

SLABJACKING

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Slabjacking can level sunken or cracked slabs for half the cost of new concrete



A worker injects grout beneath a concrete walkway that has cracked and settled. This will restore it to its original grade.

by John Meyers

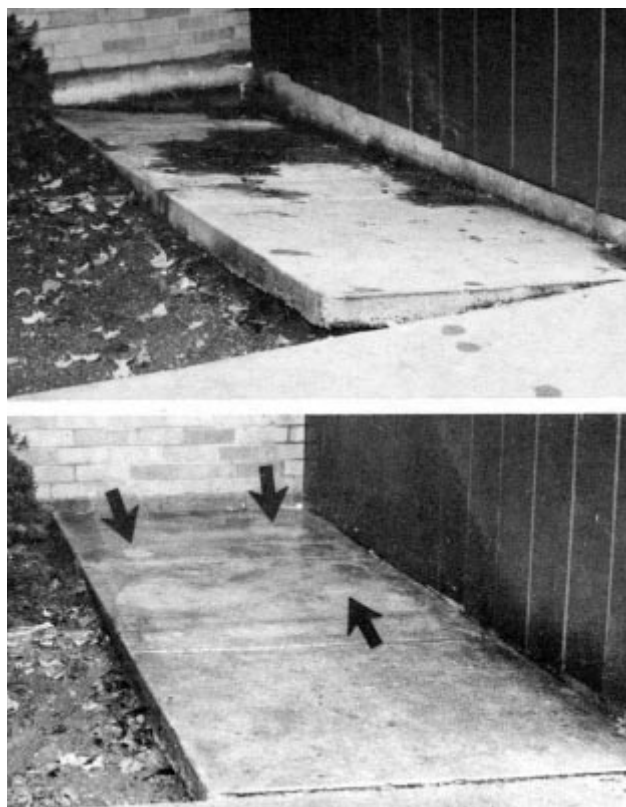


Figure 1. A perfect candidate for slabjacking, this short section of paving was completely intact (top). The crew drilled only three holes (indicated with arrows in lower photo), injected grout, and tilted the slab back into position.

Slabjacking lifts and stabilizes concrete slabs that have tilted or cracked. I've been in the business since 1981, and my company, American Concrete Raising, does nothing but slabjacking. Our prices generally run about half the cost of putting in a new slab.

Slabs settle for two reasons—poor soil and poorly compacted backfill. Soils with high clay content expand and contract as the moisture content of the soil changes. In drought years, the soil shrinks and leaves voids under the slab.

Voids also occur under slabs placed on poorly compacted fill. When contractors build a foundation, they often don't fully compact the backfill. Over time, the soil compacts itself and begins to recede. Anything resting on the soil comes down right along with it.

Slabjacks pump an aggregate-free concrete grout through holes in the slab to the area that has receded or settled. The grout further compacts the soil, and eventually the soil begins to resist the "push" of the pressurized grout. Then the slab feels the pressure and begins to lift (see Figure 1).

Where to Use It

Patios, sidewalks, slabs in attached garages, driveways, swimming pool decks, slab floors in townhouses, or pads for masonry chimneys can be repaired with slabjacking. But there are cases where slabjacking won't work.

You can't use slabjacking to repair concrete cracked into small pieces. We inject grout under pressure, and the pressure makes it hard to control small sections.

You also can't use slabjacking to raise the concrete above the grade at which it was originally placed. We don't want to take the risk of raising concrete slabs that were not built correctly in the first place.

Finally, slabjacking is only effective on slabs that are poured independently of the footing. We can't fix slabs that are attached to the footings in one monolithic pour, such as you find on many detached garages. Even grout applied under pressure can't lift a slab that is firmly attached to the dead weight of a trenched or bell footing. We can, however, jack a slab that is poured within the confines of a proper foundation wall with spread footings. We've done interior slabjacking on homes, condos, stores, and warehouses.

The basic idea behind slabjacking is simple, and indeed, when people see us do it, they get the mistaken idea that anyone can do it. I figure it takes a year or more to master the technique, and you can get yourself in a lot of trouble in that time. Slabjacking raises slabs, but we don't have any way to lower one that has been raised too much. The information in this article will give you an overview of the process, but it will not qualify you as a slabjacking professional.

Tools and Material

You need specialized tools and materials and a great deal of experience to do slabjacking effectively. We sometimes modify off-the-shelf tools to our own requirements.

Drill. We use a gas-powered rotary drill fitted with a star bit or a button

bit (see Figure 2). The two drills we like, Punjar and Cobra, are both made by Berema (P.O. Box 775, Norwalk, CT 06856; 800/243-5005). They supply bits as well.

