PAVEMENT STANDARD DRAWINGS

RIGID PAVEMENT

STANDARD DETAILS - MAINTENANCE MD.M10.MJ

Volume MJ - Jointed Reinforced Concrete Pavement

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<tr>
<td>CRCP</td>
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</tr>
<tr>
<td>JRCP</td>
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## REVISION REGISTER

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(See also MJ04)

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* **PRINCIPAL ENGINEER, PAVEMENTS, MATERIALS AND GEOTECHNICAL**

** **PRINCIPAL ENGINEER, PAVEMENTS AND GEOTECHNICAL**
TABLE 3.1: PRACTICE NOTES

1. Scope
Definitions of terms is contained in the Specification. These drawings represent “Model” or “Standard” details which are intended for use by project designers. Where design tables are provided for example, Table 3.2 for slab spacings) they are intended solely as a guide to those designers and must not be reproduced in project specific drawings for interpretation and/or application by site staff. Project specific drawings must show precise details for items such as slab replacements, jointing, crack repairs, crack repairs, spacing of tiebars, and other reinforcing. (a)

2. Dimensions
All dimensions are in millimetres (mm) unless noted otherwise.

3. Classification of maintenance practices
The maintenance practices shown in these drawings are classified according to whether they are structural or non-structural repairs. A structural repair is one which either fully or partially restores the load carrying capacity of the pavement. Structural repairs are further classified according to Best Practice or Compromise Practice. Best Practice repairs are the preferred option for repair of concrete pavements and must be adopted unless otherwise approved by the Principal.

TABLE 3.2: JOINT TYPE NUMBERS AND DESCRIPTIONS

<table>
<thead>
<tr>
<th>TYPE</th>
<th>DESCRIPTION</th>
</tr>
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<tbody>
<tr>
<td>J1</td>
<td>Longitudinal tied and jointed</td>
</tr>
<tr>
<td>J2</td>
<td>Longitudinal tied and formed</td>
</tr>
<tr>
<td>J3</td>
<td>Longitudinal tied and unjointed</td>
</tr>
<tr>
<td>J4</td>
<td>Longitudinal unjointed and formed</td>
</tr>
<tr>
<td>J5</td>
<td>Longitudinal unjointed and jointed</td>
</tr>
<tr>
<td>J6</td>
<td>Longitudinal edge</td>
</tr>
<tr>
<td>J7</td>
<td>Transverse construction tied and jointed</td>
</tr>
<tr>
<td>J8</td>
<td>Transverse construction tied and formed</td>
</tr>
<tr>
<td>J9</td>
<td>Transverse construction: sawn and dowelled</td>
</tr>
<tr>
<td>J10</td>
<td>Transverse construction: formed and dowelled</td>
</tr>
<tr>
<td>J11</td>
<td>Transverse construction: formed and drilled</td>
</tr>
<tr>
<td>J12</td>
<td>Transverse construction: jointed and dowelled</td>
</tr>
<tr>
<td>J13</td>
<td>Isolation: with subgrade beam</td>
</tr>
<tr>
<td>J14</td>
<td>Isolation: without subgrade beam</td>
</tr>
<tr>
<td>J15</td>
<td>Expansion: dowelled</td>
</tr>
<tr>
<td>J16</td>
<td>Expansion: drilled</td>
</tr>
<tr>
<td>J17</td>
<td>Hinge: tied and jointed</td>
</tr>
<tr>
<td>J18</td>
<td>Hinge: tied and formed</td>
</tr>
</tbody>
</table>

Tables 3.2 Notes:
(a) Details shown on MJ02 and MJ07 are indicative of joints which will be encountered in existing pavements and those which will be used in slab replacement work. They should not be confused with joint details on other sheets which show remedial activities such as joint resealing (MJ19-MJ21) or jointing work. They should not be adopted by field staff without design review and approval. Values in brackets show compromise limits for exclusive use by designers where their use is unavoidable. They must not be adopted by field staff without design review and approval.
(b) The suffix “d” relates to “dished” failure on dowels.

TABLE 3.3: ABBREVIATIONS

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>JRCP</td>
<td>Jointed Reinforced Concrete Pavement</td>
</tr>
<tr>
<td>SFCP</td>
<td>Steel Fibre Reinforced Concrete Pavement</td>
</tr>
<tr>
<td>PCP-R</td>
<td>Reinforced Plain Concrete Pavement (Discrete Slabs)</td>
</tr>
<tr>
<td>PCC-P</td>
<td>Plain Concrete Pavement</td>
</tr>
<tr>
<td>RCS</td>
<td>Reinforced Concrete Subbase</td>
</tr>
<tr>
<td>SMZ</td>
<td>Selected Material Zone</td>
</tr>
<tr>
<td>LCS</td>
<td>Lean-Mix Concrete Subbase</td>
</tr>
<tr>
<td>LCS</td>
<td>Lean-Mix Concrete Subbase</td>
</tr>
<tr>
<td>M258</td>
<td>Slab Replacement (Concrete Pavement)</td>
</tr>
<tr>
<td>R15</td>
<td>Kerbs and Gutters</td>
</tr>
<tr>
<td>AS/NZS 4671</td>
<td>Steel Reinforcing Materials</td>
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TABLE 3.4: SYMBOLS

<table>
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<th>SYMBOL</th>
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<tr>
<td>D</td>
<td>Joint type: &quot;D&quot;</td>
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<td>E</td>
<td>Tension</td>
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TABLE 3.5: GENERAL SLAB DIMENSIONAL LIMITS

<table>
<thead>
<tr>
<th>TYPE</th>
<th>TRAFFICKED (a)</th>
<th>UN-TRAFFICKED (a)</th>
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<tbody>
<tr>
<td>JRCP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SFCP</td>
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<td></td>
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<tr>
<td>SFCP - R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LCS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3.5 Notes:
(a) See Note 1 in Table 3.1
(b) Corner angles should be minimised wherever possible.
(c) The suffix “d” relates to “dished” failure on dowels.
(d) Where an un-trafficked slab is likely to become trafficked within 20 years, it must be designed for trafficked conditions.

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PAVEMENT STANDARD DRAWINGS
RIGID PAVEMENT
STANDARD DETAILS - MAINTENANCE MD.M10/MU
JOINTED REINFORCED CONCRETE PAVEMENT (JRPC) LEGEND

SCLER=N DIY SHEET 02

REGISTRATION NO OF PLANS
DS2013/001890

SHEET NO
ED R1

VOLUME
26

DATE
28/05/2015

NSW GOLD COAST REGIONAL SERVICE CENTRE

CYPHER - 30673 - R-30673 - PAVEMENT STANDARD DRAWINGS RIGID PAVEMENT - STANDARD DETAILS - MAINTENANCE MD.M10/MU - JOINTED REINFORCED CONCRETE PAVEMENT (JRPC) LEGEND
The following practices apply to drill-ties:

1. Drill holes (for tiebars and dowels) must be thoroughly cleaned of dust using dry oil-free compressed air through a probe inserted into the hole.
2. In Details F and G on M1.0, the sealant reservoir must be created by sawcutting or, in the case of formed joints, by boring a temporary hole to the final place.
3. Where a filler is used, the joint must be prepared for sealing by sawing in accordance with M1.0/21.

**Tiebars and drill-ties**

**In longitudinal joints, tiebars must be designed in accordance with Table 9.1 and be placed:**

- (a) not closer than 300 mm to a transverse untied joint (for example, a contraction or isolation joint);
- (b) not closer than 150 mm to a transverse tied joint;
- (c) to ensure a minimum vertical clearance of 30 mm to any proposed crack inducer or sawcut.

4. In transverse tied construction joints, tiebars must be provided at 500 c/c (and 500 c/c for drill-ties) and be placed not closer than 150 mm to a longitudinal joint or slab edge.

5. The following practices apply to drill-ties:

- (a) In transverse tied construction joints, tiebars must be provided at 500 c/c (and 500 c/c for drill-ties) and be placed not closer than 150 mm to a longitudinal joint or slab edge.
- (b) Dowels must be installed ahead of paving and must:
  - (a) be 400 mm long and of diameter in accordance with Table 7.3;
  - (b) be straight and free of irregularities which could hinder their movement (such as burrs and projections);
  - (c) be fully galvanized;
  - (d) be coated at one end with a tough, durable anchoring agent of thickness 0.75 ± 0.25 mm. At formed joints, the debonding must be on the section which lies within the second-placed slab.
  - (e) unless otherwise shown on the Drawings, be placed at mid-depth (± 25 mm) parallel to the pavement surface and parallel with the local relevant control line, with tolerances as given below.
  - (f) be supported so that no part of the assembly, except the dowel, crosses the joint.
  - (g) be equally positioned about the line of the intended joint within a tolerance of ± 25 mm.
  - (h) be placed not closer than 150 mm to a longitudinal joint.
  - (i) when laid in accordance with T365, have an average pull-out bond stress not more than 0.15 kN/cm².
  - (j) at expansion joints, have the debonded end capped to provide a clearance for movement equal to the width of the joint plus 15 ± 6 mm.

6. The alignment tolerance of individual dowels is

- (a) in the placed position:
  - ± 2 mm.
- (b) in the finished slab:
  - ± 0.2 mm.

**Dowel diameters**

- (a) For Dowels 30 mm±5
- (b) Dowels of diameter 300 mm ± 50 mm
- (c) Dowels of diameter 350 mm ± 50 mm
- (d) Dowels of diameter 400 mm ± 60 mm
The backer rod diameter should typically be about 25% larger than the joint width $W$. These values listed in Column 6 are intended as guidelines only. There are many factors which will influence the magnitude of joint closure and as it may vary substantially between different sites.

The recess varies according to joint type because of the relative potential for joint closure, and the risk of the jointing material being ejected. Allowance must be made for factors such as the depth of the backer rod after lateral compression into the joint. It is important that the upward pressure on the sealant (in hot weather) is minimised.

In isolation and expansion joints, the joint can close up to significantly less than its original width. If the recess is inadequate, this will squeeze the sealant below the surface. It will be damaged by traffic. These values listed in Column 6 are intended as guidelines only. There are many factors which will influence the magnitude of joint closure and as it may vary substantially between different sites.

The magnitude of joint opening is proportional to the mean joint depth of adjacent slabs. Hence, joints between two slabs 4.2 m apart, two slabs 3.8 m and 4.6 m, and two slabs each 4.2 m will open by the same amount.

In isolation and expansion joints, the joint can close up to significantly less than its original width. If the recess is inadequate, this will squeeze the sealant below the surface. It will be damaged by traffic. These values listed in Column 6 are intended as guidelines only. There are many factors which will influence the magnitude of joint closure and as it may vary substantially between different sites.

The recession $R_j$ can be reduced (relative to untied joints) because there is little chance of the joint closing, hence ejection of the sealant is unlikely. The terms "transverse" and "longitudinal" relate to the direction of traffic. Hence, an isolation joint which runs parallel with the through-carriageway within a median crossing is still "transverse" relative to traffic movements. A similar joint separating a ramp from the through-carriageway would be deemed to be "longitudinal".

