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FIELD GUIDE TO
CONCRETE REPAIR
APPLICATION PROCEDURES

Slabjacking

Field Guide to Concrete Repair Application Procedures

Slabjacking

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Introduction

Slabjacking is the purposeful raising of a concrete slab-on-ground, usually to a stated tolerance, or the filling of voids under the slab. *ACI Concrete Terminology* defines it as:

slabjacking—the process of either raising concrete pavement slabs or filling voids under them, or both, by injecting a material (cementitious, noncementitious, or asphaltic) under pressure.

What is the purpose of this application method?

Slabjacking is used to level and align concrete slabs-on-ground that have shifted due to settlement, erosion, flooding, or shrinkage of the soil or base below the slab.

When do I use this method?

When a concrete slab has settled or lost support, usually due to improper soil compaction, shrinkage of the soil (such as from drying out), or erosion of the sub-base, slabjacking is a common method to correct the problem. Slabjacking will level the slab, but it won't correct any underlying poor soil conditions. Therefore, prior to considering slabjacking, the soil conditions should be determined. Mitigation of poor soil conditions can sometimes be accomplished with other grouting methods. Sometimes, it may be difficult or impossible to move slabs to the desired position due to binding or other conditions. If the soil settlement is still occurring, it may be necessary to repeat the slabjacking one or more times. Slab removal and replacement should be evaluated as an alternative to slabjacking, depending on the current slab cracking, distress, and anticipated future movements. If the finished appearance of the slab is important, slabjacking may not be appropriate because the grout holes will be visible. One alternative to improve the aesthetics of the repaired area is resurfacing the slab with a polymer-modified cementitious topping to provide a more uniform appearance.

How do I prepare to use this method?

Typically, a staggered pattern of holes (Fig. 1) is drilled into the concrete about every 5 to 10 ft (1.5 to 3 m) for cementitious grouts. Badly cracked slabs may require closer spacing. A typical hole pattern might look like the one shown in Fig. 2.

The holes nearest to the slab edges and joints are typically set in about 1 to 2 ft (0.3 to 0.6 m). The spacing adjacent to cracks or joints may be varied to take advantage of the weakened plane. Usually, holes 1-1/2 to 2-1/2 in. (40 to 65 mm) in diameter are used for cementitious grouts and holes 1/2 to 3/4 in. (13 to 19 mm) in diameter are used for polymer foam grouts. The holes are usually drilled with rotary percussive rock drills, although core drills may be used if the surface appearance of the slab is important (such as a ceramic tile or terrazzo surface where the core can be replaced after grouting and sealed with a color-matched grout).

What are the application options and procedures?

The original mode of settlement must be considered to produce a gradual uniform lifting in reverse of the order of the settlement. Fluid grouts will tend to lift a larger area. This may, however, result in lifting of undesirable areas. As the slab of concrete settled and cracked, the effective length of the slab increased by the total width of the cracks. The cracks may be wider on the top than the bottom (as shown at points A and D in Fig. 3) putting the bottom of the slab into compression or wider on the bottom (points B and C) resulting in compression of the top of the slab surface.

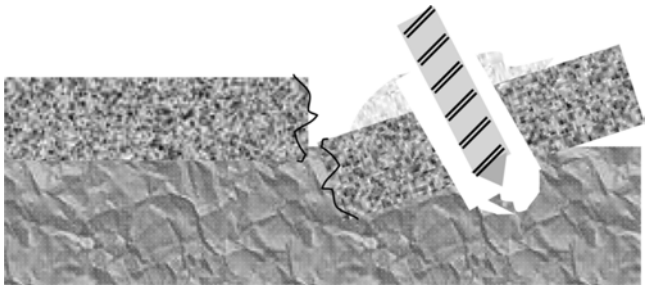

Fig. 1—Drilling holes into a settled concrete slabs.

