Top Ten Job-Site Questions

Answers to the questions asked most often in the field

❶ What is the best way to install a wood floor over a concrete slab?

Howard Brickman responds:
Concrete is a good substrate for installing wood flooring if proper precautions are taken to ensure that excessive moisture conditions are detected prior to installation, *and* controlled during the life of the floor. In addition, traditional nail-down, solid 3/4-inch strip or plank flooring must have an adequate wood substrate for proper nailing.

Concrete substrates. Even though concrete was used to build Hoover Dam, it doesn't qualify as a "waterproof" material. Actually, the opposite is true. Concrete is quite porous.

To avoid excessive moisture problems, new slabs must be detailed properly. Place at least 6 inches of gravel or crushed stone on the ground, then install a 6-mil polyethylene vapor barrier. Make sure that this vapor barrier is not destroyed when the concrete is poured. The exterior of the concrete slab should also be dampproofed prior to backfilling. Before laying the floor, the slab should be allowed to dry sufficiently.

Always check for moisture in concrete prior to installing a wood floor by taping polyethylene over a clean place on the slab and allow 12 to 24 hours for signs of moisture to develop.

Solid 3/4-inch tongue and groove strip and plank flooring cannot be installed directly to concrete. You must install a wood subfloor for nailing. Two recommended methods are a 3/4-inch "plywood-on-slab" and a "floating plywood" system.

Plywood-on-slab. Place a 6-mil polyethylene vapor retarder directly over the concrete. Lay 3/4-inch plywood sheets opposite to the direction of the finish flooring, leaving a 1/4-inch gap between panels to eliminate squeaking. Fasten the plywood to the concrete using powder-actuated fasteners or concrete nails.

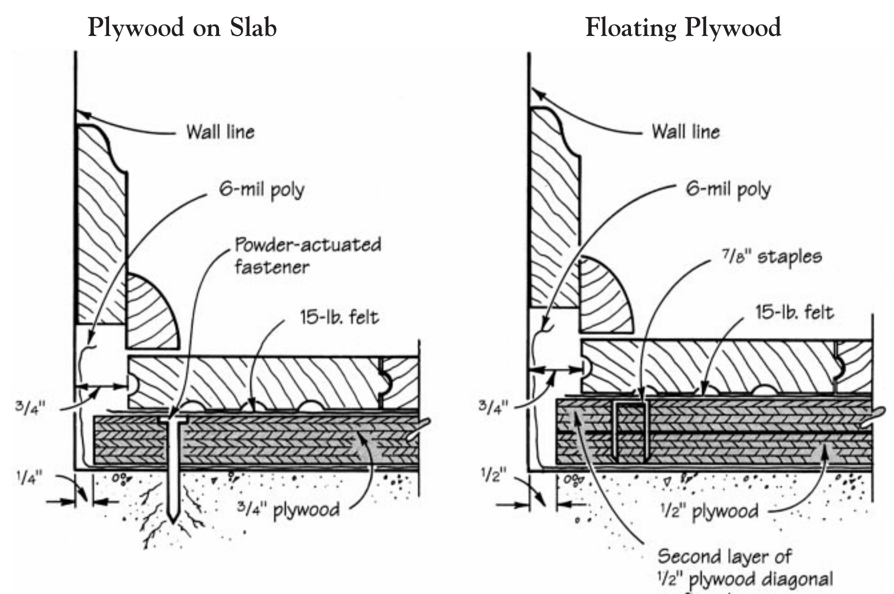
Standard 2-inch powercleats or pneumatic staples will contact the concrete surface beneath the plywood unless the machines are tilted forward by placing a 5/16-inch-thick spacer at the back edge of the nailer's faceplate. The alternative is to purchase 1 3/4-inch powercleats specifically designed for this application.

