch wood member can be used for roof or ceiling members spaced not more than 24 inches OC. A nominal 2- by 2-inch or 2- by 3-inch member should be satisfactory for truss or ceiling joist spacing of up to 48 inches.

In locating the strips, first measure the width of the room (the distance parallel to the direction of the ceiling joists). If, for example, this is 11 feet 6 inches, use ten 12-inch-square tiles and 9-inch-wide tile at each side edge. The second wood strips from each side are located so that they center the first row of tiles, that can now be ripped to a width of 9 inches. The last row will also be 9 inches, but do not rip these tiles until the last row is reached so that they fit tightly. The tile can be fitted and arranged the same way for the ends of the room.

Ceiling tiles normally have a tongue on two adjacent sides and a groove on the opposite adjacent sides. Start with the leading edge ahead and to the open side so that it can be stapled to the nailing strips. A small finish nail or adhesive should be used at the edge of the tiles in the first row against the wall. Stapling is done at the leading edge and the side edge of each tile (fig. 5-26, view B). Use one staple at each wood strip at the leading edge and two at the open side edge. At the opposite wall, a small finish nail or adhesive must again be used to hold the tile in place.

Most ceiling tile of this type has a factory finish; painting or finishing is not required after it is placed. Take care not to mar or soil the surface.

INSULATION

LEARNING OBJECTIVE: Upon completing this section, you should be able to identify the types of insulation and describe the methods of installation.

The inflow of heat through outside walls and roofs in hot weather or its outflow during cold weather is a major source of occupant discomfort. Providing heating or cooling to maintain temperatures at acceptable limits for occupancy is expensive. During hot or cold weather, insulation with high resistance to heat flow helps save energy. Also, you can use smaller capacity units to achieve the same heating or cooling result, an additional savings.

Most materials used in construction have some insulating value. Even air spaces between studs resist the passage of heat. However, when these stud spaces are filled or partially filled with material having a high insulating value, the stud space has many times the insulating ability of the air alone.

TYPES

Commercial insulation is manufactured in a variety of forms and types, each with advantages for specific uses. Materials commonly used for insulation can be grouped in the following general classes: (1) flexible insulation (blanket and batt); (2) loose-fill insulation; (3) reflective insulation; (4) rigid insulation (structural and nonstructural); and (5) miscellaneous types.

The insulating value of a wall varies with different types of construction, kinds of materials used in construction, and types and thicknesses of insulation. As we just mentioned, air spaces add to the total resistance of a wall section to heat transmission, but an air space is not as effective as the same space filled with an insulating material.

Flexible

Flexible insulation is manufactured in two types: blanket and batt. Blanket insulation (fig. 5-27, view A) is furnished in rolls or packages in widths to fit between studs and joists spaced 16 and 24 inches OC. It comes in thicknesses of 3/4 inch to 12 inches. The body of the blanket is made of felted mats of mineral or vegetable fibers, such as rock or glass wool, wood fiber, and cotton. Organic insulations are treated to make them resistant to fire, decay, insects, and vermin. Most blanket insulation is covered with paper or other sheet material with tabs on the sides for fastening to studs or joists. One covering sheet serves as a vapor barrier to resist movement of water vapor and should always face the warm side of the wall. Aluminum foil, asphalt, or plastic laminated paper is commonly used as barrier materials.

Batt insulation (fig. 5-27, view B) is also made of fibrous material preformed to thicknesses of 3 1/2 to 12 inches for 16-and 24-inch joist spacing. It is supplied with or without a vapor barrier. One friction type of fibrous glass batt is supplied without a covering and is designed to remain in place without the normal fastening methods.

