Installing Pavers

Proper preparation of the subsoil, base, and bedding layers will keep a hardscape looking great for years

by Eddie Martindale

When I explain my installation process to clients, I ask them to imagine their house without a foundation. It may look good for the first few days, weeks, or months, but eventually the walls will sag, the floors will collapse, and the roof will cave in.

Likewise, the appearance, longevity, and safety of a patio or walkway depend on the quality of its foundation. The surface can be made of anything from the newest faux-stone concrete pavers to ADA-approved bricks to granite, flagstone, mica, and other slabs. But if attention isn't given to what lies beneath it, sooner or later the surface will have unsightly dips, rolls, or other toe-catchers — and a resulting trip could easily turn into an injury and potentially a lawsuit.

Preparing the Grade

The single most important aspect of paving installation is base preparation. Every job incorporates two layers of base material. The bottom one is a thick layer of compacted crushed stone that acts as a foundation. On top of that is a thin bedding layer of sand. Once the base is prepared and the bedding course set and screeded, setting the actual pavers is pretty simple.

Figure 1. Every paver installation starts with excavating down to stable soil. Any unsuitable fill is removed and its replacement compacted to ASTM standards.

In my northern climate, the typical excavation for a walkway or patio is about 8 inches (**Figure 1**). I always excavate a minimum of 6 inches wider than the final paving dimensions in all directions, to be sure the pavers will be completely supported. For drainage, the subsoil (and consequently, all the other layers) should be sloped at least 1 inch in 8 feet prior to compaction.

The final depth of the excavation depends on the quality and compaction of the subsoil. Undisturbed soil is usually adequately compacted, but if fill was recently installed, we remove it and replace it in 4-inch lifts. We use a walk-behind plate tamper to compact each lift to the ASTM standard of 95% compaction.

The level of compaction can be tough for a small contractor to confirm. On our commercial and government jobs, engineers hired by the GC verify compaction using expensive equipment that just doesn't make economic sense for most residential work. At least one manufacturer (Weber; 800/709-3237, webermt.us) produces plate compactors with a readout that lets the operator know when the layer is fully compacted. I haven't used one, but it would take the guesswork out. As a practical matter, we find that we're pretty close to 95% compaction when the compactor bounces on the surface.

If the subsoil is wet, it often means that the clay content is high. In that case, I make sure the subsoil is properly pitched to promote drainage, and I lay down a layer of 6-ounce nonwoven polypropylene landscape fabric before adding the stone base layers. This fabric, which stabilizes the base by preventing the clay from migrating into the stone, can be the difference between success and failure.

Base Layer

The next step is to install the base stone. The formal name for what I use is 21AA, but in my area, it's called "crusher run." It's a mix of crushed stone from 1½ inches down to stone dust. Properly compacted, this stone creates a hard, concrete-like surface

Figure 2. Crusher run stone laid in 3- or 4-inch lifts forms the base layer.

Figure 3. Lengths of one-inch-diameter conduit are set into the compacted base to serve as screed guides (top). After adding stone around the guides, the crew screeds and tamps the surface (bottom).

that is extremely stable and will shed excess water while also allowing some percolation into the soil.

I fill the excavation with 4 to 5 inches of crusher run (**Figure 2**). This is the most critical phase of the installation and will determine its long-term viability. First and foremost, the crusher run needs to be compacted as thoroughly as possible. As with the subsoil, we use a walk-behind plate tamper. Bear in mind that most plate tampers will compact only a 3- to 4-inch lift of stone. For greater depths, we place the stone in several 3- to 4-inch lifts, tamping each one until the tamper literally begins to hop on the surface. With limestone or slag fill, we add water to each layer, which helps with compaction by making it easier for the stone particles to slide past each other. With crusher run, however, too much moisture can create a muddy mess that is harder to compact.

We try to keep the stone flat and in-plane while tamping, coming up to within about an inch of the final crusher-run height. We set the grade with strings, then place screed guides — 1-inch-diameter conduit or 1-inch angle irons — digging them into the base or supporting them on piles of stone as needed (**Figure 3**). After making sure the screed guides are straight, we fill around them with more stone and screed the surface flat. Then we remove the screed guides and tamp the stone.

The goal is to have as smooth a surface as possible after tamping. Most paver manufacturers require that any dips or mounds in the base material vary by no more than ¼ inch from the overall grade. This is because the sand bedding course will follow the contour of the base layer, and any variation will telegraph through to the pavers on top. A flat base surface ensures a paver surface that is as smooth as glass and will stay that way. It also saves time screeding the bedding course.

When installing products whose thickness varies — such as flagstone and bluestone — the overall base level is not as critical, because the large stones can bridge any minor variations in the sand bedding course.

Figure 4. Smaller, 3/4-inch-diameter conduit laid directly on the compacted base guides screeding of a concrete-sand bedding layer.

Figure 5. Before laying pavers, the crew removes the screed guides and fills the resulting troughs in the bedding layer with sand.

Figure 6. Many types of pavers are best installed on a loose bedding layer, then set with a plate compactor. This creates a uniformly flat surface and drives sand into the joints to lock the pavers in place.

Figure 7. Most projects begin with marking the edges and laying a soldier course of bricks or pavers. Once the edges are set, laying field courses goes quickly.

