



2021

Florida Department of Transportation Aviation Office

Airfield Pavement Distress *Repair Manual*



2021

Florida Department of Transportation Aviation Office



Airfield Pavement Distress
Repair Manual

USE OF MANUAL

This Airfield Distress Repair Manual (ADRM) has been updated with the latest information from the Federal Aviation Administration (FAA) AC150/5380-6 and the ASTM D5340-20. Additional distress pictures were added for clarity and easy recognition for maintenance and repair. This ADRM has been developed by the Florida Department of Transportation Central Aviation Office (FDOT AO).

Examples of various pavement distress types identified in this ADRM are presented by name in order to assist airfield maintenance repair performers. The various illustrations, charts and supporting information descriptions are presented to aid in the identification, severity, location, extent, and probable causes of airfield pavement distresses for both flexible and rigid pavement types.

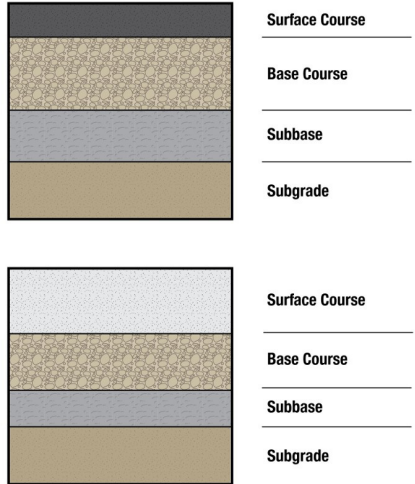
The majority of the photographs of various pavement conditions were collected and assembled specifically for the development of this ADRM.

DISCLAIMER:

This manual has been approved by FDOT AO and is based on information from FAA, ASTM, and various sources. While reasonable care has been taken in preparing this document, no responsibility or liability is accepted for errors or facts or for any opinion expressed herein.

Pavement Structure

- Surface: Typically include Portland cement concrete (PCC) and Hot-Mix Asphalt (HMA)
- Base: Generally fall into two classes:
 - Unstabilized bases consist of crushed and uncrushed aggregates
 - Stabilized bases consist of crushed and uncrushed aggregates with cement or asphalt
- Subbase: Consist of granular material, which may be unstabilized or stabilized
- Subgrade: Natural or modified soils



Load-Related Distresses



- Load, or structural, related issues can stem from repeated or heavy traffic loading, under-designed pavement section, weakened subgrade layers due to moisture, and pavement this is beyond its usable life.
 - Many of these factors can cause permanent deformation and cracking to the pavement extending beyond the surface to subgrade layers.
 - These distresses may be indicators of fatigue and/or overload.
-
- AC Pavements
 1. Alligator Cracking
 2. Rutting
 - PCC Pavements
 1. Corner Break
 2. Longitudinal, Transverse, and Diagonal (LTD) Cracking
 3. Pumping
 4. Shattered Slab/Intersecting Cracks

Climate/Durability-Related Distresses



- Climatic factors include moisture, rainfall, temperature, and freeze/thaw.
- These conditions can contribute to shrinkage and expanding of pavement, inundation of water to the subgrade, and the loss of material over time.
- AC Pavements
 1. Block Cracking
 2. Joint Reflection Cracking
 3. Longitudinal and Transverse (LT) Cracking
 4. Raveling
 5. Shoving
 6. Weathering
- PCC Pavements
 1. Blowup
 2. Durability “D” Cracking
 3. Joint Seal Damage
 4. Popouts

Construction/Material-Related Distresses



- Construction and material related factors can include sub-standard aggregates, chemical reaction within the pavement matrix, imbalanced mix-design, and improper construction techniques such as lack of curing time and over-finishing of surfaces.
 - Some of these factors may appear immediately after construction, while some may take time to develop before appearing.
-
- | | |
|---|---|
| <ul style="list-style-type: none">• AC Pavements<ol style="list-style-type: none">1. Bleeding2. Corrugation3. Depression4. Polished Aggregate5. Slippage Cracking6. Swelling | <ul style="list-style-type: none">• PCC Pavements<ol style="list-style-type: none">1. Alkali Silica Reaction (ASR)2. Scaling3. Shrinkage Cracking |
|---|---|

