Technical Note No: 8

Sub: APRRP-CC Pavements – Early age Cracks in CC pavements - Repair and Rehabilitation- Reg.

Ref: 1) Inspection of works in 12 Districts by PMC Team.

2) IRC: SP:83-2018- Guidelines for Maintenance, Repair and Rehabilitation of Cement Concrete Pavements (First Revision).

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Background: During inspection of APRRP works by PMC Team it was observed that the CC roads are experiencing cracks in some of the panels of CC pavements executed by PIUs in the field. (Fig-1).

Fig1. Cracks observed in APRRP CC roads

1. Introduction:

The concrete pavement slab expands with the rise in temperature and contracts with fall in temperature. The changes in temperature and relative humidity causes concrete pavement to crack at regular intervals. To take care of the expected cracking contraction joints are provided to ensure that cracking in concrete slab doesn't take place randomly, at other locations.

2. Factors influencing the uncontrolled (random) Cracks:

i) Deficiencies like inappropriate selection of materials

ii) Lack of timely and adequate curing

iii) Delayed joint cutting

iv) Other constructional deficiencies etc.,

Cracks are not un common to concrete construction and therefore minor shallow cracks need not be viewed as a serious problem. Many cracks can be restored easily to a condition that will serve for the design life of the pavement. In some cases, no repair may be required, while in others some preventive repairs like resealing, retexturing will be sufficient.

3. Types and causes of defects:

3.1 Distress Types:

Distress in concrete pavements is either structural or functional. Structural distresses are primarily affecting the pavement's ability to carry traffic load. Functional distresses mainly affect the riding quality and safety of the traffic.

3.2 Common Defects and Distresses in Concrete Pavements

These could be due to poor quality of materials/workmanship/design defects and environmental causes.

3.2.1 Cracking

a) Plastic shrinkage cracks

b) Crow foot or "Y" shaped cracks

c) Edge cracks

d) Corner cracks breaks

e) Transverse cracks

f) Longitudinal cracks

g) Diagonal Cracks

h) Durability" D" cracking

i) Punchouts

3.2.2 Surface defects

a) Pop- outs/Small holes

b) Animal/Wheel impressions

c) Scaling

d) Raveling

e) Deep abrasion

f) Polished aggregates/glazing/smooth surface

3.2.3 Joint Defects

a) Spalling
b) Sealant failure and/or loss
c) Faulting at joints
d) Separation at joints

3.2.4 Other miscellaneous Defects

a) Blowups
b) Pumping
c) Patch Deterioration
d) Drop off

3.3 Causes of common Distresses

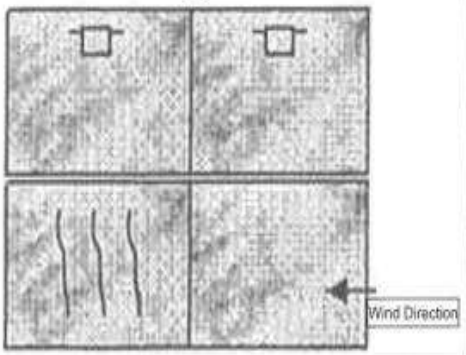
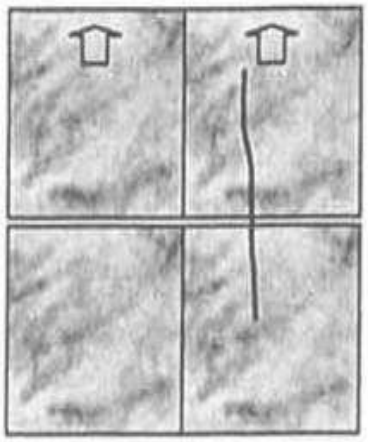
3.3.1 Plastic shrinkage cracking

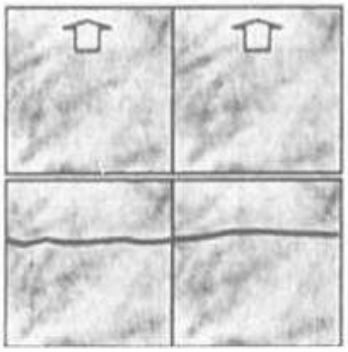
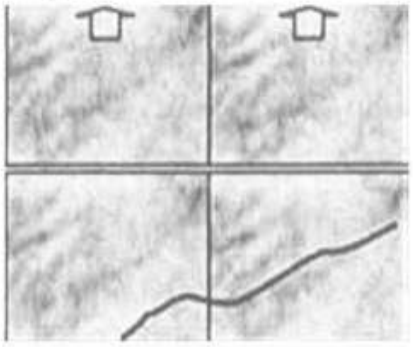
It is important not to confuse cracks arising due to restraint of the concrete at early age due to improper joint spacing and timing of joint cutting with plastic shrinkage cracks. Plastic shrinkage cracks are tight, about 0.3 m to 0.6 m long formed in parallel group's perpendicular to the direction of wind, at the time of paving. The cracks normally extend down to a depth of about 20mm-30mm. These cracks normally do not influence the overall performance of the pavement and can be repaired.

