Installing an Ornamental Tile Floor

For a crack-free tile floor, size the joists to limit deflection, use the right subfloor and underlayment, and don't forget the expansion joints

by Tom Meehan

Most of my residential tile work centers on the kitchen or bathroom, but some homeowners also like the look and feel of tile in other parts of the house. One of the most extensive jobs we've done lately involved tiling every floor but the staircase in a two-story, 2,500-square-foot house, including an ornamental rug-pattern area in the great room. This was an interesting project for us because the homeowners — who happened to own a chain of upscale tile stores — were unusually well informed about the latest tile installation products and techniques.

Preparing the Subfloor

Nothing spoils a ceramic tile floor installation like a large stress crack running across the field. To prevent this kind of expensive disaster, I always do a little pre-installation detective work to make sure the floor is structurally sound. Substrate deflection is by far the biggest contributor to tile failure. If the span is too long for the joist dimension or the joists are too widely spaced, problems are inevitable.

For most tile applications, sticking to the standard L/360 formula (span divided by 360 = maximum allowable deflection at center) will keep you out of trouble. The exception is

Installation Details

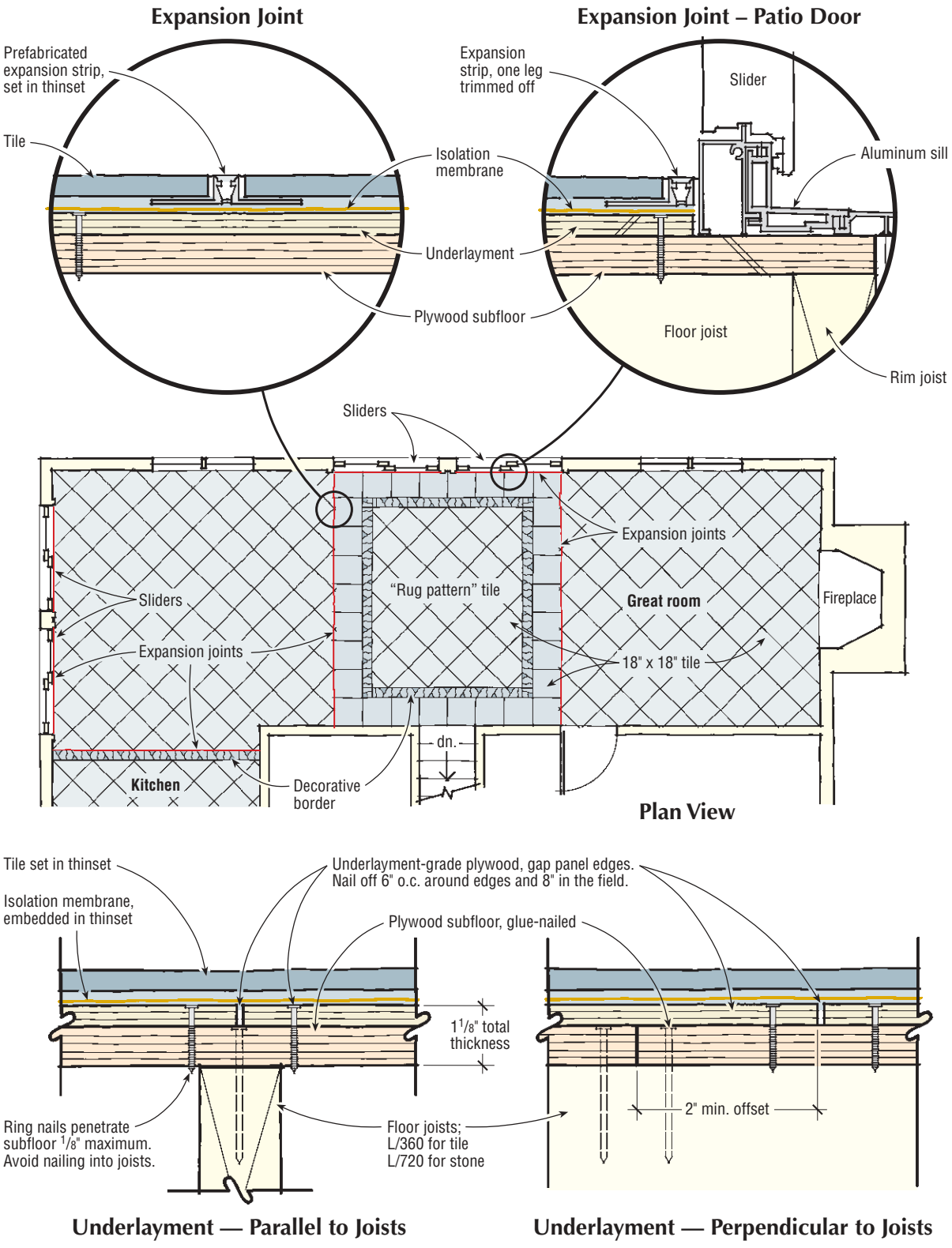

Figure 1. An uninterrupted expanse of floor tile is prone to stress cracking. Plastic expansion strips installed every 20 to 24 feet divide the field into smaller zones, minimizing cumulative movement and stress. Thermal movement at door thresholds cracks grout. It's a good idea to install an expansion strip there, too. A minimum 1 1/8-inch-thick plywood substrate and underlayment are required to limit deflection between framing members. Underlayment provides added stiffness and a disconnect between subfloor and framing movement. Proper panel layout, edge gapping, and nailing help ensure that the underlayment performs as intended.

natural stone tile, which is much more susceptible to breakage than ceramic tile. Here it really helps to have the finish floor specified before framing starts, because the Tile Council of America (TCA) recommends reducing the maximum deflection by half, to L/720.

Underlayment and plywood. Whichever deflection standard is used, the total thickness of the plywood subfloor and underlayment-grade plywood should ordinarily be at least 1 1/8 inches. According to TCA, particleboard underlayment and OSB subfloor panels are not acceptable substrate materials under ceramic or stone tile.

Underlayment edge and end seams must be offset from those of the subfloor by at least 2 inches to prevent telegraphed stress cracks. The subfloor plywood should be glue-nailed to the floor joists and the underlayment nailed off on 8-inch centers in the field and every 6 inches around the edges. Avoid nailing underlayment into the floor joists, because that can telegraph framing movement to the surface (see Figure 1, previous page). To be safe, I use underlayment nails that won't penetrate the subfloor by more than 1/8 inch. I also gap the panel ends and edges, using a nickel or a quarter as a gauge, to let the panels "work" a little without stressing the tile.

