DELIVERING FOR QUEENSLAND

Guideline

Rehabilitation technique and treatment prioritisation method of Plain Concrete Pavements (PCP)

November 2025

Queensland Government

Translating and interpreting assistance

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Contents

1 Introduction

This guideline provides guidance on the rehabilitation technique and treatment prioritisation method of the existing plain concrete pavements (PCPs) where the pavements are outside the defect liability and warranty periods. The details within this document have been compiled from:

- practitioners' field experiences
- collated pavement testing data
- Technical Specifications (Measurements) MRS39 *Lean Mix Concrete Sub-base for Pavements* and MRS40 *Concrete Pavement Base*
- supplementary specification MRSS *Concrete pavements – Slab Replacement*
- supplementary specification MRSS *Supply of Concrete for Rapid Concrete Pavement Slab Replacement,* and
- Roads and Maritime Services New South Wales (NSW) concrete pavement specifications and drawings for concrete pavement maintenance.

To request a copy of the supplementary specifications referenced within this guideline, please email *tmr.techdocs@tmr.qld.gov.au*. For more comprehensive details on the rehabilitation of PCPs, refer to the *Pavement Rehabilitation Manual*.

2 Purpose

The purpose of this document is to assist inspection and diagnosis of PCPs. This documentation includes a decision flowchart to be used for guidance on the inspection, evaluation and rehabilitation of PCPs.

3 Referenced documents

In preparing this guideline, the documents listed in Table 3 were referenced.

Table 3 – Referenced documents

Reference	Title
-	*Pavement Rehabilitation Manual*, Transport and Main Roads
-	MRTS39 *Lean Mix Concrete Sub-base for Pavements*, Transport and Main Roads
-	MRTS40 *Concrete Base Pavement*, Transport and Main Roads

Reference	Title
-	*Rehabilitation of Existing Concrete Slabs on Ipswich Road, Queensland,* (Undated, likely 1987), GH Smith B – (Metro South), Transport and Main Roads
-	*Performance of Concrete Pavements: An Overview, Queensland* (1999), Alan Carse
-	*Concrete Pavement Maintenance Manual. Berkshire, UK: The Concrete Society,* (2001), Burks Green
-	*Pavement Standard Drawings, Rigid Pavement, Standard Details, Maintenance MD, M10, MP, Volume MP, Plain Concrete Pavement (PCP)* Edition 3 Revision 1, NSW *(2015)*, Transport for NSW
-	*QA Specification M212: Routing and Sealing of Cracks (Concrete Pavement)* NSW 2020, Transport for NSW
-	*QA Specification M213: Cross stitching of Cracks and Joints (Concrete Pavement)*, NSW 2020, Transport for NSW
-	*QA Specification M215: Repair of Surface Spalls in Concrete Pavement*, NSW 2020, Transport for NSW
-	QA Specification M231: Pressure Grouting for Slab Jacking / Stabilisation, NSW 2020, Transport for NSW

4 Background

Major PCP projects (mostly un-dowelled) in Queensland include the following:

- Ipswich Road (part of Cunningham Arterial Road, now part of the Ipswich Motorway) approximately 5.6 km long. This section was constructed in 1952 and by 1983, was in poor condition. The entire section was ‘crack and seated’ and overlaid with 125 mm asphalt in 1987.
- The Bruce Highway at Sippy Downs Sunshine Coast, approximately 5 km long, was constructed in 1986 / 1987.
- The Bruce Highway at Yandina Bypass Sunshine Coast, approximately 7 km long, was constructed in 1997.
- The Pacific Highway from Reedy Creek to Tugun, approximately 12 km long, was constructed in 1982 and 1997. The entire section was ‘rubbilised’ or ‘crack and seated’ and overlaid with full depth asphalt pavement between 2021 to 2024.
- The Pacific Motorway M1 Gold Coast (contracts 2, 3 and 4) approximately 34 km long. This is Queensland’s largest PCP project (consisting of the eight lanes) that was constructed from approximately 1997 to 2000.