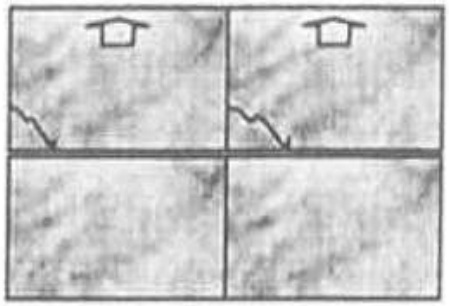
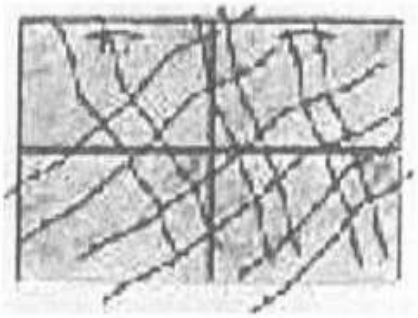
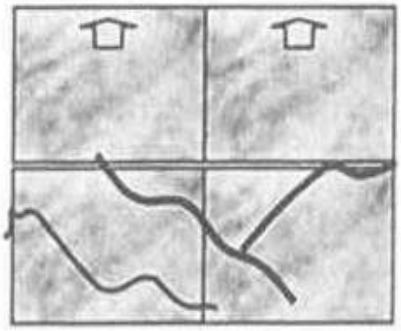
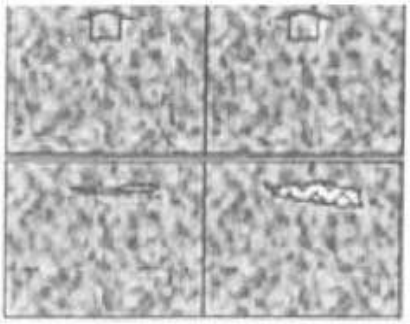
3.3.2 Drying shrinkage cracking

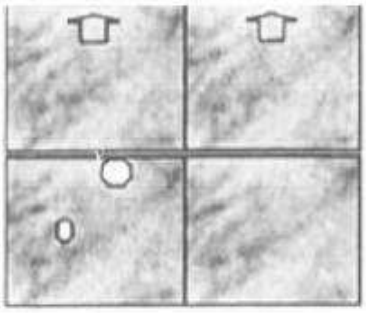
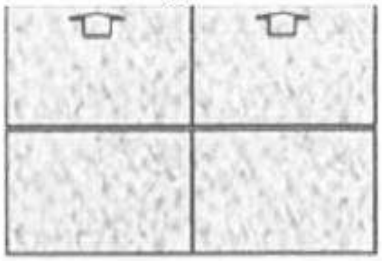
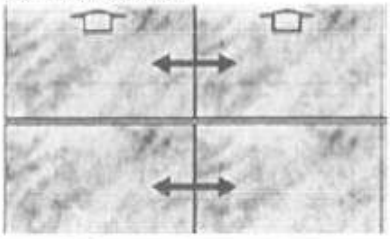
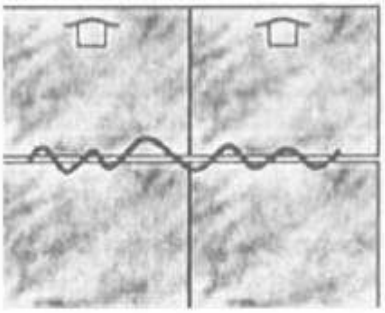
Wide/deeper cracking is usually attributable to the drying shrinkage and restraint developed in the concrete due to inadequate joint spacing, improper saw cutting. The broad causes for common type of defects are given in Table 3.1.

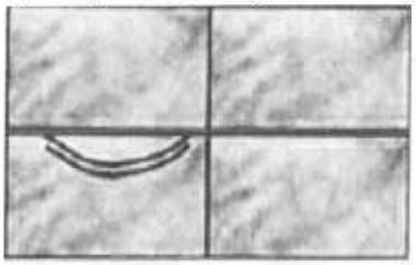
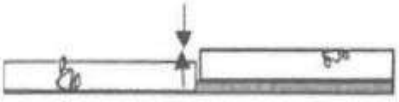
Table3.1 Type of Defects and Causes

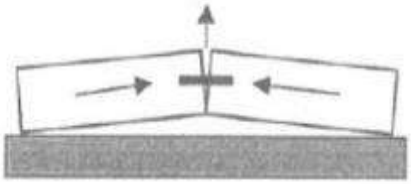
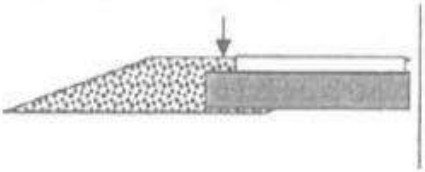
S. No.	Class and Type of Defects	Common Causes
1	Cracking	
	a) Plastic Shrinkage Cracks 	i. Drying shrinkage stresses in surface ii. Poor curing iii. Hot windy conditions iv. Excessive water at surface (bleeding)
	b) Longitudinal Cracks 	i. Excessive drying shrinkage stresses ii. Inadequate depth of joint or late joint sawing iii. Excessive joint spacing iv. Sudden/abrupt thermal and moisture gradient changes v. Downhill paving; cracks perpendicular to the direction of super elevation vi. Channelized or static heavy loading, viz. truck parking vii. Loss of sub-grade support, for instance poorly compacted sub grade viii. Settlement of embankment which leads to subsequent settlement of slabs ix. Different sub-base/sub-grade types having different modulus of elasticity and or moisture regime across the width of the cross-section x. "Vibrator trails" caused by malfunctioning or improper adjustment of vibrators on the paving machine

