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CONCRETE PAVEMENT GUIDE

PART 2 NEW CONSTRUCTION

CHAPTER 200 – CONTINUOUSLY REINFORCED CONCRETE PAVEMENT (CRCP)

Chapter 200 provides specific information about designing continuously reinforced concrete pavement (CRCP). Refer to Chapter 120 for general information about concrete pavement structure design and HDM Chapters 600 – 670 for pavement design methodology and standards.

200.1 PURPOSE AND DESCRIPTION

Continuously reinforced concrete pavement (CRCP) is concrete pavement with steel reinforcing bars with no transverse joints. CRCP is reinforced in the longitudinal direction with additional transverse bars used to support the longitudinal bars (see Figure 200-1). The longitudinal bars are lap spliced (see Section 200.2.2) to maintain continuity, ensuring continuous reinforcement.

CRCP develops transverse cracks that are spaced at random intervals due to:
1. Internal forces caused by the shrinkage of concrete
2. Expansion and contraction due to temperature changes
3. Concrete volume change resulting from moisture variation

Transverse cracks are restrained by continuous longitudinal bars that keep the transverse cracks tightly closed and minimize water penetration. Crack width can affect the corrosion rate of the reinforcing bars at the crack locations where water or deicing salts penetrate the cracks.

Figure 200–1: Epoxy coated CRCP reinforcement
The optimum amount of longitudinal bars, as detailed in the standard plans, is determined such that it satisfies all of the following three limiting criteria:

- **Crack spacing:** To minimize the potential of concrete punchouts and spalling, the spacing between consecutive cracks must be limited between 3’ (to limit punchouts) and 7’ (to limit spalling).
- **Crack width:** To minimize spalling, water infiltration, and load transfer the allowable crack width should not exceed 0.04”.
- **Steel stress:** To prevent steel yielding and excessive permanent deformation, the tensile stress in steel is limited to ≤ 75% of its ultimate tensile strength.

### 200.1.1 Benefits

CRCP has a number of benefits, including:

- Minimal maintenance is required, reducing future maintenance costs, traffic closures, and worker safety risks compared to other pavement types.
- Tighter transverse cracks and fewer joints result in smoother pavement and reduce water penetration and potential base damage.
- Lower life cycle costs despite higher initial cost.
- Ability to handle heavier truck loading and volumes.

CRCP can provide a durable highway that can withstand high traffic and truck volumes for 40 years or more. Where cost effective, CRCP is the preferred type of concrete pavement. Life-cycle cost analysis (LCCA) is the most effective methodology to help make the determination. More information is available from the Division of Maintenance Pavement Program website at: [http://www.dot.ca.gov/hq/maint/Pavement/Offices/Pavement_Engineering/LCCA_index.html](http://www.dot.ca.gov/hq/maint/Pavement/Offices/Pavement_Engineering/LCCA_index.html).

### 200.1.2 Limitations

Situations where CRCP may not be desirable include:

- For conventional highways, local roads, and areas with underground utilities. Accessing utilities for maintenance can damage CRCP and result in costly repairs.
- For parking areas or where the traffic index (TI) ≤ 11.5. CRCP is expensive to build for lightly trafficked locations.

### 200.2 Materials

#### 200.2.1 Concrete

Concrete consists of a combination of cementitious materials, coarse and fine-graded aggregate, water, and typically some property modifying admixtures. Concrete properties such as strength, durability, permeability, and abrasive wear resistance are materials dependent. Concrete properties such as strength, durability, permeability, and abrasive wear resistance are materials dependent. CRCP should be designed using the highest quality concrete materials to maximize long-term durability. Use of rapid strength concrete (RSC) is not recommended.

Section 90 of the Standard Specifications defines the required chemical and physical concrete material properties for contractor developed mix designs, with some additional requirements for concrete pavement in Section 40. For more comprehensive information about concrete materials, refer to Chapter 120 and the Division of Engineering Services [Concrete Technology Manual](#).
200.2.2 Bar Reinforcement

CRCP contains both longitudinal and transverse reinforcement bars. Steel reinforcing bar requirements are in Section 52 of the 2010 Standard Specifications. Because bar reinforcement is deformed, slippage is minimized and bonding with the concrete is increased. As a result, contraction and expansion movements are minimized. Epoxy coated bar reinforcement is required within half a mile of a salt water body and in high desert and all mountain climate regions to mitigate corrosion (see Figure 200-1). The climate map is available on the Headquarters Division of Maintenance Pavement Program website at: http://www.dot.ca.gov/hq/maint/Pavement/Offices/Pavement_Engineering/Climate.html.

