Super-Paver©

Precast Pavement Repair Manual

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Super-Slab® is a patented product protected under at least one of US Patent numbers 6,607,329 B2; 6,663,315, 6,709,192, 6,899,489, 6,962,462, and 7,004,674 and other U.S. and foreign patents pending. Additional patents are pending. Super-Slab® is a registered US Trademark owned by The Fort Miller Co. Inc.

Introduction

The Super Slab®* System was developed by The Fort Miller Co., Inc. in 1999 as a method of installing high performance precast slabs directly on grade to provide the pavement industry a rapid repair technique for use on heavily-traveled highways. Since the first project in 2001, over 1,500,000 SF of precast slabs have been successfully installed during off-peak hours with minimal impact on the traveling public. This total equates to over 25 lane-miles of highway, 85% of which is servicing over 100,000 vehicles per day.

Recently, The Fort Miller Co., Inc. recognized that traditional permanent concrete pavement with solid steel dowels is not always the best choice for some locations such as utility-intensive intersections where it is periodically necessary to remove pavement to work on below-grade utilities. Historically, utility cuts in concrete pavement were restored by drilling holes for new dowels, casting new concrete pavement in place around them, and allowing it to cure for a specified period of time before it was opened to traffic.

In response to the need for a removable and reusable pavement, Fort Miller developed the Super Paver© concept. Many of the basic principles developed and refined in the Super Slab® System have been incorporated into Super Pavers©. The most significant difference is the introduction of hollow dowels that enable the removal and reuse of the individual Super Paver© slabs. For further information regarding the initial installation of Super Pavers©, please refer to the Super Paver© Installation Manual.

The purpose of this Manual is to provide a utility crew or Public Works Department with the information they need to remove and replace Super Pavers© as part of a utility repair.

This Manual contains the instructions a general contractor, public works crew or utility repair crew would need to remove and re-install Super Pavers©. While most of these steps are variations of operations common in the construction and maintenance industry, the super-grading process is unique in that it is more exacting than current fine grading practices, and the removable aspects of the Super Dowel are a new concept in the industry. The reader is advised that successful installation and re-use of Super Paver© is contingent upon strict adherence to the techniques described herein and that the use of alternate unproven methods is not recommended.

The Super Paver© System is “new” to the construction industry. The technology described in this Manual is still under development and refinements are expected to be made as the system evolves. This Manual, therefore, should be considered a living document that will be upgraded and revised periodically as owners, designers and contractors expand their use of the Super Paver© System.

Chapter 1
The Basics of the Super-Paver© System

1. General

Successful removal and replacement of a previously-installed Super Paver© installation is dependent upon a thorough understanding of the product and the process used to originally install it. The Super Paver© System consists of precisely fabricated precast slabs, methods of installation, and materials for interlocking them together to create an integrated pavement structure. The System is comprised of the following:

1. Constant-thickness precast slabs that are fabricated to length, width and thickness as required to a tolerance of ± 1/8".
2. Techniques for precision grading to a similar tolerance.
3. Interlocking dowels and matching slots cast into the bottom of adjacent slabs.
4. Installation of non-shrink structural grout into the slots
5 Positively filling voids under the Pavers (should they exist) by pumping bedding grout into them by means of a bedding grout distribution system cast into the bottom of each Paver
6. Means and methods to remove and replace Pavers and dowels which enable the re-establishment of the pavement to "like-new" condition

2. Precast Pavers

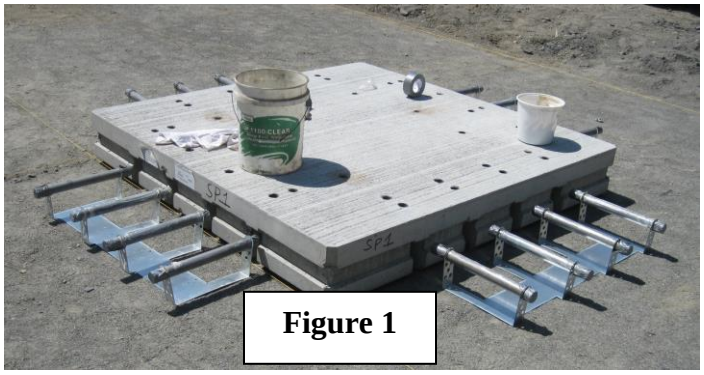

Figure 1

Super Pavers© may be fabricated as relatively light 6' x 6' square slabs or as larger square or rectangular ones as determined by the dimensions of the instersection or roadway in which they are placed. Super Pavers© are typically fabricated with dowels across transverse and longitudinal joints since traffic on city streets is repetitively crossing both. The initial slabs, i.e, slabs that are cast and installed the first time, may be cast with dowels embedded in two sides of each slab, Super-Slab style, or with slots on all four sides to fit over chair-supported dowels as shown in Figure 1.

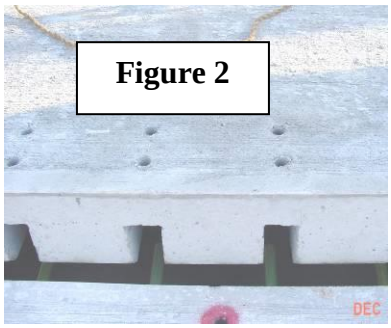

Figure 2

Paver interlock and load transfer is achieved by placing each paver over the dowels as seen in **Figure 2**. The interlock is completed by pumping non-shrink structural grout through port holes, also visible in **Figure 2.**

2. Paver Geometry

Before any pavers are fabricated it may be necessary to determine the exact geometry of the area to be paved. A detailed paver layout drawing is developed to show the plan view location of every paver. This drawing aids in calculating "x", "y", "z" values of every corner of every paver. These values are used in paver fabrication and in the Super-Grading operation as will be discussed later. The plan view shape and size of each paver is defined by specific "x" and "y" coordinate values. Similarly, vertical geometry is defined by the "z" coordinate values of the corners of each paver.

The definition of a single-plane paver is when the "z" values of all four corners reside in the same plane. An equivalent definition of a single-plane paver is when the cross-slopes of the two opposite sides of the paver are the same. Single plane pavers are used on portions of the roadway where the cross slope remains constant..

When it can be established ahead of time that all pavers are single plane, the calculation of three-dimensional coordinates is not required. A paver layout drawing or a table of paver locations is still recommended for fabrication and layout purposes.

When the "z" value of one corner of a paver is out of the plane established by the other three corners it is called a **warped plane paver** as shown in **Figure 3.** The cross slope of a warped paver varies linearly from one end of the paver to the other. Warped pavers are required in areas of a roadway where super-elevation changes (as horizontal alignment changes), or at intersections where the cross slope and profile of one roadway blends into the cross slope and profile of the intersecting roadway. For this reason it should be obvious that any Pavers removed from an existing installation must be labelled or numbered and returned to their original location and orientation.

Figure 3

3. Precision Grading

A key element of the Super-Paver© System is the precisely graded subgrade surface that minimizes, if not eliminates, vertical adjustment of slabs after they have been placed. The subgrade is graded to the same "x", "y", "z" values to which the pavers are cast, insuring they "match" vertically, as well as horizontally, within the allowable tolerances. While this is a simple concept it demands a surface accuracy that is more exacting than that commonly required for cast-in-place pavements.

4. Installation of Dowel Grout

Pre-bagged dowel grout used to fill the inverted dovetail slots is a pumpable, rapid-setting non-shrink structural grout that completes the structural connection between adjacent slabs. As of this date **Dayton Superior HD-50** and **Pro-Spec Slab Dowel Grout** are the only grouts that have been approved for use in Super-Pavers©. While there are a variety of grout pumps commercially available, the two types used most frequently have been batch-type pumps made by the ChemGrout Company, and volumetric pumps made by Machine Technologies. A detailed discussion about pump selection is beyond the scope of this Manual; consult with Fort Miller and the pump manufacturers for advice on a particular project.

5. The Bedding Grout Distribution System

The intent of providing a precise subgrade surface is to provide full and complete support to the new pavers such that they are grade-supported. Since it is difficult to fabricate perfect pavers and a perfectly matching subgrade surface, a unique U-shaped bedding grout distribution system (visible in **Figure 4**) is built into each paver to aid in the installation of void-filling grout to ensure complete and full bedding of every paver. It is

Figure 4

comprised of a half-round channel cast in the bottom of the paver bounded by foam gaskets (black in the photo) attached to the bottom of the paver. In the photo, bond-breaker is being sprayed on the bottom of the paver which will prevent the bedding grout from adhering to the paver bottom, making it easily separable if and when the paver is ever removed and re-installed.

After all of the pavers have been placed and the slots are filled with structural grout, non-structural bedding grout is pumped through a port at one end of each channel until it exudes from a port at the other end of the U-shaped channel. Because of the high fluidity of the grout, it will disperse beneath the paver, positively filling any voids in the chamber bounded by the pre-attached foam gaskets.

