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METAL SIDING

ESSENTIAL KNOWLEDGE

Aluminum and steel siding gained great popularity in the 1950s and 1960s as the most durable and cost-effective materials for replacing or covering up old, deteriorating siding. It frequently contained thin foam inserts which, manufacturers claimed, greatly enhanced the insulating qualities of the material. While the new siding may have been effective in reducing air infiltration, the thinness of the insulation and the great thermal conductivity of metal made this siding a poor performer in terms of energy.

The use of aluminum and steel siding has drastically declined in recent years with the emergence and popularity of vinyl and fiber cement siding products, to the point where metal siding now accounts for only about 1 percent of the new siding market. Primary markets include the Midwest (particularly for steel siding) where cladding must resist hailstorms and temperature extremes. In metropolitan areas where local codes require noncombustible building materials, metal siding is an obvious choice. The plethora of existing metal siding makes it a prime candidate for repair or replacement in rehab work.

TECHNIQUES, MATERIALS, TOOLS

1. MAINTAIN METAL SIDING.

Under normal conditions, metal siding will require only occasional washdown with a garden hose and a soft bristle brush. If the siding is moderately dirty, use a solution of $\frac{1}{3}$ cup of a mild clothwashing detergent to a gallon of water. For heavier dirt and stains the non-abrasive detergent can be mixed with $\frac{2}{3}$ cup trisodium phosphate (Soilax, or Spic-N-Span for example) to a gallon of water. Use mineral spirits to remove caulking compounds, tar and similar substances. Clean from bottom to the top. Rinse thoroughly. Avoid abrasive cleaners and strong solvents.

ADVANTAGES: Maintenance is simple and effective.

DISADVANTAGES: Will not remove fading and severe caulking.

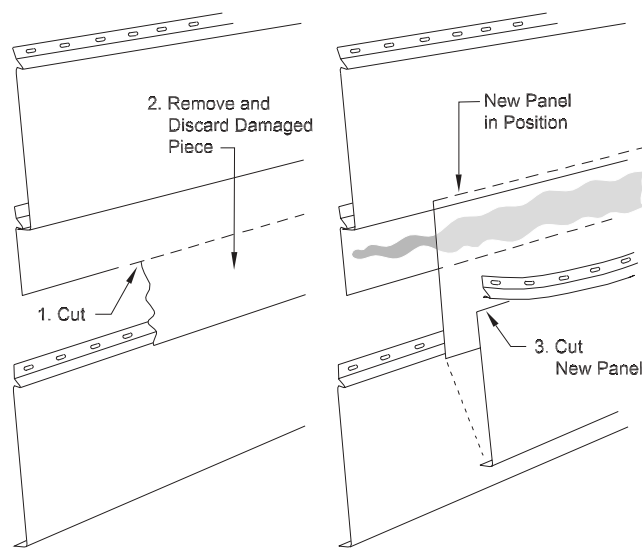


FIGURE 1

REPLACEMENT OF SIDING



FIGURE 2

ON-SITE ROLL FORMING

2. REPAIR METAL SIDING.

The replacement of metal panels is relatively simple: 1. Cut the damaged panel along its center with a utility knife or metal shears. Remove and discard the bottom section; 2. Cut and remove the top lock or a new panel; 3. Apply a heavy bead of Gutterseal (Alcoa or other brand) the full length of the defective panel; 4. Install the new panel over the Gutterseal. Apply pressure with the palm of the hand. Do not nail the panel. (Fig. 1)

ADVANTAGES: Repair is relatively simple procedure.

DISADVANTAGES: Color of replacement will not match original.

3. REPLACE EXISTING SIDING WITH STEEL SIDING.

Considered by some in the industry to be one of the highest performing siding products on the market because of its resistance to cracking, bending, high winds, and high temperatures, steel continues to have a strong niche market. Steel can be placed directly over existing siding materials, over insulated sheathing on top of existing material, or attached to furring strips placed on masonry or uneven walls. It typically comes in 12-foot lengths and panel widths of double 4 or 5-inch exposures, with a PVC or acrylic finish. A number of companies, such as ABC Seamless, provide seamless steel siding through franchised installers. It is roll-formed on site to eliminate vertical joints (Fig. 2).

ADVANTAGES: One of the strongest and most damage-resistant siding products available; lays flat and straight against most substrates; color finishes warranted against fading and peeling; noncombustible; can be touched up with paint.

DISADVANTAGES: Approximately double the cost of standard vinyl siding; 30 percent more expensive than aluminum siding. Fewer profiles, styles, colors, trim, and accessories than vinyl siding.

4. REPLACE EXISTING SIDING WITH ALUMINUM SIDING.

Aluminum continues to have some niche market appeal, although its use is diminishing. Aluminum siding is typically available in 12-foot lengths and panel widths of double 4 or 5-inch exposures, with a PVC or acrylic finish. The most popular color is white, but a limited color palette is available. Like steel siding, aluminum can be applied directly over wood-sided walls that are sound and straight, over insulated siding, and over furring strips.

ADVANTAGES: Lays straight over most substrates; less likely to show waviness than vinyl siding; lightweight, noncombustible, durable, and easy to clean.

DISADVANTAGES: More costly than vinyl; dents relatively easily; comes in limited styles and colors.

PRODUCT INFORMATION

ABC Seamless, 3001 Feichner Drive, Fargo, ND 58103; 701-293-5952.

Alcoa Building Products, P.O. Box 57, 1501 Michigan St., Sidney, OH 45365-0057; 800-962-6973;
www.alcoahomes.com.

Alside, 373 State Road, P.O. Box 2010, Akron, OH 44309; 800-257-4335.

EDCO, 8700 Excelsior Boulevard, Hopkins, MN 55343; 800-333-2580.

Norandex/Reynolds Distribution Co., 8450 South Bedford Road, Macedonia, OH 44056; 330-468-2200;
www.norandex.com; www.reynoldsbp.com.

Reynolds Building Products, One Norandex Place, Macedonia, OH 44056; 330-468-2200.

United States Seamless, Inc., 2001 First Ave. N., P.O. Box 2426, Fargo, ND 58108-2426; 701-241-8888;
www.usseamless.com.

WOOD SHINGLES & SHAKES

ESSENTIAL KNOWLEDGE

Wood shingles and shakes (thicker versions of shingles) have been used for siding for more than 300 years. Today, most of this material is milled in Canada and is made of Western red cedar, Eastern white cedar, or Alaskan yellow cedar. Pressure-preservative-treated Southern yellow pine is also used for shakes on a limited, regional basis. Western red cedar weathers a darker gray than the other two materials. A few mills make redwood shingles, but they are not as popular as cedar because they weather considerably darker. Cedar shingles and shakes are warranted against material defects for a minimum of 20 years (30 if pressure-treated with CCA) by members of the Cedar Shake and Shingle Bureau (CSSB).

Western red cedar shingles are available in a variety of grades, including No. 1 BLUE LABEL (100 percent heartwood, 100 percent clear, 100 percent end grain) and No. 2 RED LABEL with some flat grain and limited sapwood. Other grades are available for secondary structures, economy installations, and undercoursing. No. 1 is the preferred grade for both roofing and siding, but No. 2 grade is also used for siding because the weathering conditions are not as extreme as roofing.

Eastern white cedar shingles (increasingly coming from small, second growth trees) are not available in 100 percent edge grain, and are graded by knot content. Grade "A" BLUE LABEL is all heartwood with no imperfections; Grade "B" RED LABEL allows imperfection such as knots on non-exposed parts and has a recommended maximum exposure of 6 inches. Grades "A" and "B" are recommended for siding. Grade "C" BLACK LABEL is an economy grade that allows sound knots on exposed portions, and has a rustic appearance. Grade "D" is a utility grade for underlayment. Eastern white cedar shingles are available prefinished from Sovebec, Inc. (Eastern Canada's largest consortium of white cedar mills) in a tailored rebuted and squared configuration with a peroxide bleaching agent and latex stain called "Ultra Bleach," which accentuates and accelerates the silver gray weathered appearance (see Product Information).

Western red cedar shakes are available in a variety of textures and finishes including: machine grooved; handsplit face and resawn back; taper sawn on both sides (resembling an extra-thick shingle); taper split by hand both sides and straight-split by machine both sides. See the *Cedar Shake and Shingle Bureau Design and Application Manual* for detailed specifications on cedar siding.

TECHNIQUES, MATERIALS, TOOLS

1. REPLACE INDIVIDUAL CEDAR SHINGLES.

If a small number of individual shingles are badly curled, cracked, or missing, they can be removed and replaced relatively easily: Cut nails holding damaged shingles with a hack saw blade. Split shingles with a chisel and remove pieces. Cut a new shingle to fit with a 1/8 to 1/4 inch clearance each side.

ADVANTAGES: An inexpensive way to repair existing siding.

DISADVANTAGES: Will not work with a large area of defective shingles.

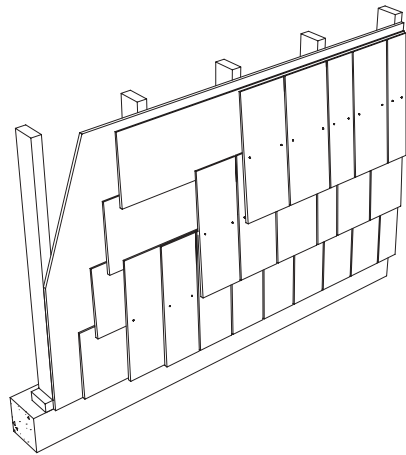
2. RESIDE WITH NEW CEDAR SHAKES AND SHINGLES.

Certain types of existing siding including vertical wood siding or paneling, and existing wood clapboard that are flat and in sound condition, can be left in place and new shingles applied over them. Shingles can be applied over beveled siding by filling in the low points of the wall with low grade timber strips (called

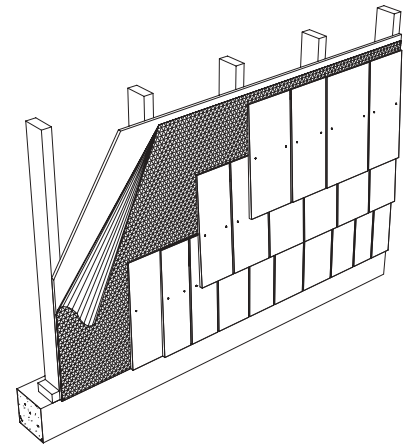
“horse feathers”) and thereby increasing the potential nailing surface, or by nailing the shingles or shakes to the high points of the bevels of each course of the old wall (Fig. 1). However, many shingle manufacturers recommend the use of furring strips or a plastic mesh product such as Cedar Breather™ be used to allow for air circulation and to reduce the potential of excessive moisture build-up behind the shingle (Fig. 2). If the existing siding is stucco or masonry, or if the surface is uneven, horizontal, or a combination of horizontal and vertical, furring is necessary to flush out the wall, allow for air circulation, and to provide a nailing surface for the new siding (Fig. 3). If the existing siding is substantially deteriorated, removal of the shingles allows for the inspection, removal, and reinstallation of existing insulation, sheathing, flashing, caulking, building paper, or housewrap as necessary. If the sheathing is nonstructural or foam, new shingles should be fastened to furring that is laid over the sheathing. Furring is typically 1 by 3 or 1 by 4 material (Fig. 4). Wherever possible, butt lines should align with tops or bottoms of windows or other openings for appearance. Shingle exposure should be consistent. Corners can be butted against corner boards or laced together on outside and inside corners, or mitered on outside corners (Fig. 5).

ADVANTAGES: An attractive, natural material for both traditional and contemporary buildings. Can be treated with a variety of coatings and preservatives or left to weather naturally. A sustainable material that comes from renewable sources. Residing over existing wall eliminates the time and expense of removing existing siding.

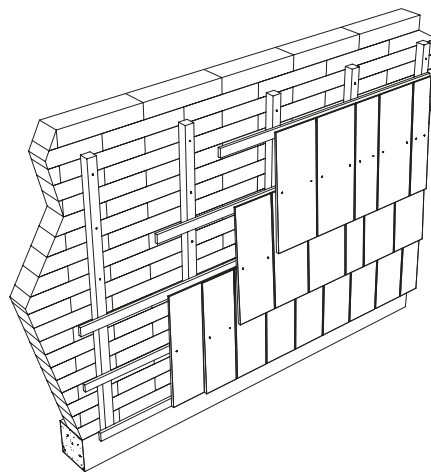
DISADVANTAGES: More costly than other siding material. Can weather unevenly in certain conditions. Combustible unless pressure-treated with fire retardants. Some warping and cupping will occur.



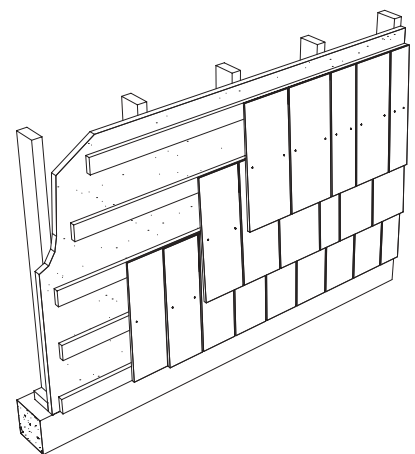
BEVELED SIDING DETAIL



CEDAR BREATHER



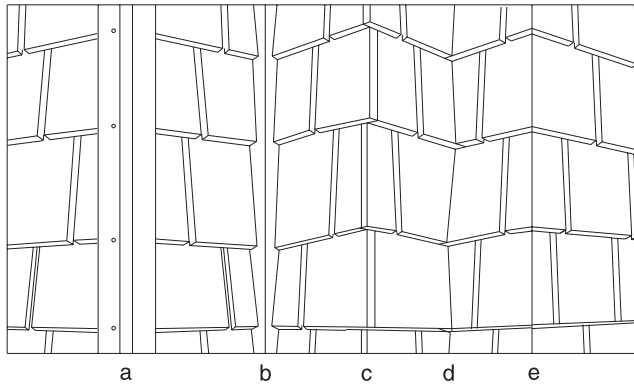
MASONRY DETAIL



STUCCO DETAIL

FIGURE 1, 2

FIGURE 3, 4



- a. Shingles butted against corner boards
- b. Shingles butted against square wood strip on inside corner, flashing behind
- c. Laced outside corner
- d. Laced inside corner with flashing behind
- e. Mitered corner

FIGURE 5

CORNER DETAILS

FURTHER READING

Cedar Shake and Shingle Bureau Design and Application Manual for Exterior and Interior Walls, Cedar Shake and Shingle Bureau, 1991.

