ITRE
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NC AirTAP
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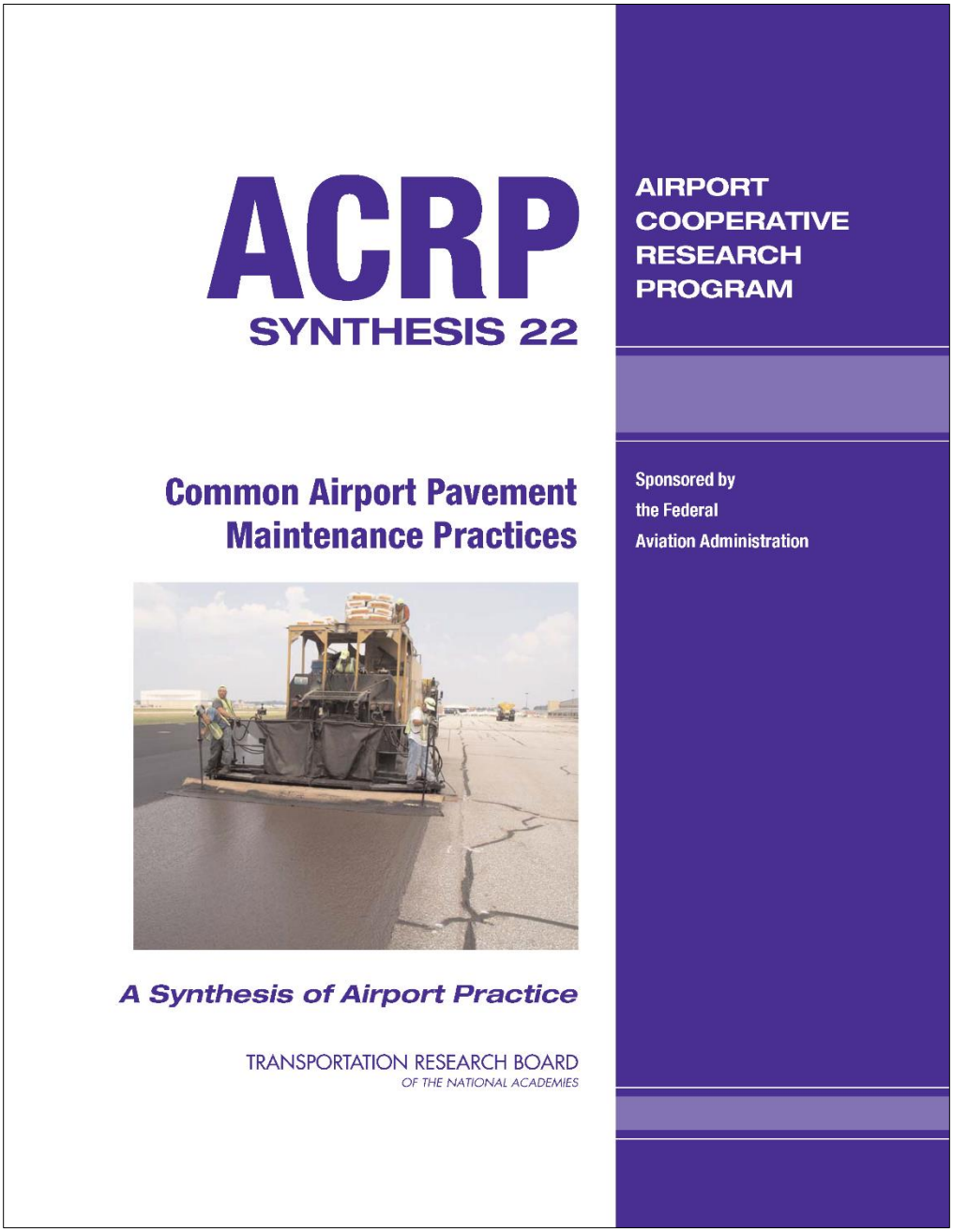
Technical Assistance Program

AIRPORT SAFETY AND MAINTENANCE WORKSHOP

EXCERPT FROM ACRP SYNTHESIS 22 "Common Airport Pavement Maintenance Practices"

The following handout pages from this ACRP publication are provided for your reference. Workshop participants are encouraged to download and review the complete publication from the TRB website at **www.trb.org/Publications/Blurbs/165167.aspx.**



Fact Sheet 5—Small-Area Patching

The Sequence of Operations for Small Patching Repairs

Small-area patching is a maintenance treatment that includes placing and spreading of bituminous mixtures, hot or cold, to repair potholes and other pavement distresses without the use of mechanical pavers or graders. The illustration shows the sequence of operations. The patching with hot mix or cold mix can be used for both bituminous pavements and PCC pavements; however, permanent repairs of PCC pavements are typically done using PCC material. If pavers or graders are used, the treatment is called machine patching and is described on a separate Fact Sheet.

