SWIFT CONFERENCE 2006
PAVEMENT DEFECTS AND REPAIR

Mounir Moughabghab PEng AAE

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
  - SHOVING 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		

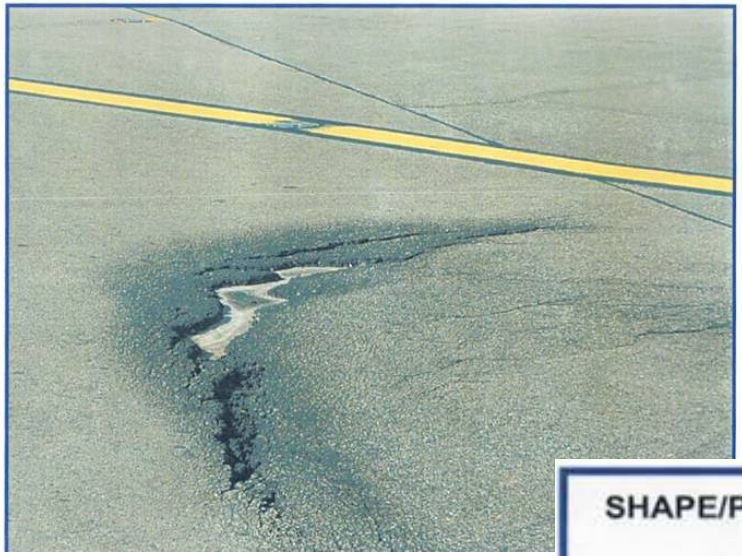
Pavement Quality Characteristics

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

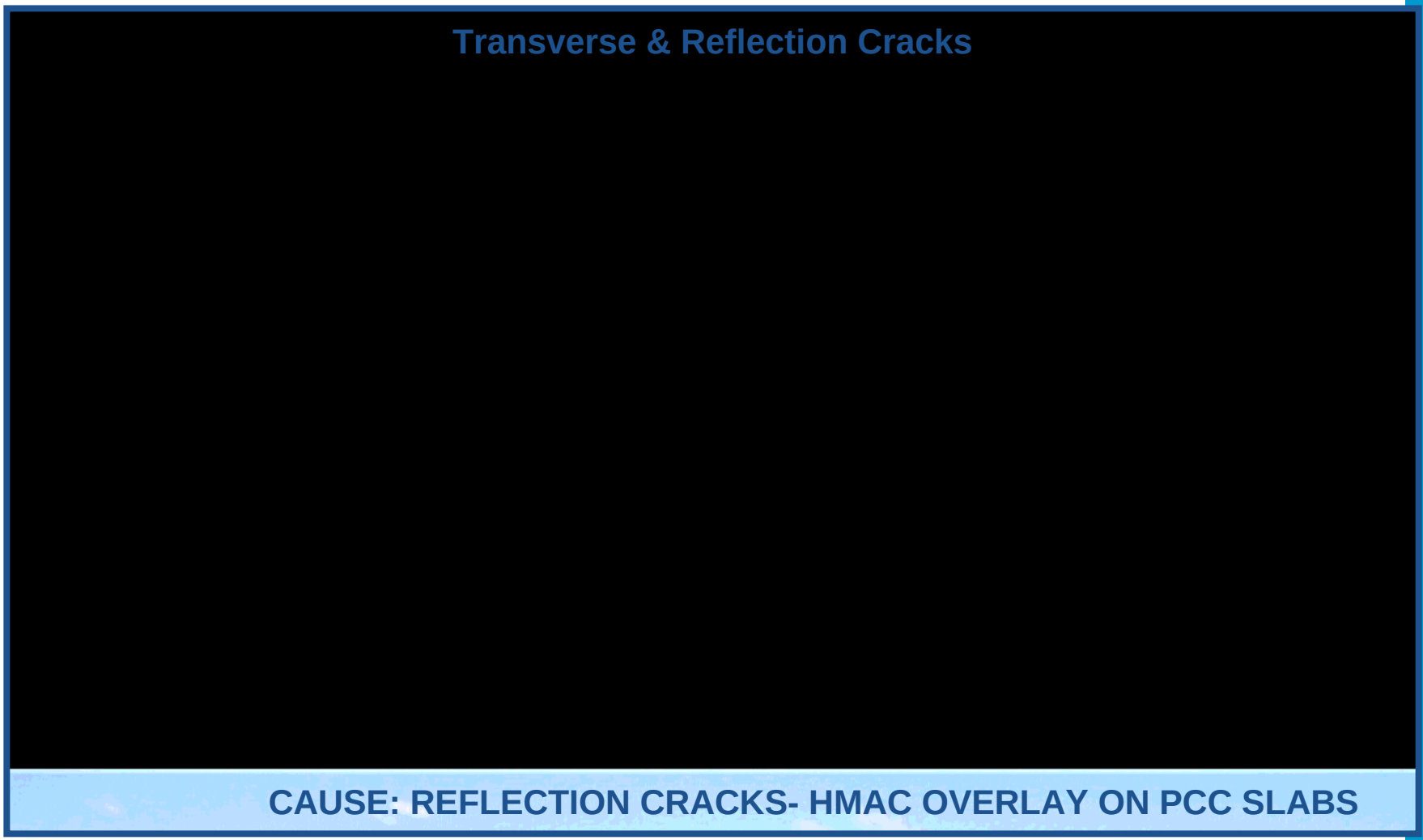
Asphalt Pavement Defects: Slippage at Inset Lights