Cedar Shake and Shingle Bureau Membership Directory and Buyers Guide, Cedar Shake and Shingle Bureau, Jan. 1998.

A Guide to Southern Pine Shakes, Southern Forest Products Association, Kenner, L.A., 1994.

The Sovebec Guide to Installing Eastern White Cedar Shingles, Charney, Canada: Sovebec, Inc.

PRODUCT INFORMATION

Cedar Breather™, Benjamin Opdyke, Inc., 65 Steamboat Drive, John Fitch Industrial Park, Warminster, PA 18974-4889; 800-346-7655.

Cedar Shake & Shingle Bureau, P.O. Box 1178, Sumas, WA 98295; 604-462-8961; www.cedarbureau.org.

Sovebec Eastern White Cedar, Sovebec, Inc., 9201 Centre Hospitalier Blvd., Charney, Quebec, Canada G6x 1L5; 418-832-1456.

SOLID WOOD SIDING

ESSENTIAL KNOWLEDGE

Solid wood siding (particularly beveled siding such as clapboard) has been popular in the U.S. for the past 300 years. The use of wood siding has increased somewhat recently, according to the Western Red Cedar Lumber Association. However, its use is expected to decline as lumber becomes more costly, as quality materials become harder to obtain, and as other similar looking and less expensive materials become more popular (such as vinyl and fiber-cement siding).

The large majority of solid wood siding comes from the Western United States and Canada and is made of Western red cedar. A small portion is also made from Western redwood, and is available from individual mills. Solid wood siding from other softwoods such as vertical grain Western Douglas Fir is occasionally available, but in decreasing amounts. Some Eastern mills produce siding from softwoods such as white pine and spruce. Wood siding is usually treated with a protective coating such as a semi-transparent or opaque stain or paint. Individual industry associations have their own finishing recommendations (see Further Reading).

Most bevel siding (the most popular form of solid wood siding) is made from resawn lumber (1 inch thick boards that are sawn from logs and then cut diagonally on a band saw. Depending on where the 1 inch boards are cut, resawn lumber can be vertical grain, curved grain, or flat grain. Quartersawn (also known as “radial sawn”) siding is made from cuts radiating out from the center of a log, with the result that each piece is vertical grain (Fig. 1). Vertical grain siding is better at resisting warping and twisting. Curved and flat grain siding tends to twist opposite to the curve of the growth ring. Vertical grain siding also takes and holds paint better than flat grain because the maximum number of grain surfaces is exposed and acts as capillaries absorbing paint or stain for better adhesion. Since vertical grain is more stable than flat grain, the paint is also less stressed by twisting.

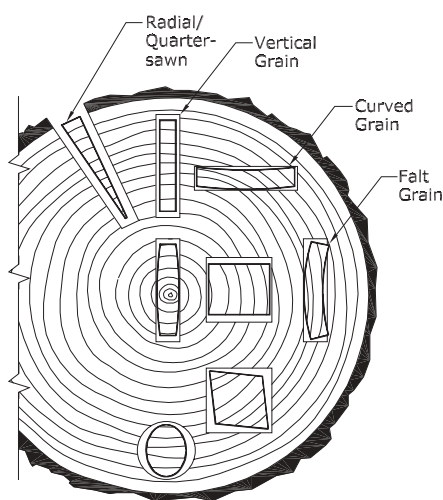


FIGURE 1

GRAIN CONFIGURATION AND SHRINKAGE CHARACTERISTICS

TECHNIQUES, MATERIALS, TOOLS

1. REPAIR/REPLACE DAMAGED PIECES OF EXISTING BEVEL WOOD SIDING.

Individual pieces of bevel wood siding can easily be removed and replaced by cutting the nails holding the damaged sections with a hacksaw blade, and then by wedging and sawing the damaged sections out. New material can then be installed to butt existing material and fastened into place.

ADVANTAGES: Most economical repair.

DISADVANTAGES: Will not work with large areas of deteriorated material, which will have to be stripped down to the sheathing or structure.

2. REPLACE DETERIORATED OR DAMAGED SIDING WITH NEW WESTERN RED CEDAR BEVEL SIDING.

Resawn Western red cedar bevel siding has either two textured sides, or one textured and one smooth sanded side, depending on grade. Clear bevel siding results in the highest quality appearance with no visible knots. Bevel siding is available in plain bevel and rabbeted bevel (Fig. 2). Plain bevel is the most popular. Rabbeted bevel lays flatter on the wall and is somewhat easier to nail, but it has a less pronounced shadow line. Bevel siding ranges in exposure from 4 to 12 inches; with a butt thickness ranging from $\frac{1}{2}$ to $\frac{7}{8}$ inch. Red cedar bevel siding is available in six traditional grades: Clear V.G. Heart (smooth face, all vertical grain); A Clear (mixed grain); Rustic (some knots, sawn texture); B Clear (more knots and other growth characteristics); Select Knotty (significant sound and tight knots); Quality Knotty (considerable knots); and Architect Knotty Bevel Siding (comes with a variety of knots and other growth characteristics and is factory primed). Bevel siding is also available finger-jointed in lengths up to 16 feet in clear and knotty grades and in smooth, resawn, and combed (multiple grooved) textures.

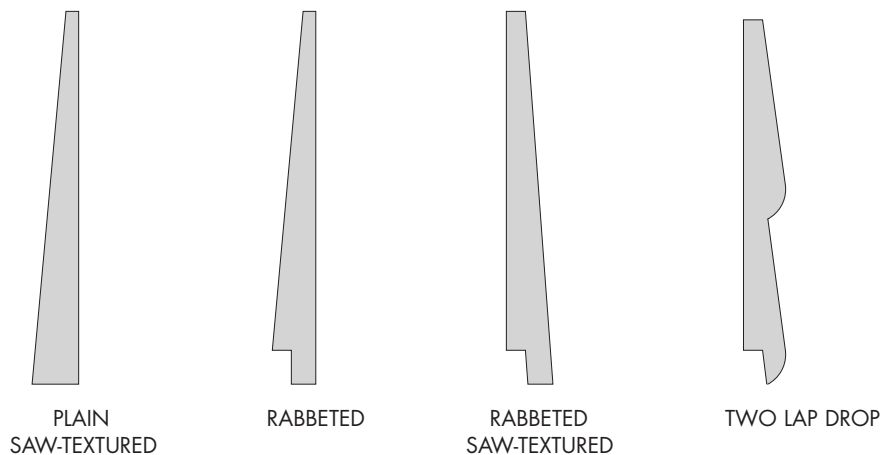


FIGURE 2

BEVEL SIDING

A number of mills have arrangements with paint/stain companies, including Olympic, Cabot, and Sherwin Williams, which will provide 5-year warranties for factory-applied primer coat, increased to 15 years after the field application of an approved topcoat. If the siding is recoated before the 15-year warranty is over, it can be extended another 15 years for up to 30 years. Although some lower grades are used in conjunction with some extended warranty painting programs, vertical grain cedar will perform the best over an extended period (see Product Information).

Bevel siding can be applied directly, over building paper or house wrap to solid siding or sheathing, or to insulating sheathing if special application requirements for the insulating sheathing are adhered to (see Further Reading). It can also be applied to furring over masonry (on uneven walls or to allow for

the ventilation of the inside face of the cedar). Face nailing of bevel siding is recommended as blind nailing will split the thin, feathered portion of the shingle (Fig. 3). Stainless steel nails are recommended, especially in areas near the ocean. Hot-dipped galvanized or aluminum nails are acceptable in less corrosive environments. A variety of inside and outside corner details is possible (Fig. 4). Mitered corners are usually caulked and can separate if the wood is not properly seasoned and knots have been allowed to get wet prior to application. Corner boards are a good alternative. Non-hardening caulks are recommended, including polyurethane, polysulfide, or latex-silicone. For more information on installation refer to *Installing Cedar Siding* (see Further Reading).

ADVANTAGES: Western red cedar bevel siding has natural decay resistance, dimensional stability, workability, and paintability. Up to 30-year warranties available from paint companies make painted bevel siding competitive with other siding products. Available in vertical grain and in a variety of sizes, lengths (up to 16 feet), and finishes.

DISADVANTAGES: Will deteriorate and discolor over time if not maintained properly. Expands and contracts with changes in humidity and will shrink over time, causing vertical joints (which should be beveled) to open. May cup and twist, especially if flat grain is used instead of vertical grain. Combustible material; more costly than other siding products.

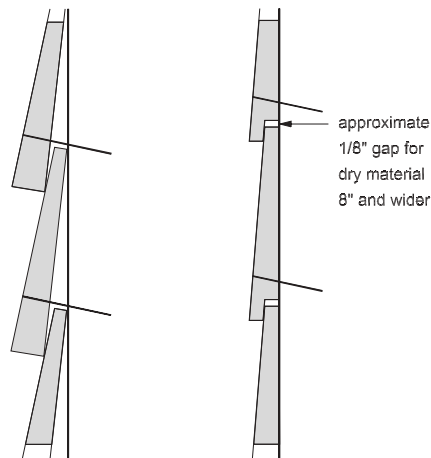


FIGURE 3

FACE NAILING OF BEVEL SIDING

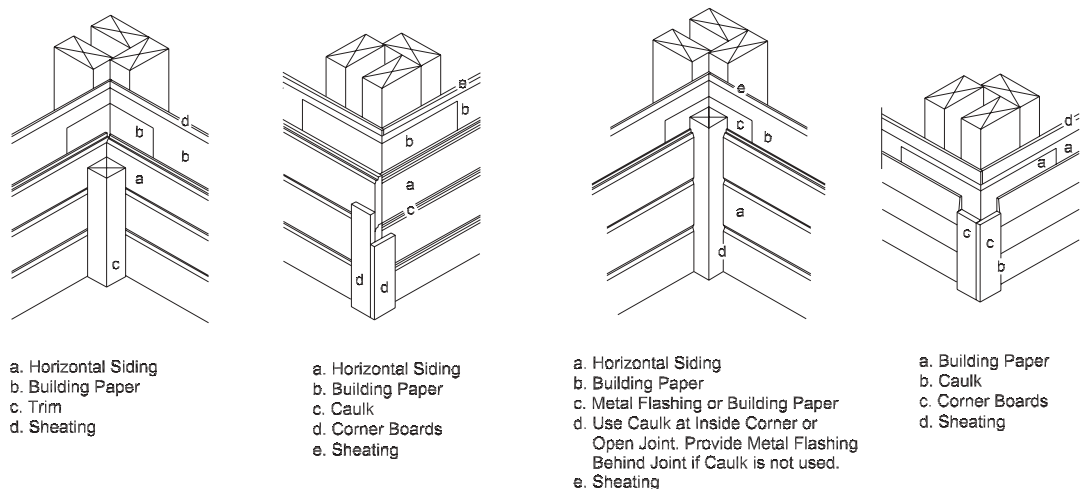


FIGURE 4

3. REPLACE DETERIORATED OR DAMAGED SIDING WITH NEW WESTERN REDWOOD BEVEL SIDING.

Redwood bevel siding has all of the favorable attributes of cedar bevel siding, but it is less available nationally and usually more costly than cedar. It comes in a variety of grades including Clear All Heart (all heartwood and free of knots); Clear (some sapwood and some small, tight knots); B Heart (a limited number of tight knots and other characteristics); B Grade (similar to B Heart except that it permits sapwood as well as heartwood). All these grades are available “certified kiln dried,” recommended for top performance and minimal shrinkage. Clear or Clear All Heart may be ordered either flat grain or vertical grain (recommended for best performance). Rustic grades are also available. Redwood bevel siding comes plain and rabbeted, smooth and rough sawn, and in a full range of sizes from 1/2 by 3 1/2 inches to 3/4 by 10 inches. Thinner widths are less likely to shrink and split than the wider widths. Redwood takes paint well, but individual mills haven’t been as aggressive as the cedar mills in developing warranty programs with the leading paint companies. Redwood bevel siding is applied and finished in the same manner as cedar. **ADVANTAGES:** Natural decay resistance, dimensional stability, paintability, and workability. Available in a variety of finishes, grains, sizes, and styles.

DISADVANTAGES: Will deteriorate and discolor over time if not maintained properly. Expands and contracts with changes in humidity and will shrink over time, causing vertical joints (which should be beveled) to open. May cup and twist, especially if flat grain is used instead of vertical grain. Combustible material; more costly than other siding products.

4. REPLACE DETERIORATED OR DAMAGED SIDING WITH NEW QUARTERSAWN SPRUCE OR PINE BEVEL SIDING.

Quartersawn Eastern spruce or pine bevel siding is available from the Granville Mfg. Co. The bevel siding comes in 1x Clear (clear, unmarked, or exposed section of siding); 2x Clear (up to one knot or blemish per piece); Cottage (not more than three knots or blemishes, no loose knots). Available in sizes from 7/16

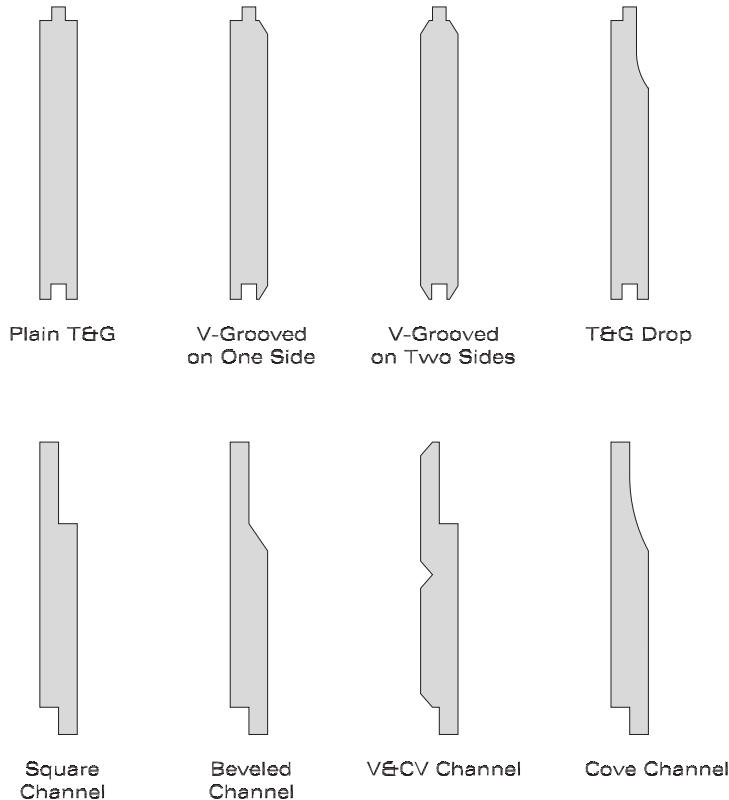


FIGURE. 5

NON-BEVEL WOOD SIDING

by 4 to 6 inches and up to 6 feet long. The material comes unpainted, primed, or painted.