Figure 2. Rather than cutting tile around door casings, the author cuts a clearance gap beneath with an undercut saw guided by a simple tile-and-cardboard gauge.

Drop cloths. Although good builders seldom ignore these basic steps, I quite often find that they've dropped the ball during drywall finishing by failing to protect the floor from paint overspray. This guarantees a tile bond that is only as strong as the paint on the floor. In such cases, I can't proceed until the floor is sanded clean.

Isolation membrane. On this job, I used a slightly different subfloor system. For added insurance against cracking and other potential problems, the owners asked me to install the tile over an isolation or uncoupling membrane called Ditra Mat (Schlüter Systems, 800/472-4588, www.schluter.com). This plastic sheet material has a waffle-like grid with undercut cavities that lock onto the dried cement in dovetail fashion; its other side is covered with a fleece-like material. The 1/8-inch-thick membrane is easy to install and allows most tile to finish flush with abutting 3/4-inch wood flooring.

According to the manufacturer, Ditra can provide a crack-free installation when applied directly over a single layer of 3/4-inch tongue-and-groove plywood decking on joists spaced up to 19.2 inches apart. The American Tile Association approves this approach for ceramic tile, although stone tile will still require a double-layer 1 1/8-inch substrate. (To be conservative, we used a double-layer 1 1/8-inch substrate beneath the Ditra Mat even though we were using ceramic tile, not stone.) Ditra Mat can also be used in place of backerboard under tile countertops (see "Tiling Over a Laminate Countertop," 3/03).

To install the membrane, I used a 3/16x1/4-inch V-notched trowel to spread a high-grade latex-modified thinset (Tec FullFlex, Tec Specialty Products, 800/832-9002, www.tecspecialty.com) mixed rather loosely to aid distribution. I snapped parallel lines at 40-inch intervals — about the width of the mat — to guide spreading the thinset. After laying the membrane, I used a 75-pound linoleum roller to drive out air pockets and voids and embed the fleece side of the mat in the thinset.

Planning the Layout

A distinguishing feature of the second-story installation was the "rug pattern" planned for the central area of the great-room floor. An 18x18-inch rectangular tile border edged by a 6-inch decorative tile band would frame an inside field of the same 18x18-inch tiles laid diagonally. A pair of patio doors in the middle of the room's front wall served as a focal point for the pattern, so I centered the border tile and field pattern on the mullion between the doors. On this job, the baseboard hadn't yet been installed, but the door casings landed directly on the underlayment. I cut the trim to allow the tile to slip underneath, using a tile and a piece of corrugated cardboard to space the blade of my Bosch 1640VS undercut saw off the floor (Figure 2).