Other-Related Distresses



- Other distress factors include causes that are not typically attributed to load, climate, or construction/material issues.
 - These factors can include surface damage from aircraft operations and defects or patch repairs of the pavement surface.
-
- AC Pavements
 1. Jet-Blast Erosion
 2. Oil Spillage
 3. Patching and Utility Cut Patching
 - PCC Pavements
 1. Corner Spalling
 2. Joint Spalling
 3. Settlement or Faulting
 4. Small Patching
 5. Large Patching and Utility Cut

Distress Effects

	Flexible Pavements	Rigid Pavements
Cracking	Longitudinal and Transverse (LT) Cracking Block Cracking Joint Reflection Cracking Alligator Cracking Slippage Cracking	Longitudinal, Transverse, and Diagonal (LTD) Cracking Corner Break Durability "D" Cracking Shrinkage Cracking Shattered Slab / Intersecting Cracks
Joint Seal Damage	N/A	Joint Seal Damage
Disintegration	Raveling Weathering Potholes* Asphalt Stripping* Jet-Blast Erosion Patching and Utility Cut Patching	Scaling, Map Cracking, Cracking** Alkali Silica Reaction (ASR) Joint Spalling Corner Spalling Blowup Popouts Small Patching Large Patching and Utility Cut
Distortion	Rutting Corrugation Shoving Depression Swelling	Pumping Settlement or Faulting
Loss of Skid Resistance	Polished Aggregate Contaminants* (Rubber/Oil Deposits) Bleeding Oil Spillage	Polished Aggregate* Contaminants* (Rubber/Oil Deposits)
* - Non-ASTM Distress ** - Referred to as "Scaling" in ASTM D5340-20		

Cracking

- Concerns:
 - Water intrusion leading to base degradation
 - FOD Potential
 - Overloading
 - Construction
- Repair Strategy:
 - Protect Base Layer
 - Mitigate current and future FOD
 - Rectify structural deficiencies, if they exist



LTD Cracking

Joint Seal Damage

- Concerns:
 - Water intrusion leading to base degradation
 - FOD Potential
- Repair Strategy:
 - Protect Base Layer
 - Mitigate current and future FOD



Joint Seal Damage

Disintegration

- Concerns:
 - FOD Potential
 - Construction
 - Materials
- Repair Strategy:
 - Mitigate current and future FOD
 - Rectify structural deficiencies, if they exist



Alkali Silica Reaction (ASR)

Distortion

- Concerns:
 - Ride Quality
 - Construction
 - Materials
 - Overloading
- Repair Strategy:
 - Improve Ride Quality
 - Rectify structural deficiencies, if they exist



Depression

Loss of Skid Resistance

- Concerns:
 - Safety
 - Construction
- Repair Strategy:
 - Improve surface conditions to restore skid resistance



Bleeding

Rehabilitation Concept

What is the best method for fixing a distress?

- Permanent/Semi-Permanent Repairs
 - Addresses Cause of Failure
 - Mitigates Distress Effects
- Temporary/Emergency Repairs
 - Mitigates Distress Effects

Repair Types

- Flexible Pavements

1. Asphalt Crack Sealing
2. Asphalt Surface Treatment
3. Asphalt Partial-Depth Patching
4. Asphalt Full-Depth Patching

- Rigid Pavements

1. PCC Crack Sealing
2. PCC Joint Sealing
3. PCC Grinding
4. PCC Partial-Depth Patching
5. PCC Full-Depth Patching
6. PCC Slab Replacement

Page Intentionally Left Blank

Asphalt Crack Sealing



Asphalt Crack Sealing

- Crack sealing is the process of cleaning and sealing (or resealing) cracks in AC pavements.
- This repair is used to fill longitudinal and transverse cracks, including reflective cracks and block cracks that are wider than 1/8-inch.
 - Depending on the size of the crack, routing and cleaning the crack may be necessary to remove the loose material within the crack for better adherence of the crack sealant to the crack face.
- The purpose of this treatment is to prevent water and incompressible materials from entering cracks and causing further deterioration of the pavement structure. Accumulation of incompressible materials in cracks may lead to spalling and is a source of FOD.
- Crack sealing is cost-effective when used as a preventive measure.