S. No.	Class and Type of Defects	Common Causes
	c) Transverse Cracks 	i. Tensile stresses developed in concrete are more than tensile strength of concrete ii. Excessive drying shrinkage stresses iii. Inadequate depth and/or late initial joint groove sawing iv. Excessive joint spacing or length I width ratio of slab More than 1.5 or length of unreinforced slab exceeds normal range 4.5-6.1 m. v. Misaligned, corroded, locked, burred on ends dowel bars vi. Crack at the end of the dowel bars; or locking of dowel bars, loose dowel bar sleeves, sleeves of poor quality. vii. Delays or interruption of concrete placing for more than 30 minutes viii. Excessive overloading ix. Sudden/abrupt thermal and moisture gradient stress changes x. Excessive sub base restraint xi. Settlement/poor sub-base support at localized area xii. Incorrect location of transverse joints at/over cross drainage structure/utility duct
	d) Diagonal Crack 	i. Excessive drying shrinkage stresses ii. Excessive thermal and moisture gradient stresses iii. Excessive joint spacing iv. Unstable sub-grade or loss of sub-base support (settlement of ulility trench, etc) v. Excessive over loading vi. Frost action

S. No.	Class and Type of Defects	Common Causes
	e) Corner Breaks 	i. The same as diagonal cracks ii. Poor load transfer iii. Dowel bar restraint iv. Curling, thin slabs are particularly susceptible to this cause
	f) Aligator (Map) Cracking 	i. Coarse aggregate expansion ii. Chemically reactive aggregate iii. Weak concrete iv. Improper curing
	g) Multiple Structural Cracks 	i. Lack of sub-grade support ii. Excessive over loading iii. Weak concrete iv. End of service life
2.	Surface Defects	
	a) Ravelling Scaling 	i. Segregation at surface ii. Crazing or fine alligator cracks iii. Frost iv. Unsound or dirty aggregates v. Weak concrete (too much water, too much fine aggregate) vi. Inappropriate curing vii. Excessive Abrasion

S. No.	Class and Type of Defects	Common Causes
	b) Popout (Small Hole), Pothole 	i. Loss of contaminated or non-durable concrete pockets at surface ii. Lack of homogeneity, uniformity and consistency of the mix iii. Loss of aggregate from concrete surface: thermal expansion, freeze-thaw iv. Inadequate compaction
	c) Loss of surface Texture, polished surface/Glazing/Smooth Surface 	i. Movement of construction traffic at an early age ii. Wear and tear under high volumes of traffic particularly under wet or uncleaned surface iii. Poor texturing during construction iv. Soft and mono-mineral aggregates v. Frequent braking and turning sections vi. Non-durable concrete
3	Joint Defects	
	a) Joint separation 	i. Insufficient or incorrect tie bar installation in longitudinal joints ii. Shoulder movement iii. Downhill slipping of slabs on a steep gradient/super elevation iv. Slippage of tie-bars at sharp curves v. High Embankment/black cotton soil
	b) Joint Seal Defects 	i. Hardening (oxidation) or softening by ultra violet radiations ii. Stripping of joint sealant iii. Extrusion of joint sealant: overfilled groove, lack of incompressible caulking strip in bottom of groove, incorrect groove dimensions iv. Adhesion failure/loss of bond between walls of groove and sealant due to: inadequate preparation of groove, inadequate priming, inappropriate sealing material, semi-set/inadequately cured "cold" concrete, moisture in groove; slurry generated due to widening of groove sticking to the walls of groove

S. No.	Class and Type of Defects	Common Causes
		v. Pressing of small stones and other incompressible matter into the sealant vi. Embrittlement of joint sealant or cohesion failure due to inappropriate sealing material, incorrect groove dimensions, lack of bond breaking strip beneath the seal vii. Inadequate or no tooling to remove air bubbles viii. Inadequate curing before opening to traffic ix. Lack or absence of sealant x. Weed growth in the joints
	c) Spalling at cracks or joints 	i. Ingress of stones and other incompressible material into joint ii. Dynamic traffic loads at slab ends, mechanical damage iii. Weak concrete, poorly compacted or non-durable, particularly at construction joints iv. Failure or defects of dowel load transfer system v. Joints intersection vi. Slab overstressing
	d) Faulting (or Stepping) in cracks or Joints 	i. Along transverse joints or cracks: buildup of material under the approach slab or slab piece; ingress of water internal erosion and pumping ii. Warping or curling following either moisture or temperature gradients iii. Along longitudinal joints: settlement of sub-grade or shoulder drop off caused by heavy traffic iv. Differential settlement/support due to inadequate foundation/or growth of tree roots v. Reduction in/or lack of load transfer due to separation of slabs