Asphalt Pavement Defects: Slippage & Shoving over PCC

Asphalt Pavement Defects: Cracks at Longitudinal Joints

Asphalt Pavement Defects: Transverse Cracks over PCC

Transverse & Reflection Cracks



CAUSE: REFLECTION CRACKS- HMAC OVERLAY ON PCC SLABS

PCC Pavement Defects: Diagonal Cracks

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

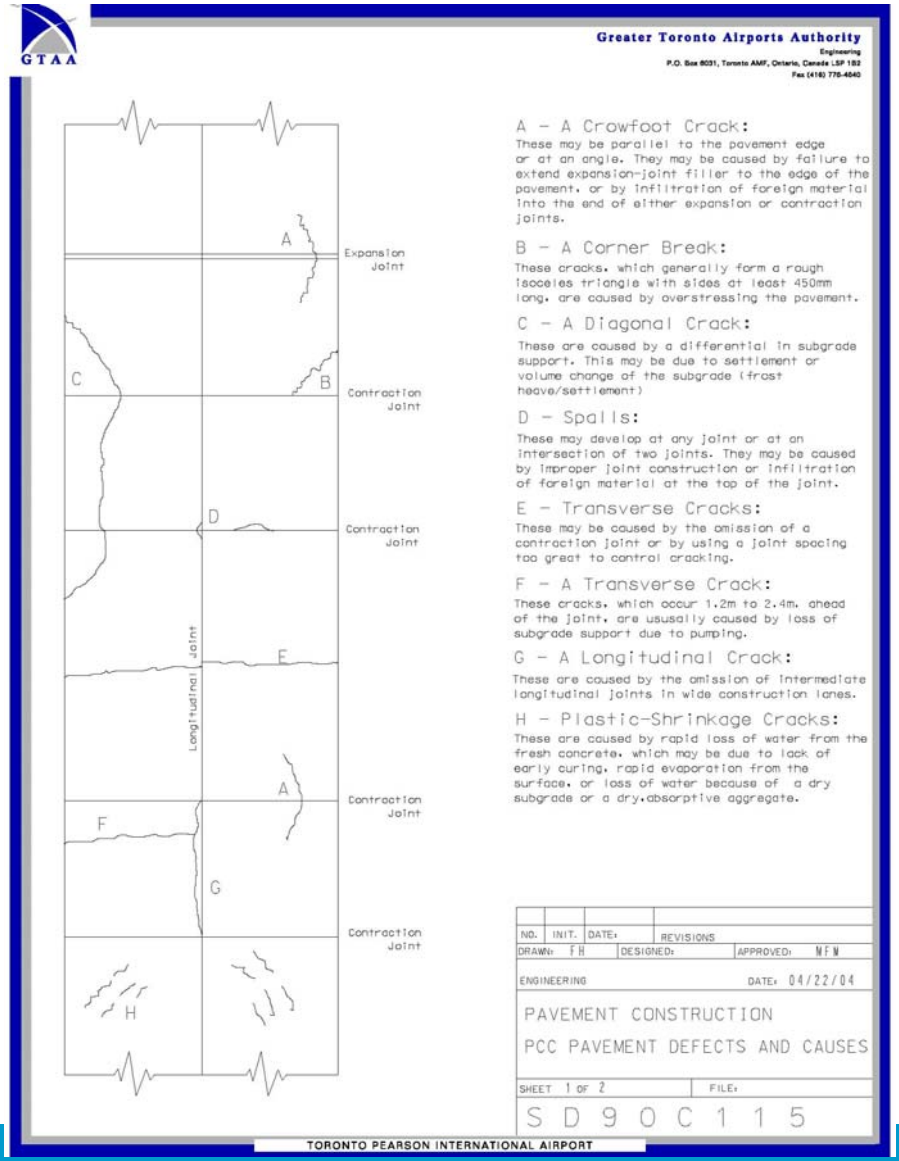
CAUSE: INPROPER JOINT SEALING, DEBRIS IN JOINT PREVENT MOVEMENT