Sources of Information and Additional Resources

California Department of Transportation, *Maintenance Technical Advisory Guide,* 2nd ed., Office of Pavement Preservation, Division of Maintenance, Sacramento, 2008.

Additional resources include:

A useful manual of practice was issued by the Federal Highway Administration as Report FHWA-RD-99-168, *Materials and Procedures for Repair of Potholes in Asphalt-Surfaced Pavements: Manual of Practice,* and is available at www.tfhc.gov/pavement/ltpp/pdf/99168.pdf.

Several highway agencies have developed manuals for patching of AC pavements. One of the most comprehensive has been published by the Minnesota Technology Transfer Center, *Best Practices Handbook on Asphalt Pavement Maintenance,* Manual No. 2000-04, Minneapolis, 2000.

Purpose and Selection Criteria

Small-area patching is used to repair localized defects such as potholes, distortion resulting from utility cuts, and small areas with severe ravelling and/or alligator cracking. The repair of potholes such as the one shown in Figure B5 reduces pavement roughness and the rate of pavement deterioration by improving drainage and reducing dynamic traffic loads. The repairs may be permanent, semi-permanent, or temporary.

Permanent repairs—Permanent repairs are used on pavements that are in good condition to bring the life span of the repaired area in line with that of the rest of the pavement. Permanent repairs require the use of appropriate patching materials and techniques, with the goal of addressing the underlying cause of the defects being repaired. Unless the original cause for the pavement defects is corrected, the repairs are susceptible to early failure.

Semi-permanent repairs—Semi-permanent repairs have a typical life expectancy of one or two years. Usually, the area is not saw cut and may be repaired with cold mix.

Temporary repair—Temporary repairs are used to hold the pavement until it can be resurfaced or permanently repaired. They are also used as emergency repairs when the pavement condition may pose a hazard to airplane operations.

FIGURE B5 Untreated pothole collects water and accelerates pavement deterioration.

Typical Service Life and Costs

Temporary patching repairs may last one year or less; permanent repairs may last 10 years or more. The cost of small-area patching is highly dependent on the extent of the repairs and on the selection of patching material. A typical unit cost for small-area patching is $20 to $40 per square yard.

Materials and Construction

The main types of patching materials include hot mix, local or agency-specified cold mix, and proprietary cold mix. A tack coat, if used, is typically an emulsion diluted with additional water. Hot-mix AC patching material provides the most durable treatment. Some suppliers of proprietary cold patching mixes suggest that their products can achieve similar performance and that their products can be successfully applied to potholes containing water. Cold mixes with single-size aggregate may not perform well in relatively large repairs. The single-size aggregate mix has low stability and is susceptible to rutting and ravelling.

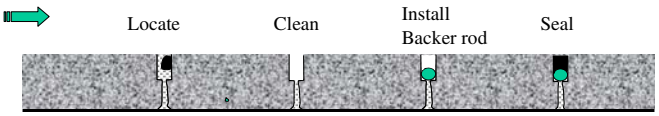
Typically, small-area *permanent* patching repair includes the following steps:

- Removal of broken pavement material in the patch area by jack hammering, cold milling, and/or pavement sawing.
- Cleaning out loose material from the patch area by blowing or brushing.
- Applying a tack coat to provide a bond between the existing pavement and the patching material.
- Placing the bituminous mix into the patch area. If the patch area is deeper than 2 in., the mix is placed and compacted in lifts until the level of the surrounding pavement is reached.
- Compacting the mix with a steel or rubber-tire roller, a vibratory plate compactor, or a hand tamper. Depending on the size and depth of the repair, and the material used, the finished repair will have crown of 0.1 to 0.4 in.
- Sealing the joint between the patch and the original pavement with hot-poured crack sealant. Sealing is typically done for larger and deeper repair areas.

Airport Experience

Patching is one of the most common pavement maintenance treatments. According to survey respondents, the majority of airports (that have AC pavements) routinely use small-area patching using hot mix and a minority of airports routinely use cold mix. None of the agencies surveyed reported poor performance of repairs using hot mix, whereas approximately 20% of agencies surveyed reported poor results using cold mix. A small minority of agencies surveyed routinely used a proprietary mix.

Fact Sheet 16—Joint/Crack Sealing of PCC Pavement



Sequence of Sealing Joints and Cracks in PCC Pavements

Sealing of joints and cracks in PCC pavements is a maintenance treatment that re-seals joints that have missing or poorly performing sealants, and seals major cracks. The sequence of the operation is shown on the above illustration.