Figure 3. After covering the subfloor with a plastic uncoupling membrane, the author squares up the layout for an ornamental rug pattern (left). Full-sized tiles are dry-fitted in both directions from a line centered on the door mullion, followed by a 6-inch decorative tile band (lower left). A diagonal half-tile border sets up the diagonal field tiles in the pattern area (below).

Getting square. The first and most important step was to check the room for square and parallel. I did this by snapping a centerline down the room's long axis, then snapping a second line at 90 degrees to the first, using my folding layout triangle aSQUARE (C.H. Hanson, 800/827-3398, www.asquaretools.com; $50) to check the angle (Figure 3). If the room is a little out of square or parallel, it's not a big deal. Working the tile pattern from a centerline allows any discrepancies to play out inconspicuously along the walls.

Cutting and dry-fitting. I checked my measurements for the rug layout by dry-fitting single rows of tile in both directions, working out from the centerline, using the proper joint spacing — in this case, 3/16 inch. To give the rug pattern a look of planned symmetry, I wanted to complete the edges of the diagonally laid field tile with full half-tiles. This layout dictated the run of the

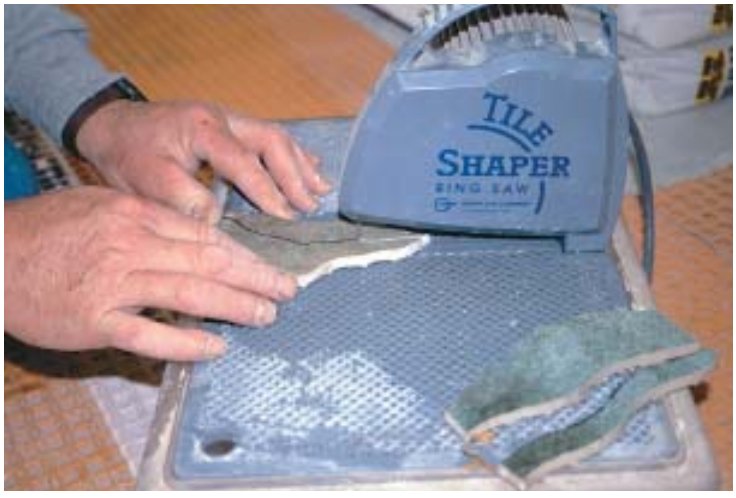

Figure 4. By expanding the border dimension of the rug pattern, the author created a space in the decorative tile layout too large for a single tile to fill yet too small for a full tile. Laying the cut-down tile at the border's corner effectively disguises the adjustment. A diamond-coated blade in a ring saw permits fast and accurate irregular cuts.

Figure 5. After drawing an accurate diagonal line on the tile, the author makes freehand cuts on a diamond-blade-equipped wet saw.

surrounding decorative band. The interlocking zigzag decorative border tile came ready to install and included special pieces to complete inside and outside corners. Theoretically, the pattern could be laid to complete the full band without having to make any cuts. However, the field tile layout stretched the decorative band layout, resulting in an undersized gap, too small to fit a full decorative tile. The owners were adamant about maintaining uniform grout lines, so I couldn't make up the difference by slightly spreading the overall layout. The irregular shape of the proprietary corner tile also ruled out any clever mitering tricks. Instead, I downsized a couple of tiles adjacent to the corner tile and split the difference between slightly reduced, recut pieces.

Cutting a zigzag line through ceramic tile is a job for a ring saw — mine is made by the Gemini Saw Company (310/891-0288, www.geminisaw.com). The saw is vaguely similar to a band saw, but the ring-shaped, diamond-coated wire blade cuts in all directions and revolves through a water bath (Figure 4). Scroll cuts are simple to make with a ring saw; any shape or radius can be cut, greatly simplifying custom inlay work.

I cut the field tile with an electric wet saw equipped with a diamond blade (Figure 5). It's possible to trim the tiles with a snap cutter, but when cutting large, 18x18-inch tile, a water saw produces less waste. The machine I use, a Tile Master XL High Production Tile Saw (Felker Tile Saws, 800/938-7925, www.felkertilesaws.com), allows me to cut larger tile on the diagonal in a single pass, rather than having to cut halfway and then flip the tile to complete the cut. When cutting on the diagonal, I draw a guideline on the tile with a permanent marker and a straightedge, from corner to corner. This helps to keep the cuts accurate as I "freehand" them through the saw blade.

Figure 6. Combing the thinset adhesive in one direction with a notched trowel distributes the adhesive evenly and allows the tile to lie flat. Limiting thinset application to no more than 20 square feet at a time prevents the cement from drying prematurely.