PCC Pavement Defects: Joint Faulting/Stepping

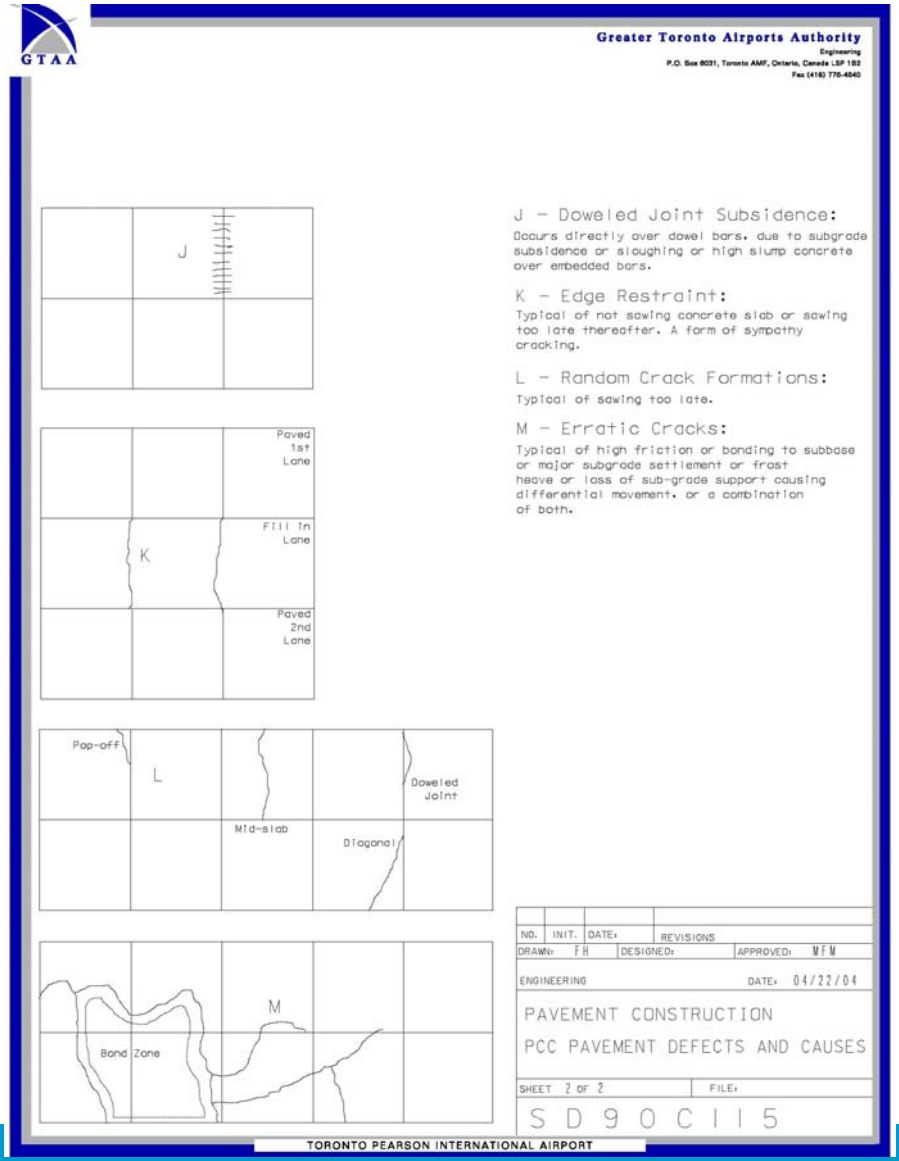
GATE 522 INFIELD TERMINAL: ERRATIC CRACKS

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

PCC Pavement Defects: Causes



PCC Pavement Defects: Causes



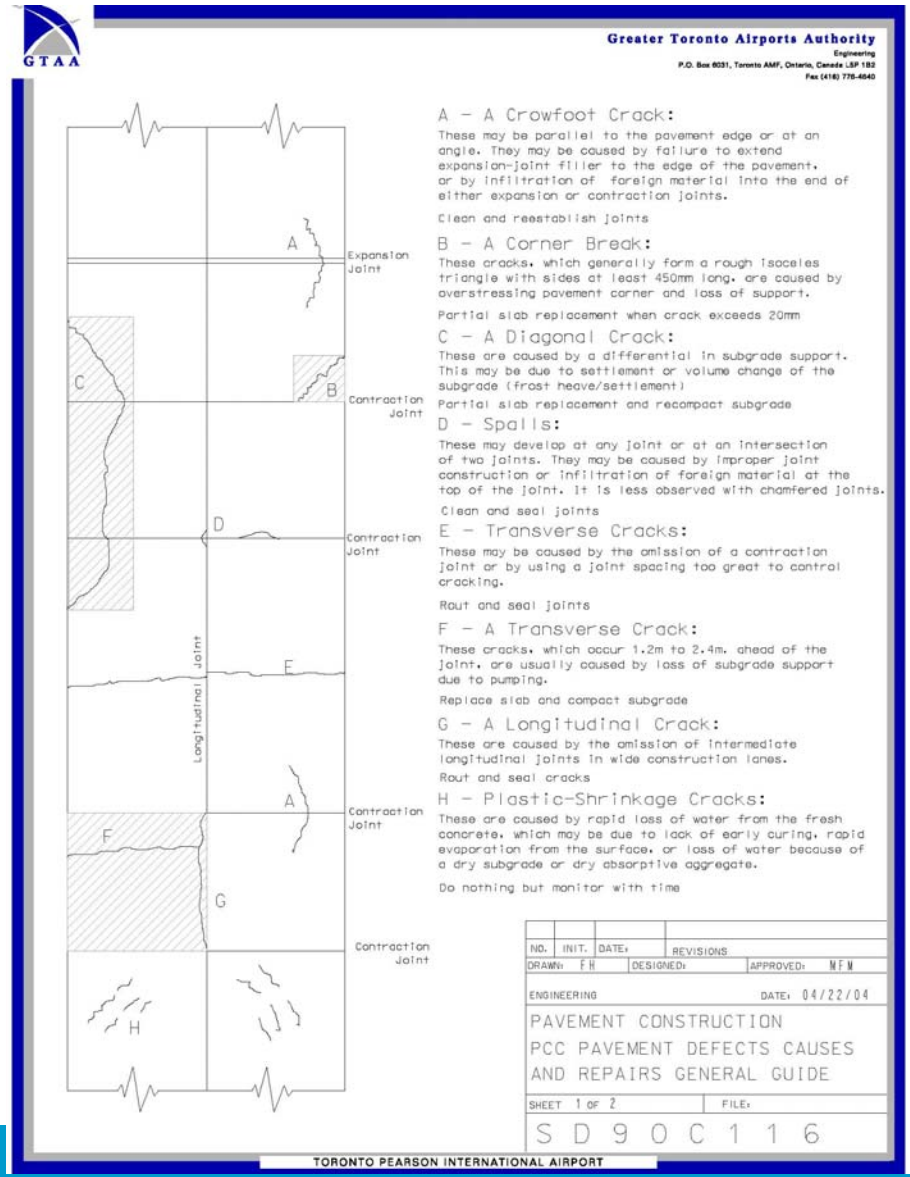
PCC Pavement Repairs: General Rules

< ¼ INCH (6.5 MM)	LEAVE ALONE
¼ – ½ INCH (6.6 – 13 MM)	ROUTE AND SEAL
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



