



## This month ...

ACPA provides the latest information about pavement restoration tips and techniques.

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## Next month...

*Read the latest information about pre-paving construction practices.*

## Full-Depth Repair for Concrete Pavements

### *Differences in repair procedures for roads, highways, and airfields*

Full-depth repair or full-depth patching involves removing and replacing at least a portion of a slab to the bottom of the concrete, in order to restore areas of deterioration.

The main difference in full-depth repairs for streets, highways, and airports is in the patch location, layout, and size. Other minor differences include the load transfer established at the perimeter joints and surface texture.

Full-depth repairs are one of the most common repairs performed on concrete pavements, because they improve pavement rideability, structural integrity, and extend pavement service life.

On concrete streets and local roads, full-depth repairs are required where utility cuts in the roadway are needed to access existing utility infrastructure or install new ones. At airports, full-depth repairs restore problem areas that might produce small concrete fragments, which can cause foreign object damage (FOD) to jet engines. On highways, full-depth repairs are typically used at deteriorated joints or cracks.

Many aspects of full-depth repairs are the same regardless of facility. These include:

- The use of full-depth sawcuts around the perimeter of the repair area.
- Removing the deteriorated concrete.
- Compacting existing or added base material.
- Reestablishing load transfer along the full-depth sawcut.
- Placing, striking off, finishing, texturing, and curing concrete in the patch area.
- Opening to traffic once desired strength of the concrete is reached.

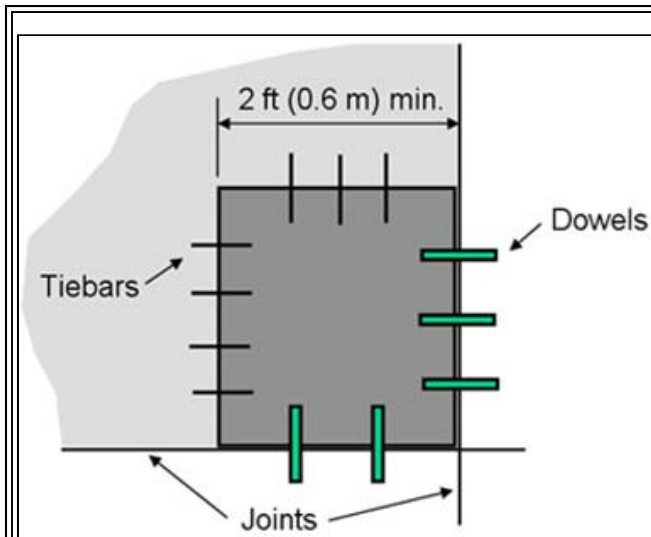
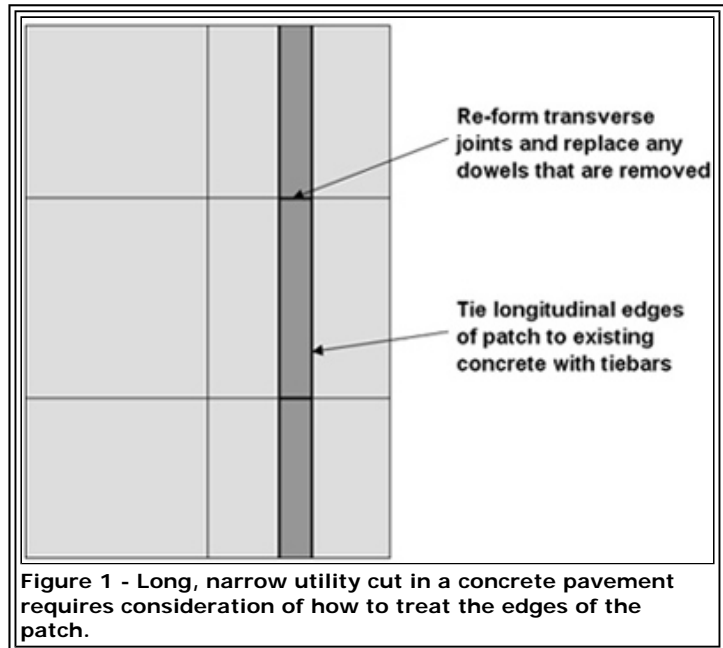
## Streets & Local Roads

Concrete streets typically receive full-depth repairs due to utility cuts in the pavement, and utility cut trenches are usually long and narrow, with the width depending on the type of utility.