ADVANTAGES: Vertical grain resists twisting and warping and accepts paint well. Authentic manufacturing meets all colonial reproduction specifications. Less costly than Western red cedar or redwood; long lifespan.

DISADVANTAGES: Requires maintenance and repainting. Available only in relatively short lengths (which shrink less). Will not match resawn siding. Available only in 2½ to 4-inch exposures. Combustible material.

5. REPLACE DETERIORATED OR DAMAGED SIDING WITH NON-BEVEL SOLID WOOD SIDING.

Non-bevel wood siding types include board and batten, drop siding, shiplap, tongue-and-groove, and variations of these types (Fig. 5). Many, including tongue-and-groove and shiplap, can be installed horizontally in the same manner as bevel siding, and vertically with blocking between studs, or over horizontal furring strips. The grades of the siding products are similar to those for bevel siding. For detailed sizes and specifications (see Further Reading and Product Information).

ADVANTAGES: A wide variety of distinctive, historically correct products for both traditional and contemporary use. Available from individual suppliers with vertical grain and extended painting warranties.

DISADVANTAGES: Requires periodic maintenance; more costly than other siding products; combustible.

FURTHER READING

Certified Kiln Dried Siding Applications, Novato, CA: California Redwood Association, 1995; 888-225-7339; www.calredwood.org.

Designer's Handbook, Vancouver, BC: Western Red Cedar Lumber Association, Nov. 1997; 604-684-0266; www.wrcla.org.

Guidelines for Installing and Finishing Wood and Hardboard Siding Over Foam Sheathing, American Forest and Paper Association; 202-463-2700; www.afandpa.org.

Installing Cedar Siding, Western Red Cedar Lumber Association; 604-684-0266; www.wrcla.org.

Natural Wood Siding—Technical Guide, Portland, OR: Western Wood Products Association, May 1998; 503-224-3930; www.wvpa.org.

Redwood Architectural Guide, Novato, CA: California Redwood Association, 1998; 888-225-7339; www.calredwood.org.

Redwood Lumber Grades and Uses, Novato, CA: California Redwood Association, Dec. 1995; 888-225-7339; www.calredwood.org.

Specifying Cedar Siding, Vancouver, BC: Western Red Cedar Lumber Association, May 1998; 604-684-0266; www.wrcla.org.

Using Redwood Siding Over Rigid Foam Insulation, Novato, CA: California Redwood Association, Sept. 1994; 888-225-7339; www.calredwood.org.

PRODUCT INFORMATION

Granville Manufacturing Co., Granville, VT 05747; 802-767-4747; quartersawn spruce and pine clapboard siding.

Siding 2000, pre-finished cedar siding: Coastal Forest Products, 451 South River Road, P.O. Box 10898, Bedford, NH 03110; 800-932-WOOD.

Skookum Lumber Co., Box 1398, Olympia, WA 98507-1398; 360-352-7633 (cedar siding).

Step Saver Siding: Factory Primed Western Red Cedar; PPG Industries, Inc., 1 PPG Place, Pittsburgh, PA 15272; 800-441-9695; www.ppgaf.com.

HARDBOARD SIDING

ESSENTIAL KNOWLEDGE

Hardboard siding was first developed by William Mason in 1922. The product is made of wood chips converted into fibers, combined with natural and synthetic binders, bonded under heat and pressure. The early success of this material led to a proliferation of hardboard manufacturers in the early 1950s when the original patents expired. More than a score of companies were producing hardboard siding by the 1970s when the EPA's newly declared environmental restrictions on the dumping of waste water from hardboard's wet manufacturing process led to the closing of a number of plants that did not have the space or resources to make required changes. By the mid-1980s hardboard siding accounted for about 30 percent of the United States residential siding market. Today, hardboard siding's market share has declined to approximately 15 percent. The number of current manufacturers has been reduced to six. The constricted market is due to the growth in use of other materials such as vinyl siding, exterior insulation and finish systems (EIFS), and fiber-cement siding.

There has been considerable publicity about class action lawsuits against certain manufacturers regarding the material's performance when exposed to moisture. Manufacturers have countered that, while lapses in quality control may have occurred, hardboard has a long history of good performance and that the majority of problems is due to inadequate field supervision (particularly regarding incorrect flashing, caulking, nailings, and painting) by installers around windows, doors, deck terminations, and other potential moisture entry points, and the lack of sufficient maintenance on the part of homeowners.

The majority of the class action lawsuits has been settled, and the major manufacturers continue to produce and sell hardboard siding with limited 25- to 30-year warranties. Some products are undergoing continued design improvements, others have changed relatively little over the years. Masonite Corp., for example, has developed a new lap siding product called HiddenRIDGE™ with concealed fasteners and interlocking design that speeds installation and provides level alignment (Fig. 2).

TECHNIQUES, MATERIALS, TOOLS

1. REPAIR EXISTING HARDBOARD LAP SIDING.

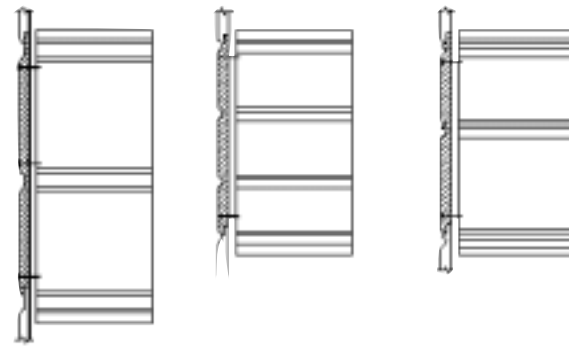
Small sections of damaged or deteriorated lap siding can be cut out and replaced with matching profiles relatively easily with conventional carpentry tools, including handsaws and power saws. Deteriorated sheathing should be replaced as required. Panel siding sections can be repaired as well, but with greater difficulty.

ADVANTAGES: Most economical repair.

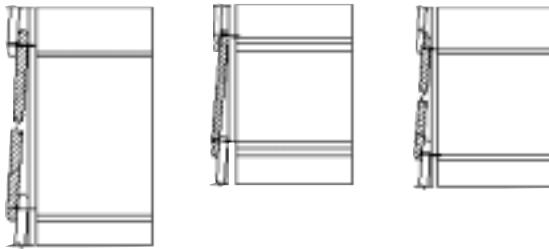
DISADVANTAGES: Large areas of damaged material have to be stripped down to sheathing or structure. Repaired sections may not exactly match existing siding.

2. REPLACE EXISTING SIDING WITH NEW HARDBOARD LAP SIDING.

Lap siding is available in $\frac{7}{16}$ and $\frac{1}{2}$ inch thicknesses and in a wide variety of configurations including shiplap siding 12 and 16 inches wide in lengths up to 16 feet with varying profiles, as well as conventional 6, 8, or 12 inches wide lap siding made to look like beveled siding (Fig. 2). Most products are pre-primed and require two coats (4 dry mils) of field painting. Masonite offers a completely pre-finished, "Colorlock" siding that comes with a 15-year limited warranty on the finish. Lap siding can be applied over



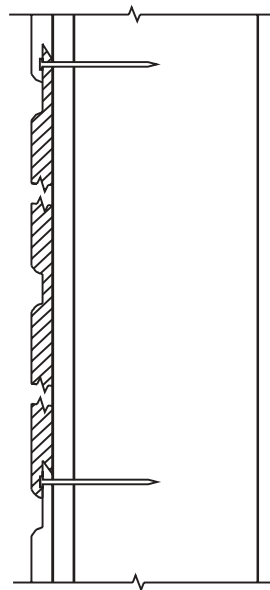
SHIPLAP SIDING



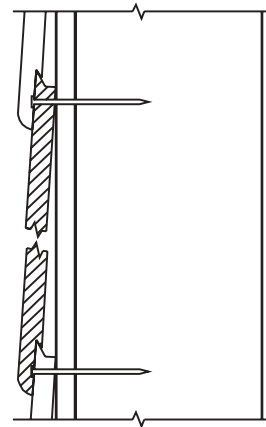
LAP SIDING

COLORLOK SIDING

FIGURE 1



SHIPLAP SIDING
HIDDEN RIDGE



LAP SIDING

FIGURE 2

existing sound and level siding, over solid or insulating sheathing, directly over studs 16 inches o.c. with an approved water-resistant barrier, or over furring strips. Staples, t-nails, or bugle head nails are not recommended. Hardboard, as all materials, will expand and contract with temperature and humidity variations. A minimum $\frac{3}{16}$ inch space is recommended between the siding and windows, door frames, and corner boards and $\frac{1}{16}$ inch between vertical butt joints, which must fall on studs. All joints must be caulked with non-hardening, mildew-resistant exterior grade sealant.

ADVANTAGES: Hardboard lap siding has been used successfully for over 50 years and remains the preferred siding material in some markets. Available in a wide variety of profiles, textures, and styles that accurately simulate the appearance of wood products. Easily worked and handled. A consistent product with no surface defects. Available in lengths up to 16'. Less costly than solid wood siding products.

DISADVANTAGES: More susceptible to moisture-related problems than other siding materials. Requires careful storage and protection during construction. Should not be applied over wet sheathing. Requires careful attention to fastening, caulking, and painting recommendations. Long lengths of siding may buckle due to expansion. Requires periodic inspection and maintenance of caulking and painting.

3. REPLACE EXISTING SIDING WITH NEW HARDBOARD PANEL SIDING.

Of the hardboard siding sold, panel siding represents about a third. It is available in 4x8 and 4x9 square-edge panels (for board and batten applications) and shiplap-edge panels. The panels come in a variety of textures and groove configurations that simulate vertically applied wood boards. The material is also available without grooves in a stucco appearance. Temple-Inland offers a 16 by 48-inch panel called "Shadowround" that simulates scalloped shingles. Hardboard panels may be applied to sheathed or unsheathed walls with studs no more than 24" o.c., or over sound flat existing siding. Panel edges must fall on and be nailed to framing members. Horizontal joints must have adequate blocking and be overlapped a minimum of 1" or be provided with Z-shaped preformed flashing. The material is available pre-primed for field painting.

ADVANTAGES: A consistent material without knots, raised grain, checks, or other surface defects. Takes paint well and has been used successfully for many years when properly installed and maintained. Can provide shear resistance when installed directly over studs. Available in a variety of attractive patterns and finishes. Easily worked and handled.

DISADVANTAGES: Requires careful storage and protection during construction. Requires careful attention to fastening, caulking, and painting requirements. Requires periodic inspection and maintenance of caulking and painting.

FURTHER READING

ANSI/AHA 135.6-1990 Hardboard Siding, Palatine, IL: American Hardboard Association, 1998.

Maintenance Tips for Hardboard Siding, Palatine, IL: American Hardboard Association, 1997.

Recommended Basic Application Instructions for Hardboard Siding, Palatine, IL: American Hardboard Association, 1994.

Today's Hardboard, Palatine, IL: American Hardboard Association, February 1998.

PRODUCT INFORMATION

American Hardboard Association, 1210 West Northwest Highway, Palatine, IL 60067; 847-934-8800.

Hardboard Manufacturers:

ABT Building Products Corp., 3250 West Big Beaver Road, Troy, MI 48084; 810-649-3300.

Collins Products, LLC, P.O. Box 16, Klamath Falls, OR 97601; 541-883-4853.

Forestex Co., P.O. Box 68, Forest Grove, OR 97116; 503-357-2131; www.stimsonlumber.com.

Georgia Pacific Corp., 133 Peachtree St., NE, Atlanta, GA, 30303; 800-284-5347; www.gp.com.

Masonite Corp., 1 South Wacker Drive, Chicago, IL 60606; 312-750-0900.

Temple-Inland Forest Products Corp., P.O. Drawer N, Diboll, TX 75941; 409-829-5511.

ENGINEERED WOOD SIDING

ESSENTIAL KNOWLEDGE

Louisiana-Pacific (the largest producer of oriented strand board (OSB)) introduced Inner-Seal™ OSB siding in the mid-1980s as an economical alternative to conventional wood siding products that had become more costly due to rising lumber prices. While the material proved popular with builders, some performance problems arose, particularly in humid environments such as the Northwest and Southeast. Where nail holes, material surfaces, and edges were not adequately painted or sealed, water penetrated, causing the OSB siding to swell and expand. Some OSB siding deteriorated due to rot, fungus, and invasion by insects, in some cases causing damage to sheathing beneath. A number of class action lawsuits were brought against the manufacturer, and L-P has settled these claims.

Since then, L-P has re-engineered the material and has reintroduced it as a “treated engineered wood product” instead of an OSB product, offering bevel-edged siding in 16-foot lengths with 6, 8, 9 1/2, and 12 inch widths; and 4 by 8 to 4 by 16 panels. The composition and production process have been substantially revised. The binder has been changed from a phenolic to methylene diphenyl diisocyanate (MDI), which is more water resistant and provides a stronger bond to the wood flakes, therefore reducing the swelling and expansion. Powdered zinc borate has been included to prevent rot, fungal growth, and insect-caused deterioration. A prefinished resin-saturated paper embossed with a pronounced wood grain is thermal-fused to the wood substrate, and a proprietary sealant treatment is applied to ends and edges. The siding is prefinished with an all-acrylic primer. Fascia and trim products are also available.

