Laying Concrete Pavers

For a driveway, walk, or patio, get the base right, and the rest of the job is straightforward

BY JOSEPH CRACCO

Drawing: Dan Thornton

My company, Modern Yankee Builders, specializes in remodeling. We end up doing all sorts of work, from framing to high-quality trim. Sometimes we even get to spend nice days outdoors, working on landscaping projects. This particular job was typical for us. It included a small kitchen addition and replacement of the old asphalt driveway with a new one made of concrete pavers. (A backyard patio or a sidewalk would use the same techniques.)

Concrete pavers offer a bunch of advantages for driveways and patios: A wide variety of styles and colors is available, uniform sizing eases installation, and aside from the excavation (which we subcontract), the few special tools needed are readily rented.

Designing for the site

Because the number of paver styles available is vast, visiting supply yards to review the possibilities and obtain samples is a good idea. A decent supply yard should be able to help with design and with determining how many of each size of paver are needed. A word of caution: Some pavers can be ordered only by the full pallet. So if I require a third of a pallet of, say, small squares to three pallets of rectangles, I'm out of luck. If my supplier quoted a price based on a per-paver basis, I may find out that what I thought was a $150 purchase now costs $450 because of that two-thirds of a pallet of small squares I don't want. I need to find a place for those extra small squares or to change my pattern.

Where I work, patios usually don't require a building permit; for driveways, however, some towns require the local public-works department to do an existing-conditions survey (sometimes they just snap a photo) prior to issuing a certificate allowing the work to proceed. When the new driveway is complete, someone returns to verify that you didn't alter the size or location of the driveway's intersection with the street. Other jurisdictions are much more restrictive, particularly for the first 20 ft. or so where a driveway meets the street. I always check local requirements before commencing work, and I start with a site survey if I'm going to be anywhere near the property lines.

Planning the excavation and fill depth was critical for making sure that the new driveway matched the height of the neighbor's driveway. To have a clean edge to butt our pavers against, we needed to cut a straight line through the neighbor's asphalt driveway and along the edge of the street. Two things were critical in cutting the asphalt. First, the cuts needed to penetrate the existing pavement completely or the excavator would hook the uncut asphalt and rip up big sections beyond the cut. Even after patching, this never looks right. Second, the cuts needed to be dead straight as well as perpendicular to each other or the job would look bad, forcing us to waste time trimming the full pavers to fit.

We could have made the cuts ourselves, but when we added up the time to rent the saw, cut 60 ft. of asphalt, and return the saw, and then factored in the rental rate, the cost to

PAVERS NEED LAYERS

The showy part of the driveway is the pavers on top, but what's below matters just as much. Choose the right materials, and compact them correctly for a flat, durable installation.

GET THE BASE RIGHT

A good excavator is crucial. *When digging down to the required depth of the base stone, be sure that the subgrade is flat so that the succeeding layers are of a consistent depth.*

Geotextile separates the layers. *The main purpose of geotextile is to prevent the crusher run from mixing into the subgrade over time and losing its bearing capability.*

Spread the crusher run. *A mix of stone from ¾ in. to dust, the crusher run helps to spread the loads from the pavers above to the subgrade below.*

Tamp to prevent settling. *Place the crusher run in two 4-in.-deep lifts. Compact the first lift, then place and compact the second.*

hire a specialized contractor to cut a dead-straight line was only a little more.

Base prep is key

No matter the kind of paver project, success depends on installing the base correctly. Pavers require a sand setting bed atop a base of crushed stone for drainage and support, as well as underlying subsoil that can handle the loads. Each paver manufacturer has specific requirements, but the ones here are fairly typical.

Elevation restrictions on all sides controlled the depth of our excavation. The driveway had to end up flush with or just a bit higher than the road and the neighbor's driveway. The edge near the front of the house needed to meet the front walk. The back had to rise slightly to eliminate what would have been a difference in height between the driveway and the client's planting bed. Ultimately, the adjacent asphalt driveway and the road were the critical control points. For the height to work out, the final elevation of the 1-in.-deep sand bed directly below the pavers would need to be 3 in. lower than the neighbor's driveway and the street. On other jobs, we might be looking for a crown to drain water off each side, or maybe a dead-flat, pitched base to send water in one direction. Over

Photos facing page: courtesy of Unilock

a 10-ft. span, the base has to be graded to within ¼ in. of flat. (Flat doesn't mean level, just planar.) The goal is to make adjustments by adding or subtracting from the crushed-stone base so that the sand setting bed ends up a uniform depth.