See Table 8.3 for calculation of effective slab length $L$ and width $W$. The recess $R_j$ can be reduced (relative to untied joints) because there is little chance of the joint closing, hence ejection of the sealant is unlikely.

For tied joints, refer to Table 8.2. The recess $R_j$ can be reduced (relative to untied joints) because there is little chance of the joint closing, hence ejection of the sealant is unlikely.

See Note (h) for interpretation of "longitudinal".

Refer to Figure 8.2 for key to dimensions $W_2$, $D_2$, $R$, and $D_2$.
It is necessary to check that the selected mesh provides adequate transverse steel to cater for the actual tied width, as shown in Table 10.1. Relief-edge distance (RED) is measured from the joint (or section) under design to the nearest relief edge. The value for RED must make allowances for stress relief. Tiebars must be placed at the spacing shown, with a tolerance of ±20% on individual bars subject to the provision of the specified number of bars per slab. Specialist advice is required.

**Table 9.1: Provision of Tiebars**

<table>
<thead>
<tr>
<th>Relief-edge Distance (RED) (mm)</th>
<th>Bar size</th>
<th>Average tiebar spacing (mm) and number of tiebars per 8.0 m slab</th>
<th>PROVISION OF TIEBARS</th>
<th>Example tiebar layout for 8.0 m slab</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 - 5.5</td>
<td>0.9</td>
<td>890 9 800 10 800 10 730 11 730 11 655 12 655 12 615 13 615 13</td>
<td>570 14 500 16 470 17 470 17</td>
<td>350 8 240 9 240 9</td>
</tr>
<tr>
<td>6.1 - 6.5</td>
<td>0.9</td>
<td>730 11 665 12 665 12 615 13 615 13 570 14 570 14 530 15 530 15</td>
<td>180 17 440 18 440 18</td>
<td>400 6 350 8 350 8</td>
</tr>
<tr>
<td>6.6 - 7.0</td>
<td>0.9</td>
<td>1020 8 890 9 890 9 800 10 800 10 730 11 730 11 695 12</td>
<td>20 350 675</td>
<td>145 TIEBARS</td>
</tr>
<tr>
<td>7.1 - 7.5</td>
<td>0.9</td>
<td>890 9 800 10 800 10 730 11 730 11 655 12 655 12 615 13 615 13</td>
<td>18 400 6</td>
<td>18 SPACES AT 300 OCC</td>
</tr>
<tr>
<td>7.6 - 8.0</td>
<td>0.9</td>
<td>890 9 800 10 800 10 730 11 730 11 655 12 655 12 615 13</td>
<td>300 8 240 9 240 9</td>
<td></td>
</tr>
<tr>
<td>8.1 - 8.5</td>
<td>0.9</td>
<td>890 9 800 10 800 10 730 11 730 11 655 12 655 12 615 13 615 13</td>
<td>18 400 6 350 8 350 8</td>
<td></td>
</tr>
<tr>
<td>8.6 - 9.0</td>
<td>0.9</td>
<td>890 9 800 10 800 10 730 11 730 11 655 12 655 12 615 13 615 13</td>
<td>20 350 675</td>
<td>145 TIEBARS</td>
</tr>
<tr>
<td>9.1 - 9.5</td>
<td>0.9</td>
<td>890 9 800 10 800 10 730 11 730 11 655 12 655 12 615 13 615 13</td>
<td>18 400 6 350 8 350 8</td>
<td></td>
</tr>
<tr>
<td>9.6 - 10.0</td>
<td>0.9</td>
<td>890 9 800 10 800 10 730 11 730 11 655 12 655 12 615 13</td>
<td>20 350 675</td>
<td>145 TIEBARS</td>
</tr>
<tr>
<td>10.1 - 10.5</td>
<td>0.9</td>
<td>890 9 800 10 800 10 730 11 730 11 655 12 655 12</td>
<td>14 550 425</td>
<td>16 SPACES AT 300 OCC</td>
</tr>
</tbody>
</table>

Table 9.1 Notes:
(a) Tiebar spacing based on 12 mm deformed 500N steel and a value of interlayer friction $\mu = 1.5$.
(b) Base Thickness = Concrete base + asphalt surfacing.
(c) Actual tiebar spacing determined as follows:
   - Provide 300 mm to 1060 mm clearance from the end of the tiebar to transverse contraction joints.
   - Space the remaining tiebars evenly in between.
(d) Tiebars must be placed at the spacing shown, with a tolerance of ±20% on individual bars subject to the provision of the specified number of bars per slab.
(e) Relief-edge distance (RED) is measured from the joint (or section) under design to the nearest relief edge. The value for RED must make allowances for stress relief contributions such as continuity effects for asphalt and limitations for future widening.
(f) Proportion of number of tiebars for slabs that are not 8.0 m long. Average tiebar spacing is not to be less than the tabulated value for an 8.0 m slab. Round up number of tiebars to next whole number. Adjust offset to joints in accordance with Figure 9.1 and tiebar spacing similar to that shown.
(g) Maximum tiebar spacing is 1400 mm.
(h) It is necessary to check that the selected mesh provides adequate transverse steel to cater for the actual tied width, as shown in Table 10.1.

**Figure 9.1**

**N10**

**Minimum Tiebar Offsets from Joints**
### TABLE 10.1: MESH REINFORCEMENT

<table>
<thead>
<tr>
<th>Slab length (m)</th>
<th>Mesh size (and Limiting RED)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BASE THICKNESS 'D' (mm)</td>
</tr>
<tr>
<td></td>
<td>≤150</td>
</tr>
<tr>
<td>7.5</td>
<td>SL82</td>
</tr>
<tr>
<td>8</td>
<td>SL82</td>
</tr>
<tr>
<td>10</td>
<td>SL82</td>
</tr>
<tr>
<td>12</td>
<td>SL82</td>
</tr>
<tr>
<td>15</td>
<td>SL82</td>
</tr>
<tr>
<td>20</td>
<td>SL92</td>
</tr>
</tbody>
</table>

**Table 10.1 Notes:**

(a) Values in brackets indicate the upper limit for relief-edge distance (RED) for the indicated mesh size. At larger distances, there is inadequate transverse steel to contain unplanned longitudinal cracking, hence a design check is required. See example in Note (b).

(b) For a base slab 250 mm thick with SL718, the transverse steel (for example, 8 mm @ 200 c/c) is inadequate for RED > 5.0 m. Hence for tied widths exceeding 10.0 m, the central lanes require increased transverse steel. SL718 would be adequate in the outer lanes where the RED is lower.

(c) Tied kerbs must be included in the calculation of RED.

(d) The values in brackets indicate the upper limit for relief-edge distance (RED) for the indicated mesh size. At larger distances, there is inadequate transverse steel to contain unplanned longitudinal cracking, hence a design check is required. See example in Note (b).

(e) In the indicated cases, mesh SL72 is theoretically suitable for base slab length, but not necessarily for large RED, but SL82 has been adopted for Roads and Maritime Services projects.

### TABLE 10.2: JOINT CORRUGATION DESIGN

<table>
<thead>
<tr>
<th>BASE THICKNESS 'D'</th>
<th>NUMBER OF CORRUGATIONS</th>
<th>CORRUGATION DEPTH 'h'</th>
<th>MINIMUM CORRUGATION HEIGHT 'v'</th>
<th>MINIMUM FLAT 'f'</th>
<th>MINIMUM VERTICAL 'g'</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;200</td>
<td>3</td>
<td>9 ± 3</td>
<td>20</td>
<td>10</td>
<td>45</td>
</tr>
<tr>
<td>200 - 240</td>
<td>3 or 4</td>
<td>10 ± 3</td>
<td>25</td>
<td>12</td>
<td>50</td>
</tr>
<tr>
<td>&gt;240</td>
<td>3 or 4</td>
<td>12 ± 3</td>
<td>30</td>
<td>15</td>
<td>50</td>
</tr>
</tbody>
</table>

**Table 10.2 Notes:**

(a) The top and bottom corrugations must be concave in the first-placed face (ie convex on the form).

(b) Two alternative form profiles are shown, one suited to slipforming and the other suited to fixed-form work.

(c) It is not necessary to match the corrugation type of existing slabs during full or part slab replacement.
At least one tie must be placed in any discrete section bounded by joints (for example, at kerb noses). Other kerb types (for example, SF) may be extruded. Such kerbs are deemed to satisfy the "with shoulder" criteria for pavement thickness design purposes (as long as they are also tied). Except for kerbs on islands (excluding mounted kerbs such as types SF, SG, SM) the angle of intersection must be 90° ± 6°, and the intersection used as a control for the location of adjacent joints. Where a base joint intersects the nose of an adjoining kerb (that is, in accordance with AS 1379 and must be either slipformed or fixed-formed (that is, they must not be extruded). Unless otherwise allowed in the Specification, kerb types SA, SB, SC, SE, SK and SL must be strength grade N32 "with shoulder" criteria.

An integral slab widening may be required in order to comply with Austroads Guide to Pavement Technology Part 2. See Detail J on MJ06 and Schedule S7.1 for further details.

A geotextile fulfills an important function in keeping granular material from entering the base/subbase interface.

Edge drains fulfill an important function in draining the water which commonly runs along the base/subbase interface.

Joints in kerbs (etc.) must be located to coincide with joints in the adjoining base, in accordance with R15. Jointed reinforced concrete pavement (JRPC) kerbs and barrier

Notes:

(a) Unless otherwise allowed in the Specification, kerb types SA, SB, SC, SE, SK and SL must be strength grade N32 in accordance with AS 1379 and must be either slipformed or fixed-formed (that is, they must not be extruded). Such kerbs are deemed to satisfy the "with shoulder" criteria for pavement thickness design purposes (as long as they are also tied). Other kerb types (for example, SF) may be extruded.

(b) An integral slab widening may be required in order to comply with Austroads Guide to Pavement Technology Part 2 "with shoulder" criteria.

(c) Edge drains fulfill an important function in draining the water which commonly runs along the base/subbase interface.

(d) At least one tie must be placed in any discrete section bounded by joints (for example, at kerb roses).

(e) Joints in kerbs (etc.) must be located to coincide with joints in the adjoining base, in accordance with R15.

Where the kerb is placed on top of base pavement, the kerb joint must be aligned with the underlying joint. Otherwise, kerb joints must be aligned at 90° ± 6° to the kerb line.

(f) The location of base joints relative to the extremities of islands and kerbs is critical. The dimensions so specified must be used as a control for the location of adjacent joints. Where a base joint intersects the nose of an adjoining kerb (that is, excluding mounted kerbs such as types SF, SG, SM) the angle of intersection must be 90° ± 6°, and the intersection must be such as to prevent the occurrence of re-entrant angles in the base.

