CONCRETE REPAIR

CONCRETE REPAIR TERMINOLOGY

**Abrasion** — Surface wear that causes progressive loss of material from a concrete surface caused by rubbing and friction against the surface by machinery, Forklift traffic or dragging of materials across slab.

Abrasive—any hard, strong substance, such as rocks, sand, water, or minerals, that will cut, scour, pit, erode, or polish another substance.

**Absorption**—the process by which a liquid is drawn into and tends to fill permeable voids in a porous solid body; also, the increase in mass of a porous solid body resulting from the penetration of a liquid into its permeable voids.

**Acid Etching**—application of acid to clean or alter a concrete surface; typically used only when no alternative means of surface preparation can be used.

Acrylic Resin—acrylic activator—a material that acts a catalyst. Created to provide both bonding powers and a hard layer of protection

Additive—a substance added to another in relatively small amounts to impart or improve desirable properties or suppress undesirable properties; any material other than the basic components of a grout system.

**Adhesion**—a state in which two surfaces are held together through interfacial effects that may consist of molecular forces, interlocking action, or both.

**Adhesive Failure**— A bond separation between an adhesive and the material bonded to.

(See Cohesive failure)

Admixture—a material other than water, aggregates, hydraulic cement, or fiber reinforcement, added to concrete, mortar, or grout, during batching or mixing to enhance plastic or hardened material properties, or both.

Accelerating—an admixture that (1) increases the rate of hydration of the hydraulic cement and thus shortens the time of setting, increases the rate of strength development, or both; (2) any substance that increases the rate of a chemical reaction.

Air-entraining—an admixture that creates microscopic air bubbles in concrete, mortar, or cement paste during mixing; used to increase the workability and freeze-thaw resistance of the mixture.

Admixture, alkali-aggregate reaction inhibiting—an admixture that reduces expansion caused by alkali-aggregate reaction.

Admixture, Anti-washout—an admixture that increases the cohesiveness of concrete to be placed under water, thus inhibiting the amount of fines washed away from the aggregates when the concrete comes in contact with water.

Admixture, Corrosion Inhibiting—an admixture that reduces ingress of chlorides or enhances the passivating layer on the surface of steel reinforcement, or both, thus
reducing or preventing corrosion.

Admixture, Retarding—an admixture that decreases the rate of hydration of hydraulic cement and increases the time of setting.

Admixture, Shrinkage Reducing—an admixture that reduces drying shrinkage by reducing the surface tension of water in the pore structure of cement paste.

Admixture, Viscosity Modifying—an admixture that can be used to produce self-leveling concrete that remains cohesive without excessive bleeding, segregation, or abnormal retardation.

Admixture, Water-Reducing—an admixture that either increases workability of freshly mixed mortar or concrete without increasing water content or maintains a given workability with a reduced amount of water.

Aggregate—granular material such as sand, gravel, crushed stone, crushed hydraulic-cement concrete, or iron blast-furnace slag which is used with a hydraulic cementing medium or polymer binder to produce either concrete or mortar. It is used primarily as an extending agent in concrete repair products.

Aggregate, Coarse—(1) aggregate predominantly retained on the No. 4 (4.75-mm) sieve; or (2) that portion of an aggregate retained on the No. 4 (4.75-mm) sieve.

Aggregate, Fine—aggregate passing the 3/8-in. (9.5-mm) sieve and almost entirely passing the No. 4 (4.75-mm) sieve and predominantly retained on the No. 200 (75-μm) sieve; or (2) that portion of an aggregate passing the No. 4 (4.75-mm) sieve and retained on the No. 200 (75-μm) sieve.

Aggregate, Gap-Graded—aggregate graded so that certain intermediate sizes are substantially absent.

Aggregate, Reactive—aggregate containing substances capable of reacting with the alkalis in portland cement; products of the reaction may cause abnormal expansion and cracking of concrete or mortar under certain service conditions.