Loose Fill

Loose-fill insulation (fig. 5-27, view C) is usually composed of materials used in bulk form, supplied in bags or bales, and placed by pouring, blowing, or packing by hand. These materials include rock or glass

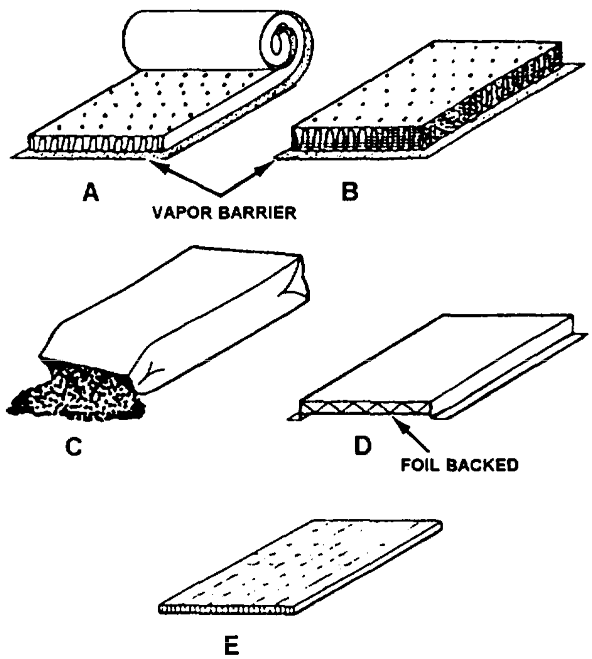

Figure 5-27.—Types of insulation.

wool, wood fibers, shredded redwood bark cork wood pulp products, vermiculite, sawdust, and shavings.

Fill insulation is suited for use between first-floor ceiling joists in unheated attics. It is also used in sidewalls of existing houses that were not insulated during construction. Where no vapor barrier was installed during construction, suitable paint coatings, as described later in this chapter, should be used for vapor barriers when blow insulation is added to an existing house.

Reflective

Most materials have the property of reflecting radiant heat, and some materials have this property to a very high degree. Materials high in reflective properties include aluminum foil, copper, and paper products coated with a reflective oxide. Such materials can be used in enclosed stud spaces, attics, and similar locations to retard heat transfer by radiation. Reflective insulation is effective only where the reflective surface faces an air space at least 3/4 inch deep. Where this surface contacts another material, the reflective properties are lost and the material has little or no insulating value. Proper installation is the key to obtaining the best results from the reflective insulation. Reflective insulation is equally effective whether the reflective surface faces the warm or cold side.

Reflective insulation used in conjunction with foil-backed gypsum drywall makes an excellent vapor barrier. The type of reflective insulation shown in figure 5-27, view D, includes a reflective surface. When properly installed, it provides an airspace between other surfaces.

Rigid

Rigid insulation (fig. 5-27, view E) is usually a fiberboard material manufactured in sheet form. It is made from processed wood, sugar cane, or other vegetable products. Structural insulating boards, in densities ranging from 15 to 31 pounds per cubic foot, are fabricated as building boards, roof decking, sheathing, and wallboard. Although these boards have moderately good insulating properties, their primary purpose is structural.

Roof insulation is nonstructural and serves mainly to provide thermal resistance to heat flow in roofs. It is called slab or block insulation and is manufactured in rigid units 1/2 inch to 3 inches thick and usually 2- by 4-foot sizes.

In building construction, perhaps the most common forms of rigid insulation are sheathing and decorative covering in sheet or in tile squares. Sheathing board is made in thicknesses of 1/2 and 25/32 inch. It is coated or impregnated with an asphalt compound to provide water resistance. Sheets are made in 2- by 8-foot sizes for horizontal application and 4- by 8-foot (or longer) sizes for vertical application.

Miscellaneous

Some insulations are not easily classified, such a insulation blankets made up of multiple layers of corrugated paper. Other types, such as lightweight vermiculite and perlite aggregates, are sometimes used in plaster as a means of reducing heat transmission. Other materials in this category are foamed-in-place insulations, including sprayed and plastic foam types. Sprayed insulation is usually inorganic fibrous material blown against a clean surface that has been primed with an adhesive coating. It is often left exposed for acoustical as well as insulating properties.

Expanded polystyrene and urethane plastic forms can be molded or foamed in place. Urethane insulation can also be applied by spraying. Polystyrene and urethane in board form can be obtained in thicknesses from 1/2 to 2 inches.

LOCATION OF INSULATION

In most climates, all walls, ceilings, roofs, and floors that separate heated spaces from unheated spaces should be insulated. This reduces heat loss from the structure during cold weather and minimizes air conditioning during hot weather. The insulation should be placed on all outside walls and in the ceiling. In structures that have unheated crawl spaces, insulation should be placed between the floor joists or around the wall perimeter.

