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Wall-Sheathing Choices

Today's sheathing materials offer strength, energy-efficiency, economy, and fire-and water-resistance—but not all in the same package

by Bruce Greenlaw

Until the end of World War II, most wood-frame houses in the United States were sheathed with sawn boards. Builders debated whether the boards should be installed horizontally or diagonally. Diagonal sheathing eliminated the need for additional wall bracing, but shrinkage sometimes distorted building frames, causing problems such as cracked stucco. Horizontal sheathing didn't brace walls, but it didn't distort them either and was easier and more economical to install. Unresolved, the issue became moot when plywood superseded board sheathing shortly after World War II.

Nowadays, most houses are sheathed with panels instead of boards (photo below). There are at least a dozen types of wall-sheathing panels on the market, most of which are structural panels that can brace walls or insulating panels that can't brace walls. Fire-resistant panels are also available, some of which can brace walls but none of which insulate. And to top this off, only certain types of structural sheathing can serve as nail base for siding materials that need intermediate fastening between studs, such as wood shingles.

When choosing sheathing materials, you need to consider not only structural, energy and combustion issues, but also code-compliance, cost, availability, job-site durability, ease of installation and, believe it or not, curb appeal (see

OSB sheathing is suitable for structural use. Both plywood and OSB panels are strong enough to brace walls against racking and in most circumstances can be used interchangeably. Sheathing walls before tilting them up can speed framing and simplify the cutting of window openings.

chart p. 52 for a side-by-side comparison of the various sheathing types).

Structural sheathing is designed to brace walls—Although plywood was available as early as 1905, it wasn't until 1938 when waterproof glue replaced hide glue that plywood caught on as a building material. By the postwar building boom of the late 1940s, plywood was well-established as high-quality structural sheathing.

Oriented strand board (OSB), on the other hand, came to market in 1981. Whereas plywood veneers usually are peeled from large-diameter logs, OSB has cross-laminated layers of compressed wood strands machined from small-diameter, fast-growing trees. OSB is nearly as strong as plywood and costs less; which is why it outsells plywood wall sheathing in many areas.

Structural-wood panels such as plywood and OSB are regulated by an approved certification agency (usually APA-The Engineered Wood Association) to verify that the panels meet code recognized performance standards (top photo). Trademark/grade stamps certify a panel's compliance and list pertinent information about a panel's thickness, exposure durability and structural rating.

Plywood and OSB wall sheathing are normally 5/16 in. to 3/4 in. thick, 4 ft. wide and 8 ft. to 10 ft. long. Building codes permit the use of 5/16-in. panels over studs spaced 16 in. o. c. and 3/8-in. panels over studs spaced 24 in. o. c., but this can make a flimsy backing for siding. Most builders opt for 3/8-in. panels over 16-in. framing and either 7/16-in. or 1/2-in. panels over 24-in. framing. If shakes or shingles will go on top, use sheathing at least 5/8 in. thick so that shingle fasteners hold fast.