Air Barrier—A material (liquid or sheet) that controls air leakage into or out of concrete and masonry wall systems.

Air Content—the volume of air voids in cement paste, mortar, or concrete, exclusive of pore space in aggregate particles, usually expressed as a percentage of total volume of the paste, mortar, or concrete.

Ambient—surrounding natural conditions or environment in a given place and time.

Application Life—the period of time during which a material, after being mixed with a catalyst or exposed to the atmosphere, remains suitable for application.

Binders—Cementing materials, either hydrated cements or products of cement or lime and reactive siliceous materials or other materials such as polymers that form the matrix of concretes, mortars, and sanded grouts.

Bleeding: (1) The flow of mixing water within, or its emergence from newly placed concrete or mortar; (2) the absorption of oil resin or plasticizer from a compound into an adjacent porous surface; (3) the diffusion of color matter through a coating from underlying surfaces causing a color change.

Blemish—any superficial defect that causes visible variation from a consistently
smooth and uniformly colored surface of hardened concrete. (See also bleaching, bloom, bug holes, efflorescence, honeycomb, laitance, mottled, popout, rock pocket, and sand streak.)

**Blistering**—(1) the irregular raising of a thin layer at the surface of placed mortar or concrete during or soon after completion of the finishing operation; (2) bulging of the finish plaster coat as it separates and draws away from the base coat; (3) the formation of air or gas pockets trapped within a thin-film coating, elastomeric membrane, or any impervious membrane.

**Bonding Agent**: A product either latex or epoxy that is used to assist the adhesion of new concrete or concrete repair material to an existing surface. 

Weld Crete – Acryl 60 – Bond Crete – Sika Latex R – Thorobond - Euco Bond

**Bond Breaker**—A material used to prevent adhesion of one surface to another.

**Bond Failure**—A fracture that results when applied force exceeds adhesion between two bonded surfaces such as a repair material or coating and concrete substrate.

**Bond Strength**—Resistance to separation of a repair from the existing substrate or from reinforcing and other materials with which it is in contact.

**Broadcast**—To toss or otherwise distribute granular material, such as sand, over a horizontal surface so that a thin, uniform layer is obtained.

**Bubbling**—a temporary or permanent film defect in which bubbles of air or solvent vapor are present in the applied film.

**Bug Hole**: The name given to a small regular or irregular void, ranging from microscopic in size to 1 inch in diameter, found at the formed surface of concrete.

**Build-Up**—The placing of repair material in layers rather than all at once.

| 1” FINAL TOPPING | 2” INITIAL TOPPING | SUBSTRATE |

**Bush-Hammer**—a serrated hammer with rows of pyramidal points used to roughen or dress a surface; to provide a bonding surface.
Cement—any of a number of materials that are capable of binding aggregate particles together. (See also cement, hydraulic.)

Cement, Blended—a hydraulic cement essentially consisting of portland cement, slag cement, or both, uniformly mixed with each other or a pozzolan through intergrinding or blending.

Cement, Calcium-Aluminate—the product obtained by pulverizing clinker consisting essentially of hydraulic calcium aluminates resulting from fusing or sintering a suitably proportioned mixture of aluminous and calcareous materials; called high-alumina cement in the United Kingdom.

Cement, Expansive—a type of cement that produces a paste that, after setting, increases in volume to a significantly greater degree than does portland-cement paste; used in some repair materials to compensate for drying shrinkage.

Cement, High-Early-Strength—Portland cement characterized by attaining a given level of strength in mortar or concrete earlier than does normal portland cement; referred to in the United States as Type III.

Cement, Hydraulic—a binding material that sets and hardens by chemical reaction with water and is capable of doing so underwater. For example, portland cement and slag cement are hydraulic cements.

Cement, Magnesium Phosphate—a blend of magnesium oxide and ammonium dihydrogen phosphate that reacts with water, rapidly producing strength and heat; rapid-setting cement that can be used at low temperatures.