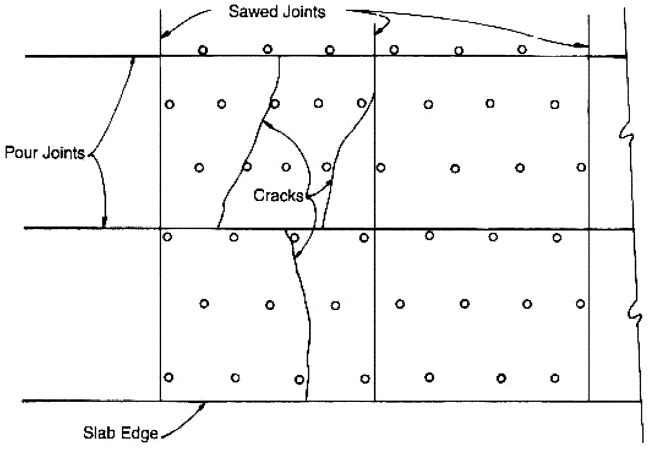

Fig. 2—Typical layout for slabjacking holes (Warner 2004).

Fig. 3—Typical cracking pattern in an idealized dip (Warner 2004).

Debris in the cracks and joints will tend to bind the slab from movement. If properly performed, slabjacking should not cause new cracks, but may result in widening or narrowing of existing cracks at the top of the slab surface. Slabjacking during hot conditions, when the thermal expansion of the slab is maximum, results in more difficulties because the slab is under higher compressive forces along its length. Binding of the slab during raising is not uncommon in these conditions as indicated by a rapid rise of pumping pressure. Continued slabjacking of a bound slab may form new cracks as the slab buckles or the grout may leak. Sometimes the release can result in an explosive rise of the slab. Misalignment of the slab frequently results, with no corrective action possible except slab replacement.

If the soil is tight to the underside of the slab, making a void may be required to start the slabjacking. A void beneath the grouting hole will distribute the pressure of the grout

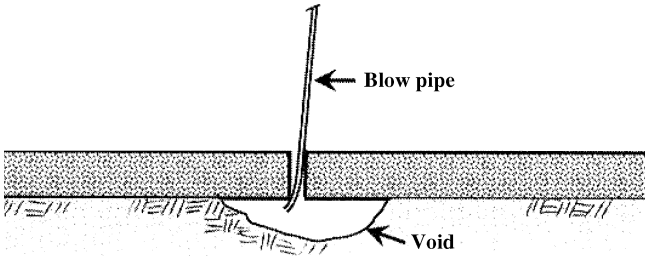

Fig. 4—A void is created under pavement to start lift (Warner 2004).

over a larger area, resulting in more control and an increased lifting area. This minimizes the initial pressure buildup while "breaking the slab loose." Compressed air or water may be used to form a void under the grout hole (Fig. 4) to provide this assistance. Adding a small amount of water to the drilled hole prior to connecting the grout nozzle may assist in separating the slab from the underlying substrate.

Lifting the slab (Fig. 5) should be performed in intervals no greater than 1/4 in. (6 mm) at any one hole location and at any one time, to avoid cracking. The use of a Y connector (Fig. 6) allows diversion of the grout along two grout hoses. Valves at the end of each hose facilitate grouting of adjacent holes. Once the desired lift is achieved in one hole, the valve to the next hole is opened at the same time the valve for the first hole is closed. The first hole header (Fig. 7) is then removed and attached to the next hole, and the process is repeated. This process minimizes interruption of the grout pumping, greatly increasing efficiency. Holes are revisited until the total desired movement is achieved at each hole. It also may be desirable to ensure that the void between holes is filled with grout by continuing to pump the grout until the grout comes out of the adjacent holes.

Usually, the grout nozzles are connected to the holes using packers (a special inflatable collar at the end of the nozzle) or barbed nozzles, or wedged in place using wooden shims driven around a pipe nipple at the end of the grout hose. It's suggested that a wet cloth cover the grout nozzle attachment to minimize spray if leaks occur. Leakage is most likely to occur when the hole is just beginning to be grouted. Typically, a worker is manning the valve and can hold the hose in place until the initial pressure spike passes. Initial pressures may be very high and then decrease to a range of 10 to 20 psi (70 to 140 kPa) if proper hole spacing and joint relief is used. Lower pressures are expected with thinner slabs, more closely spaced hole patterns, and lower viscosity (more fluid) grouts. It's sometimes possible to lift not only the slab but also shelving or equipment installed on the slab.