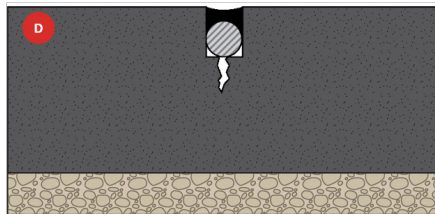
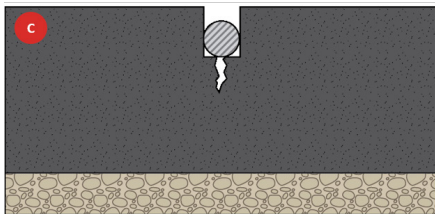
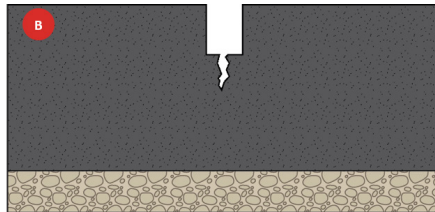
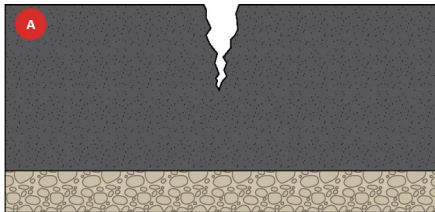
Asphalt Crack Sealing

- Permanent Repair for:
 - Block Cracking
 - Joint Reflection Cracking
 - Longitudinal and Transverse (LT) Cracking
- Temporary Repair for:
 - Alligator Cracking
 - Patching and Utility Cut Patching
 - Slippage Cracking

Asphalt Crack Sealing Procedure

1. Clean cracks with compressed hot air
2. If necessary, rout the cracks to the required width and depth
3. Make sure crack surface faces are dry
4. Install backer rod (if applicable)
5. Apply sealant uniformly from the bottom to the top of the crack
6. Make sure the surface of the sealant remains 1/4" to 3/8" below the existing pavement surface
7. Do not allow traffic until the sealants have cured

Asphalt Crack Sealing Overview



NOT TO SCALE

Page Intentionally Left Blank

Asphalt Surface Treatment



Asphalt Surface Treatment

- Application of a surface treatment provides AC-surfaced pavements with an unoxidized layer of bituminous material that can help extend the life of a pavement that is experiencing climate-related distresses.
- The surface treatment can also serve as a repair that re-establishes a bond between aggregates, slowing pavement deterioration and reducing FOD potential.

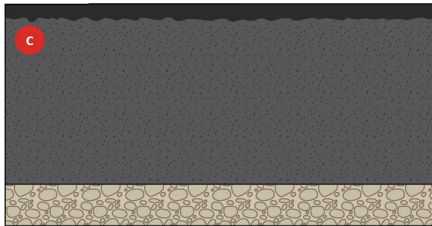
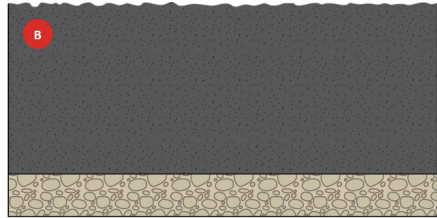
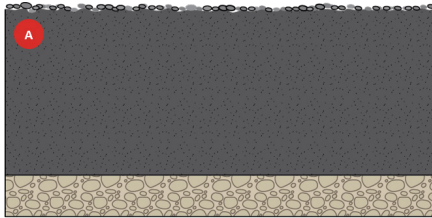
Asphalt Surface Treatment

- Permanent Repair for:
 - Weathering
- Temporary Repair for:
 - Alligator Cracking
 - Block Cracking
 - Jet-Blast Erosion
 - Joint Reflection Cracking
 - Longitudinal and Transverse (LT) Cracking
 - Oil Spillage
 - Polished Aggregate
 - Raveling
 - Shoving

Asphalt Surface Treatment Procedure

1. Thoroughly clean the pavement surface
2. Determine proper application rate using small field test sections
3. Apply the material with a calibrated asphalt distributor
4. Do not allow traffic until material has cured

Asphalt Surface Treatment Overview



NOT TO SCALE

Page Intentionally Left Blank

Asphalt Partial-Depth Patching



Asphalt Partial-Depth Patching

- This technique involves the removal of a given thickness of the surface layer using a milling machine and adding back a layer of AC pavement.
- This technique removes the deteriorated layer and provides a good bond for an overlay.
- It can correct or improve the structural capacity or functional requirement, such as skid resistance and ride quality.
- This repair is used for surface distresses that can occur over a large area.
- After milling operations are completed, any cracks still present should be cleaned and sealed prior to the placement of a tack coat and AC overlay layer(s).