Sources of Information and Additional Resources

California Department of Transportation, *Maintenance Technical Advisory Guide,* 2nd ed., Office of Pavement Preservation, Division of Maintenance, Sacramento, 2008.
Michigan Department of Transportation, *Capital Preventive Maintenance,* 2003 ed., Construction and Technology Division, Lansing, Apr. 2010.
Hicks, R.G., S.B. Seeds, and D.G. Peshkin, *Selecting a Preventive Maintenance Treatment for Flexible Pavements,* Publication FHWA-IF-00-027, Federal Highway Administration, U.S. Department of Transportation, Washington, D.C., 2000.

Additional resources include:

Evans, L.D., K.L. Smith, and A.R. Romine, *Materials and Procedures for the Repair of Joint Seals in Portland Cement Concrete Pavements—Manual of Practice,* FHWA-RD-99-146, Federal Highway Administration, McLean, Va., 1999.
A comprehensive *Concrete Pavement Repair Manual* issued by the ACPA in 2003 is available from www.pavement.com.
Engineering Technical Letter 02-8, *Silicone Joint Sealant Specification for Airfield Pavements,* 2002.

Purpose and Selection Criteria

The purpose of joint and crack sealing is to prevent incompressible materials from getting into joints, and to prevent infiltration of water and de-icing chemicals into the pavement structure. The presence of incompressible material in the joints can cause spalling and raveling when the joints close in the summer months. Excess water in the pavement structure can lead to erosion of the base support, and de-icing chemicals can corrode dowels and tie bars.

The objective of resealing is to keep all joints sealed. Typically, only working cracks with the opening (at moderate temperatures) between ¼ and ½ in. are sealed. Working cracks are typically transverse and longitudinal cracks. Re-sealing operations are carried out as scheduled maintenance when more than 50% of transverse joints start to show adhesion failures. Typically, pavements requiring joint resealing and crack sealing also require other maintenance treatments, such as partial-depth repairs.

Typical Service Life and Costs

There are three main categories of sealants for PCC pavements on the market: hot-poured bituminous sealants, silicone sealants, and compression seals (preformed or neoprene). Hot-pour sealants have a service life of 8 or more years, silicone sealants 10 years, and compression seals 12 or more years. The performance of sealants can differ significantly depending on the material and workmanship.

The typical cost of resealing operation is in the range of $3 to $4 per yard for hot-poured rubberized sealant, $4 to $5 per yard for silicone sealant, and $6 to $7 per yard for compression seals.

Materials and Construction

Typical joint and crack resealing operation consists of the following steps.

Removal of existing sealant—Damaged and underperforming sealant is removed. This may be accomplished by a mechanical device mounted on a garden-type tractor.
Preparation of sealant reservoir—Typical as-constructed transverse joints have sufficient reservoir at the top of the joint for hot-poured sealant. If the slab faces at the top of the joint do not have sufficient reservoir, the joint may be refaced by diamond saw cutting. Preformed compression seals require that joint sidewalls are perpendicular and without spalling. In the case of cracks, the reservoir is created by using a saw equipped with a special crack-sawing blade, rather than by using impact or rotary routers (e.g., those used for routing AC pavements) that can chip away at the crack face.

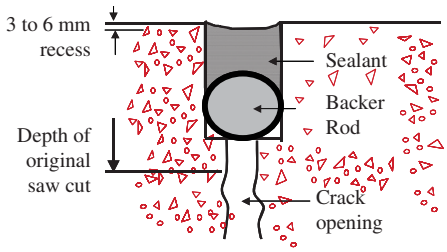


FIGURE B10 Resealed transverse contraction joint with bituminous sealant and a backer road.

Cleaning—All debris are cleaned by sand blasting or water blasting to remove all loose and weakened material, and to remove slurry residue from saw cutting. If sand blasting is used it is followed by air blasting to clean the joint. Joints must be dry before installing sealant.

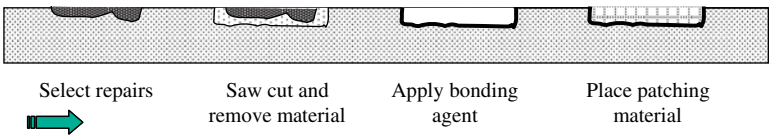
Insertion of backer rod—Bituminous sealants may require a device that would prevent a liquid sealant from seeping deep inside the joint. One such device is a backer rod (Figure B10). The backer rod keeps the sealant in place near the surface of the pavement and prevents bituminous sealant from seeping into the widened crack opening.

Sealant application—The application of hot-poured sealant is similar to the application used for sealing AC pavements. Sealing operation with compression seals requires the application of a lubricant/adhesive to the joint sidewalls before the insertion of the seal. Compression seals are typically applied by a specialized machine and primarily used on new pavements. High-modulus silicone sealants are leveled (tooled) to force the sealant into a full contact with the joint sidewalls and to produce the correct shape of the sealant on top.