Cement, Microfine—normally a proprietary blend of finely ground blast furnace slag and portland cement.

Cement, Portland: Portland cement is the most common type of cement in general use around the world, used as a basic ingredient of concrete. Mortar, stucco, and most non-speciality grout. ASTM C150 defines Portland cement as "hydraulic cement (cement that not only hardens by reacting with water but also forms a water-resistant product) produced by pulverizing clinkers which consist essentially of hydraulic calcium silicates, usually containing one or more of the forms of calcium sulfate as an inter ground addition.

Type I Portland: The common or general purpose cement. It is commonly used for general construction especially when making precast and precast-prestressed concrete that is not to be in contact with soils or ground water.

Type II Portland: This product gives off less heat during hydration. This type is for general construction exposed to moderate sulfate attack and is meant for use when concrete is in contact with soils and ground water, especially in the western United States due to the high sulfur content of the soils.
**Type III Portland:** Has relatively high early strength. This gives the concrete using this type of cement a three-day compressive strength equal to the seven-day compressive strength of types I and II. Its seven-day compressive strength is almost equal to 28-day compressive strengths of types I and II.

**White Portland:** Similar to ordinary grey Portland (Type I) cement except for its high degree of whiteness

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**CONCRETE SURFACE CRACKING**

**CAUSES-----PREVENTION------REPAIR**

**ALL CONCRETE CRACKS.** Cracks are a result of expansion, shrinkage, premature dehydration, improper finishing, surface overload, substrate settling or heaveage, poor mix design or ambient temperature variations. It is the challenge of the concrete PROFESSIONAL to control this process as much as possible by eliminating any unnecessary cracking and design his slab to allow for normal expansion and contraction. Expansion joints should be strategically located.

**ALLIGATOR CRACKS**—surface cracking that forms a pattern similar to alligator hide. It occurs most frequently in Asphalt paving.

**CAUSE:** Caused most frequently by excessive overload.
- Poor substrate preparation.
- Poor drainage
- Freeze / Thaw

**PREVENTION:** Reduce surface overload
- Verify that mix design meets traffic requirements.
- Increase thickness
- Seal properly

**REPAIR:** Existing cracks may be repaired with the use of a premium Asphalt Sealant.
- May require the removal and replacement of affected areas.
- Core the affected area to insure that there is no moisture collecting below the surface.

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**BLISTERING:** The appearance of pockets or bubbling on the surface of freshly poured concrete. These bumps vary in size.

**CAUSE:** Entrapped air or water rising through the concrete mix being trapped under sealed concrete.
- Insufficient vibration
- Excessive air content in mix design
- Improper troweling or floating.

**PREVENTION:** Do not use concrete with a high slump or excessive air content. (over 3%)
- Avoid over working the concrete.
- Do not seal too soon
- Use a Magnesium or Aluminum float on Air Entrained Concrete.

**REPAIR:** Blistering is easier prevented than repaired.
- Sanding or a light grinding of the concrete surface.
- Reseal concrete surface.

**CAPILLARY CRACKS** - A series of minute cracks winding through a masonry or concrete surface. These small channels allow the passage of water, water vapor and gases through the concrete or masonry.

**CAUSES:** Capillary cracks are a result of normal dehydration, drying shrinkage, and thermal shrinkage.

- It allows the penetration of water and water vapors into and beyond the concrete itself.
- They are very vulnerable to hydrostatic pressure and actually suck moisture into the concrete.

**PREVENTION:** Although concrete will always porous there are steps that can be taken to limit capillary action.
- The concrete mix design can include additives that “tighten” the concrete mix.
- Limited air entrainment
- Membrane waterproofing
- Mastic Damproofing / Waterproofing coatings
CONTROL JOINT CRACKS: Control joints are planned saw cut cracks which allow for movements caused by temperature changes and drying shrinkage. In other words, when the concrete does crack-you want to have an active role in deciding where it will crack and insure that it will crack in a straight line instead of randomly. They are to be strategically placed to cause the concrete to crack in a predetermined straight line.