Longitudinal Bars

Longitudinal bars strengthen the pavement, provide the desired transverse crack spacing, and keep transverse cracks tightly closed. Narrow cracks maintain aggregate interlock, providing a high level of load transfer between the fractured concrete surfaces and reducing pavement flexural stress due to traffic loading. Tight cracks also reduce water infiltration and intrusion of incompressible material.

The cross-sectional area ratio of steel to concrete should between 0.55 to 0.70% for longitudinal bars. Longitudinal reinforcement used for CRCP consists of Grade 60, No. 6 steel bars spaced from 5.5 to 8.0” center-on-center. The first bar is placed 3 to 4” from the joint or edge of pavement. The longitudinal bar depth is 4” minimum clearance from the concrete surface to the top of the bars. For CRCP thicknesses > 0.95’, 5” minimum cover is required so the transverse bars clear the sawcut at longitudinal joints (see Revised Standard Plan RSP P4).

Maintaining steel continuity by overlap splicing each steel bar in the longitudinal direction ensures good CRCP performance. The staggered splice pattern shown schematically in Figure 200-2 is recommended for lap splicing longitudinal bars. Requirements for reinforcement splicing are in Standard Specification Section 52-6.03B. Additional longitudinal bars are placed at transverse construction joints to ensure sufficient reinforcement at points of discontinuity (see Section 200.3 and Revised Standard Plan RSP P31A for other types of CRCP joints).

![Figure 200–2: Staggered lap splices](image-url)

Transverse Bars

Transverse bars are used across the entire width of CRCP lanes primarily to support the longitudinal bars during construction and to hold random longitudinal cracks tightly closed to mitigate the potential risk of punch outs. Longitudinal cracks occur approximately parallel to the roadway centerline. Since transverse bars are used across the entire width of CRCP, intermediate transverse bars are also used to tie adjacent lanes together across longitudinal contraction joints (see below and Section 200.3.3).
Transverse bars are usually Grade 60, No. 6, deformed steel bars spaced at 48” center-on-center and placed on either steel or plastic support chairs (see Figure 200-3).

![Steel chairs](image1.png)  ![Plastic chairs](image2.png)

**Figure 200–3: Reinforcement support chairs**

**Tie Bars and Intermediate Transverse Bars**
Tie bars and intermediate transverse bars hold the faces of abutting concrete in contact and maintain adequate load transfer efficiency. Tie bars are deformed, 50” long, epoxy-coated, Grade 60, No. 6, steel bars placed in the same plane as transverse reinforcement, perpendicular to the longitudinal construction joint or between a lane and shoulder. Tie bar spacing is 24” where placed midway between or on adjacent transverse bars.

Tie bars are commonly placed with a mechanical splice coupler shown in Revised Standard Plan RSP P16 because bending and straightening tie bars after concrete placement is not allowed because of potential damage to the epoxy coating and the surrounding concrete.

Intermediate transverse bars tie the adjacent slabs together. They are deformed, 50” long, epoxy-coated, Grade 60, No. 6 steel bars placed at 48” spacing in the same plane as transverse reinforcement.

**200.3 JOINTS**
CRCP joints include transverse construction joints, longitudinal construction joints, longitudinal contraction joints, expansion joints, and terminal joints. Expansion and terminal joints are discussed with pavement transitions and end anchors in Section 200.4.

CRCP does not contain transverse contraction joints like JPCP and transverse cracks and construction joints should not be sealed. Longitudinal contraction and construction joints should not be sealed except in desert and mountain climate regions (see HDM Index 622.5).
200.3.1 Transverse Construction Joints
A transverse construction joint is placed to maintain longitudinal reinforcement continuity and avoid a cold joint when concrete is placed at different times, such as when paving is interrupted at the end of a work shift or for more than 30 minutes. Additional 50" long longitudinal reinforcement is placed in the transverse construction joint in the same plane at every other longitudinal bar to provide increased shear stress and load transfer at the joint. To eliminate extra joints, transverse construction joints should be planned to coincide with terminal joints wherever possible (see Section 200.4.1 for terminal joint information). Transverse construction joints are not sealed.