If a blanket or batt insulation is used, it should be well supported between joists by slats and a galvanized wire mesh, or by a rigid board. The vapor barrier should be installed toward the subflooring. Press-fit or friction insulations fit tightly between joists and require only a small amount of support to hold them in place.

Reflective insulation is often used for crawl spaces, but only dead air space should be assumed in calculating heat loss when the crawl space is ventilated. A ground cover of roll rooting or plastic film, such as polyethylene, should be placed on the soil of crawl spaces to decrease the moisture content of the space as well as of the wood members.

Insulation should be placed along all walls, floors, and ceilings that are adjacent to unheated areas. These include stairways, dwarf (knee) walls, and dormers of 1 1/2 story structures. Provisions should be made for ventilating the unheated areas.

Where attic space is unheated and a stairway is included, insulation should be used around the stairway as well as in the first-floor ceiling. The door leading to the attic should be weather stripped to prevent heat loss. Walls adjoining an unheated garage or porch should also be insulated. In structures with flat or low-pitched roofs, insulation should be used in the ceiling area with sufficient space allowed above for cleared unobstructed ventilation between the joists. Insulation should be used along the perimeter of houses built on slabs. A vapor barrier should be included under the slab.

In the summer, outside surfaces exposed to the direct rays of the sun may attain temperatures of 50°F or more above shade temperatures and tend to transfer this heat into the house. Insulation in the walls and in the attic areas retards the flow of heat and improves summer comfort conditions.

Where air conditioning is used, insulation should be placed in all exposed ceilings and walls in the same manner as insulating against cold-weather heat loss. Shading of glass against direct rays of the sun and the use of insulated glass helps reduce the air-conditioning load.

Ventilation of attic and roof spaces is an important adjunct to insulation. Without ventilation, an attic space may become very hot and hold the heat for many hours. Ventilation methods suggested for protection against cold-weather condensation apply equally well to protection against excessive hot-weather roof temperatures.

The use of storm windows or insulated glass greatly reduces heat loss. Almost twice as much heat loss occurs through a single glass as through a window glazed with insulated glass or protected by a storm sash. Double glass normally prevents surface condensation and frost forming on inner glass surfaces in winter. When excessive condensation persists, paint failures and decay of the sash rail can occur.

CAUTION

Prior to the actual installation of the insulation, consult the manufacturer's specifications and guidelines for personal-protection items required. Installing insulation is not particularly hazardous; however, there are some health safeguards to be observed when working with fiberglass.

INSTALLATION

Blanket insulation and batt insulation with a vapor barrier should be placed between framing members so that the tabs of the barrier lap the edge of the studs as well as the top and bottom plates. This method is not popular with contractors because it is more difficult to apply the drywall or rock lath (plaster base). However, it assures a minimum of vapor loss compared to the loss when the tabs are stapled to the sides of the studs. To protect the top and soleplates, as well as the headers over openings, use narrow strips of vapor barrier material along the top and bottom of the wall (fig. 5-28, view A). Ordinarily, these areas are not well covered by the vapor barrier on the blanket or batt. A hand stapler is commonly used to fasten the insulation and the vapor barriers in place.

For insulation without a vapor barrier (batt), a plastic film vapor barrier, such as 4-roil polyethylene, is commonly used to envelop the entire exposed wall and ceilings (fig. 5-28, views B and C). It covers the openings as well as the window and doorheaders and edge studs. This system is one of the best from the standpoint of resistance to vapor movement. Furthermore, it does not have the installation inconveniences encountered when tabs of the insulation are stapled over