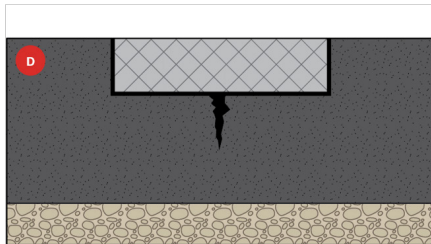
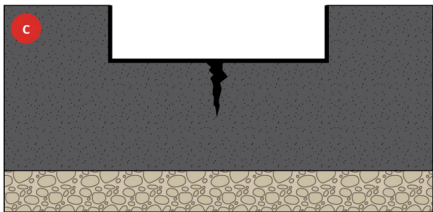
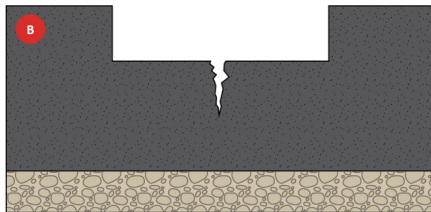
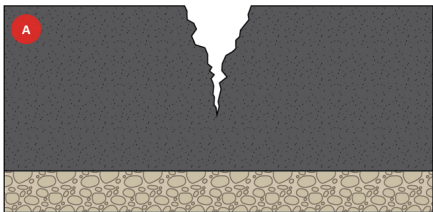
Asphalt Partial-Depth Patching

- Permanent Repair for:
 - Jet-Blast Erosion
 - Oil Spillage
 - Polished Aggregates
 - Raveling
 - Weathering
- Temporary Repair for:
 - Alligator Cracking
 - Bleeding
 - Corrugation
 - Depression
 - Patching and Utility Cut Patching
 - Rutting
 - Shoving
 - Slippage Cracking
 - Swelling

Asphalt Partial-Depth Patching Procedure

1. Mark the limits of the repair area
2. Saw cut or mill out an area a minimum of 12 inches beyond the limits of the distressed pavement area
3. Apply tack coat to the bottom and sides of the repair area
4. Fill patch area with HMA equivalent and compact to the minimum density specified
5. Use a straight-edge to verify the patch is flush with adjacent pavement
6. Do not allow traffic until the HMA has cured

Asphalt Partial-Depth Patching Overview



NOT TO SCALE

Page Intentionally Left Blank

Asphalt Full-Depth Patching



Asphalt Full-Depth Patching

- This technique involves replacing the full thickness of the AC layer and may include replacement of the base and subbase layers.
- Full-depth patching is used to repair structural and material-related distresses.
- This repair may be limited to the top AC layer (partial-depth patch) if the base and subbase layers exhibit no signs of deterioration.

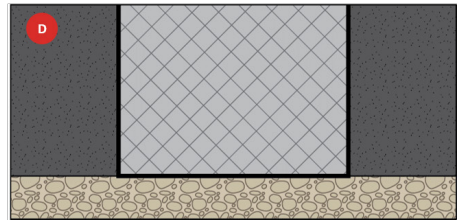
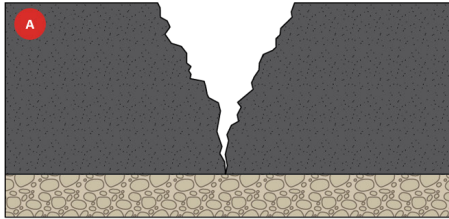
Asphalt Full-Depth Patching

- Permanent Repair for:
 - Alligator Cracking
 - Bleeding
 - Block Cracking
 - Corrugation
 - Depression
 - Joint Reflection Cracking
 - Longitudinal and Transverse (LT) Cracking
 - Patching and Utility Cut Patching
 - Rutting
 - Shoving
 - Slippage Cracking
 - Swelling
- Temporary Repair for:
 - N/A

Asphalt Full-Depth Patching Procedure

1. Mark the limits of the repair area
2. Saw cut or mill out an area a minimum of 12 inches beyond the limits of the distressed pavement area
3. Repair and re-compact the base as necessary
4. Apply tack coat to the bottom and sides of the repair area
5. Fill patch area with HMA equivalent and compact to the minimum density specified
6. Use a straight-edge to verify the patch is flush with adjacent pavement
7. Do not allow traffic until the HMA has cured