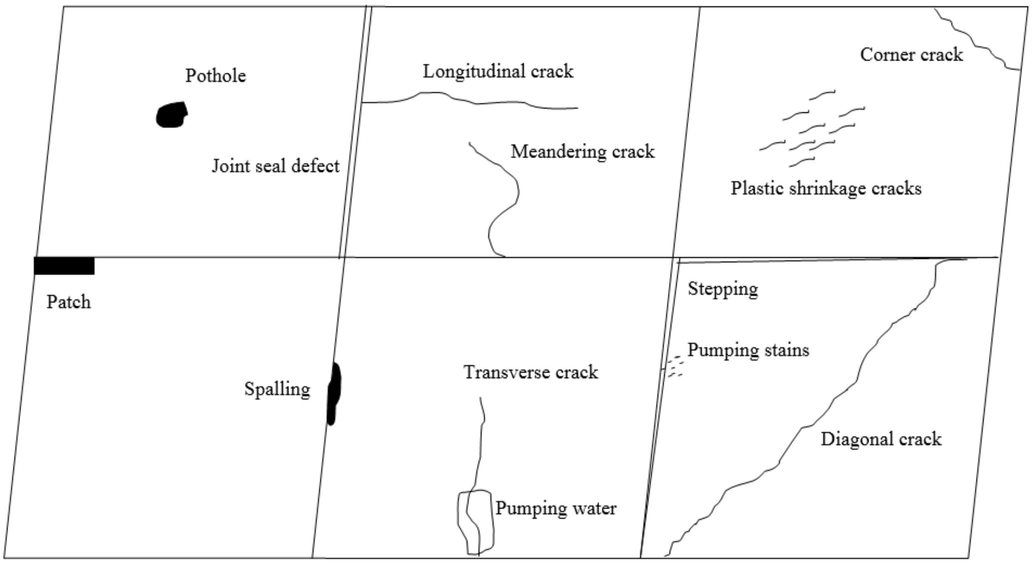
These PCPs are in various conditions. The department carries out regular surveillance and maintenance to ensure their serviceability level.

5 Existing condition evaluation

To understand which treatment methodology to apply to an existing PCP, the following process of information gathering and evaluating should be considered to help assess the asset's current condition.

1. **Pavement historical data** – establish from past pavement rehabilitation and investigation reports, a Road Management Information System data (ARMIS), as constructed plans, verbal information from local district engineers / technical officers.
2. **Defect mapping survey** – assess surface condition, classify and quantify the defects (refer Figure 5 example of distress modes).
   a. automated pavement condition and cracking survey, or
   b. manual pavement defect mapping / walkover defect mapping inspection.
3. **Automated pavement condition and cracking survey** – assess and quantify slab faulting, cracking spalling, patch repairs and joints.
4. **Ground Penetrating Radar (GPR) survey** – understand subsurface conditions such as pavement profile and thickness, existence of dowels and existence of reinforcements, detect anomalies (possible voids and moisture).
5. **Pavement investigation** – understand pavement profiles and characteristic properties and calibrating the GPR survey results. Example investigation methodology as follows:
   a. concrete coring (minimum 150 mm diameter) – to calibrate concrete base and lean mix sub-base thickness and to assess concrete pavement structural condition, with
   b. augering – to calibrate unbound or fill layer thickness, collect unbound samples and to expose sub-grade material for further insitu Dynamic Cone Penetration test.
6. **Void detection**
   a. GPR survey and followed by concrete coring to verify true extent of voids
   b. falling weight deflectometer – adopt variable load corner deflection analysis methods (zero load deflections) and corner deflection profile methods, and/or
   c. steel crowbar – tap concrete slab and assess rebound sound.

Figure 5 – Example of common PCP defects



It is important to clearly understand the distinction between the types of pavement failure mechanisms when identifying and assessing defects, cause of failure and developing rehabilitation strategies. A rehabilitation project may not adequately correct the pavement deficiency with an incorrect classification of the failure mechanism.

6 Detailed treatment prioritisation and identification

Figure 6(a) flowchart has been developed by the department's Pavement Rehabilitation Unit to analyse the data collected during the existing condition evaluation. The flowchart assists with treatment prioritisation and identifies the likely suitable treatment method to rectify failed concrete pavements.