S. No.	Class and Type of Defects	Common Causes
4.	Deformation	
	a) Blow Up or buckling 	i. Accumulation of incompressible material in the joints ii. Excessive expansion resulting from combined adverse thermal and moisture conditions iii. Wrong spacing of joints
	b) Drop-off (Lane shoulder) 	i. Wear and tear from stray and parked vehicles ii. Poor quality of shoulder material i.e. not suited for the purpose iii. Settlement of shoulder iv. Erosion of unpaved shoulder due to surface run-off in rainy season

4. Distress Rating System

4.1 A 5-Level distress rating system is recommended in these guidelines and given in Table 4.1

Table 4.1 Five Level Distress Rating System

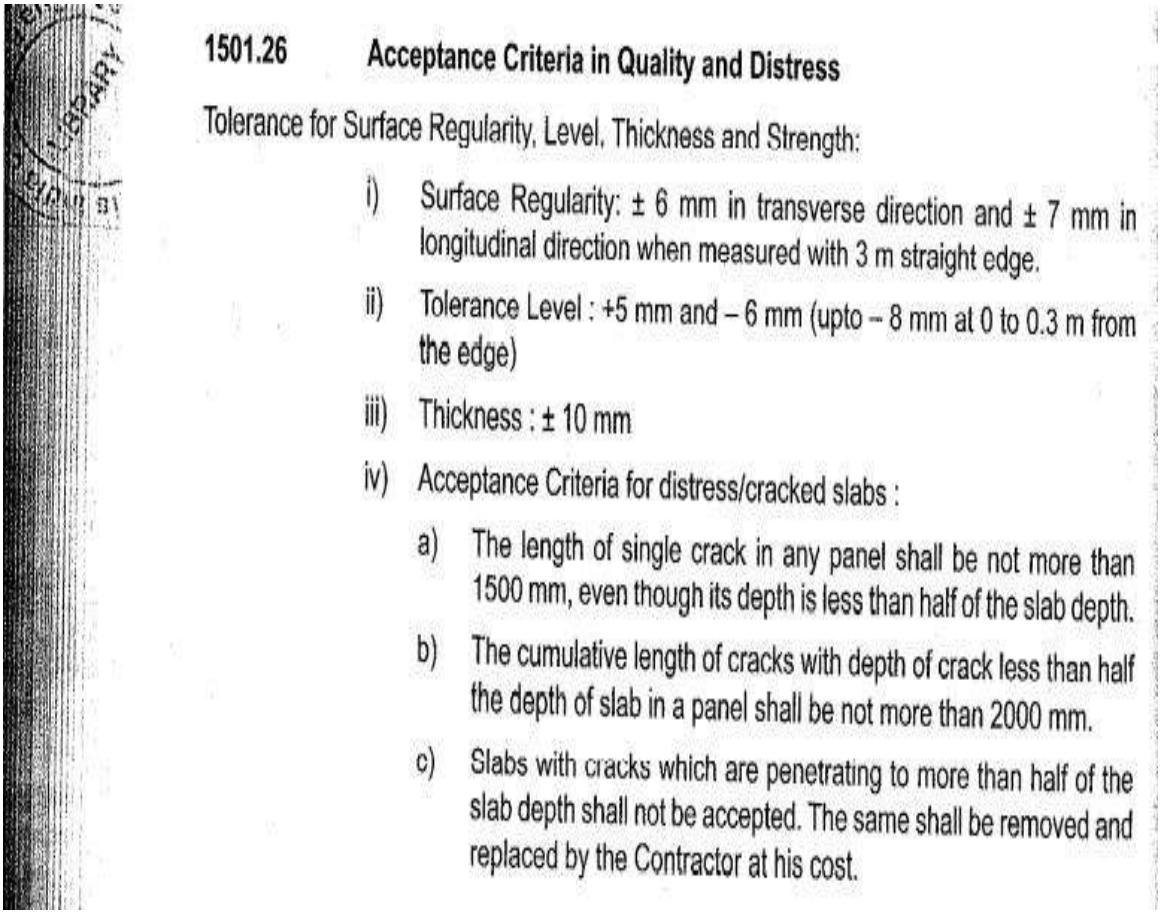
Distress Rating	Slab Condition	Severity(Defects) Rating
0	Excellent	Not Discernible
1	Very Good	Minor
2	Good/Average	Moderate
3	Fair	Major
4	Poor	Extreme
5	Very Poor	Unsafe/Unserviceable

5. Timing of Distress Repair

5.1 New Construction

The acceptance criteria for new construction shall be governed by IRC: SP:62 "Guidelines for design and construction of Cement Concrete pavements for Low Volume Roads". The acceptance criteria prescribed for cracked slabs is in line with the MoRD 2014 specification Clause 1501.26. In case where the contract clauses do not provide any specific acceptance criteria for new construction then for such cases it is recommended that acceptance criteria should be that all distresses of low severity (2 or less) vide Table 4.1 shall be accepted with minor repair as per the Discretion of the Engineer-in- Charge. In case severity of 4 and 5, it should not be accepted. For severity 3 the client may apply its discretion depending upon the nature/type of distress and considering that certain types of repairs like partial depth repairs etc. are likely to last 6-8 years only.

