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CONCRETE PAVEMENT GUIDE

PART 4: REHABILITATION STRATEGIES

CHAPTER 420 – UNBONDED CONCRETE OVERLAY (UBCO)

This chapter provides guidelines and design criteria for rehabilitation with an unbonded concrete overlay (UBCO) using an HMA interlayer and a new surface of either JPCP or CRCP. For more information about CRCP, refer to Chapter 200. For JPCP, see Chapter 210.

420.1 PURPOSE AND DESCRIPTION

An unbonded concrete overlay (UBCO) consists of a new JPCP or CRCP concrete layer over an HMA interlayer used as a bond breaker to separate the new concrete from the existing concrete (see Figure 420-1). The new concrete layer is at least 0.70' thick, designed according to [HDM Index 623.1](#), and the minimum HMA interlayer thickness is 0.10'.

UBCO overlays may be used over either existing JPCP or CRCP to increase the structural capacity of the pavement structure. Existing JPCP should be cracked and seated under Section 41-6 of the 2010 Standard Specifications to improve overlay performance and limit cracking potential.

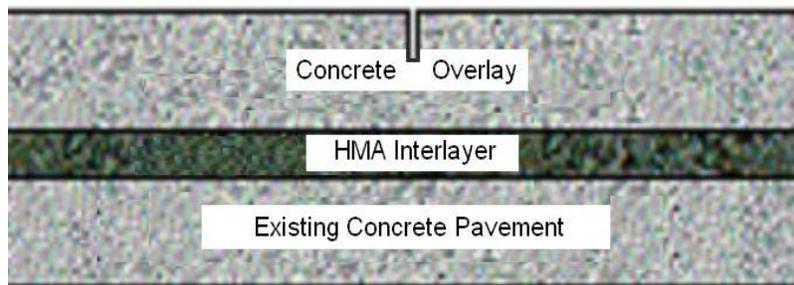


Figure 420-1: Unbonded concrete overlay layers

420.1.1 Appropriate Use

UBCO is used where the existing concrete pavement structure is in poor condition with severe distress extents including:

- 10-20 % 3rd stage cracking > 3/4" wide pending LCCA results
- 20% 3rd stage cracking > 3/4" wide
- 10% rutting > 1" deep
- 15% transverse, longitudinal, or corner cracking > 3/4" wide
- 15% spalling > 2 ft²

The existing pavement structure must have pavement distresses repaired prior to the UBCO placement (see Section 420.3.1). Existing poor subgrade material with moisture-related problems may benefit from UBCO since the pavement structural capacity is increased and drainage problems can be addressed as part of the design.

420.1.2 Cost Effectiveness

UBCO is most cost effective over severely distressed concrete pavement where existing traffic can be detoured away from the construction zone and in rural areas with high truck traffic volumes. Fewer overhead structures throughout the project increases cost effectiveness since limited vertical clearance for UBCO often requires tapers and pavement structure reconstruction for approaches. Compared to other rehabilitation strategies such as lane replacement, UBCO strategies increase the pavement's structural capacity and do not require extensive demolition and removal of existing pavement, saving construction costs and time. However, adjacent pavement around interchanges or intersections must be overlaid to match the UBCO profile grade. Future maintenance and rehabilitation demand is also reduced with a new UBCO surface compared to HMA alternatives such as CSOL.

Life-cycle cost analysis (LCCA) should be completed to determine whether UBCO is more cost effective over the analysis period compared to other rehabilitation alternatives. For 3rd stage cracking > 3/4" between 10 and 20% extent, LCCA should be used consider the cost effectiveness of preservation using individual slab replacement. More information about LCCA is available from the Headquarters Division of Maintenance Pavement Program website at:

http://www.dot.ca.gov/hq/maint/Pavement/Offices/Pavement_Engineering/LCCA_index.html.

420.2 MATERIALS

420.2.1 Interlayers

HMA Type A interlayers are typically designed 0.10' to 0.15' thick to provide a bond breaker between the existing concrete pavement and new CRCP or JPCP surface. The HMA interlayer improves smoothness, prevents bonding between the existing and new concrete layers, reduces reflective cracking, and provides flexibility for concrete pavement curling due to temperature differentials between the top and bottom of the concrete surface (see Figure 420-1).