Asphalt Full-Depth Patching Overview



NOT TO SCALE

Page Intentionally Left Blank

PCC Crack Sealing



PCC Crack Sealing

- Crack sealing is the process of routing, cleaning, and sealing (or resealing) cracks in PCC pavement to prevent water from infiltrating into the pavement foundation and to stop the accumulation of incompressible materials in the cracks.
 - Routing and cleaning of the crack is often necessary to adhere the crack sealant to both sides of the crack.
 - Water entering cracks can weaken the subgrade, potentially leading to pumping, corner breaks, and/or shattered slabs.
 - Accumulation of incompressible materials in cracks may lead to spalling, which is a source of FOD.

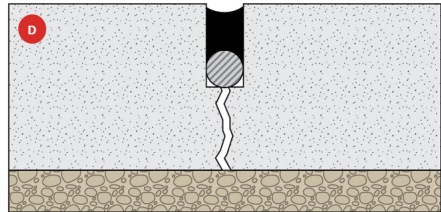
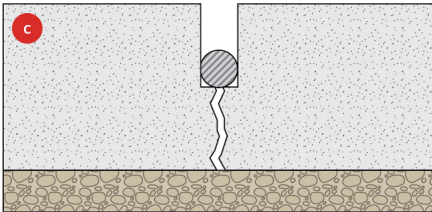
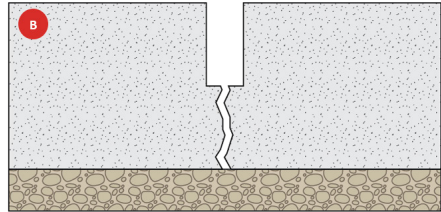
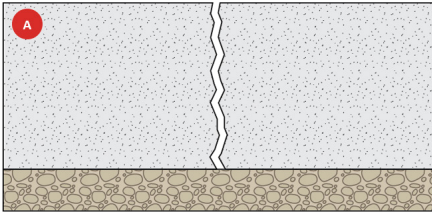
PCC Crack Sealing

- Permanent Repair for:
 - N/A
- Temporary Repair for:
 - Corner Break
 - Durability “D” Cracking
 - Large Patching and Utility Cut
 - Longitudinal, Transverse, and Diagonal (LTD) Cracking
 - Shattered Slab/Intersecting Cracks
 - Shrinkage Cracking (Drying Shrinkage)
 - Small Patching

PCC Crack Sealing Procedure

1. Clean cracks with compressed hot air
2. If necessary, rout the cracks to the required width and depth
3. Make sure crack surface faces are clean and dry
4. Install backer rod (if applicable)
5. Apply sealant uniformly from the bottom to the top of the crack
6. Make sure the surface of the sealant remains 1/4" to 3/8" below the existing pavement surface
7. Do not allow traffic until the sealants have cured

PCC Crack Sealing Overview



NOT TO SCALE

Page Intentionally Left Blank

PCC Joint Sealing



PCC Joint Sealing

- Joint sealing is the process of cleaning and sealing (or resealing) joints in PCC pavement to prevent water from infiltrating into the pavement foundation and to stop the accumulation of incompressible materials in the joints.
 - In some cases, it may be necessary to re-saw the pavement joints to remove old material prior to resealing.
 - Water entering joints can weaken the subgrade, potentially leading to pumping, corner breaks, and/or shattered slabs.
 - Accumulation of incompressible materials in joints leads to spalling of the concrete, which is a source of FOD.

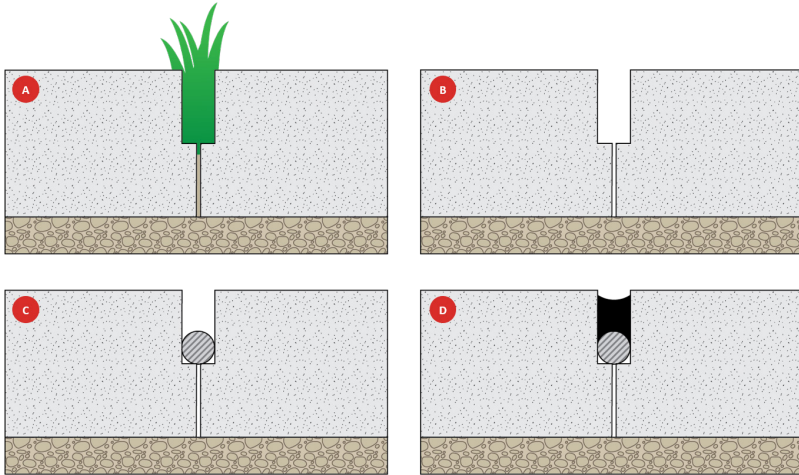
PCC Joint Sealing

- Permanent Repair for:
 - Corner Spalling
 - Joint Seal Damage
 - Joint Spalling
- Temporary Repair for:
 - Pumping