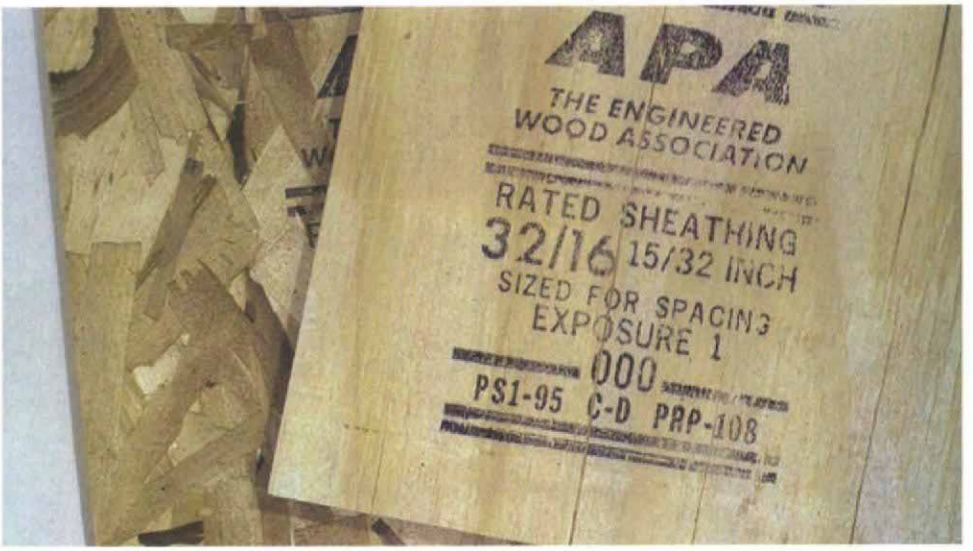
Structural panels can be installed vertically, though installing them horizontally provides more stiffness for a given panel thickness. The APA recommends horizontal application to walls that will be stuccoed, but this can also make sense when the sheathing will back wood shingles. Horizontal edges between panels normally need to be blocked, which is why most builders prefer to install the panels vertically to save on labor. If you do install panels horizontally, stagger the vertical joints to distribute fasteners evenly throughout the wall.

Regardless of panel orientation, space panels 1/8 in. apart (the diameter of an 8d nail) at the edges to allow for moisture-induced expansion. Although this practice is often ignored in the field, I've seen tight joints buckle, leaving a raised ridge. Panels that are "sized for spacing" (indicated on the trademark) are undersize lengthwise and widthwise by up to 1/8 in., which makes it easy to space panels while keeping the vertical joints centered on studs.

Questions still remain about the ability of OSB to resist impact and blow-off during hurricanes. If you live in a hurricane zone, check with your building department to make sure it's okay to use OSB. Or use plywood.

When shopping for standard plywood wall sheathing, ask for CDX plywood ("C" and "D" refer to the grade of veneer used on the sides of the panel, and "X" refers to the use of exterior glue), which is the trade term for Exposure 1, performance-rated sheathing. Exposure 1 panels can withstand temporary exposure to weather during construction. Structural 1 panels have about 10% more shear strength than standard panels do and commonly are required for sheathing shear walls (stiff walls that are anchored to foundations to resist the high lateral loads typically generated by earthquakes and high winds).

Gypsum sheathing is fire-resistant—Gypsum sheathing (bottom photo) is a common choice for commercial work but accounts for only about 5% of the residential wall-sheathing market. Still, it can make a good substrate for many residential-siding materials, though it typically



Approved structural-wood panels carry an APA-The Engineered Wood Association certification. Besides certifying that these panels conform to code-approved specifications, the APA grading stamp also indicates the thickness of the panel, its suitability for exposure to weather and its span rating.

Gypsum sheathing is typically used beneath stucco. Fire-resistance and low cost are the chief selling points of gypsum sheathing. Bottom to top: National Gypsum Company Gold Bond Jumbo square edge, Louisiana-Pacific FiberBond and Georgia-Pacific Dens-Glass Gold.

Wall-sheathing comparison

Sheathing	Advantages	Disadvantages
Plywood	Can brace walls; highest shear strength and impact-resistance; can provide a nail base for wood shingles.	Most-expensive structural sheathing; low R-value.
Oriented strand board (OSB)	Can brace walls; cheaper than plywood; can provide a nail base for wood shingles.	Use might be restricted in hurricane areas; low R-value.
Gypsum	Excellent fire-resistance; can brace walls in some areas; low cost	Low impact-resistance; normally must be covered within 30 days; low R-value; can't be used as nail base.
Cement board	Excellent fire-resistance; can be used as a drainage board for EIFS; rot-proof.	Expensive; doesn't brace walls; heavy; low R-value; can't be used as nail base.
Laminated fiber	Can brace walls; low cost; high resistance to air infiltration; lightweight.	Can't be used as nail base; low R-value.
Fiberboard	Can brace walls; best insulating structural sheathing; low cost.	Most types can't be used as nail base.
Expanded polystyrene (EPS)	Highest R-value per dollar; insect-resistant panels available; lightweight.	Doesn't brace walls; thermal barrier required between sheathing and living space; low compressive strength; can't be used as nail base.
Extruded polystyrene (XPX)	High R-value; virtually water-proof; strongest foam in compression; lightweight.	Doesn't brace walls; thermal barrier required between sheathing and living space; can't be used as nail base.
Polyisocyanurate	Highest R-value per inch; more fire-resistant than other foams; lightweight.	Doesn't brace walls; thermal barrier usually required between sheathing and living space; can't be used as nail base.