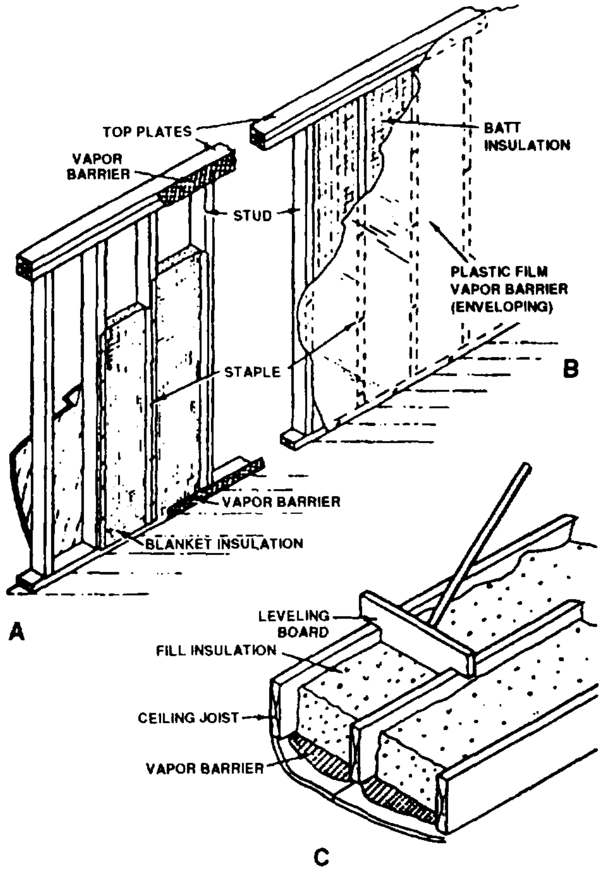

Figure 5-28.—Application of insulation.

the edges of the studs. After the drywall is installed or plastering is completed, the film is trimmed around the window and door openings.

Reflective insulation, in a single-sheet form with two reflective surfaces, should be placed to divide the space formed by the framing members into two approximately equal spaces. Some reflective insulations include air spaces and are furnished with nailing tabs. This type is fastened to the studs to provide at least a 3/4-inch space on each side of the reflective surfaces.

Fill insulation is commonly used in ceiling areas and is poured or blown into place (fig. 5-28, view C). A vapor barrier should be used on the warm side (the bottom, in case of ceiling joists) before insulation is placed. A leveling board (as shown) gives a constant insulation thickness. Thick batt insulation might also be combined to obtain the desired thickness with the vapor barrier against the back face of the ceiling finish. Ceiling insulation 6 or more inches thick greatly reduces heat loss in the winter and also provides summertime protection.

Areas around doorframes and window frames between the jambs and rough framing members also require insulation. Carefully fill the areas with