PCC Joint Sealing Procedure

1. Clean joints with compressed hot air
2. If necessary, rout the joints to the required width and depth
3. Make sure joint surface faces are clean and dry
4. Install backer rod (if applicable)
5. Apply sealant uniformly from the bottom to the top of the joint
6. Make sure the surface of the sealant remains 1/8" to 1/4" below the existing pavement surface
7. Do not allow traffic until the sealants have cured

PCC Joint Sealing Overview



NOT TO SCALE

Page Intentionally Left Blank

PCC Grinding



PCC Grinding

- Grinding is the process of removing a thin layer of the existing concrete by grinding it with a series of closely spaced, rotating saw blades.
- This method is used to re-profile jointed concrete pavements with poor ride quality due to faulting or warping.
- Grinding is also used to restore transverse drainage and to provide a textured pavement surface.
- The concern with this type of maintenance is that if too much material is removed, the overall structural composition of the pavement section may change, potentially reducing the overall life of the pavement.

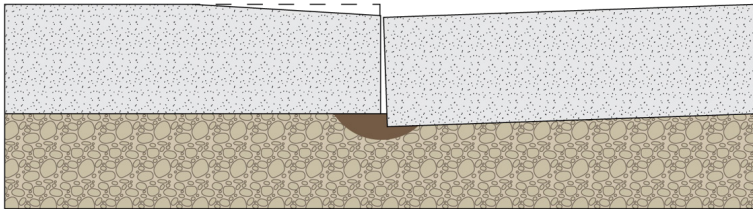
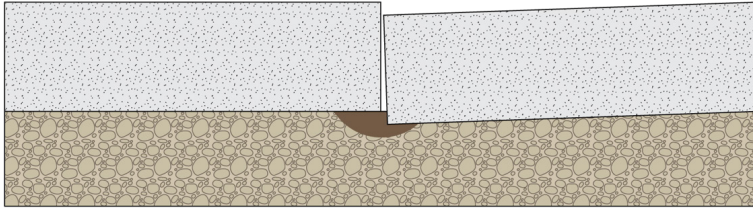
PCC Grinding

- Permanent Repair for:
 - Settlement or Faulting
- Temporary Repair for:
 - Blowup
 - Scaling
 - Shrinkage Cracking

PCC Grinding Procedure

1. Mark the limits of the repair area
2. Start and end grinding operations perpendicular to the pavement center-line
3. Continuously remove the grinding slurry residue using an on-board wet-vacuum
4. Feather out the grinding operation using the American Concrete Pavement Association (APCA) guideline of 1' for every 0.1" of faulting
5. Clean area thoroughly prior to opening for traffic

PCC Grinding Overview



NOT TO SCALE

Page Intentionally Left Blank

PCC Partial-Depth Patching



PCC Partial-Depth Patching

- PCC partial-depth patching involves removing shallow, localized areas of deteriorated or spalled PCC pavement and replacing them with a suitable patch-like cement concrete or epoxy concrete.
- This method is used to repair distresses that are confined to the top few inches of the slab, such as joint and corner spalling.
- This repair would require restoring the joint sealant if near a joint.