Chapter 2 - Removing and Reinstalling Super Pavers©

Many of the steps required for removing and reinstalling Super Pavers© are identical to the steps required for the initial installation. However, there are some unique operations which will be described further in the following sequences. The descriptions that follow describe a "typical" operation where it is the intent of the Agency or Utility to make maximum use of the reusability of all the components of the system. In some situations, it may be desirable to discard the existing Pavers and replace them with new Pavers. In those cases, several of the steps required for cleaning and preparing the Pavers can be omitted. The description that follows is an abbreviated explanation of the procedures involved in removing and replacing Super Pavers©. For a more complete in-depth explanation of the procedures, refer to the detailed instructions in the following chapters.

1. Paver Removal

The area of Pavers requiring removal will be determined by the extent of the space required for the underground work being contemplated. Once this perimeter is determined, the joints between the existing Pavers must be sawcut full-depth to allow for removal of the pavers.

2. Drill out the Lifting Holes and Grout Ports

The lifting holes which were used to initially place the slabs need to be visually located and the grout drilled out in order for the inserts in the slab to be re-used for slab removal. A 3/4" diameter bit can be used for this purpose, although a 15/16", if available, will remove more of the old grout. A rotary hammer drill is the proper tool for this work, and a 6" depth should be sufficient for any size Paver.

At this time, it is also efficient to drill out the old dowel grout and bedding grout ports. These should be visible as round circles on the Paver surface. These were originally 1-1/4" diameter ports, so the same size bit should be used to re-open them. Due to the larger diameter, air-powered drills may be most efficient for this purpose. Stop drilling dowel grout ports when the bit hits the old dowel beneath the port. Drill the bedding grout ports entirely through the Paver.

3. Lift Out the Slabs

Use the same style lifting bails that were used to set the slabs originally – Dayton Superior T-26 double-swivel lifting bails, or equal, three per Paver. Bolt them down with 1" diameter coil-thread bolts, and tighten securely before lifting.

Place the Pavers somewhere they will be out of the way, and turn them over onto wood blocking when setting them down, preferably using nylon straps to protect the Paver edges.

At this time, the required underground utility work can be started.

4. Extract the Dowels from the Remaining Pavement

The halves of the dowels remaining in the existing pavement now can be extracted. Thread a 3/4" coil thread bolt, at least 18" long, into the nut in the back of the dowel. It is most efficient to use an air-powered impact wrench for turning the bolt, although electric wrenches and socket wrenches can work. Turn the bolt, which will push against the concrete behind the dowel and thrust the dowel out of the hole. Once the dowel is removed, the hole will need to be reamed out to a diameter of 1-3/4" as preparation for the replacement removable dowel, which will then be epoxied in. (per the instructions given in Chapter 4, following)

5. Clean and Prepare the Pavers for Reinstallation

Previously (Step 3), the Pavers have been positioned upside-down, outside the work area, where they can be prepared for reinstallation.

The existing dowel grout in the underslab slots needs to be removed. Experience will determine what is the most efficient way to accomplish this task. To date, the method used has been to use a hand-held demolition saw to cut two relief cuts in the old grout in each slot. The grout can then be removed using jackhammers and long-handled pry bars.

Any bedding grout adhering to the slab bottom needs to be removed with a scraper. Any bedding grout remaining in the half-round channel also needs to be removed, either by scraper or jackhammer.

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6. Re-Grade the Area in Preparation for Setting Slabs

After the required utility work is complete, the holes or trenches need to be backfilled and compacted using good construction practices. Good quality granular material meeting State or Municipal specifications should be used for the top 12”, and fine-graded to an

elevation ½” below the bottom of the Pavers. Install the stone dust bedding, and Super Grade (as described in Chapter 3) using Fort-Miller supplied grading equipment.

7. Install New Dowels

Install new removable Super Dowels in the perimeter pavement around the utility excavation (in accordance with the steps described in Chapter XXX for anchoring dowels into existing pavement)

8. Reinstall the Pavers

Using a 3-way lifting sling or chain system, reinstall the Pavers (using the same steps and techniques as described in Chapter 4)

9. Regrout the Pavers

Using the proper materials and equipment (as described in more detail later in Chapter 5) install dowel grout and bedding grout in all Pavers.

Chapter 3

Precision Grading (Supergrading)

1. General

Fort Miller provides specialized grading equipment for the use of Contractors, Utility Crews, or Public Works Crews involved in the removal and replacement of Super Pavers©. Use of the equipment is described in the following sections.

2. Bedding Material

The Super-grading process is facilitated by using "fine" bedding material that is easy to compact and grade by machine or by hand. This material, known in the Northeast as "stone dust" or screenings, is a by-product of most quarry operations and is commonly available in most areas. The gradation of this material is shown in **Table 1**.

BEDDING MATERIAL GRADATION

SIEVE SIZE DESIGNATION	PERCENT PASSING BY WEIGHT
½" MAX	100
NO. 4	80-100
NO. 10	55-75
NO. 40	10-40
NO. 200	0-20

3. Providing a Fully Compacted Subgrade

To achieve full compaction, bedding material is placed in two passes. In the initial pass the material is placed and graded high (to allow for compaction). The bedding material is fully compacted with conventional compaction equipment. Conventional plate compactors and vibratory rollers are shown in **Figure 11** and **Figure 12**. After compaction a final super-grading (shaving) pass is made, leaving behind a precisely-graded, **fully compacted supergrade.**

Figure 11

Figure 12

4. Supergrading Small Areas with Hand Operated Graders

The Fort Miller Co., Inc. has developed four different models of hand operated graders that have been specifically designed for various types of repair projects. See the Fort Miller "Hand Operated Grader Operating Manual" for details and further information about the complete family of equipment. For most removal and replacement operations, the Shutter Screed will be the most appropriate equipment for the task. This is a lightweight aluminum screed that runs on rails set on the adjacent pavement to guide the screed in creating an accurately-graded subgrade.

If both rails are set vertically parallel (to each other), the Screed will grade a single-plane surface. If they are set at two different grades (non-parallel) a warped plane surface will result.

The Screed is designed to grade the bedding material described in Table 1. **It is not designed to excavate compacted dense graded base material, new or old and it should not be used for that purpose.**

Proper and efficient operation of the Screed requires specialized training that is provided by the Fort Miller Co. This includes instruction in periodic checking of the screed depth settings to insure they have not slipped out of adjustment.

10. Other Grading Methods and Devices

Traditional screeds and string line grading methods, such as those shown in **Figure 16** and **Figure 17** have proven to be slow, inaccurate and **incapable of grading or trimming fully compacted bedding material to the required tolerance.** The roadway grader shown in **Figure 18** is too big for most areas, too slow and incapable of achieving the required accuracy.

Figure 16

Figure 17

Figure 18

Use of these devices may result in un-compacted subgrade surfaces that compromise long- term pavement performance. It may also result in non-uniform surfaces that may be a safety hazard if pavers placed upon them are opened to traffic before they are grouted. For these reasons, use of these poorly-controlled grading devices is not recommended.

11. Touching Up Around Edges

Hand tools, such as those shown in **Figure 19**, are useful and necessary for touch-up work and for grading around the edges of the hole. Skilled laborers who are have an "eye" for grade and who are capable of grading to the required tolerance should be chosen to do this work.

If it is necessary to add bedding material in the touch-up process it must be fully compacted, the same as the rest of the bedding material, before the final grading pass is made.

Figure 19

12. Checking the Subgrade for Accuracy

It is a good practice to periodically check the subgrade surface for accuracy during the grading process. Stops and starts of the grading machine may leave high (or low) spots behind that should be identified and corrected. A 10' straight edge, such as that shown in **Figure 20** is useful to identify variations in the surface (in the order of ± 1/8") that are not perceptible to the eye.

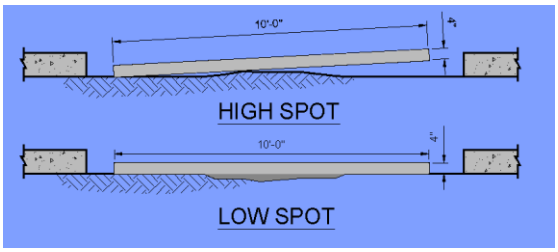


Figure 20

It is especially important to thoroughly check all edges of the hole that are inaccessible to the grading machine. The depth gage shown in **Figure 21** is useful for this purpose and can be used by both workmen and inspectors.

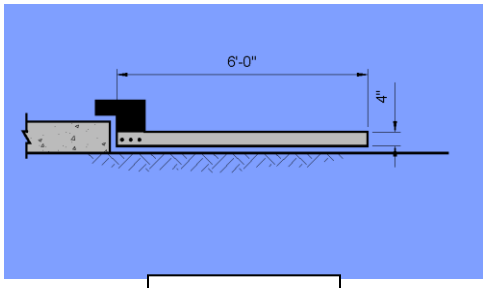


Figure 21

Routine and disciplined checking of the super grade surface is the best way to maximize the speed of the setting process. If a Paver does not fit within tolerance, time is wasted while the Paver is picked up again so the subgrade can be checked and re-graded. It is much easier and faster to make proper checks ahead of time so each paver can be set only once.