Figure 200–4: Transverse construction joint

200.3.2 Longitudinal Construction Joints
Longitudinal construction joints occur between separately placed adjoining lanes. Tie bars are used to hold the adjoining faces of concrete (see Figure 200-5 and Section 200.2.2). Longitudinal construction joints should not be sealed except in desert and mountain climate regions.

Figure 200–5: Longitudinal construction joint
200.3.3 **Longitudinal Contraction Joints**

Longitudinal contraction joints are necessary to control cracking in the longitudinal direction due to warping, expansion, and shrinkage stresses caused by temperature variations (Figure 200-6). Longitudinal joints are typically placed between 12’ lanes or between the lane and shoulder (see *Revised Standard Plan RSP P16*). Where there are no lanes, longitudinal joints should be spaced at 12’ intervals and no more than 14’ apart. When widened lanes are used, longitudinal joints are omitted at the edge of traveled way. Longitudinal joints are held together by intermediate transverse bars and should be saw cut to a depth that would allow at least ½” clearance to any dowel bars, tie bars, or bar reinforcement (see Section 200.2.2). Longitudinal contraction joints should not be sealed except in desert and mountain climate regions.

![Figure 200–6: Longitudinal contraction joints](image)

200.4 **Terminal Joints, Pavement Transitions, & End Anchors**

Where CRCP terminates at a different pavement type or structures approach slab, a pavement transition, terminal joint, or anchor must be provided at the end of the CRCP section to:

1. Isolate adjacent pavement of different types or structures approach slab.
2. Anchor CRCP so that excessive horizontal movement does not occur.
3. Accommodate horizontal movement that would otherwise damage CRCP and the adjacent pavement or structure approach slab.

Regardless of the CRCP length, the central portion of CRCP remains fully restrained by the underlying base so no movement or change in length will be experienced except for the last 200 to 300’ at the end of pavement.

Terminal joints, expansion joints, wide flange beam terminal, and pavement end anchors are described in the following sections. Criteria for where to use the various types of transition joints are identified in Table 200-1:
Table 200–1: Transition Joint Applications

<table>
<thead>
<tr>
<th>Transition Type</th>
<th>Location</th>
<th>Notes</th>
<th>CRCP Length (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal Joint</td>
<td>At each end of a CRCP segment</td>
<td></td>
<td>&lt; 1,200</td>
</tr>
<tr>
<td>Type A</td>
<td>CRCP/ existing AC transitions</td>
<td>Used independently</td>
<td>Yes</td>
</tr>
<tr>
<td>Type B</td>
<td>CRCP terminus/ future pavement</td>
<td>Used independently</td>
<td>Yes</td>
</tr>
<tr>
<td>Type C</td>
<td>CRCP terminus/ temporary HMA</td>
<td>Used independently</td>
<td>Yes</td>
</tr>
<tr>
<td>Type D</td>
<td>CRCP/ existing JPCP or approach slab transitions</td>
<td>Use with expansion joint, pavement end anchor, or wide flange beam terminal</td>
<td>Yes</td>
</tr>
<tr>
<td>Type E</td>
<td>CRCP/ new JPCP or approach slab transitions</td>
<td>Use with expansion joint, pavement end anchor or wide flange beam terminal</td>
<td>Yes</td>
</tr>
<tr>
<td>Expansion Joint</td>
<td>CRCP to bridge, approach slab, or pavement transitions</td>
<td>Yes&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Yes</td>
</tr>
<tr>
<td>Pavement End Anchor (grade ≥ 3%)</td>
<td>CRCP/ concrete pavement or approach slab transitions</td>
<td>Use with expansion joint</td>
<td>No</td>
</tr>
<tr>
<td>Wide Flange Beam Terminal Joint (grade &lt; 3%)</td>
<td>CRCP/ bridge, approach slab, or pavement transitions</td>
<td>Use with expansion joint</td>
<td>No</td>
</tr>
</tbody>
</table>

<sup>1</sup>When CRCP is ≤ 500’, provide only 1 side.
<sup>2</sup>Use pavement end anchor for profile grades > 3%. Provide 1 anchor lug per 1 % profile grade (5 maximum).
<sup>3</sup>Do not use wide flange beam terminal joints on profile grades > 3%.

### 200.4.1 Terminal Joints

Terminal joints are provided at transverse joints and at the beginning and end of CRCP segments. They are used to minimize deterioration where CRCP abuts flexible pavement and to minimize faulting where CRCP abuts another type of concrete pavement. The various terminal joint types are shown in Revised Standard Plan RSP P31A and briefly discussed below.