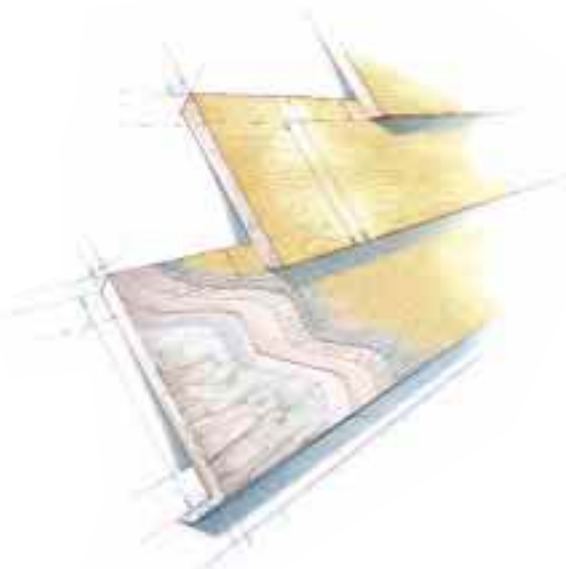
TECHNIQUES, MATERIALS, TOOLS

1. REPLACE DAMAGED OR DETERIORATED SIDING WITH NEW L-P SMART LAP™ SIDING.

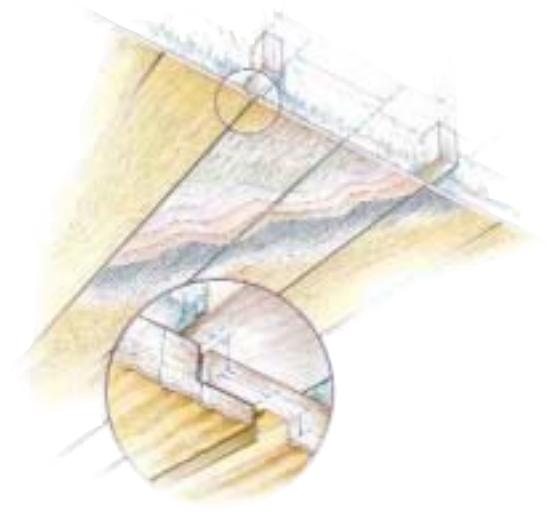
Depending on the most cost-effective approach, engineered wood lap siding can be installed directly to studs with a weather barrier (Fig. 1); directly to nailable sheathing; over “fan-fold” insulating sheathing; or to furring strips over masonry or irregular surfaces (siding should not come in contact with masonry). If a rainscreen/drainage channel behind the siding is desired the siding can be installed over vertical furring strips at a maximum spacing of 24 inches o.c. Sections of existing Inner-Seal™ OSB siding that have swelled, edge cracked, or otherwise deteriorated, can be cut out and replaced with new sections of L-P engineered wood siding, which will closely match the appearance of the old OSB siding. For complete instructions refer to *Application Instructions for Smart Panel™ and Smart Lap™ Siding*.

ADVANTAGES: Lightweight, strong, easily worked with conventional tools; appearance of textured painted cedar siding; joints at trim similar to wood bevel siding; lays flat. Dimensionally stable; will not warp or cup; free from knot holes; resistant to end-checking and splitting, shrinkage, and buckling. Twenty-five-year prorated limited warranty against fungal degradation, and cracking, peeling, separating, chipping, flaking, or rupturing of the resin-impregnated surface overlay. Environmentally sound; made from a renewable resource.

DISADVANTAGES: Requires repainting and recaulking over time. New product with limited performance history. Combustible material. Currently not available in smooth patterns.



SMART LAP



SMART PANEL

FIGURE 1, 2

2. REPLACE DAMAGED OR DETERIORATED SIDING WITH NEW L-P SMART PANEL™ AND EZ PANEL™ ENGINEERED WOOD PANELS.

Available in a variety of thicknesses and patterns simulating vertically grooved plywood siding (Fig. 2). Panels have shiplapped edges and may be used directly over studs, over structural or nonstructural sheathing, over existing sound wood siding, and on furring strips over masonry and uneven walls. Panels should not contact masonry surfaces and vertically grooved panels should not be applied horizontally. Nails must be stain and corrosion resistant and have a minimum 1/4 inch head. Nails driven below the surface must be sealed. All joints must be caulked with non-hardening paintable sealant with a service life of at least 25 years. Horizontal trim should not be placed over grooved siding without proper flashing. If flashing is not practicable, space trim away from siding so that moisture is not trapped between siding and trim. For detailed installation and painting requirements refer to *Application Instructions for Smart Panel™ & EZ Panel™ Siding*.

ADVANTAGES: Less costly than plywood. Smart Panel™ can act as a shear wall; does not require sheathing. Comes primed and can be painted any color. Natural looking wood grain texture. Easily handled and installed with conventional tools. Twenty-five-year prorated limited warranty against fungal degradation, cracking, peeling, separating, chipping, flaking, or rupturing of the resin-impregnated surface overlay. Comparable five-year warranty on EZ Panel™, which is a utility grade.

DISADVANTAGES: Engineered panels require regular repainting and recaulking. New product with limited performance history. Combustible material.

FURTHER READING

Application Instructions for Smart Panel™ & Smart Lap™ Siding, Louisiana-Pacific, March 1998.

PRODUCT INFORMATION

Louisiana-Pacific, 111 SW Fifth Avenue, Portland, OR 97204; 800-648-6893; www.LPcorp.com (Smart Lap™, Smart Panel™, and EZ Panel™ siding).

PLYWOOD PANEL SIDING

ESSENTIAL KNOWLEDGE

Plywood panel siding has been a popular material, especially in the Northwest, North Central, and Northeastern states, since the early 1950s. Its use has declined in the last decade, however. Further market erosion is expected in the next decade as other siding products, such as vinyl siding and fiber cement, continue to increase in popularity.

As a material, plywood panel siding has changed very little in terms of specifications or product configuration, except that a variety of special veneer facings is now available that increases paintability and extends the life of the siding. Some of these products include Simpson Forest Products' Guardian™ siding made with a medium density overlaid resin-impregnated craft paper; Roseburg Forest Products' Breckenridge Siding™ made with "okoume" hardwood surface overlay imported from New Zealand; and Stimson Lumber Company's Duratemp™ made with a hardboard surface overlay. As an alternative to special surface overlays, many manufacturers offer preprimed plywood siding, although the great majority of siding is still sold as unprimed.

TECHNIQUES, MATERIALS, TOOLS

1. REPAIR EXISTING PLYWOOD SIDING.

Sections of damaged or deteriorated plywood panels can be cut out and repaired with conventional carpentry tools if there is sheathing below, but the most typical repair would be to replace the individual panel. **ADVANTAGES:** Most economical repair.

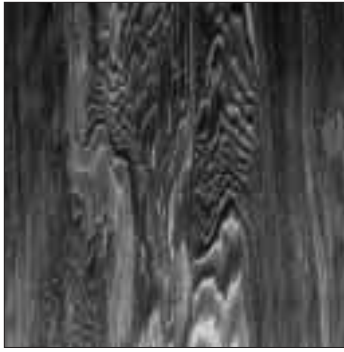
DISADVANTAGES: Repair of individual panels is often not practical, especially if panel is fastened directly to structure.

2. REPLACE EXISTING SIDING WITH NEW PLYWOOD PANEL SIDING.

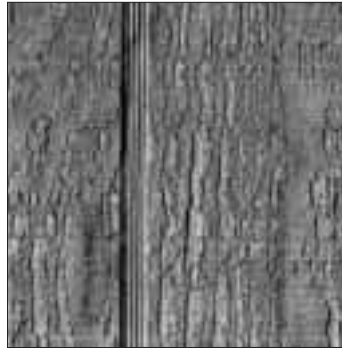
Made from Douglas fir or (increasingly) Southern pine veneers, plywood siding is available in 4 by 8, 4 by 9, and 4 by 10 panels in varying thicknesses, including $\frac{11}{32}$, $\frac{15}{32}$, and $\frac{19}{32}$ inches. Panels are available smooth faced or textured, grooved or ungrooved, square or shiplap edged. Siding patterns include channel-grooved, brushed, overlaid, Texture 1-11, reverse board-and-batten, rough sawn, and kerfed rough sawn (Fig. 1). Battens can be applied for a board-and-batten appearance. Depending on the depth of the grooves, the panels are designed to be attached directly to framing members 16 or 24 inches o.c., or over existing flat siding, insulating or solid sheathing, or furring strips against masonry or uneven walls. Plywood siding must be primed and finish painted or stained within 30 days of installation. Unless properly maintained, the surface ply will degrade due to UV and weathering effects and will become brittle, cracked, and eroded.

ADVANTAGES: Long history of successful applications. Can be applied directly to studs without sheathing. Can provide shear resistance. Easily worked and erected with conventional tools. One panel covers a large surface area. Dimensionally stable. Available in a variety of textures and styles. Products with special overlaps have surfaces that, after painting, will not split, check, or crack. Limited 25-year warranties are available.

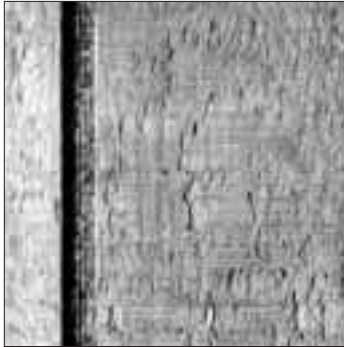
DISADVANTAGES: Vertical grooves impart a distinctive, "contemporary" appearance that may not be suitable given the existing design of the house to be rehabed. Use is generally confined to Northern regions



BRUSHED



CHANNEL GROOVE



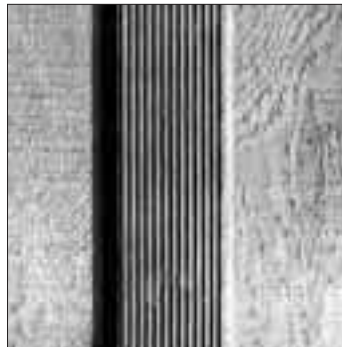
TEXTURE 1-11



LAP SIDING



SMOOTH OVERLAID T1-11



REVERSE BOARD-AND-BATTEN



KERFED



OVERLAID T1-11

PLYWOOD PANEL TEXTURES

FIGURE 1

of the U.S. Conventional plywood without overlays requires careful attention to initial painting/staining recommendations. Combustible. Requires on-going maintenance.

FURTHER READING

303 Siding Manufacturing Specifications, APA Engineered Wood Association, March 1997.

Performance Rated Siding, APA Engineered Wood Association, April 1996.

Residential Design and Construction Guide, APA Engineered Wood Association, April 1996.

PRODUCT INFORMATION

Breckenridge Siding™: Roseburg Forest Products, P.O. Box 1088, Roseburg, OR 97420; 800-859-6998.

Champion International Corporation, One Champion Plaza, Stamford, CT 06921; 800-874-3240.

Duratemp Plywood Siding™: Stimson Lumber Company, 520 Southwest Yamhill, Suite 325, Portland, OR 97204; 800-445-9758.

Georgia-Pacific Corporation, P.O. Box 105605, Atlanta, GA 30348-5605; 800-284-5347.

Guardian Siding™: Simpson Timber Company, Third and Frankline, Shelton, WA 98584; 800-782-9378.

Louisiana-Pacific, 111 Southwest Fifth Avenue, Portland, OR 97204; 800-231-1292.

U.S. Forest Industries, Inc., P.O. Box 820, Medford, OR 97501; 800-541-6906.

FIBER-CEMENT SIDING

ESSENTIAL KNOWLEDGE

Fiber-cement siding, in its present form, is a relative newcomer to the U.S. homebuilding market, having been introduced in the late 1980s. Asbestos-cement siding, an earlier incarnation of the material, had been used extensively in the U.S., as well as in Europe, throughout the 20th century. The use of asbestos in the U.S. was discontinued in the 1970s. Currently fiber-cement siding products are composed of Portland cement, sand, clay (in some products), and specially treated wood. Today's products are thicker, less brittle, and easier to cut and work with than asbestos materials. They are also available in a wider variety of products such as backer board, lap siding, panel siding, trim, soffits, and fascias.

Fiber-cement siding has generated a great deal of interest among builders and homeowners because of its strength and impact, rot, and fire resistance. Expectations are that the use of fiber-cement products and the development of new product types, such as fiber-cement shingle siding, will increase dramatically in the next several years.

Fiber-cement siding can be cut and drilled with conventional wood-working tools (although some installers use diamond-tipped masonry blades for cutting) or scored with special shearing tools and broken much like paper-faced drywall. Fiber-cement panels are available either preprimed or unpainted, depending on the individual manufacturer. Paint adheres very well to the material's slightly textured and porous surface. The material itself is not affected by intermittent wetting, but it will discolor and stain unless painted.

TECHNIQUES, MATERIALS, TOOLS

1. REPAIR EXISTING FIBER-CEMENT SIDING.

Dented, cracked, or otherwise distressed siding can be repaired with the use of a latex-modified cementitious patching compound available from fiber-cement manufacturers or from specialty product manufacturers (see Product Information). Damaged sections can be cut out with hand or power saws and new sections installed as necessary. Joints between new and old materials should be primed and caulked.

ADVANTAGES: Can be repaired in much the same manner as solid wood siding.

DISADVANTAGES: Some of the wood grain and stucco patterns have changed somewhat. Adjoining new and old sections may not match exactly.

2. REPLACE EXISTING SIDING WITH FIBER-CEMENT LAP SIDING.

Fiber-cement lap siding is typically available in a variety of textures, widths from 6 to 12 inches, lengths up to 12 feet, and in thicknesses between $\frac{5}{16}$ and $\frac{7}{16}$ inches (Fig. 1). It can be installed directly to studs with a suitable weather barrier such as housewrap or building paper, or over solid or insulating sheathing, existing solid wood siding, or furring strips applied to uneven walls or existing masonry surfaces. Fiber-cement lap siding can be used with conventional wood, fiber-cement, hardboard, or vinyl trim. Lap siding is fastened by means of stainless or galvanized steel nails, or by means of screws with corrosion-resistant coatings. Staples are not recommended. Refer to individual manufacturer's installation manuals for specific recommendations.

