

SWIFT CONFERENCE 2006 PAVEMENT DEFECTS AND REPAIR



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Outline

1. Introduction to Pavement Defects

2. Pavement Quality Characteristics

3. Asphalt Pavement Defects

4. PCC Pavement Defects

5. PCC Pavement Repairs

6. Catchbasin/Manhole Top Adjustment

Introduction to Pavement Defects

→ DEFECTS INFLUENCES ON PAVEMENT QUALITY

- RIGID PAVEMENT
- FLEXIBLE PAVEMENT

→ TYPICAL FLEXIBLE PAVEMENT DEFECTS AT TPIA

- LONGITUDINAL CRACKS
- TRANSVERSE CRACKS
- SLIPPAGE CRACKS
- SHOIVING AND RUTTING

→ TYPICAL RIGID PAVEMENT DEFECTS AT TPIA

- SPALLING AT JOINTS
- CORNER CRACKS
- TRANSVERSE CRACKS
- ERRATIC CRACKS

→ STANDARD DRAWINGS FOR REPAIR WORK

Pavement Quality Characteristics

Pavement Defects	Defect Influence on Pavement Quality Characteristics				
	Strength	Smoothness	Skid Resistance	Structural Integrity	Surface Drainage
Asphalt Pavements					
Transverse Cracking		X		X	
Longitudinal Cracking	X			X	
Alligator Cracking	X			X	
Map Cracking	X			X	
Block Cracking		X		X	
Raveling		X		X	
Rutting	X	X	X		X
Bleeding			X		

Pavement Quality Characteristics

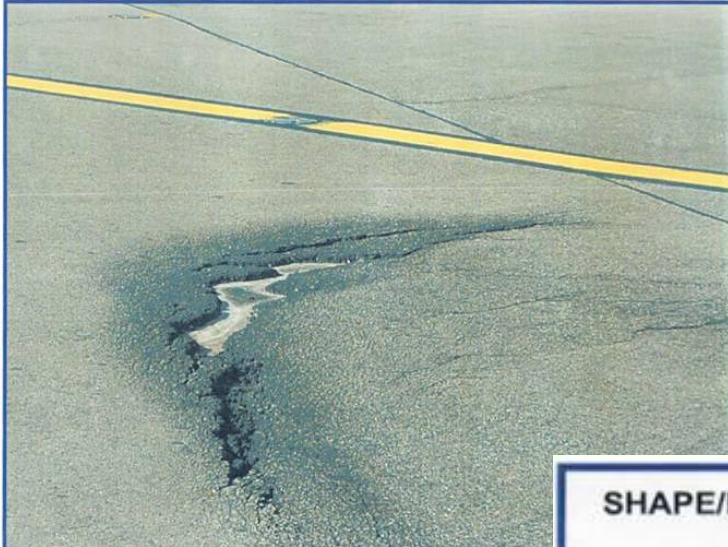
Pavement Defects	Defect Influence on Pavement Quality Characteristics				
	Strength	Smoothness	Skid Resistance	Structural Integrity	Surface Drainage

Concrete Pavements					
Slab Cracking	X	X		X	
Corner Cracking	X			X	
Edge Cracking	X			X	
Scaling & Spalling		X		X	
Joint Faulting		X			

Pavement Quality Characteristics

Pavement Defects	Defect Influence on Pavement Quality Characteristics				
	Strength	Smoothness	Skid Resistance	Structural Integrity	Surface Drainage
All Pavements					
Surface Texture			X		X
Rubber Deposits			X		
Settlement/ Ponding		X	X		X
Frost Heave		X			
Patching		X		X	
“Pot-Holes”		X		X	
Shoulder Erosion				X	
Shoulder Slopes					X
Catch Basin Heave					X

Asphalt Pavement Defects: Slippage Crack



Taxiway Delta
Constructed 1997
Observed November 1, 2000
Repaired November 10, 2000

- SHAPE/PATTERN:** These Crescent shaped cracks resulting from horizontal forces inducted by traffic. The ends of curved crack point in the direction of the thrust of wheels on the pavement surface. This does not mean they invariably point in the direction of traffic flow. If brakes are applied on a vehicle going downhill the thrust of the wheels is reversed due to braking action. Slippage occurring in this circumstance will result in cracks pointing uphill.
- CAUSE:** Slippage cracks result from the lack of bond between the surface layer and the course beneath. The lack of bond may be due to dust, oil, rubber, dirt, water or other non-adhesive material between the two courses. Usually, such a lack of bond exist when no tack coat has been used or when no prime coat was used with thin asphalt lift placed on the aggregate base. Slippage cracks my result from mixtures having a high sand content, as well as due to improper compaction.
- REPAIR METHOD:** Remove the affected asphalt layer(s) and replace with surface patch. Apply recommended rates of prime or tack coats as applicable.