GTAA

Greater Toronto Airports Authority

Engineering

P.O. Box 6031, Toronto AMF, Ontario, Canada L5P 1B2

Fax (416) 776-4540

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

NO.	INIT.	DATE:	REVISIONS
DRAWN: FH	DESIGNED:	APPROVED: MFM	

ENGINEERING DATE: 04/22/04

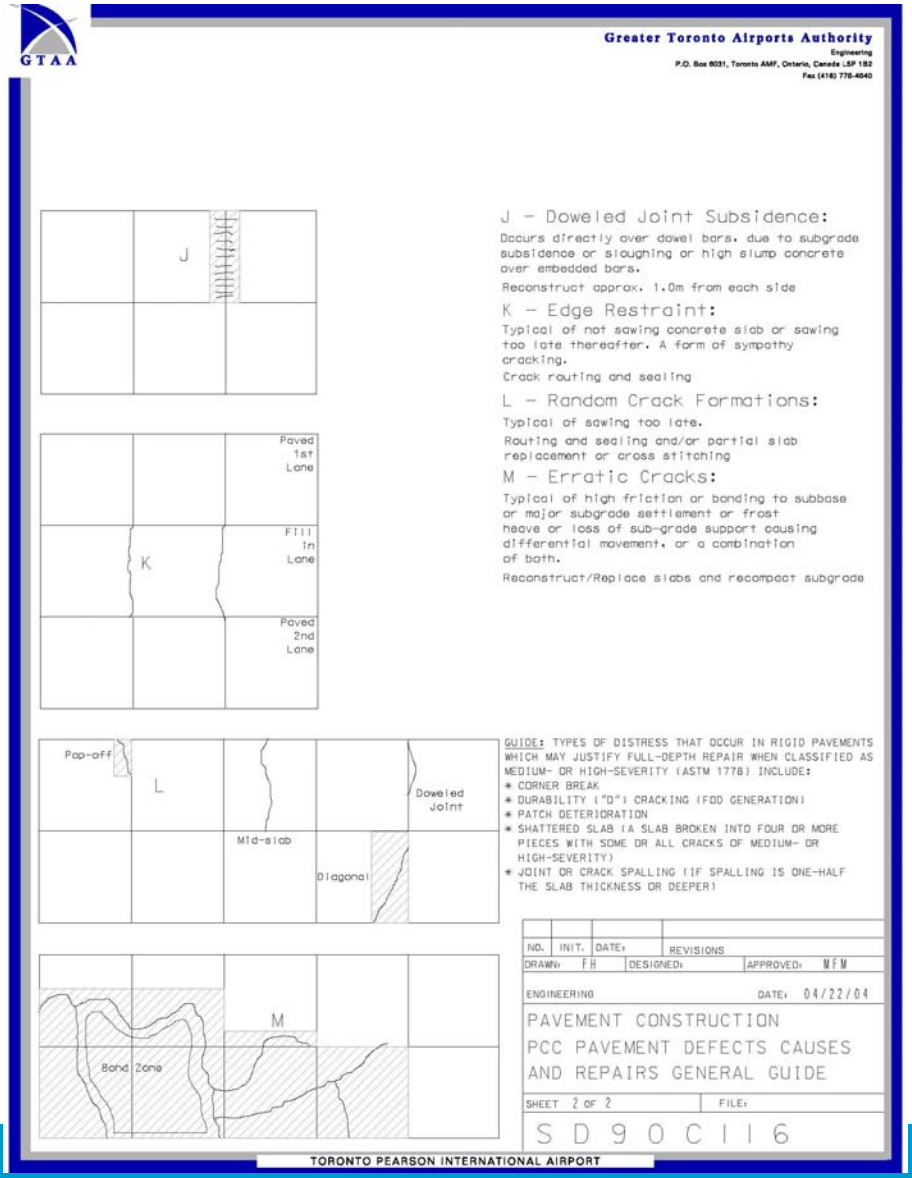
PAVEMENT CONSTRUCTION
PCC PAVEMENT DEFECTS CAUSES AND REPAIRS GENERAL GUIDE

SHEET 1 OF 2 FILE:

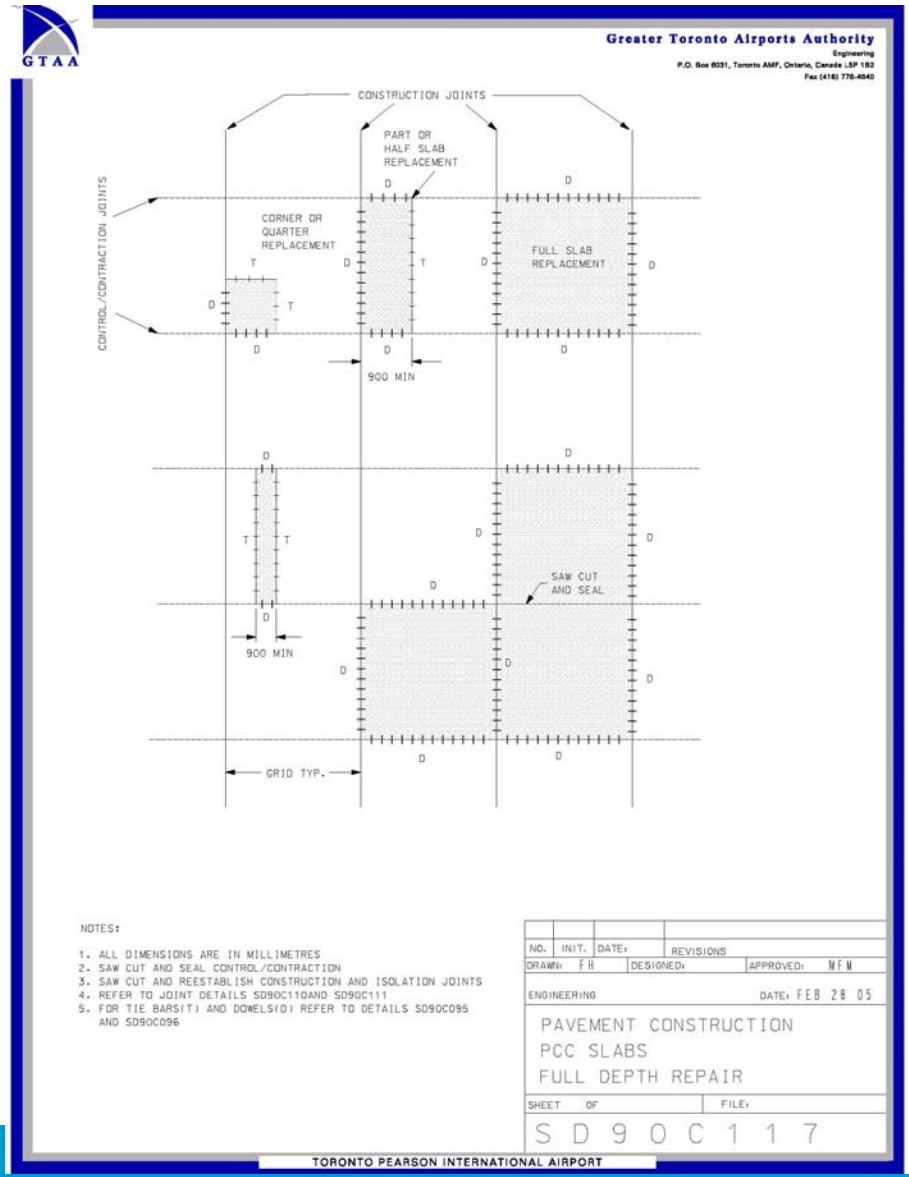
S D 9 0 C 1 1 6

TORONTO PEARSON INTERNATIONAL AIRPORT