Floating plywood system. Place a 6-mil polyethylene vapor barrier over the concrete. Lay 1/2-inch plywood sheets along the long axis of the room. Place a second layer of 1/2-inch plywood at 45 degrees over the first layer. Again, leave 1/4-inch gaps between sheets of plywood to eliminate squeaks. Then fasten the two layers of plywood together using 7/8-inch pneumatic staples. Leave a minimum of 1/2-inch expansion space at the perimeter for normal-sized areas. It is a good idea to increase expansion for large areas. When similar systems are used in large spaces, such as gymnasiums, a 2-inch expansion space is required.

Laying the floor. When laying any wood floor, be sure to:

- Use 15-pound asphalt-saturated building paper or felt under all nail-down floors
- Start the flooring *straight* using a chalk line or string
- Use plenty of nails
- Make use of the tongue and groove *or* splines when changing direction and or working from one room to another.

— Flooring contractor Howard Brickman is the owner of Brickman Flooring Co., which sells, installs, and finishes wood floors. He also conducts training seminars at his shop for flooring contractors and finishers.



Wood floors over concrete: *Solid-wood strip or plank flooring must have an adequate wood substrate for secure nailing over concrete. Use either the "plywood-on-slab" method (left) or the "floating plywood" system (right).*

❷ Should you lay decking bark side up or bark side down?

Paul Fisette responds:
Depending on the wood type, moisture content, and exposure, deck boards can cup, twist, or decay. Theoretically, you can ensure that a board will cup downward to shed water, and thereby reduce deterioration, by exposing one face or the other. In fact, seldom does a week pass that I'm not involved in a discussion about whether to install deck boards either bark side up or bark side down. But such recommendations usually only account for one of a handful of factors that control cupping.

Original moisture content. The original moisture content of a piece of lumber controls a board's final shape. Wood is stable when its moisture content is above 30% (fiber saturation point). As wood dries below 30%, it shrinks. Wood shrinks and swells twice as much in the direction parallel to the growth rings as it does perpendicular to the growth rings. The combined effect of these different rates of movement causes lumber to deform.

Flat-sawn lumber, which is cut so its wide face is parallel to the growth rings, cups as it gains or loses moisture. A good way to visualize the typical distortion is to imagine that the growth rings straighten as wood dries. Therefore, wet lumber will tend to cup toward the bark side as it dries. Kiln-dried lumber, on the other hand, is usually surfaced after the lumber has been dried, and will tend to cup away from the bark side as it gains moisture.

Heartwood and sapwood. Heartwood is often more resistant to decay than sapwood of the same species. But heartwood is difficult to impregnate with wood-preserving chemicals, while sapwood is easy to treat. As a result, the most resistant face of treated wood is often the bark side.

Shelling. Growth rings have two parts — earlywood and latewood. The inner layers of each growth ring (closest to the center of each ring) are formed during the early part of the growing season. The outer layer grows later in the season. Repeated cycles of wetting and drying sometimes cause the layers of earlywood to separate from the layers of latewood. This separation, called shelling, occurs infrequently. When it does, it is associated with flat-sawn softwoods like Southern Yellow Pine and Douglas fir, that is laid barkside down.

In-use conditions. No matter which face is up, the ultimate shape of a board will be influenced by its moisture content. If one side is wetter than the other, that side will expand and cup the board. Since the underside of a deck built close to the ground experiences higher relative humidity than the upper surface, which is exposed to wind and sun, the boards often cup upward.

Pick the best face. When all is said and done, you needn't remember all these factors when trying to decide which face to install up. In truth, the answer is very simple: *Pick the best looking face*, selecting out the faces with the most knots and wane, and install your decking best face up. Secure fastening and an annual coating of water repellent will do the most for keeping the boards flat.

— Paul Fisette is a wood technologist and director of the Building Materials Technology and Management program at the University of Massachussets in Amherst, Mass.

❸ What's the best method to keep cedar siding and trim looking naturally orange and new?

William Feist responds:
Unless you shrink-wrap each piece of cedar, it will darken and eventually weather to a silvery gray, or worse, to a blotchy dark gray. Clear finishes with UV inhibitors will slow down the weathering process, but these still need to be reapplied every two years or so. Eventually the color will change anyway, even indoors.