Intermediate joints may be required in the patch area. Where necessary, follow these recommendations:

1. Put the new joints in-line with the existing joints so that the original panel sizes are again in-place.
2. Replace any dowel bars that were removed.
3. Tie the longitudinal edges of long patches to the existing concrete by drilling and grouting tiebars (see Figure 1).

Patches in streets typically require only a drag texture such as burlap drag or a broom finish.



## Airports

Full-depth repairs at airfields are often located at the corner of a slab, where some deterioration has occurred requiring a repair to prevent FOD. These patches are typically small, and require drilling and grouting dowel bars and tiebars into the perimeter joints (see Figure 2).

If the repair is on a runway, the patch will likely have to be grooved to match the grooves in the existing pavement. If the repair is on a taxiway or apron, a burlap drag texture is usually sufficient.

## Highways

The most common location for deterioration to occur on a concrete highway is at the transverse joints or cracks, which is where contraction and expansion of the concrete slabs is accommodated, and where moisture has an opportunity to enter the pavement system.

These are the distressed locations typically restored by full-depth patches. The patches are usually a full lane-width wide, such as 12 feet (3.6 m), and 4 to 6 feet (1.2 to 1.8 m) long (see Figure 3).

The required length depends on the size of the drilling equipment used to drill the holes in the existing concrete for the dowels. The texture should match the surrounding pavement, in type and depth, so that the patch blends in to the pavement imperceptibly.

Despite the minor differences, the purpose of full-depth repairs for any facility remains the same: repair and preserve the existing concrete pavement, extend its life and defer expensive rehabilitation options.



**Figure 3 - A full-depth patch in a highway is typically placed at deteriorated transverse joints or cracks, and is usually at least one lane wide.**

### ***Key Factors for Effective Full-Depth Repairs***

Full-depth repair is a long-term solution for most types of distresses found in concrete pavements, including the repair of structural damage. Restoration techniques are all designed to fix specific types of distress. Below are some key points in performing long lasting, cost effective full-depth repairs.

#### **Allow Adequate Working Room**

Full-depth repairs should be a minimum of 6 ft. longitudinally (or enough room to drill dowel bar holes) and full-lane width (except for continuously reinforced concrete pavements).

#### **Prepare for Changes During Repairs**

While preparing restoration plans, allowances for altering the repair quantities and types is recommended.

#### **Uniform, Stable Platform**

Full-depth repairs require a uniform, stable platform. If poor support conditions were the cause of the distress, they must be repaired prior to placing the concrete. Two methods of removing the existing concrete are lift-out and break-up.

#### **Saw Cuts**

Full-depth perimeter saw cuts are required regardless of the method used for concrete removal. These saw cuts result in smooth faces at the transverse joint locations. Effective load transfer at the transverse joints is necessary to prevent differential movement (faulting), which can occur in roadways with moderate to heavy truck traffic volumes.

#### **Placement Techniques**

Standard concrete placement techniques are used for normal portland cement-based materials. Refer to the manufacturer's recommendations for proprietary materials and recognize the special requirements for high performance concrete mixes.

#### **Texturing**

Strike-off should be in the longitudinal direction if possible. This results in the smoothest repairs but is left to the discretion of the contractor. Texturing should match the existing pavement or provide adequate surface friction for good skid resistance and wet weather performance.

# Tips on Avoiding the 'Holidays'

In diamond grinding, a "holiday" refers to unground areas on the pavement surface. Holidays can impact the surface characteristics of a pavement, and therefore, should be avoided.

Continuous diamond grinding is an excellent technique for smoothing out a relatively old, faulted, or otherwise rough concrete pavement. Proper grinding requires a thorough understanding of a project's specifications.