ADVANTAGES: Smooth lap siding is close to wood in appearance when painted. Performs well in high-humidity environments; will not rot; termite resistant; non-combustible; good impact resistance; can be



SMOOTH FINISH



TEXTURED



SMOOTH BEADED LAP



TEXTURED BEADED LAP



COLONIAL SMOOTH



COLONIAL ROUGHSAWN

LAP SIDING TEXTURES

FIGURE 1

painted or stained. Up to 50-year limited product warranty against manufacturing defects.

DISADVANTAGES: Wood grain is somewhat more pronounced than rough-sawn cedar. Surface texture can be distracting in appearance at joints where grain does not align. Requires periodic painting and caulking, although requires less frequent painting than wood. Variety of siding patterns is less than with other



SMOOTH FINISH



STUCCO FINISH



CEDAR TEXTURE WITH $\frac{5}{8}$ - INCH GROOVES, 8-INCH ON-CENTER



CEDAR TEXTURE WITH MOLDED GROOVES AT 4-INCH INTERVALS

FIGURE 2

PANEL SIDING TEXTURES

siding materials. Heavier than wood. Cutting of material with saws produces silica dust. Brittleness of material results in significant wear on tools.

3. REPLACE EXISTING SIDING WITH FIBER-CEMENT PANEL SIDING.

Fiber-cement panels are typically 4 by 8, 4 by 9, and 4 by 10, and typically in $\frac{5}{16}$ -inch thickness. A variety of textures is available, depending on the manufacturer (Fig. 2). Installed vertically to studs directly, the panels can act as shear wall bracing. They can also be installed over solid sheathing, existing flush solid wood siding, or over furring strips against masonry or uneven walls. If required by code, a weather barrier must be installed. Corrosion-resistant nails or screws may be used. Staples are not recommended. Joints should fall on structural framing members and are typically caulked or covered with a batten strip. Horizontal joints are flashed with metal Z flashing.

Horizontal joints are flashed with metal Z flashing.

ADVANTAGES: Installs quickly, covering a large area; performs well in high-humidity environments. Can provide shear bracing. Termite resistant, noncombustible, good impact resistance. Can be painted or stained; up to 50-year limited product warranty against manufacturing defects.

DISADVANTAGES: Textures do not accurately reflect materials they simulate. Heavier and more brittle than most siding materials. Material requires special tools to cut and install; requires periodic painting and caulking. Cutting of material with saws produces silica dust. Variety of panel patterns and textures is less than other types of panel materials.

FURTHER READING

“On Site with Fiber-Cement Siding,” David Frane, *Journal of Light Construction*, January 1998.

PRODUCT INFORMATION

FIBER-CEMENT MANUFACTURERS

ABTco., 10115 Kinsey Ave., Suite 150, Huntersville, NC 28075; 800-566-2282; www.abtco.com (lap and panel siding).

FCP™, Inc. (successor sales arm of Eternit, Inc.), Excelsior Industrial Park, P.O. Box 99, Blandon, PA 19510-0099; 888-327-0723 (Cemplank™ smooth, rough-sawn, and wood grain lap siding; Cempanel™ smooth, stucco, and wood grain vertical siding panel).

James Hardie Building Products, Inc., 26300 La Alameda, Suite 250, Mission Viejo, CA 92691; 800-9-HARDIE; www.jameshardie.com (Hardiplank™ smooth, rough sawn, and wood grain lap siding; Hardipanel™ smooth, stucco, wood grain vertical siding panels; Shingleside™ fiber-cement shingle; Hardisoffit™, Harditrim™).

Maxitile, Inc., 17141 S. Kingview Ave., Larson, CA 90746; 800-338-8453 (MaxiPlank™ smooth and wood grain lap siding; MaxiPanel™ smooth, wood grain, V-groove, stucco panels; MaxiTrim™).

Temple-Inland Forest Products Corp., Inc., P.O. Drawer N, 303 Temple Dr., Diboll, TX 75941; 800-231-6060.

CUTTING TOOLS

Pacific International Tool & Shear, P.O. Box 1604, Kingston, WA 98346; 800-297-7487.

PATCHING PRODUCTS

Macklanberg Duncan™, 4041 North Santa Fe, Oklahoma City, OK 73118; 800-654-8454.

VINYL TRIM AND VENT ACCESSORIES

Tamlyn and Sons, 10406 Cash Road, Houston, TX 77477; 800-334-1676.

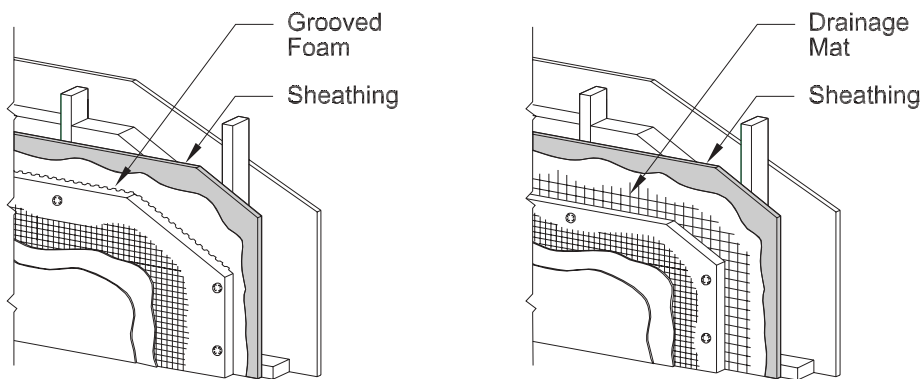
EXTERIOR INSULATION AND FINISH SYSTEMS

ESSENTIAL KNOWLEDGE

Developed in Europe in the 1950s, and introduced into the U.S. by Dryvit Systems, Inc. in the early 1970s, exterior insulation and finish systems (EIFS), which are sometimes called synthetic stucco systems, have largely replaced conventional three-coat Portland cements stucco systems. The industry's association, the EIFS Industry Members Association (EIMA) estimates that EIFS currently account for about 3.5 percent of the residential wall market in the U.S.

The system's attributes include the benefits of insulation outside the structure (a significant thermal break advantage); reduced air infiltration due to the monolithic nature of the finished membrane; and great design flexibility. While many of the thousands of buildings clad with EIFS have had few, if any, problems, poor EIFS performance has been documented on individual projects on an ongoing basis, particularly in climates with severe temperature swings and high moisture levels. Most recently, attention has focused on large-scale repairs to houses in Wilmington, N.C., following the discovery that moisture had entered the EIFS barrier cladding systems through the juncture between EIFS and windows or doors, at deck terminations, at roof/wall connections, and at window sills. In the absence of drainageways, moisture trapped behind the EIFS cladding caused deterioration of the substrate. The adverse publicity and class-action lawsuits that followed have led to a curtailment in the use of barrier EIFS systems in some states, although not nationally.

Concern about the use of EIFS among the public, the insurance industry, building officials, and manufacturers has also led to the development and promotion of new EIFS products that incorporate drainageways and moisture barrier membranes behind the insulation boards that allow infiltrating water to drain out (Fig. 1). The EIFS industry remains fragmented (EIMA represents only 8 of the 30 to 40 EIFS manufacturers, although its members produce an estimated 85 to 90 percent of the systems sold) and EIFS installation systems and details vary among manufacturers. However, American Society for Testing Materials (ASTM) has developed recommended installation details and specifications that are part of a new ASTM standard (ASTM C1397) for barrier type systems. Water managed systems have yet to be addressed by ASTM. EIMA is working with the National Association of Home Builders (NAHB) Research Center to develop a third-party applicator certification program.



GROOVED INSULATION BOARD

DRAINAGE LATH/MAT

TECHNIQUES, MATERIALS, TOOLS

There are two major classifications of EIFS: barrier systems (which depend on the integrity of the EIFS surface, flashing, and sealants to prevent entry of water), and drainage systems (which employ a variety of drainage techniques to allow moisture, that may have entered, to exit the system).

1. REPAIR EXISTING EIFS.

The repair of small damaged areas of EIFS, where the substrate is sound, is relatively simple. The affected area is cut out and the system is rebuilt in much the same way as it was originally installed. If the damage was caused by water infiltration from deficient flashing, the flashing should be repaired or replaced before corrective work begins. If the sealant has failed it should be removed and replaced or covered with caulking products designed for this remedial work. Dow Corning, among other manufacturers, has developed a variety of restoration recommendations and remedial products, including a preformed silicone extrusion (Dow Corning 123 silicone seal – Fig. 2) that is designed to span failed sealant joints and weatherseals at the perimeter of windows and other wall penetrations (see Further Reading). If the deterioration due to faulty installation or water entry is extensive, the EIFS may have to be removed in its entirety and, in some cases, the sheathing, trim, windows, and structure as well.

ADVANTAGES: Repairs are simple and work well on small damaged areas where significant water penetration and substrate deterioration has not occurred.

DISADVANTAGES: Serious water entry problems can require extensive removal and rebuilding work. Repaired areas will probably not match the color of adjacent existing areas and may require a new color coat.

2. INSTALL AN EIFS BARRIER SYSTEM.

Barrier systems have been the basic industry standard until recently, and EIMA and many manufacturers maintain that when properly detailed and installed they will perform satisfactorily. Some manufacturers, however, disagree. U.S. Gypsum offers only draining, water-managed systems and Senergy, Inc. will not authorize the installation of barrier systems on wood frame construction (all manufacturers agree that barrier systems work over masonry block or concrete substrates that are relatively unaffected by mois-

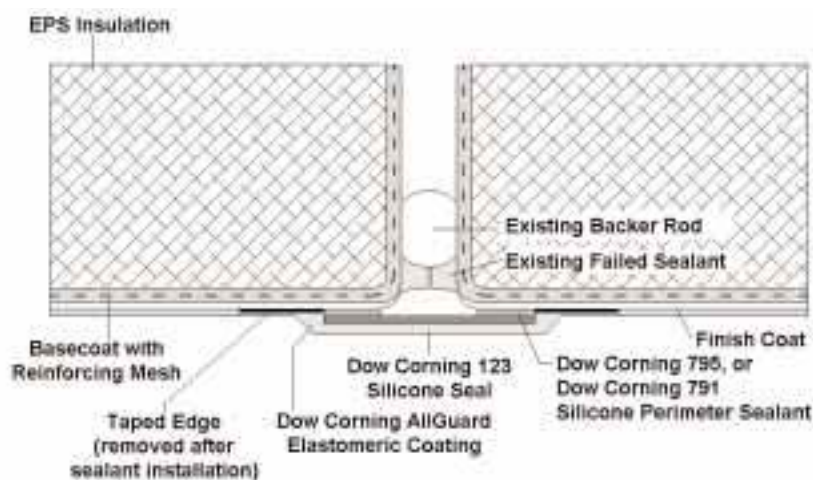


FIGURE 2

SILICONE SEAL

ture). EIFS typically consist of insulation board made of polystyrene (usually expanded) or polyisocyanurate foam, which is secured to the exterior wall surface (usually DensGlass Gold[®], plywood, OSB, or fiber-cement board) with a specially formulated adhesive or with mechanical fasteners. The foam provides insulation and allows the coating to flex during temperature swings. Some manufacturers provide EIFS without

the insulation for installation over masonry or directly to sheathing when insulation is not required (Fig. 3). A water-resistant base coat is applied to the top of the insulation and reinforced with glass-fiber mesh for added strength. A final coat, typically acrylic, similar to a thickened acrylic paint with a fine aggregate, is applied as the finish surface. Some manufacturers provide elastomeric coatings, which are softer and more flexible than the coatings typically used.

ADVANTAGES: More effective than (although often used in conjunction with) comparable between-the-studs insulation, especially over metal studs. Provides an important thermal break. Reduces air infiltration (EIMA claims up to a 55 percent reduction over standard masonry or wood construction). Provides attractive exteriors and design flexibility through a wide variety of colors and textures. Can be fashioned into a variety of shapes and sizes to produce decorative details such as cornices, quoins, keystones, arches, columns, reveals, shadow lines, special moldings, etc. Relatively easy to clean and repair small areas.

DISADVANTAGES: Proper detailing and choice of an experienced applicator is critical. Some manufacturers have significantly less experience than others and have more limited technical support staff. Some manufacturers have model code research reports, others do not. Many residential contractors do not have the skills and experience of commercial applicators. The specification control and inspection, typical with commercial work, is frequently absent on residential projects. Warranties vary considerably and should be studied and compared carefully. Insurance and code agencies may not allow barrier systems without certification by design professionals as to their proper detailing. Some states, such as North Carolina, and model codes (UBC) do not allow the use of barrier systems with wood-frame construction. The use of barrier systems should be carefully monitored on a case-by-case basis, as the codes are changing. Extreme heat, dryness, cold (especially freeze-thaw), and moisture conditions affect the system's performance. Proper flashing, high-performance sealants, and weather barriers are essential to good performance, but sealants should not be relied upon in the absence of other weather barriers. Requires careful selection of windows and flashing detailing to assure wall integrity is not compromised by water weeping into the wall cavity at sill and sill/jamb interface. Termites and carpenter ants can tunnel into foam plastic and use it as a habitat.

3. INSTALL AN EIFS MOISTURE DRAINAGE SYSTEM.

Moisture drainage systems, also called water-managed or rain-screen systems, have been used in commercial applications since the early 1990s, and are currently becoming the system of choice for housing among architects, designers, builders, and code officials. They are similar to barrier systems except that

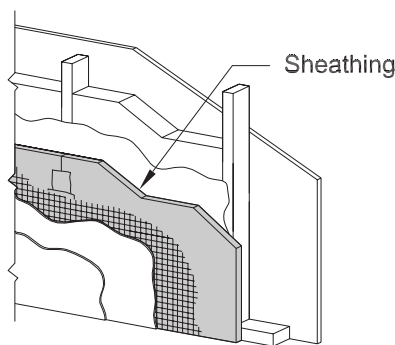


FIGURE 3

EIFS WITHOUT INSULATION

they employ a drainageway behind the insulation either in the form of vertical grooves cut in the insulation board, vertical furring strips, or a woven fabric drainage mat or other drainage system (Fig. 1). Proper flashings, weather barriers, and sealant details remain critical as water should still be kept out of the system. EIFS systems should stop well above grade to restrict insect access and allow for inspection.