Base joints must be extended into the adjoining kerb/median in like type.
NOTES
Typical slab replacements and repairs
1. Figure 12.1 shows various allowable RCP slab repair configurations. S12.1 describes each RCP slab repair case. Repairs must comply with one of these configurations, or a combining combination.
RCP cracking
2. Contain types of transverse cracking in RCP are to be expected and will usually not be injurious as long as they are vertical or oriented, and as long as the reinforcement is adequate. Those cases have been labeled as "design cracking".
Longitudinal cracking in RCP is undesirable because the resulting arrested slabs are susceptible to transverse cracking which will be more closely spaced than the desirable "design cracking". Existing transverse joints
4. The drawings in the "B" set typically show existing transverse joints as Type J9 (pavement contraction) whereas they may actually be Type J10 (formed contraction) or Type J16 (expansion), depending on the original construction method. (Before the adoption of sawcutting, RCP pavements were typically constructed using the "chequerboard" method whereby alternate slabs were fully formed and paved, and the remaining slabs were formed at a later date.)
5. In longitudinal slab repairs, a full-depth expansion cavity must be provided otherwise the repaired slab will bear the compressive forces of the full slab width when expansion acts later to close transverse joints. In these cases, especially, cases 1, 2, and 3, the width of the new expansion cavity should be less than the width of existing joint (below any sawcut and/or sealant). In full-width slab repairs, it is assumed that the full section will have the capacity to withstand these compressive forces. However, where doubt exists, it is recommended that a filler be provided of nominal thickness 7 ± 3 mm.

LENGTH OF SLAB
Width of residual slab.
FORMED AND DOWELLED
REGISTRATION NO OF PLANS
MJ

J9 LONGITUDINAL EDGE

J9 FORMED AND DWOLLED

J8 SAWN AND DWOLLED

COMMON JOINT TYPES - JRCP

Figure 12.1: TYPICAL SLAB REPLACEMENTS

SCHEDULE 12.1 (S12.1)

CASE 1: Longitudinal central strip repair - Compromise Practice
(a) The repair must extend between existing transverse joints.
(b) The new transverse joints are expansions (Type J16d) to provide an expansion cavity consistent with the cavity in the adjoining (existing) Type J9. See Note 5 (S12.1)
(c) See Note 10 (S12.3)

CASE 2: Longitudinal edge strip repair - Compromise Practice
(a) The repair must extend between existing transverse joints.
(b) The new transverse joints are expansions (Type J16d) to provide an expansion cavity consistent with the cavity in the adjoining (existing) Type J9. See Note 5 (S12.1)
(c) See Note 10 (S12.3)

EXPL A NATION
SCHEDULE 12.2 (S12.2) CASE STUDIES (REFER TO FIG 12.1)
CASE 3 : Transverse joint repair - Best Practice
(a) The repair must extend between existing longitudinal joints.
(b) The new sections of longitudinal joint must be consistent with the existing.
(c) If the existing longitudinal joint is usually the joint on the slab repair must provide an expansion cavity of similar width.
(d) The transverse joints need not be parallel but at corner angles must comply with Schedule 12.5 limits.

CASE 4 : Full-slab replacement - Compromise Practice
(a) See Note 10 (S12.3)

CASE 5 : Part-length repair - mid-slab - Best Practice
(a) The repair must extend between existing longitudinal joints.
(b) The new sections of longitudinal joint must be consistent with the existing.
(c) The new transverse joints are elements (Type J16d) to provide an expansion cavity consistent with the cavity in the adjoining (existing) Type J9. See Note 5 (S12.1)
(d) See Note 10 (S12.3)

CASE 6 : Full-slab replacement - Best Practice
(a) The repair must extend between existing longitudinal joints.
(b) The new sections of longitudinal joint must be consistent with the existing.
(c) The repair must extend between existing transverse joints.
(d) The repair must extend between existing transverse joints.
(e) See Note 10 (S12.3)

CASE 7 : Transverse joint repair - Best Practice
(a) The repair must extend between existing transverse joints.
(b) The new transverse joints are expansions (Type J16d) to provide an expansion cavity consistent with the cavity in the adjoining (existing) Type J9. See Note 5 (S12.1)
(c) See Note 10 (S12.3)

CASE 8 : Full-slab replacement - Best Practice
(a) The repair must extend between existing longitudinal joints.

CASE 9 : Transverse joint repair - Best Practice
(a) The repair must extend between existing longitudinal joints.

CASE 10 : Full-slab replacement - Best Practice
(a) The repair must extend between existing longitudinal joints.
SCHEDULE 13.1 (S13.1) CASE STUDIES (REFER TO FIGURE 13.1)

CASE 1: Kerb replacement
(a) Where traditional shaped JRCP slabs develop corner cracks near intersecting J7 joints as shown, the side of the JRCP slab and sitting kerb should ideally be reconstructed as shown in details K5 to provide adequate shoulder support.
(b) Replace existing part-slab with SFCP. Seek specialist advice regarding the use of mesh or bar reinforcement in detector slabs.

CASE 2: Single detector loop (drill-tied)
(a) Replace existing part-slab with SFCP. Seek specialist advice regarding the use of mesh or bar reinforcement in detector slabs.

CASE 3: Single detector loop (mid-slab)
(a) Replace existing part-slab with SFCP. Seek specialist advice regarding the use of mesh or bar reinforcement in detector slabs.

CASE 4: Double detector loop
(a) Replace existing part-slab with SFCP. Seek specialist advice regarding the use of mesh or bar reinforcement in detector slabs.

\[ J > 1.5 \text{ m} \]
\[ J = 0, \] or
\[ 1.0 \text{ m} \text{ MAX} \]
\[ 0.15 \text{ m} \text{ MIN} \]
\[ 6.0 \text{ m} \text{ MAX} \]
\[ 4.8 \text{ m} \text{ MIN} \]
\[ 0.8W \text{ preferred MIN} \]
\[ 1.5 \text{ m} \text{ MIN} \]

Figure 13.2: MISMATCH OF TRANSVERSE JOINTS

Figure 13.2 Notes:
Scenario 1: Pour B follows Pour A.
There is a risk of reflection cracking in Pour B (as shown) within days of casting. The risks are magnified by early trafficking because heavy vehicles will induce hinge deflections at the transverse joints of Pour A.
If the joint layout cannot be arranged such that \( J > 1.5 \text{ m} \), the existing slab will be damaged by the action of installing tie bars to the potential crack path, and until failure from the longitudinal joint within the overlap length \( J \).

Scenario 2: Pour A follows Pour B. Reflection cracking will not occur if the initial pour overlaps the second pour.

GENERAL NOTES:
- **A** = Length of slab R & R
- **B** = Length of slab R & R
- **C** = Length of slab R & R
- **D** = Length of slab R & R
- **E** = Length of slab R & R
- **F** = Length of slab R & R

**SCHEDULE 13.2 (S13.2) KEY AND NOTES**

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYMBOL</td>
</tr>
<tr>
<td>DIMENSION</td>
</tr>
<tr>
<td>DESCRIPTION AND COMMENTS</td>
</tr>
</tbody>
</table>

**G. VOROBIEFF**

Transport
Roads & Maritime Services
NSW

PAVEMENT STANDARD DRAWINGS
RIGID PAVEMENT
STANDARD DETAILS - MAINTENANCE MD.M10.MJ
JOINTED REINFORCED CONCRETE PAVEMENT (JRCP)
SLAB REPLACEMENT - MISCELLANEOUS WORK

REGISTRATION NO OF PLANS
ED 2 REV 1 28/05/2015 MJ

NO OF SHEETS 26

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13
**SCHEDULE 14.1 (S14.1) CASE STUDIES UNACCEPTABLE PRACTICES**

**CASE 1: Skewed trench - crossing a transverse contraction joint**

- (a) Corner angles more acute than 60°-80° are at risk of corner cracking and/or spalling.
  - This applies both to the residual (original) slabs and to the new trench slab.
- (b) All contraction joints must be continuous between free edges. If the contraction joint is not
  - Reliably aligned across the new trench slab, unplanned cracking will result (regardless of reinforcement).

**CASE 2: Skewed trench - mid-slab**

- (a) The slab cut-out is located in an area of high stress and so creates a risk of corner cracking.
  - Skewed cracking produces acute corners which are then prone to secondary cracking.
- (b) Because of the high deflections within corner cracks, mesh and/or bar reinforcement provides
  - Limited benefit. Large crack deflections (and openings) expose the reinforcement to rapid
  - Corrosion and possibility also to yield failure.

**CASE 3: Drainage pit - slab corner**

- (a) The transverse cracks induced by the pit resemble "design cracking" and are unlikely to cause
  - Distress unless they intersect joints (or cracks) at skew angles less than 60°-80°.
- (b) However, the existence of two close-spaced parallel cracks increases the risk of longitudinal
  - Cracking (resulting in block cracking).

**CASE 4: Drainage pit - mid-slab**

- (a) The slab cut-out is located in an area of high stress and so creates a risk of corner cracking.
  - Skewed cracking produces acute corners which are then prone to secondary cracking.
- (b) The relative contraction movements between the pit and the slab will increase with increasing
  - Distance of the pit from the slab centroid. The design of the isolation joint must cater for the worst
  - Case.

**CASE 5: Service pit - slab corner**

- (a) Consistent with Case 1, corner angles more acute than 60°-80° are at risk of corner cracking.
  - This applies to both the original slab and to the replacement slab.
- (b) Consistent with Case 3, mesh and/or bar reinforcement provides limited benefit. Large crack
  - Deflections (and openings) expose the reinforcement to rapid corrosion and possibility also to yield
  - Failure.

**CASE 6: Service pit - slab corner**

- (a) Consistent with Case 3, mesh and/or bar reinforcement provides limited benefit. Large crack
  - Deflections (and openings) expose the reinforcement to rapid corrosion and possibility also to yield
  - Failure.
- (b) There will be large contraction movements of the slab relative to the pit because of the distance
  - To the slab centroid. The design of the isolation joint must cater for the worst case.

**CASE 7: Patch repair - corner or part-width or part-length**

- (a) The cut-out is certain to generate cracking. If the crack runs square to the adjacent longitudinal
  - Joint then further distress may occur because of the increased risk of longitudinal cracking
  - (resulting in block cracking). If the crack intersects at a skew then secondary cracking is inevitable.

**CASE 8: Patch repair - corner or mid-length of slab**

- (a) A Type J joint would increase the risk of block cracking because it would reduce the size of
  - The residual slab.
- (b) Comments under Case 7 also apply.

**CASE 9: Service pit - mid slab, circular**

- (a) A circular pit located within the centre (not length-wise) of the slab is likely to generate a single
  - Transverse crack which is unlikely to cause distress because it effectively constitutes
  - "design cracking".
- (b) A Type J joint is desirable to produce a controlled crack which would reduce the risk of acute
  - Intersections at the pit.
- (c) The relative contraction movements between the pit and the slab will increase with increasing
  - Distance of the pit from the slab centroid. The design of the isolation joint must cater for the worst
  - Case.

**CASE 10: Patch repair or utility - mid-slab, rectangular**

- (a) The cut-out is certain to generate cracking. If the crack runs square to the adjacent longitudinal
  - Joint (there is an increased risk of longitudinal cracking (resulting in block cracking). There is a high
  - Risk that the cracking will be skewed.
- (b) The relative contraction movements between the pit and the slab will increase with increasing
  - Distance of the pit from the slab centroid. The design of the isolation joint must cater for the worst
  - Case.

