



PHOSCRETE FORMULA 1 [MALP Series]

INSTALLATION GUIDE

Installation Overview

Using Phoscrete concrete repair materials is easy, but for best results, it is important to follow the directions provided in this installation guide.

Visit phoscrete.com¹ for the latest versions of this installation guide and all technical documents. Contact our installation support team for help anytime.

What is MPC and what is MALP?

PHOSCRETE concrete materials are MPC (**M**agnesium **P**hosphate **C**ement) concretes. Unlike conventional concrete, MPC is not produced with Portland cement. PHOSCRETE FORMULA 1 concretes are the MALP version of MPC [**M**agnesium **P**hosphate **C**ement] concretes. Phoscrete's MALP concrete materials mix with a Liquid Phosphate Activator, not water. MALP products include:

Short Name	Full Product Name	Application
F1-HC	PHOSCRETE FORMULA 1- HC [Formerly Phoscrete HC]	Horizontal and Castable
F1E-HC	PHOSCRETE FORMULA 1E-HC [Formerly Phoscrete HC-Endure]	Horizontal and Castable
F1-HF	PHOSCRETE FORMULA 1-HF	Hot Floor Refractory
F1E-HF	PHOSCRETE FORMULA 1E-HF	Hot Floor plus Endure

What is PHOSCRETE[®] ENDURE[™]?

PHOSCRETE concrete formulas labeled "1E" are packaged with the PHOSCRETE ENDURE[™] admixture, a bio-based, liquid soy-methyl-ester polystyrene (SME-PS) concrete durability enhancer. When mixed with ENDURE, PHOSCRETE MALP concretes become hydrophobic, with exceptional freeze-thaw and salt scaling resistance properties that protect concrete 10+ years.

Properties of PHOSCRETE F1 Concretes

PHOSCRETE F1 concrete materials are very rapid hardening, with high early strength gain. Phoscrete bonds strong – both chemically and mechanically - to conventional concrete substrates with no cold joints. Phoscrete also bonds super strong to itself, wet or cured, so repairs can be completed in segments or lifts with no cold joints. Phoscrete stops rust on contact, prevents chloride penetration, does not shrink, and resists cracking even under severe stress and/or environmental conditions.

At temperatures above 70°F (21°C), PHOSCRETE F1 concrete is traffic-ready in less than one [1] hour. F1 concretes typically achieve one [1] hour strengths of: compressive 5,000 psi (35 MPa) and a bond (by slant/shear) 1,500 psi (10 MPa). Phoscrete F1 ultimate strengths are: compressive 10,000 psi (70 MPa), tensile 700 psi (5 MPa), and 3,000 psi (20 MPa) bond.

For detailed technical data and performance characteristics, visit phoscrete.com.



Important things to know when working with PHOSCRETE F1 [MALP Series]:

- ▶ **Never add water** when mixing or placing MALP, mix only with PHOSCRETE Liquid Activator.
- ▶ **Always add liquid first into an empty pail** when mixing. Next add Phoscrete admixtures, including ENDURE. Then blend in the Dry Mix powder.
- ▶ **Do NOT extend Phoscrete F1 with aggregates or sand.** Phoscrete F1 is pre-extended.
- ▶ **Mix one full bag of PHOSCRETE F1-Dry Mix into one full jug of PHOSCRETE Liquid Activator.**
Wet to Dry (WTD) mix ratio is 18.75%
- ▶ Liquid Activator is the same formula and volume packaging for all PHOSCRETE F1 products.
- ▶ Phoscrete F1 products are usually mixed one kit at a time in standard 5-gallon (or larger) buckets on installations requiring 2 pallets of material or less (96 kits). On larger volume repairs, multiple kits of PHOSCRETE F1 can be mixed at once using a rubber tipped, paddle-type mortar mixer. The Multiquip WM70PH8 Whiteman mortar mixer with a HDPE plastic drum is recommended. On smaller repairs, it is recommended to use Phoscrete Small Pails that have 2-gallon capacity and are available for all PHOSCRETE F1 products. Small Pail coverage is [1] board foot (.0833 cf or 12" x 12" x 1").
- ▶ Use a heavy-duty drill designed for mixing concrete materials. Phoscrete recommends the Bosch GBM-9-16 mixing drill or the Collomix Paddle Mixer XO. Ensure your generator and extension cords can supply sufficient power to the mixing drills.
- ▶ PHOSCRETE Urethane Mixing Augers (Small and Large) are excellent tools for fast and easy mixing of Phoscrete in a bucket. A special notched version of the auger is available for Collomix.
- ▶ Do not over-mix Phoscrete. Mix approximately one minute, until material is fully wetted out (no dry material remains) and shows uniform consistency. Then, place and finish immediately.
- ▶ Typical working time is 5-15 minutes (temperature dependent).
- ▶ **In warm temperatures, cool or supercool PHOSCRETE Liquid Activator in advance.** 40 lbs ice on top of 16 jugs of Phoscrete Liquid Activator fit in a 150-quart insulated cooler (available from Phoscrete). Phoscrete Liquid Activator can be supercooled down to 0°F (-20°C) in a chest freezer. When cooling the Liquid Activator on ice only (no freezer), refresh the ice in the cooler after 4 hours to keep the Liquid Activator below 40°F (5°C) for longer working time. Refer to [Phoscrete Best Practices - Warm Temperature Concrete Repair Guidelines.](#)ⁱⁱ
- ▶ **Use PHOSCRETE Fast-Set Admix in cold temperatures** to accelerate set time. Refer to [Phoscrete Best Practices - Cold Temperature Concrete Repair Guidelines.](#)ⁱⁱⁱ
- ▶ Phoscrete F1 concretes require a dry surface (NOT Saturated Surface Dry -SSD) for strongest bond. Primer is not generally required.
- ▶ **Use PHOSCRETE Primer** (scrub coat + thin layer) for challenging applications where maximum bond strength is required.
- ▶ **Use PHOSCRETE ENDURE Admix** to improve freeze/thaw and salt-scaling durability. Note that ENDURE dissolves polystyrene (foam board) so when casting Phoscrete with foam board, apply painters' (masking) tape on areas in direct contact with Phoscrete F1E products. Refer to [Phoscrete Best Practices for Endure Admix Usage Chart](#)^{iv}
- ▶ Place Phoscrete using standard concrete tools (magnesium or plastic float, margin trowel).
- ▶ Phoscrete does not bond to plastic, polystyrene (foam board), or petroleum products. Phoscrete does not bond to wet surfaces or wet/dry slurry from saw cut demolition.
- ▶ Dampen gloves and wipe down tools with water (and shake off) for ease of placement and best finish, but do not pour water directly on wet Phoscrete.
- ▶ Clean tools, buckets, clothing, and boots with water. Clean hands with soap and water.



Phoscrete Installation Support

Phoscrete technical support personnel are available to travel on-site for application training and start of work. Virtual interactive training is also available, and the most up-to-date documentation and installation videos are published at phoscrete.com. Contractors with recent experience working with Phoscrete may receive a letter of qualification upon request.

Phoscrete Packaging

Phoscrete is manufactured and delivered on pallets in Kits (Large Dry Mix bags, Liquid Activator jugs, plus Endure Admix jugs), in Small Pails (containing small Dry Mix bags and jars containing Liquid Activator and Endure Admix), and in Patch Kit Tubs (Dry Mix baggies and jars containing Activator and Endure), LTP (Less than Pallet) orders are packaged in shippable boxes. Refer to the Technical Data Guides found at phoscrete.com for weights and yields of specific products.

Shelf Life, Lot Numbers, Disposal, Health, Safety, and Environmental

When components are properly stored, **the shelf life of Phoscrete F1 Dry Mix is two [2] years. The shelf life of Phoscrete Liquid Activator is one [1] year. Shelf life of Phoscrete Endure is 18 months.** Store Dry Mix indoors, in low humidity. Store Activator indoors and minimize temperature swings. Store Endure in temperatures above 41°F (5°C).

14 Digit Phoscrete Lot Numbers [PNX-YYMMDD-LBB] are printed on every bag of Dry Mix, every jug of Liquid Activator, and every jug of Endure so be sure to check the lot numbers before installing. Here is how to decode a Phoscrete product batch number:

Dry Mix Bags: [PNX-YYMMDD-LBB] First digit "P" is for Phoscrete. "N" is FORMULA (1 or 3) X=Formula Variation [1=HC, 2=VO, etc.) "YYMMDD" is the year, month, day. "L" is the production location. The last 2 digits BB are the batch number. For example: "P11-221012-C07" means the Phoscrete Formula 1-HC Dry Mix was bagged on Oct. 12, 2022, in Chicago, Batch 07.