ADVANTAGES: All the advantages of barrier EIFS with the additional protection of drainageways to evacuate

moisture from the system. Perceived by most builders, architects, and designers as an improved system. Recommended or required by increasing numbers of insurance companies and code agencies.

DISADVANTAGES: Generally require mechanical fastening of the foam insulation board, which is more labor intensive than adhesive applications. Require more attention and cost for secondary weather barriers and accessories. Require careful attention to system details, including housewrap overlaps to avoid the channeling of moisture behind these weather barriers, particularly at windows, doors, and other openings. Termites and carpenter ants can tunnel into foam plastic backing and use it as a habitat. There has been limited testing and performance data on the various drainage systems employed. Some building researchers and experts remain unconvinced that this system solves all the performance problems with barrier systems.

FURTHER READING

EIFS Design Handbook, CMD Associates, 1800 Westlake Avenue North, Suite 203, Seattle, WA 98109; 206-285-6811; www.eifs.com/aboutcmd.htm.

EIFS New Construction Inspection Manual, CMD Associates, 1800 Westlake Avenue North, Suite 203, Seattle, WA 98109; 206-285-6811; www.eifs.com/aboutcmd.htm.

EIFS Restoration Guide, Dow Corning #62-510B096; 517-496-6000.

"EIFS Wall Weathers 75-mph Wet Spray Test with No Sealers," *Energy Design Update*, October 1998, pp. 10-12.

"Housewraps vs. Felt," Paul Fiset, *Journal of Light Construction*, November 1998.

Installation Checklist, Exterior Insulation Manufacturer's Association (EIMA), 3000 Corporate Center Drive, Suite 270, Morrow, GA 30260; 800-294-3462; www.eifsfacts.com.

"Installing Water-Managed Synthetic Stucco," Russ Minkovich, *Journal of Light Construction*, September 1998.

"Sill Sentry Designed to Treat Leaking Windows," *Energy Design Update*, June 1998, pp. 12-13.

"Synthetic Stucco," Steven Culpepper, *Fine Homebuilding*, October/November 1996.

PRODUCT INFORMATION

EIFS Industry Members Association (EIMA), 3000 Corporate Center Drive, Suite 270, Morrow, GA 30260; 800-294-3462; www.eifsfacts.com.

Dow Corning Corporation, Midland, Michigan 48686-0994; 517-496-6000; www.dowcorning.com.

Dryvit Energy Systems, Inc., One Energy Way, P.O. Box 1014, West Warwick, RI 02893; 800-556-7752; www.dryvit.com.

Finestone (Simplex Products Div.), 1149 Treat Street, Adrian, MI 49221-0010; 517-263-8881.

Omega Products Corp., P.O. Box 1889, Orange, CA 92668; 714-935-0900; www.omega-products.com.

Parex, Inc., P.O. Box 189, Redan, GA 30074; 800-537-2739; www.parex.com.

Pleko Systems International, Inc., P.O. Box 98360, Tacoma, WA 98498; 206-472-9637; www.pleko.com.

Retro Tek, 4987 County Highway North, Sun Prairie, WI 53590; 800-225-9001.

Senergy Division of HSC, 10245 Centurion Parkway North, Jacksonville, FL 32256; 904-996-6000.

Stuc-o-Flex International, Inc., 17639 Northeast 67th Court, Redmond, WA 98052; 800-305-1045.

TEC Incorporated, 315 South Hicks Road, Palatine, IL 60067; 847-358-9500.

Universal Polymers, Inc., 319 North Main Street, Springfield, MO 65804; 800-752-5403.

US Gypsum Company, 125 South Franklin Street, Chicago, IL 60606; 800-USG-4YOU; www.usg.com.

W.R. Bonsal Co., 8201 Arrowridge Blvd., Charlotte, NC 28273; 800-334-0784; www.bonsal.com.

15.2 STUCCO

ESSENTIAL KNOWLEDGE

Portland cement stucco is a traditional finish material that has been in use in North America for over 300 years. Currently installed as a three-coat system (scratch, brown, and color coat) it is sometimes abbreviated to a two-coat system, particularly over masonry.

TECHNIQUES, MATERIALS, TOOLS

1. PATCH EXISTING STUCCO.

Hairline cracks are very difficult to patch without making the repair more noticeable than the defect. Some installers recommend “dusting” with stucco. Cracks between $\frac{1}{8}$ to $\frac{1}{4}$ inch can be repaired by scraping out the topcoats to expose scratch coat. An acrylic bonding agent can be used to help bond the repair coats. On even larger cracks or holes, a self-adhesive fiberglass mesh can be used to strengthen the repair. Some large holes will require the repair of the building paper behind the wire mesh. For recoloring old stucco a “fog” coat of cement, color pigment, and lime, but no sand, is sometimes used. Acrylic additives increase ease of application and cover. Elastomeric coatings can also be used to seal and recolor old stucco.

ADVANTAGES: Stucco repair is relatively easy and cost-effective.

DISADVANTAGES: If large areas are affected, removal may be more practical.

2. INSTALL A STUCCO EXTERIOR WALL FINISH.

Stucco is installed in the Northeastern and North Central states over gypsum sheathing using dimple or expanded metal diamond lath that holds the plaster away from the sheathing allowing for better cement bond, expansion and contraction with temperature changes, and for the creation of a drainageway. Over masonry substrates, stucco is typically applied directly to the substrate without lath. In hotter climates in the South and Southwest, stucco is often installed over paper-backed lath without sheathing material. This requires adequate bracing of the walls to prevent shear cracks. Stucco can be colored and scored to appear like brick, stone, and other materials.

ADVANTAGES: A proven material that stands up well to moisture in cold climates; can have integral color or can be coated with elastomeric coatings. Can have a variety of finishes. Easily repaired.

DISADVANTAGES: Requires experienced applicators. Requires fogging to prevent excessive fast curing and hairline cracking. Integral color can fade, especially if a dark color is chosen. Can be stained at grade by rain-splattered earth. Requires reinforcement at all openings and periodic expansion joints. Stucco is a poor insulator.

FURTHER READING

Oriental Stucco, U.S. Gypsum Co., P682, April 1993.

Portland Cement Plaster Stucco Manual, Portland Cement Association, No. EB049, 1996.

“Patching Stucco,” Ron Webber, *Journal of Light Construction*, September 1997.

ESSENTIAL KNOWLEDGE

Trim has always been an important element in the appearance of houses, as well as a key weather and waterproofing component. As a finishing element around doors, windows, porches, roof edges, at corners, and at other building features, trim provides a decorative element and scale. There is a wide variety of material available for use as trim other than traditional solid wood, such as laminated wood lumber, engineered wood, wood/thermoplastic composites, fiber cement, and polymers. These new materials have the appearance of wood trim but promise longer service life. The major threats to trim are ultraviolet radiation, water damage, snow and ice, mold, rot, and insect infestation (all except ultraviolet (UV) related to moisture). Materials should be selected, detailed, and installed to limit the effects of exposure.

TECHNIQUES, MATERIALS, TOOLS**1. REPAIR EXISTING WOOD TRIM WITH EPOXY FILLER.**

The decision whether to repair or replace the existing trim will depend on its condition, and whether the building is historically significant (if so, follow the U.S. National Park Services' *Guidelines for Rehabilitating Historic Buildings* referenced in Further Reading). Before repair or replacement, the conditions that caused damage to the trim should be corrected, if possible, and the decision to repair or replace can then be addressed. Most wood, even if it is seriously decayed, can be reconstituted by means of liquid epoxy consolidants that impregnate the wood fibers and harden into a mass that can be sawn, planed, drilled, nailed, sanded, glued, and painted. Most of these epoxy materials have weatherability as good as or better than wood, and work well at sills, thresholds, and other parts of the building that cannot be easily replaced. Epoxy putties are also available that work in conjunction with liquid epoxy to rebuild missing sections of decorative features and trim (Fig. 1).

ADVANTAGES: Restoration of damaged trim material may be less disruptive and less expensive than replacement. Helps maintain historical integrity of trim.

DISADVANTAGES: Requires careful application. May not be cost-effective for average rehabilitation project. May not be practicable if deterioration is extensive.



FIGURE 1

USE OF EPOXY PUTTY TO REBUILD TRIM**2. INSTALL NEW TRIM.**

If a building's trim has deteriorated to the extent that it is unsightly or does not function as intended, and if epoxy consolidation is not cost-effective, the trim and any deteriorated substrate should be removed and replaced. If deterioration was caused by a lack of flashing (especially window or door heads), sealants or

poor detailing, those deficiencies should be corrected or the condition will be repeated. The choice of trim material has expanded considerably beyond that of solid wood. Trim options include:

■ **SOLID WOOD:**

For trim and fascias, solid wood is still the favorite material in many parts of the country due to its ease of application and general availability. Wood species include white and (to a lesser extent) southern yellow pine, imported pine species, and locally available fir including Douglas fir and Hem-fir. Heartwood grades of Western red cedar and redwood are more expensive, but considered more dimensionally stable and resistant to decay because of their natural extractives. Cedar often comes rough-sawn. Redwood is available in wide boards and is often used for fascias. Clear, vertical grain, all-heart wood material takes paint better, is more stable, and lasts longer than other grades. Finger-jointed trim is increasingly used and is available in larger sizes because it is comprised of glued sections of material. Back priming of all solid wood trim is recommended to protect it from moisture and to keep it from warping. Finished sides are best protected with two coats of paint or stain.

■ **LAMINATED VENEER LUMBER (LVL):**

At least one company, South Coast Lumber, makes LVL trim products. Its ClearLam™ product is made of Douglas fir core veneers and older face veneers glued together with phenolic adhesives and sprayed with a preservative to protect the trim in the field. The face is overlaid with a phenolic-based medium density overlay (MDO) sheet that eliminates face checking and serves as an excellent substrate for paint. All edges are fully coated with an elastomeric edge coating and primer. Easy to cut, nail, and install, ClearLam™ can be used for fascia, corner boards, and window and door trim, dimensionally stable without knots, checks, or cracks.

■ **ENGINEERED WOOD TRIM**

Engineered trim is a composite of wood fibers and resins. It resembles hardwood, but has added waxes, resins, and oils to give it better weather resistance. Engineered wood can be used for corner boards, fascias, rake boards, soffits, and door and window trim. A relatively inexpensive, uniform, consistent product, smoother and straighter than regular wood.

■ **WOOD/THERMOPLASTIC TRIM**

Wood/thermoplastic trim is a relatively new composite product made from thermoplastic resins and wood fiber. This material is exceptionally durable and is becoming popular for exterior decking applications and as window sills and door jambs. Several companies make limited sizes of flat stock for trim and extruded brickmold.

■ **FIBER-CEMENT TRIM**

Fiber-cement trim is available from manufacturers of fiber-cement siding products and is generally used in conjunction with those materials, although it need not be. Used as fascias, rake boards, corner boards, soffits, and window and door trim. Available in smooth and wood grain finishes, primed or unprimed. This material takes paint well and is available with a 50-year warranty against warping, cracking, and delamination.

■ **POLYMER TRIM**

Polymer trim, made from high density polyurethane, is cost effective in replicating the appearance of heavily decorative trim elements such as columns, railings, balusters, brackets, trellises, pediments, shutters, etc.

FURTHER READING

“Alternatives to Solid Wood Exterior Trim,” Paul Fiset, Building Materials and Wood Technology Program, University of Massachusetts at Amherst, www.umass.edu/bmatwt/index.html.

The Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings, Washington: US Dept. of the Interior, National Park Service Preservation Assistance Division, 1990.

PRODUCT INFORMATION

RESTORATION PRODUCTS

Abatron, Inc., 5501 95th Avenue, Kenosha, WI 53144; 800-445-1754.

Conservation Services, 8 Lakeside Trail, Kinnelon, NJ 07045; 973-838-6412.

Gougeon Bros., Inc., P.O. Box 908, Bay City, MI 48707; 517-684-7286.

Preservation Resource Group, P.O. Box 1768, Rockville, MD 20849-1768; 301-309-2222; www.prginc.com.

LAMINATED VENEER LUMBER

South Coast Lumber Co., 815 Railroad Ave., P.O. Box 670, Brookings, OR 97415; 541-469-4177.

ENGINEERED WOOD

SmartTrim™, Louisiana-Pacific Corp., 1 East First Street, Duluth, MN 55802; 800-648-6893; www.lpcorp.com.

Prime Trim™, Georgia Pacific Corp., 133 Peachtree Street, NE, Atlanta, GA 30303; 404-652-4000.

Trim Craft™, Temple Inland Forest Products, P.O. Box N, Biboll, TX 75941; 800-231-6060; www.temple.com/tpgl.html.

Protrim™, ABT Co., 10115 Kencei Avenue, Suite 150, Halesville, NC 28078; 800-927-3146; www.altco.com/trim.htm.

Forestrim™, Forestex, P.O. Box 68, Forest Grove, OR 97116; 503-357-2131.

American Hardboard Association, 520 North Hicks Rd., Palatine, IL 60067; 312-934-8800.

WOOD/THERMOPLASTIC COMPOSITE

Durawood PE, The Eaglebrook Companies, 2600 West Roosevelt Rd., Chicago, IL 60608; 312-491-2500.

FrameSaver™, BMS, P.O. Box 631247, 1124 Bennet Clark Rd., Nacogdoches, TX 75963; 409-569-8211.

Crane Plastics Co., P.O. Box 1047, Columbus, OH 43216; 800-366-8472.

FIBER CEMENT

Cem-Trim™, FLP Inc., Excelsior Industrial Park, P.O. Box 99, Blandon, PA 19510-0099; 888-327-0723; www.flpinc.com.

Harditrim™, James Hardie Building Products, 26300 Los Alameda, Suite 250, Mission Viejo, CA 92691; 888-J-HARDIE; www.jameshardie.com.

Maxitrim™, Maxitile, Inc., 17141 South Kingview Avenue, Lason, CA 90746; 310-217-0316; www.maxitile.com.

Temple Inland Forest Products, P.O. Box N, Biboll, TX 75941; 800-231-6060; www.temple.com.

POLYMER

Fypon, 22 West Pennsylvania Avenue, Stewartstown, PA 17363; 800-537-5349.