CAUSES: Control Joints are deliberately made to “control” the location of inevitable concrete shrinkage cracks
- Control Joint Saw cuts depth should be 25% of the total thickness of the concrete slab. Saw cuts for a 4” slab should be 1” deep. A 6” slab should be 1 ½” deep.
- Control Joint Spacing for a 4” slab should be cut no less than 8’ apart and no more than 12’ apart.

PREVENTION: Control Joints should be sealed with a suitable, Semi-Rigid or flexible joint sealant.
- The location / Spacing of control joints is critical to the integrity of the slab.
CONTROL JOINT SPACING

<table>
<thead>
<tr>
<th>Slab Thickness</th>
<th>Joint Spacing</th>
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<tbody>
<tr>
<td>4”</td>
<td>8’ - 12’</td>
</tr>
<tr>
<td>5”</td>
<td>10’ - 15’</td>
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<tr>
<td>6”</td>
<td>12’ - 18’</td>
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<tr>
<td>7”</td>
<td>14’ - 21’</td>
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<tr>
<td>8”</td>
<td>16’ - 24’</td>
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<tr>
<td>9”</td>
<td>18’ - 27’</td>
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<tr>
<td>10”</td>
<td>20’ - 30’</td>
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CRAZING CRACKS.- A network of fine random cracks or fissures in a concrete surface. They do not affect the structural integrity of the concrete. They are typically 1/8” to 1/4” deep.

CAUSE: Poor or inadequate surface curing.
- Rapid Moisture evaporation
- Hard Steel Trowling
- Sprinkling of cement on concrete surface
- Mix design contains too much water
- Finishing while bleed water is still on the surface.

PREVENTION: Begin curing process as soon as possible.
- Keep surface as wet as possible
- Never sprinkle dry cement on concrete surface.
- If a vapor barrier is required on the sub grade, cover it with 3 to 4 inches of a compactable, granular fill.

REPAIR: Crazing cracks are not typically repaired since they do not continue to grow and do not affect the structural integrity of the concrete.
- Any repair is strictly aesthetic.
- Sealants and hardeners tend to make the cracks more obvious.

DELAMINATION: Delaminations are similar to blisters in that delaminated areas of surface mortar result from bleed water and bleed air being trapped below the prematurely closed (densified) mortar surface.

CAUSES: The primary cause is finishing before the bleed water has occurred.
- May also be caused by the oxidation resulting from the corrosion of reinforcement steel.
- Premature or excessive hard trowel finishing.
- Concrete poured directly on vapor barrier

**PREVENTION:** The simplest way to prevent delamination is to start final finishing of the slab after the bleeding process has run its course.
  - Proper timing of finishing is critical.
  - Consider wind, hot ambient temperature and low humidity when scheduling concrete pours’
  - At air contents greater than 3%, a dense, hard-troweled surface is not necessary.
  - Do Not pour at less than 40 degrees Fahrenheit.

**REPAIR:** Remove any loose materials from the affected area. You can test the surface area with a hammer to locate any hollow or loose spots.
  - Clean area of any surface dust, oil or grease
  - Provide a depth of 1/8” to 1/4” depth on the area to be patched. Avoid feather edge if possible.
  - Drill a series of ½” diameter holes a minimum of 2” deep in the area to be repaired. These will serve as anchor points for the patch product.

**EXPANSION JOINT CRACKS**

**CAUSES:** Excessive pressure on the edge of a formed expansion joint by Forklift traffic or vehicle traffic on highways.
  - Concrete shrinks as it cures (about 1/16 inch for each 10 linear feet.
  - Poor forming leaving irregular joint edges
  - Improperly placed expansion joints.
  - Rapid dehydration.
  - Water seepage through expansion joint cracks.