Asphalt Pavement Defects: Shoving and Rutting



Asphalt Pavement Defects: Shoving and Rutting



Asphalt Pavement Defects: Slippage at Inset Lights



Asphalt Pavement Defects: Slippage at Inset Lights

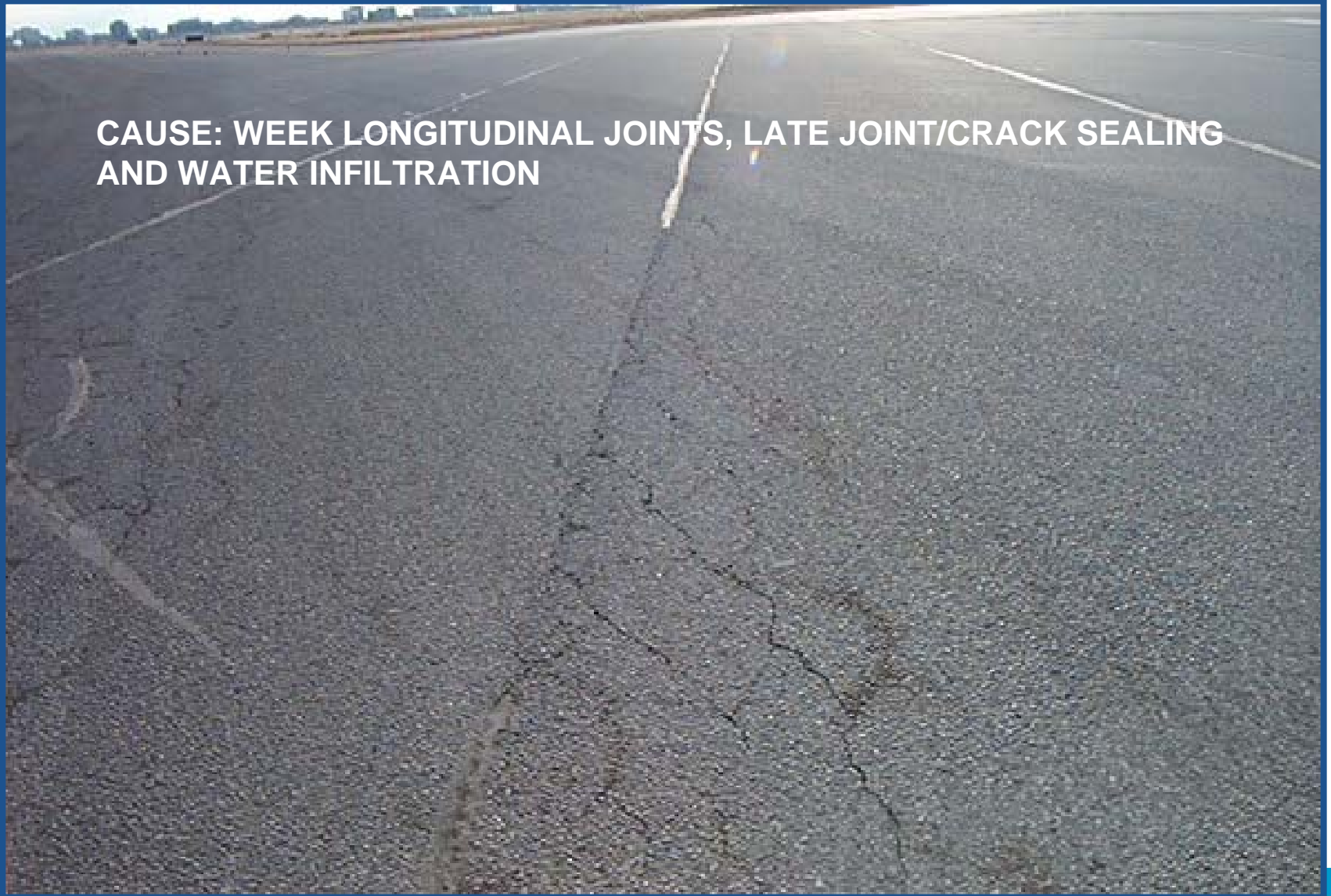


Asphalt Pavement Defects: Slippage & Shoving over PCC



Asphalt Pavement Defects: Cracks at Longitudinal Joints

CAUSE: WEEK LONGITUDINAL JOINTS, LATE JOINT/CRACK SEALING AND WATER INFILTRATION



Asphalt Pavement Defects: Transverse Cracks over PCC

Transverse & Reflection Cracks

CAUSE: REFLECTION CRACKS- HMAC OVERLAY ON PCC SLABS

PCC Pavement Defects: Diagonal Cracks



CAUSE: DIFFERENTIAL SUBGRADE SUPPORT & SETTLEMENT

PCC Pavement Defects: Diagonal Cracks



PCC Pavement Defects: Corner & Diagonal Cracks



PCC Pavement Defects: Transverse Cracks



CAUSE: LOSS OF SUBGRADE SUPPORT,

PCC Pavement Defects: Spalling at Joints & Compression Cracks



CAUSE: INPROPER JOINT SEALING, DEBRIS IN JOINT PREVENT MOVEMENT

PCC Pavement Defects: Joint Faulting/Stepping



CAUSE: LOSS OF KEYWAY SUPPORT

GATE 522 INFIELD TERMINAL: ERRATIC CRACKS



**CAUSE:
SUBGRADE SETTLEMENT, FROST HEAVE, FRICTION BONDING TO SUBBASE**

PCC Pavement Defects: Causes



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Fax (416) 776-4640



A - A Crowfoot Crack:

These may be parallel to the pavement edge or at an angle. They may be caused by failure to extend expansion-joint filler to the edge of the pavement, or by infiltration of foreign material into the end of either expansion or contraction joints.

B - A Corner Break:

These cracks, which generally form a rough isosceles triangle with sides at least 450mm long, are caused by overstressing the pavement.

C - A Diagonal Crack:

These are caused by a differential in subgrade support. This may be due to settlement or volume change of the subgrade (frost heave/settlement).

D - Spalls:

These may develop at any joint or at an intersection of two joints. They may be caused by improper joint construction or infiltration of foreign material at the top of the joint.

E - Transverse Cracks:

These may be caused by the omission of a contraction joint or by using a joint spacing too great to control cracking.

F - A Transverse Crack:

These cracks, which occur 1.2m to 2.4m ahead of the joint, are usually caused by loss of subgrade support due to pumping.

G - A Longitudinal Crack:

These are caused by the omission of intermediate longitudinal joints in wide construction lanes.

H - Plastic-Shrinkage Cracks:

These are caused by rapid loss of water from the fresh concrete, which may be due to lack of early curing, rapid evaporation from the surface, or loss of water because of a dry subgrade or a dry, absorptive aggregate.

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DRAWN:	FH	DESIGNED:	APPROVED: MFW
ENGINEERING		DATE: 04/22/04	
PAVEMENT CONSTRUCTION			
PCC PAVEMENT DEFECTS AND CAUSES			
SHEET 1 OF 2		FILE:	
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PCC Pavement Defects: Causes

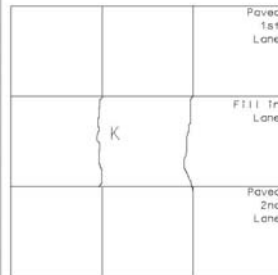


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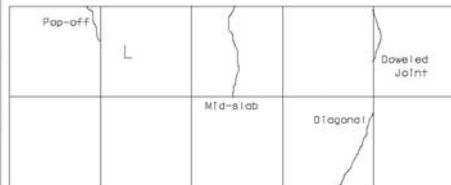
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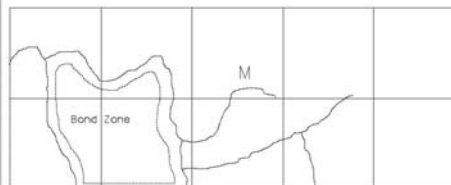
J - Doweled Joint Subsidence:
Occurs directly over dowel bars, due to subgrade subsidence or sloughing or high slump concrete over embedded bars.



K - Edge Restraint:
Typical of not sawing concrete slab or sawing too late thereafter. A form of sympathy cracking.



L - Random Crack Formations:
Typical of sawing too late.



M - Erratic Cracks:
Typical of high friction or bonding to subbase or major subgrade settlement or frost heave or loss of sub-grade support causing differential movement, or a combination of both.

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PCC PAVEMENT DEFECTS AND CAUSES			
SHEET 2 OF 2		FILE:	
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PCC Pavement Repairs: General Rules

- | | |
|--|----------------------------|
| ■ $< \frac{1}{4}$ INCH (6.5 MM) | LEAVE ALONE |
| ■ $\frac{1}{4} - \frac{1}{2}$ INCH (6.6 – 13 MM) | ROUTE AND SEAL |
| ■ $\frac{3}{8} - 1$ INCH (9.5 – 25 MM) | TIE STITCHING & ROUTE SEAL |
| ■ > 1 INCH (25 MM) | FULL DEPTH REPAIR |