Most states' specifications for continuous diamond grinding require the grinding machine to come in contact with at least 90-95% of the pavement area. States require the machine to have a minimum coverage of the pavement it is grinding to ensure:

1. The pavement is aesthetically pleasing.
2. There is adequate skid resistance across the entire pavement.
3. There are no differences in noise levels (ground vs. un-ground areas).



An inadequate understanding of the state specification left this project with 30% holidays.

To avoid holidays, contractors should understand the specifications for required coverage before grinding.

Also, the grinding head should not be lowered for isolated low spots (holidays) that are less than 2.7 sq. ft. (0.25 sq. m). If the grinding operation leaves an unacceptable amount of holidays, the grinding head should be lowered and another pass should be made.

Following these tips will prevent pavements from experiencing the kind of holidays that are never happy occasions.

## ***A look back***

### *The first diamond-ground pavement*

The first-ever continuous diamond grinding project was performed in the fall of 1965 on a section of the San Bernardino Freeway just east of Los Angeles, Calif. The freeway, now a part of Interstate 10, was originally constructed in 1946. The pavement was structurally sound, but there was considerable spalling and joint faulting.

A contractor was hired to grind the pavement using small, simple, and effective grinding equipment. The ride specifications called for 7-in./mile as measured with the California profilograph and a 0.2-in. blanking band. Diamond grinding was the only remedial step taken on the project. This first-ever grinding project provided 19 years of service.

In 1984, Caltrans awarded a contract to rehabilitate the pavement section with a second round of diamond grinding. In 1997, the 51-year-old concrete pavement was ground for a third time. (The 8-inch pavement had carried more than 43 million equivalent single axle loads, between 1946 and 1997.)

After almost 60 years of service and currently carrying more than 200,000 vehicles per day, some sections of the original concrete pavement were recently replaced.



**Diamond grinding improves surface characteristics and environmental benefits of concrete pavements.**

## Top Five Advantages of Concrete Pavement Restoration

Concrete pavement restoration (CPR) is a series of techniques used to manage the deterioration in concrete pavements (see [Table 1](#)). Asphalt overlays are sometimes used on concrete pavements that have deteriorated. However, CPR has several advantages over asphalt. Here are the top five:

1. **CPR addresses the cause of a pavement distress, minimizing further deterioration.** Covering the distress with an asphalt overlay does not correct the cause of the distress. Eventually, the distress manifests itself again, usually as a larger, more expensive problem.
2. **CPR costs less and lasts longer than asphalt overlays.** CPR projects have lasted between seven to 10 years, and some have performed for more than 17 years before a second CPR.
3. **CPR is quicker and causes less traffic disruption.** CPR repairs only those areas that need improvement, such as the driving lane or the keel section of a runway. It does not have to be placed over the entire pavement width, as does an asphalt overlay.
4. **CPR preserves the safety of concrete pavements.** Concrete does not rut, washboard, or shove. These defects can cause serious safety problems for asphalt pavements at intersections or other locations, where traffic is starting, stopping, and turning. Concrete's light color reflects light better than asphalt, which improves vision and makes driving at night and in inclement weather safer.
5. **CPR preserves environmental benefits of concrete pavements.** Concrete's light color reduces the number of street lights needed for the same illumination on an asphalt pavement. The light surface also keeps areas cool. Concrete pavements and trees can reduce temperatures by ten degrees, which conserves energy in high-energy-use urban areas. Finally, the hard concrete surface makes vehicles more fuel efficient. Concrete pavements do not deflect like asphalt pavements, so they reduce truck fuel consumption by as much as 20 percent.

*Table 1. There are ten CPR techniques that can be used to manage the deterioration in concrete pavements.*

<b>Concrete Pavement Restoration Technique</b>	<b>Used to:</b>
Full-Depth Repairs	Repair cracked slabs and joint deterioration.
Partial Depth Repair	Repair joint and crack slab deterioration.
Diamond Grinding	Extend serviceability; improve ride and skid resistance; reduce noise.
Dowel-Bar Retrofit	Restore load transfer at joints and cracks.
Joint and Crack Resealing	Minimize infiltration of water and incompressible material into joint system.
Slab Stabilization	Fill small voids underneath the concrete slab.
Cross-Stitching	Repair low and medium severity longitudinal cracks.
Grooving	Reduce wet weather accidents and prevent hydroplaning.
Retrofitting Edge Drains	Add a longitudinal drainage system.
Retrofitting Concrete Shoulder	Decrease pavement edge stresses and corner deflections.