Lower viscosity grouts are susceptible to leaking and may actually migrate through the soil to tunnels, sewers, or other unintended areas. This is usually shown by a sudden drop in grouting pressure that does not slowly increase. Sometimes, unexpected voids are found while grouting and pressure will be restored once filled. If no pressure increase occurs during continued pumping, grouting of a sewer or other underground cavity is likely occurring.

Monitoring of the grout pressure is very important. A pressure gauge should be mounted near the pump discharge

Fig. 5—Pumping of the slabjacking grout in the drilled hole showing grout flow resulting in slab displacement.

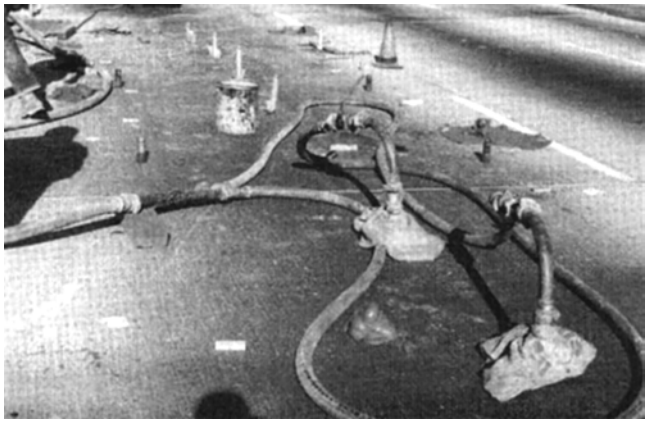

Fig. 6—A Y-fitting from a main delivery line divides into two branches (Warner 2004).

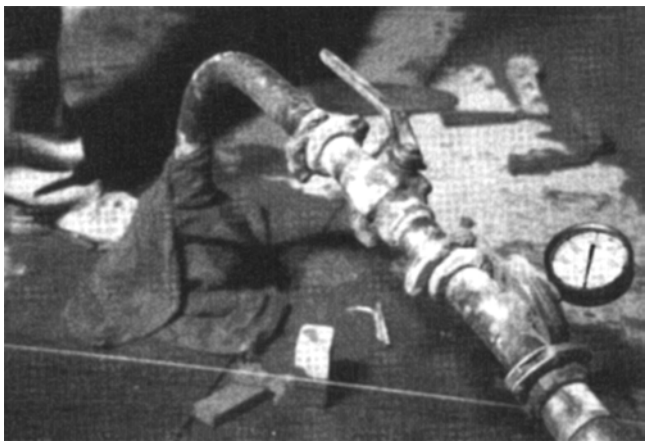

Fig. 7—Typical header setup with wet burlap bag around connection to protect against splatter (Warner 2004).

and another near the grout discharge nozzle. A sudden difference between these two readings indicates the line is plugged. Monitoring the gauge at the nozzle will indicate when to begin grouting the next hole. Gauge savers are required to isolate the gauge mechanism from the grout. It's especially important to monitor lift over cracks and joints, as these are the areas where both the movement will occur first and be the largest. A piece of masking tape bridging the crack or joint is useful for measuring changes in joint width. Placing parallel sticks slanting in the same direction in

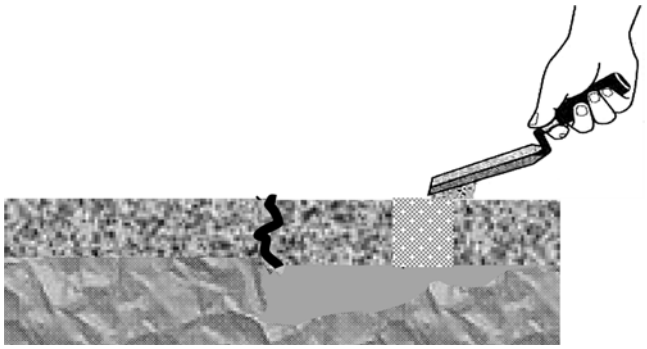

Fig. 8—Filling of holes used for grout pumping after completion of slabjacking.

ungrouted holes provides an indicator of grout movement before the hole is filled. As the grout flows below the slab, it will move the stick, indicating the location of the grout flow.