Figure 7. To prevent cracking, at least 95% of each tile should be contacting the thinset. The only way to check this is to pry up an occasional tile and look — but be careful not to crack the tile or dislodge the isolation membrane in the process.

Installing the Tile

Before spreading thinset for the tile, I snapped control lines on the mat to ensure that the tile courses would remain straight. Thinset should be spread in one direction to eliminate voids and heavy deposits and allow the tile to lie flat. I try not to mix more thinset than I'll use in one hour and spread no more than about 20 square feet at a time to ensure that it stays fresh and tacky (Figure 6).

Checking the bond. To ensure straight grout lines, I always keep the edge of the tile right on the edge of the chalk line. I stand back and eyeball the floor from a distance from time to time to look for tiles that I may have pushed out of line while cleaning up the thinset squeeze-out. As I install each tile, I press it into the thinset and give it a good 1/2-inch slide to ensure complete contact with the cement.

It's a good idea to lift a set tile once in a while to make sure you're getting a complete bond (Figure 7). I do this by sliding a trowel under the tile and lifting it slowly to break the suction. This requires care when the tile is laid over Ditra Mat, because the suction can pull the mat free from its fabric backing. The tile should have at least 95% thinset coverage. Voids in the bond, or thinset missing under one of the corners, may cause the tile to crack. Replacing cracked tile is a labor-intensive task that can be avoided if you take the proper precautions. The larger the tile, the more important it is to have perfect thinset coverage.

Expansion joints. An uninterrupted field of floor tile should include an expansion joint at least every 20 to 24 linear feet. On this job, the rug-pattern border offered the best opportunity, because it cut all the way across the room, while the field tile ran diagonally on either side of the border. I installed a prefabricated expansion joint, also made by Schlüter (Figure 8, next page). This plastic strip is made to mimic a grout joint and comes in a variety of colors. Its attached webbing extends 1 inch under the tile in either direction. The expansion joint effectively divides the tile field into separate areas, reducing cumulative stress.

To play it safe, I also installed expansion strips against the aluminum sills of the patio doors. I've often found cracked grout at these junctions, caused by metal expansion and contraction.

Figure 8. Large, uninterrupted expanses of tile should be divided into smaller sections with expansion joints to avoid stress cracks. The author uses a proprietary plastic strip that's available in a variety of colors for a good match with the grout (above left). Another strip, placed in front of the metal door sill, protects the adjoining grout and tile from damage caused by thermal expansion (above right).

Figure 9. A line snapped across the points of the completed rug pattern permits accurate layout of the field areas to either side (left). Full half-diagonals initiate the general area installation (above).

Figure 10. To prevent dried grout from sticking to the tile, spread only as much grout as can easily be cleaned within an hour (above). Clean water and regular rinsing with a sponge make for efficient cleanup. As the grout haze dries on the tile surface, the author and crew polish it away with soft rags and paper towels (right).

I maintained a 1/4-inch gap between the tile and walls around the perimeter of the room. It's important to clear this gap of any debris during grouting. The remaining gap is covered by baseboard.

Grouting and Finishing

Because this job involved such a large area, we began grouting one section before we'd finished laying the tile on the other side of the room. We completed the rug area first, then continued laying the diagonal field on either side. To ensure that the pattern would be consistent on both sides of the rug border, we pulled a chalk line across the rug diagonals (Figure 9, previous page).

My helper, Chuck Young, grouted the floor with Mapei's Ker 200 series polymer-modified gray grout (Mapei, 800/426-3734, www.mapei.com). The key to efficiently grouting a large area is to make the joints as regular and even as possible and to clean the floor well as you go. Because grout that sets up on the surface of the tile becomes difficult to clean off, it's also important to avoid spreading grout over too wide an area — no more than you can clean off within an hour (Figure 10).

Before grouting, I give some thought to the temperature of the room. Ideally, it should be a comfortable 65°F to 70°F. In a room with a lot of windows, direct, baking sunlight can cause the grout to dry too quickly. To avoid that, I'll wait until the sun moves off that section of the floor.

By the time Chuck finished spreading the grout, the first section was ready for a wash with clean water and a sponge, regularly rinsed and squeezed out. Using too much water can weaken the cement-based grout. As we completed each area, Chuck polished the floor with a clean paper towel or a rag to take off the dried grout haze. We took care of the small amount of cleaning that remained with a mildly acidic tile cleaner.

The following week, we returned to seal the grout and tile. We coated the entire surface with MiraSeal 511 Impregnator (Miracle Sealants, 800/350-1901, www.miraclesealants.com) using an ordinary pump-up spray applicator, then thoroughly ragged the floor to remove the excess. Proper ventilation is important when using this or any sealer; off-gassing from the uncured product should be considered a health hazard.

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