Outwater Plaster Industries, P.O. Box 347, Woodridge, NJ 07075; 800-835-4400; www.outwater.com.

Style-Mark, Inc., 960 West Barre Road, Archibold, OH 43502; 800-446-3040; www.style-mark.com.

SEALANTS & CAULKS

ESSENTIAL KNOWLEDGE

Sealants and caulks are the first line of defense, serving as a barrier to both water and air infiltration. However, not all joints are meant to be caulked; some provide an exit for air or moisture trapped within the wall assembly. In low-rise residential structures sealants and (to a lesser extent) caulks are used as elements of a weather barrier system that includes the exterior finish material, drainage planes (building paper or housewrap), ice and weathershield membranes, and flashing. Sealants and caulks are typically used at expansion joints, joints between dissimilar materials, joints at window and door openings, at the juncture of siding and trim, and at flashing. Several factors should be considered in order to achieve satisfactory performance of both sealants and caulks.

■ **Material Selection:** Materials must have the proper physical characteristics for the specific application, including elasticity (the ability of a sealant to return to its original profile), elongation (the ability of a sealant to stretch, as expressed as a positive or negative percentage), adhesion (bonding between the sealant and adjacent materials), durability, paintability, and compatibility with substrate and adjacent materials.

■ **Weatherability:** Sealants vary with respect to weathering characteristics. Indications of weathering include hardening of the material, chalking or discoloration, alligatoring, wrinkling, bubbling, sagging, erosion, or softening of the sealant surface. Sealants and caulks showing these characteristics should be replaced.

■ **Joint Design:** Sealant manufacturers recommend that sealants should adhere to only two surfaces by use of polyethylene backer rods or bond breaker tape. Three-surface adhesion will lead to cohesive failure (tearing). Narrow (less than $\frac{3}{8}$ inch) or excessively deep sealant joints, that exceed a depth to width ratio of 1 to 2, may not allow for the proper compression, elongation, or adhesion of sealants. Small joints prove to be the most difficult to seal because the smallest movement can represent a significant percentage of expansion. Interior applications typically do not require nearly the same degree of elongation because the temperature is maintained within a narrow range.

■ **Installation:** The leading cause of sealant failure is improper installation, elements of which include improper priming or cleaning of the substrate; installation over incompatible coatings, materials, or contaminants (including existing sealants and lubricants); installation during periods of excessive cold or heat, rain, or dampness. Such failures are prime reasons for replacement of sealants and caulks in rehab work.

The distinction between caulk and sealant, terms often used interchangeably, is essentially the ability to conform to movement. Caulk typically provides for less movement but is easier to work and is used for interior applications, while a sealant is used for exterior purposes. Caulking usually refers to latex sealing compounds that meet ASTM C 834 *Standard Specification for Latex Sealing Compounds* while sealants usually refer to ASTM C 920 *Standard Specifications for Elastomeric Joint Compounds*.

Manufacturers' instructions and technical assistance should be closely followed. The selection of caulk should be guided by knowledge of the materials that are to be adhered and the material properties that are most critical, such as elongation, durability or ease of installation.

Sealants are continuously evolving with new formulations for lower cost, ease of installation, adherence, flexibility, and durability. Newer formulations have allowed greater range of uses, but no one product is ideal in all these respects. It is estimated that there are over 300 sealant manufacturers. Some make their own sealants while others sell sealants manufactured by others under their "private label." Among the most common types are:

- Latex and oil-based sealants, generally referred to as caulks with low flexibility and relatively poor durability, are low cost and easy to work, suitable for interior applications not exposed to prolonged moisture.
- Acrylic latex, sometimes referred to as rubberized latex, is a more durable and elastic variation suitable for interior and exterior applications. Small amounts of silicone emulsions are frequently added to enhance performance somewhat.
- Butyl rubber is commonly employed in insulated window assemblies and between layers of metal flashings because of its good adhesion qualities, ability to resist water and temperature extremes, and because it remains tacky. It has only moderate flexibility and is difficult to install.
- Kraton, a primer-less, solvent-based, synthetic rubber that has become popular as a general purpose sealant that adheres to most common substrates. Because it is solvent-based, it may shrink slightly.
- Silicone, used extensively in curtain wall, exterior insulation and finish systems (EIFS), and glazing applications. It is the most elastic and durable sealant, but not generally paintable. It is difficult to remove, and not suitable for porous materials in some formulations. Minimal shrinkage.
- Polyurethanes have excellent movement and durability characteristics, but the flexibility degrades over time, particularly in direct sunlight, and they are difficult to apply and clean-up.

TABLE 1

TYPES OF CAULKING MATERIALS

BASE TYPE	RETAIL \$ (per 10 oz)	EST. LIFE (years)	USES	CLEAN UP
Oil	1-2	1-3	Most dry surfaces*	paint thinner
Polyvinyl acetate	1.50-2	1-3	Indoor surfaces only*	water
Styrene rubber	2-2.50	3-10	Most dry surfaces*	paint thinner
Butyl	2.50-3	4-10	Masonry and metal**	paint thinner
Acrylic latex	2-4	5-20+	Most dry surfaces*	water
Kraton	5-7.50	10-15	Most dry surfaces*	paint thinner
Polyurethane	4.50-10	15-20+	Masonry**	acetone, MEK
Silicone	4-7	20+	Glass, Aluminum* (not for masonry)	paint thinner, naphtha, toluene

* wood, drywall, aluminum; e.g., gaps in wood frames around perimeter of house, plumbing penetrations, gaps in rough openings around windows and doors, boots around supply and return HVAC grills, seal between bottom plates and subfloor.

** gaps in masonry construction.

All sealants require surface preparation and appropriate primers as directed by the manufacturer. Sealants are only able to provide for movement in two directions; if the sealant contacts a third surface it will detach from the surface with the least adhesion. Sealants typically are applied with half the width adhered to either side of the opening in an hour glass shape (Fig. 1). The width of the opening is exposed on one side and must be prevented from adhering to materials along its other side with a non-adhering surface referred to as a bond breaker or backer material. The bond breaker material also serves to shape and support the profile of the sealant and as a secondary barrier.

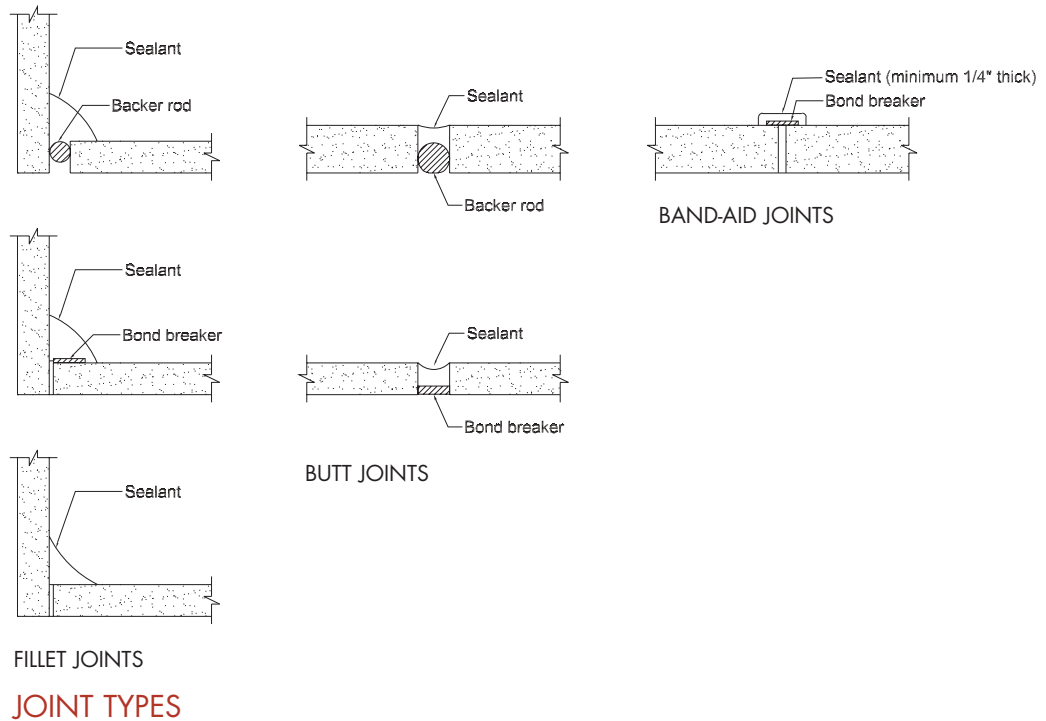


FIGURE 1

TECHNIQUES, MATERIALS, TOOLS

1. PREPARE SURFACE, REMOVE EXISTING SEALANTS

All surfaces must be sound, clean, dry, and free of frost, dirt, oil release agents, loose particles, efflorescence, old sealants, and other foreign substances that impair adhesion bond. On impervious surfaces, such as glass, metals, or paints, sealant manufacturers may recommend a commercial grade solvent cleaner such as Xyol, toluene, or alcohol, or may produce one themselves. For porous surfaces such as cement board, concrete, concrete block, old brick, and stone, joints can be cleaned by cutting, scraping, sandblasting, saw cutting, or grinding. Remaining loose dust and particles should be removed by dusting with a stiff non-metallic brush, vacuuming, or blowing with oil-free compressed air. Some sealants require a primer prior to application, some do not. Follow manufacturers recommendations.

ADVANTAGES: Proper preparation will help ensure maximum life of sealant performance.

DISADVANTAGES: Removing contaminants and old sealants, especially silicones, is time consuming and expensive.

2. INSTALL SEALANT.

Proper installation of sealant is absolutely critical to performance. The methods of preparation and installation vary among manufacturers and it is best to consult their literature for instructions. Sealants are available in essentially four types: preformed, tube, cartridge, bulk. Typically, the easier the installation

method, the lower the anticipated performance. For this reason materials available in tubes tend to be water soluble caulk materials suitable for interior repairs. Materials designed for exterior purposes, specifically windows and doors, require higher performing materials and larger quantities. These materials generally require some form of mechanical means of applying the sealant. The traditional hand-operated gun provides a relatively simple device with convenient cartridges. Larger bulk-loading guns are also available to provide for economy in the packaging of materials or when two-part sealants are to be combined on site. Applications of large amounts of sealant are ideally suited for power-assisted equipment. Traditionally this was pneumatically driven, requiring an air compressor. New equipment developed specifically for this purpose is either electrically or battery driven. With the requirements of application being so specific, these power tools and preformed materials provide for consistency of application.

ADVANTAGES: New automated tools and new materials provide for greater ease of installation and performance than ever before. The wide variety of materials is suitable for virtually any condition.

DISADVANTAGES: The improper selection of sealants has the potential of damaging or discoloring adjacent materials.

FURTHER READING

“Caulking,” Al Brendenberg, *Today's Homeowner*, www.todayshomeowner.com/todayarticles/paint/04.97.62.html.

“Caulking About the Weather,” Josh Garskof, *Old-House Journal*, November/December 1996.

“Caulks and Sealants,” *Fine Homebuilding*, Bruce Greenlaw, June/July 1990.

“Premature Sealant Failure,” *The Construction Specifier*, David H. Nicastro and Joseph P. Solinski, April 1997.

“Silicone Caulking Basics,” Brian Zavitz, *Fine Homebuilding*, August/September 1997.

PRODUCT INFORMATION

AC Products, 172 East La Jolla Street, Placentia, CA 94870; 800-238-4204.

AEI, 3 Shaw's Cove, P.O. Box 6003, New London, CT 06320-1777.

ChemRex/PL Adhesives & Sealants, 889 Valley Park Drive, Shakopee, MN, 55379; 800-433-9517.

DAP, 2400 Boston Street, Suite 200, Baltimore, MD 21224; 800-543-3840; www.dap.com.

Dow Corning Corporation, Midland, MI 48606-0994; 517-496-6000; www.dowcorning.com.

Franklin International, Construction Adhesives and Sealants, 2020 Brooks St., Columbus, OH 43207; 800-877-4583; www.franklini.com.

GE Silicones, 260 Hudson River Road, Waterford, NY 12188; 800-255-8886; www.ge.com.

Insta-Foam Products, Inc., 1500 Cedarwood Drive, Joliet, IL 60435; 800-800-3626.

Macco Adhesives, 925 Euclid Avenue, Cleveland, OH 44115; 800-634-0015; www.liquidnails.com.

Macklanburg-Duncan, 4041 North Santa Fe, Oklahoma City, OK 73118; 800-654-8454; www.macdunc.com.

Miracle Adhesives, TAC Intl, Air Station Industrial Park, Rockland, MA 02370; 800-503-6991.

NPC Sealants, 1208 South Eighth Avenue, P.O. 645, Maywood, IL 60153; 800-654-1042.

OSI Sealants, 7405 Production Drive, Mentor, OH, 44060; 800-321-3578; www.osisealants.com.

Polytite, 324 Ridge Avenue, Cambridge, MA 02140; 800-776-0930; www.polytite.com.

Red Devil, 2400 Vaux Hall Road, Union, NJ 07083; 800-4-A-DEVIL; www.reddevil.com.

Resource Conservation Technology, 2633 North Calvert Street, Baltimore, MD 21218; 410-366-1146. 83

PAINT & OTHER FINISHES

ESSENTIAL KNOWLEDGE

Paints, stains, and other coatings protect wood from the deteriorating effects of moisture and ultraviolet radiation. Areas exposed to the greatest amount of sun and wind-driven rain deteriorate the fastest—typically the south and west exposures, and the higher portions of the building.

