

A photograph of a modern house with a gravel driveway and a large tree in the foreground. The house is a two-story structure with a dark roof and light-colored siding. The driveway is made of gravel and leads to a two-car garage. A large tree with green leaves is in the foreground on the left, partially obscuring the title. The title is in large, bold, yellow letters.

# Long-lasting Gravel Driveways

Get the drainage and base right, and gravel can be an economical alternative to asphalt

BY DAVID CROSBY

**W**hen John Denver sang, “Country roads, take me home,” he probably wasn’t singing about paved roads. There’s a certain charm to an unpaved road or driveway that you just can’t get with asphalt. Of course, it doesn’t hurt that gravel is also far less expensive up front and over time, and that if you ever have to remove or realign a gravel driveway, you can just rip it up, rake it out, and re-vegetate.

Because many people opt for a gravel driveway as a cost-saving measure, it tends to be used as an excuse for poor site prep and installation. But that’s a missed opportunity, because site prep and installation mean the difference between a job so good you never notice it and a hassle that you live with because you can’t afford to fix it.

Like any unpaved road, a properly built gravel driveway is as much art as science. It’s not just dirt and rocks; it’s a built structure. The right approach may vary not only from state to state



**Top layer**  
¾-in. crushed aggregate spread to a thin layer (about 1 or 2 stones thick)

**Subgrade**  
Minimum of 4 in. to 6 in. of tightly compacted aggregate base course (ABC)

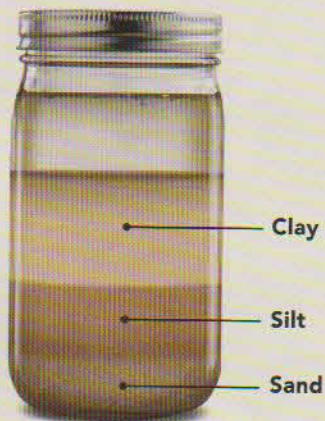
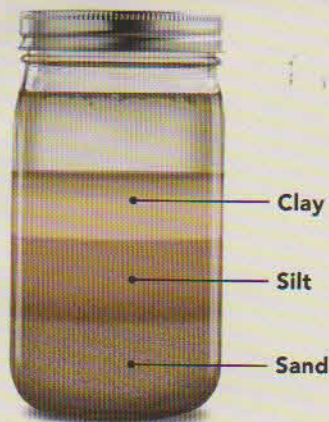
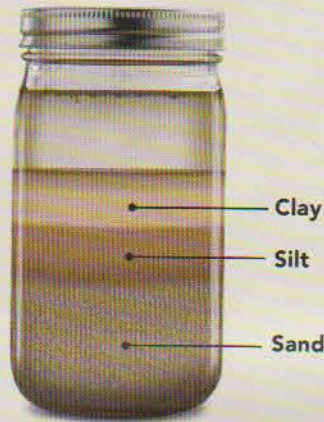
**Base layer**  
At least 6 in. of soil—existing, supplemented, or brought to the site—blended to optimal moisture content and compacted

**Undisturbed native soil**

# GET TO KNOW YOUR SOIL

The first step is to assess your existing subgrade. The ideal soil is a balanced mix of gravel, coarse sand, fine sand, silt, and clay. The acceptable range of mixtures is wide, but you might need to add material to get the desired results.

After digging past the topsoil, fill part of a jar with soil from which you've removed all of the rocks. Fill the jar with clean water, leaving a little room at the top, then close it and shake the contents. When you stop, the soil will begin to settle into layers. What settles immediately is sand. What settles in a few minutes is silt. What settles in a few hours is clay. What floats is organic.



## Take the glass-jar test

**Test results:** If your soil is about two-thirds sand and one-third silt and clay, it will work well as a subgrade. Sand and gravel of various sizes is ideal. If you don't have enough fines to hold the soil together under load, it will still work as a subgrade, but plan on importing material for the last couple of lifts.

**Next steps:** Get the grade you want; compact it as you go; establish your ditches, turnouts, and water bars; and top it with the best material that is available locally.

**Test results:** If your soil is between one-quarter and one-half sand, with the rest silt or clay, then it is going to be prone to heaving, mushing out from under the load that is applied (so-called displacement failures), and settling. It generally will be a muddy mess.

