Module 4-5

Full-Depth Repairs

Objectives

Describe alternative methods

Identify repair areas

Design acceptable repairs

Describe proper construction procedures

List specific materials and procedures

Introduction

Full-depth concrete repairs

- **JPCP**
- **JRCP**
- **CRCP**

Full-depth bituminous patches are not recommended

Purpose

Restore rideability

Prevent further deterioration of distressed areas

Prepare for an overlay

Candidate Distresses (JCP)

Blowup (L, M, H)

Corner break (L, M, H)

D-cracking (M, H)

Deterioration of or near repairs (M, H)

Longitudinal cracking (M, H)

Spalling (M, H)

Transverse cracking (M, H)

Candidate Distresses (CRCP)

Blowup (L, M, H)

D-cracking (M, H)

Deterioration of or near repair (M, H)

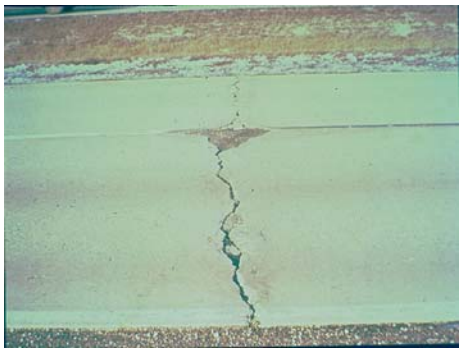
Localized distress (M, H)

Longitudinal cracking (M, H)

Punchout (L, M, H)

Transverse cracking (M, H)

Candidate Distresses (JCP)



Candidate Distresses (JCP)

Effectiveness

Can provide good long-term performance (>10 years)

Critical factors

- **Timing of repairs**
- **Proper load transfer design**
- **Quality of construction**

Design Considerations

Selecting repair boundaries

Multiple-lane repairs

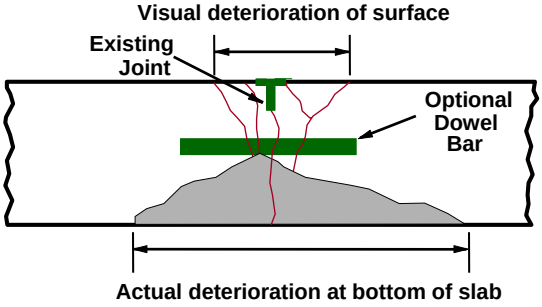
Repair materials

Load transfer design

Curing and opening to traffic

Cost considerations

Potential Extent of Deterioration at Joint



Minimum Repair Dimensions (JCP)

Doweled or tied repairs

- **Length ≥ 1.8 m (6 ft)**
- **Width ≥ 3.6 m (12 ft)**

Non-doweled or non-tied repairs

- **Length ≥ 1.8 m (6 ft) for low traffic**
  ≥ 2.4 m (8 ft) for med-high traffic
- **Width ≥ 3.6 m (12 ft)**

Guidelines for Selecting Repair Boundaries (JCP)

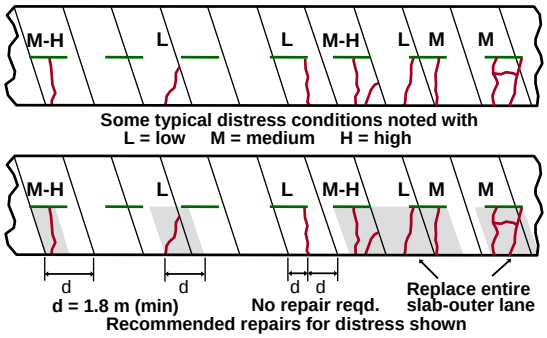
Repairs longer than 4.6 m (15 ft) require an intermediate joint