**PREVENTION:** A sufficient number of properly placed joints will limit cracking.
  - Be sure expansion joint edges are properly formed.
  - Be mindful of vehicle and material traffic over the joint.
  - Some industrial plants require epoxy flooring in heavy traffic areas.
  - Mechanical expansion joints in heavy traffic areas.
MECHANICAL EXPANSION JOINTS

REPAIR:  The cause must be determined to effectively repair the problem

- All cracked material must be removed from the joint.
- Clean the joint thoroughly
- Joint should be completely dry
- Some joints may require re-sawing and replacement
- Use an epoxy to restructure the joint edges
- Properly seal the joint

HONEYCOMBING:  The term used to describe areas of the surface that are coarse and rocky.

CAUSES:  This deformation of the concrete surface is typically caused by poor consolidation of concrete inside a form or a pour.
- Poor vibration inside a wall or slab.

- Uneven distribution of form release chemicals.
- Aggregate too large to pass through condensed rebar.
- Stiff or dry concrete mix.
- Improper placing procedures

PREVENTION:  Close attention must always be paid to:

- Mix design
- Proper Forming technique
- Rebar placement
- Proper concrete placement technique.

REPAIR:  Clean area of any loose materials, oil or grease.
- Clean remaining surface with air or pressured water.
- Apply a trowelable polymer cementitious product to the affected surface.
- Allow material to cure before sealing or back fill.
SETTLEMENT CRACKS: Cracks in a wall or foundation caused by the settlement or sinking of the foundation or slab.

CAUSES: Typically caused by a deterioration of the substrate supporting the wall or foundation.
- Poor Compaction at construction
- Soil shrinkage under slab
- A floating slab unanchored to footing
- Insufficient drainage / washout

PREVENTION: Be sure that substrate is properly compacted.
- Be sure footings are installed below frost line.
- Insure proper drainage
- Foundation walls should be doweled into footings
- Be sure walls and floors are properly reinforced.

REPAIR: Settlement repair should be done by a professional.
- Settled slabs can be pumped with foam for elevation.
- Piers can be installed below existing slab.
- Install proper drainage

SPALLING CRACKS: Spalling is the deterioration of concrete at a deeper degree than normal scaling.

CAUSES: There are several factors that can cause concrete spalling.
- Gassing or expansion within the concrete.
- Impact loads.
• Weathering
• Improperly constructed joints
• Reinforcing steel corrosion
• Poor Mix design

PREVENTION: Proper mix design is a big factor in preventing Spalling.
• Properly designed and constructed joints
• Epoxy coated rebar
• Proper drainage

REPAIR: Spalling can be repaired if less than 1/3 of the depth of the slab is affected.
• The repair area should be square or rectangular.
• Concrete should be removed to a minimum depth of 1 ½”
• All lose materials must be removed and sand blasted.
• Exposed rebar must be cleaned down to bare steel and coated with epoxy.
• A bonding agent should be used with replacement concrete or patching material. (Some products say that they do not require a bonding agent. However, this is inexpensive insurance.)
• Replacement product should be cured

CONCRETE SPALLING

STRUCTURAL CRACKS: Cracks formed in a Masonry or concrete surface due to failure in the substrate or foundation. Most commonly caused by a sinking or settling of the foundation. (See Settlement Cracks)

CAUSES: Settlement or failure of foundation or slab.

PREVENTION: Be sure project has adequate drainage
STRUCTURAL CRACK IN MASONRY

COHESIVE FAILURE: A separation in the adhesive itself.

CURE TIME: The time required for a product to reach its full hardness and compressive strength.

EPOXY: A two part Product consisting of a resin and a hardener which can be used as a paint, an adhesive or a coating. It can be used as a repair grout with the addition of an aggregate.

MIXING EPOXIES: Parts A & B should be thoroughly and equally mixed prior to application.

MIXING EPOXY GROUT: Parts A & B should be thoroughly mixed prior to the addition of an aggregate. The aggregate should be introduced gradually and thoroughly.