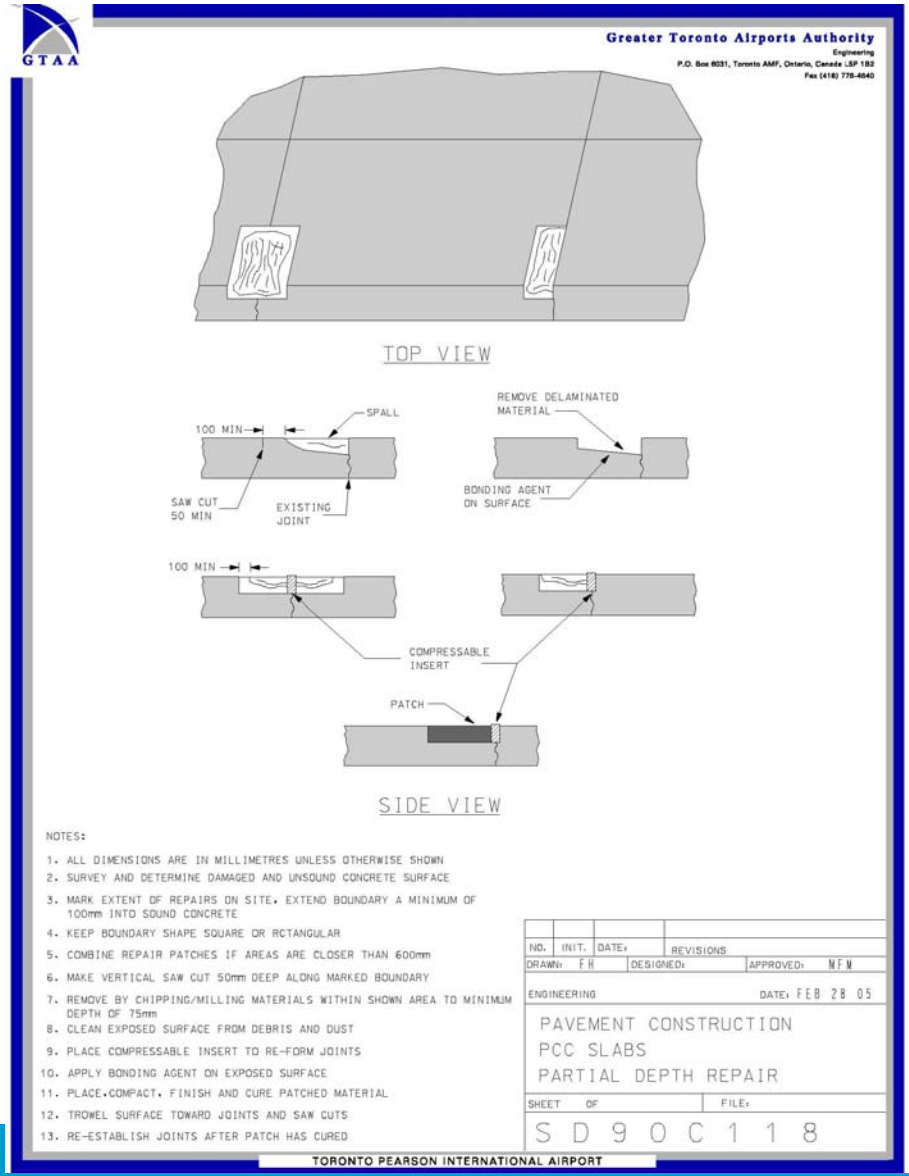
PCC Pavement Repairs: General Guide



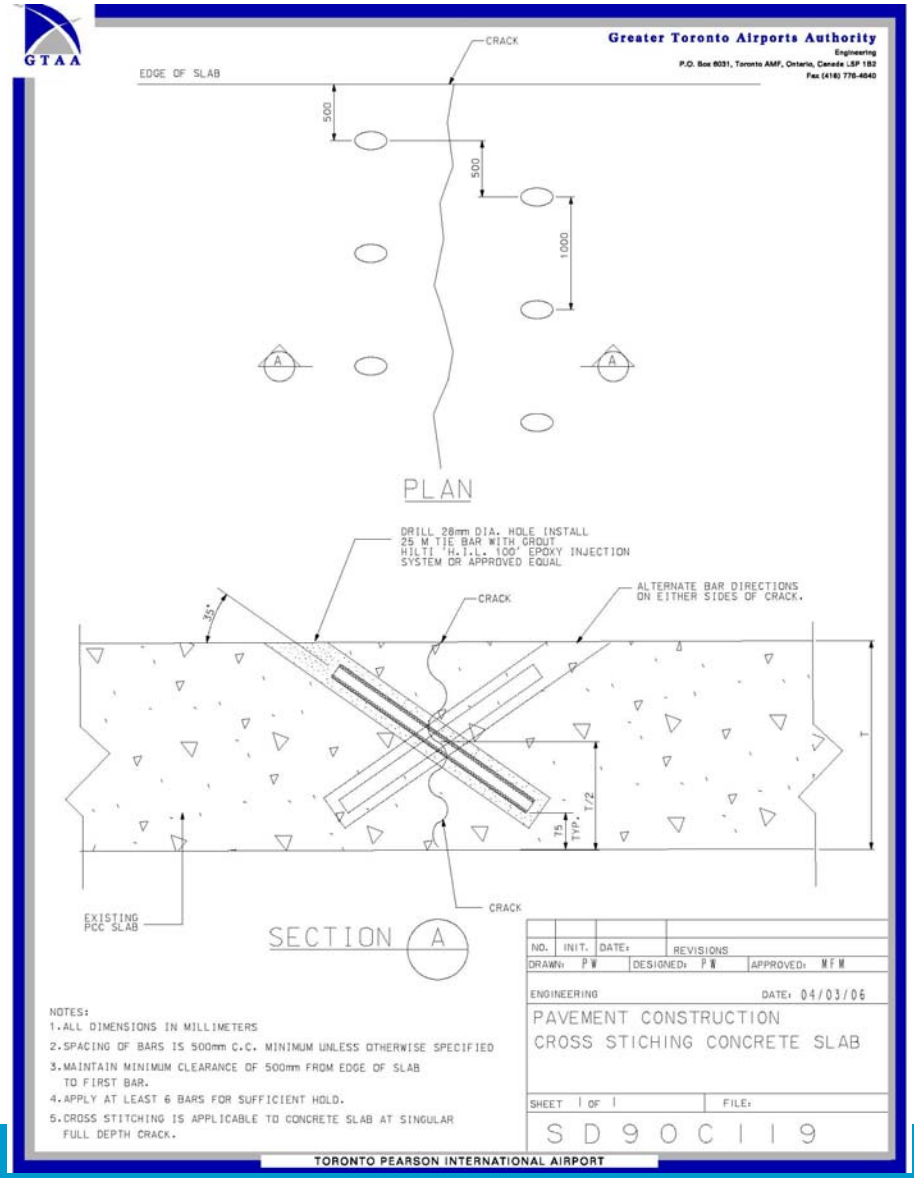