**Terminal Joint Type (A)**

Use Type A terminal joints where new CRCP transitions to existing AC pavement. Type A terminal joints consist of 2 contraction joints at 10 and 15’ from the CRCP terminus at the existing AC pavement. Dowel bars are not used.

**Terminal Joint Type (B)**

Use Type B terminal joints where newly constructed CRCP terminates and pavement will be constructed in the future. CRCP at the terminus will be supported by the reinforced concrete slab and backfilled with material that can be removed when the new pavement will be constructed.

**Terminal Joint Type (C)**

Use Type C terminal joints where newly constructed CRCP terminates and temporary HMA pavement will be constructed. CRCP at the terminus will be supported by the reinforced concrete slab. Type C terminal joints are mostly used in construction where temporary traffic for staging is required.
Terminal Joint Type (D)
Use Type D terminal joints where new CRCP is constructed next to existing JPCP or a structure approach slab. Type D terminal joints consist of a transverse construction joint with dowel bars drill and bonded to existing concrete.

Terminal Joint Type (E)
Use Type E terminal joints where new CRCP is constructed next to new JPCP or a structure approach slab. Type E terminal joints consist of a transverse construction joint with dowel bars placed at the joint of CRCP and the new concrete.

200.4.2 Expansion Joints
An expansion joint is provided to accommodate large expansion of pavement exceeding ½” in conjunction with wide flange beam terminal joints or pavement end anchors. Expansion joints are typically used where CRCP abuts up to bridges, structure approach slabs, or other types of concrete pavement (see Figure 200-6). Expansion joints are not used at pavement transitions between flexible and concrete pavement (see Section 200.4.5 and Revised Standard Plan RSP P30).

Where an expansion joint is used, a support slab beneath the joint is constructed to provide a bearing surface to support the free edges of abutting concrete pavement. Expanded polystyrene ¼ to ½” thick is placed over the support slab to prevent bonding and allow the pavement to easily expand and contract. The expansion joint should be doweled and sealed using a Type B seal with a movement rating ≤ 2” as shown on Standard Plan B6-21.

Figure 200–7: Expansion joint

200.4.3 Wide Flange Beam Terminal Joints
A wide flange beam terminal system is used to accommodate movement at the joint between the abutting end of a CRCP on one side and end of a bridge, approach slab, or another concrete pavement on the other side (see Figure 200-7). The wide flange beam size is dependent on pavement thickness. Within the limits of wide flange pavement terminal installation, the subgrade should be prepared and compacted in the same manner as the rest of the roadbed before additional pavement structure layers are placed on top of the subgrade. For expansive subgrade, reference HDM Index 614.4.

The wide flange beam is set partially into a 10’ long, 12” thick support slab to provide end support for the CRCP on each side of the wide flange beam. In order to achieve long-term performance without significant repairs, wide flange beam designs should consider:
- Expansion joints at the bridge approach slabs or between the wide flange beam and pavement end transition to allow pavement end movements.
- Load transfer across the joint.
- Corrosion resistance. Wide flange beam terminal joints should not be used in high mountain or high desert climate regions due to corrosion from deicing salts. If wide flange beams are placed near salt water, galvanized and epoxy coated flange beams are corrosion resistant alternatives.
- Fatigue loading under heavy truck traffic. Using a thicker or wider flange can also provide for improved fatigue resistance.
- Rigid connection to bridge-side pavement. Wide flange beams can fail when the top flange separates from the beam web. Eight-inch long studs ¾” in diameter can be welded to the web and flange bottom, spaced alternately at 9” and anchored to the end of concrete pavement on the bridge side of the joint to maintain rigid connectivity and prevent failure. Maintaining the rigid connection can help maintain profile and cross slope at the joints over the service life.
- Future grinding. Wide flange beam terminal joints should not be used where a ½” or more of grinding is expected during the CRCP service life.

The project plans should show the wide flange terminal joint location by station on the layout and quantity sheets. In conjunction with wide flange beam terminal joints, an expansion joint is provided to accommodate large pavement expansion exceeding ½” (see Section 200.4.2). Refer to Revised Standard Plans RSP P32A, RSP P32B, and Figure 200-8.
200.4.4  Pavement End Anchors

Pavement end anchors restrain movement using a series of concrete lugs placed underneath the pavement that anchor to well-compacted subgrade (see Figure 200-9 and Revised Standard Plan RSP P31B). Pavement end anchors are used in combination with Type AN expansion joints to restrain CRCP movement at transitions with another type of concrete pavement or structure approach slab. Forms should not be used to construct the lugs.