On any paver job, the excavation and the base materials that follow have to extend at least 8 in. beyond the edge of the pavers so that the edge of the base doesn't crumble under load. In this case, that didn't apply to the side that abutted the neighbor's drive because there was an existing compacted base there. Fortunately, the subsoil was suitable. If the soil had had significant amounts of clay or organic matter (both of which can hold a great deal of water, causing frost heave in cold climates), we would have had to excavate to good soil and to use more crushed-stone fill, driving up the cost of the project.

After Don Lemonde, our excavation contractor, removed the old asphalt driveway and hauled it to a recycling facility, he dug out all the soil down to a little more than 12 in. below what would be the final elevation of the pavers. After grading the subsoil to eliminate pockets, which retain water, Don compacted the excavation with a 4000-lb. walk-behind vibrating compactor, running over it twice in perpendicular directions. Compactor weight refers to the force the compactor exerts as it vibrates, not the machine's actual weight. These walk-behind machines weigh a little more than 200 lb. and are readily rented.

Fill the excavation back up

The next step was to install a layer of geotextile, a synthetic fabric that increases the stability of the soil and the aggregate base. Geotextiles keep fine soil particles from migrating into the aggregate, which helps to maintain its drainage capacity. This becomes even more important when the base assembly is below a permeable pavement.

Above the geotextile, Unilock, the paver manufacturer, required 8 in. of compacted ¾-in. crusher-run gravel, a blend of crushed stone ranging in size from ¾ in. down to dust. Manufacturers specify how big a lift (or layer) of gravel can be installed at one time, based on the size of the compactor. A 4000-lb. vibrating compactor allows for 4-in. lifts.

After Don finished, we had the pavers delivered. The pattern called for three different paver sizes, plus another for a border. We had the pallets placed as close as possible to the work area to save time and labor. We try to stage the correct quantity of each size paver so that the first ones to be used are close at hand and the others become more accessible as the work progresses. With the limited space here, we ended up locating a third of the pallets on the front lawn and the remaining pallets at the back of the property.

Create a sand setting bed

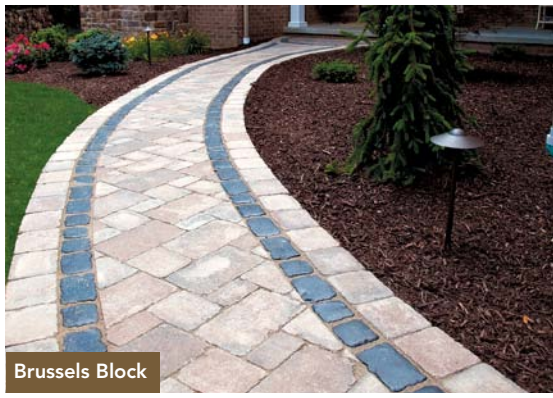
The crusher run was to be topped with ¾ in. to 1 in. of coarse, angular sand (concrete sand, as opposed to mortar sand or play sand) in which to bed the pavers. Before my helper Kevin and I tackled that step, however, we verified Don's grade. He had it perfect, but if he'd been off, we'd have adjusted it by adding or subtracting crusher run with shovels and rakes, then compacting again.

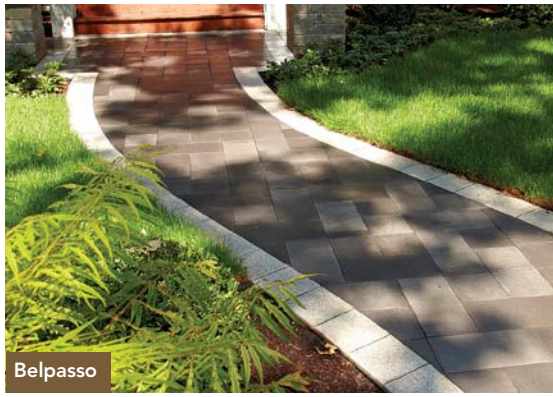
To make the setting bed a uniform depth, we set 1-in.-dia. EMT-conduit guides at the correct height, filled around them with sand, and used a straightedge to screed off the excess. There are a number of methods for setting the exact level of the screed guides. A simple way is to set a string ½ in. higher than where you want the tops of the pavers to end up. The extra ½ in. allows for the pavers to be compacted into the sand bed. Set the screed guides on the subbase, and place pavers on each end. Adjust the guides up or down by adding or removing material below them until the pavers are even with the strings. If the base is right, little adjustment should be needed. In this case, because the neighbors' asphalt controlled our elevation, we simply set a ½-in. spacer on their driveway and used a 10-ft. piece of conduit in place of the strings.