Chapter 4

Super-Paver© Installation

1. General

Once the supergrading is complete Paver placement is relatively easy and straight forward. Since the elevations of the Pavers are controlled by the subgrade surface, the most important task of installing pavers is to get the Pavers placed in the correct horizontal location.

The size and type of setting equipment are important for efficient installation. Small rubber-tired backhoes typically used by utility and public works crews are adequate for handling standard 6x6 Pavers. Larger rubber-tired excavators would be needed for larger size Pavers. On jobs with a combination of Super Pavers© and/or Super Slabs®, hydraulic cranes may be needed for the Super Slabs®.

In some extremely confined areas, such as in tunnels or under some bridges, Pavers may need to be placed with loaders or high-capacity fork trucks. In these cases the Pavers should be fabricated in sizes appropriate for the equipment used. At the very beginning of the project the contractor should decide what setting equipment will be used and have the precast Pavers fabricated accordingly.

Maximum allowable joint widths are usually specified by the agency or owner of the project. For new construction these are frequently established as 1/2" for both transverse and longitudinal joints.

5. Wetting the Subgrade Before Setting

Just prior to setting slabs the subgrade surface (bedding material) is lightly sprayed with water as shown in **Figure 23**. This is done to prevent dry subgrade material from "damming up" the flow of bedding grout when it is installed and to prevent "drying out" the bedding grout as it flows along the subgrade surface.

Figure 23

If the bedding material is already wet it may not be necessary to spray it. Judgment of the "wetness" of the bedding material must be exercised before proceeding to this step. Nevertheless, it is critical that appropriate equipment be provided by the contractor so that the subgrade can be watered at any time.

6. Applying Bond Breaker to Pavers and Dowels

Figure 24

When any Paver is lifted and in the air, prior to being set, bond breaker should be sprayed on the bottom of the slab and the interior faces of all underslab slots. Just prior to placement of each subsequent Paver, bond breaker is sprayed on the vertical end of the previously set slab, and the dowels that have been set into the underslab slots, similar to the view shown in **Figure 24**. This lubricates the dowels and prevents dowel grout from bonding to both sides of the joint, thereby minimizing potential break-up of the grout during subsequent expansion and contraction of the Pavers.

7. Rigging (Hooking up to) the Paver

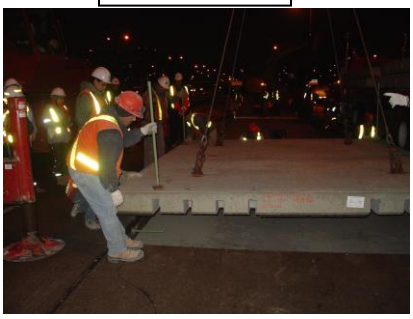
Three coil-threaded lift anchors are cast into each 6x6 Paver for lifting purposes. Different configurations of lifting anchors may be required for different sizes of Pavers. Lift bails are temporarily bolted to these inserts to permit attachment of lift cables during lifting operations. The shop drawings will clearly indicate what type of lifting cables are to be used.

It is important to recognize that Pavers lifted with equal length chains or slings will hang in a level position. If the subgrade is level, the entire Paver will touch the ground at the same time.

Paver placement is facilitated if the entire Paver (all four corners of the Paver) touches the ground at the same time. If the subgrade has a significant cross-slope, it is advisable to adjust the cable lengths such that the Paver hangs from the machine in a position that it is roughly parallel to the subgrade surface. This can be easily accomplished by using extra shackles in the appropriate legs of the set of cables or by using commercially-available adjustable grab chains.

8. Controlling the Pavers During Setting

Figure 26



Tie-off ropes should be used for safe and controlled paver placement. As the slab is lowered into its final location, position is best maintained with steel rods (used as positioning handles) inserted into corner grout ports **(Figure 26). It is not advisable to use steel bars, wedges or any other devices in the joints for aligning purposes since they create large point loads that are apt to spall or chip the edges of the Paver.**

9. Checking the Pavers for Surface Match

As soon as the Paver is set, the vertical match to adjacent Pavers is checked as shown in **Figure 27**. In most cases Paverss will match within the specified vertical tolerance if the specified grading procedures have been followed. In the unusual case a Paver does not match, lift it and correct the subgrade as required to make the Paver match within the specified tolerance **at this time.** A mismatch is usually the result of not checking the subgrade before setting the Paver. If it occurs, more care should be given to checking before the next Paver is set.

Figure 27

Chapter 5
Grouting Super Pavers©

1. General

Dowel and bedding grouts described in Chapter 1 are vital to effective Paver interlock and full and complete Paver support. The following sections should be carefully read and understood before proceeding with Super-Paver© installation.

2. Dowel Grout

Pre-bagged dowel grout used to fill the inverted dovetail slots is a pumpable, rapid-setting non-shrink structural grout that completes the structural connection between adjacent Pavers. A core taken from one such slot **(Figure 28)** shows how dowel grout completely fills the slot around the dowel creating the structural Paver-to-Paver interlock.

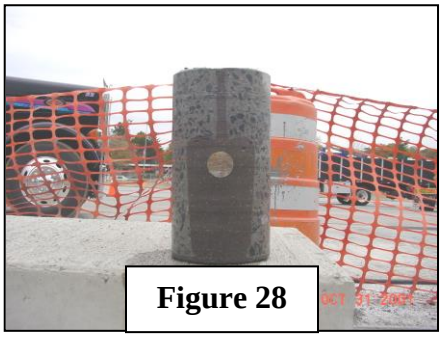


Figure 28

As of this date **Dayton Superior HD-50** (mixed with 3.625 quarts/3.5 liters of water per bag) and **Pro-Spec Slab Dowel Grout** (mixed with 4.0 quarts/3.785 liters of water per bag) are the only grouts that have been approved for use in Super-Paver©.

3. Trial Batching

Dowel grout is a pre-bagged material that must be mixed and used in strict accordance with the manufacturer's directions. The exact amount of water, the mixing time and the mixing equipment specified by the manufacturer should always be used.

It is important to conduct trial batches before installation **to determine how long it takes for the grout to achieve the specified opening strength of 2500 psi at the temperature anticipated at the time of installation**. Trials should be conducted and repeated until a reliable trend of "strength vs. time" is identified. The mix design that achieves the specified strength in the allotted time becomes the recipe that is used during actual grouting operations.

The rate of strength gain is determined by breaking standard 2" grout cubes at cure intervals comparable to those expected during the actual operation. It is important to use grout cubes and not concrete cylinders for grout testing, as the cylinders will give inaccurate results.

During actual grouting operations the grout temperature should be kept the same as the temperature of the corresponding trial batch. In hot summer weather, ice may be required to keep grout mixture temperatures cool. In cold weather it may be necessary to keep un-mixed grout (bags) in a warm place and to heat mixing water to bring the grout mixture **to the same level as the trial batch recipe** to ensure the same strength gain as the trial batch. Steps may also need to be taken to bring the slabs to a warmer temperature, as the mass of the colder Pavers will quickly draw the heat from the relatively small grout mass.

4. Installing Dowel Grout

Before any grout is installed on the project, a Fort Miller technician will be made available to provide a grout training session for the contractor. This brief training session provides an opportunity to verify that the proper equipment (pump, hoses, water storage tank, generators, compressors, grout nozzles, hauling trailer, etc.) is available, functioning properly and compatible, and for the workmen to become familiar with the equipment and the unique properties of the grout. It is also an opportunity for mortar cubes to be made and tested to verify that all grout mixtures achieve the proper strength and other parameters. Fort Miller highly recommends that contractors take advantage of this opportunity, as the grouting operation can be problematic. Issues identified during the training session can be rectified before time and money is wasted during valuable night or weekend work windows.

The first step in installing dowel grout is to install foam grout seals in any open joints (typically at the shoulder end or interior end of transverse joints) to prevent the loss of dowel grout during the pumping operation. This is done by installing a bead of spray urethane foam at the end of the joint. Also, any shoulder or other edges can be backfilled with specified shoulder material, recognizing that the backfill material needs to be fully compacted if it is to be left in place permanently.

While there are a variety of grout pumps commercially available, the two types used most frequently on precast pavement projects so far have been batch-type pumps made by the ChemGrout Company, and volumetric pumps made by Machine Technologies. A number of different models are available and it is therefore advisable to consult with the manufacturer directly to source the right pump for the project.

Figure 29

A typical ChemGrout batch-type pump, equipped to mix and to pump the grout, is shown in **Figure 29**. Grout is mixed in batches in a mixer chamber. After it

has been thoroughly mixed it is then discharged directly into the grout pump hopper. While the grout is being pumped another batch can be mixed in the mixer.

Another type of pump that is becoming more popular is the Volumetric Mixing Pump. With this pump, the pre-mixed grout powder is poured into the storage hopper on the top of the pump. An electric motor turns an auger that moves the grout through a mixing chamber, where it is mixed with water that is flowing into the chamber from the water tank and water system. One major advantage of this type of pump is that the flow of grout can be continuous without stopping to mix batches and clean out the hoppers and hoses. A remote electric switch can also be mounted on the grout pipe so that the nozzleman can stop and start the flow of grout. This greatly eliminates any waste and also makes for a neater and cleaner job. With these pumps, the water meter needs to be carefully calibrated to ensure the proper water/cement ratio is maintained to achieve the proper grout strength before opening the road to traffic.