Repairs should be 1.8 m (6 ft) from transverse joints and cracks

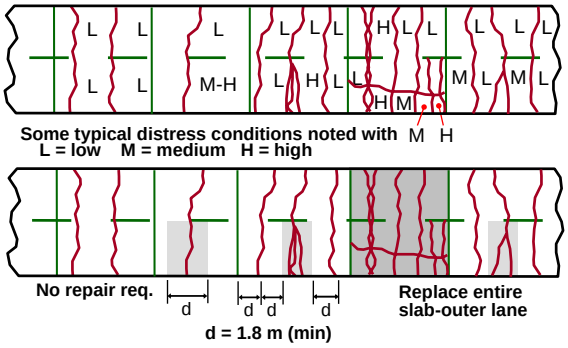
Extend repairs 0.3 m (1 ft) beyond joints

Cracks located 3 m (10 ft) or more from a joint can be repaired alone

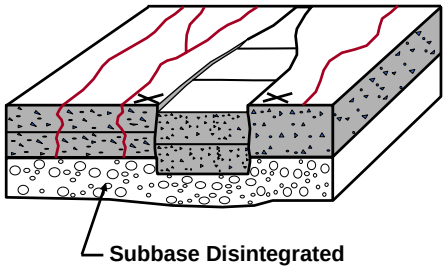
Repair Recommendations (JPCP)



Repair Recommendations (JRCP)



Potential Extent of Deterioration at Punchout



Guidelines for Selecting Repair Boundaries (CRCP)

Minimum repair length

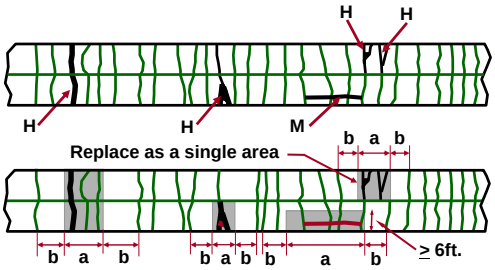
- **1.8 m (6 ft) if steel is tied**
- **1.2 m (4 ft) if steel is mechanically connected or welded**

Repairs should not be closer than 460 mm (18 in)

Minimum repair width is 1.8 m (6 ft)

Full width patches are recommended

Repair Recommendations (CRCP)



Example Repair

Example Repair (What's Wrong?)

Example Repair (What's Wrong?)

Curing Times for Repair Materials

Blended cements	2- 4 hours
Sulfo-aluminate cements	2- 4 hours
Type III with accelerator	4- 6 hours
Type I with accelerator	6- 8 hours
Type III with water reducer	12-24 hours
Type I	24-72 hours

Curing and Opening to Traffic

Curing methods

- Curing compound
- Insulation blankets

Opening criteria

- Minimum strength
- Minimum time

Load Transfer Methods

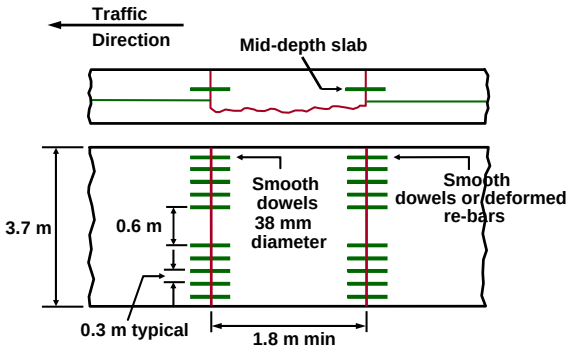
Dowel bars

Tie bars

Undercutting

Aggregate interlock

Recommended Load Transfer Design



Load Transfer - Dowel Bars

Undercut Method of Load Transfer

Tie-bar Load Transfer (plus Undercut)

Cost Considerations

Average cost about $80/m^2 ($95/yd^2)

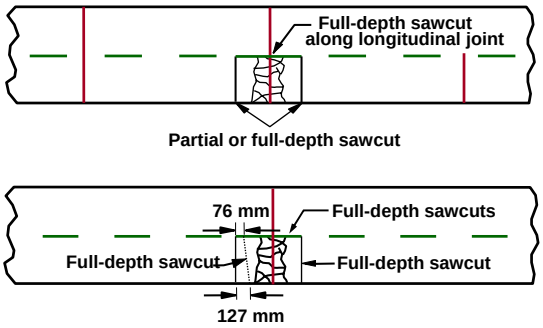
Slab replacement is preferred over several full-depth patches