FEATHER EDGE: The act of applying a single repair product from a deeper depth of 1 to 2 inches to a very thin level.

INTREGAL: A product or admixture added to a mix design to improve
performance of the concrete.

JOINTS: There are basically 4 types of concrete construction joints used in construction

CONSTRUCTION JOINT: A formed joint in a concrete slab which typically involves the use of Metal Key-Joint.

CONTROL JOINTS: Saw cut or tooled joints in a concrete slab to encourage the expansion, contraction cracks to form in a pre-determined straight line.

EXPANSION JOINT: A joint in a concrete slab, wall or other structure which allows for the expansion and contraction of the concrete without unnecessary cracking. Various materials are used to fill the spacing between two concrete slabs or a slab and a wall. It can be placed between two new slab pours or between a new pour and an existing slab or wall.

Expansion Joint Materials Include: Fiber - Asphalt - Ceramar - Redwood

ISOLATION JOINT: A joint which provides expansion / contraction capabilities
around a column base, a wall or other structure.

HAMMER TEST: The act of testing a concrete surface for voids by taping it with a Hammer to locate voids below the surface.

POLYMER CONCRETE: Thermosetting resins are used as replacements for Portland Cement in a cementitious product. Polymers have a faster curing time, better chemical resistance, lower permeability, resist corrosion, high tensile strength, and more flexibility. It also can be used with aggregates such as silica, quartz, granite and limestone. It is used widely in the manufacture of drain systems as well as decorative concrete applications.

REBAR CORROSION: This is the deterioration of reinforcement steel within a Concrete Slab or wall. This is caused by the infiltration of water through the Concrete to the steel. The resulting chemical reaction of oxidation leads to the fracturing of the concrete surrounding the rebar.

CORROSION REPAIR: Involves the exposure, cleaning and epoxy coating of damaged rebar. (Proper Cleaning is Critical)

Step One: Remove surrounding concrete until rebar is fully exposed.

Step Two: If the rebar is sound it can be thoroughly cleaned down past the rust / oxidation until new steel is exposed.

Step Three: The rebar can then be coated with an epoxy. If the rebar has deteriorated beyond repair, new steel may be doweled in to the existing concrete.
Step Four: Once the epoxy has cured the damaged area may be formed and poured with an appropriate repair product.

**SATURATION:** The process of pre-wetting a concrete substrate in order for the substrate to absorb surface water rather than drawing moisture from the cementitious repair product. Early dehydration of the repair product can cause undue cracking in the repair.

**SCARIFYING:** May also be referred to as concrete plaining. The act of roughing a concrete surface in order to get to a level, clean, rough bonding surface. This image shows concrete before scarification on the left and after on the right.
STEPS IN CONCRETE REPAIR

STEP ONE: Clearly identify the area that must be repaired.
- Concrete Spalling
- Expansion Joint Cracks
- Cracks in Slabs

STEP TWO: Identify the cause of the problem. If the source of the damage is not dealt with then the problem will continue to occur.
- Heavy Traffic
- Pressure Fracture
- Expansion Contraction Cracks
- Water penetration
- Poor finishing

STEP THREE: GOOD SURFACE PREPERATION IS THE KEY TO ANY REPAIR

- Clean the concrete to remove fractured particles as well as all substances that could inhibit the ability of an overlay to bond, such as dust, dirt, oil and grease. It's also necessary to strip away any coatings, sealers or paints that may have been applied to the concrete.
- Removing any unsound concrete, such as minor spalling, scaling or delamination, down to solid concrete.
- Filling active cracks so they don't mirror through to the overlay. Typically any cracks equal to or wider than the width of a credit card will require repair.
- Profiling, or roughening, the concrete surface to improve the "grip" or bonding of the overlay.
- Scarify the surface to a depth of minimum depth of 1/4 inch. This can be accomplished either by a hand held Bushing Hammer which can be
electric or air powered or much larger machines that you walk behind or ride. Both use either carbide or Industrial Diamonds to remove the existing surface.