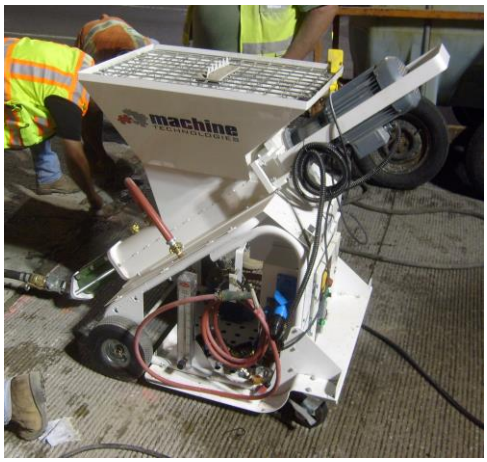


Figure 30

The dowel grout is installed by placing the grout nozzle in the port of each slot until grout exudes from the joint as shown in **Figure 30**. As soon as the grout comes up in the joint, the nozzle is then moved to the second slot and the procedure repeated. It is important to monitor the level of the grout in each port hole and to refill them if required.

The dowel grout materials described above gain strength rapidly and are known in the construction industry as "hot grouts". **They must be mixed and pumped expeditiously to avoid grout setting up in the pump or in the hose.** In short, the pump must be pumping either water or grout and it should only be stopped for the briefest amount of time or the grout is likely to set up. For best results with the ChemGrout-type pumps, the mixer, the pump, and the hoses should be thoroughly cleaned after every 3 or 4 batches.

Do not drive on any freshly-grouted Paver with any construction equipment or vehicle until the required grout strength of 2500 psi has been reached. To do so may result in deformation of uncured dowel grout compromising future efficiency of load transfer between Pavers. It is advisable to provide the grouting crew with a supply of cones or barrels so that the freshly-grouted Pavers can be marked off to prevent construction traffic from inadvertently driving on the Pavers until the grout has reached 2500 psi.

Dowel grout is always installed before the bedding grout to insure dowel slots are filled with the right grout. Bedding grout is much more fluid than dowel grout and if it is installed first, it may leak past one of the bottom gaskets and flow into a dowel slot resulting in non-structural grout around the load transfer dowels.

1. Calculating Dowel Grout Quantities

A sample calculation for calculating the amount of dowel grout that is needed is shown in **Appendix A**. Keep in mind that joints must also be filled with dowel grout. Judgment should be exercised when ordering material to allow for possible waste due to low subgrades or to hot wasted batches caused by hot weather.

2. Bedding Grout

Bedding grout is used to fill any **voids** that may exist between the bottom of the Paver and the subgrade surface, after the Paver has been set. By virtue of the precise subgrade surface the Paver is "essentially" subgrade-supported the moment it is placed in position and the bedding grout fills only the voids between the areas of subgrade contact.

Bedding grout is distributed to the voids by pumping the grout into ports that extend from the top of the slab to the half-round grout channels that are cast in the bottom of the Paver. A grout port is cast into the Paver at each end of each channel making it possible to pump grout into one end until it comes out the other, giving proof that the grout has reached any voids that exist along the channel. Foam gaskets attached to the bottom edges of the Paver create a bounded bedding grout distribution system that enables positive filling of all voids.

6. Bedding Grout Mix Design

Bedding grout is a mixture of cement, water and plasticizing admixture designed to meet the following criteria:

a) The grout mixture must have a flow rate of 17 to 20 seconds as measured by ASTM C939 in a ½" flow cone to insure fluidity
b) The mixture must reach a strength of 600 psi (4 Mpa) in 12 hours

The admixture is the same as that used in grout designed for rock bolts and post-tensioning ducts, and contains water-reducing, shrinkage-compensating and thixotropic agents. The grout mixture is designed as designated by the manufacturer of the admixture. A technical sheet for one acceptable admixture is shown in **Appendix D**.

Trial batching, similar to that required for dowel grout, must be conducted with bedding grout to develop an acceptable formula that meets all of the specified criteria. A suggested recipe for bedding grout is shown in **Appendix B.** The temperature recommendations discussed in Section 3 are also applicable for bedding grout as well.

As with the dowel grout trials, recipes identified at this time are to be used in actual grouting operations.

Pre-mixed and bagged bedding grout is now available. The advantage of using the pre-mixed material is that it eliminates variations due to mixing the components in the field. When using volumetric pumps, it is especially valuable because it eliminates the step of pre-mixing the dry components in the field before they are introduced into the hopper.

In colder temperatures it may be necessary to use an accelerator in the bedding grout mixture in order to achieve the required strength in the time frame allowed. The accelerator manufacturer should assist in selecting and specifying the type and required dosage of the accelerator.

Since the bedding grout described above is not tested nor approved for freeze/thaw durability, the top two inches of all bedding grout port holes should be filled with dowel grout.

7. Installing (Pumping) Bedding Grout

Figure 31

The same grout mixer/pump used for dowel grout is used to mix and install bedding grout. Install the bedding grout by placing the grout nozzle in the port (painted red to distinguish it from a dowel grout port) at one end of the bedding grout channel, similar to **Figure 31**. Pump bedding grout until it exudes from the corresponding port at the other end of the grout channel, which is an indication that the discrete grout chamber beneath the Paver has been filled. After the chamber has been filled the grout seeps slowly into voids under the Paver, as indicated by the lowering of the grout level in the ports. **It is important to keep adding grout in the ports to keep the level within 2" of the top of the Paver, as this maintains enough grout pressure to ensure all voids under the Paver are filled.**

Very little pressure is required to pump bedding grout through the distribution channel. If high pressure develops it is most likely the result of the grout distribution channel becoming plugged because of lumpy bedding grout (grout not properly mixed), grout setting up too quickly (because of hot weather), dry bedding material creating a dam, or bedding material having shifted location during a rainy period. All of these factors should be checked and corrected as necessary. The Paver should be visually monitored throughout the pumping process to insure increased pressure does not cause the Paver to rise.

If grout fails to reach the end of the grout chamber and come out of the corresponding grout port it will be necessary to "back pump" from the terminal port. Before this is attempted, check to make sure the bedding grout is properly mixed, lump free and flowing freely from the nozzle. Back pumping should only be allowed as a stop gap measure.

Glossary

Bedding Grout	A thin bedding grout material consisiting of cement, water and shrinkage compensating – plasticizing admixture designed to fill voids under previously-placed Pavers
Bedding Grout Distribution System	Half-round channels cast into the bottom of the Paver which enable complete distribution of bedding grout under the Paver
Dowel Bars	Round load-transfer dowels that transfer load across joints
Dowel Grout	Non-shrink structural grout pumped into inverted dovetail slots to encompass dowels, completing the structural connection between Pavers
Inverted dovetail slot	The dovetail shaped slot (informally referred to as a "mouse hole") cast in the bottom of Pavers to encompass matching dowels
Single Plane Paver	A Paver whose entire surface resides in the same vertical plane
Stone Dust	Fine aggregate used as bedding material underneath Pavers with a maximum aggregate size of approximately 1/2" (12 mm)
Super-grade	A fully compacted subgrade surface that is parallel to the finished pavement surface and is theoretically correct to within a tolerance of ± 1/8" (3mm)
Super-grading	A grading process that utilizes specialized laser or mechanically controlled grading devices to achieve a three dimensional subgrade surface that is theoretically correct to within a tolerance of ± 1/8" (3mm)
Warped Plane Paver	A Paver that has one corner above or below the vertical plane established by the remaining three corners and whose sides are vertically straight and whose cross sections taken at right angles to the long side are vertically straignt

Appendix A

Dowel Grout Quantity

Vol. Grout / Typ. Slab = No. Slots x Slot Vol. + Vol. under slab + Vol. Jts. + Vol. Chamfer

From Figure A.1

$$\text{Slot Vol.} = \frac{(W1 + W2)}{2} \times H \times L + 2 \times \left(\pi \times \frac{d^2}{4} \times h \right)$$

Where : W1 = bottom width of slot;

W2 = top width of slot;

H = slot height;

L = slot length;

d = diameter of grout port

Note: quantities and dimensions of slots may vary.