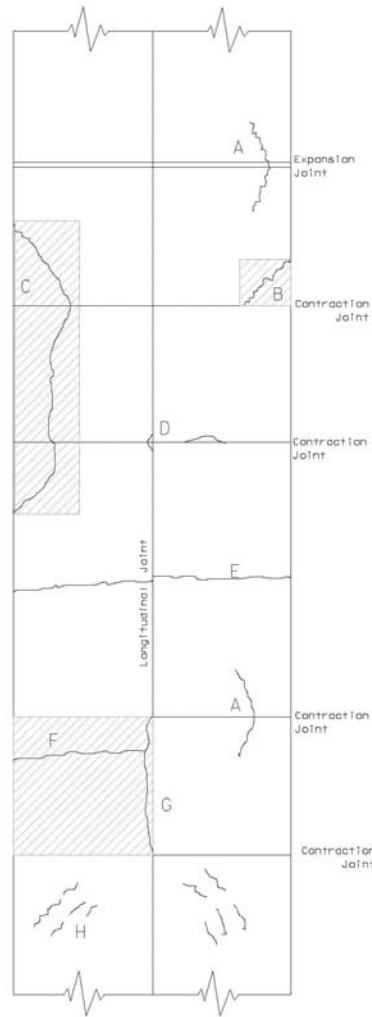
NOTES:

- PCC SLABS WITH MORE THAN TWO CRACKS OVER 13 MM WIDE, FULL SHOULD BE REPLACED
- CORNER CRACKS LARGER THAN 13 MM SHOULD BE PARTIALLY FULL DEPTH REPLACED

PCC Pavement Repairs: General Guide



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A - A Crowfoot Crack:

These may be parallel to the pavement edge or at an angle. They may be caused by failure to extend expansion-joint filler to the edge of the pavement, or by infiltration of foreign material into the end of either expansion or contraction joints.

Clean and reestablish joints

B - A Corner Break:

These cracks, which generally form a rough isosceles triangle with sides at least 450mm long, are caused by overstressing pavement corner and loss of support.

Partial slab replacement when crack exceeds 20mm

C - A Diagonal Crack:

These are caused by a differential in subgrade support. This may be due to settlement or volume change of the subgrade (frost heave/settlement)

Partial slab replacement and recompact subgrade

D - Spalls:

These may develop at any joint or at an intersection of two joints. They may be caused by improper joint construction or infiltration of foreign material at the top of the joint. It is less observed with chamfered joints.

Clean and seal joints

E - Transverse Cracks:

These may be caused by the omission of a contraction joint or by using a joint spacing too great to control cracking.

Rout and seal joints

F - A Transverse Crack:

These cracks, which occur 1.2m to 2.4m ahead of the joint, are usually caused by loss of subgrade support due to pumping.

Replace slab and compact subgrade

G - A Longitudinal Crack:

These are caused by the omission of intermediate longitudinal joints in wide construction lanes.

Rout and seal cracks

H - Plastic-Shrinkage Cracks:

These are caused by rapid loss of water from the fresh concrete, which may be due to lack of early curing, rapid evaporation from the surface, or loss of water because of a dry subgrade or dry absorptive aggregate.

Do nothing but monitor with time

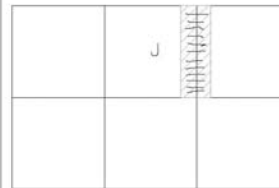
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PAVEMENT CONSTRUCTION PCC PAVEMENT DEFECTS CAUSES AND REPAIRS GENERAL GUIDE			
SHEET 1 OF 2		FILE:	
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PCC Pavement Repairs: General Guide



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J - Doweled Joint Subsidence:

Occurs directly over dowel bars, due to subgrade subsidence or sloughing or high slump concrete over embedded bars.

Reconstruct approx. 1.0m from each side

K - Edge Restraint:

Typical of not sawing concrete slab or sawing too late thereafter. A form of sympathy cracking.

Crack routing and sealing

L - Random Crack Formations:

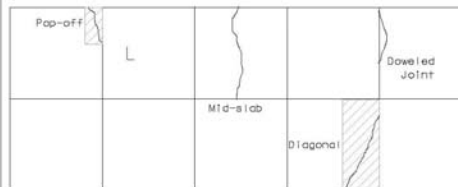
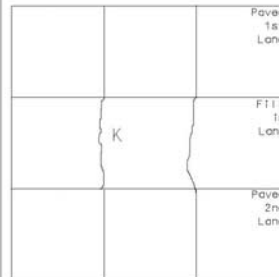
Typical of sawing too late.

Routing and sealing and/or partial slab replacement or cross stitching

M - Erratic Cracks:

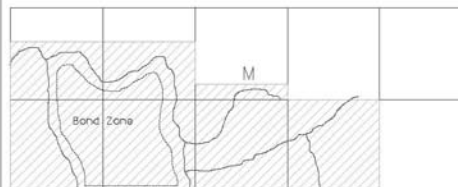
Typical of high friction or bonding to subbase or major subgrade settlement or frost heave or loss of sub-grade support causing differential movement, or a combination of both.