Riding Scarifier
- Remove any remaining chemicals
- Remove any remaining Caulking
- Remove any loose toppings

Bushing Bit
- Remove any residual dust
- Clean cracks with a wire brush & air

STEP FOUR: Saturate the surface area to be repaired IF YOU ARE USING A CEMENTITIOUS REPAIR PRODUCT. Wet the surface thoroughly but do not leave standing water. A saturated surface prevents the transfer of moisture from the repair product into the slab. Be sure the surface area is completely dry if you are using an epoxy product.

STEP FIVE: Apply a Bonding Agent. Some products say “No Bonding Agent...
Required.” However a Latex Bonding Agent is cheap insurance to insure the bonding of a cementitious product. Brush or roll the bonding agent over the entire affected area. At the very least, apply a slurry mix of the repair product to the repair area. Use an Epoxy Bonding agent if an Epoxy Repair Product is being used.

STEP SIX: Select the appropriate repair product and mix exactly as indicated on the product data sheet.

- Use exactly the amount of water recommended by mfg. Be aware of mix Proportions if you are not using a full bag.
- Mix only as much product as can be applied in 10-15 minutes, depending on the product.
- Mix until all lumps are removed from the mixture
- Mix with a low RPM (600 RPM or lower) hand mixer and the recommended mixing paddle. Large volume repairs may require the use of a mortar mixture.

MIXING PADDLES: It is important to use the correct paddle to insure through mixing.

- Quick Mix Paddle
- Spiral Mixer
- Bucket Mortar Mixer

- Apply the product with a trowel. Repairs over 2” in depth should be applied in layers. Some products are limited to 1” depths.
- Finish the repair product with a steel trowel as shown below. A broom may be used to alter the appearance of the repair product to resemble existing concrete.

STEP SEVEN: Allow the product to properly cure/harden before use

- Refer to Product Specifications to determine if a curing
CHOOSING A CONCRETE REPAIR PRODUCT

1. Clearly identify the cause of the problem.
   - No product will be effective if the cause of the problem is not corrected.
   - Do everything Possible to correct the cause of the problem.

2. Determine the performance requirements of the concrete.
   - Know the proper PSI strength required for the product to be effective
   - Do you need an Epoxy or will a cementitious product suffice? Epoxies typically have greater PSI strength.
   - Is the repair Horizontal, Vertical or Overhead?
   - Is a smooth “dressed” surface required?

3. Determine the length and depth of repair required to be successful.
   - Different products are required for different depths.
   - Will an aggregate be required to extend the product depth?

4. Determine the set time allowed for the repair.
   - The correct product selection may require that the troubled area be out of commission for a longer period of time.

5. Consider the customer’s experience with repair products.
   - Even the most expensive products will not be effective if not applied correctly.

6. Consult your Manufacture’s Representative to confirm your recommendation. Do Not rely solely on your personal opinion.
REQUIRED EQUIPMENT / MATERIALS:
- Injection Ports
- Medium Viscosity or Gel Epoxy to seal cracks surface
- Low Viscosity Epoxy to inject directly into the crack
- Mechanical Pumping system which includes a gun, hose and Compressor.
- Rotary Hammer / Chipping hammer
- 4 ½” Grinder

STEP ONE: Remove any fractured or loose concrete particles with a wire brush or Widen the crack mechanically with a chipping hammer.

STEP TWO: Clean Cracks with air pressure.

STEP THREE: Drill 1 / 2” holes in the surface of the crack to receive injection ports. Insert Injection Ports approximately 6 inches apart.

STEP FOUR: Insert ports into pre-drilled holes and cover the crack exterior with medium viscosity or Gel surface seal epoxy. Be sure that ports are well seated but not obstructed by the epoxy. Allow surface seal epoxy to set.
STEP FIVE: Begin injection of Low viscosity epoxy at the lowest level of the crack. Continue to pump until the epoxy exits the closest port above the one you are injecting. Cease injection once you have reached the top of the crack.