Mortar mixer. For residential and small commercial jobs, we mix our grout in a 3-bag mortar mixer, with a 7-cubic-foot capacity. Having the right mixer is extremely important in slabjacking because you want all the materials to be completely mixed together for a consistent grout. We use a "souped up" model that has improved engine cooling and that protects the engine and wheels from dust.

Grout. We have our own proprietary mix of portland cement, sand, fly ash, and some other ingredients. The ingredients are blended to our specs and shipped ready for use. We control the mix by adding more or less water.

In general, slabjacking grout is made from a mix of 5% to 20% portland cement; sand that is not too fine or too coarse (sand that passes through a No. 8 sieve is about right); and water. A lit-

tle silt in the mix won't hurt, but you don't want clay particles in the soil because they will shrink. Some slabjackingers use as much as 25% silt in the dry ingredients. This saves money and makes the grout more workable, but the grout won't be as strong. Slabjacking was originally known as "mudjacking" because contractors in the 1930s injected mud slurry beneath pavement, but lifting slabs with cement-based grouts is more common today (see "Midnight Mudjacking," next page).

The slump of the grout that we inject depends on the needs of the specific job. In the course of one job, the crew may go through three different mixtures at different stages in the process—a thin, a stiff, and a medium. You control the slump by the amount of water added to the dry mix.

Slabjacking pump. When the grout is thoroughly mixed, we transfer it into a slabjacking pump (see Figure 3). We use a pump with a maximum pressure of 500 psi (at the gauge, not the nozzle). The pump should put out 100 to 150

cubic feet per hour. We're using a HydraJack pump now that works well for us, but there are others on the market that are the right size for residential and commercial jobs (see "For More Information").

The pump manufacturer supplies a 10-foot hose, and that's all we need most of the time. The equipment is small enough that we can move it right up to the work site. We can work with a hose as long as 40 feet, but we have about 1 psi pressure drop for every foot of hose, so the pump has to have plenty of capacity to compensate for the pressure drop.

Mechanical jacks. We occasionally need mechanical jacks if we're raising a very heavy structure. You sometimes see a chimney tilting away from the house. If the chimney rests on a slab, we would place jacks under the chimney and jack it back to grade, then pump under either side to stabilize the soil.

Miscellaneous tools. We also need a supply of wood plugs to seal grout holes if grout starts oozing out of adjacent holes as we're pumping. On most residential work, you can just place your foot over the hole and wait for the grout pressure to take the grout in another direction. We've also used pressure gauges to monitor pressure at the point of injection, but gauges like this are more common on highway projects. Most of the time, we get a good feel for how much pressure is building up under the slab with just our fingertips or by listening to the laboring of the pump. These provide a good enough "gauge" for an experienced operator.

Analyzing The Problem

Slabjacking crews must know how to work with different kinds of slabs and be able to imagine hidden conditions. Our objective is to reverse the conditions that caused the problem. But first you have to figure out the problem.

The first step is to analyze the con-

dition of the slab. We don't worry about the slab's thickness or reinforcing. We only want to know whether the slab has integrity. If there are a few cracks, we can make the repair. But if the cracks are too numerous or the pieces of concrete too small, we tell the people to break it up and replace it.

The next thing we look for is how much the slab has dropped. The most I've ever seen a patio drop is 9 inches, but we've repaired floors in warehouses that have dropped 17 inches.

Once we know how far the slab must rise to get back on grade, we can figure how much of a void will need to be filled. In addition to the lift, we add a factor for how much the soil will compress once we start pumping. This tells us how much material we have to pump in, and gives us a basis for estimating the labor.

Laying Out the Holes

When we're on the job, we lay out the injection holes. We don't put any hole closer than 1 foot from the edge of the slab. We lay out the rest of our holes in staggered rows, with holes 3 to 5 feet apart.

The more the slab has dropped, the farther back you'll have to go to fill the void. This means drilling more holes because the grout only spreads so far. Our policy is to always place holes on both sides of a crack to fully support the slab. If you don't place injection holes on both sides of a crack, you'll have new cracks opening up a few inches behind the original crack (see Figure 4).

We drill a series of 1 3/4- to 2-inch grout holes. With the gas-powered drill, we can get through a 5-inch slab in 20 seconds. Depending on the soil or fill beneath, we may drill farther.

For the grout to start flowing, we need a void just beneath the hole. If the soil is loose, the first injection of grout creates the void as we pump. But with dense subsoil or soil pressed tight against the slab, we may need to blow out a hole with compressed air, water, or more drilling. For this, we often flare out the bottom of the hole with a rotary hammer and chisel bit.

Grouting Tips

Once we've prepared the holes, we load well mixed mortar into the pump, insert the nozzle in the grout holes, and start pumping in the material.

The grout that goes in first to compact the soil is best described as a "flowable" grout. A little grout is injected in each hole. Next, the workman makes another pass at the holes, this time increasing the pumping pressure and

Figure 2. A gas-powered rotary drill takes 20 seconds to go through a 5-inch slab. A star or ball bit on the drill leaves a clean hole, ready for patching.