Reconstruct/Replace slabs and recompact subgrade



GUIDE: TYPES OF DISTRESS THAT OCCUR IN RIGID PAVEMENTS WHICH MAY JUSTIFY FULL-DEPTH REPAIR WHEN CLASSIFIED AS MEDIUM- OR HIGH-SEVERITY (ASTM 1778) INCLUDE:

- * CORNER BREAK
- * DURABILITY ("D") CRACKING (FOD GENERATION)
- * PATCH DETERIORATION
- * SHATTERED SLAB (A SLAB BROKEN INTO FOUR OR MORE PIECES WITH SOME OR ALL CRACKS OF MEDIUM- OR HIGH-SEVERITY)
- * JOINT OR CRACK SPALLING (IF SPALLING IS ONE-HALF THE SLAB THICKNESS OR DEEPER)

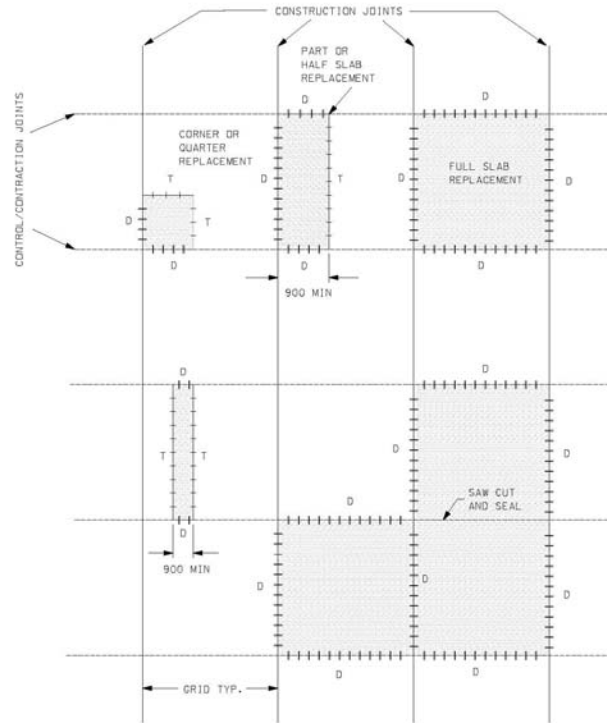


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PCC Pavement Repairs: Full Depth Repair



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NOTES:

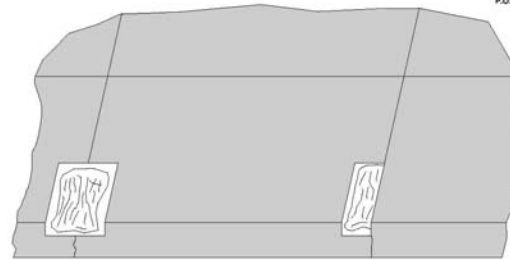
1. ALL DIMENSIONS ARE IN MILLIMETRES
2. SAW CUT AND SEAL CONTROL/CONTRACTION
3. SAW CUT AND REESTABLISH CONSTRUCTION AND ISOLATION JOINTS
4. REFER TO JOINT DETAILS SD90C10 AND SD90C11
5. FOR TIE BARS(T) AND DOMELS(D) REFER TO DETAILS SD90C095 AND SD90C096

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PAVEMENT CONSTRUCTION PCC SLABS FULL DEPTH REPAIR			
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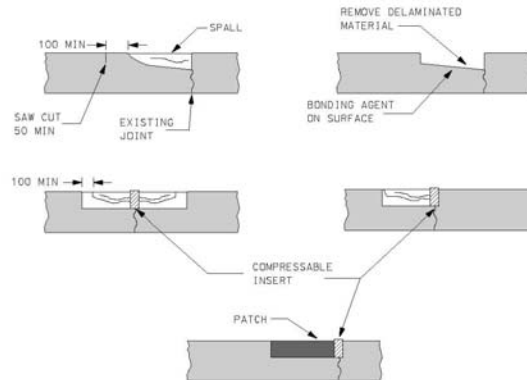
PCC Pavement Repairs: Partial Depth Repair