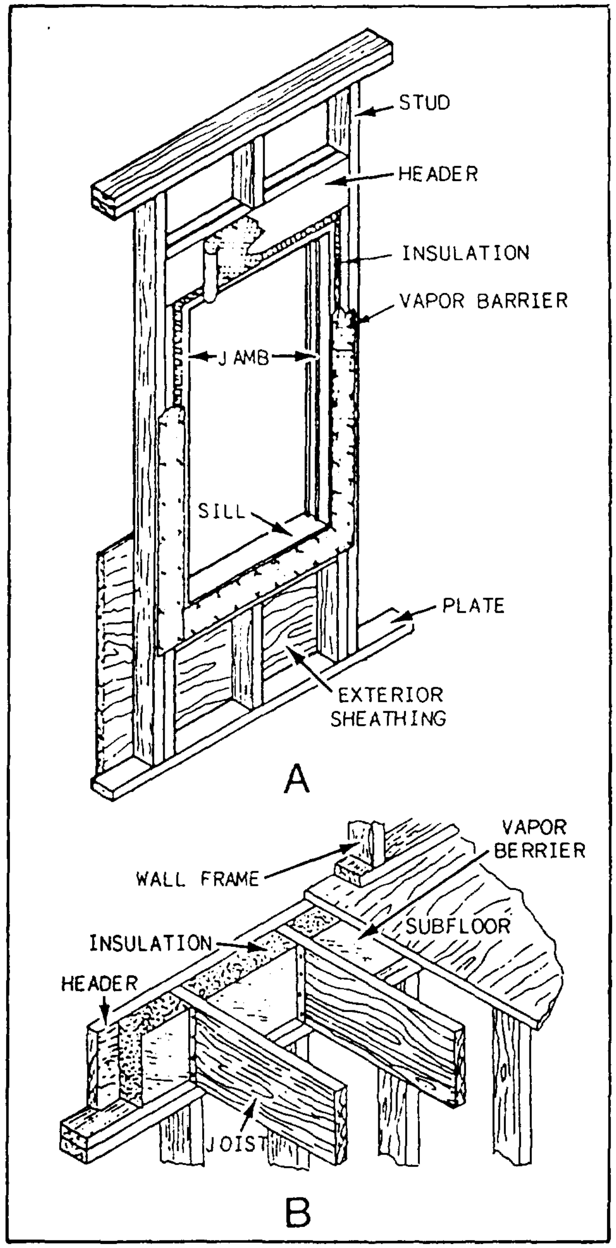

Figure 5-29.—Precautions in insulating.

insulation. Try not to compress the material, which may cause it to lose some of its insulating qualities. Because these areas are filled with small sections of insulation, a vapor barrier must be used around the openings as well as over the header above the openings (fig. 5-29, view A). Enveloping the entire wall eliminates the need for this type of vapor-barrier installation.

In 1 1/2- and 2-story structures and in basements, the area at the joist header at the outside walls should be insulated and protected with a vapor barrier (fig. 5-29, view B). Insulation should be placed behind electrical outlet boxes and other utility connections in exposed walls to minimize condensation on cold surfaces.

VAPOR BARRIER

Most building materials are permeable to water vapor. This presents problems because considerable water vapor can be generated inside structures. In cold climates during cold weather, this vapor may pass through wall and ceiling materials and condense in the wall or attic space. In severe cases, it may damage the exterior paint and interior finish, or even result in structural member decay. For protection, a material highly resistive to vapor transmission, called a vapor barrier, should be used on the warm side of a wall and below the insulation in an attic space.

Types

Effective vapor-barrier materials include asphalt laminated papers, aluminum foil, and plastic films. Most blanket and batt insulations include a vapor barrier on one side, and some of them with paper-backed aluminum foil. Foil-backed gypsum lath or gypsum boards are also available and serve as excellent vapor barriers.

Some types of flexible blanket and batt insulations have barrier material on one side. Such flexible insulations should be attached with the tabs at their sides fastened on the inside (narrow) edges of the studs, and the blanket should be cut long enough so that the cover sheet can lap over the face of the soleplate at the bottom and over the plate at the top of the stud space. However, such a method of attachment is not the common practice of most installers.

When a positive seal is desired, wall-height rolls of plastic-film vapor barriers should be applied over studs, plates, and window and doorheaders. This system, called “enveloping,” is used over insulation having no vapor barrier or to ensure excellent protection when used over any type of insulation. The barrier should be fitted tightly around outlet boxes and sealed if necessary. A ribbon of sealing compound around an outlet or switch box minimizes vapor loss at this area. Cold-air returns, located in outside walls, should be made of metal to prevent vapor loss and subsequent paint problems.

Paint Coatings

Paint coatings cannot substitute for the membrane types of vapor barriers, but they do provide some protection for structures where other types of vapor barriers were not installed during construction. Of the various types of paint, one coat of aluminum primer followed by two decorative coats of flat wall oil base