The best thing you can do is to approximate the color of new wood by putting on a cedar-tone stain. First, install the siding with the rough side out. A smooth surface holds less finish and weathers much quicker than a rough-sawn surface. Finish the rough surface with two coats of a lightly-pigmented, semitransparent, oil-based stain. Be sure to choose one that contains a water repellent and a preservative or mildewcide for best performance. Apply the first coat and let it soak into the wood 20 to 60 minutes and then apply the second coat. If you allow the first coat to dry, the second coat cannot penetrate into the wood. About an hour after applying the second coat, use a cloth, sponge, or dry brush to remove any excess stain. Otherwise, the stain that does not penetrate into the wood will form an unsightly film and glossy spots. Two coats of oil-based stain on rough wood will last from four to eight years, depending on the weather conditions it is exposed to.

If you have weathered and discolored wood siding, you can regain the new look of cedar by cleaning off the dirt and mildew with a solution of one third cup liquid household detergent (be sure it is ammonia-free), one quart liquid household bleach (containing 5% sodium hypochlorite), and three quarts warm water. Follow this up with a water rinse and then use an oxalic acid bleach solution made with about a half pound of oxalic acid per gallon of water. Be sure to rinse with water again. This oxalic acid bleach solution will draw out the tannins in the wood and revive the orangeish tone of the cedar. At this point, you can let the wood weather naturally, or apply the cedar-tone semitransparent stain.

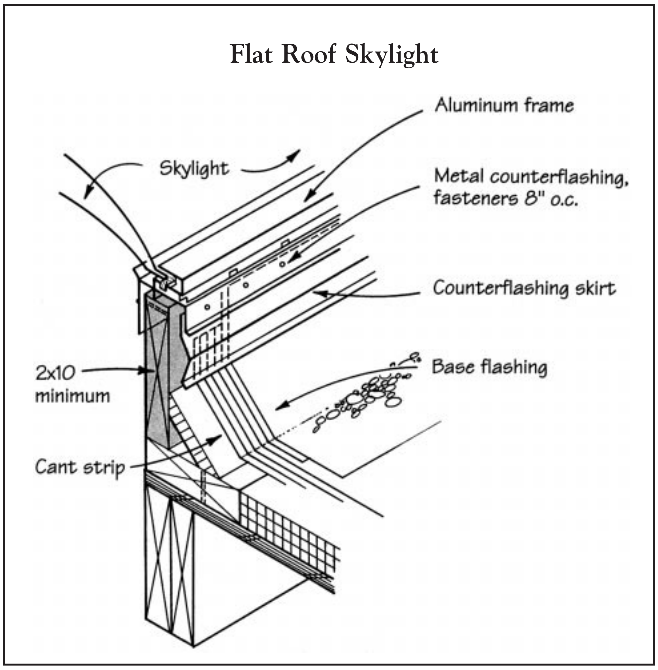
— William Feist is a research chemist who specializes in coating technology at the Forest Products Laboratory in Madison, Wis.

❹ How should a skylight be installed on a flat roof?

Jim Carlson responds:
A skylight opening on a low-slope or flat roof must have a raised curb to allow for proper flashing and counterflashing.

The raised curb should be at least 8 inches above the finished roof surface (see illustration, next page). Depending on the roofing material, you may need to install a cant strip at the base of the curb. A cant strip provides a more gradual transition for the roofing membrane to turn up from horizontal to vertical.

The field plies of the roof membrane should be turned up the vertical face of the curb, above the head of the cant strip. However, the turned-up field plies are not adequate curb flashing by themselves. To properly flash the skylight curb, membrane base flashing should be installed before the skylight is set in place. The base flashing reinforces the membrane at the curb-to-roof intersection.