**CASE 11: Patch repair or utility - edge**

- (a) The comments for Case 10 apply.
- (b) Comments under Case 7 also apply.

**CASE 12: Longitudinal trench**

- (a) Trenching will produce elongated slabs which will lead to reduced life unless dimensional limits
  - Are observed.
- (b) Comments under Case 7 also apply.

**CASE 13: Mismatched transverse contraction joint**

- (a) This is similar to Case 7 and 8.
- (b) Comments under Case 7 also apply.

**CASE 14: Detector loop sawcutting**

- (a) Sawcuts act as crack initiators, particularly under flexural fatigue loading.
- (b) It is difficult to establish safe limits for sawcut depth because fatigue is a highly variable distress
  - Mechanism, and stress levels vary widely in different zones of the slab.
- (c) The presence of reinforcing mesh within the slab can significantly reduce the sensitivity of the loop
  - To detect the presence of vessels.

**FIGURE 14.1: UNACCEPTABLE WORK PRACTICES**

SEE SCHEDULE 14.1 FOR EXPLANATORY NOTES
SCHEDULE 15.1 (S15.1): FULL AND PART-SLAB R & R

ACTIVITY 1. Sawcutting

1. Two types of sawcuts are typically required:

(a) Perimeter cuts along existing joints (or with a minor offset) to:
   - assist in slab removal;
   - reduce the risk of edge and anti-damage on the slabs which are to remain;
   - correct defects in the joints or adjacent slabs.

(b) Internal cuts within the slab to break it into manageable pieces to facilitate removal of a maximum with a minimum to adjacent slabs and to the subbase.

2. Internal cuts are typically just less than full-depth, but should not be deep enough to touch a concrete subbase. Their location will depend on whether existing lateral aspects to be sawed or not.

3. (a) To save labour, sawcuts must be located to provide lap lengths of 300 mm for N12 bars and 400 mm for N16 bars. Shorter lengths are allowed (in accordance with AS3600) for wider spaced.

(b) If existing lateral aspects are to be replaced by drill-lift, sawcuts would typically be about 200 mm from joints, but may be varied to suit individual conditions.

3. Perimeter cuts may be either full-depth or part-depth, and their precise location relative to the joint needs consideration. Factors include:

(a) whether bar cuts are to be saved or not;
(b) whether defects in the exposed face need to be corrected (for example spalling and/or cracking);
(c) whether the existing corrugations or keyways are to be sawed, see also Activity 3.

Where existing corrugations are conforming, it is preferable to retain them (perhaps with minor corrections) rather than replacing them with a sawcut surface.

4. Longitudinal sawcuts which forcefully an existing longitudinal joint may extend to 250 mm beyond the limits of removal. Longitudinal sawcuts which are off-set from an existing longitudinal joint must not extend beyond the limits of removal. Transverse sawcuts must not extend beyond the limits of removal.

5. Every effort must be made to prevent sawcutting slurry from entering joints or cracks not extend beyond the limits of removal. Transverse sawcuts must

6. (a) The perimeter strip is then removed manually, in accordance with Note 2.1.

(b) Where existing corrugations are conforming, it is preferable to retain them (perhaps with minor corrections) rather than replacing them with a sawcut surface.

(c) Internal sawcuts are used to break the slab into smaller pieces for removal.

(d) In the slabs which are to remain.

7. Every effort must be made to prevent sawcutting slurry from entering joints or cracks in the slabs which are to remain.

4. Reinforcement of new cut

1. Drill-lift must be provided to replace or supplement existing rebars. The final splicer spacing must be as follows:

   - Transverse construction joints: 500 mm centres.
   - Longitudinal joints: design spacings in accordance with Table 5.1.

2. All other feature details must be in accordance with Schedule 5.2.

3. Where two adjoining slabs (joined by a common longitudinal joint) are to be replaced by drill-lift, the debonding treatment on LCS is wax emulsion applied at a rate of 0.5 litre/m². The exposed horizontal gap between the subbase and the base should also be sealed with a water resisting sealant if excavated to 0.5 m below the slab face.

4. Before the replacement base is placed, the full face of all joints must be thoroughly spalled, and the pavement should not be opened to traffic until the concrete has attained insitu strength.

5. Concrete mix

1. All waste material resulting from the above operations must be removed.

2. A cover aggregate may be warranted to facilitate access by workers and construction vehicles.

3. Solidification of concrete

1. Dowels must be provided in accordance with Schedule 7.2.

2. At formed joints the dowel length within the second placed slab must be debonded to minimise early stress on the fresh concrete.

5. Subbase repairs

1. Seek specialist advice for assessment and repair of subbase.

2. Cracks in the subbase should be examined for wavelengths, length, and for excessive crack widths. The major risks associated with such defects are:

   (a) reflection of subbase cracks into the new base;
   (b) high-impact loading which may initiate unplanned base cracking.

7. Cleaning out the repair

1. It is important to achieve a suitable level of debonding between the subbase and base layers, for the following reasons:

   - strong bonding may initiate unscheduled base cracking;
   - very low friction can result in poor induction of joints.

2. Debonding must confirm with N025.

3. The typical debonding treatment on LCS is wax emulsion applied at a rate of 0.5 litre/m². For granular subbase (including mixed concrete), a slurry emulsion must be used. A cover aggregate may be warranted to facilitate access by workers and construction vehicles. An alternative method of debonding the subbase and base is to place polyethylene sheeting on the subbase in accordance with N025.

8. Subbase debonding

1. Fascia

2. Before the replacement base is placed, the full face of all joints must be thoroughly cleaned and then treated with a fascia agent in accordance with Schedule 7.1.

3. Joint and cracks

(a) (a) All joints, cracks and any underlying cracks in the exposed subbase must be treated with a silicon sealant to prevent ingress of grout. The exposed horizontal gap between the subbase and the base should also be sealed with a water resistant sealant if excavated to 0.5 m below the slab face.

(b) The exposed horizontal gap between the subbase and the base should also be sealed with a water resistant sealant if excavated to 0.5 m below the slab face.

(c) Ingress of grout will create uneven bedding under the adjacent slab when the direction of curing reverses.

10. Reinforcement

1. Replacement rebars must be meshed as shown in Table 10.1.

2. Mesh must be placed to cover specify as in Note 9.1 Schedule 7.1.

11. Concrete mix design

1. The concrete mix must be designed with consideration of:

   (a) structural and thickness design requirements;
   (b) construction logistics;
   (c) strength development needs to suit trafficking requirements.

12. Placing of new concrete

1. Work must be in accordance with N025.

13. Jointing

1. New joints must be designed and constructed in accordance with N025-M025.

14. Opening to traffic

1. The pavement should not be opened to traffic until the concrete has achieved insitu compresive strength of 20 MPa.

2. In order to monitor the rate of strength gain actualy achieved on site, additional cylinders should be cast and curred alongside the slab and in a similar manner. Progressive testing of these cylinders will provide the best guidance for timing of access to the repair area.

3. In cases where the requirements of Note 14.3 are not practicable, experience with similar materials and work processes may be used to guide the user.

Note:
(a) Notes in this Schedule are refered to by both Activity and Method number. For example note 14.1 relates to trafficking strength.
### Joints Exposed During R & R

#### Exposed Joint Type

<table>
<thead>
<tr>
<th>Joint Type</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>Longitudinal; tied and sawn</td>
<td>Refer to Figure 16.1</td>
</tr>
<tr>
<td>J2</td>
<td>Corrugated; tied and formed</td>
<td>Further remedial treatment may be required under the following conditions:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(a) When a joint becomes sawn</td>
</tr>
<tr>
<td>J3</td>
<td>Kept</td>
<td>Refer to Figure 16.3</td>
</tr>
<tr>
<td>J4</td>
<td>But</td>
<td>Refer to Figure 17.1</td>
</tr>
<tr>
<td>J5</td>
<td>Longitudinal; tied and ribbed</td>
<td>When an existing J4 face is exposed, the required treatment will depend on whether the new joint will be tied or untied. The alternatives are as follows.</td>
</tr>
<tr>
<td>J6</td>
<td>New untied joints are not expected to transfer shear loads and do not need to be scabbled.</td>
<td></td>
</tr>
<tr>
<td>J7</td>
<td>New untied joints are not expected to transfer shear loads and do not need to be scabbled.</td>
<td></td>
</tr>
<tr>
<td>J8</td>
<td>Transverse construction: sawn</td>
<td>Not valid.</td>
</tr>
</tbody>
</table>

#### Transverse Construction: Formed and Dowelled

<table>
<thead>
<tr>
<th>Joint Type</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>J9</td>
<td>Transverse construction; sawn and dowelled</td>
<td>Treat in accordance with Table 10.2.</td>
</tr>
<tr>
<td>J10</td>
<td>Transverse construction; formed and dowelled</td>
<td>Treat in accordance with Table 20.10.</td>
</tr>
<tr>
<td>J11</td>
<td>Transverse construction; formed</td>
<td>Not valid.</td>
</tr>
<tr>
<td>J12</td>
<td>Transverse construction; formed and dowelled</td>
<td>Treat in accordance with Table 10.2.</td>
</tr>
<tr>
<td>J13</td>
<td>Transverse construction; formed</td>
<td>Not valid.</td>
</tr>
<tr>
<td>J14</td>
<td>Transverse construction; formed and dowelled</td>
<td>Treat in accordance with Table 10.2.</td>
</tr>
</tbody>
</table>

#### Transverse Construction: Dowelled

<table>
<thead>
<tr>
<th>Joint Type</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>J15</td>
<td>Transverse construction; dowelled</td>
<td>Treat in accordance with Table 20.14.</td>
</tr>
<tr>
<td>J16</td>
<td>Transverse construction; dowelled</td>
<td>Treat in accordance with Table 10.20.</td>
</tr>
</tbody>
</table>

#### Transverse Construction: Tied and Sawn

<table>
<thead>
<tr>
<th>Joint Type</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>J17</td>
<td>Hinge: tied and sawn</td>
<td>Refer to Figure 16.1.</td>
</tr>
<tr>
<td>J18</td>
<td>Longitudinal edge and beamed</td>
<td>Where widening is required at a Type J18, treat the edge according to the new joint type.</td>
</tr>
</tbody>
</table>

#### Transverse Construction: Untied and Dowelled

<table>
<thead>
<tr>
<th>Joint Type</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>J19</td>
<td>Untied joints do not need to be scabbled.</td>
<td></td>
</tr>
<tr>
<td>J20</td>
<td>Carry out spall repairs in accordance with MJ 24 and MJ 25.</td>
<td></td>
</tr>
<tr>
<td>J21</td>
<td>Design a sealant in accordance with MJ 08.</td>
<td></td>
</tr>
</tbody>
</table>