Minimum HMA interlayer thickness should be increased to 0.15' or greater to improve performance and trigger compaction quality requirements in Section 39 of the Standard Specifications. Thicker interlayers account for existing pavement surface undulations and rough surfaces. Alternatively, a separate HMA leveling lift and bid item can be included in the project. The interlayer thickness can also be varied to cost effectively modify cross slopes.

Tack coat is applied to the existing concrete surface prior to HMA interlayer placement to improve HMA bonding to the existing concrete pavement. Some HMA interlayers may be designed with a geosynthetic pavement interlayer (GPI) to help retard reflective cracking in the UBCO.

420.2.2 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. Section 90 of the 2010 Standard Specifications defines the required chemical and physical concrete material properties for contractor developed mix designs, with some additional requirements for JPCP or CRCP specified in Section 40.

For more comprehensive information about concrete materials, refer to Chapter 120 and the [Concrete Technology Manual](#).

420.3 ENGINEERING CONSIDERATIONS

420.3.1 *Pre-Overlay Repairs*

Estimate repair quantities during preliminary and final project design. If the existing concrete pavement has distress such as cracking, spalling, or loss of underlying support, it should be repaired prior to interlayer placement according to [HDM Index 625.1](#). Existing JPCP may require spall repair (see Ch. 310) or individual slab replacements (see Ch. 320).

Some repairs may require use of nonstandard special provisions. More cost effective JPCP repairs for well-supported slabs may be possible by filling joints, cracks, and spalls > ¾" wide and 1" deep with No. 4 graded minor HMA, analogous to the process detailed for crack, seat, and overlay (see Ch. 410 and Section 41-6 of the 2010 Standard Specifications). For CRCP, any punchouts or other severe failures should also be repaired (see Ch. 380).

Extensive faulting > ¼" or an IRI > 170 inches/mile should be repaired by grinding (see Ch. 340) and the cause should be evaluated and addressed (see Section 110.2.1). If the existing concrete has extensive surface irregularities, the HMA interlayer may require increased design thickness or an additional item for HMA leveling to fill in depressions. Severe localized faulting or rocking slabs should be replaced together with underlying base (see Section 320.2).

A visual field survey is needed to identify existing pavement distress and evaluate potential repair locations and strategies. Deflection testing with a falling weight deflectometer (FWD) may help assess the underlying support condition of the existing pavement structure where distress conditions indicate potential problems. Ground Penetrating Radar (GPR) or coring are other options for investigating the base, subbase, and subgrade conditions and thicknesses.

420.3.2 *Design*

JPCP or CRCP pavement thickness is determined for UBCO using the standard design catalogs for new concrete pavement structures in [HDM Index 623.1](#). The catalogs are based on mechanistic-empirical analysis principles considering climate region, subgrade type, and applied traffic loads (traffic index). The minimum thickness for unbonded concrete overlays is 0.70'. Existing JPCP or CRCP is considered stabilized base, analogous to LCB in a new concrete pavement structure. Existing JPCP should be cracked and seated under Section 41-6 of the 2010 Standard Specifications to limit strain and reflective cracking potential in the overlay layers. The HMA interlayer is not accounted for in the design but does provide some structural benefit.

UBCO can be designed for a 20 or 40-year life according to [HDM Topic 612](#). For more information about CRCP design, refer to Chapter 200. For JPCP design, see Chapter 210.

To select the best materials and determine layer thicknesses, successful pavement structure designs must consider these and other engineering factors such as traffic control and estimated costs.



Figure 420-2: Unbonded concrete overlay construction

420.3.3 *Traffic Handling and Safety*

Adequate attention must be given to traffic handling to ensure safe, quality work and accurate cost estimates. UBCO usually requires the use of construction staging, temporary ramps, or detours. During initial construction stages, traffic can use the adjacent lanes or shoulders if they are wide enough and structurally adequate for anticipated traffic loading. Inadequate shoulder conditions may require partial reconstruction.

For more information about traffic handling alternatives, refer to Section 120.3.4, Chapter 200 for CRCP, and Chapter 210 for JPCP. Consult with the district traffic operations, traffic management, construction and public information offices for guidance on traffic handling, safety, scheduling, and communication issues.