## ***ACPA Product Showcase***



### ***Guidelines for Full-Depth Repair***

This 20-page technical publication covers design and construction practices for repairing concrete pavement slabs with structural and joint deterioration.

The information in "Guidelines for Full-Depth Repair" is applicable to concrete streets, highways, and airfields. It lists requirements for jointed concrete pavements and continuously reinforced concrete pavements. The cost of this publication is \$12.75. To order TB002P, go to [www.pavement.com](http://www.pavement.com); call toll-free 1-800-868-6733; or fax requests to 847-966-9666.

## ***Concrete Pavement News Digest***

### **White Paper Details Methods, Materials for Soil, Stabilization, Structural Support**

[URETEK USA](http://www.uretek.com) is offering a free technical white paper detailing the benefits and methodology of deep injecting high-density polyurethane to stabilize soils, lift pavements, and strengthen infrastructures.



This comprehensive, 11-page white paper provides insights into conditions encountered with shifting, unstable and damaged base soils.

The paper also details how high-density polyurethane reconstitutes base conditions, while also presenting a step-by-step overview of the process.

The paper includes case studies on both an industrial building and a highway application of the process. Click [here](#) to download the white paper, as well as additional information about the company.

For additional information, contact URETEK USA, PO Box 1929, Tomball, TX 77377. Phone: (toll-free) 888-357-3835. Visit the company's website at [www.uretekusa.com](http://www.uretekusa.com).

## ERES Consultants Announces Name Change

[Applied Research Associates, Inc.](#) (ARA), announced that its ERES Consultants, Eckrose/Green, and CGH Pavement Engineering offices, which operate as the company's transportation sector, will now be known solely by the corporate name — ARA.

Due to the growth of transportation-related technologies, the name change underscores the unified, integrated nature of all of its products and services, according to ARA.



In addition to traditional pavement engineering services, ARA now offers the transportation community with services and technologies in many areas, including transportation economics, life cycle cost analysis, and surface characteristics, including skid testing, texture, and noise studies. For more information, visit ARA's website, [www.ara.com](http://www.ara.com).

## ACPA Announces Annual Reception at Research Meeting

ACPA will host its 9th Annual "TRB-Willard Reception" during the 84th Annual [Transportation Research Board](#) (TRB) Meeting in the Crystal Room at the Willard InterContinental, 1401 Pennsylvania Ave., Washington, D.C., on January 10 at 5:00 - 7:30 p.m.



The Association invites transportation professionals to join us for an evening of refreshments and conversation with other professionals representing every quarter of the transportation and transportation-research community. Guests are kindly asked to RSVP on or before January 3, via e-mail at [TRB2005@pavement.com](mailto:TRB2005@pavement.com).

## Society for Concrete Pavements Announces International Conference

The [International Society for Concrete Pavements](#) (ISCP) released the brochure for the 8th International Conference on Concrete Pavements in Colorado Springs, Colo.

The brochure includes everything you need to know about the conference, from technical topics to be discussed to available recreational activities. The event, co-sponsored by ACPA, will be

held August 13 - 18, in Colorado Springs, Colo.



The ISCP is still seeking papers to be presented at the conference, "Innovations for Concrete Pavement: Technology Transfer for the Next Generation." It is focused on federal, state, and municipal engineers; consulting engineers; contractors; materials suppliers; and academia.

For more information, contact Jason Weiss, Purdue University, at [iscp8@ecn.purdue.edu](mailto:iscp8@ecn.purdue.edu).

**ACPA Concrete Pavement Progress** is published 12 times per year and covers current practices and case histories in the concrete pavement industry. **ACPA Concrete Pavement Progress** is distributed free of charge to public officials, ACPA members, executive committee, board of directors, and affiliated chapter/state paving associations.

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