**Next steps:** This is the soil you need to compact tightly to increase the bearing strength and to reduce the chances of water saturating the subgrade. Consider bringing in gravel and blending it with the existing soil as you work it.

**Test results:** If you have mostly clay and silt, including fine sand but very little coarse sand, you're at risk of the driveway behaving in a plastic manner when it gets wet. To determine the risk here, do a follow-up test: Take a small clump of the soil, wet it slightly so it is moldable, and roll it between your palms or fingers. If it rolls out into a long thin shape like a worm without breaking, you have problem soil.

**Next steps:** The smartest thing you can do is hire a good equipment operator. If that isn't an option, consider bringing in some pit-run gravel, which will reduce the chances of heaving and settling.

or climate to climate, but possibly from one end of your property to the other. Depending on where you are, the available materials will differ, as will the site conditions, drainage, and existing soil types.

I've built unpaved roads in mountains, deserts, forests, coastal regions, and swamps, and they all have held up well. Every job was unique, but there were always basic principles to apply and common mistakes to

avoid. In my experience, most problems with unpaved driveways can be traced back to one or more of these three things: bad design, moisture, or unsuitable soils.

### Well-graded works best

Compared to the scholarly works that have been published on the subject of structural fill and road base, what is offered here is a gross oversimplification. Still, the principle

remains: A good subgrade for an unpaved road is analogous to the foundation of any other structure. To achieve the desired strength and stability, the subgrade should be well graded, meaning that a mixture of stone, gravel, coarse and fine sands, silt, and clay exists in the right proportions (see "Get to know your soil," above).

The idea is that the stone and coarse gravel provide a lot of the bearing capacity, the sand

## Moisture and compaction

Soil reaches its maximum density for any given compaction effort at what's called optimum moisture content. In some parts of the country, the existing moisture content of the soil already will be optimal; in other regions, however, you will need to haul in water or get rid of it.

You can hire a geotechnical engineer to determine optimum moisture content, but a simple test will give an idea of where you stand: Compress a handful of dirt into a baseball-size clump, squeezing it as hard as you can. If you have liquid on your hands, the soil is too wet. You need to rip (scarify) the subgrade of the proposed driveway to let the soil dry, and possibly even flip it a few times.

If there is no liquid on your hands and the clump stays together, then the next test is to drop it from shoulder height. If you drop the clump and it splats, it is too wet, and you may have high-plasticity soil, which requires further investigation. If it crumbles or shatters, the dirt is too dry and must be scarified, wet down, allowed to sit, and possibly turned over a few times before compacting. If it cracks into several pieces but more or less stays together rather than splats, the moisture content is acceptable. That amount of water in the soil will help the particles slide past each other without turning to mud and will enable you to work the voids out of the soil efficiently.



fills in the different-size spaces between the stone and gravel and helps with drainage, and the fines (silt and clay) bind everything together. That's in a perfect world. In the real world, where money matters and sometimes we have to use whatever is available, it's still possible to build a good driveway.

If after you remove the layer of organic soil the native soil seems dense and well graded, you might not have to do anything

more to this layer of the driveway. Often, though, it needs some attention. Be on the lookout for poorly graded, loose, highly plastic soil. If the soil has too high a moisture content to properly compact, it will need to be flipped and possibly augmented before smoothing it out and recompacting (see "Moisture and compaction," above). You also might need to bring in granular material to help with drainage, such as

## How hard is it to do a gravel driveway?

People often ask me if the installation and maintenance of a gravel driveway are within reach of a nonprofessional. I encourage anyone who is so inclined to do this work themselves. Machinery can be rented, local quarries are a wealth of knowledge when it comes to working with local soils, and lots of high-quality information is available in print and online. One of my favorite resources is *The Massachusetts Unpaved Roads BMP Manual*, a free PDF available at [berkshireplanning.org](http://berkshireplanning.org). It's packed with information, and although it was written with a New England bent, it has been the gold standard nationwide for many years.

A skid-steer loader and a mini-excavator or a small backhoe are all the rental equipment needed for most residential work. On driveways that are longer than about 50 yards, a small motor grader is handy but not essential.

A plate compactor or static roller are the two common options for compacting, but be mindful of the damage you can cause to nearby structures with vibratory compaction equipment. It's surprisingly easy to crack plaster or drywall. If there's any doubt at all, you're better off static rolling or wheel rolling in thin lifts.

