CONCRETE INFORMATION

Proper Use of Isolation and Expansion Joints in Concrete Pavements

Isolation and expansion joints accommodate anticipated differential horizontal and vertical movements that occur between a pavement and a structure. Their purpose is to allow movement without damaging adjacent structures. Contraction or control joints also absorb some movement; however, their main function is to control the location and geometry of the natural cracking pattern in the concrete slab. Because pavement performance can be significantly affected by the planned use and location of isolation and expansion joints, care should be taken in their design. Though the terms are sometimes used interchangeably, isolation joints are not expansion joints.

Isolation joints isolate the pavement from a structure, another paved area, or an immovable object. In this publication, isolation joints include full-depth, full-width joints found at bridge abutments, intersections, or between old and new pavements. The term isolation joint also applies to joints around in-pavement structures such as drainage inlets, manholes, footings, and lighting structures.

Expansion joints are defined in this publication as full-depth, full-width joints placed at regular intervals of 50 to 500 ft (15 to 150 m) (with contraction joints in between). This is an old practice that often caused joint pumping, spalling, and corner breaks. The fact that these joints are not needed and often create problems is a major theme of this publication.

Isolation Joints

Isolation joints lessen compressive stresses that develop at T- and unsymmetrical intersections, ramps, bridges, building foundations, drainage inlets, manholes, and anywhere differential movement between the pavement and a structure may take place. They are also placed adjacent to existing pavements, especially when it is not possible or desirable to match joint locations in the older pavement. Isolation joints should be 1/2 to 1 in. (12 to 25 mm) wide. Greater widths may cause excessive movement. They are filled with a pre-formed joint filler material to prevent infiltration of incompressibles.

Isolation joints used at structures such as bridges, should have dowels to provide load transfer. The end of the dowel must be equipped with a closed-end expansion cap into which the dowel can move as the joint expands and contracts. The cap must be long enough to cover 2 in. (50 mm) of the dowel and have a suitable stop to hold the end of the cap at least the width of the isolation joint plus 1/4 in. (6 mm) away from the end of the dowel bar. The cap must fit the dowel bar tightly and be watertight. The half of the dowel with the capped end must be coated to prevent bond and permit horizontal movement. Figure 1 shows a doweled isolation joint.

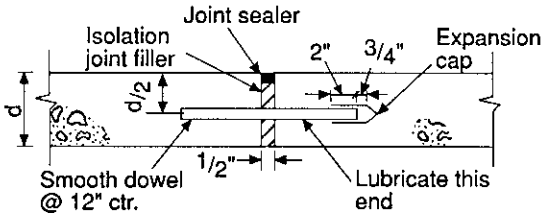

Fig 1. Doweled Isolation Joint.

Isolation joints at T- and unsymmetrical intersections or ramps are not doweled so that horizontal movements can occur without damaging the abutting pavement. Undoweled isolation joints are normally made with thickened edges to reduce the stresses developed at the slab bottom. The abutting edges of both pavements should be thickened by 20 percent starting on a taper 5 ft (1.5 m) from the joint. The isolation joint filler material must extend completely through the entire thickened-edge slab. Figure 2 shows a thickened-edge isolation joint.

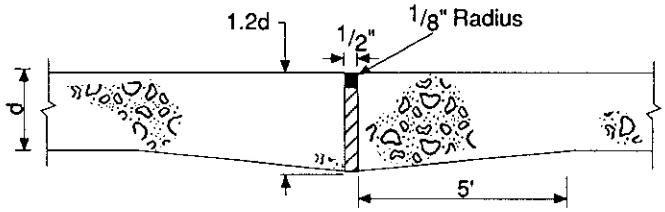

Fig 2. Thickened-Edge Isolation Joint.

Isolation joints used at drainage inlets, manholes, and lighting structures do not have thickened edges or dowels. Figures 3a and 3b show details of these isolation joints.