PCC Pavement Repairs: Full Depth Repair



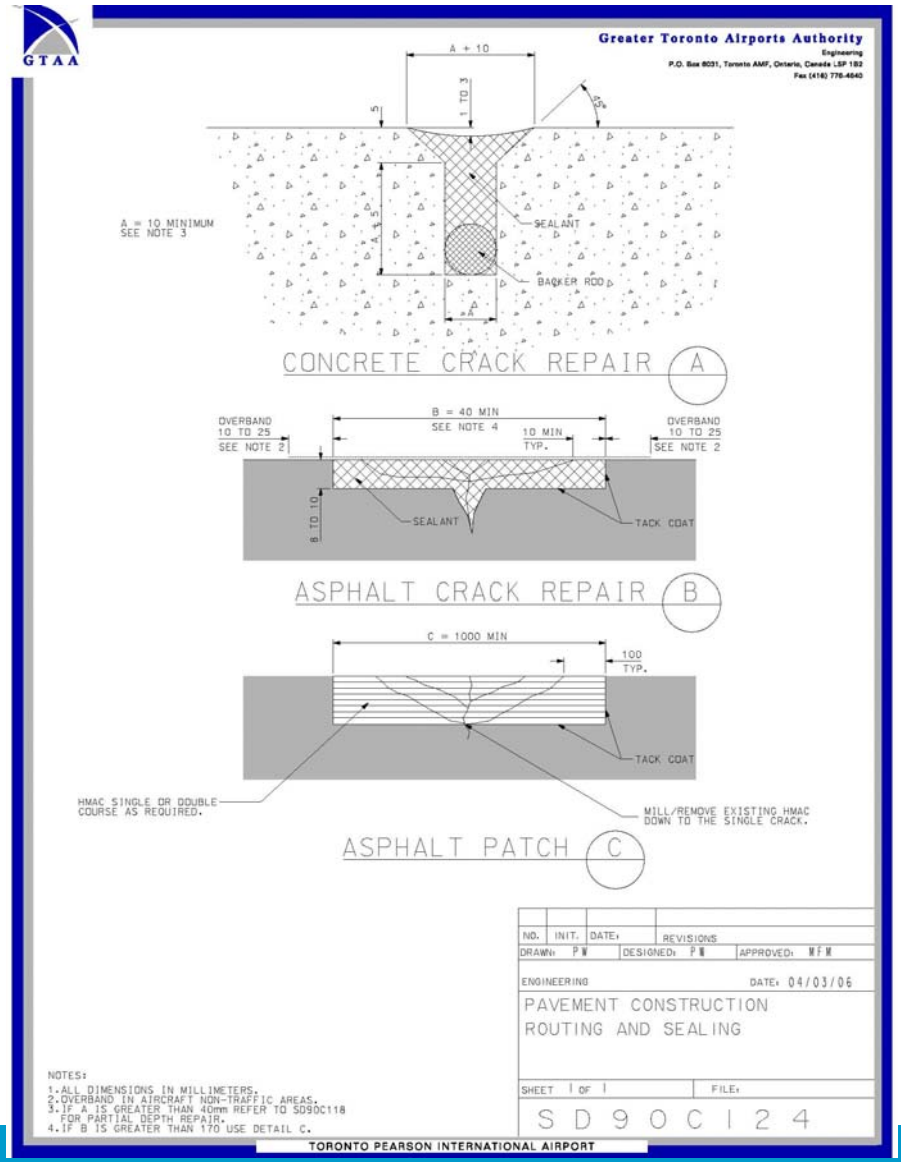
PCC Pavement Repairs: Partial Depth Repair