#### Transverse Construction: Formed and Dowelled

<table>
<thead>
<tr>
<th>Joint Type</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>J22</td>
<td>Formed joint normally do not require sealing, but a (sealed) joint may be desirable in some situations to minimise the stress on the adjoining slabs, particularly where a spall repair has been carried out.</td>
<td></td>
</tr>
<tr>
<td>J23</td>
<td>Transverse construction; formed and dowelled</td>
<td>Not valid.</td>
</tr>
<tr>
<td>J24</td>
<td>Transverse construction; formed and dowelled</td>
<td>Design a sealant in accordance with Table 10.2.</td>
</tr>
<tr>
<td>J25</td>
<td>Transverse construction; formed and dowelled</td>
<td>Design a sealant in accordance with Table 10.2.</td>
</tr>
</tbody>
</table>

#### Transverse Construction: Dowelled, Tied and Sawn

<table>
<thead>
<tr>
<th>Joint Type</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>J26</td>
<td>Transverse construction; dowelled and tied</td>
<td>Design a sealant in accordance with MJ 08.</td>
</tr>
<tr>
<td>J27</td>
<td>Transverse construction; dowelled and tied</td>
<td>Design a sealant in accordance with MJ 08.</td>
</tr>
<tr>
<td>J28</td>
<td>Transverse construction; dowelled and tied</td>
<td>Design a sealant in accordance with MJ 08.</td>
</tr>
</tbody>
</table>

#### Transverse Construction: Untied and Dowelled

<table>
<thead>
<tr>
<th>Joint Type</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>J29</td>
<td>Design a sealant in accordance with MJ 08.</td>
<td></td>
</tr>
<tr>
<td>J30</td>
<td>Carry out spall repairs in accordance with MJ 24 and MJ 25.</td>
<td></td>
</tr>
</tbody>
</table>

#### Transverse Construction: Dowelled, Tied and Sawn

<table>
<thead>
<tr>
<th>Joint Type</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>J31</td>
<td>Transverse construction; dowelled and tied</td>
<td>Design a sealant in accordance with MJ 08.</td>
</tr>
</tbody>
</table>

### Notes

- (a) Where widening is required at a Type J6, treat the edge according to the new joint type. See MJ4 and MJ5 for guidance on the treatment of sawn and roughed edges.
- (b) Where a joint becomes sawn, it is serious and should be removed and treated as required.
- (c) The joint effectively converts to a Type J2, scabbled. |

### Figures

#### Figure 16.1: Existing Joint Recess

<table>
<thead>
<tr>
<th>Case 1: Exposed concave face</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW SLAB</td>
</tr>
<tr>
<td>SAWCUT</td>
</tr>
<tr>
<td>SCABBLE</td>
</tr>
<tr>
<td>POTENTIAL SPALL</td>
</tr>
<tr>
<td>CRACK</td>
</tr>
<tr>
<td>INDUCED CRACK</td>
</tr>
<tr>
<td>TEBRIS</td>
</tr>
<tr>
<td>TIEBAR</td>
</tr>
</tbody>
</table>

**Option 1:** Sawcut and scabbel as shown to provide the specified minimum vertical face dimension.

**Option 2:** Sawcut to the bottom of the top corrugation. Suitable the sawn section which is more than 25 mm from the top (as shown in Figure 17.1).

#### Figure 16.3: Keyed Joints

<table>
<thead>
<tr>
<th>Case 1: Typical keyed joint</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW SLAB</td>
</tr>
<tr>
<td>SAWCUT</td>
</tr>
<tr>
<td>COMMON</td>
</tr>
<tr>
<td>HINGE</td>
</tr>
<tr>
<td>TEBRIS</td>
</tr>
</tbody>
</table>

**Option 1:** Replacement of the convex slab does not carry the same risk as with the concave slab. However, the top section of the convex side remains at risk of future failure (particularly if the top vertical face is less than about 45 mm) and so the preventative work is warranted in conjunction with replacement of the convex side. |

**Option 2:** The sawn (as shown) may also be desirable in order to: |
- (a) или (b) After spall removal (or rounding), and/or |
- (c) Untied joints do not need to be scabbled. |
- (e) Untied joints do not need to be scabbled. |
- (c) Untied joints do not need to be scabbled. |
- (b) Untied joints do not need to be scabbled. |
- (a) Untied joints do not need to be scabbled. |
- (b) Untied joints do not need to be scabbled. |
- (c) Untied joints do not need to be scabbled. |
- (d) Untied joints do not need to be scabbled. |
- (a) Untied joints do not need to be scabbled. |
- (b) Untied joints do not need to be scabbled. |
- (c) Untied joints do not need to be scabbled. |
- (d) Untied joints do not need to be scabbled. |
- (a) Untied joints do not need to be scabbled. |
- (b) Untied joints do not need to be scabbled. |
- (c) Untied joints do not need to be scabbled. |
- (d) Untied joints do not need to be scabbled. |
Case 1: Model ribboned joint

Case 2: Curled and vertical

Case 3: Curled and inclined

Case 4: Curled and inclined

Case 5: Curled and vertical

Case 6: Curled and inclined

Case 7: Curled and inclined

Figure 17.2 Notes:
1. Ribboned joints are no longer used for new construction or maintenance work.
2. Where the new joint will be tied, a sealant will not be required in most cases. Where the new joint will be untied, a sealant must be designed in accordance with MJ08.
3. Shading indicates the following:
   - [x] Spall
   - [ ] Sawcut
   - [ ] Sawcut and scabble.
   - [ ] Carry out a spall repair as shown on MJ24 and MJ25.

Specifications required that ribbons be placed as shown here. However, their accuracy was highly variable and they will often be found deeper and/or curled and/or inclined.

Where the ribbon was well installed, joint exposure will leave a face which requires little or no treatment (apart from debonding) before concrete placement.

Where deep sawing is used, the face must be scabbled below the line D/3+10 mm from the top (as shown in Figure 17.1). Sawcut and scabble.

The location of the sawcut is dictated by the vertical face dimension (of 45 mm minimum) and the need to transition the underlying face at a slope not greater than 1 in 3.

Carry out a spall repair as shown on MJ24 and MJ25.

The warrant for scabbling is detailed under Activity 3 (S15.1). The face must be debonded in accordance with Activity 9 (S15.1).

Scabbling must be thorough enough to expose coarse aggregate damage from scabbling and to minimise arris spalling.

The top and bottom sections must be left smooth to prevent surface with indentations 4-6 mm deep that will provide a key for the new slab.

Scabbling to near vertical face dimension, and the limiting slope (of 45 mm maximum) and the need to transition the underlying face at a slope not greater than 1 in 3.

Consideration also needs to be given to the resulting face after treatment.
TABLE 18.1: STITCHING NOTES

<table>
<thead>
<tr>
<th>CASE 1</th>
<th>Longitudinal cracking</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>May be suitable for stitching</td>
</tr>
<tr>
<td>(b)</td>
<td>Success is improved for d greater than 1 m.</td>
</tr>
<tr>
<td>(c)</td>
<td>Cracking could be due to an inactive shoulder joint which may need sawing and/or deepening.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CASE 2</th>
<th>Slowed longitudinal cracking</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>May be suitable for stitching if completed before the crack reaches another longitudinal joint or slab edge.</td>
</tr>
<tr>
<td>(b)</td>
<td>Secondary corner cracking is likely if it is less than 70%.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CASE 3</th>
<th>Transverse mid-slab cracking</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>May be suitable for stitching</td>
</tr>
<tr>
<td>(b)</td>
<td>Success is improved for d greater than 1.5 m.</td>
</tr>
<tr>
<td>(c)</td>
<td>See Note 2 of Case 1.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CASE 4</th>
<th>Longitudinal cracking</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>May be suitable for stitching where d is greater than 0.6 m and concrete is sound.</td>
</tr>
<tr>
<td>(b)</td>
<td>Success is reduced if other distress such as advanced arris spalling is present because this could indicate low strength concretes.</td>
</tr>
<tr>
<td>(c)</td>
<td>For d less than 0.6 m (approximately) refer to Case 5.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CASE 5</th>
<th>Small area objects</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Not suitable for stitching where d is less than 0.6 m (approximately). Treat according to Case II on MJ12 (or Case II if approved).</td>
</tr>
<tr>
<td>(b)</td>
<td>Multiple cracking. Ongoing deterioration is likely.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CASE 6</th>
<th>Late slab cracking</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Not suitable for stitching. Drying deterioration is likely.</td>
</tr>
<tr>
<td>(b)</td>
<td>This crack is usually opening as the contraction joint and so stitching would lock up the joint.</td>
</tr>
<tr>
<td>(c)</td>
<td>Treat according to Case II on MJ12 (or Case II if approved).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CASE 8</th>
<th>Late edge cracking</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Not suitable for stitching.</td>
</tr>
<tr>
<td>(b)</td>
<td>The crack is starting to open as the contraction joint and so stitching would lock up the joint.</td>
</tr>
<tr>
<td>(c)</td>
<td>Treat according to Case II on MJ12 (or Case II if approved).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CASE 10</th>
<th>Longitudinal tie joint</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>May be suitable for stitching (no supplement needed).</td>
</tr>
<tr>
<td>(b)</td>
<td>Do not stitch joints which are intended to be untied.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CASE 11</th>
<th>KERBS (TIED)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>May be suitable for stitching.</td>
</tr>
<tr>
<td>(b)</td>
<td>For convenience, insert all stitch bars from the pavement side.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CASE 12</th>
<th>Anchor Slabs</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Stitching is not required or warranted in reinforced anchor slabs.</td>
</tr>
<tr>
<td>(b)</td>
<td>In unreinforced anchor slabs (tie is, superseded design) stitching has had only moderate success because secondary cracking is likely.</td>
</tr>
</tbody>
</table>

TABLE 18.2: STITCHING LENGTHS

<table>
<thead>
<tr>
<th>Base thickness (D) (mm)</th>
<th>Offset drill hole to crack (L1) (mm)</th>
<th>Length of drill hole (L1) (mm)</th>
<th>Length of stitch-bar (L2) (mm)</th>
<th>Length of protection (L3) (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>190</td>
<td>150</td>
<td>330</td>
<td>280</td>
<td>40.5</td>
</tr>
<tr>
<td>250</td>
<td>210</td>
<td>370</td>
<td>230</td>
<td>45.5</td>
</tr>
<tr>
<td>300</td>
<td>250</td>
<td>340</td>
<td>260</td>
<td>45.5</td>
</tr>
<tr>
<td>350</td>
<td>280</td>
<td>400</td>
<td>280</td>
<td>45.5</td>
</tr>
<tr>
<td>400</td>
<td>310</td>
<td>450</td>
<td>300</td>
<td>50.5</td>
</tr>
<tr>
<td>450</td>
<td>340</td>
<td>500</td>
<td>330</td>
<td>50.5</td>
</tr>
<tr>
<td>500</td>
<td>370</td>
<td>550</td>
<td>360</td>
<td>60.5</td>
</tr>
<tr>
<td>550</td>
<td>400</td>
<td>600</td>
<td>390</td>
<td>60.5</td>
</tr>
<tr>
<td>600</td>
<td>430</td>
<td>650</td>
<td>420</td>
<td>75.5</td>
</tr>
</tbody>
</table>