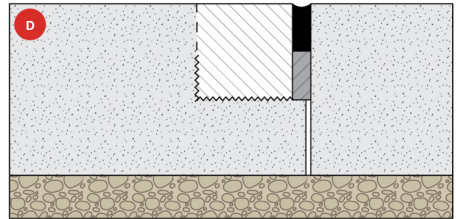
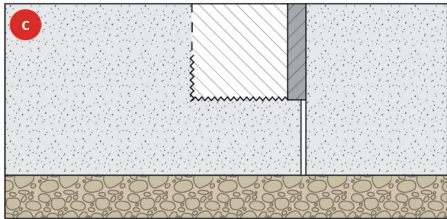
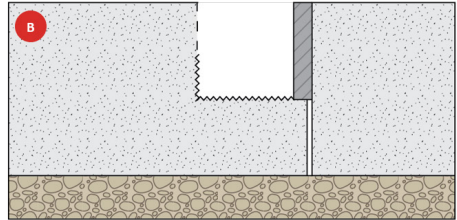
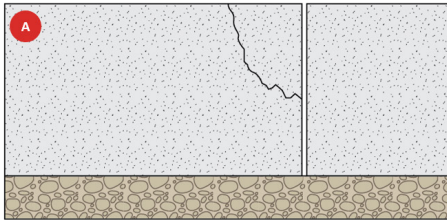
PCC Partial-Depth Patching

- Permanent Repair for:
 - Corner Spalling
 - Joint Spalling
 - Small Patching
- Temporary Repair for:
 - Corner Break
 - Durability “D” Cracking
 - Large Patching and Utility Cut
 - Longitudinal, Transverse, and Diagonal (LTD) Cracking
 - Scaling

PCC Partial-Depth Patching Procedure

1. Mark the limits of the area to be repaired
2. Make vertical saw cuts a minimum of 2" in depth and 3" beyond the limits of the repair area. Repair area should be a rectangular area
3. Remove all unsound concrete and at least ½" of visually sound concrete
4. Clean the repair area with high-pressure water
5. Form a new joint sealant reservoir between the repair area and the adjacent slab
6. Place the patch and finish to match texture of adjacent pavement
7. Cure the patch in accordance with the material manufacturer's recommendation
8. Place joint sealant
9. Protect the patch from traffic until the material has set

PCC Partial-Depth Patching Overview



NOT TO SCALE

Page Intentionally Left Blank

PCC Full-Depth Patching



PCC Full-Depth Patching

- Full-depth patching involves replacing the full thickness of the PCC layer within a limited portion of a PCC slab.
- This repair is used for areas exhibiting structural and material-related distresses.
- This repair requires restoring load transfer if near a joint or crack.

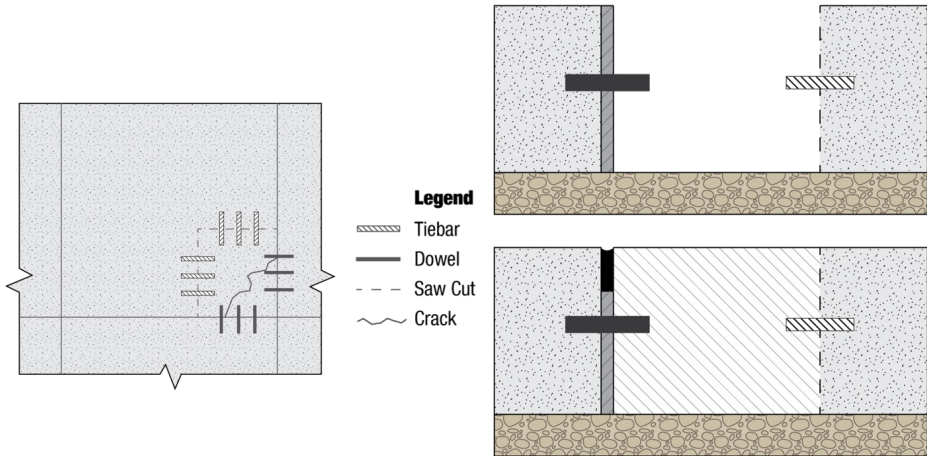
PCC Full-Depth Patching

- Permanent Repair for:
 - Corner Break
 - Large Patching and Utility Cut
 - Longitudinal, Transverse, and Diagonal (LTD) Cracking
 - Scaling
 - Small Patching
- Temporary Repair for:
 - Alkali Silica Reaction (ASR)
 - Blowup
 - Durability “D” Cracking

PCC Full-Depth Patching Procedure

1. Mark the limits of the area to be repaired
2. Make full-depth vertical saw cuts at least 2' beyond the limits of the repair area. Make saw cuts perpendicular to constructed joints
3. Remove all unsound concrete
4. Restore subgrade or base material if required
5. Install deformed tie bars into the face of the parent panel and dowel bars into the face of the adjacent panel(s)
6. Form a new joint sealant reservoir between the repair area and the adjacent panel(s)
7. Fill the repair area with concrete and consolidate with a vibrator
8. Finish the surface to match the existing surface
9. Cure the patch in accordance with the material manufacture's recommendation
10. Place joint sealant
11. Protect the patch from traffic until the material has set