Figure 3. A slabjacking pump pressurizes the grout and pushes it through the injection hose. The operator controls the flow and pressure with controls on the handle.

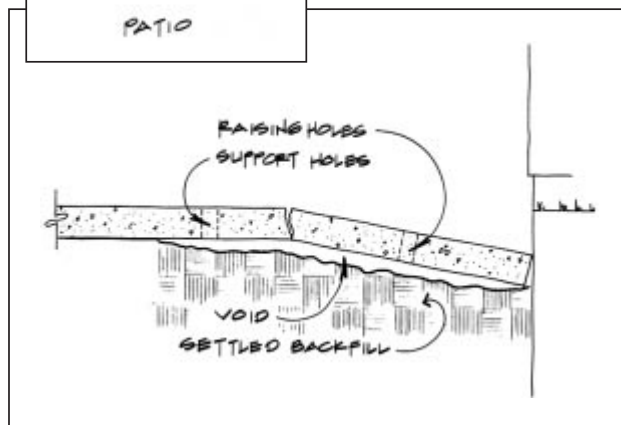
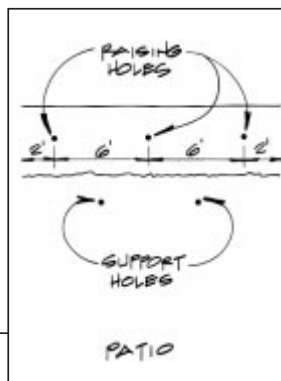
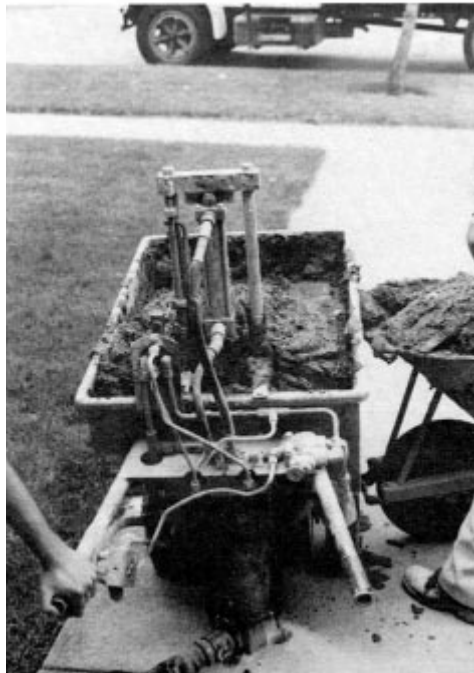


Figure 4. A patio typically cracks when the backfill settles. The three lift holes on the fallen piece (inset) are used for raising. The holes on the other side of the crack are injected to fill voids and provide support.

pumping more slurry in. The pressure compacts the soil, and the slab may start showing some signs of movement. Now the worker is ready to do the actual lifting.

By going back to each hole, always starting at the lowest point, he begins the raising itself. The operator may use a different grout than the one used to compact the soil. The pump operator never raises the slab more than 1/4 to 3/8 inch at a time through any one grout hole. If too much grout is injected in one hole, too much stress builds up in the slab. Concrete has very little flex, and you could crack off a corner. You can control the rate of lift by varying the grout, the pumping rate, or the pressure.

The size, condition, and construction of the slab determine what kind of grout we use during the lift. If the edge of the slab is confined (for example, by a foundation wall), we might use a more flowable grout. But on most exterior residential work, a flowable grout would spill out from under the edges of the slab. When we're injecting grout near the edge of an unconfined slab, we're more likely to use a stiff mixture with zero slump. We also use a stiff mix when we're lifting more than an inch or two, even on confined slabs.

The pumping rate varies from 0.25

cubic feet to 2 cubic feet per minute. The higher rates are used when we're filling voids prior to the lift, with large deep voids, or when using a flowable grout to lift a large area at a time. We use lower injection rates when we start lifting and during the final phase when we're trying to get a perfect level. The operator on the hose must make changes in injection rate slowly, without stopping grouting, because he doesn't want the material to set up until it has flowed where it's supposed to. If we're pressure grouting the voids only, and not trying to do any lifting, we stop when we see grout coming out of adjacent holes.

Pump pressure varies too. At the start of a lift the mud pump might be cranked up to 500 psi, but once the lift starts, we lower the pressure to 25 to 50 psi at the point of injection. We use lower pressures with fluid grouts than with stiff mixtures since it takes more pressure to push a zero slump grout through the hose.

Filling the remaining space in the void beneath the slab comes last. For that, we may switch to material that resembles a thick paste, working the same patterns as before. Unfortunately, there are no hard and fast rules for what kind of mix to use or what rate or pump pressure to use during injection.