420.4 PLANS, SPECIFICATIONS, AND ESTIMATING

420.4.1 *Plans*

UBCO is shown in the same manner as new construction on the project typical sections and layout sheets. At a minimum, include:

1. Title Sheet showing limits of project and pavement work.
2. Typical Cross Sections showing existing and proposed pavement widths and thicknesses.
3. Profiles showing the design finished grade of the roadway.
4. Superelevation diagrams showing roadway design cross slopes and transitions.
5. Construction Details for unique items of work not addressed on the typical sections or Standard Plans.
6. Quantity Sheets specifying types and amounts of work. Locations and limits of UBCO should be tabulated in the roadway quantity tables consistent with what is shown on layout sheets.
7. Standard Plans and Revised Standard Plans for CRCP (see Ch. 200) or JPCP (see Ch. 210).

420.4.2 Specifications

Table 420-1 lists some related specifications that may be used for UBCO work.

Table 420-1: Unbonded Concrete Overlay Related 2010 Standard Specifications

Section	Description	Notes
39-1	HMA	Use for HMA interlayers, HMA leveling, and individual slab replacements with HMA (nSSP required)
40-2	CRCP	Use for CRCP overlay construction
40-4	JPCP	Use for JPCP overlay construction
41-4	Spall Repair	Pre-overlay repair of existing distress. May use SSP 41-4 for fast-setting concrete material.
41-6	Crack and Seat	Use for cracking and seating existing JPCP to improve UBCO performance
41-9	Individual Slab Replacement (RSC)	Pre-overlay repair of existing distress

420.4.3 Cost Estimating

Unit cost estimates are typically based on historical bid prices which can be found in the Contract Cost database accessible on the intranet at <http://sv08data.dot.ca.gov/contractcost/>. Contract cost data unit prices by year are also published online through the Office of Engineer website at <http://www.dot.ca.gov/hq/esc/oe/awards/>.

Unit costs estimates should be adjusted based on project location, quantity of concrete, availability of materials used in the concrete mix, proximity of batch plants to construction site, and construction constraints such as lane availability and environmental restrictions. Typically, shorter construction windows result in lower productivity and higher bid costs. Mobilization of equipment, staging, traffic handling, and equipment setup are associated costs that must be considered in UBCO estimates. A separate mobilization item may be needed for UBCO projects.

UBCO may include estimates for associated work using the items listed in Table 420-2. The primary UBCO costs are the HMA interlayer, paid by the tonnage placed; and the concrete overlay volume, calculated based on the dimensions shown on the project plans. If the existing concrete is rough with extensive surface irregularities or IRI > 170 inches/mile, grinding may be needed or the HMA interlayer may require increased thickness or an additional item for HMA leveling to fill in depressions. Isolated failures should be repaired before overlaying using JPCP individual slab replacement or CRCP full-depth repair. For a complete list of potential pavement bid items, refer to the [Office Engineer website](http://oe.dot.ca.gov/occs.html) at: <http://oe.dot.ca.gov/occs.html>.

For assistance with UBCO questions or recommendations, contact the Office of Concrete Pavement and Pavement Foundations in the Headquarters Division of Maintenance Pavement Program. Concrete pavement design tools, standards, and guidance are available online at http://www.dot.ca.gov/hq/maint/Pavement/Offices/Pavement_Engineering/index.html.

Table 420-2: Unbonded Concrete Overlay Related 2010 and 2015 Bid Items

UBCO Work	Item Code	Description	Unit	Notes
Pre-Overlay Repairs	410121	Spall Repair (Fast-Setting Concrete)	SQYD	Can be used with SSP 41-4 for pre-overlay repair of severe spalls.
	411105	Individual Slab Replacement (RSC)	CY	Use for severe 3 rd stage cracking > ¾" wide
	420201	Grind Existing Concrete Pavement	SQYD	Use for extensive faulting > ¼"
	Nonstandard	CRCP Full-Depth Repair	SQYD	Repairs for existing CRCP. Contact HQ Division of Maintenance Pavement Program for nSSP use.
Interlayer	390135	HMA (Leveling)	TON	Use for rough surfaces with extensive irregularities and depressions
Interlayer	390102	HMA (TYPE A)	TON	0.10' minimum thickness
Concrete Pavement	400050	CRCP	CY	Design based on HDM Index 623.1
	401050	JPCP	CY	Design based on HDM Index 623.1
	Various	Joint Seal	LF	Use for sealing transverse joints in desert or mountain climate regions using individual material item code