Skylights on flat roofs: *To prevent leaks on a low-slope or flat roof, a skylight opening should have a curb at least 8 inches above the finished roof surface and have sufficient flashing, as shown.*

Base flashing is simply made from strips cut from rolls of the roofing material, or from membrane flashing stock, depending on the roof system you are using. Feather the base flashing plies onto the field of the roof, with the uppermost ply extending approximately 4 inches beyond the toe of the cant strip.

Once the curb has been flashed, the skylight and counterflashing can be installed. Counterflashing is usually made of sheet metal, and should be wide enough to extend over the base flashing a sufficient distance to keep out wind-driven rain and snow. Most manufactured skylight assemblies have a metal flange that serves as counterflashing. Depending on the specific climate, you may need to insert an additional metal "counterflashing skirt" to extend the pre-made flange.

— Jim Carlson is deputy director of Technology and Research for the National Roofing Contractors Association.

❺ What causes a concrete slab to crack and how can it be prevented?

Don Marsh responds:
Concrete cracking is caused by stresses due to drying shrinkage, temperature change, or applied loads.

Drying shrinkage. Drying shrinkage is an inherent and unavoidable property of concrete. During the setting and hardening stages, excess mixing water in the concrete evaporates, causing the concrete to dry from the surface inwards. Shrinkage begins near the surface, pulling at the moist inner portions of the concrete, which are restrained by friction on the subgrade, reinforcing steel, and building connections. This restraint prevents the concrete from shrinking freely and uniformly, resulting in cracking.

While drying shrinkage and some cracking is inevitable, it can be reduced by specifying adequate compressive strength, minimizing the water content, spacing control joints properly, and adequately curing the concrete.

Compressive strengths are governed by local building codes. In general, basement walls require a minimum 2,500 psi concrete, while flatwork ranges from 3,000 to 4,000 psi. For residential work, recommended slumps range from 3 to 5 inches for flatwork, and 5 to 7 inches for basement walls. Once the concrete is ordered to a specified slump, don't add more water at the site to speed the pour.

The purpose of control joints is to confine cracking to predetermined points in a slab, rather than letting them occur randomly. Control joints should be tooled or sawn to a depth of one quarter the slab thickness. Joints should be spaced at intervals not more than 30 times the slab thickness. Driveways wider than 10 feet require both transverse and longitudinal control joints.

Curing helps reduce shrinkage cracking and maintains slab strength.

Concrete cracks: *Some shrinkage cracks are inevitable. But you can reduce them by specifying adequate compressive strength, minimizing the water content, spacing control joints properly, and sufficiently curing the concrete.*

Typically, curing involves keeping the concrete moist and covered for five to seven days, or applying a spray-on compound that forms a membrane on the surface.

Temperature changes. Extreme temperature changes immediately following, and up to a year after, slab placement can have the same adverse effects on concrete as drying shrinkage. Proper control joint spacing is the most effective method to guard against this.

Applied-load cracking. This occurs when the weight of an object on a slab stresses the concrete beyond its tensile strength. Such cracking often occurs, for example, when a heavy truck drives over a sidewalk designed only for pedestrian and light vehicular traffic. To prevent load-stress cracking, make sure a slab is built over a uniformly compacted, well-drained subgrade, and is thick enough to withstand the kind of use it will get. In residential concrete, 4 inches is the minimum thickness for walkways and patios. Garage slabs and driveways should be 5 to 6 inches thick if any heavy truck traffic is anticipated, otherwise 4 inches is adequate.

— Don Marsh is the media services representative for the the Portland Cement Association in Skokie, Ill.

❻ What is the best way to retrofit foundation insulation?

J. D. Ned Nisson responds:
The three common options for foundation insulation are exterior foam, interior foam, and interior framed wall with fiberglass batts. Which approach is best depends on a few site-specific variables, including climate, soil conditions, and homeowner preference. Consider these questions when making your decision:

Is the basement heated? How cold are the winters? Heated basements obviously require higher R-value than unheated basements. Since exterior foam is practically limited to R-5 or R-10, interior insulation is more suitable, especially in very cold climates.