The pump operator must be skilled in evaluating site conditions, such as soil type, slab conditions, and general construction conditions that might have an impact on the job. For instance, it's up to the operator to know when he's pumping too much grout and to call a halt if he suspects a drain tile is filling up.

The pump operator must be especially careful when our job is to compact the soil, not raise a slab. We recently compacted the soil beneath newly constructed bleachers at Arlington Race Course because the contractor was worried about settlement. On these jobs, we need to pump just enough to compact the soil without lifting.

Compacting the soil or raising a residential slab back to grade doesn't take long. A patio takes about three hours to raise, depending on size and access to it. On stores and warehouses, we can do sections of 2,000 to 3,000 square feet a night.

Buttoning Up

When the slab is back to the original level, the operator goes back and cleans grout out of the holes. Then he patches them with a mortar mix that is a close match to the original, and the job is done.

We don't patch cracks because patching is too time consuming. Most of the time, the slab looks fine once it's at the right level. Patching products often just call attention to the crack.

It takes the grout quite a while to set up and harden because there's no way for moisture to escape. But once under the slab, the grout is locked in. You can go ahead and use it, even though it isn't fully cured. We recently repaired a slab at a country club in the morning and they held a wedding reception there the same afternoon. ■

John G. Meyers is president of American Concrete Raising Inc., Bensenville, Ill. In addition to repairing slabs, the company now offers a franchising program to get others started in the slabjacking business.

Midnight Mudjacking

In the early 1960s, when I first heard about slabjacking, I worked for a company that sold and installed packaging machinery in factories. The constant vibration of the heavy machinery frequently made the floor settle and crack, and my job was to move the machine, cut out the floor, pour a new pad, and remount the machine. The customer lost two to three weeks of production time, and faced a costly repair.

One day I got a call from a customer in Ohio saying he had found a man who could raise the floor without moving the machine. The man promised he could complete the work in a few hours by "mudjacking." I had no idea what he meant, so I dropped by to watch. I met an elderly gentleman who drilled holes around the equipment. He started pumping material into the holes under pressure, and he leveled the entire floor in six or seven hours, which meant the customer had no down time at all. All this was done at a fraction of the cost of replacing the concrete.

The contractor told me he had learned "mudjacking" in the South Pacific while he was serving in the Navy's C.B.s. At night, after the aircraft had finished landing on the runway, the C.B.s would pump the runways back up. The soil was so unstable that the runways required this nightly maintenance. He told me this was where mudjacking was developed. Later, I met contractors from California who had been using "mudjacking" since the 1930s to repair highways.

Although I thought the cure was miraculous, the mudjacking equipment was so large that it wasn't practical to use it on anything except a big factory floor or a highway. But it intrigued me, and I could see the need for a slabjacking service.

Mudjacking is the term used in the

early days of the business, and its name comes from the "Mudjack" machine, which pumped a mud slurry under the pavement. Other materials that have been pumped under pavement include portland cement, lime, flyash, asphalt bitumen, casting plaster, limestone dust, and calcium chloride. Even hot asphalt was injected, but its purpose was to seal the concrete and prevent surface water penetration, not lift the slab.

In the late 1970s, I heard pumps were getting smaller and more compatible with residential work. That's when I decided to get into the business. We have a lot of soil movement in this part of the country, and I thought slabjacking would be more economical than busting concrete apart year after year and replacing it.

Slabjacking is a better alternative than replacing the concrete because we're getting to the cause of the problem—the unstable soil beneath the concrete. Replacing concrete doesn't always make the soil more stable.

Slabjacking is also the most cost-effective alternative. We figure our costs run about half the cost of replacement. The country is running out of room in landfills, and it doesn't make sense to bust up concrete and replace it.

Finally, slabjacking doesn't disturb the landscaping. There are no forms and no mess.

We've had a number of requests to help contractors get started in the business, and last November we set up a formal franchising program. We have a full program where they train with our crews, and learn all operations, including sales and marketing. Our franchising fee is \$15,000, and the reason we're making it reasonable is because we want people who are going to do high quality work and provide a service to their customers.—J.M.

For More Information

Mortar Mixers

Anchor Manufacturing Co.
2922 W. 26th St.
Chicago, IL 60623
312/247-2530

Slabjacking Pumps

Airplaco
"Hydra Jak 1530 or 1536"
4141 Airport Road
Cincinnati, OH 45226
513/321-2950

Chemgrout
"Chemgrout" equipment
Box 1140
La Grange Park, IL 60525
708/354-7112

Hydraulic Mud Pumps, Inc.
"HM Power Pump"
1202 Woodview Lane
Manitowish, WI 54220
414/684-8515

Voeller
Voeller Pumps
455 No. Moore Road
P.O. Box 325
Port Washington, WI 53074
414/284-3114