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TOP VIEW



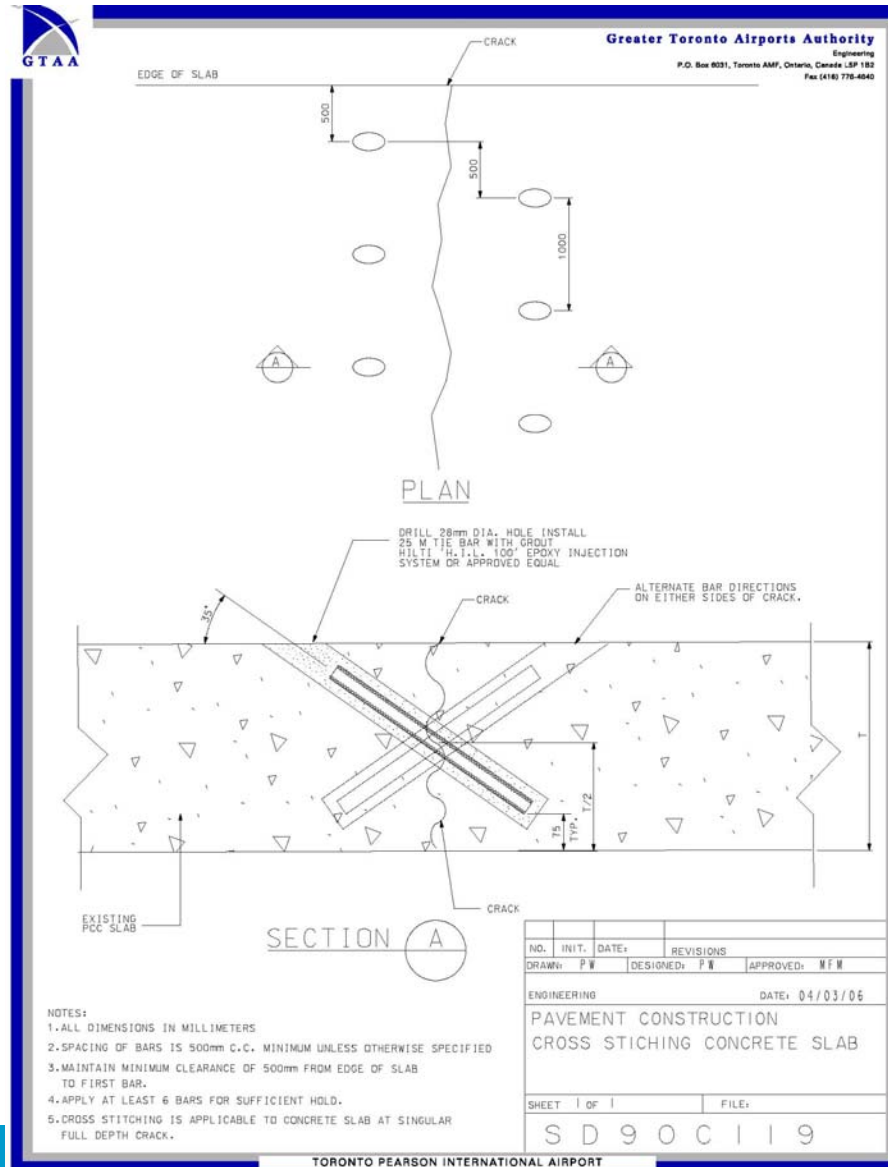
SIDE VIEW

NOTES:


1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN
2. SURVEY AND DETERMINE DAMAGED AND UNSOUND CONCRETE SURFACE
3. MARK EXTENT OF REPAIRS ON SITE. EXTEND BOUNDARY A MINIMUM OF 100mm INTO SOUND CONCRETE
4. KEEP BOUNDARY SHAPE SQUARE OR RECTANGULAR
5. COMBINE REPAIR PATCHES IF AREAS ARE CLOSER THAN 600mm
6. MAKE VERTICAL SAW CUT 50mm DEEP ALONG MARKED BOUNDARY
7. REMOVE BY CHIPPING/MILLING MATERIALS WITHIN SHOWN AREA TO MINIMUM DEPTH OF 75mm
8. CLEAN EXPOSED SURFACE FROM DEBRIS AND DUST
9. PLACE COMPRESSIBLE INSERT TO RE-FORM JOINTS
10. APPLY BONDING AGENT ON EXPOSED SURFACE
11. PLACE, COMPACT, FINISH AND CURE PATCHED MATERIAL
12. TROWEL SURFACE TOWARD JOINTS AND SAW CUTS
13. RE-ESTABLISH JOINTS AFTER PATCH HAS CURED

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PAVEMENT CONSTRUCTION			
PCC SLABS			
PARTIAL DEPTH REPAIR			
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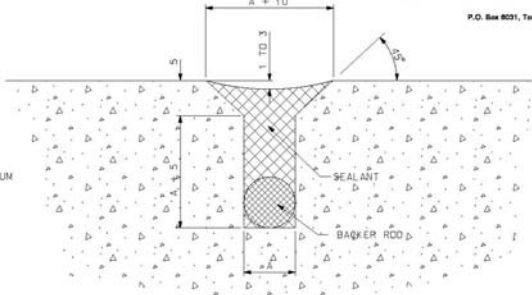
PCC Pavement Repairs: Cross Stitching