Extract of MoRD 2014: Clause 1501.26



1501.26 Acceptance Criteria in Quality and Distress

Tolerance for Surface Regularity, Level, Thickness and Strength:

i) Surface Regularity: ± 6 mm in transverse direction and ± 7 mm in longitudinal direction when measured with 3 m straight edge.

ii) Tolerance Level : +5 mm and – 6 mm (upto – 8 mm at 0 to 0.3 m from the edge)

iii) Thickness : ± 10 mm

iv) Acceptance Criteria for distress/cracked slabs :

a) The length of single crack in any panel shall be not more than 1500 mm, even though its depth is less than half of the slab depth.

b) The cumulative length of cracks with depth of crack less than half the depth of slab in a panel shall be not more than 2000 mm.

c) Slabs with cracks which are penetrating to more than half of the slab depth shall not be accepted. The same shall be removed and replaced by the Contractor at his cost.

6. Distress to be Repaired

Single, shallow fine/hair cracks do not require repair. Fine plastic shrinkage cracks are believed to be self-healing. Fine interconnecting cracks (crazing) should be considered as surface distress and repaired with low viscosity epoxy resigns as shown in figs 6.1 and 6.2 before propagating further and developing ravelling.

Fig.6.1 Plastic Shrinkage cracks repaired With low viscosity Epoxy.

Fig.6.2 Close up view of Epoxy Sealing

7. Repair material & Repair Techniques:

The Table 7.1 gives a guide to the selection of suitable patching material according to the size and depth of patch contemplated. Photographs illustrating the typical repair techniques is also enclosed as Appendix A for guidance. Repair actions for different degrees of severity of Distress in Concrete Pavements shall be based on the procedures mentioned in Table 4.5.

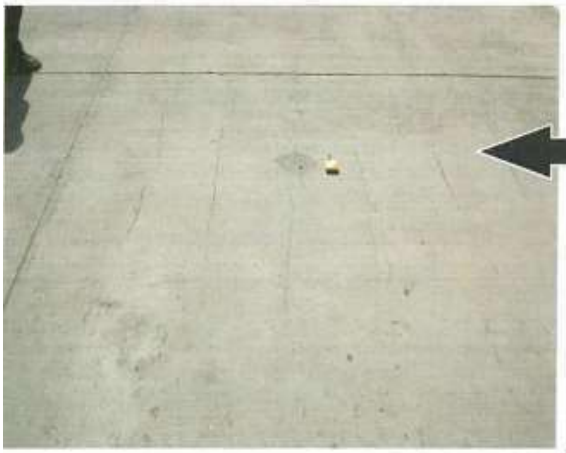
Table 7.1 Guidelines for selection of Type of product for repair of Common Defects in Concrete Pavement.

Sl. No	Type of Defect	Extent of Damage		Type of Product Recommended for Trial
		Maximum Surface Area	Minimum Depth	
1	a) Full Depth Repair b) Partial Depth repair	All All	Full Depth >100 mm	Conventional Cement Concrete modified with additives or polymers
2	Small Popouts	< 0.12m^2	30 mm	Epoxy Mortar (1:3)
3	Spalled Joints, Scaling	< 0.12m^2, Longest Dimension not Exceeding 600 mm	65 mm	Epoxy Mortar (1:3)
			75 mm	Epoxy Concrete (1:8)
4	Large Spalled Areas, Scaling	> 0.12 m^2, or Longest Dimension Exceeding 600 mm	30 mm	Elastomeric Concrete
		> 0.5 m^2	100 mm	Polymer Modified Cementitious Concrete
5	Corner Breaks	< 0.12 m^2	30 mm	Epoxy Mortar
		> 0.12 m^2	65 mm	Elastomeric Concrete/Epoxy Mortar

Appendix **A**

PHOTOGRAPHS ILLUSTRATING COMMON TYPES OF DEFECTS AND SUGGESTED TYPICAL REPAIR TECHNIQUES AS PER THE DISTRESS SEVERITY

	**FULL DEPTH REPAIR** (Width of Repair 1.5 m minimum) Note: example illustrated caused by Blowup Severity Rating 5
Photo 1 Blowup and Transverse Cracking	Recommended Treatment As Above
	**One Corner Break** **EPOXY CONCRETE REPAIR (LOCAL)** **Two Corner Breaks** **FULL DEPTH REPAIR (1.5 m minimum)** Note: Severity Rating 4 is illustrated in example
Photo 2 Deep Corner Break	Recommended Treatment as Above
	**SEAL WITH LOW VISCOSITY EPOXY** See Para & **Fig. 5.1** Note: Severity Rating 2 is illustrated in example
Photo 3 Shallow Corner Break	Recommended Treatment as Above