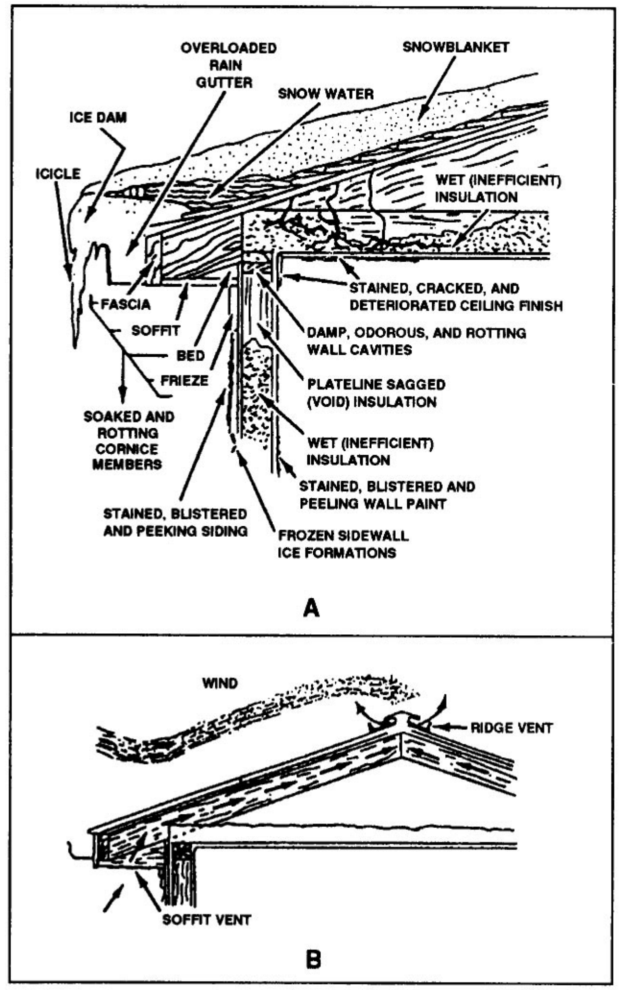

Figure 5-30.—Ice dams and protective ventilation.

paint is quite effective. For rough plasterer for buildings in very cold climates, two coats of aluminum primer may be necessary. A pigmented primer and sealer, followed by decorative finish coats or two coats of rubber-base paint, are also effective in retarding vapor transmission.

VENTILATION

Condensation of moisture vapor may occur in attic spaces and under flat roofs during cold weather. Even where vapor barriers are used, some vapor will probably work into these spaces around pipes and other inadequately protected areas and through the vapor barrier itself. Although the amount might be unimportant if equally distributed, it may be sufficiently concentrated in some cold spots to cause damage. While wood shingle and wood shake roofs do not resist vapor movement, such roofings as asphalt shingles and built-up roofs are highly resistant. The most practical method of removing the moisture is by adequate ventilation of roof spaces.