PCC Pavement Repairs: Routing and Sealing

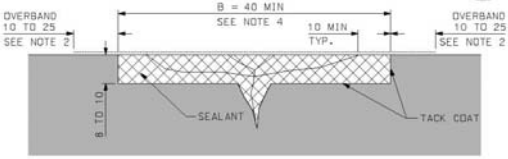


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A = 10 MINIMUM
SEE NOTE 3

CONCRETE CRACK REPAIR (A)



OVERBAND 10 TO 25
SEE NOTE 2

B = 40 MIN
SEE NOTE 4

10 MIN
TYP.

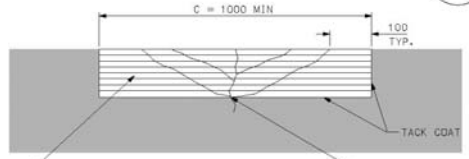
OVERBAND 10 TO 25
SEE NOTE 2

B TO 10

SEALANT

TACK COAT

ASPHALT CRACK REPAIR (B)



C = 1000 MIN

100
TYP.

TACK COAT

HMAC SINGLE OR DOUBLE
COURSE AS REQUIRED.

MILL/REMOVE EXISTING HMAC
DOWN TO THE SINGLE CRACK.

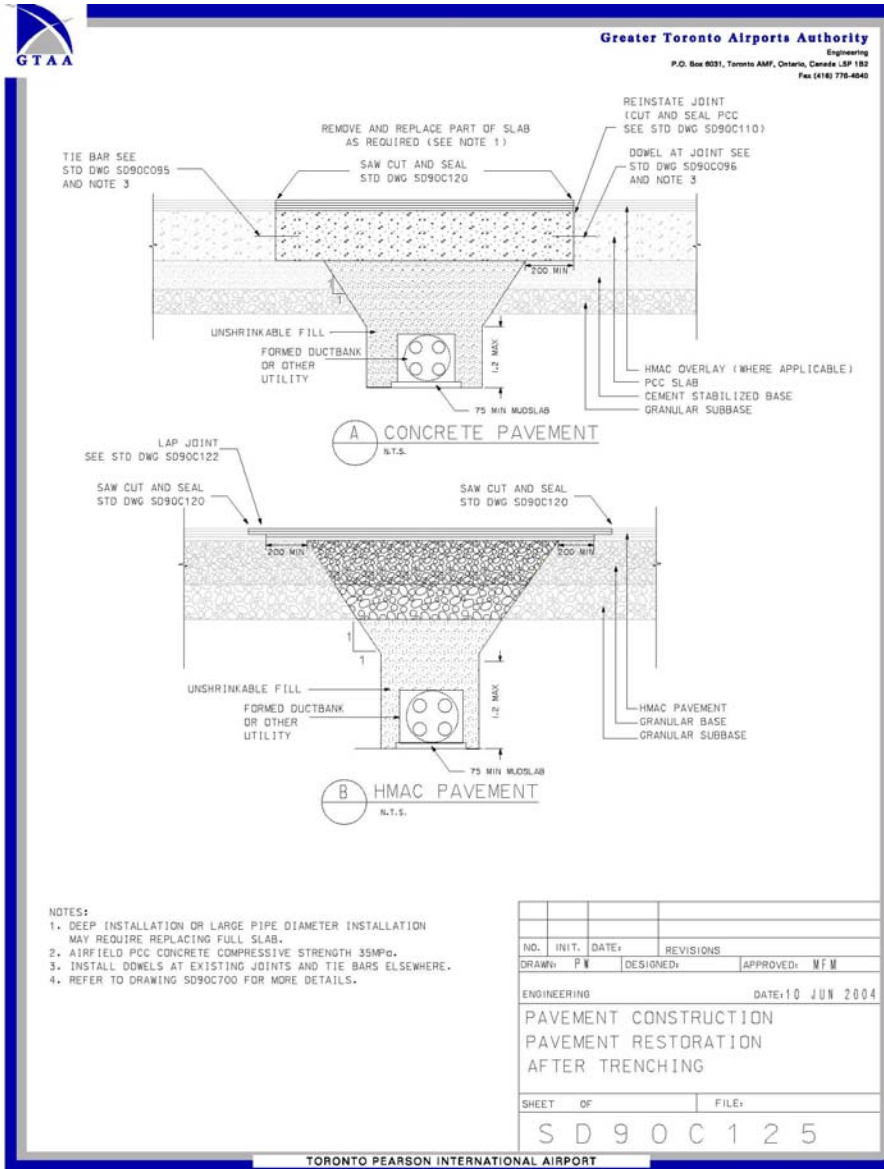
ASPHALT PATCH (C)

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ENGINEERING		DATE: 04/03/06	
PAVEMENT CONSTRUCTION ROUTING AND SEALING			
SHEET 1 OF 1		FILE:	
S D 9 0 C 1 2 4			

NOTES:
 1. ALL DIMENSIONS IN MILLIMETERS.
 2. OVERBAND IN AIRCRAFT NON-TRAFFIC AREAS.
 3. IF 'A' IS GREATER THAN 40mm REFER TO SD9DC118 FOR PARTIAL DEPTH REPAIR.
 4. IF 'B' IS GREATER THAN 170 USE DETAIL C.