isn't structural. It's most commonly used as an underlayment for stucco, but I've seen it installed beneath everything from cedar shingles to limestone veneer.

Gypsum sheathing can be scored with a utility knife and snapped apart just like interior drywall. But unlike standard interior drywall, which would disintegrate quickly outdoors, gypsum sheathing has water-repellent paper faces, and it can also have water-resistant cores for extra protection in moist climates or for use beneath synthetic stucco (EIFS). Manufacturers claim that you don't have to install building paper over gypsum sheathing unless it's required by code or unless the sheathing will be exposed to the elements for longer than a month. I'd consider papering it (and most other sheathing materials) anyway to tie into flashing (see *FHB* #100, pp. 58-63).

Gypsum sheathing's biggest selling point is that it's inherently fire-resistant because gypsum contains chemically bound water. Type-X gypsum sheathing is thicker than the standard variety and has special additives in the core for even better fire protection. Type-X sheathing is a popular (and sometimes code required) choice for fire-rated walls in areas threatened by wildfires or on homes that have less than the minimum required setback from property lines. Standard gypsum panels are either ⅜ in. or ½ in. thick. Type-X panels are ⅝ in. thick. Both types come in 2-ft. and 4-ft. widths. The 2-ft. wide panels have V-shaped tongue-and-groove long edges and are installed horizontally with the grooves facing down to shed water. These panels are easy to handle, and rows can be installed in concert with strips of asphalt-impregnated building paper or stucco lath as installers make their way up ladders or scaffolding. The narrow panels provide limited shear strength, though, so they can't be used as wall bracing. Most areas allow ½-in. or thicker 4-ft. wide gypsum panels to brace walls, provided the panels are applied vertically according to code. The next edition of the Uniform Building Code will no longer allow this, though. Four-ft. wide panels come in lengths up to 10 ft. for covering tall walls or for overlapping floor framing.

Two paperless gypsum products are also worth a mention; both are stronger and more weather-resistant than conventional gypsum sheathing. Louisiana-Pacific's FiberBond panels (800-411-2500) have fiber-reinforced gypsum and perlite cores that are sandwiched between two beefy layers of fiber-reinforced gypsum. The fiber, which comes from recycled newsprint, makes these panels the strongest gypsum panels on the market. In fact, the structural panels are the only APA-rated gypsum panels available and, like APA-rated plywood and OSB, bear the APA trademark. FiberBond panels also can be exposed to weather for up to 60 days instead of the usual 30 days.

Georgia-Pacific's Dens-Glass Gold panels (800-225-6119) have a silicon-treated gypsum core surfaced on both sides by fiberglass mats. They also have on one side an alkali-resistant coating that eliminates the need to apply a primer/sealer when installing high-alkaline, adhesively applied EIFS.

Dens-Glass Gold sheathing not only is stronger than normal gypsum sheathing, but it's also the most weather-resistant gypsum sheathing around; you can expose it to the elements for up to six months with no problem. This sheathing might be overkill for most residential work, but I would consider using it where long construction delays or high humidity is common. FiberBond and Dens-Glass Gold sheathing both come in regular or type-X panels that can be installed vertically or horizontally without sacrificing wall strength.

All gypsum panels share one drawback: They can't be used as a nail base for siding because they offer little resistance to nail withdrawal. If you plan to shingle over them, you'll have to add a nail-base sheathing or horizontal wood strapping on top.