Table 18.2 Notes:
(a) To suit slit angle a = 30° and cover t = 25 mm
(b) See Fig 18.2 for protection details

**NOTES**

1. Cross Stitching Compronsation Practice is a technique which may extend the service life of a slab before more extensive repairs such as slab replacement are necessary.
2. Cross stitching may only be used with the written approval of the Principal.
3. Cross stitching of ACIP cracks or tied joints is only needed where the crack/fissure joint opens up beyond 0.5 mm, due to causes such as inadequate or corroded mesh reinforcement or others (as applicable). Cracks that are not opening (i.e., are stable) should not be stitched and may also not be required to be noted. See Fig 18.2.12.
4. Stitching is unlikely to be effective if:
   (a) the slab has two or more cracks, or
   (b) the concrete has low strength (less than 25 MPa), or
   (c) where base thickness is less than 140 mm.
5. Crack stitching will be most successful if it is completed very soon after formation of the crack, before it widens. Poorly tied joints should also be stitched before they widen. Early stitching will:
   (a) maximise load transfer between slabs, hence:
   (b) significantly reduce the chances of secondary cracking;
   (c) avoid the need for routing and sealing.
   For the same reason, stitches must be heat fixed (heat is, applied) during warmer weather (or during the middle of the day) when the crack is most tightly closed.
6. The decision to stitch (p) preference to alternatives such as slab replacement should take consideration factors such as:
   (a) the quality of the concrete (as indicated by distress additional to cracking, such as arris spalling, surface abrasion, condition of adjacent slabs),
   (b) intensity of heavy vehicular traffic,
   (c) previous stress under similar conditions.
7. Protection must be provided in accordance with Figure 18.2 if the crack is wider than 0.5 mm. Suitable protection is provided by bittuminous paint with a thickness of 0.2 to 0.5 mm.
8. Use compressible self expanding polyurethane resin (foam) to seal wider cracks and joints only.

**ILLUSTRATIONS**

**FIGURE 18.1: TYPICAL CROSS-STITCHING APPLICATIONS**

**FIGURE 18.2: STITCH-BAR PROTECTION**

**SCHEDULE 18.2 (S18.2)**

**METHOD**

1. Investigate base thickness, determine the required length of stitch-bar, and offset of drill-holes.
2. Mark hole locations.
3. Drill holes (drill hole vertically for the first 10 mm to start). If crack sealing is required, the initial hole diameter must be less than the final hole diameter of 16 mm.
4. Where the crack widens exceeds 1 to 2 mm, seal it (at the level of the stitch-bar) with self expanding resin (foam) to prevent escape of the epoxy.
5. Where sealing has been undertaken, ream the hole after the self expanding resin (foam) has set using a tool to approximately 25 mm below the surface.
6. Thoroughly clean holes using a vacuum cleaner.
7. Inject resin to the manufacture's instructions to fill approximately 1/3 of the depth of the hole.
8. Insert the stitch-bar while gently oscillating the bar. Push the bar to the required depth.
9. Inject further resin if required:
   a) to the surface if the resin is the capping material, or
   b) to approximately 25 mm below the surface.
10. If the capping material is different from the resin, top off with the capping material after the resin has set.
11. After the capping material has set, open to traffic.

**TABLE 18.4: STITCH-BAR SPACINGS FOR TRANSVERSE AND CORNER CRACKS**

<table>
<thead>
<tr>
<th>Spacing (mm)</th>
<th>Joint offset (A) (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN</td>
<td>MAX (TYPE AND MIN)</td>
</tr>
<tr>
<td>Transverse cracks</td>
<td>500</td>
</tr>
<tr>
<td>Corner cracks</td>
<td>300</td>
</tr>
</tbody>
</table>

**TABLE 18.3: STITCH-BAR SPACINGS FOR LONGITUDINAL CRACKS AND JOINTS**

<table>
<thead>
<tr>
<th>Base thickness (D) (mm)</th>
<th>Spacing(R)r (mm)</th>
<th>Joint offset (A) (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 - 3.5</td>
<td>1200</td>
<td>300</td>
</tr>
<tr>
<td>3.6 - 4.0</td>
<td>900</td>
<td>600</td>
</tr>
<tr>
<td>4.1 - 4.5</td>
<td>600</td>
<td>900</td>
</tr>
<tr>
<td>4.6 - 5.0</td>
<td>300</td>
<td>1200</td>
</tr>
<tr>
<td>5.1 - 5.5</td>
<td>900</td>
<td>1500</td>
</tr>
<tr>
<td>5.6 - 6.0</td>
<td>600</td>
<td>1800</td>
</tr>
<tr>
<td>6.1 - 6.5</td>
<td>300</td>
<td>2100</td>
</tr>
<tr>
<td>6.6 - 7.0</td>
<td>180</td>
<td>2400</td>
</tr>
<tr>
<td>7.1 - 7.5</td>
<td>900</td>
<td>2700</td>
</tr>
<tr>
<td>7.6 - 8.0</td>
<td>600</td>
<td>300</td>
</tr>
<tr>
<td>8.1 - 8.5</td>
<td>300</td>
<td>330</td>
</tr>
</tbody>
</table>

**TABLE 18.5: SCHEDULES**

<table>
<thead>
<tr>
<th>ISSUE</th>
<th>DATE</th>
<th>SHEET NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>28/05/2015</td>
<td>18</td>
<td>SHEET 26</td>
</tr>
</tbody>
</table>
SCHEDULE 19.1 (S19.1)

1. This procedure is for the resealing of transverse and longitudinal joints in JCP. It is not suitable for open joints and MJ22 and MJ23 are also suitable for sealing of joints that were previously unseen and/or unsealed. Example: transverse construction joints; longitudinal formed filler joints, kerf joints. (Some of the reasons for seeing these joints are to minimise air spalling, to minimise water ingress and to protect against corrosion.)

2. Sealant performance is affected by the application of the concrete, hence:
   (a) the old sealant must be fully removed because it may be incompatible with the new one.
   (b) compressed air must be dried and could be at a pressure of about 410 kPa.
   (c) cleaning (preferably by washing) should be undertaken immediately after sawing (before the slurry dries) to minimise adherence of fine to joint faces.
   (d) at all times of sawing, the reservoir must be thoroughly clean and dry, and must be free from all loose fines (such as dust from worn concrete) and any other material which may reduce the bond.
   (e) The cleanliness of the joint faces must be tested in accordance with T379. An acceptable limit is when Grade 1 (None) visual quality is achieved. The adhesion of the sealant must be tested in accordance with T370.

3. Grit blasting should not be required if wet cleaning has been satisfactory. Grit blasting may create further dust, in which case the joint must be thoroughly redecorated before sawing.

4. Ingress of solids into existing joints (and underlying cracks) should be minimised. If there is a spine in the old sawcut below the reservoir, it should not be disturbed. Where no spine is found, the sawcut below the reservoir should be thoroughly flushed out with high pressure air or water during the cleaning process. In order to maximise the progressive flushing of sawcutting debris, cutting should proceed from the high side of the pavement towards the low side.

5. Sealants and their backer rods should be continuous between longitudinal joints. At joint junctions, priority must be given to the joint which will undergo the greatest movement. For example:
   (a) transverse contraction joints must be continuous across longitudinal filled joints.
   (b) longitudinal isolation joints should be continuous, with priority over contraction joints.

6. The permanent sealant must be an intumscible silicone sealant, sized and installed in accordance with the manufacturer’s written instructions.

7. Sealants must extend down the full vertical face of joints at all edges to prevent the ingress of verge materials into the joint. At longitudinal joints, the edge sealant must prevent the ingress of concrete into the transverse joints during subsequent paving runs.

8. In the widening of (re)sawing, it is not necessary to remove all spalling. Even in new construction, minor spalling (3-6 mm) is unavoidable and does not usually affect the performance of silicone sealants.

9. In Table 19.2, select the row corresponding to the nominated W’    .

10. If W’    exceeds the existing joint width, adopt the values in that row for the (re)sawing.

11. In Table 19.2, select the row corresponding to the nominated W’    .

12. If the depth of joint D’ or the filling of the reservoir exceeds the existing joint width, adopt the values in that row for the (re)sealing.

13. In Table 19.2, select the row corresponding to the nominated W’    .

14. For untied joints:
   (a) Design joint opening Oj    or the width required to remove the desired amount of spalling.
   (b) Place the sealant in accordance with the specification and in accordance with manufacturer’s instructions (including a primer, where required). Tool it to enhance the bond and to provide the finishing touches.