Is the site wet? If the basement walls have a history of moisture problems, or if the site appears poorly drained, interior fiberglass is risky, no matter how well protected. Interior or exterior foam is fine under these conditions. Recent research at the University of Minnesota, however, showed that interior foam is much more effective in keeping moisture out than exterior foam.

Is this a termite area? In termite areas, use only interior insulation. Exterior foam foundation insulation serves as a hidden pathway for termites on their way to the tasty wood wall and floor framing. Termite sheilds often don't work, and even soil treatment may not always be effective. Terminex Corporation, a leading termite exterminating service, refuses to treat houses in the Southeast with exterior foam foundation insulation.

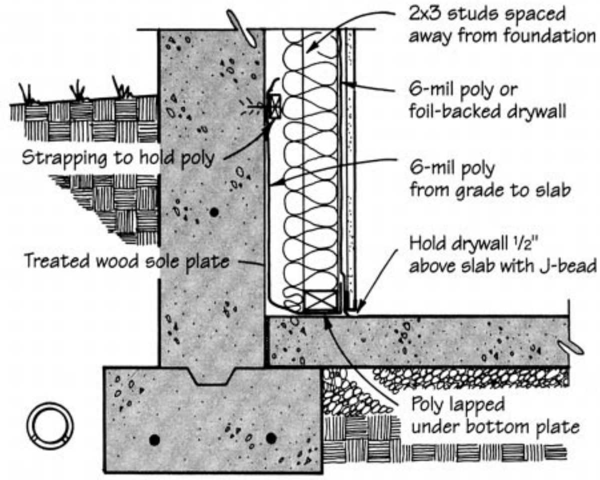
Is the basement to be finished? If the basement is to be finished, then the obvious choice is between an interior framed wall or interior foam. If there are any questions about moisture, I'd recommend foam.

Commonsense questions. Is the basement so full of junk that any work would require hazardous duty pay? How about the outside? How difficult would it be to excavate 2 feet? 4 feet? 7 feet? Is there extensive shrubbery around the house? These considerations have obvious implications regarding interior vs. exterior insulation.

My favorite system. Except in wet basements, the most sensible retrofit in my opinion is an interior framed wall with fiberglass batts. One nagging question is whether to install an interior vapor retarder, a moisture barrier, or both. There are as many answers to that question as there are building consultants. I prefer to install a poly moisture barrier against the inside foundation wall, and a vapor retarder beneath the drywall, starting the moisture barrier at grade level, as shown in the illustration above. This leaves an escape route through the top of the foundation for any moisture that might accumulate in the wall.

— J. D. Ned Nisson is an energy consultant and editor of Energy Design Update*, a monthly technical newsletter on energy-efficient building design and construction, as well as the energy columnist for* JLC.

Retrofit Foundation Insulation



Foundation insulation: *This foundation system has proven itself in both the U.S. and Canada. Notice that the polyethylene moisture barrier ends at grade level to allow an escape route for moisture through the top of the foundation. The 2x3 stud wall is spaced away from the foundation wall to allow for thicker insulation and to keep the wood away from wet concrete. The gypsum board is spaced 1/2 inch above the floor to keep moisture from wicking up.*

❼ Why does mildew grow in the closet?

