Standard Drawing Report

Date: October 4, 2017

Technical Owner: Civil – Brett I. Kesterson, P.E.

Standard Drawing No. P-551 **Calculation Book No.** 551

Drawing Title: Sidewalks

REGISTERED PROFESSIONAL ENGINEER
9676PE
Brett I. Kesterson
OREGON
JULY 14, 1978
BRETT I. KESTERSON

Expires 06/30/2019

Background Information, Including Reference Material:

The earliest documented sidewalks were constructed for the 1905 Lewis and Clark Expo in NW Portland. These sidewalks were constructed with a loose layer of aggregate approximately 3 inches thick. A cement mixture was the added to the top and was allowed to filter into the aggregate to create a 4 inch thick sidewalk. Hence the workers were called cement finishers, not concrete finishers. These older sidewalks have more or less aggregate and the cement may or may not have reach the full depth of the aggregate, but the overall sidewalk thickness tends to be consistent at 4 inches. In the 1960's the ready-mix industry began expanding throughout the country. The cement sidewalks then gave way to concrete sidewalks. Even as lumber dimensions began to change over the years, the thickness of sidewalks still remained at 4 inches.

The sidewalk details first appeared before the 1970's. Over the years, different variations of sidewalk construction occurred throughout Portland, but were not well documented. Around 2008-10 an effort was made to document the different designs of sidewalks adjacent to or behind curbs.

Jointing Guidance: Portland Cement Association (PCA) document on Placing Joints in Concrete Flatwork: Why, How, and When.

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FHWA Designing Sidewalks and Trails for Access Parts 1 (1999) and II (2001), Rev. ed.

Assumption Made:

Sidewalks are poured to a true thickness of 4 inches, not a nominal 3-1/2 inches.

Sidewalk subgrade was assumed to have poor soils, low reliability and poor serviceability to account for soil conditions throughout City. Flexural strength of 478psi from 3000psi compressive strength.

Design Narrative:

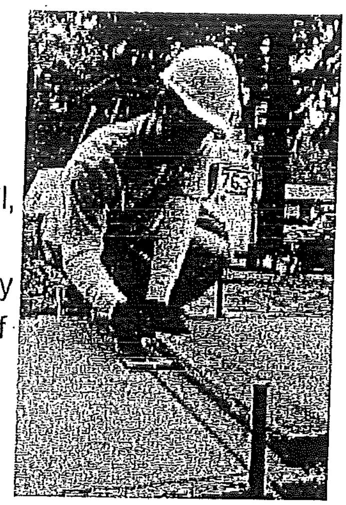
The back calculation for pavement loads shows the concrete sidewalk to have capacity for 18,900 ESAL's over 20 years. While this is adequate for passenger cars and light duty trucks, a thicker section should be considered if maintenance vehicles will use the sidewalk to access facilities.

Recommend not exceeding 8 feet for scoring grid.

These designs conform to Federal Highway Administration (FHWA) ADA Accessibility Guidelines and Practices.

Placing Joints in Concrete Flatwork: Why, How, and When

Contraction/Control Joints



Contraction/control joints are placed in concrete slabs to control random cracking. A fresh concrete mixture is a fluid, plastic mass that can be molded into virtually any shape, but as the material hardens there is a reduction in volume or shrinkage. When shrinkage is restrained by contact with supporting soils, granular fill, adjoining structures, or reinforcement within the concrete, tensile stresses develop within the concrete section. While concrete is very strong in compression the tensile strength is only 8 to 12 percent of the compressive strength. In effect, tensile stresses act against the weakest property of the concrete material. The result is cracking of the concrete.

There are two basic strategies to control cracking for good overall structural behavior. One method is to provide steel reinforcement in the slab which holds random cracks tightly. When cracks are held tightly or remain small, the aggregate particles on the faces of a crack interlock thus providing load transfer across the crack. It is important to recognize that using steel reinforcement in a concrete slab actually increases the potential for the occurrence of random hairline cracks in the exposed surface of the concrete.

The most widely used method to control random cracking in concrete slabs is to place contraction/control joints in the concrete surface at predetermined locations to create weakened planes where the concrete can crack in a straight line. This produces an aesthetically pleasing appearance since the crack takes place below the finished concrete surface. The concrete has still cracked which is normal behavior, but the absence of random cracks at the concrete surface gives the appearance of an un-cracked section.

Concrete slabs-on-ground have consistently performed very well when the following considerations are addressed. The soils or granular fill supporting the slab in service must be either undisturbed soil or well compacted. In addition, contraction joints should be placed to produce panels that are as square as possible and never exceeding a length to width ratio of 1.5 to 1 (Figure 1). Joints are commonly spaced at distances equal to 24 to 30 times the slab thickness. Joint spacing that is greater than 15 feet require the use of load transfer devices (dowels or diamond plates).

Figure 1a: Joint Spacing in Meters

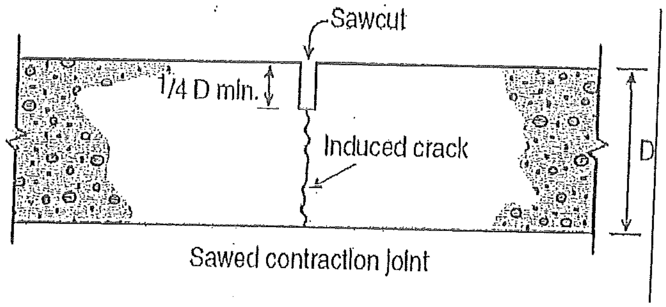
Figure 1b: Joint Spacing in Feet

Contraction joints may be tooled into the concrete surface at the time of placement. Joints may be tooled into the surface (first pass) prior to the onset of bleeding or immediately with the first pass of the floating operation. The longer the first pass for jointing is delayed the more difficult it will be to shape clean straight line joints. Tooled joints should be re-established with each successive pass of finishing operations.

Joints may also be sawed into the hardened concrete surface. It is important to understand that the longer sawing is delayed the higher the potential for cracks to establish themselves before sawing is complete. This means that any cracks that occur before the concrete is sawed will render the sawed joint ineffective. Timing is very important. Joints should be sawed as soon as the concrete will withstand the energy of sawing without raveling or dislodging aggregate particles. For most concrete mixtures, this means sawing should be completed within the first six to 18 hours and never delayed more than 24 hours. Early-entry saws are available which may allow cutting to begin within a few hours after placement.

Contraction/control joints must be established to a depth of ¼ the slab thickness (Figure 2). Proper joint spacing and depth are essential to effective control of random cracking.

Figure 2: Minimum Depth of Contraction Joints



Sawed contraction joint

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