Within the flowchart, 'C' is defined as the combined cracking length in a slab and 'L' is the slab length as shown in Figure 6(b).

Figure 6(a) – Plain concrete pavement rehabilitation treatment prioritisation and identification

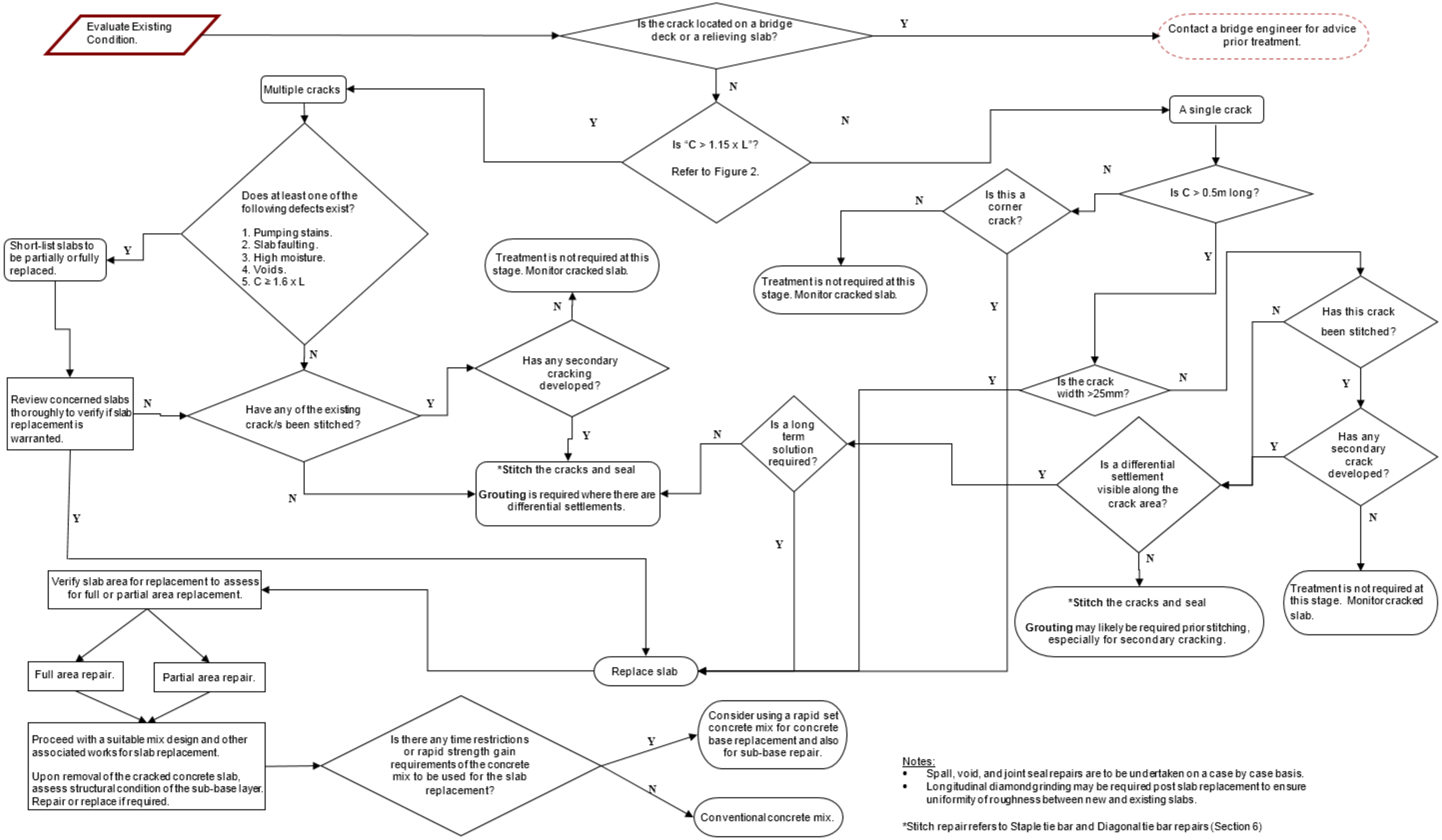
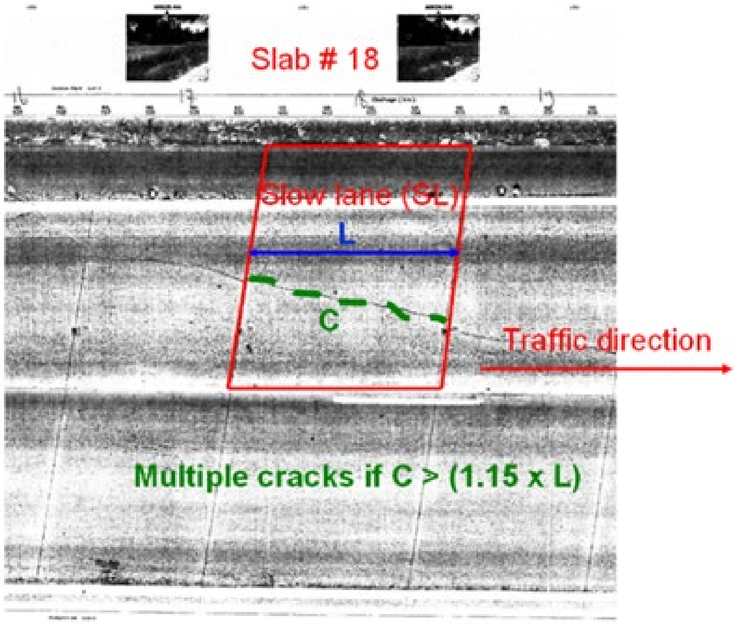