Airport Experience

A majority of surveyed airports reported routine use of silicone sealants, half of the responding airports have used bituminous sealants, and a minority of responding airports has used neoprene sealants. The silicone sealants as reported by survey respondents performed best, with all airports reporting very good or good performance. A majority of surveyed airports reported very good or good performance using bituminous sealants or compression sealants.

Fact Sheet 17—Partial-depth (Patch) Repairs of PCC Pavement



Construction Steps of Partial-depth Repair of PCC Pavement

Partial-depth patch repair of PCC pavements is a maintenance activity that includes removal of damaged material from shallow areas and replacing it with new PCC material or AC material. The key construction steps involved are shown in the above illustration.

Sources of Information and Additional Resources

California Department of Transportation, *Maintenance Technical Advisory Guide,* 2nd ed., Office of Pavement Preservation, Division of Maintenance, Sacramento, 2008.
Michigan Department of Transportation, *Capital Preventive Maintenance,* 2003 ed., Construction and Technology Division, Lansing, Apr. 2010.
Ohio Department of Transportation, *Pavement Preventive Maintenance Guidelines,* Office of Pavement Engineering, Columbus, May 2001.
Hicks, R.G., S.B. Seeds, and D.G. Peshkin, *Selecting a Preventive Maintenance Treatment for Flexible Pavements,* Publication FHWA-IF-00-027, Federal Highway Administration, U.S. Department of Transportation, Washington, D.C., 2000.

Additional resources include:

A comprehensive manual of practice, *Concrete Pavement Repair Manual,* issued by the ACPA in 2003, is available from www.pavement.com.
Fowler, D., D. Zollinger, and D. Whitney, *Implementing Best Concrete Pavement Spall Repairs,* FHWA/TX-08/5-5110-01-1, National Technical Information Service, Springfield, Va. [Online]. Available: www.ntis.gov.
UFC 3-270-03, *Concrete Crack and Partial-Depth Spall Repair,* U.S. Department of Defense, Washington, D.C., 2006, 68 pp.

Purpose and Selection Criteria

The purpose of partial-depth repairs is to repair localized shallow areas of damaged pavement, such as joint and corner spalling (joint chipping, cracking, and breaking), and any loss of material caused by weak concrete. The objective is to prevent further deterioration, restore pavement smoothness, remove the potential for loose material coming off the pavement, and facilitate joint resealing.

Partial-depth repairs are typically done only for surface distresses that affect up to one-half of the slab thickness. Partial-depth repairs are not suitable for slabs with poor load transfer and areas where reinforcing steel or load transfer devices are exposed. Partial-depth repairs cannot effectively address spalls caused by durability (D) cracking or alkali silica reaction (ASR) damage. If there are several moderate or severe spalls present along one joint, it may be necessary and more economical to repair the joint using a full-depth repair.

Partial-depth repairs are often done in combination with full-depth repairs, joint re-sealing and diamond grinding as part of a pavement rehabilitation project.

Typical Service Life and Costs

A partial-depth repair can last as long as the slab itself, typically 10 years or more. A typical cost of a partial-depth repair operation is in the range of $160 to $220 per square yard.

Materials and Construction

The selection of repair material depends on a number of factors including time constraints, climate, repair size and configuration, experience with local materials, and future maintenance and rehabilitation plans. Ideal repair materials have similar physical properties, such as elastic modulus, strength, and thermal expansion, as the original concrete. PCC repair materials can be general-use hydraulic cement or high early-strength hydraulic cement. There are also rapid-set proprietary patching materials on the market. Bonding agents, if used, are typically sand–cement slurries or epoxy-modified cement slurries. AC material is typically used for temporary repairs only.

FIGURE B11 Prepared repair area; the insert, separating the repair area from the joint, extends beyond the saw cut into the existing longitudinal joint.

The patching procedure using PCC materials consists of the following steps:

1. Marking the boundaries of deteriorated and/or delaminated concrete.
2. Removal of existing concrete by saw cutting and chipping, or by milling, to create vertical surfaces of the sides of the excavated area.
3. Cleaning of the excavated area by sand blasting or water blasting.
4. Installation of a joint breaker, if the repairs are adjacent to joints, as shown in Figure B11.
5. Application of bonding agent (if used).
6. Placement of the patch material and its consolidation.
7. Finishing and texturing to match surrounding surface.
8. Application of a curing compound to retain moisture.
9. Joint resealing if the patch is adjacent to a joint.

The use of AC material for patching of PCC pavements is considered to be a temporary repair. For this reason, the excavated area is typically not saw cut and a joint breaker is not installed.

Airport Experience

About one-half of the airports surveyed routinely used or have tried partial-depth repairs with PCC material, a majority of surveyed airports have used AC material, and a large minority of surveyed airports has used proprietary materials. Overall, the performance of PCC materials was reported to be better than the performance of AC or proprietary materials.