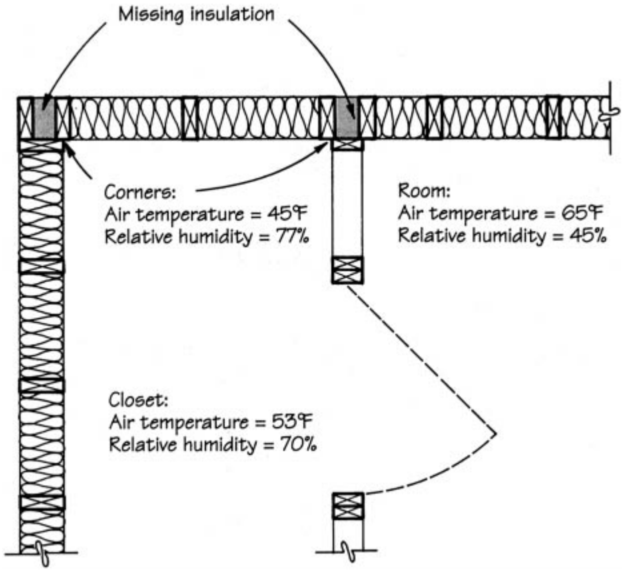
Marc Rosenbaum responds:
To control mildew growth, we must first look at the relationship between air, water vapor, and relative humidity (RH). Water vapor is water in its gas form, and is present in air. The warmer the air, the more water vapor it can hold; the colder the air, the less water vapor it can hold. RH is a measure of how much water vapor is in the air compared to the maximum amount of water vapor the air can hold at that temperature. As air cools, without changing its water vapor content, its RH goes up. As the air continues to cool, it reaches the point where the water vapor it contains is all that it can hold — this is 100% RH. Cooling the air any further will result in condensation as some of the water vapor changes to liquid.

Mildew can only grow on surfaces where the RH exceeds 70%. Closet surfaces tend to be colder than adjacent rooms, because of poor air circulation from the heated room to the closet, and because, relative to their size, they often have more exterior surface area for heat to escape. A corner or cold wall section lacking proper insulation is particularly vulnerable. Since these areas are colder, but have just as much moisture in the air as adjacent rooms, they have higher RH and are prone to mold and mildew.

To control the mildew, we have to lower the RH of the closet below 70%. To do this, we either have to raise the closet temperature or lower the amount of water vapor present in the air.

When troubleshooting a closet mold problem, measure temperature and RH in the adjacent room with a sling psychrometer. If the room RH is 30%, then it will be difficult (and hard on the occupants' respiratory systems) to reduce RH much, so look for ways to raise the closet temperature. Either increase heat flow into the closet (in some cases, louvered doors may permit enough heated room air to circulate; in other cases, you may have to put in some heat

Mildew in Closets



Mildew conditions: *Mold and mildew often grow in closets since the colder temperatures raise the relative humidity above 70%. Missing insulation at corners and framing intersections is often to blame.*

directly), or cut heat loss from the closet (add insulation, seal air leaks).

If the room RH is 50% or greater, look for ways to reduce the amount of moisture in the air. First, control the moisture at its source. Is it coming from a hot tub, lots of plants, or a gross of gerbils? Is it coming from the six cords of firewood drying in the basement? Next, if the problem occurs in the heating season, increase ventilation levels to replace humid house air with cold outdoor air holding little moisture. As a last resort, use mechanical dehumidification.

Closet mildew problems often occur with other moisture problems that the homeowner is not aware of, so a comprehensive "footing to ridge" assessment may be in order.

— Marc Rosenbaum, P.E., of Energysmiths, in Meriden, N.H., designs and engineers everything from hvac systems to solar, low-energy use homes.

❽ What causes truss uplift and how can it be prevented?

Henry Spies responds:
Truss uplift is caused by differential shrinkage between the upper and lower chords of a truss. In a well-insulated house, the bottom chord is buried in ceiling insulation. In the winter, that chord is kept much warmer, and tends to dry to a lower moisture content than the top chord, which is exposed to the ventilated attic air. This dry bottom chord shrinks. Most of the shrinkage takes place across the grain, but there is some lengthwise movement as well.

In a triangular structure, such as a truss, if the bottom member of the triangle is shortened while the two top chords remain the same length, the peak of the triangle rises, pulling up the bottom chord, which is attached by webbing or a king post. As the ceiling rises, unsightly corner cracks may open up. If the partition is firmly attached to the bottom chord, the partition may even be lifted off the floor deck. *This is not a structural problem*, just a cosmetic one.

