Continuously Reinforced Concrete Pavement
California Practices

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Why Continuously Reinforced Concrete Pavements (CRCP)?

- Smoother over time
- Low maintenance costs/exposure
  - No transverse joints
- Thinner slab thickness relative to jointed concrete pavement
- Higher capacity of truck loading and volumes
CRCP Sustainability

- Long lasting pavement solution
- Lower energy footprint
- Incorporates recycled materials
- Reduces noise pollution
- Decreases life cycle cost
- Reduces cost to motorists
History

- First used in 1921
- CA built test section in 1948 in Fairfield
- 2\textsuperscript{nd} test section built on I-205 in 1970’s
- Both sections were overlayed because surrounding jointed concrete pavement failed

CA CRCP after 60 years
Typical CRCP Design Features

- Long life
  - 40+ years
- Concrete thickness
  - 9 to 13 inches
- Steel content
  - 0.7 to 0.8 percent
- Lap spliced
  - Continuous longitudinal reinforcement
- Depth to steel:
  - 4.0” to 6.0”
- Asphalt concrete base used
Typical CRCP Design Features (Cont.)

- Crack spacing
  - 3 to 8 feet
  - Ideal to limit punchout and spalling
- Crack width
  - 0.04 inches
- Deformed steel
  - Grade 60
- Max tensile stress
  - 0.75 of ultimate
- One-layer steel
- Widened lane or concrete shoulder
Best Suited For

- High traffic locations
- High truck traffic
- Isolated locations

- Long-term consistency
- New highways
- Concrete overlays
Least Suited For

- Areas of frequent underground work
- Variable width widening
- Low truck volumes
  - Not cost effective
  - No designs TI<11.5
    (6.6 million ESALs)
No Approved Designs for High Mountain and High Desert Regions
CHAPTER 620
RIGID PAVEMENT

Topic 621 - Types of Rigid Pavements

Index 621.1 Jointed Plain Concrete Pavement (JPCP)

JPCP is the most common type of rigid pavement used by the Department. JPCP is engineered with longitudinal and transverse joints to control where cracking occurs in the slabs (see Figure 621.1). JPCPs do not contain steel reinforcement, other than tie bars and dowel bars (see Index 622.4 for tie bars and dowel bars). Additional guidance for JPCP can be found in the “Jointed Plain Concrete Pavement Design Guide” on the Department Pavement website.

621.2 Continuously Reinforced Concrete Pavement (CRCP)

Although the Department has used CRCP on a limited basis in the past, CRCP is still not very common. For this reason, the Department has decided not to use CRCP for TIs less than 11.5 or in High Mountain and High Desert climate regions. Since CRCP uses reinforcing steel rather than weakened plane joints for crack control, saw cutting of transverse joints is not required for CRCP. Longitudinal joints are still used. Transverse random cracks are expected in the slab, usually at 3-foot to 5-foot intervals (see Figure 621.1). The continuous reinforcement in the pavement holds the cracks tightly together. CRCP typically costs more initially than JPCP due to the added cost of the reinforcement. However, CRCP is typically more cost-effective over the life of the pavement on high volume routes due to improved long-term performance and reduced maintenance. Because there are no sawn transverse joints, properly built CRCP should have better ride quality and less maintenance than JPCP. Additional CRCP guidance are under development and will be posted in the “Continuously Reinforced Concrete Pavement Design Guide” on the Department Pavement website.

621.3 Precast Panel Concrete Pavement (PPCP)

PPCPs use panels that are precast off-site instead of cast-in-place. The precast panels can be linked together with dowel bars and tie bars or can be post-tensioned after placement. PPCP offers the advantages of:

- Improved concrete mixing and curing in a precast yard.
- Reduced pavement thicknesses, which is beneficial when there are profile grade restrictions such as vertical clearances.
- Shorter lane closure times, which is beneficial when there are short construction windows.

The primary disadvantage of PPCP is the high cost of precasting. PPCP also needs a smooth base underneath the precast panels during construction to even out the loads on the slab and avoid uneven deflection that could lead to fracturing at the joints, slab settlement, and premature cracking. PPCP is currently used on an experimental basis in California, and must follow the procedures for experimental projects and special designs discussed in Topic 606.

Topic 622 - Engineering Requirements

622.1 Engineering Properties

Table 622.1 shows the rigid pavement engineering properties that were used to develop the rigid pavement catalog in Index 623.1. The values are based on Department specifications and experience with materials used in California. The predominant type of concrete used in California for rigid pavement is Portland cement concrete. Other types of hydraulic cement concrete are sometimes used for special conditions such as high strength concrete.
621.2 Continuously Reinforced Concrete Pavement (CRCP)