STEP SIX: Allow the Epoxy to set and cure.

STEP SEVEN: Grind the surface of the concrete until the epoxy covered area is smooth with the concrete surface. The amount of grinding will depend on the final surface finish desired.

EPOXY INJECTION EQUIPMENT: The equipment for epoxy injection can vary according to the size and location of the cracks.

1. A two part epoxy caulking gun may be used on larger more open cracks.
2. A high pressure pump may be required for hairline cracks.

### EPOXY INJECTION PRODUCTS:

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<th>VENDOR</th>
<th>SURFACE SEAL</th>
<th>INJECTION EPOXY</th>
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<tr>
<td>BASF</td>
<td>Conressive Std. LVI</td>
<td>Epoxeal GS</td>
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<tr>
<td>Dayton Superior</td>
<td>Sure Bond J58</td>
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<tr>
<td>Simpson</td>
<td>CIP</td>
<td>ETI SLV</td>
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### CONCRETE FINISHING / REPAIR TOOLS

**BROOM:** A concrete broom is used to apply a rough, non-skid finish to the surface of a concrete slab. They are available in various widths and types.

**FLOATS:**
- Aluminum - Aluminum floats have many of the same characteristics as magnesium floats, but they are roughly 30% heavier and 30% stronger. Like magnesium, aluminum opens the pores of fresh concrete, allowing bleed water to evaporate.
- Bull Float – A Bull Float is used to level ridges and fill low spots in a concrete pour by screeding. They also embed large aggregate particles.
- **Magnesium Float** - Magnesium smooths the surface of fresh concrete and opens the pores for proper evaporation, all without pulling at the surface. Most magnesium floats are extruded or cast.

- **Rubber** – Rubber floats are used primarily for stucco, drywall or tile applications

- **Wood** - A wood float is the least expensive option, but it isn’t durable over the long haul. Because a wood float constantly soaks up bleed water, is dragged over a rough concrete surface, and is hosed down after use, it loses its edge over time.

**EDGER:** Edging compacts the concrete next to the form where floating and troweling are less effective. This makes the edge of the slab more durable and less likely to scale and chip.

**GROOVER:** Jointing or grooving the concrete serves the same purpose as sawing control joints. The purpose is to control the location of cracks that may form when the slab "contracts" due to drying shrinkage or temperature changes.
KUM-A-LONG: A concrete Kum-A-Long or Rake is used to evenly spread or distribute freshly poured concrete. The hook on one side is to be used to pull wire mesh up into the concrete rather than place the concrete on top of the mesh.

SCREED: A screed is a flat board, or a purpose-made rectangular aluminum tool, used to smooth or level concrete after it has been placed. There are hand held screeds as well as motorized and self propelled Power Screeds.

TROWEL: Troweling produces a hard, smooth, dense surface and is done immediately after floating. Troweling can be done by machine or by hand.

Brick Trowel – Masonry trowel or pointing trowel) is a tool with a handle and flat metal blade, used by masons for leveling, spreading, or shaping substances such as cement, plaster, or mortar, as well as for breaking bricks to shape them or smoothing a mould.

Corner Trowel – A trowel used for shaping concrete around internal or external corners; the handle is located at the center of a 90-degree bend.
Margin Trowel – A flat-nosed trowel used to work mortar in tight spaces and corners where a larger pointed trowel will not fit. Typically 5” X 2”

Swimming Pool Trowel - A variation of the concrete finishing trowel; rounded blade prevents it from digging into wet concrete.

Machine Trowel – (Trowel Machine) A Walk behind or rideable gasoline powered machine to put the final finish on a concrete slab.

Trowel Machine Blades: There are three types. Float - Finish - Combination

- Float Blade: Breaks down high spots and brings water to the surface
- Finish Blade: Closes and polishes the slab
- Combination: Can Float and Finish, depending on the angle of the blade.