Figure 6(b) – Cracking length (C) and slab length (L)



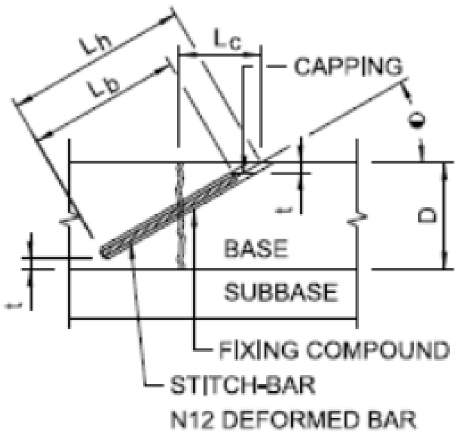
7 Treatment summaries

Transport for NSW has developed standard drawings and specifications for the PCP treatments. These technical documents have been developed to suit NSW conditions. These standard drawings and specifications may be adopted for Queensland-based projects. The following section defines the treatments as identified in Figure 6(a) flowchart.

- **Spall repair –** spalling at joints can be caused from curling / warping stresses, but also by the penetration of incompressible material into the joint causing cracking when the slab expands. Partial depth repairs may be used to repair spalled areas at joints and cracks. Spalls should be treated before they extend below the top third of the slab. It is recommended that the 'limits' of a repair area for a spall should be made with a concrete saw, square or near square in shape and at least 50 mm beyond the limit of any spalling. The depth of sawing of the repair area should be greater than the depth of spalling at the edge of the spalled area and not less than 50 mm. All loose spalled material should be removed from the base of the spalled area prior to repair. Refer to appropriate technical guidelines.

- **Joint or crack sealing –** silicone sealing of exposed cracks or joints. Bitumen sealing is not recommended for this process as it is likely to be very temporary and unsightly. Refer to appropriate technical guidelines.
- **Diagonal tie bar repair (cross stitch) –** insert reinforced steel rods diagonally and epoxy resin to hold the crack together. It is used only for cracks or joints that are not intended to open / close and is generally unsuited to concrete slab thicknesses less than 190 mm and when the cracking gap is greater than 25 mm. Refer to Figures 7(a), 7(b) and 7(c).