Some sheathings are better for specific kinds of siding—Cement board (top photo, facing page) isn't a common residential-wall sheathing, but it has made inroads as a sturdy, rot-proof and fire-resistant underlayment for synthetic stucco, exterior tile and thin-brick veneer. Cement board typically comes in ½-in. thick nonstructural 3-ft. or 4-ft. wide panels consisting of aggregated portland cement with fiberglass mesh embedded in both sides. Joints between panels are reinforced if necessary with exterior fiberglass-mesh tape covered with a special joint compound. Cement board is quite porous, so weather-resistant building paper is required over or under it, depending on the application.

Thin panels can brace walls—Amazing as it sounds, nominal ⅛-in. thick sheathing panels can serve as structural wall bracing. Laminated-fiber panels, including Energy Brace (Fiber-Lam Inc., P. O. Box 2002, Doswell, Va. 23047; 804-876-3135) panels (bottom photo, facing page) and Thermo-ply (Simplex Products Division, P. O. Box 10, Adrian, Mich. 49221-0010; 517-263-8881)

consist of layers of cellulose fiber that are pressure-laminated using a water-resistant glue. Thermo-ply is made primarily of preconsumer and postconsumer recycled material, and Energy Brace uses mostly virgin stock. Panels are treated for water-resistance and usually are faced with polyethylene on both sides, aluminum foil on both sides, or poly on one side and aluminum on the other.

Thermo-ply and Energy Brace panels come in three color-coded grades. Structural-grade panels, which have red lettering on them, span studs spaced 16 in. o. c. Slightly thicker panels with blue lettering on them span studs at 24 in. o. c., or they can span studs at 16 in. o. c. for added stiffness. Standard-grade panels (green lettering) are thinner than the others and are the only ones that can't be used as wall bracing. In some areas, Simplex also sells a black-lettered panel that is slightly thinner than red panels and can also brace 16-in. o. c. stud walls.

Foil-faced panels are sometimes installed next to an airspace to add a bit of R-value to walls or to serve as radiant barriers. The foil also makes a house look like it's gift-wrapped, at least until it gets covered by siding. Nevertheless, if you don't need foil, you might want to stick with polyethylene-faced panels so that siding installers (and passersby) don't get blinded by the glare that foil-faced panels can generate.

Simplex and FiberLam also promote their sheathing as air barriers. Both sell 48¾-in. wide by 8-ft. long panels that can be lapped at vertical seams for extra airtightness (center photo). Four-ft. wide panels are also available. Manufacturers claim that the panels are easy to cut with a utility knife. This is true if you have arms like Popeye's and an unlimited supply of sharp blades. I'd use a circular saw.

Fiberboard panels can insulate and brace a wall—The first fiberboard plant in the United States was built in 1908, the same year people started driving Model T Fords. Developed as a paper byproduct, fiberboard was hailed as one of the first insulating sheathings (bottom photo, p. 54). Since energy has become expensive, though, fiberboard has lost some of its luster. That's because the R-value of the thickest fiberboard panels on the market is just 2.06, as opposed to a maximum of about R-8 for 1-in. thick polyisocyanurate foam sheathing.

Nevertheless, fiberboard sheathing is still readily available in many areas, and for good reason. It repels water, it's economical, and structurally rated panels can eliminate the need for additional wall bracing. It can also make a good sound barrier in noisy neighborhoods, and building scientists seem to like it (along with gypsum sheathing) because it breathes better than most other sheathing materials. This means that it allows water vapor to escape from buildings in cold climates instead of trapping it inside walls, where it can condense and cause mildew, rot or other problems.

Nonstructural cement board is a good choice for thin-brick veneer, tile and synthetic stucco. Because it is porous, cement board, such as USG's Durock sheathing, requires a weather-resistant building paper over or under it to protect the framing. This sheathing can be scored with a carbide knife and snapped apart by hand.