The performance of paints and stains on wood and wood-based composite products (plywood, oriented strand board, laminated beams, etc.) is affected by the wide range of properties between and within wood species. Understanding the physical characteristics of various wood species contributes to appropriate paint and stain selection. Varying properties affecting the performance of finishes include:

- **Density:** High density woods (southern pine, Douglas fir, oak) tend to swell, cup, and check more than low density, “light” woods (redwood, cypress, western red cedar) causing stresses in film coatings that can lead to cracking and flaking.
- **Grain characteristics:** Vertical grain woods (western red cedar, redwood) have excellent paint-holding characteristics because of their narrow bands. Flat grained woods (southern pine, Douglas fir) have dense, wide bands and hold paint less well, especially if smooth finished.
- **Texture:** Some hardwoods (oak, ash) have large pores that cause pin holes to form in the finish. Other hardwoods (yellow poplar, magnolia, and cottonwood) have smaller pores and good paintability. Paint and penetrating stains will last longer on rough-sawn lumber and plywood than on smooth surfaces because, in order to achieve the proper coverage, the paint buildup is necessarily greater. Smooth surfaces of some species, including western red cedar, may exhibit a condition known as “mill glaze” created during the planing or drying process. This condition can inhibit the adherence of solid body stains.
- **Knots, extractives, and other irregularities:** Knots absorb finish differently than the surrounding wood. Pitch (resin), oils, and other extractives can leach out of wood and cause staining. Better grades of wood have fewer defects and are preferable for painting.
- **Growth ring orientation:** Flat-grained, softwood lumber (typically used in most grades) shrinks and swells to a greater extent than vertical-grained lumber. Edge-grained softwoods (available at a premium price) cup less and hold paint better than flat-grained wood of the same species (Fig. 1).

Most residential paints and stains are classified as oil or alkyd-based or latex-based (which includes acrylic). Oil or alkyd-based paints contain inorganic pigments suspended in a natural oil such as linseed, or synthetic resin (alkyd), and usually a solvent such as mineral spirits (paint thinner), toluene, or xylol (all petroleum distillates). These paints cure by reacting with oxygen to form a polymeric film. Latex paints contain inorganic pigments, petroleum-based solvents, and various latex resins, but the solvent is mostly water. The curing of both paints releases volatile organic compounds (VOCs) but the amount is much less in latex paints (7 to 9 percent, compared to as much as 50 percent for alkyds). New paints on the market release very low or no VOCs.

Modern exterior latex paints, especially the all-acrylic, are generally considered to perform better than oil or alkyd-based coatings. Even though alkyd paints provide a more permeable barrier to moisture, acrylic paints are faster drying, more elastic, hold color better, tend not to crack as much, and are easier to work with and clean up. In general, latex paints and solid-color stains can be applied over either oil or latex-based finishes. Oil-based coatings should only be applied over oil-based finishes and not latex products. Better quality paints contain a greater amount of pigment by weight, cover better, last longer, and are more cost-effective than lower-quality paints.

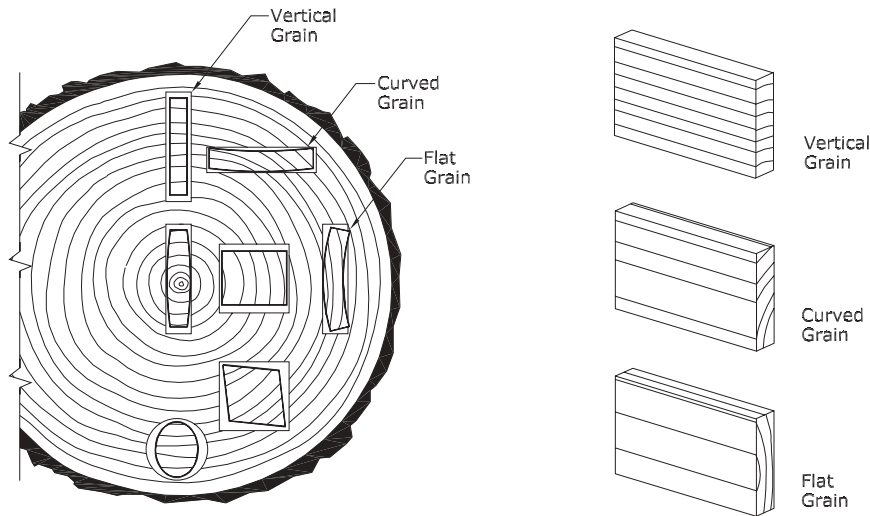


FIGURE 1

GROWTH RING/GRAIN ORIENTATION

TECHNIQUES, MATERIALS, TOOLS

1. MAINTAIN EXISTING COATED SURFACES.

Painted, stained, or treated surfaces must be protected from UV radiation, rain, dirt, and mold and mildew to perform properly. Roof overhangs can help, however, soffits and sidewalls under wide overhangs will still collect dirt and water-soluble salts (which can interfere with the adhesion of new paints). Dirt, salts, and chalk (individual pigment particle from weathered paint) can be removed by scrubbing with non-metallic bristle brushes and water. For stubborn stains, a non-ammoniated detergent can be added. Mold and mildew can be removed by scrubbing with a mixture of one or two parts of bleach to a gallon of water. Surfaces should be rinsed thoroughly with clean water prior to refinishing. All landscaping should be protected.

ADVANTAGES: Cost-effective, will increase service life of coatings.

DISADVANTAGES: Surfaces will eventually need refinishing.

2. PREPARE PREVIOUSLY COATED SURFACES.

Film-forming paints and solid color stains can fail by cracking, flaking or peeling. Such failures are typically caused by moisture penetration, painting over weathered wood, prolonged weathering, too much time between application of primer and top coat applications, and chalked, mildewed, or dirty surfaces that were insufficiently cleaned prior to coating. Blistering, another common failure mode, can be caused by high temperature or moisture. Temperature blisters are caused by rapid increases in temperature soon after painting or by poor quality paint. Moisture blisters can occur anytime excessive moisture penetrates the surface edges, or back side of the painted material. The source of the moisture should be eliminated prior to refinishing. Deteriorated coatings can be removed by scrubbing, scraping, sanding, heat, chemical

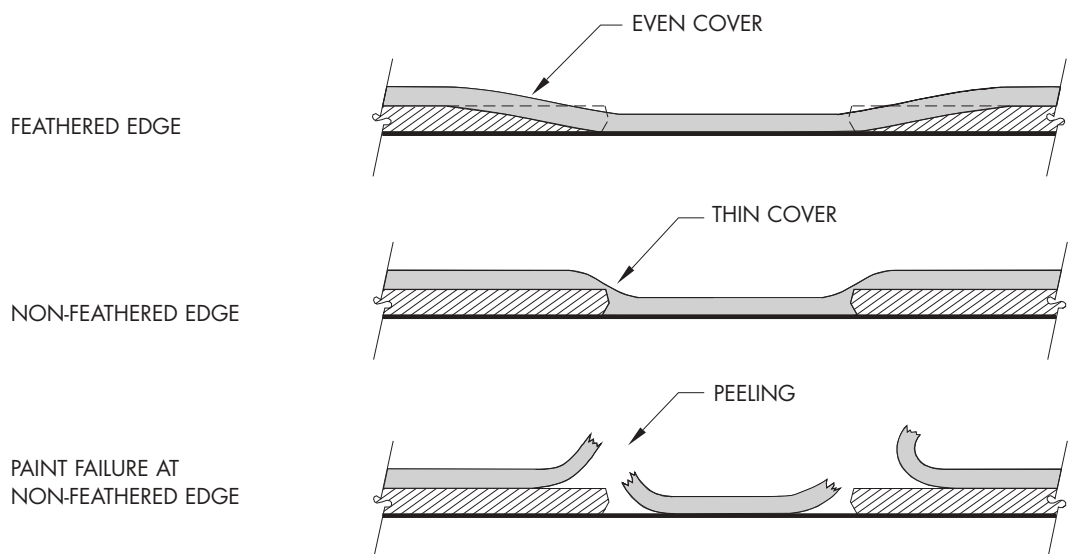
strippers, or pressure washing. Scrubbing is discussed in paragraph 1 above; scraping is best done with long handled professional scrapers; sanding is best done with orbital or siding sanders equipped with tungsten carbide abrasive disks (less likely to clog than conventional sandpaper); electrically heated paint removers can be used to soften and strip oil- or alkyd-based paints; chemical strippers such as lye and trisodium phosphate (TSP) contain caustic solutions and should be used with care. Naturalizing and sanding is essential. Refer to chemical manufacturers's recommendations and directions. Wet sand blasting and high-pressure water sprays are also used, but sand blasting can easily erode and destroy materials. Pressure washing can be effective for large areas, but should also be used carefully as it can also damage material. Dry sandblasting should never be used as it is too destructive. Paint can be removed with an open-flame blowtorch, but this should be left to professionals as the danger from fire is constant and lead paint can give off noxious fumes. National (Occupational Safety and Health Administration (OSHA) and HUD), state, and local health departments should be contacted for recommendations and requirements affecting the removal of lead paint (for houses built or painted prior to 1978).

ADVANTAGES: Proper preparation will make painting easier and enhance the coating performance.

DISADVANTAGES: Time-consuming and expensive.

3. APPLY PAINT TO NEW OR EXISTING WOOD OR WOOD-BASED COMPOSITE MATERIALS.

To achieve maximum paint life on new wood, the U.S. Forest Products Laboratory recommends that new wood be initially treated with a paintable water repellent preservative (especially at openings such as windows and doors where water can collect on horizontal surfaces such as sills, and at lap, butt, and end joints of siding where the edge grain is exposed). On existing painted surfaces, sanding is particularly important in order to feather the edges of the existing paint to allow for uniform coverage where new and old coatings abut. If the existing paint is not feathered, the new paint will fail first (Fig. 2). High-quality stain-blocking acrylic latex primers are recommended. Alkyd or oil-based primers are recommended for woods with water-soluble extractives such as redwood and western red cedar, and are still preferred by many professional painters for new wood. Raw wood should be primed within a few weeks of installation as a longer delay can cause loss of adhesion. Two coats of good-quality all-acrylic house paint over the primer are recommended, especially on south and west exposures. A one-coat acrylic house paint over a properly applied primer should last four to five years; two coats can last twice as long. As with all remedial work, the various product manufacturers' recommendations for paint selection, surface preparation, and paint application should be followed. Most paint failures occur when recommendations are not followed.



ADVANTAGES: Paint protects materials from weathering and deterioration due to the effect of rain and sun, and can dramatically alter the appearance of a house. Has the highest percentage of solids of conventional wood finishes, and can conceal surface defects and discolorations. New formulations of VOC-free paints are odorless, fast drying, and can be applied at lower temperatures than conventional latex paints, and adhere well, including over alkyd paints.

DISADVANTAGES: Paint is not a preservative and will not protect a substrate from decay if moisture penetrates the surface or is absorbed from behind. Will fail if applied incorrectly or without proper preparations. Not recommended for horizontal exposed surfaces such as wood decking, as water can get behind paint film and lead to decay. Requires periodic maintenance and repainting. Some new formulations dry so quickly that it is sometimes difficult to keep a wet paint edge. Alkyd paints are not recommended for use directly on masonry or other alkaline surfaces except over an alkali-resisting primer or sealer, not; or over a un-primed galvanized metal surface. Too frequent refinishing, especially with oil-based paints and solid-color stains, can lead to a thick coating buildup and subsequent cracking and peeling.

4. APPLY OIL-BASED PENETRATING STAINS TO NEW OR EXISTING WOOD OR WOOD-BASED MATERIAL.

Oil-based penetrating stains use linseed oil or alkyd formulas to seal and protect the wood substrate. Stains typically contain fungicides, water repellants, UV blockers, and other additives. These stains are available in varying degrees of pigment densities, from virtually clear and semi-transparent formulations designed to reveal and enhance the grain, to increasingly opaque coatings including semisolid and solid stains that hide the grain, but allow the substrate texture to be expressed. The greater the amount of pigment, the greater the hiding power and UV protection. Solid color stains are usually applied over primers, transparent stains are not.

ADVANTAGES: Time proven, popular coatings that protect and enhance the appearance of substrates. Resists blistering, cracking, and peeling better than paints (especially the more transparent formulations). Can be applied over a wide variety of new solid sidings, including shingles, shakes, plywoods, and trim. Can be used over some previously stained wood of an equal or less dense pigment formulation.

DISADVANTAGES: Not recommended for use over oriented strand board (OSB), cementitious or hardboard products (especially those with medium density overlay surfaces). May not penetrate and may cause unwanted gloss and blotchiness when used over existing unweathered penetrating stains. Not recommended for decking unless specially formulated for that use. Transparent and semi-transparent finishes require more frequent reapplication than more solid stains, especially for smooth-faced woods.

5. APPLY SOLID COLOR ACRYLIC STAINS TO NEW OR EXISTING WOOD OR WOOD-BASED MATERIAL.

The paint industry's interest in developing water-based low-VOC emitting stains has led a number of manufacturers to develop newly formulated, all-acrylic stains for siding products. These flat stains are not penetrating stains, but form protective films. They are thinner coatings than acrylic paints and are designed to resist cracking, blistering, and peeling while retaining the texture of the substrate materials. Used with primers, these stains are more flexible and have better color retention than oil-based stains. They can be used over previously treated oil-based penetrating stains, trim, and a variety of other materials, including primed metal, cured masonry, plywood, medium density overlaid plywood and hardboard, cementitious siding, and stucco.

ADVANTAGES: Protects and provides strong color accents to substrate materials. Less likely to peel than paints.

DISADVANTAGES: Not as long-lasting or easily cleaned as all-acrylic paints.

6. APPLY SPECIALTY COATINGS.

Many specialty coatings are available that compliment paint and stain products, including:

- Paints designed specifically for masonry.
- Tinted and untinted bleaching oils that contain oxides to accelerate the weathering process.
- Slightly tinted, clear, oil-based finishes that retard the normal gray weathering of wood and impart a slight reddish-brown tint.

■ Wood cleaners that are formulated to remove mildew, mold, algae, and dirt using chemicals such as sodium hydroxide.

■ Wood “brighteners” that are formulated to remove tannin bleed in extractive-prone woods, such as cedar and redwood.

ADVANTAGES: Unique and potentially useful products for special needs.

DISADVANTAGES: Difficult to anticipate the results of these products without careful research and inspection of their use on existing buildings, or examination of samples.

FURTHER READING

“Finishes for Exterior Wood—Selection, Application, and Maintenance,” U.S. Department of Agriculture, Forest Service, Forest Products Laboratory, Forest Products Society, Madison, WI, 608–231–2152.

“Latex Enamel Problems and Solutions,” James Berney, Dan Greenough, and Doug Kelly, *Journal of Light Construction*, January 1997.

“The Art of Painting,” Brad Lemley, *This Old House*, June 1998.

APPENDIX

PROFESSIONAL ASSOCIATIONS & RESEARCH CENTERS

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