 **Severity Rating < 3** **CROSS-STICHING See Fig. 5.1 (Para)**	**Severity Rating 3 or more** **WHOLE SLAB REPLACEMENT** Note: The condition of the slabs illustrated here treated with Cross-Stitching deteriorated further under traffic after monitoring for 6 months. All cracked slabs were finally replaced in total (whole full depth) during the DLP.
Photo 4 Longitudinal Crack	Recommended Treatment As Above.
	**WHOLE SLAB REPLACEMENT** Note: Severity Rating 3 is illustrated in example.
Photo 5 Multiple Connecting Cracks	Recommended Treatment As Above
	**WIND DIRECTION** **SEAL WITH LOW VISCOSITY EPOXY** Note: Severity Rating 2 is illustrated in example
Photo 6 Discrete Plastic Shrinkage Cracks	Recommended Treatment As Above

	**FULL DEPTH REPAIR** **(Width = 1.5m, Minimum)** See Fig. 5.1 (Para) Note: Severity Rating 4 is illustrated in example
Photo 7a Transverse Crack Near Joint	Recommended Treatment As Above
	**A) WHOLE SLAB REPLACEMENT** For New Construction (DLP) or **B) CHIP AND SEAL** **MONITOR AS WORKING CRACK** SHORT TERM MEASURE For Old Concrete Panels Note: Severity Rating 4 is illustrated in example
Photo 7 b Transverse Crack Near Middle (1/3rd)	Recommended Treatment As Above
	**ROUTE GROOVE AND APPLY** **FLEXIBLE SEALANT** **MONITOR PEFORMANCE** Note: Example illustrated is treatment on 50 year old concrete slabs constructed (Oct/1952) in medium trafficked urban environment.
Photo 8 Working Crack	Recommended Short Term Measure

	**SCARIFY AND FILL UP WITH A WEAR RESISTANT TRAFFICABLE GRAVEL** (CBR > 30, PI in range 3 – 12) When Dropoff in any 100m stretch > 40 mm For NH/SH > 70 mm For Other Roads See Table 4.4
Photo 9 Drop Off	Recommended Treatment
	**Severity rating < 2** **DO NOTHING** **Severity Rating > 3** **LOCAL EPOXY MORTAR REPAIR** To DEPTH 65 mm with 20 mm Drill Holes for "Key" Note: Example illustrated has Severity Rating 3
Photo 10 Impressions Early Traffic Damage	Recommended Treatment
	Cracking and/or faulting caused by restrained thermal movements around or settlement below a manhole or inlet. **FULL DEPTH REPAIR IN REGULAR SHAPE** **WITH REINFORCEMENT**
Photo 11 Manhole/Inlet Cracking Failure	Recommended Treatment

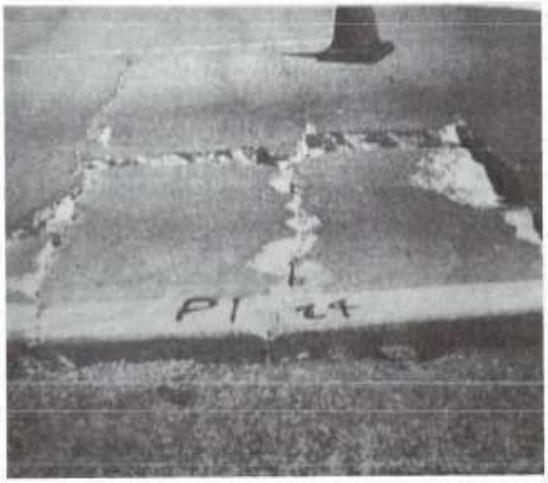
	**EPOXY MORTAR REPAIR** See Fig. 5.1 Note: Severity Rating 3 is illustrated in example
Photo 12 Pop Out	Recommended Treatment As Above
	**SHAPE MERGEFORMAT** Water trapped under edge of CRCP at Matching point with Paved Shoulder causing cracking and punching out under heavy traffic loading **IMPROVE DRAINAGE BELOW BASE AND RECONSTRUCT FULL DEPTH PATCH**
Photo 13 Punchout (CRCP only)	Recommended Treatment As Above
	**Severity Rating < 4** **DO NOTHING** **Severity Rating 5 or more** **WHOLE SLAB REPLACEMENT** For New Construction (DLP) **MILL & PLACE BONDED OVERLAY** Trial For Old Construction Note: Severity Rating 5 is illustrated in example
Photo 14 Ravelling **(lose of laitance/fine aggregates in surface)**	Recommended Treatment

Photo 15 Scaling

Recommended Treatment

Severity Rating < 2
PARTIAL DEPTH REPAIR

Severity Rating 3 or more
WHOLE SLAB REPLACEMENT

Note: Severity Rating 3 is illustrated in example

Photo 16 Joint Sealant Failure

Recommended Treatment

Cause of adhesion failure : loss of sealant bond/ adhesion to sides caused by separation of slabs.