Type III expansive subgrade with a plasticity index (PI) ≥ 12 or low stiffness may not be effective for end anchors, but a wide flange beam terminal joint may be considered as an alternative (see Section 200.4.3).

The project plans should show the pavement end anchor location by station on the layout and quantity sheets.

![Figure 200–9: Pavement end anchor](image)

200.4.5  Pavement End Transitions

Pavement end transitions are made up of different pavement materials constructed within the same lane. The pavement transitions can be CRCP abutting an approach slab or flexible pavement. For CRCP transitioning to existing AC or new HMA pavement, a doweled, reinforced concrete panel is recommended as an alternative to a Type A terminal joint at the transition to reduce damage from impact loading. An expansion joint is not required (see Revised Standard Plan RSP P30).
200.5 DESIGN

200.5.1 Performance
CRCP should be engineered for a 40-year design life. HDM Topic 612 defines pavement design life as the optimum number of years that CRCP should be expected to perform before reaching its terminal serviceability or a condition that requires major rehabilitation.

CRCP is designed to have no more than 10 punchouts/mile at the end of its design life (see Figure 200-10 and HDM Topic 622). This performance criterion differs from JPCP, which is primarily based on cracking and joint faulting.

200.5.2 Pavement Structure Layers
The general engineering procedures for new CRCP construction, reconstruction, and widening are discussed in Chapter 120 and HDM Topic 623. Minimum design thicknesses for CRCP pavement structure layers are selected based on the subgrade type, climate region, and TI using HDM Tables 623.1B through M. CRCP is constructed using HMA Type A base, with Class 2 aggregate subbase added on Type II subgrade.

200.5.3 Shoulders
A tied CRCP shoulder or widened traffic lane with HMA or JPCP shoulders and no tie bars can be used adjacent to CRCP traffic lanes. Drainage inlets placed in the shoulder area should be called out by type and follow the applicable details shown on Revised Standard Plans RSP P45 and RSP P46.

Tied CRCP Shoulders
Tied CRCP shoulders are constructed monolithically with the CRCP mainline using no longitudinal construction joints. Longitudinal and transverse bars are extended through the shoulder area (see Revised Standard Plan RSP P4). The shoulder cross slope should match the lane cross slope and may require a design exception. The pavement structure design for the tied concrete shoulder should match the adjacent traffic lane.

Tied concrete shoulders are the most adaptable and preferred type when future widening is anticipated within the pavement design life, or when the shoulder will be used temporarily for stage construction or

Figure 200–10: Typical edge punchout
as a bus or truck lane. When tied concrete shoulders are expected to be converted into a future traffic lane, they should be built to the same geometrics and pavement structure standards as the CRCP traffic lane.

**Widened Lanes**

CRCP widened lanes are 14’ wide with either JPCP panels or HMA shoulders (see Figure 200-11 and Revised Standard Plan [RSP P5A](#)). The edge of traveled way is striped for a 12’ lane width, so the additional 2’ width becomes part of the shoulder and keeps the wheel path away from the edge of pavement. This reduces critical edge stresses from heavy vehicle loading. During future maintenance or construction operations, the wider shoulders can be used to detour traffic.

HMA or JPCP shoulders may be placed adjacent to the widened lane. JPCP used in a shoulder application is constructed without tie bars. The design standards for lane and shoulder addition with widened lane are provided in Revised Standard Plan [RSP P5B](#).

![Figure 200–11: Widened CRCP lane with HMA shoulder](image)

**200.5.4 Temporary CRCP Gaps During Construction**

Temporary CRCP gaps are sometimes necessary to allow for construction cross traffic so the contractor can move equipment from one side of the mainline to the other for paving. The gap is a planned opening in mainline paving located where cross traffic operation is anticipated. A minimum 1,000’ opening is necessary to allow enough room for equipment maneuverability. If the mainline opening is paved, transverse construction joints are formed on both ends and longitudinal reinforcement continuity must be maintained for load transfer. Both sides of the construction joints must follow lap staggering and joint construction procedures. An expansion joint is necessary on one side of the construction joint to provide for expansion of the hardened concrete to prevent damaging the adjacent fresh concrete.