The Bedding Course

I typically set pavers in a 3/4-inch-deep bedding course of concrete sand. Mason sand is too fine, and block sand is too coarse — like buckshot — but concrete sand sets nicely and perks water quickly, two critical attributes for walkways and patios. Many contractors use stone dust as a bedding material. While this is easy to use and compacts nicely, my locally available variety is limestone, which tends to dissolve and cause efflorescence on the paving above.

For screed guides, we place smaller, 3/4-inch conduit directly on the surface of the compacted base layer; we then place the sand and screed again (**Figure 4**). Once the sand is leveled, we remove the screeds and fill in the troughs (**Figure 5**).

Most manufacturers recommend laying concrete pavers on a loose setting bed, then tamping afterward with a plate compactor (**Figure 6**). This helps to achieve a flat surface, and also works sand up into the joints, locking the pavers in place. Sometimes, however, if we are doing a lot of designs, we may compact the sand first to minimize damage to the surface from foot traffic.

We also compact the bedding layer first when laying clay brick; otherwise, the compactor may break the pavers. Sand for use below clay bricks can be compacted by tamping, but I prefer to use water because it will absolutely compact all areas. I thoroughly wet the sand, let it sit for a few minutes to allow the water to perk through, then screed it smooth. The sand will be a perfect 3/4 inch thick.

Laying Pavers

The smaller units of brick or pavers — whose thickness is uniform, typically in the 2- to 3-inch range — are much easier to install when the base is mirror-smooth. Their consistent

Figure 8. Seams in a running-bond pattern are offset by a half-brick. As seams "catch up" to each other on curves, inserting a cut paver resets the pattern.

Figure 9. For many curves, the author lays the pavers beyond the line of the curve and cuts them in place.

thickness also makes them easier to lay than stone, whose thickness often varies.

The first course is typically a soldier course, where the long dimension of the bricks or pavers runs perpendicular to the direction of the field pavers (**Figure 7**). We start by marking the edge of the first course with spray paint.

With a curve, I set the center point of the radius and use a long tape measure like a compass to find the edge. Once the outer soldier course is laid, I step back to see how it really looks, and make any necessary adjustments. I never depend only on my paper design. Rarely does the final installation look exactly like the plan.

Curves are tricky. For example, if you are laying a running bond — where successive courses are offset by a half-brick — the joints on a curve will start to line up (**Figure 8**). You need to be constantly on the lookout for this, and when the joints are within an inch or so of being aligned, cut the next brick to restore the half-brick seam pattern. Otherwise, when you stand up and admire your work after laying most of the brick, you'll realize that the pattern is awful.

Once the borders are laid, the field paver installation goes quickly. To be as efficient as possible I typically leave all cuts to the end, and always use a wet saw to minimize dust. Depending on the installation, I use either a hand-held cutoff saw or a tub saw. If there are a bunch of assembly-line cuts, a tub saw is the way to go. In other cases, to avoid a lot of foot traffic through the bedding layer, it makes sense to cut right next to where the brick is to be installed. For this, I'll lay a small piece of plywood on the adjacent pavers and use it as a "cutting board" to cut pavers with a hand-held saw.

Some cuts are made in place. For example, if I'm cutting a curved detail into a patio, I'll lay the pavers to extend beyond where the curve will be, then use a cutoff saw to make a clean, consistent cut (**Figure 9**). For an inlay, I will lay all of the field tile, then cut out the inlay pattern (**Figure 10**).

Once the cuts are done, I install an edge restraint, but I don't use the prefabricated kind. A number of manufacturers sell brick-edge restraint; it's typically plastic (although aluminum ones are now available, too) and is installed alongside the paving with 10- or 12-inch spikes. Unfortunately, I've

Figure 10. To create clean borders for inlays, all field pavers are set and compacted, then the pattern is cut out.

Figure 11. Mortar trowelled along the edge of the soldier course serves as an edge restraint. The author has found that this detail holds up well to freeze-thaw cycles.

Figure 12. Mason sand swept across the finished surface fills the joints between pavers.

found these products rise with the freeze-thaw cycle and do not go back down.

Instead, once the paving installation is done, I use a straight trowel to remove the sand from beyond the outer paver course, exposing the over-extended crusher-run base. Then I trowel a monolithic triangular-shaped mass of mortar along the paving, carrying it about an inch up the sides of the pavers and down to the base at a 45-degree angle (**Figure 11**). The entire border is eventually hidden by mulch or top-dressed with soil and grass seed.

This edging bonds to the paving and moves with it during freeze-thaw cycles, then settles back down once the frost is out of the ground. I've done it this way for over 30 years with no issues.

Figure 13. Though it should be installed in bone-dry conditions, wetting polymeric sand in place initiates a reaction that turns it into a flexible mortar. On some materials, however, it can leave a visible haze.

Filling the Cracks

The final step is sweeping sand across the surface to fill in the areas between the bricks or pavers (**Figure 12**). Polymeric sands, a great improvement over ordinary sand, have become very popular over the last few years. They look like sand but once misted with water, they set up like a flexible mortar that minimizes washout, ants, and weed growth (**Figure 13**). Poly sand must be swept in when the pavers are bone dry or it will stick to the surface. I use it on concrete pavers only, though, because it leaves a bit of a haze that's not readily apparent on concrete but shows up like a sore thumb on clay brick and natural stone. On those products, I sweep in mason sand.

There are myriad paving products available, and which one you end up working with will depend on the site, the design, and the client's wishes. But the installation is not subjective: Do it right and it will last for generations.

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