Liquid Activator Jugs: [PAX-YYMMDD-LBB] First digit "P" is for Phoscrete. "A" is MALP Liquid Activator. "X" is Supplier Identifier. "YYMMDD." "L" is the production location. "BB" is the tote number. For example: "PA1-220917-C02" means the Phoscrete MALP Liquid Activator from Supplier 1 was bottled on Sept. 17, 2022, in Chicago, Tote 03.

Small Pails: [PAX-YYMMDD-LBB] Full lot numbers of liquid and dry components are printed on the bag and jar Inside the Small Pails. On the outside label, the production date for the enclosed Phoscrete Liquid Activator is printed because it has the shortest shelf life.

Endure Jugs, Drums, or Totes: [PEX-YYMMDD-LBB] "PE" indicates Phoscrete Endure. "X" is Supplier Identifier, "YYMMDD." BB indicates for the tank number. For example: "PE3-210626-I02" the ENDURE from supplier 3 was batched on June 26, 2021, in Iowa, tank 02.

Refer to [Phoscrete Best Practices - Activator Safe Disposal](https://phoscrete.com)^v at phoscrete.com for more information



Phoscrete STRONGLY advises against installing expired material, material improperly stored, or material opened or damaged. If you cannot avoid installing a questionable material, first mix a full kit (or pail) in your shop and observe mixing properties, time of set, and maximum temperature to verify the material is consistent with fresh product.

Disposal: Hardened Phoscrete concrete and PHOSCRETE Dry Mix powder can be disposed in any dumpster or landfill. PHOSCRETE Liquid Activator must be neutralized before disposing. Refer to [Phoscrete Best Practices for Liquid Activator Disposal](#) at phoscrete.com. Contact your Phoscrete representative for any questions regarding disposal of improperly stored or expired material. Always follow local environmental regulations when disposing of Phoscrete.

Health, Safety, and Environmental: Read, understand, and follow all Installation Instructions, Safety Data Sheets, and product label information for this product prior to use. The latest SDS can be obtained by visiting phoscrete.com, emailing your request to safety@phoscrete.com, or calling +1 561-420-0595. Use only as directed. For Hazardous Materials [or Dangerous Goods] Incident Spill, Leak, Fire, Exposure, or Accident, Call CHEMTREC® 24 Hours 800-424-9300 / +1 703-527-3887. Contracted by Phoscrete, CCN 866520.

Personal Protection Equipment

When mixing, placing, and finishing Phoscrete, wear a particle filtration mask, nitrile-coated gloves, and eye protection. Have water and an eye wash station handy. Wash your hands with soap and water after working with Phoscrete.

Surface Preparation

- ▶ Follow [ICRI Guidelines 310.1R^{vi}](#) for preparing the surface prior to placing Phoscrete.
- ▶ Remove all loose and damaged concrete from the repair area to reach sound concrete. Remove concrete contaminated by asphalt, oils, or other bond-inhibiting materials. Remove previously installed non-cementitious repair materials.
- ▶ Use appropriate mechanical means to obtain an exposed aggregate surface profile correspondent to a Concrete Surface Profile (CSP) rate between 7 and 9 according to [ICRI Guidelines 310.2R^{vii}](#). Hydro demolition is not recommended for Phoscrete F1 without time to allow substrate to dry.
- ▶ Remove exposed rust scale with a wire brush or use an angle grinder with a wheel brush. Because Phoscrete naturally stops rust on contact, sandblasting to completely remove rust from rebar is not necessary. Remove concrete beneath and around rebar whenever possible.
- ▶ For horizontal repairs, insure at least a one-inch [1"] depth throughout the repair (do not leave a feather edge). Thicker is better for lasting horizontal repairs, and two-inch [2"] minimum thickness is recommended. For expansion joint headers/nosings, four-inches [4"] (10 cm) minimum thickness is recommended. Encapsulate the rebar with Phoscrete for best results.
- ▶ Use an angle grinder and wheel brush to remove slurry from the substrate after wet/dry saw cutting, especially over vertical edges. Blow out any remaining dust.
- ▶ Use a torch and lightly "kiss" the substrate surface to burn off residual oils (after thorough mechanical removal), to dry damp concrete. Be careful because extended heat on conventional concrete can cause concrete's thermal degradation.