Figure 7(a) – Diagonal tie bar repair

Base thickness D (mm)	**Offset: drill hole to crack L_c (mm)**	**Length of drill hole L_h (mm)**	**Length of stitch-bar L_b (mm)**	**Length of protection L_p (mm)**	
190	165	330	280	40 ± 5	
200	175	350	300	40 ± 5	
210	180	370	320	45 ± 5	
220	190	390	340	45 ± 5	
230	200	410	360	45 ± 5	
240	210	430	380	50 ± 5	
250	215	450	400	50 ± 5	

Notes:

1. To suit drill angle of 30° and cover (ct) of 25 mm, refer to above diagram.
2. See Figure 7(b) following for protection details (L_p). Protection must be provided if the crack is wider than 0.5 mm. The suitable protection is by bituminous paint with a thickness of 0.2 mm to 0.5 mm.

Figure 7(b) – Stitch bar protection – Lp

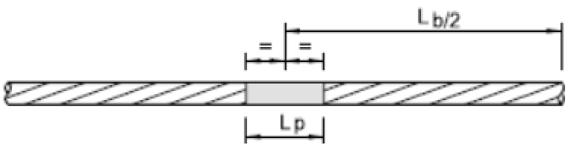


Figure 7(c) – Cross stitching of longitudinal crack

Courtesy of John Hodgkinson.

- **Staple tie bar repair** - tie slabs together at cracks or joints to evenly distribute the load across both the crack and un-dowelled concerned joint. The implementation of the staple tie bar repair in Queensland has been limited, when compared to the diagonal tie bar repair (cross stitching). This treatment has been undertaken on several existing longitudinal cracks on the concrete slabs on the Bruce Highway, Sippy Downs area. Refer to Figures 7(d) and 7(e).

Figure 7(d) – Staple tie bar repair

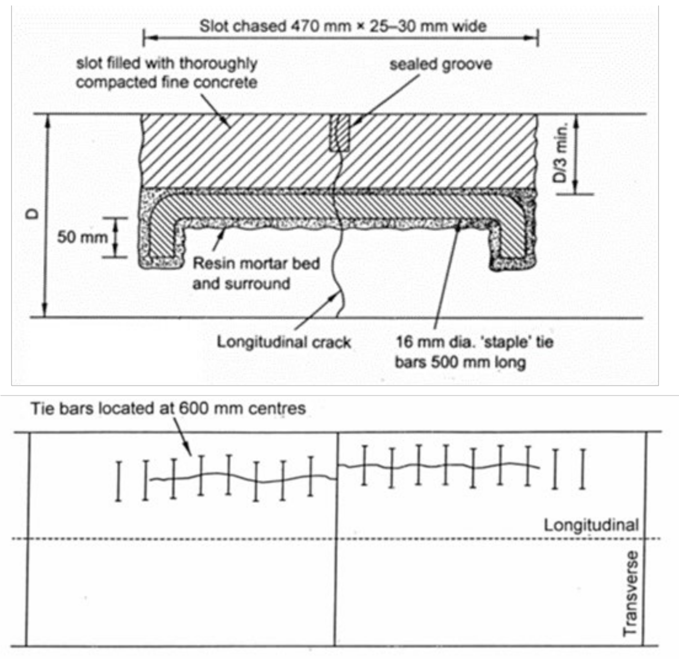
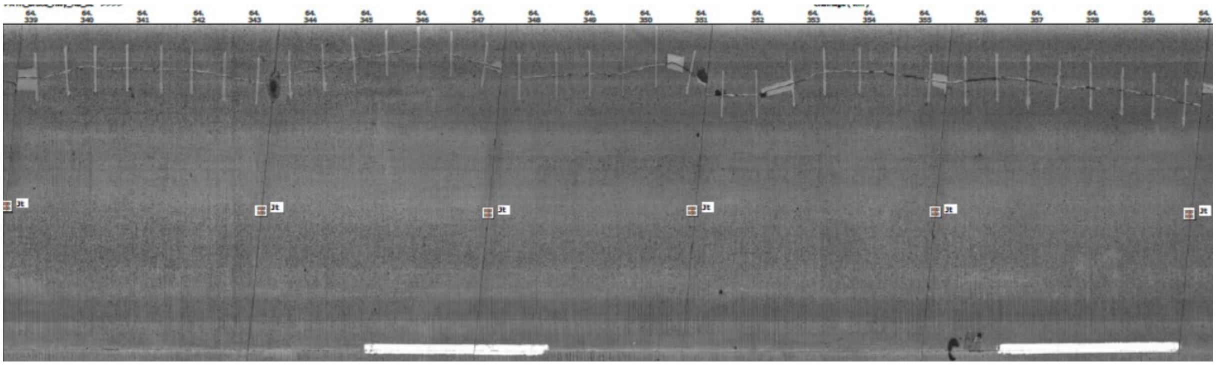