The final elevation of the slab can be monitored using a surveyor level or laser level. A grid of leveling lines can be stretched across the slab at 4 to 5 ft (1.2 to 1.5 m) intervals and set at a fixed distance above the desired slab elevation. A gauge block is periodically inserted between the string and the slab to measure lift. Because grout flow will continue even after the grout pump is stopped, the individual monitoring the final slab elevation should be prepared to stop pumping just before the final elevation is reached.

Once the desired lift and alignment of the slab have been achieved, the grout holes may be finished with a repair mortar (Fig. 8), have the drilled cores reinserted, or otherwise filled level and flush with the realigned slab.

How do I select the correct materials?

For cementitious grouts, mortar-type mixtures are used that often include fly ash to promote pumpability. The mixture proportions and consistencies of grouts used for slabjacking vary widely, depending on applicator preference and experience and on the depth of the void beneath the slab. Usually, only a fraction of the holes drilled are used for raising the slab, especially if low-mobility grouts (such as are used for soil compaction grouting) are used, as the lifting is then done by forming pedestals of the stiff grout under the slab. Extra holes may be drilled to fill between the pedestals and achieve continuous support of the slab (depending on the slab thickness, reinforcement, and load on the slab) or to lift any areas that are not raised by the original hole pattern.

If polymer foams or grouts are used, the holes typically have smaller diameters of 1/2 to 3/4 in. (13 to 19 mm). These are usually dual-component materials that are mixed while injecting. The grout then foams, producing the lifting action. The use of polymer foams can speed the work due to the rapid reaction and produces less mess than cementitious grouts. The cavity under the slab, however, frequently is not completely filled due to the rapid reaction of the grout.

What equipment do I need?

- A drill or coring device to drill the slabjacking holes;
- A mixer for the slabjacking grout;
- A pump suitable for the slabjacking grout and pressures required;
- Hoses, valves, and gauges suitable for the installation;
- String lines, levels, and other measuring devices to verify proper final elevation of the slab; and
- A source of water for mixing the grout and cleaning equipment (unless polymeric materials are used, which require solvent for cleanup).

What training do I need?

- Familiarity with the coring or drilling equipment;
- Familiarity with the mixing and pumping equipment;
- Familiarity with leveling and measurement devices; and
- Understanding of and familiarity with the slabjacking operation (such as when and where to start and stop grouting).

What are the safety considerations?

- Drilling, mixing, and pumping equipment may be electrically powered. Proper grounding and routing of the power supply is required to avoid shock;
- The Material Safety Data Sheet (MSDS) for the materials used for grouting contain guidance for material handling, personal protective equipment, and material disposal;
- Slabjacking uses grout pumped under pressure sufficient to lift the slab. Frequently, high pressures are encountered when pumping begins. Suitable precautions need to be used such as working pressure monitoring gauges and hoses with the proper pressure rating to prevent hose bursting or grout squirting; and
- Slabjacking grout will follow the course of least resistance. If underground structures such as sewers, utility lines, or drains are present, these can be unintentionally filled with the grout rather than lifting the slab.

Preconstruction meeting

Prior to proceeding with the repair, a preconstruction meeting is recommended. The meeting should include representatives from all participating parties, including the owner, engineer, contractor, and materials manufacturer, and specifically address the parameters, means, methods, final appearance, and materials necessary to achieve the repair objectives.

How do I verify that the material was correctly applied?

- Ungrouted holes can be used as inspection points to verify grout travel;
- Grout coming out of adjacent holes not only partially fills the holes, but indicates continuity of support between the holes;
- The required level and alignment of the slab has been achieved;
- Cracks have closed; and
- The volume of grout pumped is approximately that of the volume under the slab (high grout loss indicates that the grout may be travelling from under the slab or filling a sewer line).

What are the benefits of slabjacking?

- Slabjacking can be done in virtually any weather;
- The material injected beneath the slab provides a strong base;
- There is little or no disruption to landscaping;
- The cost of slabjacking is often less than half that of constructing a new slab; and
- Slabjacking can virtually eliminate downtime compared to removing and replacing the slab.

Possible problems with slabjacking

- The additional weight of slabjacking grout plus the original slab may cause additional soil settlement;
- If the soil settlement has not terminated, the slabjacked slab will continue to settle; and
- If the concrete continues to sink, there is a very good possibility that the concrete slab was installed on poorly compacted fill material. Subsurface erosion and the continued shrinking of the supporting soil are also possibilities.

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