15. Joint depth
   (a) Use a polyurethane sealant for the joints that are parallel to the traffic.

16. Joint depth
   (b) Use a polyurethane sealant for the joints that are perpendicular to the traffic.

17. Joint depth
   (c) Use a polyurethane sealant for the joints that are at right angles to the traffic.

18. Joint depth
   (d) Use a polyurethane sealant for the joints that are at an angle to the traffic.

19. Joint depth
   (e) Use a polyurethane sealant for the joints that are at an acute angle to the traffic.

20. Joint depth
   (f) Use a polyurethane sealant for the joints that are at an obtuse angle to the traffic.

21. Joint depth
   (g) Use a polyurethane sealant for the joints that are at a right angle to the traffic.

22. Joint depth
   (h) Use a polyurethane sealant for the joints that are at an acute angle to the traffic.

23. Joint depth
   (i) Use a polyurethane sealant for the joints that are at an obtuse angle to the traffic.

24. Joint depth
   (j) Use a polyurethane sealant for the joints that are at a right angle to the traffic.

25. Joint depth
   (k) Use a polyurethane sealant for the joints that are at an acute angle to the traffic.

26. Joint depth
   (l) Use a polyurethane sealant for the joints that are at an obtuse angle to the traffic.

27. Joint depth
   (m) Use a polyurethane sealant for the joints that are at a right angle to the traffic.

28. Joint depth
   (n) Use a polyurethane sealant for the joints that are at an acute angle to the traffic.

29. Joint depth
   (o) Use a polyurethane sealant for the joints that are at an obtuse angle to the traffic.

30. Joint depth
   (p) Use a polyurethane sealant for the joints that are at a right angle to the traffic.

31. Joint depth
   (q) Use a polyurethane sealant for the joints that are at an acute angle to the traffic.

32. Joint depth
   (r) Use a polyurethane sealant for the joints that are at an obtuse angle to the traffic.

33. Joint depth
   (s) Use a polyurethane sealant for the joints that are at a right angle to the traffic.

34. Joint depth
   (t) Use a polyurethane sealant for the joints that are at an acute angle to the traffic.

35. Joint depth
   (u) Use a polyurethane sealant for the joints that are at an obtuse angle to the traffic.

36. Joint depth
   (v) Use a polyurethane sealant for the joints that are at a right angle to the traffic.

37. Joint depth
   (w) Use a polyurethane sealant for the joints that are at an acute angle to the traffic.

38. Joint depth
   (x) Use a polyurethane sealant for the joints that are at an obtuse angle to the traffic.

39. Joint depth
   (y) Use a polyurethane sealant for the joints that are at a right angle to the traffic.

40. Joint depth
   (z) Use a polyurethane sealant for the joints that are at an acute angle to the traffic.

41. Joint depth
   (A) Use a polyurethane sealant for the joints that are at an obtuse angle to the traffic.

42. Joint depth
   (B) Use a polyurethane sealant for the joints that are at a right angle to the traffic.

43. Joint depth
   (C) Use a polyurethane sealant for the joints that are at an acute angle to the traffic.

44. Joint depth
   (D) Use a polyurethane sealant for the joints that are at an obtuse angle to the traffic.

45. Joint depth
   (E) Use a polyurethane sealant for the joints that are at a right angle to the traffic.

46. Joint depth
   (F) Use a polyurethane sealant for the joints that are at an acute angle to the traffic.

47. Joint depth
   (G) Use a polyurethane sealant for the joints that are at an obtuse angle to the traffic.

48. Joint depth
   (H) Use a polyurethane sealant for the joints that are at a right angle to the traffic.

49. Joint depth
   (I) Use a polyurethane sealant for the joints that are at an acute angle to the traffic.

50. Joint depth
   (J) Use a polyurethane sealant for the joints that are at an obtuse angle to the traffic.

51. Joint depth
   (K) Use a polyurethane sealant for the joints that are at a right angle to the traffic.

52. Joint depth
   (L) Use a polyurethane sealant for the joints that are at an acute angle to the traffic.

53. Joint depth
   (M) Use a polyurethane sealant for the joints that are at an obtuse angle to the traffic.

54. Joint depth
   (N) Use a polyurethane sealant for the joints that are at a right angle to the traffic.

55. Joint depth
   (O) Use a polyurethane sealant for the joints that are at an acute angle to the traffic.

56. Joint depth
   (P) Use a polyurethane sealant for the joints that are at an obtuse angle to the traffic.

57. Joint depth
   (Q) Use a polyurethane sealant for the joints that are at a right angle to the traffic.

58. Joint depth
   (R) Use a polyurethane sealant for the joints that are at an acute angle to the traffic.

59. Joint depth
   (S) Use a polyurethane sealant for the joints that are at an obtuse angle to the traffic.

60. Joint depth
   (T) Use a polyurethane sealant for the joints that are at a right angle to the traffic.

61. Joint depth
   (U) Use a polyurethane sealant for the joints that are at an acute angle to the traffic.

62. Joint depth
   (V) Use a polyurethane sealant for the joints that are at an obtuse angle to the traffic.

63. Joint depth
   (W) Use a polyurethane sealant for the joints that are at a right angle to the traffic.

64. Joint depth
   (X) Use a polyurethane sealant for the joints that are at an acute angle to the traffic.

65. Joint depth
   (Y) Use a polyurethane sealant for the joints that are at an obtuse angle to the traffic.

66. Joint depth
   (Z) Use a polyurethane sealant for the joints that are at a right angle to the traffic.
**Figure 21.1(a): Butt face**

**Figure 21.1(b): Corrugated face**

**Figure 21.4(a): Ineffective reseal**

**Figure 21.4(b): Short lived reseal**

**Figure 21.4(c): Effective reseal**

**Figure 21.5(a): Good practice**

**Figure 21.5(b): Poor practice**

**Figure 21.2: Transverse Sawn Contraction Joints (Type J9)**

**Figure 21.3: Isolation Joints (Type J14)**

**Figure 21.4: Sealant Reservoir Faults**

**Figure 21.5: Sealant Installation - General**
TABLE 22.1: ROUT DIMENSIONS - TIED AND STITCHED CASES

<table>
<thead>
<tr>
<th>Rout width (mm) $W_R$</th>
<th>Sealant type</th>
<th>Rout depth (mm) $D_R$</th>
<th>Backer rod shape and size $(h_R, l_R)$</th>
<th>Sealant thickness (mm) $D_S$</th>
<th>Sealant recess $(R_S)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 x 3</td>
<td>Silicone or Polyurethane</td>
<td>15 x 5, 0</td>
<td>18 mm cut to ½ round $(h_R = 5 \text{ mm})$</td>
<td>7 (+ 3, 0)</td>
<td>3 (+ 2, 0)</td>
</tr>
<tr>
<td>30 x 5</td>
<td>Polyurethane</td>
<td>30 (+ 7, 0)</td>
<td>30 mm cut to ½ round $(h_R = 15 \text{ mm})$</td>
<td>10 (+ 5, 0)</td>
<td>3 (+ 2, 0)</td>
</tr>
<tr>
<td>50 x 7</td>
<td>Polyurethane</td>
<td>30 (+ 7, 0)</td>
<td>50 mm, all segment of height 14 mm $(h_R = 14 \text{ mm})$</td>
<td>11 (+ 5, 0)</td>
<td>4 (+ 2, 0)</td>
</tr>
</tbody>
</table>

(a) For untied/unstitched cases, this table may be used on the condition that the sealant is of silicon with width less than 18 mm and all dimensions satisfy criteria in accordance with Table 19.1.

(b) In tied joints, polyurethane is preferable to silicone. Distensible furs are likely to be in concentration.

(c) Routing widths listed in Table 22.1 are limited to 3 categories. The values (and the number of 3) are suggested for logistical purposes only and may be varied if deemed desirable. However, the maximum width of 50 x 7 mm should only be varied after careful consideration and after suitable trialing.

Table 22.1 Notes:

1. The purpose of routing and resawing is:
   (a) To produce a reservoir lap with vertical sides and which is suitable for sealing.
   (b) To clean the faces to maximize sealant adhesion.
2. The width of sealants should be on the outer part of the day because they will increase at other times due to contraction and curving.
3. At the time of sealant installation, side walls of the reservoir must be thoroughly clean and free from all loose debris, pulverized concrete dust, and other material which may be deleterious to the adhesion of the sealant. Grit blasting is not required when the routed concrete faces have been prepared in accordance with the guidelines. The cleanliness of the joint faces must be tested in accordance with T379. An acceptable result is when Grade 1 (None) visual rating category is achieved. The adhesion of the sealant must be tested in accordance with T360.
4. The backer rod shown in Table 22.1 must be continuous closed-cell polyethylene. It must be accurately slit in a jig to the required shape. The backer rod is to be depressed to the bottom of the reservoir so as to seal the exposed crack/joint. If necessary, the backer rod must be held in place by a suitable flexible adhesive such that the rod will not be dislodged with the actions of wind or seasonal installation.
5. At slab edges and formed joints, sealants must extend down the vertical face of the routed section, including any underlying cracks.
6. Where a polyurethane sealant will cross an unjointed joint, a filler must be placed within that joint so that the polyurethane is discontinuous.
7. Where a polyurethane is used in a longitudinal joint, its surface must be blinded with sand to increase friction values.
**SCHEDULE 23.1 (S23.1)**

**Typical Routing Procedure**

- (a) This procedure is applicable to joints and cracks where sawcutting is not feasible. It is applicable to both longitudinal and transverse cases. It is applicable only to tied and/or stitched applications where structural crack repairs are not required.
- (b) The width of cut should generally be such that it will impact on about 85% of the total length of spalled crack within a selected section. This is referred to as the '85th percentile cracked width', which is limited to 85% of the width of the crack and/or joint (W or Wg). However, selection criteria for the cut width may differ between sites, depending on factors such as:
  - (i) the curvature (or 'crookedness') of the crack, in terms of the capacity of the router to follow its path,
  - (ii) the economics of doing a single cut versus multiple passes.
- (c) Routing will generally not be warranted where:
  - (i) the crack width Wg < 5 mm (NDM)
  - (ii) the 85% spalled width Wg > 55 mm (NDM)

**SCHEDULE 23.2 (S23.2)**

**Tied Longitudinal Joint Routing Procedure**

- (a) This procedure is applicable to longitudinal joints which are tied or untied, and have only minor spalling.
- (b) Sawcut should always be considered before routing.
- (c) The cutting width (either sawn or routed) should generally be such that it will impact on about 85% of the total length of spalled joint within a selected section. However, the width may differ between sites depending on factors such as the economics of doing a single cut versus multiple passes.
- (d) For cut and seal dimensions: see Table 22.1.

**SCHEDULE 23.3 (S23.3)**

**Tied Transverse Routing Procedure**

- (a) This procedure is applicable to transverse joints which are tied and/or stitched and which have only minor spalling.
- (b) Sawcutting should always be considered before routing.
- (c) The cutting width (either sawn or routed) should generally be such that it will impact on about 85% of the total length of transverse joint within a selected section. However, the width may differ between sites depending on factors such as the economics of doing a single cut versus multiple passes.
- (d) For cut and seal dimensions: see Table 22.1.

**SCHEDULE 23.4 (S23.4)**

**Combined Routing and Repairing Procedure**

- (a) This procedure is applicable to multiple spalling types where a combination of routing and structural repair is needed. It is applicable only to tied or stained joints and cracks.
- (b) The suggested sequence of operations is as follows:
  - (i) Rout (or sawcut) the length of crack (or joint) adjoining the wide spall. (Routing or sawing at a later date may damage the repair).
  - (ii) Insert a temporary filler to width Wg.
  - (iii) Repair the wide spall in accordance with MJ24 and MJ25.
  - (iv) Install the sealant over the full length of routed crack plus repair, in accordance with Detail T, U, or V as applicable.

**SCHEDULE 23.5 (S23.5)**

**Untied Joint Routing Procedure**

- (a) This procedure is applicable to untied joints, either longitudinal or transverse (such as isolation, isolation, or jointed). It which contains sections of substantial spalling.
- (b) Because of the magnitude of cyclic movement, at least part of the repair width must be a silicone (or a mixture of more than 85% spalled width in MJ19-MJ21).
- (c) For Wg = 18 mm: re-saw and seal in accordance with MJ19-MJ21
- (d) For Wg = 57 mm: re-saw and seal in accordance with MJ24 and MJ25.