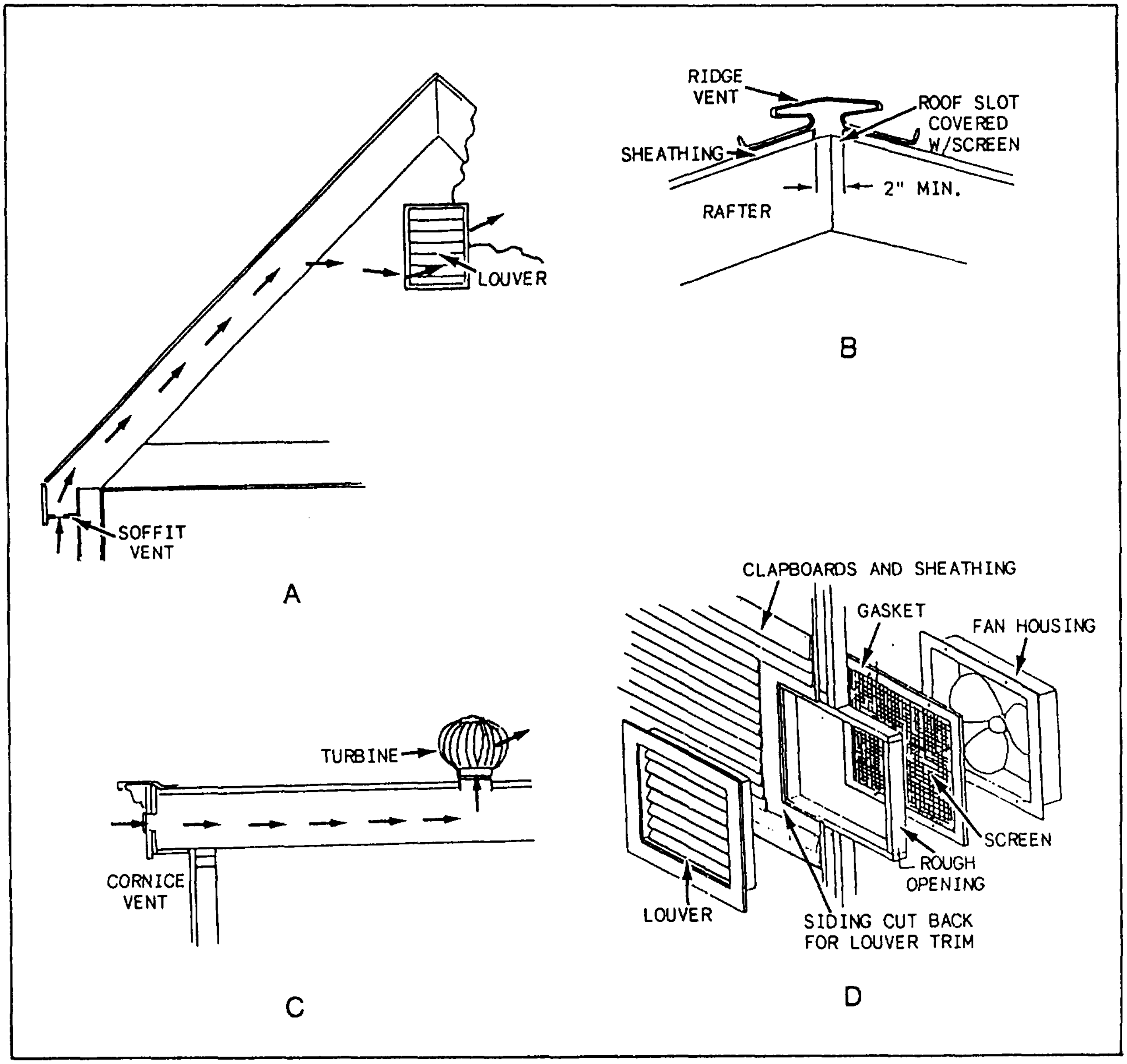

Figure 5-31.—Attic outlet vents.

A warm attic that is inadequately ventilated and insulated may cause formation of ice dams at the cornice (fig. 5-30, view A). During cold weather after a heavy snowfall, heat causes the snow next to the roof to melt. Water running down the roof freezes on the colder surface of the cornice, often forming an ice dam at the gutter that may cause water to backup at the eaves and into the wall and ceiling. Similar dams often form in roof valleys. Ventilation provides part of the solution to these problems. With a well-insulated ceiling and adequate ventilation (fig. 5-30 view B), attic temperatures are low and melting of snow over the attic space greatly reduced.

In hot weather, ventilation of attic and roof spaces offers an effective means of removing hot air and lowering the temperature in these spaces. Insulation should be used between ceiling joists below the attic or roof space to further retard heat flow into the rooms below and materially improve comfort conditions.

It is common practice to install louvered openings in the end walls of gable roofs for ventilation. Air movement through such openings depends primarily on wind direction and velocity. No appreciable movement can be expected when there is no wind. Positive air movement can be obtained by providing additional openings (vents) in the soffit areas of the roof overhang (fig. 5-31, view A) or ridge (view B). Hip-roof structures are best ventilated by soffit vents and by outlet ventilators along the ridge. The differences in temperature between the attic and the outside create an air movement independent of the wind, and also a more positive movement when there is wind. Turbine-type ventilators are also used to vent attic spaces (view C).

Where there is a crawl space under the house or porch, ventilation is necessary to remove the moisture vapor rising from the soil. Such vapor may otherwise condense on the wood below the floor and cause decay. As mentioned earlier, a permanent vapor barrier on the soil of the crawl space greatly reduces the amount of ventilation required.

Tight construction (including storm windows and storm doors) and the use of humidifiers have created potential moisture problems that must be resolved by adequate ventilation and the proper use of vapor barriers. Blocking of soffit vents with insulation, for example, must be avoided because this can prevent proper ventilation of attic spaces. Inadequate ventilation often leads to moisture problems, resulting in unnecessary maintenance costs.

Various styles of gable-end ventilators are available. Many are made with metal louvers and frames, whereas others may be made of wood to more closely fit the structural design. However, the most important factors are to have properly sized ventilators and to locate ventilators as close to the ridge as possible without affecting appearance.