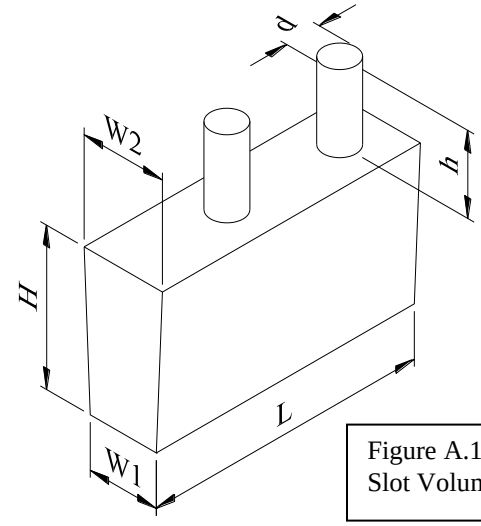


Figure A.1
Slot Volume

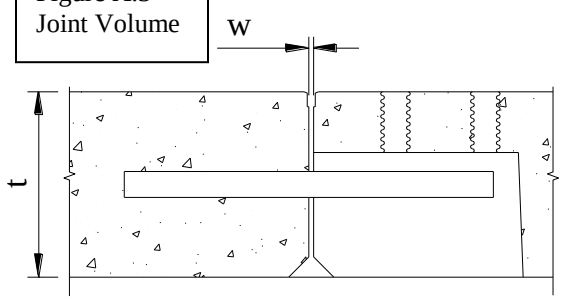
From Figure A.2:

$$\text{Vol. under slab} = \text{Area under slab} \times \text{estimated average grading accuracy}$$

$$\text{Area under slab} = Ws \times Lt + (Ls - Lt) \times L\ell$$

Where: Ls = slab length; Ws = slab width ;Lt = transverse slot length; $L\ell$ = longitudinal slot length

Figure A.3
Joint Volume



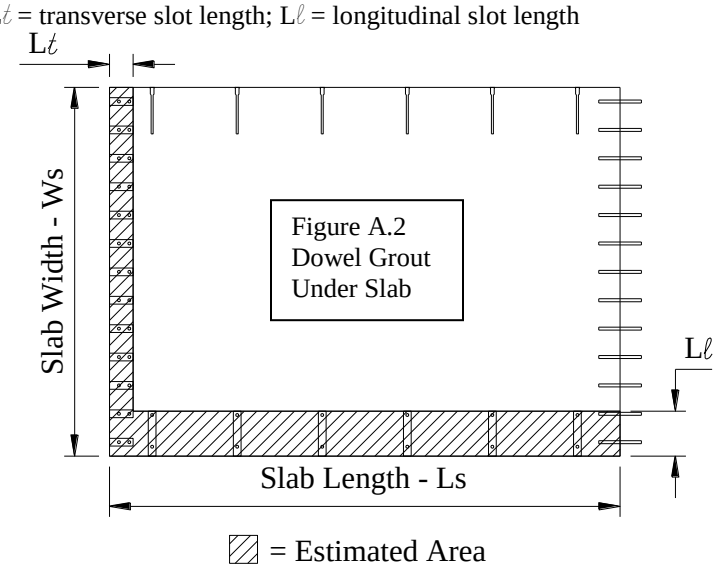


Figure A.2
Dowel Grout
Under Slab

From Figure A.3:

Vol. Jts. = (Ls + Ws + w) x w x t

Where: Ls = slab length;

Ws = slab width;

w = joint width;

t = slab thickness

From Figure A.2 and A.3:

Volume in Chamfer = 2 x (Ls +Ws) x [½ x 1” x 1”]

Transverse Slot (includes vertical round grout port)

Slot Vol. = {[3” + 2-1/2”]/2 wide x 5-5/8” high x 8” deep} + {π x 5/8” x 5/8” x 4” high}

= { .225 x .47 x .66} + {3.14 x .0025 x .33}

= .075 Cubic Feet per slot

Vol. of Grout / Transverse Joint = 6’ long x 9” high x ½” (assumed average width) = .18 CF per side

Volume in Chamfer (chamfer is 1” x 1”):

Vol. Chamfer = 4 sides x 6’ x { ½ x 1” x 1” } = .15 CF per slab

Vol. Grout / Typ. Slab

Vol. Grout / Typ. Slab = (16 slots x .075 CF) + (4 sides x .18 CF) + (.15 CF) = **2.07 CF**

Bedding Grout Volume Beneath Paver : Assume ¼” grout thickness beneath entire slab (this includes waste)

Area under slab = 6’ x 6’ x .02’ = **.72 CF per Paver**

Estimated Average Grading Accuracy = +/- 1/8”

It is recommended that 20% waste be added to the final dowel grout volume for estimating purposes. For smaller projects, or on single-weekend closures, 20% may not be enough.

What most contractors have found to be a good strategy on larger jobs is to order enough grout for about half the job, or as much as a truckload to get good volume pricing. Monitor the grout usage for a while to verify quantities, then order the balance of the required grout.

Appendix B

BEDDING GROUT

Required Properties

Flow Rate of 17-20 seconds through a standard ASTM C939 Flow Cone (½" opening)

Compressive Strength 4 MPa in 12 hours (cubes)

Suggested Bedding Grout Mix Design *

Cement – 5 (94 lbs) bags = 470 lbs (Type III Portland Cement)

Water – 26 gals (0.46 w/c)

Flow Cable 1 (25 lbs) bag (5.32% of Portland Cement)

Bedding Grout Yield per 5 (94 lbs) Bag Batch

Bedding Grout Yield per 5 (94 lbs) Bag Batch

Component	Absolute Volume
$\text{Cement- } 5\,\text{bags} \times 94\,\frac{\text{lb}}{\text{bag}} \times \frac{1}{3.15 \times 62.4\,\frac{\text{lb}}{\text{ft}^3}} = 2.39\,\text{ft}^3$	2.39 ft^3
where 3.15 is the specific gravity of cement	
$\text{Water - } 0.46(\text{w/c}) \times 94\,\frac{\text{lb}}{\text{bag}} \times \frac{5\,\text{bags}}{62.4\,\frac{\text{lb}}{\text{ft}^3}} = 3.465\,\text{ft}^3$	3.465 ft^3
$\text{Flow Cable - } 1\,\text{bag} \times 25\,\frac{\text{lb}}{\text{bag}} \times \frac{1}{2.2 \times 62.4\,\frac{\text{lb}}{\text{ft}^3}} = 0.182\text{ft}^3$	0.182 ft^3
where 2.2 is the specific gravity of flow cable	
	6.038 ft^3

For estimating purposes assume 1 cubic foot bedding grout yields 48 SF at ¼" thick.

* Actual quantities may vary to meet required flow rate of 17-20 seconds and a compressive strength of 600 psi in 12 hours.

APPENDIX C

DAYTON SUPERIOR®
Chemical & Cement Products

Technical Data

HD-50™
Rapid Setting Heavy Duty Flowable Repair Mortar

PRODUCT DESCRIPTION:

HD-50 is a fast setting, fiber reinforced, latex modified, heavy duty concrete repair mortar designed for areas where a rapid strength gain is required to minimize downtime. HD-50 is a cement based compound having similar characteristics to normal portland cement mixes and is bondable and compatible with portland cement concrete. It does not contain chlorides or magnesium phosphates.

HD-50 is a one component product requiring only water to mix and apply, simplifying restoration of concrete surfaces. Areas repaired with HD-50 can be opened to traffic within one hour because the compressive strength of the patch is already in excess of 2,000 psi.

PURPOSE:

HD-50 is a rapid setting, cement based concrete mortar designed for the repair of heavy duty surfaces such as concrete highways, bridge decks, parking structures, airport runways, freezer rooms, industrial and warehouse floors, and loading docks.

HD-50 is a flowable material and is not designed for vertical and overhead patching, unless the repair is formed. HD-50 can be installed in weather as cold as 10°F (-12°C), provided cold weather instructions are followed.

ADVANTAGES:

- Can be opened to use or traffic within 60 minutes.
- High compressive strength quickly – over 2,000 psi in one hour.
- Resists salt penetration and damage from freeze/thaw cycles.
- Contains no chlorides or magnesium phosphate (not a chemical concrete).
- Meets ASTM C-928; Specification for Very Rapid Hardening Cementitious Repair Materials.
- Can be applied in cold temperatures down to 10°F (-12°C), if cold weather instructions are followed.
- Non Corrosive.
- Bondable and compatible with portland cement concrete.
- Aggregate Extension – Up to 60% on repairs greater than 2 inches (5cm) deep.