Figure 7(e) – Staple tie bar repair at concrete pavement of Bruce Highway on Sippy Downs – northbound slow lane from approximately Chainage 64.339 km to 64.360 km



- **Slab replacement** - removing partial or full area of the existing slab to the full concrete base depth and replacing it with new concrete. Refer to the Concrete Pavement Maintenance Standard Drawings Volume MP:
  Plain Concrete Pavement (PCP) for detailed slab replacement procedures for technical guidelines. Consideration of any time restrictions or rapid strength gain requirements, should be considered when deciding concrete mix design (that is, rapid set concrete or conventional concrete mix).
- **Pressure grout injection for slab stabilisation** - it restores support to concrete slabs by filling voids that develop underneath the concrete slab at joints, cracks or the pavement edge. Slabs that have 'dropped' can be lifted by the grout pressure to restore the surface profile to match surrounding slabs. In general, voids can be formed at different pavement strata which determine the target grouting depth as follows:
  - shallow grouting: target voids between concrete base layer and a sub-base layer, and/or
  - deep grouting: target voids below the sub-base layer; that is, granular layer, fill, sub-grade replacement layer or sub-grade layer.

  Currently, there are 2 common grouting techniques in Queensland:

  1. cementitious grouting, and
  2. expanding polyurethane foam grouting.

  The **cementitious grouting** mix is prepared on site. A site setup should allow a working space for on-site grouting mix production; that is, stack of cement bags, mixing chamber and a grouting pump. Upon grouting completion, a specified curing time is required prior to opening for traffic. The required grouting holes are generally of minimum 30 mm in diameter and need to be plugged using an epoxy material.

For the **expanding polyurethane** foam grouting, the premix grouting liquid is stored in a vacuumed tank and is delivered on site in a tanker truck. The truck is equipped with a pressure pump to inject the expanding polyurethane directly to the grouting holes. The required site preparation is minimal compared to the cementitious grouting, but usually costs more than the cementitious grouting. The grouting holes are generally 10 mm to 15 mm in diameter and can be plugged using the same grouting material (the expanding polyurethane foam grouting). The grouting shall have a sufficient curing time to achieve the required strength prior to opening for traffic.

Depending on project specific requirements and site condition, the adopted grouting technique in a proposed project (cementitious vs polyurethane) shall be considered.

The following is a brief procedure of pressure grouting:

1. Carry out a one-day production field trial to establish a site-specific working procedure.
2. Submit proposed nominated grouting mix for approval. The minimum grout compressive strength shall be 8 MPa at 24 hours.
3. Set up locations of grouting holes to ensure vertical and horizontal filling of voids is achieved. The radius between grouting drill holes is usually between 1.5 m to 2 m. The grouting hole must not exceed 50 mm diameter. Refer to Figure 7(f) for details.
4. Determine the grouting depths. Insert a sleeve into the grout holes for a deep grouting below the sub-base concrete layer. The sleeve shall pass completely through the base concrete and sub-base concrete. Remove the sleeve after the grouting is completed.
5. Monitor the slab level regularly during void grouting or slab jacking using survey level equipment.
6. During slab jacking, care needs to be taken when injecting the resin underneath the slab. The expansion of the resin needs to be monitored to ensure the slab raises to intended or designed level. Upon grouting completion, plug the grouting holes properly.