A large magnesium screed typically used for concrete flatwork is ideal for flattening the sand, but a straight 2x4 or even a level also will work. Keeping some sand in front of the screed as you go will help to fill low spots, but letting too much build up can bow the screed and throw off the grade. Once the sand bed is flat, we gently pull out the guides and sprinkle sand into the depressions. I'm looking for a variation in the sand bed of no more than ⅛ in. in 10 ft. More than this means that you'll end up with dips that hold puddles. Over time, these areas will sink even more because the water will wash the fines out of the soil below the low spot in a vicious cycle. We build the sand setting bed in 10-ft. sections, the length of the screed guides, laying pavers over each section before building the next. You could do

Design possibilities

There are several concrete-paver manufacturers, each with its own product line. Offerings vary by region as well, so you'll have to shop around.


Brussels Block


Belpasso


Camelot


Courtstone

the entire sand bed at once, but if you end up not laying pavers over an area, odds are that you'll come back to find that kids, dogs, or cats have destroyed your work. Once the sand is down and screeded, don't walk on it, or you'll create divots.

Setting the pavers

If you don't count how your back feels by the end of the day, setting pavers is the easy part. We usually start at a corner, guided by an existing fixture such as a foundation wall, or in this case, the neighbor's driveway and the street, and then fill in the field using a picture of the pattern as our guide. Without such an edge, we'd create a square starting corner by installing heavy plastic angles called edge restraints atop the base, fastening them with long galvanized spikes per the paver-manufacturer's requirements.

It's important to keep the pattern running straight and true. On this project, we had a 67-ft.-long straight line for one edge and only a 9-ft.-wide driveway, so we didn't need additional benchmarks. In other situations, we set up a centerline to guide the layout. To establish a centerline, you can set a stringline, which often gets in the way, or you can snap a chalkline on the sand setting bed, which is my preferred method.

It's important to set pavers flat, making sure not to dig a corner into the sand bed. When the pavers are compacted, the disturbed sand may even out, but I don't leave this to chance. It's easy to hold the paver about 1 in. above the setting bed, move it in contact with one or, preferably, two sides of the adjacent pavers, then slide it straight down onto the sand.

The pavers used here are made with ribs that bear on neighboring pavers to maintain a consistent gap. Without this contact, the entire assembly would be compromised. Each paver's ability to withstand vertical loads depends on its resisting lateral loads while pushing straight down on the underlying base. If a paver can rock under load, it will eventually fail. (Imagine a tire rolling over a single paver; first one edge and then the other would be pushed into the sand.) Each paver's ability to withstand lateral loads depends on its distributing the load to the pavers around it. If you have 8 ft. of pavers but 8 ft. 1 in. of space to fill, don't gap each of the pavers a little bit to take up the extra space. You must either cut fillers or move the edge in 1 in.

Similarly, before the pavers are compacted into the sand bed, they are susceptible to

MAKE A FLAT SAND BED

Determine the elevation. *A piece of conduit resting atop a few pavers determines the height of the sand bed. The partially buried pieces of conduit are used as screed guides. Set them ½ in. high to allow for compaction.*

Start in a square corner. *This helps create two straight edges to work from, easing the balance of the installation. The mitered corner blocks are a simple custom touch.*

Lay the pavers. *Place the pavers carefully so that they maintain proper contact with each other. Standing on boards spreads out your weight and prevents the set pavers from tipping.*

Top inset photo, facing page: courtesy of Joseph Cracco

Screed the sand flat. *A level or other straightedge rides on the conduit guides (later removed) to screed the sand.*

Install edging. *Spike plastic edge restraints to the ground as the job progresses.*

A circular saw with a diamond blade cuts pavers easily. *A light water mist cools the blade, extending its life and preventing it from warping due to heat, and it keeps the silica-laden dust down. Make sure to be plugged into a GFCI-protected outlet.*

Don't play around with sand

For bedding, we use concrete sand (also known as coarse sand or sharp sand). Unlike play sand, whose grains are smooth and round, concrete sand is angular. Its flat sides engage each other, creating a solid bed. In comparison, play sand's grains move around like ball bearings. If you drove over pavers set in play sand, they would rotate, digging in on one side and lifting on the other as the play sand moved. Concrete sand's stability minimizes this motion. Ultimately, this means that the pavers will remain flat much longer.