Deck Spall
Ideal Site Preparation



Use Foam Board to Establish Expansion Joints
Use painter's tape with FTE

- ▶ Use bond breaking materials such as polystyrene foam board to prevent Phoscrete from bonding across expansion joints. Mark form with a chalk line to substrate to establish the level for finishing. Soak wooden forms with and screeds with water, or paint with urethane paint or release agent to prevent bonding to the form and for slip-forming cast repairs. Note that release agents prevent the Phoscrete-to-Phoscrete bond.

Primer Treatment

PHOSCRETE PRIMER is not generally required for Phoscrete repair installations. The use of Phoscrete Primer is advised for challenging conditions to achieve a stronger bond. Phoscrete Primer improves bond strength as much as 50% by reducing voids at the bond line interface. All Phoscrete repair materials (F1, F3, Primer) bond to itself, effectively creating a monolithic pour (no cold joints).

When using Primer, prepare the concrete substrate service as noted in the previous section. Then, (1) aggressively scrub freshly mixed Phoscrete Primer on the prepared substrate surface to fill all voids; (2) apply a thin ¼" layer of Phoscrete Primer over the scrub coat; (3) wait at least 15 minutes for the thin layer to set up; (4) mix, place, and the finish Phoscrete F1 repair material.

Phoscrete's chemical and mechanical bond to Portland cement concrete is very good without primer treatment. Use PHOSCRETE PRIMER for best results in challenging conditions. Phoscrete F1 or F3 can be used as an alternative to Phoscrete Primer, following the primer treatment described above.

Small Pail Mixing Instructions

Phoscrete Small Pails are 2-gallon pails containing a paper bag of Dry Mix and a jar of Liquid Activator. PHOSCRETE F1-HC, F1E-HC, F1-HF and F1E-HF are available in Small Pails for small concrete repairs, or for a final, finishing mix to save a full bag. Phoscrete Primer is also packaged in Small Pails and smaller tubs. Refer to Technical Data Guides for coverage details.

- ▶ Remove all items from the small pail and empty the entire content of the Phoscrete Liquid Activator jar into an empty pail. Note for F1E products, the Endure Admix is in the same jar.
- ▶ Add scoop(s) of Fast-Set or Slow-Set admixtures per [Phoscrete's Best Practices for Cold Temperature](#) and [Warm Temperature Guidelines](#).
- ▶ Empty entire contents of the Dry Mix bag into the pail.
- ▶ Insert the PHOSCRETE Small Mixing Paddle or similar into the pail. Slowly power up the 3/8" drive, min. 18V portable mixing drill and run on the highest torque setting for approximately one [1] minute, or until the material is completely wetted out (no dry material remains) and shows a uniform consistency. F1-HC/HF mix to a flowable consistency.

Large Bag Bucket Mixing Instructions

- ▶ PHOSCRETE Dry Mix bags and Liquid Activator jugs are typically mixed as kits in [5] gallon (or larger) buckets. Refer to the Technical Data Guides for coverage details.
- ▶ When mixing more than 5 cubic feet (10+ kits of Phoscrete) for a single placement, it is recommended that [2] persons mix from [2] buckets each, with a runner steadily delivering freshly mixed material to the finishers.
Watch installation videos at phoscrete.com for mixing examples.
- ▶ Remove chilled Liquid Activator jugs from cooler with ice. Empty the entire content of the Liquid Activator jug into the bucket. Pour the Liquid Activator against the walls of the bucket to avoid splashing, and to clean the bucket walls after each mix.
- ▶ F1E products: using the provided beaker, measure then pour 8 ounces (245 ml) of Endure Admix from the provided gallon Endure Jug into the bucket containing Phoscrete Liquid Activator.
- ▶ Add scoop(s) of Fast-Set, or Slow-Set admixtures per [Phoscrete's Best Practices for Cold Temperature](#) and [Warm Temperature Guidelines](#), for admix measure and for best practices on cooling/supercooling PHOSCRETE Liquid Activator.
- ▶ Empty entire content of the Dry Mix bag(s) into the bucket.
- ▶ Use PHOSCRETE's Large Urethane Mixing Augers with a dual or variable speed drill mixer (minimum 7-amp drill, ½" chuck with side handle), and mix approximately 45 seconds, or until the material is completely wetted out (no dry material remains) and shows a uniform consistency. Do not overmix.
- ▶ Empty the bucket into prepared site, place and finish immediately.
- ▶ Clean bucket and mixing paddle with water only after the final pour.