SPECIFICATIONS:

Meets ASTM C-928: As a Type R-3 mortar which includes the following tests:

1. Compressive Strength – ASTM C-109

	At 75°F (24°C)	At 40°F (4°C)	At 100°F (38°C)
1 Hour	2500 psi (17.2 MPa)	–	–
3 Hours	3500 psi (24.1 MPa)	2700 psi (18.5 MPa)	5100 psi (35.1 MPa)
1 Day	6145 psi (42.4 MPa)	6100 psi (42.0 MPa)	6300 psi (43.4 MPa)
7 Days	7370 psi (50.8 MPa)	6860 psi (47.3 MPa)	7300 psi (50.3 MPa)
28 Days	7990 psi (55.1 MPa)	7800 psi (53.8 MPa)	8500 psi (58.6 MPa)

2. Bond Strength ASTM C-882
   1 day 1,950 psi (13.4 MPa)
   7 days 2,250 psi (15.5 MPa)

3. Length Change of Hardened Cement Mortar and Concrete ASTM C-928

Change	Water Storage	Air Storage	Differential
28 Days	+.051%	-.082%	.133%
ASTM C-928	Max. to .15%	Max. to -.15%	Max. .20%

4. Scaling Resistance (Freeze/Thaw) - ASTM C-672 Average of 3 specimens:
   Scaling Resistance - .71 lbs./ft^2 (3.5 kg/m^2)
   ASTM C-928 Spec. - 1.0 lbs. /ft^2 (4.9 kg/m^2)

5. Rapid Freeze/Thaw Test: ASTM C-666
   At 300 Cycles - No loss.

6. Chloride Ion Permeability - ASTM C-1202
   Elapsed Time - 360 minutes
   Chloride Permeability Rating - Very Low

SURFACE PREPARATIONS:

For best results follow the ACI standards for concrete preparation, removing all residue, grease, dirt, oil, etc. from the surfaces to be in contact with the repair material. All loose concrete must be removed until firm substrate is exposed. Saw cut the perimeter of the repair to a maximum depth of 1/2" (1.3 cm). Best results will be obtained by saw cutting the area to be repaired, providing uniform depth, a high surface profile and firm bonding areas. Minimum repair depth of 1/2" (1.3 cm) is required. All surfaces to be repaired should be in a saturated surface dry (SSD) condition with no standing water on the surface. A scrub coat or an approved bonding agent like Dayton Superior Ad Bond (J-40) is recommended.

Dayton Superior Chemical & Cement Products 3 CONCRETE

11/03 **For Commercial/Industrial Use Only** 14-3

DAYTON SUPERIOR®
Chemical & Cement Products

Technical Data

PLACEMENT INSTRUCTIONS:

When mixing less than a full bag, always first agitate the bag so that a representative sample is obtained. HD-50 requires only water for mixing at the rate of 3.25 qts. (3L) per 50 lbs. (22.7 kg) of material. Place water into the mixing container and then add the repair material to the water. The product can be mixed with a mud paddle in a 5 gal. (18.9L) container, or can be mixed in a mortar mixer, preferably with rubber-tipped blades. Continue mixing until the material is free of lumps (approx. 3-5 minutes). Mix as close as possible to the area to be repaired. Do not allow material to build up on equipment and wash periodically with water. Do not re-temper the mixed material or use admixtures. Place immediately after mixing, working the material firmly into the sides and bottom to eliminate air pockets and assure maximum bond. Where practical, work from one side to the other and screed to the level of the surrounding concrete. Trowel the surface or provide a desired finish. Working time is 15 minutes. HD-50 should be extended 60% by weight with clean 3/8" (1.0 cm) pea gravel on patches deeper than 2" (5 cm). For aggregate extension greater than 60%, contact Dayton Superior. On hot or windy days, a moist cure for 1 hour is recommended, or apply one of Dayton Superior water based curing compounds, such as J-18 or J-11-W.

HOT AND COLD WEATHER APPLICATIONS:

COLD - HD-50 can be applied in temperatures down to 10°F (-12°C), provided these instructions are followed. When applied in cold weather (below 40°F, 4°C), heat the surrounding concrete until warm to the touch. Warm the repair material and use approx. 90°F (33°C) mixing water. After placement, the repaired patch should be covered with a construction insulating blanket for a minimum 1-3 hours to keep material from freezing and to assure proper set and bond.

HOT - When placing the material in hot weather, cold water should be used as a mixing agent. Ambient and water temperatures will affect the setting time. Colder temperatures will extend the setting time, and warmer temperatures will shorten the setting time. At 70°F (21°C), the initial setting time is between 15 and 20 minutes. In applications where temps. are above 90°F (33°C) it is recommended the repair area be soaked with water, or use of an approved bonding agent like Dayton Superior Ad Bond (J-40) be applied to prevent the rapid loss of the moisture in the patch material. The repair area should be covered with wet burlap or one of Dayton Superior water based curing compounds, such as J-18 or J-11-W.

YIELD:

.42 cubic ft. per 50 lb. (.012 m^3/ 22.7 kg) bag
.60 cubic ft. per 50 lb.(.017 m^3/22.7 kg) bag with 60% extension (30 lbs. or 13.6 kg) with 3/8" (1 cm) pea gravel.

PACKAGING:

50 lb. (22.7 kg) bags, 50 bags per pallet

LIMITATIONS:

Do not attempt to retemper HD-50 after initial mixing. Do not add other cements or admixtures. HD-50 is a fast-setting product and mixing equipment should be cleaned with water at the earliest time. Shelf life of this material is approx. one year. Store on pallets in a cool, dry area and free from direct sunlight.

WARNING:

Skin is sensitive to cement. Wearing protective gloves and goggles is recommended. Avoid contact with eyes. Avoid prolonged contact with skin. Contains portland cement. Wash exposed skin promptly with water. May cause skin irritation as well as cement burns. In case of eye contact, flush eyes repeatedly with clean water and contact a physician. Harmful if ingested. Read MSDS before using product.

TECHNICAL SERVICES:

Contact the technical staff for assistance at:

1-866-329-8724 • 1-913-233-1750 • FAX: 1-913-279-4806
daytonsuperiorchemical.com

WARRANTY

Warranty, Warranty Disclaimer and Exclusive Remedy – Dayton Superior Corporation warrants, for 12 months from the date of manufacture or for the duration of the published product shelf life, whichever is less, that at the time of shipment by ("the Company"), the product is free of manufacturing defects and conforms to ("the Company's") published specifications in force on the date of acceptance by ("the Company") of the order. ("the Company") shall only be liable under this warranty if the material has been applied, used, and stored in accordance with ("the Company") instructions in the product's technical data sheet.

The purchaser must examine the product when received and promptly notify ("the Company") in writing of any non-conformity before the product is used, or no later than 30 days after such non-conformity is first discovered. If ("the Company"), in its sole discretion, determines that the product breached the above warranty, it will, in its sole discretion, replace the non-conforming product, refund the purchase price or issue a credit in the amount of the purchase price. This is the sole and exclusive remedy for breach of this warranty.

Only a ("Company") officer is authorized to modify this warranty. The sales information on the ("the Company's") website and received by the customer during the sales process does not supersede this warranty and the specifications of the product in force on the date of sale. THE FOREGOING WARRANTY SHALL BE EXCLUSIVE AND IN LIEU OF ANY OTHER WARRANTY, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND ALL OTHER WARRANTIES OTHERWISE ARISING BY OPERATION OF LAW, COURSE OF DEALING, CUSTOM, TRADE OR OTHERWISE.

Limitation of Liability – Dayton Superior Corporation shall not be liable in contract or in tort (including, without limitation, negligence, strict liability or otherwise) for loss of sales, revenues or profits; cost of capital or funds; business interruption or cost of downtime, loss of use, damage to or loss of use of other property (real or personal); failure to realize expected savings; frustrations of economic or business expectations; claims by third parties (other than for bodily injury), or economic losses of any kind; or for any special, incidental, indirect, consequential, punitive or exemplary damages arising in any way out of the performance of, or failure to perform, this Agreement, even if ("the Company") could foresee or has been advised of the possibility of such damages. The Parties expressly agree that these limitations on damages are allocations of risk constituting, in part, the consideration for this agreement, and also that such limitations shall survive the determination of any court of competent jurisdiction that any remedy provided in these terms or available at law fails of its essential purpose.

Dayton Superior Specialty Chemical Corp • 4226 Kansas Avenue, Kansas City, KS 66016
Telephone (913) 233-1750 • Fax (913) 279-4806 • daytonsuperiorchemical.com

HD-50
Technical Application Bulletin

Application of the HD-50 as a dowel grout for the Super Slab™ Full Depth Pavement Replacement Slab System

When used in the Super Slab™ System it is recommended to pump the HD-50 using a maximum water content of 3.625 qts./50 lb. [3.43 L/22.7 kg] bag.

The following HD-50 test data is representative @ the 3.625 qts.[3.43L]:

Property	Test Results
Compressive Strength (1 hour)	12.7 Mpa [1842 psi]
Compressive Strength (3 hour)	22.8 Mpa [3306 psi]
Compressive Strength (24 hour)	31.5 Mpa [4568 psi]
Compressive Strength (28 day)	53.4 Mpa [7743 psi]
Expansion (%)	0.06%
Freeze/Thaw (% loss)	0.0%
Bond Strength	2.8 Mpa [406 psi]
Set Time (minutes)	37 min.

For application or product questions call the technical services group @ 866-329-8734

PRO SPEC®
A SAKRETE® BRAND

SLAB DOWEL GROUT

Mixing

1. Mix as close to the area being repaired as possible. Slab Dowel Grout requires only the addition of water.
2. Use 4 quarts (3.8 L) per 50 lbs. (22.7 kg). Place the potable water into the mixing container and then while mixing add the grout.
3. Slab Dowel Grout can be mixed in a mortar mixer or by using a paddle attached to a heavy duty 1/2" drill (650 r.p.m.).
4. Mix for 2-3 minutes to a lump-free consistency.
5. Do not retemper or overwater.