TORONTO PEARSON INTERNATIONAL AIRPORT

PCC Pavement Repairs: Restoration After Trenching

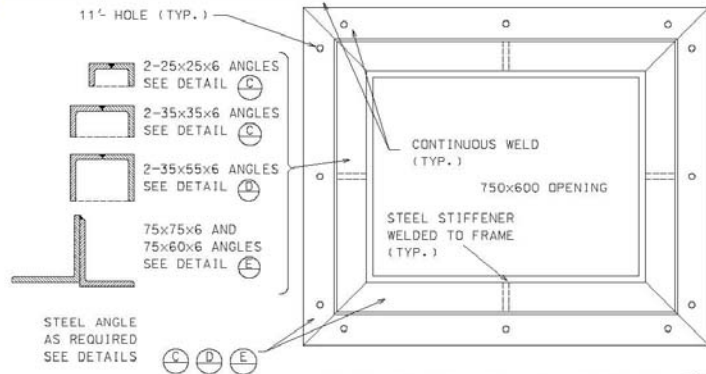


Catchbasin/Manhole Top Adjustment

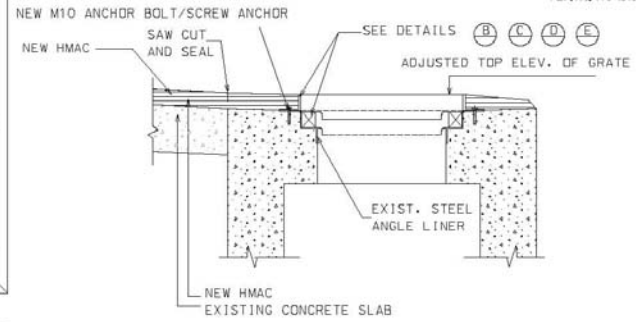


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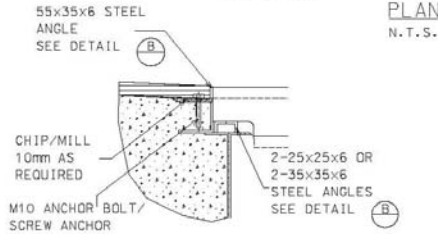
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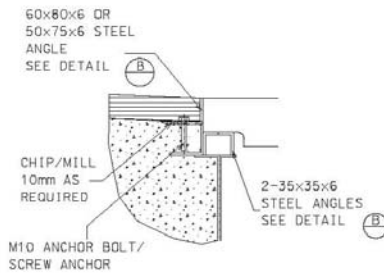
PLAN DETAIL OF ADJUSTMENT (B)
N.T.S.



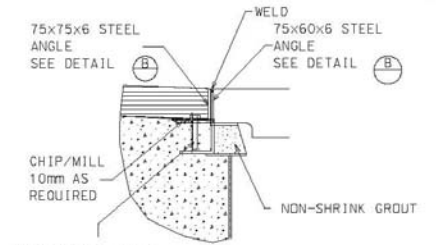
MANHOLE ADJUSTMENT (A)
N.T.S.



DETAIL - 25-35mm ADJUSTMENT (C)
N.T.S.



DETAIL - 40-60mm ADJUSTMENT (D)
N.T.S.



DETAIL - 65-75mm ADJUSTMENT (E)
N.T.S.

- NOTES:
- EXAMINE EXISTING CONDITIONS AND PREPARE SCHEDULE AND SHOP DRAWING FOR EACH MANHOLE TO BE ADJUSTED AND SUBMIT FOR ENGINEER'S REVIEW.
 - ALL STEEL ELEMENTS/FRAMES ARE TO BE HOT DIP GALVANIZED AFTER FABRICATION.
 - ANCHOR BOLTS/SCREW ANCHORS TO BE HOT DIP GALVANIZED. USE TAPCON OR NATIONAL CONCRETE ACCESSORIES PRODUCTS OR EQUAL OR BETTER.

NO.	INIT.	DATE:	REVISIONS
DRAWN: PW		DESIGNED: MFM	APPROVED: MFM
ENGINEERING			DATE: 08 AUG 97
CATCHBASIN/MANHOLE TOP ADJUSTMENT			
SHEET OF		FILE:	
S D 9 0 C 3 0 6			