As the machine operator, it's your responsibility to locate utilities before you dig, to learn basic operations of the machine, and to know typical safety guidelines. Understand where your blind spots are, don't let children or pets anywhere near the work area, and instruct anyone helping you not to walk behind the machine or approach until they have made eye contact and received positive acknowledgment from you.

Finally, don't force the machine out of its operating capacity. You can make a much bigger mess in a few minutes with one of these machines than you can clean up by hand in a weekend, so go easy, and take your time.

# DURABILITY DEPENDS

Bad drainage is the main ingredient in just about every recipe for driveway failure. Ideally, the drainage issue is addressed by laying out the driveway to follow the natural terrain. But that's often not possible, so you must also incorporate drainage strategies.

**Build ditches.** If the native soil isn't too rocky or goopy, building ditches along one or both sides of the driveway gives you material to work with when crowning the driving surface. The ditches also provide a way to drain runoff from the driveway, and they offer another means for diverting the path of overland flow. You often can cut earth away on the high side to create the ditch, and then use it as fill on the low side. On relatively flat sites, or where you are forced to cross contour lines, you may need ditches on both sides.

CUT



# ON DRAINAGE

**Take advantage of the existing terrain.** When possible, avoid steep areas, as these contribute to erosion, accelerated wear, and spinning tires. They also are safety hazards when accelerating or braking. Avoid areas that are below the elevation of the surrounding terrain, as they will be difficult to drain, resulting in mud and frost heaves. For driveway width, 10 ft. is very tight, 12 ft. to 14 ft. is comfortable, and 16 ft. allows cars to pass each other.

**Use water bars to divert flow.** Sometimes no matter what you do, water still wants to run across the driveway, which leads to erosion and a constant maintenance headache. A solution is one or more water bars—pairs of shallow ditches and berms that run 30° to the direction of travel. The angle ensures that you won't have two wheels in the low spot or on the high spot at any time, making for a more comfortable ride and minimizing driveway damage.

**Raise and crown the road.** How far to elevate the roadbed above the ditches or the surrounding terrain is a judgment call. There's only one rule: Make it high enough so that it doesn't get wet and turn to mud or heave. In general, well-graded granular soils on a firm, well-drained subgrade require less elevation than soils that are more clay or silt, and a slope of between ½ in. and ¾ in. per ft. of road width is a good balance of driving comfort and drainage.

FILL

3-in.-minus gravel, which is a mixture of rocks sized from a maximum of 3 in. down to dust. In some cases, you might need to import all of the material for this layer.

On top of this subgrade layer, my favorite options are a state-spec aggregate base course (usually called ABC) or a screened and blended product. Unprocessed gravel—usually sold as pit-run or bank-run gravel—can be an excellent and inexpensive amendment to soils that would otherwise be unsuitable in wet weather. It's important not to use too much, though, because without enough fines to hold it together, it will be unstable.

## Finishing up and maintaining

You may or may not want a topping, and it often comes down to budget. A top layer of clean stone gives a finished appearance, wears better, is a little stronger, and mostly eliminates mud in wet weather. It's a nice touch if you can afford it.

On my company's premium work, we topped the last 8-in. lift of aggregate base course with no more than an inch of ¾-in. crushed aggregate. That stone topping should be just one or two rocks thick; otherwise, you start sliding around in it as you drive. The crushed part is important, too. People seem to like the way round rock looks, but it is slippery to drive on and rarely wears well or stays in place.

Anybody with a gravel driveway will tell you that maintenance is essential. Normal driving wears the particles on the surface smaller and smaller until wind and water carry them away; ruts can appear with rainstorms; a "washboard" surface appears wherever speed, acceleration, or braking is excessive; surface material gets shoved to the outside of curves; and as the original profile changes, the driveway gets muddy.

Once the driveway starts becoming unpleasant to travel on, running a grader over it and re-establishing the crown may be all that's required. But the worse it gets, the faster it gets worse, so timely maintenance pays. If the soils in your area have high plasticity—that is, they get muddy and slippery when wet, you might need to import sand, gravel, or ABC from time to time. □

David Crosby has worked in various aspects of construction for almost four decades. Most recently, he ran an excavation business in Santa Fe, N.M.