Application

Slab Dowel Grout completes the structural connection between adjacent slabs and is therefore a very important part of the Super-Slab System®. It is a special pumpable rapid strength mix design for filling and connecting dowels and must completely fill the inverted dovetail slots and do the job that cast in place concrete normally does. And for it to make the Super-Slab System® viable it must reach strength quickly and perform as well as cast-in-place concrete. ProSpec Slab Dowel Grout meets these stringent requirements minimizing down time and insuring durability.

Place immediately after mixing working the grout firmly into the sides and bottom of the cavity eliminating air pockets and insuring bond and coverage. ProSpec Slab Dowel Grout can also be placed by pumping. Because of the early strength gain the grout must be pumped rapidly to avoid having the grout set-up in the pump or hose. It is important to pre-test insuring that the technique and equipment is suitable for the task. Install the ProSpec Slab Dowel Grout by placing the hose nozzle in the back port of each slab until grout exceeds from the port near the joint. Continue pumping until the grout fills the joint as specified in the Fort Miller installation drawings. After several slots have been filled, monitor the grout level in previously grouted ports and add material as required.

CAUTION! Do not drive on any freshly grouted slab with any construction equipment or vehicle until the specified grout strength of 2500 psi (17.2 MPa) has been reached. To do so may compromise future efficiency of load transfer between slabs. Follow installation instructions as outlined by the Fort Miller Co. Inc. Super Slab System® pertaining to precast concrete placement slab installation (518.695.6000).

Clean Up

Use water to clean all tools immediately after use.

PRE-BLEND

2

PRO SPEC®
A QUIKRETE® BRAND

SLAB DOWEL GROUT

Description

ProSpec® Slab Dowel Grout is a non-shrink high compressive strength, non-metallic grout used for placing prefabricated concrete pavements.

Features

- Over 2500 psi (17.24 MPa) compressive strength in 2 hours
- Meets ASTM C 928, Standard Specification for Packaged, Dry, Very Rapid Hardening Cementitious Materials for Concrete Repair
- Non-shrink
- Special mix design formulated to meet the requirements of the Fort Miller Co. Inc. Super Slab System®
- Excellent bond
- Resists freeze/thaw damage
- High fluid – can be pumped through 1 1/4" grout hole ports
- Cement based, non-corrosive – not a chemical concrete
- Non-metallic

Uses

- Specifically designed to complement precast concrete slab placement
- Fill inverted dovetail slots in precast slabs

Technical Data

Working Time @ 70° F (21° C)

30 minutes; pumpable for 20 minutes

Set Time ASTM C 191 @ 70° F (21° C)

Initial set	Approx. 35 min.
Final set	Approx. 40 min

Compressive Strength ASTM C 109 @ 75° F (24° C)

2 hours	2,500 psi (17.2 MPa)
3 hours	4,000 psi (27.5 MPa)
1 day	5,200 psi (35.8 MPa)
7 days	6,200 psi (42.7 MPa)
28 days	7,500 psi (51.7 MPa)

Test Length Change of Hardened Cement Mortar and Concrete ASTM C 928

Change (28 days)	ASTM C 928 requirement
Water storage	+0.04% (max. to 0.15%)
Air storage	-0.01% (max. to -0.15%)
Differential	0.14% (max. 0.20%)

Freeze/Thaw Test (using 2" cubes); NY DOT Test Method 701-13F/502-3P

Mixing water	8.0 qts./100 lbs.
Method of curing	7 days @ 72° F, 50% RH

Testing results using a NaCl solution

	3% NaCl solution	10% NaCl solution
Loss after 25 cycles	No loss (weight gain of 1.01%); Condition of specimens: slight surface popping, 5%	No loss (weight gain of 1.43%); Condition of specimens: no visible degradation
Loss after 50 cycles	no loss (weight gain of 1.51%); Condition of specimens: slight surface popping, 30%	No loss (weight gain of 2.38%); Condition of specimens: slight surface popping, <5%

Test results obtained under controlled laboratory conditions.
Reasonable variations can occur due to changes in ambient conditions.

PRE-BLEND PRODUCTS, INC.

1

PRO SPEC
A SAKRETE BRAND

SLAB DOWEL GROUT

Best Performance

- Do not re-temper after mixing
- Do not over water or add other cements or additives
- Ideal ambient, surface and material temperatures are in the range of 40° to 100° F (4° to 38° C) for mixing and placing.
- Ideal mixed product temperature at placement is 65-70° F (21° C), where the initial setting time is 35 minutes. Hot temperatures will shorten setting time, while cold temperatures will extend setting time
- Hot Weather:
  Keep bagged Slab Dowel Grout cool. Mix Slab Dowel Grout using ice water to extend working time
- Cold Weather:
  Do not use antifreeze or accelerators and keep Slab Dowel Grout warm. Combine the warmed repair material with 90° F (32° C) mixing water

Refer to

- ACI 305 Standard on Hot Weather Concreting
- ACI 306 Standard on Cold Weather Concreting

Yield

50 lbs. (22.7 kg) yields approximately 0.45 ft³ (7 m³)
50 lbs. (22.7 kg) extended with 30 lbs. (14 kg) of 3/8" (10 mm) pea gravel yields approximately 0.65 ft³ (10 m³)

Packaging

50 lbs. (22.7 kg) moisture resistant bag

Storage

Keep in cool/dry place unexposed to sunlight and tightly reseal container.

Shelf Life

One year when stored properly in original unopened container.

PRE-BLEND PRODUCTS, INC.

3

PRO SPEC®
A SAKRETE BRAND

SLAB DOWEL GROUT

Caution

KEEP OUT OF REACH OF CHILDREN AND ANIMALS. WARNING!

Contains Portland cement and silica sand. May irritate eyes and skin. Avoid contact with eyes or prolonged contact with skin. In case of contact, flush thoroughly with water. The wearing of gloves and safety goggles is recommended.

In case of eye contact, flood eyes with potable water and call physician. DO NOT RUB EYES. Do not take internally. Crystalline silica sand may cause serious lung problems. Avoid breathing dust and wear a respirator in dusty areas.

Consult Material Safety Data Sheet for further information.

First Aid

Inhalation: Remove to fresh air

Eye Contact: Irrigate eye with water or consult physician if irritation persists.

Skin Contact: Washed exposed skin area with soap and water; consult a physician if irritation persists.

Ingestion: Immediately consult a physician.

ProSpec is the registered trademark of Sakrete of North America
8201 Arrowridge Blvd., Charlotte, NC 28273 • www.sakrete.com • e-Mail: prospec@sakrete.com

PRE BLEND™

APPENDIX D

Master Builders Technologies

running mixer

3. Slowly add the 100 kg's of cement into the running mixer. Mix for 3 minutes until a lump free mixture is formed and adjust to final workability with the remaining water.

PREPARATION

1. Always use a stiff PVC tube to pump the grout. A normal pump grout should be used (i.e. small piston or worm pump).
2. Flush anchor holes with air or water before installation of the anchors.

PRE-GROUTED ANCHORS:

1. Place the PVC hose in the bottom of the drill hole
2. Start pumping
3. Withdraw the pipe slowly. To ensure complete filling of the hole some surplus grout should be allowed to flow out of the hole when the anchor is installed.
4. The thixotropic nature of the grout will ensure that it stays in the hole , even overhead.
5. Install the anchor and lock it into position so that it cannot move.

PRE-GROUTED ANCHORS: , TUBE ANCHORS ;

1. Connect the hose to the anchor and start pumping.
2. Continue until the grout is squeezed out between the disc and the rock.
   When grouting tube anchors , it may be necessary to make the grout more fluid . However , ensure that the grout is pumped into the hole and does not flow into it or there may be a risk of incomplete filling .

Packaging

MEYCO® Fix Flowcable is available in 10 kg paper bags.

Storage

If stored in unopened bags in a dry cool place MEYCO® Fix Flowcable has a shelf life of at least 12 months.
Do not use the product if the bag has been opened for more than one month .

Safety Precautions

MEYCO® Fix Flowcable is highly alkaline when wet. Avoid contact with the skin and eyes. Wash skin contact with soap and water . Should eye contact occur flush with plenty of clean water and seek medical advice.

During handling wear eye protection and a dust mask. The use of suitable gloves and /or a barrier cream is recommended.

This product is meant for professional use only , keep away from children.

The information given here is true , represents our best knowledge and is based not only on laboratory work , but also on field experience. However, because of numerous factors affecting results, we offer this information without guarantee and no patent liability is assumed. For additional information or questions , contact your local MBT respresentative.

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MEYCO® FLOWCABLE

Admixture for Cementitious Grouts

Description

MEYCO Flowcable admixture is a special multicomponent rheoplastic admixture used in cement-based grouts to reduce the mixing water requirements and produce a flowable, pumpable, thixotropic, non-shrink, non-segregation, impermeable, high-strength grout with any type of portland cement. MEYCO Flowcable admixture is used for rock and ground support and stabilization, as well as grout used for the protection of post-tensioned cables in prestressed concrete and for full encapsulation of tunnel and mine rock bolts and anchors.