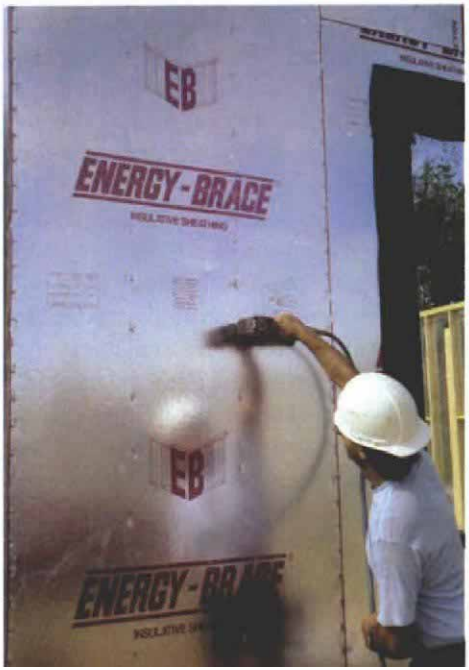
Many of the fiberboard-sheathing panels on the market are made by members of the American Fiberboard Association (AFA, 1210 W, Northwest Highway, Palatine, Ill. 60067; 847-9348394). These panels are made of wood and agricultural byproducts (such as sugar cane); are impregnated and coated on at least one side with asphalt for strength and weather-resistance; measure 4 ft. wide by either 8 ft. or 9 ft. long; and come in two types, regular and structural (formerly called "intermediate"). Regular panels are ½ in. thick, and structural panels are either ½ in. or 25/32 in. thick.

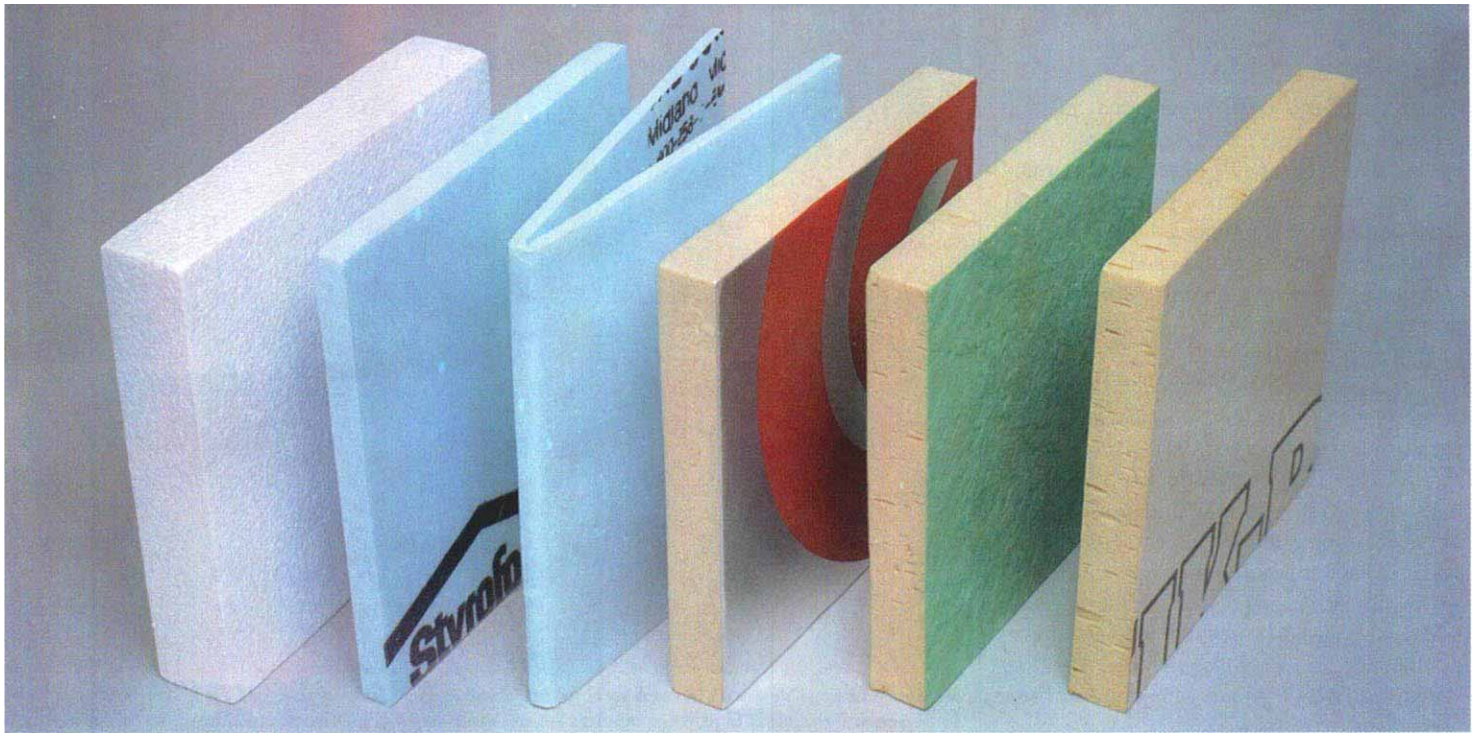
If you plan to use fiberboard panels as wall bracing, choose structural panels, which are labeled "structural" on the face, and apply them according to code. Regular panels can be used as economical fillers between strategically placed structural fiberboard, plywood or OSB panels. Like plywood and OSB, fiberboard panels should be spaced ⅛ in. apart to allow for expansion, and all horizontal edges should be supported by framing or blocking.