Phoscrete recommends:
Bosch GBMg-16
9 Amp 5/8" Drill Mixer
with Side and D-Handles

Mortar Mixer Instructions (Mix Multiple Kits at Once)

- ▶ Position mortar mixer close to prepared site. Turn on mortar mixer.
- ▶ Remove chilled Liquid Activator jugs from cooler with ice.
Pour the entire content of up to six [6] jugs of PHOSCRETE Liquid Activator into a rubber-tipped, paddle-style mortar mixer. A polyethylene drum is recommended for easy cleanup.
- ▶ Measure and add 1% ENDURE by weight using the provided beaker.
- ▶ Add scoop(s) of Fast-Set, or Slow-Set admixtures as appropriate into the drum. Refer to [Phoscrete's Best Practices for Cold Temperature](#) and [Warm Temperature Guidelines](#) for admix measure and for best practices on cooling/supercooling PHOSCRETE Liquid Activator.
- ▶ Break the requisite number of PHOSCRETE Dry Mix Bags over the mortar mixer and run paddles until the material is completely wetted out (no dry material remains) and shows a uniform consistency. Mix for a maximum of 3 minutes. Do not overmix.
- ▶ Stop the mixer and empty contents directly into the prepared site.
- ▶ Return mixer to upright position and add the next batch of Phoscrete Liquid Activator, allowing the mixer to spin continuously to prevent material remaining in the drum from hardening. Add Dry Mix bags when ready for the next placement.
- ▶ Clean mixer with water after final pour.



Phoscrete recommends:
Whiteman WM70PH8
Polyethylene-Drum Mortar Mixers
for mixing up to 6 kits at a time.



Placing and Finishing Phoscrete

Plan on between 5-15 minutes working time (ambient and activator temperature dependent) to place and finish each batch of Phoscrete.

After mixing, empty into prepared site immediately. If a delay causes Phoscrete to begin setting up in the bucket/pail/mixer, discard the mix. When mixing in a mortar mixer, whenever possible, empty the material directly into the prepared site.

On inclines, start at the bottom of the slope and work your way up. On steep inclines, allow the material placed first to set to control the slump from subsequent pours. Remember, Phoscrete bonds to itself wet or cured with no cold joints.



Expansion Joint Header Installation



Bridge Deck Spall Repair

Finish using standard concrete tools: magnesium or plastic floats, steel margin trowels, and screeds. Push material toward (not away from) edges for maximum bond. Wipe trowels and rinse gloves with water to prevent Phoscrete from sticking to the trowel or gloves for the smoothest finish. Be sure to shake off excess water. DO NOT pour water directly onto wet Phoscrete.

Blend multiple pours: Before the material has set, use vibration, or wiggle your trowel in the Phoscrete F1 mix to blend each new pour with the previous pour at the point of contact to get a nice finish.

Install in lifts: When installing Phoscrete F1 concretes greater than 4" thick, install Phoscrete in lifts, and leave 2" for the final lift to achieve the best finish. Scarify the surface of each lift to improve the mechanical bond. For best finish, save the coldest Liquid Activator and/or wait for the material to begin cooling down before placing the final lift.

Use a **concrete pencil vibrator** to increase material flow in tight spaces, to blend multiple batches, and to reduce expansion in horizontal applications. Vibration reduces voids at the substrate interface and increases density by allowing air bubbles to escape.

Prior to final set, Phoscrete F1 may expand slightly, more in cold conditions because it takes longer to set. Expansion improves the mechanical bond to the adjacent concrete with no damage. When you observe expansion, compensate by using slightly less material at the center of the patch to avoid "doming."

Once the Phoscrete surface starts to develop a "**skin**," stop finishing. Initial and final set are imminent.



Grinding Phoscrete

For horizontal patches subject to heavy traffic, and for headers of expansion joints, Phoscrete will last longest when finished level to the concrete approach. When finished too high, constant vehicular impact will ultimately damage Phoscrete, same as any concrete. In addition, smoother rideability enhances user satisfaction and reduces truck impact that can cause damage to the structure.