The joint filler material occupies the gap between the slabs and must be continuous from one pavement edge to the other and through curb and gutter sections. This

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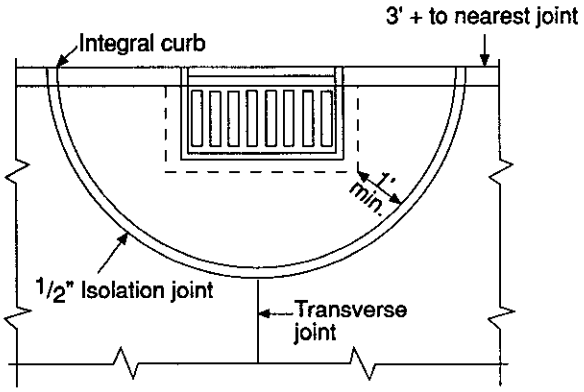

Fig 3a. Isolation Joint for Drainage Structures.

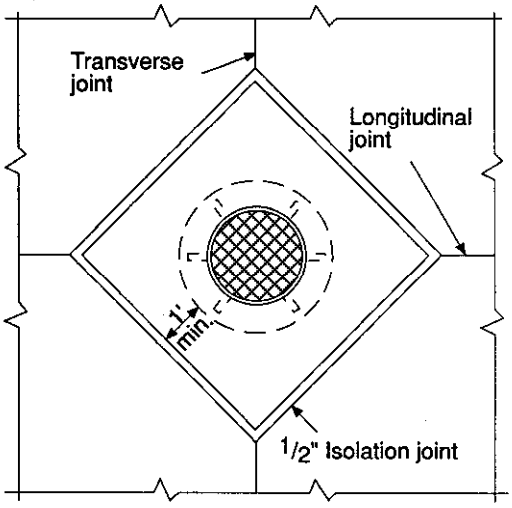

Fig 3b. Isolation Joint for Manhole Covers.

filler material is usually a non-absorbent, non-reactive, non-extruding material typically made from either a closed-cell foam rubber or a bitumen-treated fiber board. No plug or sliver of concrete should extend over, under, through, around, or between sections of the filler, or it will cause spalling of the concrete. After the concrete hardens, the top of the filler may be recessed about 3/4 in. (20 mm) below the surface of the slab to allow space for the joint sealant to be placed later.

Expansion Joints

In the past, some engineers used various spacing combinations of expansion and contraction joints in an attempt to relieve compressive stresses in the pavement and prevent blow-ups that developed on hot summer days. Unfortunately, this practice led to other failures and general poor pavement performance. In 1940, the U.S. Bureau of Public Roads conducted a series of tests to evaluate expansion joints. These tests found that expansion joints progressively close over the years causing greater openings at nearby contraction joints. This led to spalling, loss of aggregate interlock, and sealant failure, which in turn allowed water and incompressibles into the joint causing pumping, faulting, and corner breaks. As a result, it was concluded that expansion joints should not be used in concrete pavements built with normal aggregates under normal temperatures with contraction joints spaced less than 60 ft (18 m).

Good design and construction of contraction joints has virtually eliminated the need for expansion joints, except under special conditions. The improper use of expansion joints can lead to high construction and maintenance costs, pavement growth, and the problems listed above. By eliminating unnecessary expansion joints, failures are minimized and the pavement will provide better performance.

Pavement expansion joints are only needed when:

1. the pavement is divided into long panels (60 ft (18 m) or more) without contraction joints in-between.
2. the pavement is constructed while ambient temperatures are below 40° F (4° C).
3. the contraction joints are allowed to be infiltrated by large incompressible materials.
4. the pavement is constructed of materials that in the past have shown high expansion characteristics.

In most situations, these criteria do not apply. Therefore, expansion joints should not normally be used. For more information about these and other types of joints in concrete pavements see PCA publications *Design and Construction of Joints for Concrete Streets, Design and Construction of Joints for Concrete Highways,* and *Design of Concrete Airport Pavement.*

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