The Homasote Company (800-257-9491), which isn't an AFA member, makes high-density fiberboard sheathing panels out of recycled newsprint. Homasote claims that the panels can be used as a nail base for shingles (ordinary fiberboard can't be), provided the shingles are secured with ring-shank nails. The panels aren't treated with asphalt, so they don't have the char-

Laminated-fiber sheathing has a thin profile, yet is structurally rated. Lightweight ⅛-in. thick structural-grade pressure-laminated cellulose panels by Simplex are poly-faced (left) or foil-faced (right) and are strong enough to brace walls.

Thin sheathing can be lapped at the edges to reduce air infiltration. Laminated-fiber sheathing is available in 48¾-in. wide panels that can be lapped at the seams, which increases its performance as an air barrier.





Foam insulates walls. Left to right ATM Perform Guard insect-resistant EPS; Dow Duramate film-faced XPS; Dow Bluecor P/P XPS fanfold; Celotex Tuff-R foil-faced polyisocyanurate; Celotex Sturdy-R fiberglass-faced polyisocyanurate; Celotex Quik-R polyisocyanurate for EIFS.

acteristic black or dark-brown color of most fiberboard panels, and they aren't as weatherproof. Water-resistant building paper should be installed on top.

Rigid-foam sheathing can insulate a wall but not brace it–Some manufacturers tout their rigid-foam board as an energy-efficient replacement for other types of sheathing. That's like touting Hondas as energy-efficient replacements for pickup trucks": Rigid foam simply does not qualify as wall bracing. Foam also can't serve as a nail base for shingles as some sheathings can. And unlike gypsum sheathing, foam can be more of a fire hazard than a fire retardant without a proper thermal barrier, though, for instance, Celotex chemically modifies its Thermax sheathing for fire-resistance.

But foam sheathing allows builders to produce the R-19 walls required by code in many areas without switching from 2x4 to 2x6 framing. And because foam envelops wall framing, it reduces thermal bridging through the framing itself and can prevent condensation from forming in the wall cavities.

Most rigid foam comes in 4-ft. wide by 8-ft. or longer panels, but 16-in. wide and 24-in. wide panels are also available for horizontal application (2-ft. by 4-ft. panels are available in some areas for stucco contractors). The choice of foam-panel thicknesses can be daunting, but the most popular panels range up to 1 in. thick. Some foam panels have tongue-and-groove or shiplap edges for a more airtight installation; others have square edges. Also available are fanfold panels that are installed directly over old siding as an underlayment for new siding. These panels are ⅜ in. or ½ in. thick and come in 4-ft. wide by 50-ft. long sheets that are folded like accordions with creases spaced 2 ft. apart.