**200.5.5 Standard Plans**

Table 200–2: CRCP Related Standard Plans

<table>
<thead>
<tr>
<th>Plan Sheet</th>
<th>Title</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>P4</td>
<td>Continuously Reinforced Concrete Pavement</td>
<td>For new CRCP construction, reconstruction, widening, and lane replacement at standard lane width.</td>
</tr>
<tr>
<td>P5A</td>
<td>Continuously Reinforced Concrete Pavement (Widened Lane)</td>
<td>For 14’ wide concrete panels to reduce punchouts where edge loading is increased from high truck traffic volumes. Consider a rumble strip.</td>
</tr>
<tr>
<td>P5B</td>
<td>Continuously Reinforced Concrete Pavement (Widened Lane) –Lane and Shoulder Addition or Replacement</td>
<td>For widening an existing roadway using 14’ wide concrete panels to reduce punchouts where edge loading is increased from high truck traffic volumes. Consider a rumble strip.</td>
</tr>
<tr>
<td>P10</td>
<td>Concrete Pavement – Dowel Bar Details</td>
<td>Use where concrete pavement transition panel is placed between CRCP and existing HMA.</td>
</tr>
<tr>
<td>P13</td>
<td>Continuously Reinforced Concrete Pavement Single Piece Transverse Bar Assembly</td>
<td>Details for longitudinal bar support used for new construction, reconstruction, widening, and lane replacement in lieu of using plastic chairs for longitudinal bar support.</td>
</tr>
<tr>
<td>P14</td>
<td>Continuously Reinforced Concrete Pavement Transverse Construction Joint</td>
<td>Details for longitudinal bar continuity including additional longitudinal bar spacing and staggered placement.</td>
</tr>
<tr>
<td>P16</td>
<td>Continuously Reinforced Concrete Pavement Tie Bars and Joint Details</td>
<td>Use in conjunction with RSP P4 for new construction, reconstruction, widening, and lane replacement in curved lanes. Shows tie bar placement at construction joint, intermediate bar placement at contraction joint, and location of longitudinal joint saw cutting.</td>
</tr>
<tr>
<td>P18</td>
<td>Concrete Pavement-Lane Schematics and Isolation Joint Detail</td>
<td>Shows general cases for locating isolation joints. Use on all new construction widening and lane replacement.</td>
</tr>
<tr>
<td>P30</td>
<td>Concrete Pavement End Panel Pavement Transitions</td>
<td>Indicates where concrete panel pavement transitions are located. This plan is used where existing or new HMA abuts to approach, JPCP or CRCP at transverse joint.</td>
</tr>
<tr>
<td>P31A</td>
<td>Continuously Reinforced Concrete Pavement-Terminal Joint Details</td>
<td>Shows general cases where terminal joints are located. Used at existing asphalt concrete pavement, new HMA, temporary pavement, and at construction limits where future pavement is anticipated.</td>
</tr>
<tr>
<td>P31B</td>
<td>Continuously Reinforced Concrete Pavement Expansion Joint and Anchor Details</td>
<td>Use with Standard Plan B6-21 for pavement anchor terminals between the end of CRCP and bridges, approach slabs, or other pavement types.</td>
</tr>
<tr>
<td>P32A</td>
<td>Continuously Reinforced Concrete Pavement Wide Flange Terminals</td>
<td>Use with Standard Plan B6-21 between the end of CRCP and bridges, approach slabs, or other pavement types.</td>
</tr>
<tr>
<td>P32B</td>
<td>Continuously Reinforced Concrete Pavement Wide Flange Terminals</td>
<td>Use for new construction, reconstruction, widening, and lane replacements where CRCP lanes end.</td>
</tr>
<tr>
<td>P34</td>
<td>Continuously Reinforced Concrete Pavement-Lane Drop Paving Details</td>
<td>For new construction, reconstruction, and widening of exit and entrance ramp gore areas adjacent to CRCP lanes.</td>
</tr>
<tr>
<td>P35</td>
<td>Concrete Pavement-Ramp Gore Area Paving Details</td>
<td>For drainage inlets without concrete apron. Isolation joint is used around the drainage inlet. Transverse CRCP reinforcement is terminated 2” from the longitudinal isolation joint edges.</td>
</tr>
<tr>
<td>P45</td>
<td>Concrete Pavement – Drainage Inlet Detail No. 1</td>
<td>For drainage inlets without a concrete apron. Isolation joint is used around the concrete apron. Transverse CRCP reinforcement is terminated 2” from the longitudinal isolation joint edges.</td>
</tr>
<tr>
<td>P46</td>
<td>Concrete Pavement – Drainage Inlet Detail No. 2</td>
<td>For drainage inlets with a concrete apron. Isolation joint is used around the concrete apron. Transverse CRCP reinforcement is terminated 2” from the longitudinal isolation joint edges.</td>
</tr>
</tbody>
</table>
200.5.6 Standard Specifications
Table 200-3 lists some pavement CRCP related 2010 Standard Specifications that may be used by the pavement engineer on CRCP projects. The Division of Maintenance Pavement Program website at is also a good source of information for CRCP design.