Severity rating < 2
DO NOTHING

Severity Rating > 3
RESEAL WHERE FAILURE/DAMAGE EXCEEDS 25% OF JOINT LENGTH

Note: Example illustrated is Severity Rating 4 at a Longitudinal Joint

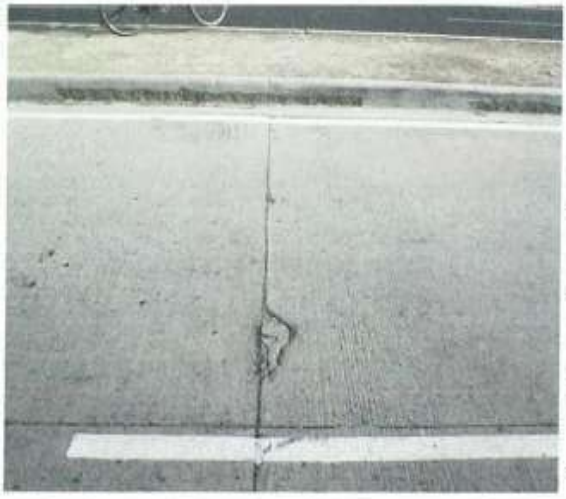


Photo 17 Shallow Spalling at Joint

Recommended Treatment

PARTIAL DEPTH REPAIR

Note: Severity Rating 4 is illustrated in example (> 60 x 10 cm)

Maximum Surface Area	Minimum Depth	Patch Material
< 0.5 m^2	30 mm	Elastomeric Concrete
> 0.5 m^2	100 mm	Epoxy Concrete

	Cause: Misalignment of dowel bars, Inadequate compaction and/or Compression Failure **FULL DEPTH REPAIR (1.5 m) EACH SIDE OF JOINT**
Photo 18 Deep Spalling at Joints	Recommended Treatment
	Cause : Inadequate compaction and Finishing 2nd Days concrete versus 1st Days concrete. Deficiencies vide: • Levelling • Finishing • Compaction **FULL DEPTH REPAIR (1.5 m minimum) ONE SIDE ONLY**
Photo 19 Cracking and Scaling at Construction Joint	Recommended Treatment
	**PARTIAL DEPTH REPAIR (MINIMUM WIDTH 100 mm x 65 mm DEEP)**
Photo 20 Expansion Joint Damage	Recommended Treatment

	**Severity Rating 5** **WHOLE SLAB REPLACEMENT**
Photo 21 Shattered Slabs	Recommended Treatment
	**WHOLE SLAB REPLACEMENT** **With Reinforcement added in Top** **(as precaution against reflective cracking)** **DLC only requires replacement if in a shattered state.**
Photo 22 Cracking of DLC Below PQC	Recommended Treatment
	Cause: Adhesion Failure and/or Vandalism **SEAL TO SECURE ENDS** **WITH COMBATABLE LIQUID SEALANT.**
Photo 23 Compressive Seal - Loosening	Recommended Treatment

	The unsound area will be marked with colored marker after sounding with hand held hammer. It will Saw Cut with light weight Concrete Saw cutter. The chisel will also be used to cut & take out the debris. The pit will be air cleaned and filled with epoxy concrete/PCC depending upon depth of spall.
Photo 24 Spalling along the Joint	Recommended Treatment
	Full Depth repair after removing unsound and cracked concrete.
Photo 25 Shallow Corner Break	Recommended Treatment
	Fill the Pit with Epoxy Concrete/Quick Setting Cementitious Material depending upon the depth of the cut
Photo 26 Pit Cut out for Partial Depth Repair	Recommended Treatment

	Deepen & Widen the Pit and repair with quick setting Cementitious Material
Photo 27 Partial Depth Repair Failure	Recommended Treatment

8. Conclusion:

Many types of cracks such as uncontrolled transverse partial depth cracks, plastic shrinkage cracks, etc., have been observed on the APRR Project roads that have been completed recently. All such cracks can be prevented or minimized by making aware the site staff about the precautions to be taken during concrete paving. Due care during construction can reduce the troubles which otherwise would be very difficult and costly to remove after the concrete has set.

These types of repairs are carried out within the panel. If the crack wider than 1.5 mm is experienced within 1-1.5 m at the transverse or longitudinal joint it is always necessary to carry out full depth repairs.

The sealing of all kind of cracks in PQC must be done instantly with approved material to avoid/arrest the further development; however final repair and rectification may be taken up subsequently.

Encl: Table 4.5

31/3/21

Design Engineer
PMC-APRRP
Vijayawada.

~~Encl: Table 4.5~~

Table 4.5

Table 4.5 Repair Actions for Different Degrees of Severity of Distress* in Concrete Pavements

*According to the 5 level severity rating system : 0 - Not Discernible, 1 - Minor, 2 - Moderate, 3 - Major, 4 - Extreme and 5 - Unsafe/Unserviceable