Fiberboard sheathing can both insulate and brace walls. Although fiberboard's R-value is relatively low, structural fiberboard (bottom) can be used with economical asphalt-coated regular fiberboard (top) to build an insulated, breathable and sound-deadened wall.

EPS is a good choice for EIFS siding–Foam sheathing is available in three types: expanded polystyrene (EPS), extruded polystyrene (XPS) and polyisocyanurate (top photo). EPS, or "headboard," is widely regarded as the environmentally friendly foam because it's the only one that doesn't contain ozone-damaging blowing agents. It's made of steam-puffed polystyrene beads that are molded into blocks and sliced into panels. EPS has the lowest R-value per inch of the three types, averaging about R-4, but it can deliver the most R-value per dollar.

Unfaced EPS sheathing is commonly used in residential EIFS and one-coat stucco systems. It's inexpensive, high spots can be rasped off easily, and panels can be cut quickly and cleanly into stucco moldings using a hot wire or a hot knife (available through EIFS suppliers). EPS panels faced with polyethylene or foil are also available. Both facers improve weather resistance and durability, and foil adds R-value when facing an airspace. Panels treated with nontoxic borate resist termites, carpenter ants and other wood-boring insects.

XPS stands up to the weather–Extruded polystyrene, or XPS, is made of the same plastic as EPS, but XPS is inflated with blowing agents that give it higher R-values per inch (typically R-5). XPS panels come with or without plastic film facers. Most builders prefer faced panels because they withstand rougher handling, but unfaced XPS panels are becoming increasingly popular as an underlayment for stucco,

XPS panels resist blow-off better than the other rigid foams. And because the foam is highly water-resistant, panels can be exposed to rain during construction without the worry of water absorption (after all, XPS buoyancy billets are used for floating-marina docks). And XPS panels can eliminate the need for housewrap or other air barriers, especially when the panels are installed

vertically with the edges supported by framing. Sealing panel seams with sheathing tape can further decrease air infiltration.

Because some solvents dissolve polystyrene panels, allow siding that's pretreated with water repellents or wood preservatives on the back to dry before it contacts the foam. Also, be careful not to get solvent-based insecticides on polystyrene panels.

Polyisocyanurate panels have the highest R-value per inch—Unlike the polystyrenes, polyisocyanurate is unaffected by solvents. Polyiso is also the R-value king. Panels average R-6.5 per in., but I've seen panels that rate as high as about R-8 per in.

Polyiso panels are faced either with aluminum foil for maximum energy-efficiency or with coated fiberglass for maximum strength. Foil prevents the rapid intrusion of nitrogen and oxygen into the foam, which allows the R-value of the foam to stabilize at the highest level. Placing reflective foil next to a ¾-in. airspace in a wall increases the R-value of the wall by 2.77. Foil also repels water and prevents the intrusion of water vapor, both of which could reduce the R-value of polyiso foam.

Reflective foil has been accused of overheating vinyl siding on sunny days and causing it to "oil can," or form ripples. But several vinyl-siding manufacturers have told me that reflective foil has a minimal effect on siding temperatures and that oil canning is caused by improper siding installation (driving nails too tight). Regardless, nonreflective, coated-foil facers are available for those builders who want foil without the glare or who don't trust reflective foil next to a particular siding.

Panels with water-resistant, coated-fiberglass facers for added strength and for puncture-resistance are also available. Like fiberglass batts, though, the facers can make your skin itch as you handle the panels, and the panels lose about 25% of their R-value to the facing.

Specially faced polyiso panels, including Stucco-Shield II (Atlas Roofing Corp., 1775 The Exchange, Suite 160, Atlanta, Ga. 30339; 770-933-4461) and Quik-R Wall Insulation (The Celotex Corp, 4010 Boy Scout Blvd., Tampa, Fla. 33607; 813-873-4000), are designed for use as EIFS substrates. These panels don't always need rigid backing as EPS panels do, and they're manufactured with tight thickness tolerances that are supposed to speed troweling and minimize stucco waste and stress cracks. Polyiso doesn't melt, though, so it can't be cut with hot wires or hot knives as the polystyrenes can. It's typically cut with a utility knife instead. □

Bruce Greenlaw is a contributing editor of Fine Homebuilding. *Photos by the author.*

Sheathing-installation tips

• **Use the right fasteners and follow recommended fastening schedules—** All model building codes include fastening schedules for structural-sheathing materials used as wall bracing. The schedules list acceptable fasteners and tell how far apart to space them along panel edges and over intermediate supports.

