Jointing Concrete Overlays

A. General Information

Bonded and unbonded concrete overlays can be placed on existing concrete pavements, asphalt pavements, and composite pavements. Although some normal joint design criteria apply to all concrete overlays, the various overlay options require special design considerations. For the purposes of this section dealing only with jointing guidance, guidelines for concrete overlays over asphalt and composite pavements are combined because of their similarity.

B. Bonded Concrete Overlays

1. Bonded Concrete Overlays of Concrete Pavements:

a. Joint Design: The bonded overlay joint type, location, and width must match those of the existing concrete pavement in order to create a monolithic structure. Matched joints eliminate reflective cracking and ensure that the two layers of the pavement structure move together, helping maintain bonding. To minimize curling and warping stresses, some agencies have successfully created smaller overlay panels by sawing additional transverse and longitudinal joints in the overlay between the matched joints. An important element in transverse joint design is joint dimensions. The depth of transverse joints should be full depth plus 0.50 inch. To prevent debonding, the width of the transverse joints should be equal to or greater than the width of the underlying joint or crack in the existing pavement. If the pavement system experiences expansion and the overlay pushes against itself because the width of the transverse overlay joint is less than the width of the underlying existing pavement crack, debonding may occur. The width of the existing underlying pavement crack may be determined by spot excavating along the pavement edge. Longitudinal joints should be sawed at least one-half the thickness of the overlay. Tie bars, dowel bars, or other embedded steel products are not used in bonded concrete overlays to minimize restraint forces in the bond.

b. Joint Sawing: Timely joint sawing is necessary to prevent random cracking. Sawing should begin as soon as the concrete is strong enough that joints can be cut without significant raveling or chipping. Lightweight early-entry saws allow the sawing crew to get on the pavement as soon as possible. To help match transverse joint locations, place guide nails on each edge of the existing pavement at the joints; after the overlay is placed, mark the joint with a chalk line connecting the guide nails.

2. Bonded Concrete Overlays of Asphalt and Composite Pavements:

a. Joint Design: The recommended joint pattern for bonded overlays of asphalt is small square panels, typically in the range of 3 to 8 feet, to reduce curling and warping stresses. It is recommended the length and width of joint squares, in feet, be limited to 1.5 times the overlay thickness in inches. In addition, if possible, longitudinal joints should be arranged so that they are not in the wheel path. The use of tie bars or dowels is not necessary because of the small panel spacings.

b. Joint Sawing: Timely joint sawing is necessary to prevent random cracking. Joint sawing should commence as soon as the concrete has developed sufficient strength so that joints can be cut without significant raveling or chipping, typically within 3 to 6 hours of concrete placement. Lightweight early-entry saws with 1/8 inch wide blades may be used to allow the sawing as soon as possible. Transverse joints can be sawed with conventional saws to a depth of T/4. Transverse joint sawcut depths for early-entry sawing should not be less than 1.25 inch. Longitudinal joints should be sawed to a depth of T/3. Joint sealing is not required.

C. Unbonded Concrete Overlays

1. Unbonded Concrete Overlays of Concrete Pavements:

a. Joint Design: Load transfer is better in unbonded overlays of concrete pavements than in new JPCPs because of the load transfer provided by the underlying pavement. Doweled joints are used for unbonded overlays of pavements that will experience significant truck traffic, typically pavements 8 inches and thicker. Joints are typically mismatched to maximize load transfer from the underlying pavement. Shorter joint spacing should be used to reduce the risk of early cracking due to enhanced curling caused by the stiff support provided by the underlying pavement (see Table 5G-5.01). Using lane tie bars may be appropriate in open-ditch (or shoulder) sections of unbonded overlays if the overlay is 5 inches or greater. In this category, a #4 tie bar (0.50 inch) may be appropriate. The use of tie bars in confined curb and gutter sections should be considered if the overlay is 6 inches or greater.

Table 5G-5.01: Typical Transverse Joint Spacing

Unbonded Resurfacing Thickness	Maximum Transverse Joint Spacing
< 5 inches	6 x 6 foot panels
5 to 7 inches	Spacing in feet = 2 times thickness in inches
> 7 inches	15 feet

Source: Harrington, 2008.

b. Joint Sawing: Timely joint sawing is necessary to prevent random cracking. Transverse joints can be sawed with conventional saws to a depth of between T/4 (minimum) and T/3 (maximum), but not less than 1.25 inch. Transverse joint sawcut depths for early entry sawing should not be less than 1.25 inch. Saw longitudinal joints to a depth of T/3.