COMPACT AND FILL

Pound 'em down. *With a layer of plywood as protection, use a plate compactor to set the pavers firmly in the sand bed.*

Fill the joints. *Sweep a graded material such as fine stone dust over the pavers until the joints are full.*

Fill the joints again. *Sweep in more joint filler after compaction to bring it up to the level of the pavers.*

Finally filled. *When done, the filler should end just below the level of the pavers.*

rolling if you step on the edge instead of the middle. I lay walk boards on the pavers I've just set, and move them as the setting progresses. Not only can I walk across the planks and not worry about rolling the pavers, but the planks also act as a great place to stage the next row without the risk of chipping the set pavers.

We picked from several pallets at once to ensure an even distribution of any color variation. Once we distributed the pavers, Kevin and I laid them as a team. Each paver went from the pile to Kevin's hands to mine, and then to the sand bed without having to be put down and picked back up again.

On the house side, we placed edge restraints as we installed the pavers. Long galvanized spikes secure the edging to the base.

Cutting pavers

Edges often mean cutting pavers. I use a wet saw to minimize dust, which is laden with silica and is a real health hazard. On a project with a lot of cuts, I set up my tile saw on a stand. We set all of the full pavers, then my helper marks the cuts and brings them to me at the saw. While I'm cutting the paver he just marked, he takes the paver I just cut, places it where it belongs, then marks the next paver to be cut.

For efficiency, I plan the job to make as few cuts as possible. There were only eight on this entire driveway. When there are few cuts to make, I don't drag out the tile saw. Instead, I use an old circular saw with a diamond blade. The pavers on this job had distressed edges, so I roughed up the cut edges with a hammer. The final step in setting the pavers was to backfill against the edge restraints with soil.

Finishing up

With all the pavers laid, we were ready to compact them into the base and to fill the joints. It's important to compact as soon as possible after setting is complete. Wait too long, and rain or traffic can tilt pavers out of alignment. If heavy rain hits before we can compact, we wait a day for the sand to dry out a little. We closely inspect the pavers before compacting, replacing any damaged ones. Once compacted, heaven and earth need to be moved to get a paver back out.

Pavers should be isolated from the compactor to prevent damage to their surface. Special "paver saver" pads can do this, but our rental yard doesn't have them. Instead, we used scrap sheets of ¼-in. lauan plywood.

Compacting is done in two steps. The first compaction drives the pavers down into the sand and levels each paver to the adjacent ones. This operation also drives some of the sand up between the pavers. After running the compactor in two passes over an area determined by how much plywood we had, I moved up the driveway while Kevin started filling the joints with graded joint material. Using a stiff-bristle broom on the area I had just compacted, he swept off the excess so that it wouldn't be ground into the paver surface with the second compaction.

When I reached the driveway's end, I doubled back to begin compacting the areas Kevin had filled. This second compaction vibrated the joint filler and settled it well below the surface of the pavers. Kevin then swept in more filler to top off the joints. □

Joseph Cracco is a remodeling contractor from Cumberland, R.I. Photos by Andy Engel, except where noted.

A case for permeable pavers

Unlike traditional concrete-slab or asphalt driveways, paver driveways can be permeable, as the one is in the project shown here. This means that rather than increasing runoff, rainwater can soak through these pavers into the ground.

Storm-water runoff is an environmental problem. When water can't soak into the ground where it falls, the runoff can cause damaging erosion and carry sediments and pollutants into waterways. Humans exacerbate this problem by constructing buildings and paving over the ground. When water can soak into the ground directly, pollutants such as motor oil are retained at the point of origin, where they can be digested by naturally occurring microorganisms. Densely populated municipalities usually limit the percentage of a lot that can be covered with impermeable structures, such as roofs or traditional pavement. This means, for example, that you might not be able to build as large an addition as you'd like. Here, because we replaced an impermeable concrete driveway with permeable pavers, the percentage of impermeable coverage on the lot shrank, even though we had just built an addition. It's not just the pavers that must be permeable, but the filler as well. On this job, we filled the joints with Aqua Rock, a granite product made specifically for permeable-paver joints. It fulfills the requirements for lateral-load transfer as well as the appropriate flow of water.