As soon as 15 minutes following the final set of the last finishing pour, Phoscrete can be milled using a walk-behind grinder or an angle grinder. Grind before Phoscrete achieves ultimate strength if possible.

When installing Phoscrete for expansion joint headers, grind the exposed corner to a 45° angle prior to installing the joint seal. Refer to [Phoscrete Best Practices for Expansion Joint Installation](#).^{viii}

Sealing Phoscrete

Film-forming sealers, such as epoxies can be applied as soon as 15 minutes following the final set of the last pour of Phoscrete since Phoscrete does not outgas after cure.

In many instances, sealers can be applied after 15 minutes following the final set of Phoscrete even in cold temperatures, thanks to the heat given off on set. Wait until the temperature of the installed Phoscrete material drops below 100°F (38°C) before applying any type of sealers.

Expansion Joints

Phoscrete Formula 1 is an excellent material for installation and repair of expansion joint headers. Because Phoscrete mixes, places, and finishes fast, joint seals can be installed as soon as 15 minutes following initial set of the final pour, allowing an expansion joint installation to be completed in one lane closure. Refer to [Phoscrete Best Practices for Expansion Joint Installation](#).

Opening Phoscrete to Traffic

Phoscrete achieves set when a nail can no longer be pressed into the corner of a Phoscrete repair area. Phoscrete F1 typically achieves final set less than five [5] minutes after working time is ended, is ready for heavy traffic one [1] hour following initial set of the final pour.

When ENDURE Admix is used, the surface of the repair may be slippery. After allowing one hour for the ENDURE admixture to penetrate, brush concrete dust from the demolition, or broadcast sand or baking soda to absorb any admixture remaining on the surface, and ensure the road is safe for vehicular traffic.

Ensure the Phoscrete repair is level to the adjacent concrete. Grind as noted above.

Prior to installing any type of sealers, and prior to leaving the job site, hammer-test the Phoscrete repair and listen for any hollow spots. Common reasons Phoscrete may not adequately bond to the concrete substrate include:

- Placed Phoscrete that already began to set in the bucket/mixer.
- Contaminated substrate (oils, dirt, moisture)
- Excessive voids in the bond interface.
- Phoscrete placed against unsound concrete substrate.

If you detect delamination in your Phoscrete repair, quickly remove the delaminated areas, and correct the cause (mechanically remove contaminated substrate), use Phoscrete Primer if appropriate, then mix, place and finish with additional Phoscrete. The fresh Phoscrete will bond strong to the adjacent Phoscrete that remains in place with no cold joints.



Phoscrete Repairs Last!

When properly installed, Phoscrete is fast, easy to use, and it lasts. The more often you use Phoscrete, the better experienced you become, and the more you will turn to Phoscrete to fix damaged concrete once and for good.

Phoscrete Technical Support

Visit our website for the latest installation guides and technical data.

Contact Phoscrete installation support anytime for guidance for your concrete repair projects:

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URLs for Referenced Hyperlinks in this Document

This document is published at phoscrete.com where you can click on the referenced hyperlinks in the document. If you have a printed version, full URLs are end-noted below.

ⁱ Refer to the latest published Phoscrete Technical and Safety Data Guides Phoscrete Quick Start Guides, Full Installation Guides, Best Practices, and Videos: <https://www.phoscrete.com/technical/>

ⁱⁱ <https://www.phoscrete.com/phoscrete-best-practices-warm-temperature-concrete-repair-guidelines/>

ⁱⁱⁱ <https://www.phoscrete.com/phoscrete-best-practices-cold-temperature-concrete-repair-guidelines/>

^{iv} <https://www.phoscrete.com/phoscrete-best-practices-endure-admix-usage-chart/>

^v <https://www.phoscrete.com/phoscrete-activator-safe-disposal/>

^{vi} <https://icri.ce21.com/item/3101r2008-english-pdf-guideline-surface-preparation-repair-deteriorated-concrete-resulting-reinforcing-steel-corrosion-342512>

^{vii} <https://icri.ce21.com/item/3102r2013-english-pdf-selecting-concrete-surface-preparation-sealers-coatings-polymer-overlays-concrete-repair-342521>

^{viii} <https://www.phoscrete.com/phoscrete-bridge-expansion-joint-installation-guidelines-1/>