2. Unbonded Concrete Overlays of Asphalt and Composite Pavements:

a. Joint Design: The load transfer design is the same as for new concrete pavements. Doweled joints are used for unbonded overlays of pavements that will experience significant truck traffic, typically pavements 8 inches and thicker. For pavements less than 6 inches thick, the maximum spacing in feet is 1.5 times the slab thickness in inches. For pavements 6 inches thick or greater, a maximum joint spacing in feet of two times the slab thickness in inches is often recommended for unbonded overlays. A 6 inch overlay would thus receive a maximum 12 foot joint spacing. The maximum recommended spacing is typically 15 feet. The use of tie bars for unbonded overlays should follow conventional use for pavements 5 inches thick or more. Using lane tie bars may be appropriate in open-ditch (or shoulder) sections of unbonded overlays if the overlay is 5 inches or greater. In this category, a # 4 tie bar (0.50

inch) may be appropriate. The use of tie bars in confined curb and gutter sections should be considered if the overlay is 6 inches or greater.

b. Joint Sawing: Timely joint sawing is necessary to prevent random cracking. Transverse joints can be sawed with conventional saws to a depth of between T/4 (minimum) and T/3 (maximum). When there is evidence of some wheel rutting on the existing asphalt pavement, sawcut depth is of particular concern for unbonded overlays because the distortions in the underlying asphalt pavement can effectively increase the slab thickness. Transverse joint sawcut depths for early-entry sawing should not be less than 1.25 inch. Longitudinal joints should be sawed to a depth of T/3. Always match overlay joints to the joints in any concrete patches in the existing pavement and cut the joints full depth.

Table 5G-5.02: General Jointing Practices for PCC Overlays

Construction Consideration of Joints	Bonded Overlays of Concrete	Bonded Overlays of Asphalt or Composite	Unbonded Overlays of Concrete	Unbonded Overlays of Asphalt or Composite
Typical Thickness:	***3 to 4 inch***	***3 to 4 inch***	***5 to 12 inch***	***5 to 12 inch***
Joint spacing for concrete overlays requires special consideration for each type:				
• Joints are to be matched with underlying concrete to prevent cracking.	X			
• Joints are typically mismatched to maximize load transfer from the underlying pavement.			X	
• Recommended length and width of panels in feet should be limited to 1.5 times the overlay thickness in inches.	X	X		
• Because of the potential for higher curling and warping stress from a rigid underlying pavement, shorter than normal spacing is typical.			X	X
Joint sawing:				
• The timing of sawing is critical. Sawing joints too early can cause excess raveling.	X	X	X	X
• Sawing must be completed before curl stresses exceed the bond strength developed.	X	X		
• Sawing too late can cause excess stresses, leading to uncontrolled random cracking.	X	X	X	X
• Transverse joint saw-cut depth for conventional saws.	Full Depth + 0.50 inch	T/4	T/4 min. - T/3 max.	T/4 min. - T/3 max.
• Transverse joint saw-cut for early-entry saws.	Full Depth + 0.50 inch	Not < 1.25 inch	Not < 1.25 inch	Not < 1.25 inch
• Longitudinal joint saw-cut depth.	T/2 (at least)	T/4 – T/3	T/4 – T/3	T/4 – T/3
• Transverse joint width must be equal to or greater than the underlying crack width at the bottom of the existing transverse joint.	X			
• Joint type, location, and width must match those of the existing pavement to create a monolithic structure.	X			
• Recommended joint pattern is square panels		X		
Sealing:				
• Seal joint using low-modulus hot-pour sealant with narrow joint.	X	**	*	*
Other considerations:				
• Doweled joints are used for pavements that experience heavy truck traffic, 8 inch pavements and thicker.			X	X
• Lane tie bars may be appropriate in open ditch (or shoulder) sections of unbonded overlays if the overlay is 5 inches or greater.			X	X
• Tie bar use in curb and gutter sections should be considered if the overlay is 6 inches or greater.			X	X

* Some states have experienced problems with asphalt stripping of the separation layer, particularly under heavy truck traffic and high speeds. Therefore, sealing is important in these conditions. On lower speed roadways without a heavy traffic loading, some states successfully do not seal.

** Joint between overlay and non-integral curb and gutter.

Source: Harrington, 2008.

D. References

Harrington, D. *Guide to Concrete Overlays: Sustainable Solutions for Resurfacing and Rehabilitating Existing Pavements*. Second Ed. National Concrete Pavement Technology Center, Iowa State University. ACPA publication no. TB021.02P. 2008.