PCC Full-Depth Patching Overview



NOT TO SCALE

Page Intentionally Left Blank

PCC Slab Replacement



PCC Slab Replacement

- Slab Replacement involves replacing the full thickness of the PCC layer over an entire PCC slab.
- This repair is used for areas exhibiting structural, climate, durability, and material-related distresses.
- This repair requires restoring load transfer with adjacent slabs through dowels or similar means.

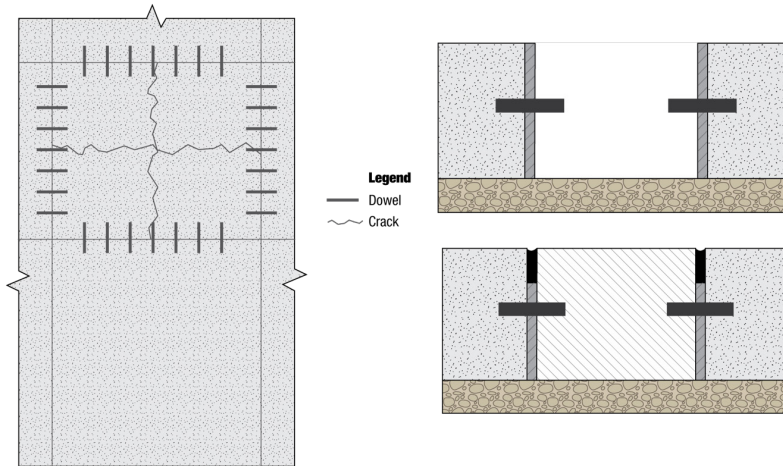
PCC Slab Replacement

- Permanent Repair for:
 - Alkali Silica Reaction (ASR)
 - Blowup
 - Durability “D” Cracking
 - Popouts
 - Pumping
 - Scaling
 - Settlement or Faulting
 - Shattered Slab/Intersecting Cracks
- Temporary Repair for:
 - N/A

PCC Slab Replacement Procedure

1. Mark the limits of the area to be repaired
2. Make full-depth vertical saw cuts parallel to and in between constructed joints
3. Remove all unsound concrete
4. Restore subgrade or base material if required
5. Install dowel bars into the face of the adjacent panel(s)
6. Form a new joint sealant reservoir between the repair area and the adjacent panel(s)
7. Fill the repair area with concrete and consolidate with a vibrator
8. Finish the surface to match the existing surface
9. Cure the repair area in accordance with the material manufacture's recommendation
10. Place joint sealant
11. Protect the repair area from traffic until the material has set

PCC Slab Replacement Overview



NOT TO SCALE

Common Techniques

Repair Work Type	Routing	Milling	Saw Cut
Asphalt Crack Sealing	X		
Asphalt Surface Treatment			
Asphalt Partial-Depth Patching		X	X
Asphalt Full-Depth Patching			X
PCC Crack Sealing	X		
PCC Joint Sealing	X		
PCC Grinding		X	
PCC Partial-Depth Patching			X
PCC Full-Depth Patching			X
PCC Slab Replacement			X

Common Materials

Repair Work Type	Tack/Prime Coat	Backer Rod / Sealant	Dowel Bars	Tie Bars	PCC	HMA	Rejuvenator
Asphalt Crack Sealing		X					
Asphalt Surface Treatment							X
Asphalt Partial-Depth Patching	X					X	
Asphalt Full-Depth Patching	X					X	
PCC Crack Sealing		X					
PCC Joint Sealing		X					
PCC Grinding							
PCC Partial-Depth Patching		X			X	X	
PCC Full-Depth Patching		X	X	X	X	X	
PCC Slab Replacement		X	X		X		

Any questions or comments regarding the Airfield Pavement
Distress Repair Manual, please contact:

Dr. Abdul Hatim, Ph.D.

Airport Engineering Manager

FDOT Aviation Office

605 Suwannee Street, MS 46

Tallahassee, FL 32399-0459

Phone: (850) 414-4504

Fax: (850) 414-4508

Email: abdul.hatim@dot.state.fl.us