Although the Department has used CRCP on a limited basis in the past, CRCP is still a relatively new concept to California. For this reason, the Department has decided not to use CRCP for TIs less than 11.5 or in High Mountain and High Desert climate regions. Since CRCP uses reinforcing steel rather than weakened plane joints for crack control, saw cutting of transverse joints is not required for CRCP. Longitudinal joints are still used. Transverse random cracks are expected in the slab, usually at 3-foot to 5-foot intervals (see Figure 621.1). The continuous reinforcement in the pavement holds the cracks tightly together. CRCP typically costs more initially than JPCP due to the added cost of the reinforcement. However, CRCP is typically more cost-effective over the life of the pavement on high volume routes due to improved long-term performance and reduced maintenance. Because there are no sawn transverse joints, properly built CRCP should have better ride quality and less maintenance than JPCP. Additional CRCP guidance are under development and when completed will be posted in the “Continuously Reinforced Concrete Pavement Design Guide” on the Department Pavement website.
## Similarities to JPCP

- Use same design tables in HDM
- Choose CRCP option from tables
- Use same Std Spec Section 40
- Use same mix design process
- Pay for by CY
Caveats

- Need min 16-ft horizontal clearance
- Only concrete shoulder or widened lane options
- Show on plans and pay for as CRCP
- Use SSP 40-025 in lieu of SSP 40-010
- Coefficient of thermal expansion must be $6.0 \times 10^{-6}$ in/in/$^\circ$F max
- Requires end joint details at terminus
Standard Plan P4 – CRCP Layout Details

Plug and go
Plans Includes Details for Transverse Construction Joints
Lap Splices

- Uses Std Specs 51 for concrete structures
- Minimum lap length 45 bar diameters
- Bar laps should be staggered
- Minimum distance between staggered laps should be the same as the lap length
Identify which to use where on layouts
Type A

- For abutting to exist asphalt pavement
- Pay by LF
- Transverse joints included in price
Type B

- Project to be continued in the future
  - Use when ending pavement
- Alternate design if future project is soon
  - Extend steel beyond concrete for lap splice
- Pay by LF
Type C

- Use when abutting to temp pavement that will be replaced in future project
- Pay temp pavement separately
- Pay by LF
Type D and E

- For joining to JPCP or bridge approach slabs
- Type D for existing JPCP or approach slab
- Type E for new
- Pay for by LF
Standard Plan P31B – Expansion Joint and Pavement Anchor Details

Use to control movement at end CRCP
Pavement Anchor

- Place near end of CRCP run
- May need one or more
- Cross drain and permeable material included in anchor price
- Pay for by LF
Expansion Joint

- Place between wide flange beam or pavement anchor and terminal joint
- Place in short section-between two structures or different pavement types
- Pay for by LF
- Joint seal paid for separately (Type B, MR=2”)
Option to pavement anchor to accommodate movement
Beam details and quantities
Wide Flange Beam

- Wide flange beam and support slab paid as one unit by LF
- Expansion joint paid separately by LF
- Joint seal paid for separately (Type B, MR=2”)
- Additional LCB paid separately by CY
Wide Flange Beam (Cont.)
# CRCP Design and Construction Guide

**Title Page (June 5, 2007)**

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CRCP Projects


2. Brawley, Route 78/111 PM 14.6 to 19.5, 3-mile long, 2 lane each dir. Est. completion 10/23/2012.

3. Stockton, Route 5, PM 25.3 to 28.5, 2.5-mile long. In design, due to HQ 2/6/2012.


7. San Francisco, Route 101, PM 8.2 to 9.2, 2.5-mile long, in construction, 75% complete.
Division of Maintenance Home Page
http://www.dot.ca.gov/hq/maint

Division of Maintenance
The California Department of Transportation (Caltrans) owns or controls 350,000 acres of Right of Way and maintains 10,200 centerline miles of highway and 12,312 state highway bridges. Caltrans also inspects 12,075 local bridges.

Mission and Vision
Caltrans Improves Mobility Across California

Goals

SAFETY
Provide the safest transportation system in the nation for users and workers.

MOBILITY
Maximize transportation system performance and accessibility.

DELIVERY
Efficiently deliver quality transportation projects and services.

STEWARDSHIP
Preserve and enhance California's resources and assets.
The Pavement Program was established to program pavement projects, as well develop pavement design, construction and maintenance standards. It also develops, evaluates and implements pavement specifications and test methods. The Caltrans Pavement Program Steering Committee (PPSC) provides strategic direction to the program, while the Pavement Management Council (PMC) is responsible for establishing policies, procedures and practices for pavement design, construction, rehabilitation and maintenance. Under the direction of PPSC, Caltrans works with the industry and the Federal Highway Administration, through the Rock Products Committee (RPC) to coordinate efforts to improve construction methods, material specifications and test methods utilized in the construction and preservation of transportation facilities.

Pavement Program Offices

PLANNING & PROGRAMMING

PAVEMENT MANAGEMENT & PERFORMANCE

ASPHALT PAVEMENTS

CONCRETE PAVEMENTS AND PAVEMENT FOUNDATIONS
Concrete Pavement and Pavement Foundation Subpage

http://www.dot.ca.gov/hq/maint/Pavement/Offices/Pavement_Engineering/index.html
Rigid Pavements Subpage

http://www.dot.ca.gov/hq/maint/Pavement/Offices/Pavement_EngineeringRigid_Pavement.html
Time to Build!

Thank You