- **Lower cost**
- **More reliable repair**

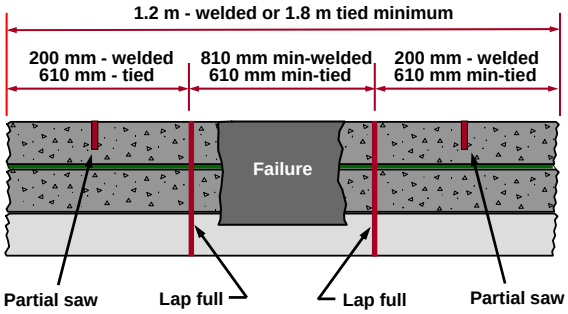
Construction Steps

Layout repair locations
Saw concrete
Remove concrete
Prepare area
Provide load transfer
Prepare joint
Place and finish concrete
Cure
Seal joints

Sawcut Locations (JCP)



Sawcut Locations (CRCP)



Sawcut

Concrete Breakup

Concrete Removal

Concrete Removal

Concrete Removal - Lift Out Method

Concrete Removal - Lift Out Method

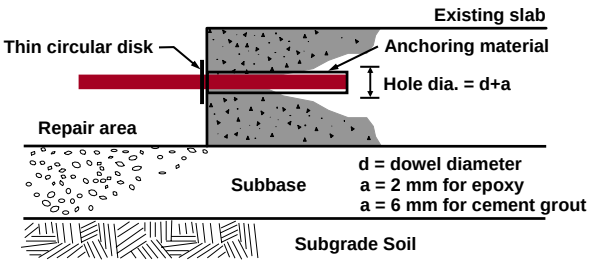
Concrete Removal - Lift Out Method

Problem with Lift Out Method

Prepare Area

Prepare Area - Add/Recompact Base

Dowel Bar Placement



Reinforcing Steel Placement (CRCP)

Match existing steel

Connect to existing steel

- Tied splice
- Welded splice
- Mechanical connection

Provide support (chairs) to prevent bending of steel

Provide minimum 60mm (2.5 in) cover

Gang Drill Dowel Holes

Gang Drill

Gang Drill

Holes Drilled

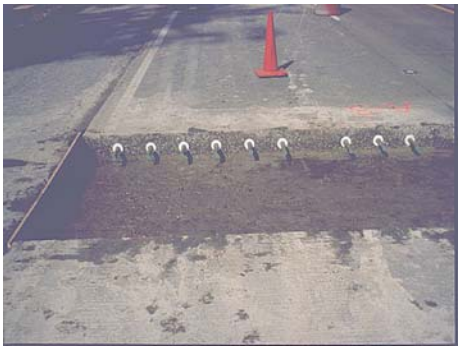
Cleaning Holes (Air Blast)

Injecting Grout (or Epoxy)

Placing Dowels

Dowels in Place with Grout Retaining Washers

Area Prepared with Dowels in Place



Concrete Placement and Finishing

- **Avoid use of additional water for workability**
- **Ensure adequate vibration near edges of repair**
- **Best results with vibratory screed**
- **Avoid over-finishing**
- **Match surface level and texture**

Curing

Methods

- **Curing compound**
- **Wet burlap**
- **Polyethylene sheeting**

Insulation blankets can accelerate curing and provide higher strengths

Concrete Placement

Concrete Finishing

Application of Curing Compound

Curing - Use of Insulation Blanket

Joint Sealing

Transverse and longitudinal joints

Saw and seal as soon as possible after concrete placement

Reduces spalling and moisture infiltration

Follow procedures for joint sealing (Module 4-2)

What's Wrong Here?

…And Here?

…And Here?

What About This?

Summary

Bituminous patches not recommended

Repairs should address the extent of the deterioration

Slab replacement is more economical than multiple full-depth repairs

Provide load transfer (dowels) on JPCP

Restore continuity of steel on CRCP