   Refer to appropriate technical guidelines.

Figure 7(f) – Typical grout hole arrangements for PCPs

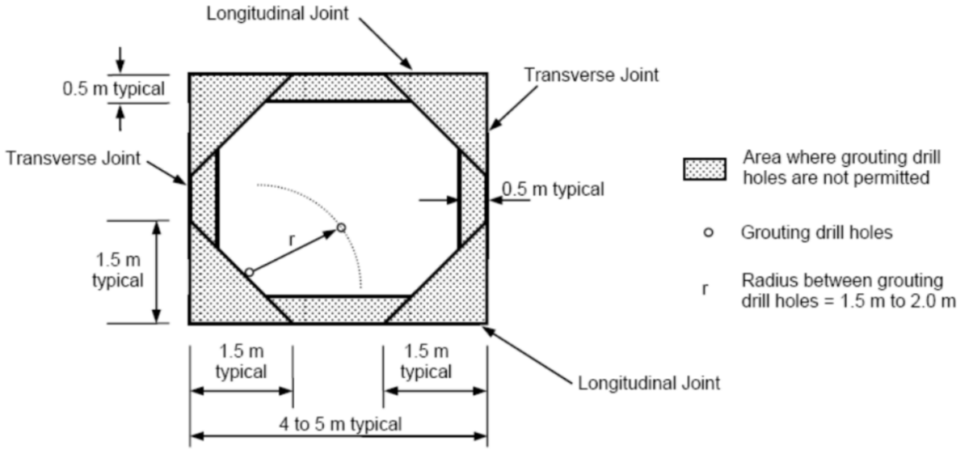
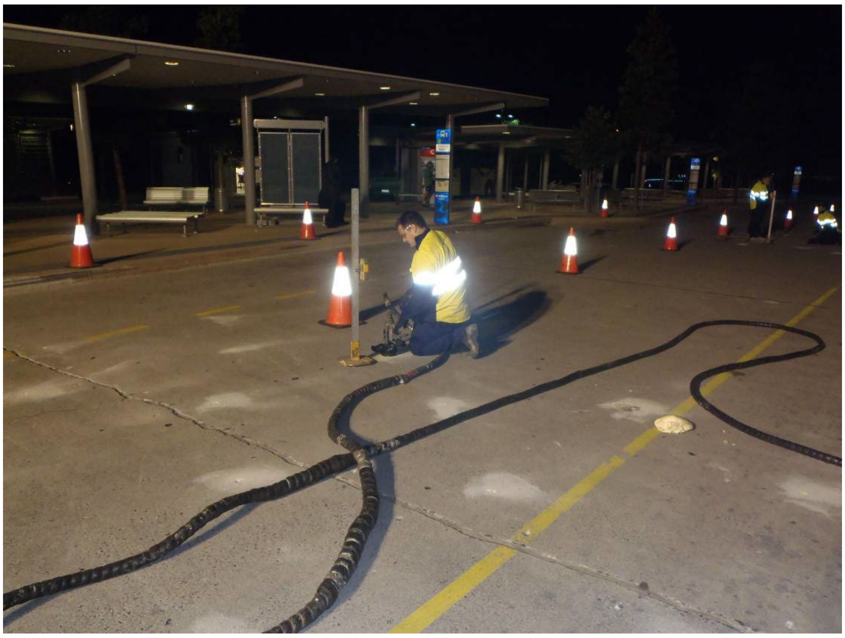


Figure 7(g) – Pressure injecting grout using expanding polyurethane foam – Logan Hyperdome bus station



Courtesy of Jason Wilson.

- **Longitudinal Diamond Grinding -** it restores or improves skid resistance, removes faults at joints or cracks by levelling the pavement surface and reduces traffic noise, refer to Figure 7(h). Refer to appropriate technical guidelines.

Figure 7(h) – Diamond grinding in progress

Courtesy of George Vorobieff, RMS, NSW

8 Monitoring

As is the case with any pavement rehabilitation works, consistent monitoring is required post-restoration works to ensure treatments perform as intended and do not continue to deteriorate further.