Applications

Recommended for use in:

- Neat cement or cement-sand grouts for anchoring applications in rock and concrete
- Grouts used in tunneling, dams, mining or other geotechnical operations
- Preplaced aggregate grouting
- Contact and consolidation grouting

Features

When used in the recommended applications, MEYCO Flowcable admixture produces a thixotropic grout with the following unique properties:

- Low water-cement ratio
- Bleedwater control
- High-early strength*
- Long potlife (open time)*
- High ultimate strength*

** These parameters are dependent upon the type of cement used in the grout.*

Benefits

- Pumps and places more easily
- Shrinkage compensated
- Dense, compact and impermeable, ensuring maximum protection of steel members against corrosion caused by aggressive agents

Performance Characteristics

Mixing: MEYCO Flowcable admixture should be uniformly distributed in the mixing water when possible before the other solids are added.

Dosage: MEYCO Flowcable admixture is formulated to be used at a dosage in the range of 2.5-6.0 lb/cwt (2.5-6.0 kg/100 kg) of cementitious material. Dosages may vary according to application and desired concrete properties. For dosages outside the recommended range, contact your local sales representative.

Product Notes

MEYCO Flowcable admixture is not recommended for precision grouting of machinery, column bases, etc.

Storage and Handling

Storage Temperature: MEYCO Flowcable admixture should be stored in unopened packaging in clean, sheltered, dry conditions at 50-90 °F (10-32 °C).

Shelf Life: MEYCO Flowcable admixture has a shelf life of 12 months when properly stored. Depending on storage conditions, the shelf life may be greater than stated. Please contact your local sales representative regarding suitability for use if the shelf life of MEYCO Flowcable admixture has been exceeded.

MEYCO

Product Data: MEYCO® FLOWCABLE

Packaging

MEYCO Flowcable admixture is supplied as a dry powder in 25 lb (11.4 kg) moisture resistant bags.

Related Documents

Material Safety Data Sheets: MEYCO Flowcable admixture.

Additional Information

For additional information on MEYCO Flowcable admixture, contact your local sales representative.

The Admixture Systems business of BASF Construction Chemicals is a leading provider of innovative admixtures for specialty concrete used in the ready-mixed, precast, manufactured concrete products, underground construction and paving markets throughout the North American region. The Company's respected Master Builders brand products are used to improve the placing, pumping, finishing, appearance and performance characteristics of concrete.

BASF Construction Chemicals
Admixture Systems

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APPENDIX E

PRO SPEC®

BEDDING GROUT[1]

Description
ProSpec® Bedding Grout is a non-shrink high compressive strength, non- metallic grout used for placing prefabricated concrete pavements.

FEATURES:

- Over 3500 psi compressive strength in 24 hours
- Special mix design formulated to meet the requirements of the Fort Miller Co. Inc. Super Slab System®
- Excellent bond
- Resists freeze/thaw damage
- High fluid – can be pumped through 1 1/4" grout hole ports
- Cement based, non-corrosive – not a chemical concrete
- Non-metallic•

USES:
- Ideal for bedding grout for precast concrete roadway panels,

Technical Data:
Compressive Strength ASTM C 109
1 day >3500 psi
7 days > 7000 psi
28 days >8000 psi
Flow (cone) ASTM C939
<30 Seconds

Mixing Requirements
Mixing Water 7 qts/35 lb. bag (41.7%).
Water can be adjusted for +/- 5% based on ambient conditions and jobsite situations.
Curing Method ASTM C 1107

1. Mix as close to the area being repaired as possible. ProSpec Bedding Grout requires only the addition of water.
2. Use 7 quarts+/- 5% based on ambient conditions and jobsite situations to 35 lbs. bag (41.7%)
Place the potable water into the mixing container and

then while mixing add the grout.
3. ProSpec Bedding Grout can be mixed in a mortar mixer or by using a paddle attached to a heavy duty 1/2" drill (650 r.p.m.).
4. Mix for 2-3 minutes to a lump-free consistency.
5. Do not retemper or overwater.

Application: (Note: Always install ProSpec Slab Dowel Grout before Bedding Grout. Do not drive on any slab with any construction equipment or vehicle until the Dowel Grout has achieved 2,500 psi [17.2 mPa]. To do so may compromise future efficiency of load transfer between slabs.)
ProSpec Bedding Grout is a special mix design formulated to meet the requirements of Bedding Grout for use in the Fort Miller Co., Inc. Super Slab System. The purpose of bedding grout is to fill any small voids that may exist between the slab and the prepared subgrade after the "supergrading" process has been completed. Bedding grout is installed by pumping into the bedding grout distribution system cast into the underside of each slab. Pump the grout into the lowest of the two connected ports and keep pumping until grout exudes from the uphill port. The bedding grout is very fluid, but the grout will take a short while to disperse beneath the slab, so that the port will need to be refilled occasionally until the level ceases dropping in the port. The refilling is easily accomplished by a laborer who tops off the ports from a pail, pouring the grout directly into the port, or into plastic funnels provided by Fort Miller for this purpose. Continue with the pumping of bedding grout into each distribution channel until all the channels in each slab have been grouted. Leave the bedding grout level down 2" from the top of the slab (or remove grout if required) and cap off with ProSpec Slab Dowel Grout.

For Super Slab Systems* installations, follow installation instructions as outlined by The Fort Miller, Co. Inc. (518-695-5000; www.FortMiller.com).

*Patented system by The Fort Miller Co.

Clean up:
Use water to clean all tools immediately after use.

Best Performance:
Do not re-temper after mixing
• Do not over water or add other cements or additives
•When grouting slab connectors the ProSpec Slab Dowel Grout may be driven on by construction equipment and vehicles once it has achieved 2,500 psi (17.2mPa) regardless of the strength achieved by the bedding grout.
• Ideal ambient, surface and material temperatures are in the range of 40º to 100º F (4º to 38º C) for mixing and placing.
• Ideal mixed product temperature at placement is 65-70º F (21º C), where the initial setting time is 35 minutes. Hot temperatures will shorten setting time, while cold temperatures will extend setting time
• Hot Weather:
Keep bagged ProSpec Bedding Grout cool. Mix ProSpec Bedding Grout using ice water to extend working time
• Cold Weather:
Do not use antifreeze or accelerators and keep ProSpec Bedding Grout warm. Combine the warmed repair material with

90º F (32º C) mixing water

Refer to
• ACI 305 Standard on Hot Weather Concreting
• ACI 306 Standard on Cold Weather Concreting

Packaging:
35 lb. bags

Yield:
35 lb. bag = 0.41 Cubic Feet

Storage:
Keep in cool/dry place unexposed to sunlight and tightly reseal container.

Unit weight:
120 pounds per cubic foot.

Shelf Life:
One year when stored properly in original unopened container.
Keep in cool/dry place unexposed to sunlight and tightly reseal container.
35 lbs. moisture resistant bag

APPENDIX F

Equipment and Materials Required for Super-Slab® Installation

(Equipment by Fort Miller in BOLD) (Not all materials needed for every job)

1. Drilling and Anchoring Dowels
   a. Gun for dowel epoxy injection. Air- or battery-powered preferred for production jobs
2. Grading
   a. 3' aluminum asphalt lutes or landscape rake for fine tuning the stone dust, square- and round-point shovels, heavy-duty garden rakes (in case the subgrade needs work), vibratory compactor, water source/system for moistening stone dust
   b. **Shutter Screed (supplied by Fort Miller)**
   c. Rails, Pin Straight Edge with shims (supplied by Fort Miller for setting rails)
   d. **Depth gage (supplied by Fort Miller)** for checking subgrade surface
3. Setting Slabs
   a. Lifting Equipment and rigging for setting slabs. Rigging must be long enough for chain/sling angle to exceed 60 degrees. Backhoe or crane of adequate capacity. Provide means of adjusting sling length so that slabs hang at approximate design cross-slope, ie, chains or extra shackles.
   b. 2 tie off ropes, (4) 1 ¼" bars, approximately 4' long to be used for guiding slab into position. Wrenches for tightening lifting brackets.
   c. 4" X 4" high density plastic shim packs if slabs are not grouted same night
   d. Bond breaker (form oil in sprayer or equal) to be applied to edges of slabs and dowels as required
4. Grouting (Equipment should be mounted on trucks and trailers for grout crew)
   a. Group pump/mixer of adequate capacity for mixing and pumping grout
   b. 1" grout hose with appropriate connectors and fittings, approx. 25' long, and one spare hose
   c. Grout nozzle to fit grout hose (first nozzle will be supplied by Fort Miller – 1" pipe thread)
   d. Graduated plastic water pails for measuring grout water (available in paint dept. of local hardware stores). Drill holes at the proper water level
   e. Thermometer (infra red preferred) to measure grout water and powder temperature. Heating system for mix water and slabs if cold weather work.
   f. Pointing trowels, squeegees, brooms, and several five-gallon pails
   g. ASTM flow cone to check flow rate (during mix design process)
   h. Grout testing equipment as required by Specification and/or Agency
   i. **Funnels for providing head to ensure dispersal of bedding grout**
   j. Water system of adequate capacity and pressure. VERY IMPORTANT!
   k. 50-gallon drums, or tub, for holding grout washwater