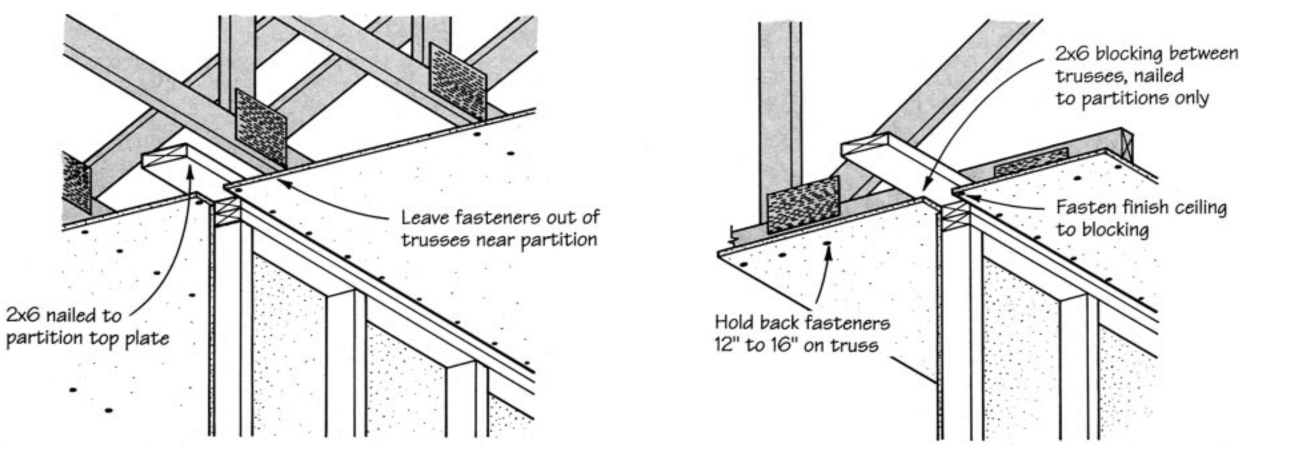
In the summer, when the temperature and moisture content of the top and bottom chords are nearly the same, the truss will come back to its original position, closing any cracks that have formed. In many instances, this cycle will occur only once. In others it will occur on an annual basis.

How can you keep this from happening? You can't fool Mother Nature. A truss manufacturer can select chord members that come from the outer parts of the tree, which helps. The "juvenile wood" near the center of the tree moves more with changes in moisture content than the mature wood. But the most practical thing a builder can do is to use details which will prevent the cracks from showing.

A connector such as the *Stud Claw* (Stud Claw/USA, 5370 Chestnut Ridge Rd., Orchard Park, NY 14127; 716/662-7877) can be used to connect the top plate of an interior partition to the truss. A single nail that slides in a groove is tacked into the bottom truss chord, allowing the truss to move vertically with seasonal changes. The ceiling drywall should not be nailed to the bottom chord of the truss within 16 inches of an interior partition. Instead, it can be supported by corner clips nailed to the wall studs, or nailed to a wider top plate, as shown in the illustrations. This allows the drywall to flex in the 16-inch space between the last nail in the chord and the partition. The corner is held solid, so the tape does not break. The deflection of the drywall is usually unnoticeable.

— Henry Spies is a building consultant formerly with the Small Homes Council-Building Research Council of the University of Illinois, and the Q&A columnist for JLC.

Truss Uplift Solutions



Parallel Partitions **Perpendicular Partitions**

Preventing ceiling cracks: *When trusses are parallel to partitions (left), install 2x6 nailers for fastening the ceiling drywall. Do not nail the drywall to the bottom chords near partitions. When trusses are perpendicular to the partitions (right), install "dead wood" blocking to attach the ceiling drywall, and hold the nailing back 12 to 16 inches on either side of the partition.*

❾ How should wood siding be installed over rigid foam insulation?