Ridge vents require no special framing, only the disruption of the top course of roofing and the removal of strips of sheathing. Snap chalk lines running parallel to the ridge, down at least 2 inches from the peak. Using a linoleum cutter or a utility knife with a very stiff blade, cut through the rooting along the lines. Remove the roofing material and any roofing nails that remain. Set your power saw to cut through just the sheathing (not into the rafters) along the same lines. A carbide-tipped blade is best for this operation. Remove the sheathing. Nail the ridge vent over the slot you have created, using gasketed roofing nails. Remember to use compatible materials. For example, aluminum nails should be used with aluminum vent material. Because the ridge vent also covers the top of the roofing, be sure the nails are long enough to penetrate into the rafters. Caulk the underside of the vent before nailing.

The openings for louvers and in-the-wall fans (fig. 5-31, view D) are quite similar. In fact, fans are usually covered with louvers. Louver slats should have a downward pitch of 45° to minimize water blowing in. As with soffit vents, a backing of corrosion-resistant screen is needed to keep insects out. Ventilation fans may be manual or thermostatically controlled.

When installing a louver in an existing gable-end wall, disturb the siding, sheathing, or framing members as little as possible. Locate the opening by drilling small holes through the wall at each corner Snap chalk lines to establish the cuts made with a reciprocating saw. Cut back the siding to the width of the trim housing the louver (or the louver-with-fan), but cut back the sheathing only to the dimensions of the fan housing. Box in the rough opening itself with 2 by 4s and nail or screw the sheathing to them. Flash and caulk a gable-end louver as you would a door or a window.

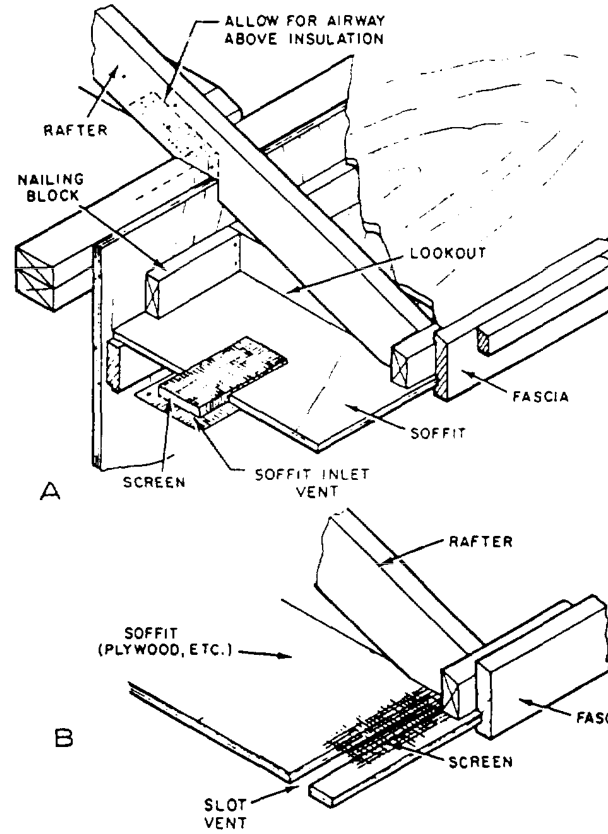

Figure 5-32.—Inlet vents.

Small, well-distributed vents or continuous slots in the soffit provide good inlet ventilation. These small louvered and screened vents (see fig. 5-32, view A) are easily obtained and simple to install. Only small sections need to be cut out of the soffit to install these vents, which can be sawed out before the soffit is installed. It is better to use several small, well-distributed vents than a few large ones. Any blocking that might be required between rafters at the wall line should be installed to provide an airway into the attic area.

A continuous screened slot vent, which is often desirable, should be located near the outer edge of the soffit near the fascia (fig. 5-32, view B). This location minimizes the chance of snow entering. This type of vent is also used on the overhang of flat roofs.

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 you are studying the latest revisions.

Drywall: Installation and Applications, W. Robert Harris, American Publishers, Inc., Homewood, Ill., 1979.

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

Wood-Frame House Construction, L.O. Anderson, Forest Products Laboratory, U.S. Forest Service, U.S. Department of Agriculture, Washington, D.C., 1975.