<table>
<thead>
<tr>
<th>Section</th>
<th>Section Title</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>39-1</td>
<td>Hot Mix Asphalt</td>
<td>Use for CRCP with HMA shoulders or base.</td>
</tr>
<tr>
<td>40-1</td>
<td>Concrete Pavement</td>
<td>Use for general concrete pavement construction requirements.</td>
</tr>
<tr>
<td>40-2</td>
<td>Continuously Reinforced Concrete Pavement</td>
<td>For use with all CRCP.</td>
</tr>
<tr>
<td>40-3</td>
<td>Jointed Plain Concrete Pavement</td>
<td>Use for CRCP where adjoining JPCP is constructed.</td>
</tr>
<tr>
<td>41-5</td>
<td>Joint Seals</td>
<td>Use for sealing CRCP longitudinal joints as required in mountain and desert climate regions.</td>
</tr>
</tbody>
</table>

200.5.7 Cost Estimating
The quantity of CRCP is measured and paid for by the cubic yard based on the volume of concrete from the dimensions shown on the project plans. The unit price for bid item 400050 includes furnishing and placing longitudinal, transverse, and additional reinforcement; tie bars, epoxy coating, and terminal anchors such as wide flange beams, pavement end anchors, expansion joints, and terminal joints. Full compensation includes all steel beams, stiffener plates, end plates, drilled holes, welding, cutting, polystyrene sheet, joint filler, joint seals, concrete, reinforcement, and bond breaker materials; labor, equipment, tools, and incidentals necessary to complete terminal anchor construction work. HMA, AS, and other base materials are paid for separately (see Table 200-4).

<table>
<thead>
<tr>
<th>Item Codes</th>
<th>Item Description</th>
<th>Unit</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>400050</td>
<td>Continuously Reinforced Concrete Pavement</td>
<td>CY</td>
<td>40-2</td>
</tr>
<tr>
<td>390132</td>
<td>Hot Mix Asphalt</td>
<td>TON</td>
<td>39</td>
</tr>
<tr>
<td>250201</td>
<td>Class 2 Aggregate Subbase</td>
<td>CY</td>
<td>25</td>
</tr>
<tr>
<td>401083</td>
<td>Shoulder Rumble Strip (Concrete Pavement, Ground-In)</td>
<td>STA</td>
<td>40-1</td>
</tr>
<tr>
<td>Various</td>
<td>Joint Seal or Isolation Joint Seal</td>
<td>LF</td>
<td>41-5</td>
</tr>
</tbody>
</table>

Table 200-5 shows the approximate volume of concrete and bar reinforcement weight per lane-mile of CRCP for a standard 12’ lane width with various pavement thicknesses. Based on project bid data through 2013, CRCP costs range from $150 to $295 per yd³.
Table 200–5: CRCP Bulk Quantities

<table>
<thead>
<tr>
<th>Pavement Thickness (ft)</th>
<th>Concrete Volume (yd³/lane-mile)</th>
<th>Total Bar Reinforcement Weight¹ (pounds/lane-mile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75</td>
<td>1,760</td>
<td>152,663</td>
</tr>
<tr>
<td>0.80</td>
<td>1,877</td>
<td>160,594</td>
</tr>
<tr>
<td>0.85</td>
<td>1,995</td>
<td>168,524</td>
</tr>
<tr>
<td>0.90</td>
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¹Includes transverse and longitudinal bars. Weight of reinforcement bars is shown for information only. Do not use for cost estimating: bar reinforcement is included in the CRCP unit price.

REFERENCES