David Utterback responds:
When installing wood siding over rigid foam sheathing, you must protect the siding from moisture and heat buildup, and use proper nailing.

Moisture protection and heat buildup. Since foil-faced foam is a moisture barrier, it should be used with a continuous-film vapor retarder on the inside wall under the interior finish to keep condensation out of the wall cavity. However, you may get some condensation between the sheathing and the siding, and some heat buildup beneath the siding. These conditions can cause cupping, splitting and peeling if the siding is not installed and finished properly.

Siding should be backprimed to prevent moisture that accumulates between the foam sheathing and wood siding from being absorbed into the back of the siding. If the back of the siding is left unprimed, it will absorb moisture at a faster rate than the finished front side, causing cupping. And without backpriming, that same moisture can be drawn through the siding when the sun comes out, causing the finish to blister. Building paper, applied between the foam and the siding, will absorb some moisture, which can help minimize problems. It can also absorb some of the heat that builds up there, helping to prevent excessive drying and splitting. The splitting problem is usually compounded by improper nailing practices.

Another way to prevent both the moisture accumulation and the heat buildup is to fur the exterior walls with 1x2s over the rigid foam sheathing before applying the finish siding. This creates a $^3/_4$-inch air space between the sheathing and the siding, providing a natural way to ventilate the excess heat and moisture from this space. Some type of vent strip or screen should be used at the top and bottom of the wall to keep out insects. Door and window jambs must also be extended to allow for the extra thickness of the exterior walls.

Nailing. Proper nailing will ensure quality performance of the wood siding. Always use non-corrosive fasteners and never double-nail solid wood siding materials. Nails should penetrate at least 1 to $1^1/_2$ inches into studs or blocking under the foam sheathing. Ring-shank or spiral-shank siding nails are recommended for increased holding power.

Nails should also be set flush with the surface of the siding but not overdriven. If the nails are set too hard, the foam sheathing will compress, causing waviness in the siding.

— David Utterback is a field representaive for the Western Wood Products Association.

❿ In a mild climate, should the vapor barrier be on the interior or the exterior of the walls?

Frank Vigil responds:
The answer is simple. Or, more accurately, the question is irrelevant since codes in most states with mild climates *require* a vapor barrier on the side which is warm in winter — the inside. However, it is important to remember that walls built in this climate must have the potential to dry.

Mild (or "mixed") climate zones are those areas requiring both heating and cooling for several months of the year. During hot, humid, summer months, the predominant vapor drive will be from the outside in during the sunny daytime. At night, the wall should dry to the outside, if given the opportunity. An exterior sheathing of plywood or OSB will act as a mild vapor retarder, but will still allow the wall to dry to the outside at night.

To fully understand why this is important, you must understand what a vapor barrier does. First, let's be technically accurate and call this a vapor diffusion retarder! A vapor shield, such as polyethylene sheeting, can only *slow* the flow of vapor diffusion — it can't stop it.

Vapor retarders are intended (at least in theory — probably not too well in practice) to limit the amount of moisture — in vapor form — that passes through the building. The rate of vapor diffusion is determined by the permeability of the building material and the driving force, which is air pressure. The higher the pressure or the lower the permeability, the greater the vapor diffusion will be.

Vapor diffusion is also a function of surface area. A vapor retarder that has 30% holes would only be 70% effective. However, this may not be as critical as you think.

Diffusion is only one way moisture migrates through a wall, and the least important. The others, in order of importance, are bulk moisture (rain and snow), capillary action (wicking), and air-transported moisture (leakage of humid air). Thus, having a few small tears in the vapor retarder of a wall is less important than sealing all the wall penetrations, such as electrical outlets, light switches, and gaps between the interior wall board and the framing.

If all this seems confusing, remember, given the opportunity, most conventional wall systems are somewhat forgiving. Control the moisture in the order of importance, and you should have no problem. ■

— Frank Vigil is senior project manager with the North Carolina Alternative Energy Corporation, currently developing a voluntary, statewide performance standard for new construction.