



# Facilities Development Manual

ORIGINATOR Director, Bureau of Highway Construction		PROCEDURE 14-10-10
CHAPTER 14	Pavements	
SECTION 10	Pavement Design	
SUBJECT 10	Concrete Pavement Design	

## **Standard Pavement Type**

WisDOT policy establishes jointed plain concrete pavement with dowels as the standard type of concrete pavement to be used on highways in Wisconsin. Details for this type of concrete pavement are shown in SDDs 13C11 and 13C13.

## **Traffic Loading**

See [Procedure 14-1-5, "Traffic."](#)

## **Modulus of Subgrade Reaction**

Westergaard's Modulus of Subgrade Reaction (k) is used in this procedure to express the supporting capability of the subgrade soil. It represents the load in pounds per square inch on a loaded area, divided by the deflection in inches of that loaded area, psi/inch.

The "k" value is best estimated on the basis of previous experience or by correlation with other tests. The "k" value to be used for design purposes is to be determined and reported in the soils report.

## **Design Equation**

WisDOT uses the WisPAVE program to design concrete pavements. See [Procedure 14-15-10](#) for instructions on how to obtain this software. WisPAVE uses the AASHTO 1972 Portland Cement Concrete design equation (1) as its theoretical basis for concrete pavement thickness design.

## **Design Thickness**

Design concrete pavements to the nearest ½ inch.

$$\log(\text{ESAL}) = 7.35 \log(D + 1) - 0.06 + \frac{\log\left(\frac{4.5 - P_t}{4.5 - 1.5}\right)}{1 + \frac{1.62 \times 10^7}{(D + 1)^{8.46}}} + (4.22 - 0.32 P_t) \log\left[\left(\frac{f_t}{690}\right) \frac{D^{0.75} - 1.132}{D^{0.75} - \frac{18.42}{\left(\frac{E}{k}\right)^{0.25}}}\right]$$

where: ESAL = Total Life Rigid ESAL's (see [Procedure 14-1-5](#))  
 D = Concrete Slab Thickness (inches)  
 $P_t$  = Terminal Serviceability Index (WisDOT uses 2.5)  
 $f_t$  = Working Stress of Concrete (490 psi)  
 E = Modulus of Elasticity of Concrete (4,200,000 psi)  
 k = Modulus of Subgrade Reaction (psi) (refer to Soils Report)

## Transverse Contraction Joints

### Spacing

The spacing of transverse contraction joints for rural WisDOT concrete pavements is uniform at 15 feet for thicknesses of 9-1/2 inches or less. The spacing is uniform at 18 feet for pavements greater than 9-1/2 inches in thickness.

For urban pavements the spacings are as follows:

- 12 feet for pavement thicknesses of 6 and 6-1/2 inches
- 14 feet for pavement thicknesses of 7 and 7-1/2 inches
- 15 feet for pavement thicknesses of 8, 8-1/2, 9 and 9-1/2 inches
- 18 feet for thicknesses of 10 inches and greater

### Orientation

Transverse contraction joints will be constructed normal (90°) to the centerline.

## Longitudinal Joints

Two types of longitudinal joints are used in concrete pavement--construction and sawed. Construction type longitudinal joints are used in the following situations:

1. For lane-at-a-time construction
2. Along ramp tapers
3. Along concrete shoulders and curb and gutter (when poured separately)
4. Along lanes added to existing pavement

Tie bars are typically used across these joints. In the fourth case, when adding lanes to existing pavement, holes are drilled into the longitudinal face of the existing slab. Tie bars are then driven into the holes prior to pouring the added lane.

Sawed-type longitudinal joints are used in the following situations:

1. Along the center line or between lanes
2. Along concrete shoulders (when poured with the pavement)

Tie bars are used across this type of longitudinal joint. For tie bar spacing, refer to the SDD titled Concrete Pavement Longitudinal Joints and Pavement Ties.

## **Intersection Joint Layout**

Refer directly to the American Concrete Pavement Association (ACPA) publication regarding concrete information, titled "Intersection Joint Layout". For a copy of this publication, contact the Wisconsin Concrete Pavement Association at 608-240-1020.

## **Sealing**

It is department policy to not seal or fill longitudinal or transverse joints in concrete pavements. Joints in new concrete pavements will be cut as narrow as possible (on the order of 1/8 inch in width). No joint sealants, sealant systems or fillers will be utilized on any type of concrete pavements except for research purposes.

This policy applies to new construction of all rural and urban highways, all functional classes of highways, all types of concrete pavement, all base course structures, and all soil types. The only exception to this would be local projects (local ownership and maintenance responsibilities) where a local government has expressed a preference for filling or sealing. In this case, a hot-pour asphalt, without over-banding, is recommended as the sealant material and it would be at the expense of the local unit of government.

## **Construction Joints**

All transverse construction joints are of the butt type and are tied with bar steel reinforcement as shown on the standard detail drawing for the particular type of concrete pavement being constructed.

On concrete pavement projects with auxiliary lanes the placement of the longitudinal construction joint is important for traffic operations. When the total length of the auxiliary lane, including taper and longitudinal section, exceeds 800 feet the construction joint for concrete pavement shall be located at lane width. The designer should prepare a detail drawing to direct the contractor to "box-out" or otherwise construct the pavement showing the proper lane width, which should also be the construction joint location. Therefore, the construction joint shall be placed at the location of the proposed lane pavement marking.

## **Tining**

When the design speed of a concrete highway is 40 mph or greater, the surface shall receive a tined finish in accordance with Chapter 8, Section 8.10, "Texturing," of the Wisconsin Department of Transportation's Construction and Materials Manual.

When tining is required, add a note to the appropriate typical section to indicate which sections of concrete pavement are to be tined.

## **References**

- (1) AASHTO Interim Guide for Design of Pavement Structures, 1972, Chapter III Revised, 1981.★