**Notes:**

- (i) Insert a temporary filler to width Wg.
- (ii) Prepare and repair the wide spall in accordance with MJ24 and MJ25. Allow adequate curing time.
- (iii) Sawcut (or rout) the length of spalled joint (excluding the repair) in preparation for sealing.
- (iv) Install silicone sealant over the full length of joint in accordance with MJ24-MJ25.
### Table 24.1: Classification of Spalls and Selection of Repair Method

<table>
<thead>
<tr>
<th>Type</th>
<th>Dimensions</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aris rounding AR</td>
<td>W x 30 mm (no limit on depth)</td>
<td>See Figure 24.1 for options</td>
</tr>
<tr>
<td>Minor spall M</td>
<td>See Figure 24.1(a)</td>
<td>W x 50 mm (no limit on depth)</td>
</tr>
<tr>
<td>Thin bonded repairs</td>
<td>At Joints</td>
<td>See Figure 24.2.1(a)</td>
</tr>
<tr>
<td>Thin bonded repairs</td>
<td>At Cracks</td>
<td>See Figure 24.2.1(b)</td>
</tr>
<tr>
<td>Thin bonded repairs</td>
<td>At Joints</td>
<td>See Figure 24.1(c)</td>
</tr>
<tr>
<td>Thin bonded repairs</td>
<td>At Cracks</td>
<td>See Figure 24.1(b)</td>
</tr>
<tr>
<td>Full-depth repairs</td>
<td>W x 50 mm</td>
<td>See Figure 24.1(b)</td>
</tr>
<tr>
<td>Full-depth repairs</td>
<td>H x D/2</td>
<td>See Figure 24.1(c)</td>
</tr>
<tr>
<td>Deep spall D</td>
<td>W x 50 mm</td>
<td>See Figure 24.1(b)</td>
</tr>
<tr>
<td>Deep spall D</td>
<td>H x D/2</td>
<td>See Figure 24.1(c)</td>
</tr>
</tbody>
</table>

### Figure 24.1: Type SC - Shallow Continuous Spall
- **Figure 24.1(a):** Minor (M)
- **Figure 24.1(b):** Shallow Discrete (SD)
- **Figure 24.1(c):** Shallow Continuous (SC)

### Table 24.2: Type SD - Shallow Discrete Spalls

- **Figure 24.2(a):** Plan view
- **Figure 24.2(b):** Stage 1 (Section view)
- **Figure 24.2(c):** Stage 2 (Section view)

### Figure 24.2(a) Notes:
- Mark out the square or rectangular perimeter area to be replaced. This area must have minimum dimensions of 100 mm and be at least 20 mm beyond all unsound concrete.
- Remove any existing spalls to a minimum of 100 mm beyond the perimeter.

### Figure 24.2(b) Notes:
- For repairs near the junction of four slab corners, a former must be placed along each joint.
- The forming groove must be at least 10 mm deeper than the deeper patch (where 2-sided).
- Extend at least 100 mm beyond each end of the patch perimeter.
- The forming groove must be of a width suitable for the specific joint type, and desirably 2 to 5 mm wider than the existing joint, hence:
  - for isolation and expansion joints: 20 - 30 mm (TYP) wide.
  - for PCP contraction joints: 9 - 12 mm (TYP) wide.
  - for test construction joints: 5 - 10 mm (TYP) wide.
- Chase out a perimeter groove around the other three sides, to a minimum depth of 15 mm. This should be done with a single-head scalping tool or a router and template. This must form vertical edges to the patch. All edges must be rough; see Note 2 Schedule 25.2.
- Remove the concrete within the perimeter groove to produce a reasonably even surface. A single or multi-head scalping tool is suitable for this removal.
- Clean out the patch using a vacuum cleaner and/or oil-free compressed air (plus wire brush if required). The vacuum is recommended for minimizing ingress of grit into joints and cracks. The compressed air is intended to remove any shattered aggregate or concrete.
- Fix a joint former securely into the forming groove so that the top is flush with the finished surface level. Caulk all paths and gaps where repair material could escape or contact adjoining slabs. See Notes 3 and 4 Schedule 25.2.
- For epoxy resin patches, prime the exposed surfaces in accordance with the manufacturer’s recommendations. For cementitious grouts, saturate all patch faces with water (or wet rags) for at least 10 hours (to ensure that the patch material is not sucked dry). Mop the floor in a mist condition until the next stage.
- Immediately before placing the patch material, remove all free water (using oil-free compressed air and/or rags). Prime all surfaces by brushing or other notified bonding agent.
- Place the repair material into the patch within the time limit specified by the manufacturer. Where a delay occurs, the primer must be protected against drying.
- Thoroughly compact the material using a vibrating hammer, seeing special care to work fine material into all gaps, edges, and corners. Provide a tamped or finished surface.
- Cementitious repairs must be cured with hydration volume curing compound. It must be applied as soon as the mix reaches the low-sheen condition.
- Cover the patch with moist hessian and then polythene sheeting as soon as possible without marking the surface texture. Secure all edges of the sheeting to prevent drying.
- Curing and protection should be maintained for a minimum of 24 hours, but preferably three days.
- Clean and seal the joint in accordance with MJ18-MJ21, and after removing the joint former. Where a program of measuring and sealing of joints is to follow, joint cleaning will be achieved during that program. Otherwise, the faces can be regrouted with an angle-grinder to maximise sealant bond.

### Figure 24.3: Type SC - Shallow Continuous Spalling
- **Figure 24.3 Notes:**
  - Follow the procedure in accordance with Figure 24.2, except:
    - (a) The minimum depth of patch must be 30 mm.
    - (b) Saturate the perimeter groove by sawcutting.
  - Chase this sawcut with a router to roughen the vertical faces. See also Note 2 Schedule 25.2.

### Figure 24.4: Type SD - Shallow Discrete Spalls
- **Figure 24.4 Notes:**
  - Use saw or a port forming groove along the line of the joint (to hold the joint former). For repairs at the junction of four slab corners, a former must be placed along each joint.
  - The forming groove must be at least 10 mm deeper than the deeper patch (where 2-sided).
  - Extend at least 100 mm beyond each end of the patch perimeter.
  - The forming groove must be of a width suitable for the specific joint type, and desirably 2 to 5 mm wider than the existing joint, hence:
    - for isolation and expansion joints: 20 - 30 mm (TYP) wide.
    - for PCP contraction joints: 9 - 12 mm (TYP) wide.
    - for test construction joints: 5 - 10 mm (TYP) wide.
  - Chase out a perimeter groove around the other three sides, to a minimum depth of 15 mm. This should be done with a single-head scalping tool or a router and template. This must form vertical edges to the patch. All edges must be rough; see Note 2 Schedule 25.2.
  - Remove the concrete within the perimeter groove to produce a reasonably even surface. A single or multi-head scalping tool is suitable for this removal.
  - Clean out the patch using a vacuum cleaner and/or oil-free compressed air (plus wire brush if required). The vacuum is recommended for minimizing ingress of grit into joints and cracks. The compressed air is intended to remove any shattered aggregate or concrete.
  - Fix a joint former securely into the forming groove so that the top is flush with the finished surface level. Caulk all paths and gaps where repair material could escape or contact adjoining slabs. See Notes 3 and 4 Schedule 25.2.
  - For epoxy resin patches, prime the exposed surfaces in accordance with the manufacturer’s recommendations. For cementitious grouts, saturate all patch faces with water (or wet rags) for at least 10 hours (to ensure that the patch material is not sucked dry). Mop the floor in a mist condition until the next stage.
  - Immediately before placing the patch material, remove all free water (using oil-free compressed air and/or rags). Prime all surfaces by brushing or other notified bonding agent.
  - Place the repair material into the patch within the time limit specified by the manufacturer. Where a delay occurs, the primer must be protected against drying.
  - Thoroughly compact the material using a vibrating hammer, seeing special care to work fine material into all gaps, edges, and corners. Provide a tamped or finished surface.
  - Cementitious repairs must be cured with hydration volume curing compound. It must be applied as soon as the mix reaches the low-sheen condition.
  - Cover the patch with moist hessian and then polythene sheeting as soon as possible without marking the surface texture. Secure all edges of the sheeting to prevent drying.
  - Curing and protection should be maintained for a minimum of 24 hours, but preferably three days.
  - Clean and seal the joint in accordance with MJ18-MJ21, and after removing the joint former. Where a program of measuring and sealing of joints is to follow, joint cleaning will be achieved during that program. Otherwise, the faces can be regrouted with an angle-grinder to maximise sealant bond.
**Figure 25.1(a): Option 1**
- Description of the option and its suitability for joint spall repairs.
- Notes on the procedure, including the use of a silicone designed in accordance with Table 19.1.
- Suggested limits for the width of silicone patches.

**Figure 25.1(b): Option 2**
- Description of the option and its suitability for joint spall repairs.
- Notes on the procedure, including the use of polyurethane for bonding.
- Suggested limits for the width of polyurethane patches.

**Figure 25.1(c): Option 3**
- Description of the option and its suitability for joint spall repairs.
- Notes on the procedure, including the use of a silicone designed in accordance with Table 19.2.
- Suggested limits for the width of silicone patches.

**Table 24.1**
- Provides guidelines for polyurethanes.
- Lists options for joint spall repairs.

**Schedule 25.1**
- Guidelines for setting up for removal of joint spall.
- Description of the steps involved in the repair process.

**Schedule 25.2**
- Guidelines for setting up for removal of joint spall.
- Description of the steps involved in the repair process.

**Notes**
- Spalling repairs are sensitive to standards of workmanship and will yield a low success rate unless close attention is given to detail in every aspect.
- For design widths ≤ 18 mm, use a silicone in accordance with Table 19.1.
- For design widths > 18 mm, use a silicone in accordance with Table 19.2.

**Recommendations**
- For tied joints, transverse or longitudinal:
  - Use a silicone designed in accordance with Table 19.2. Adopt W/D as low as feasible.
  - For untied transverse joints:
    - Use a silicone in accordance with Table 19.1.
  - For untied longitudinal joints:
    - For designs widths ≤ 18 mm, use a silicone in accordance with Table 19.1.
    - For widths > 18 mm: not feasible, assess alternatives. Seek specialist advice.
FIGURE 26.1: TYPICAL JPCP TERMINAL ANCHOR DEFECTS

FIGURE 26.2: SCHEMATIC TERMINAL DESIGN AT BRIDGES
FOR ROAD SKEW $\geq 84^\circ$
SEE NOTE 1 (S26.1)

FIGURE 26.3: SCHEMATIC TERMINAL DESIGN AT FLEXIBLE PAVEMENT
SEE NOTE 1 (S26.1)

SCHEDULE 26.1 (S26.1)

NOTES
Anchors
1. Refer to Volume CJ Jointed Reinforced Concrete Pavement for standard details of various anchor designs.
2. JRPC terminal slabs constructed before 2003, this dimension was 4500 ± 500.
3. Anchor drains are constructed only where the longitudinal grade on that side of the anchor falls towards the anchor. Where the grade falls away from the anchor, the drain is deleted and the subbase is extended to the anchor. The depth of the drain is nominal only and is adjusted to suit soil grade and drainage requirements.

SCHEDULE 26.2 (S26.2)

JRCP ANCHOR DEFECT CASES

CASE 1: Shrinkage cracking over anchors
(a) Rout and seal cracks in accordance with MJ22 and MJ23 if warranted.

CASE 2: Transverse joint spalls
(a) Repair in accordance with MJ24 and MJ25 if warranted.

CASE 3: Corner cracking
(a) Repair in accordance with Case 9 shown on MJ12 (or Case 8 if approved) if secondary cracking occurs.

CASE 4: Anchor rotation / sliding
(a) This defect usually manifests itself in the form of faulting and/or crushing at the J14 or F7 and/or F4 joints. It may also lead to buckling of the JRPC and/or SFRP-R terminal slabs and/or bridge approach slab. Due to the various repercussions of this defect, seek specialist advice.

CASE 5: Transverse cracking
(a) Rout and seal cracks in accordance with MJ22 and MJ23 if warranted.

CASE 6: Longitudinal cracking
(a) Rout and seal cracks in accordance with MJ22 and MJ23 if warranted.

CASE 7: Longitudinal joint spalls
(a) Repair in accordance with MJ24 and MJ25 if warranted.