Plywood sheathing, for instance, is normally applied with 6d or 8d nails spaced 6 in. apart along the edges and 12 in. apart over intermediate studs. But I've had to space the nails closer in seismic areas because of variations in local codes.

Rigid-foam sheathing doesn't brace walls, so there are no code-enforced fastening schedules for it. These schedules are normally supplied by panel manufacturers and are designed to ensure that panels are pulled tight against the framing for maximum airtightness and don't blow off before they're covered with siding. Foam panels that are included in synthetic-stucco systems actually support the stucco and should be installed according to stucco manufacturers' recommendations.

In general, nail-base sheathings such as plywood and OSB are secured with common or deformed-shank nails. Gypsum, fiberboard and the rest of the sheathing panels are more often fastened with galvanized roofing nails.

Gypsum sheathing is sometimes secured to wood framing with type-W screws. Where I live, you can't use screws if the sheathing will brace walls. Cement board can be fastened with special noncorrosive screws because it doesn't brace walls.

To save time, most pros install sheathing with pneumatic nailers or staplers at every opportunity. Nailers, preferably the type that drive round-head nails, can be used for installing structural wood panels. Pneumatically driven staples with 7/16-in. crowns can secure structural-wood, gypsum, laminated-fiber and fiberboard panels. Wider crowns usually are preferred for foam sheathing.

• **Don't overdrive sheathing fasteners**—Sheathing fasteners should be placed at least ⅜ in. away from panel edges to prevent tearout. Also, be careful not to overdrive fasteners; if they break through the surface of the sheathing, their holding power will drop substantially.

To prevent overdriving of pneumatic fasteners, you might have to adjust the gun to leave fastener heads slightly proud of the sheathing surface, and then hammer them flush. Hand-nailing also helps to suck up panels tight against framing to prevent gaps and to minimize air infiltration.

• **Allow for framing shrinkage**—Solid wood shrinks across the grain as it dries. Multistory buildings framed with solid lumber can shrink considerably between floors, where wall plates and rim joists form a thick sandwich of horizontal framing members. Some builders space wall sheathing ½ in. between floors to allow for this shrinkage. I'd space them ¾ in. apart, especially with deep joists.

The easiest way to provide this gap is to tack a ¾-in. wide wood strip over bottom panels to provide temporary support as top panels are fastened to the framing. Joints between rigid-foam panels can be filled with a compressible-foam backer rod and a compatible sealant to prevent heat loss and, in the case of EIFS stucco, moisture infiltration.

Framing shrinkage can be cut in half by using kiln-dried framing lumber, or it virtually can be eliminated by using engineered framing lumber.

• **Sheath first, then cut the openings**—The speediest way to sheath walls is to panel over window and door openings, and then cut out the openings. Openings in walls that are presheathed with wood-base panels can be marked on the panels as they're installed and cut with a circular saw before the walls are raised. If the sheathing is installed on upright walls, openings can be cut from inside the house with a reciprocating saw or with a chainsaw.

Gypsum sheathing can be cut out fast with a drywall cutout tool, which resembles a laminate trimmer, but this can be done only from the sheathed side of the wall. Unfaced or poly-faced polystyrene-foam panels can be cut with a hot knife (available from EIFS suppliers). These and other rigid-foam panels also can be cut with a drywall handsaw, a utility knife or a sharp kitchen knife that's long enough to use the framing as a cutting guide.

Cement board can be cut with a reciprocating saw fitted with a carbide-tipped blade, but most installers score and snap the panels to fit around openings before the panels are installed because it's faster that way and because it doesn't make dust.—*B. G.*