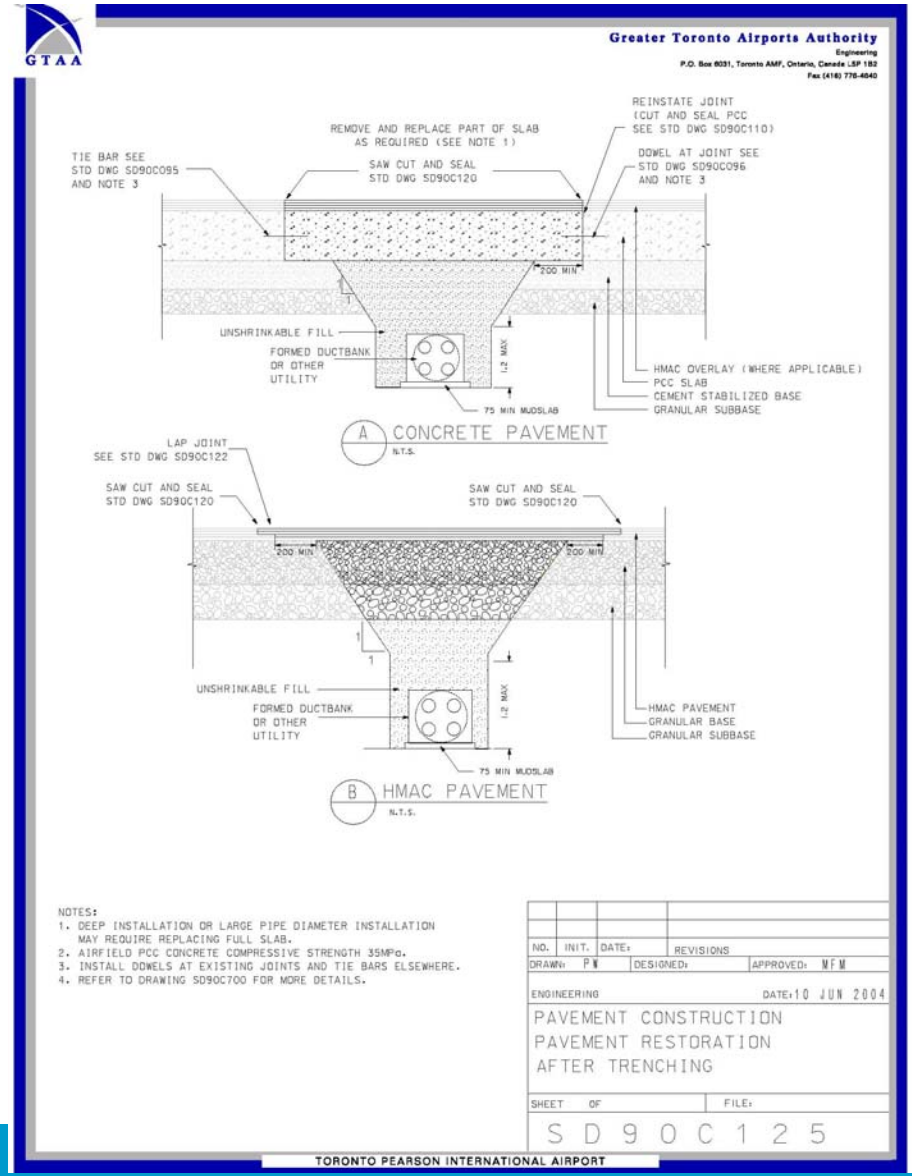
PCC Pavement Repairs: Cross Stitching



PCC Pavement Repairs: Routing and Sealing



PCC Pavement Repairs: Restoration After Trenching



Catchbasin/Manhole Top Adjustment