S.No.	Type of Distress	Degree of Severity	Assessment Rating	Repair Action	
				For the case d < D/2	For the case d > D/2
1	CRACKING Single Discrete Cracks Not intersecting with any joint	0	Nil, not discernible	No Action	
		1	w < 0.2 mm, hair cracks		
		2	w = 0.2 - 0.5 mm, discernible from slow-moving car	Seal without delay	Full Depth Repair Dismantle and reconstruct affected portion - See Para 5.4
		3	w = 0.5 - 1.5 mm, discernible from fast-moving car		
		4	w = 1.5 - 3.0 mm	Seal, and stitch if L > 1m	
		5	w > 3 mm		
2	Single Transverse (or Diag	0	Nil, not discernible	No Action	
	intersecting with one or more joints	1	w < 0.2 mm, hair cracks	Route and Seal	Seal and Cross-stitch or staple
		2	w = 0.2 - 0.5 mm, discernible from slow vehicle		
		3	w = 0.5 - 3.0 mm, discernible from fast vehicle	Seal, and stitch if L > 1m	Full Depth Repair Dismantle and reconstruct affected portion - See Fig 5.5 and Refer Chapter 9
		4	w = 3.0 - 6.0 mm	Not applicable	Staple or Dowel Bar Retrofit
		5	w > 6 mm, usually associated with spalling, and/or slab rocking under traffic	Not applicable (Full Depth Crack)	Staple or Dowel Bar Retrofit
3	Single Longitudinal Crack intersecting with one or more joints	0	Nil, not discernible	No Action	
		1	w < 0.5 mm, discernable from slow moving vehicle	Seal, and stitch if L > 1m	Seal and Cross-stitch or staple
		2	w = 0.5 - 3.0 mm, discernible from fast vehicle		
		3	w = 3.0 - 6.0 mm	Seal and Staple	Partial Depth Repair with or without dowel bar retrofit, or
		4	w = 6.0 - 12.0 mm	Not applicable	
		5	w > 12 mm, usually associated with spalling, and/or slab rocking under traffic	Not applicable (Rocking/Spalling indicates Full Depth Crack)	Full Depth Repair Dismantle and reconstruct affected portion - See Fig 5.6 and Chapter 9
4	Multiple Cracks intersecting with one or more joints or cracks	0	Nil, not discernible	No Action	
		1	w < 0.2 mm, hair cracks	Seal, and stitch if L > 1m	
		2	w = 0.2 - 0.5 mm, discernible from slow vehicle		Dismantle and reconstruct whole slab
		3	w = 0.5 - 3.0 mm, discernible from fast vehicle	Full depth repair	
		4	w = 3.0 - 6.0 mm panel broken into 2 or 3 pieces		
		5	w > 6 mm and/or panel broken into more than 4 pieces		Reinstate subbase, Reconstruct whole slab
				For the case d < D/2	For the case d > D/2
5	Corner Break	0	Nil, not discernible	No Action	
		1	w < 0.5 mm, only 1 corner broken	Seal with low viscosity epoxy to secure broken parts	
		2	w < 1.5 mm, L < 0.6 m, only one corner broken		
		3	w < 1.5 mm, L < 0.6 m, two corners broken	Partial Depth Repair - See Fig. 8.3	Full depth repair
		4	w > 1.5 mm, L > 0.6 m or three corners broken		
		5	three or four corners broken		Reinstate subbase,
6	Punchout	0	Nil, not discernible	No action	
	(Applicable to CRCP only	1	w < 0.5 mm, L < 3 m / m^2	Not applicable (Punchout is Full Depth Distress)	Seal with low viscosity epoxy to secure broken parts
		2	either w > 0.5 mm or L < 3 m / m^2		
		3	w > 1.5 mm and L < 3 m / m^2		
		4	w > 3 mm, L < 3 m / m^2 and deformation		Full depth repair - Cut out and replace damaged area taking care not to damage reinforcement
		5	w > 3 mm, L > 3 m / m^2 and deformation		

7	Ravelling or Honeycomb type surface	0	Nil, not discernible	No action	Not Applicable
		1	r < 2 %	Local repair of areas damaged and liable to damage	
		2	r = 2 - 10 %		
		3	r = 10 - 25%	Bonded Inlay if affecting 2 or 3 slabs	
		4	r = 25 - 50 %		
		5	r > 50% and h > 25 mm	Reconstruct slabs if affecting 4 or more slabs	
8	Scaling	0	Nil, not discernible	No action	Not Applicable
		1	r < 2 %	Local repair of areas damaged and liable todamage	
		2	r = 2 - 10 %		
		3	r = 10 - 20%	Bonded Inlay	
		4	r = 20 - 30 %		
		5	r > 30 % and h > 25 mm	Reconstruct slab	
9	Polished Surface / Glazing	0		No action	Not Applicable
		1	t > 1 mm		
		2	t = 1 - 0.6 mm	Monitor rate of deteriotion	
		3	t = 0.6 - 0.3 mm		
		4			
		5	t < 0.3 mm	diamond Grinding'if affecting 50% or more slabs in a continuous stretch of minimum 5 km	
10	Popout (Small Hole), Pothole	0	d < 50 mm; h < 25 mm; n < 1 per 5 m2	No action	Not Applicable
		1	d = 50 - 100 mm; h < 50 mm; n < 1 per 5 m2	Partial depth repair 65 mm deep	
		2	d = 50 - 100 mm; h > 50 mm; n < 1 per 5 m2		
		3	d = 100 - 300 mm; h < 100 mm n < 1 per 5 m2	Partial depth repair 110 mm i.e 10 mm more than the depth of the hole	
		4	d = 100 - 300 mm; h > 100 mm; n < 1 per 5 m2		
		5	d > 300 mm; h > 100 mm ; n > 1 per 5 m2	Full depth repair	