Concrete Q&A

Expansion Joints in Exterior Pavements?

Q. *I'm an architect in an area where the average high temperature in July is 85 °F (29 °C), and the average low temperature in January is 20 °F (–7 °C). When specifying concrete slabs for driveways, parking lots, sidewalks, and other exterior pavements, I require the contractor to install expansion joints at a maximum spacing of 30 ft (9 m) with stainless steel pins used to transfer load across the joint. An engineer recently told me that, according to the American Concrete Institute, no expansion joints are needed in any flatwork exterior concrete pavements. Is this true and, if so, what is the rationale for it?*

A. Several ACI documents state that expansion joints are seldom, if ever, needed in concrete pavements. "Guide for Design of Jointed Concrete Pavements for Streets and Local Roads (ACI 325.12R-02)"[1] states that:

"Performance studies have indicated that expansion joints are only necessary at relatively fixed structures such as a light pole footing and drop inlet boxes. In the past, designers placed transverse expansion joints to relieve compressive forces in the pavement and to limit blowups. In many cases, however, the expansion joints allowed too much opening of adjacent transverse contraction joints, which led to loss of aggregate interlock and sealant damage. By eliminating unnecessary expansion joints, adjacent contraction joints will remain tight and provide good load transfer and joint effectiveness."

"Joints in Concrete Construction (ACI 224.3R-95)"[2] states that expansion joints are no longer used in mainline pavements, except that expansion joints with dowels for load transfer are used at bridges. A footnote explains this as follows:

This hot summer day, cracking the sidewalk

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Questions in this column were asked by users of ACI documents and have been answered by ACI staff or by a member or members of ACI technical committees. The answers do not represent the official position of an ACI committee. Only a published committee document represents the formal consensus of the committee and the Institute.

We invite comment on any of the questions and answers published in this column. Write to the Editor, *Concrete International*, 38800 Country Club Drive, Farmington Hills, MI 48331; contact us by fax at (248) 848-3701; or e-mail Rex.Donahey@concrete.org.

"At one time, blowups were a major consideration for joints in highway pavements. These typically occurred when incompressible materials entered unsealed joints, often in the winter when joint widths were greatest. In summer, the pavement expanded in response to daily and seasonal temperature changes. For a joint containing incompressible material, compressive stresses developed that led to failure in some cases. Properly designed pavements with sealed and maintained joints are not susceptible to blowups. True expansion joints in pavements are needed only in very unusual conditions of construction or with unusual materials."

"Guide for Design and Construction of Concrete Parking Lots (ACI 330R-01)"[3] states that, while isolation joints are sometimes referred to as expansion joints, they are rarely needed to accommodate concrete expansion. When contraction joints are properly spaced, the use of expansion joints should be limited to the role of isolating the slab from other structures or fixed objects.

That being said, there have been some documented cases of pavement blowups in long stretches of concrete sidewalks (refer to photos). In one case, sections of 6- to 8-ft-wide (1.8- to 2.4-m) golf-cart paths buckled in hot weather, even though contraction joints had been cut every 6 to 8 ft (1.8 to 2.4 m). Sometimes the paths blew up and cracked at the joint, and sometimes at midpanel. To solve the problem, the contractor started installing 1-in.-thick (25 mm) fiberboard through the full depth of the path and at 250-ft (76-m) intervals. Three dowels at each expansion joint provided the needed load transfer. This practice eliminated the buckling.[4]

Also, cases of damage to fixed structures caused by expansion of concrete pavements have been described in the literature. Burke describes bridge damage caused by pavement forces,[5] and Albright describes expansion of concrete roadway pavements with small-radii curves that created radial forces large enough to move houses.[6] In the latter case, it's doubtful that expansion joints spaced at 30-ft (9-m) intervals in the roadway would have prevented the problem.

References

1. ACI Committee 325, "Guide for Design of Jointed Concrete Pavements for Streets and Local Roads (ACI 325.12R-02)," American Concrete Institute, Farmington Hills, MI, 2002, 32 pp.

2. ACI Committee 224, "Joints in Concrete Construction (ACI 224.3R-95) (Reapproved 2001)," American Concrete Institute, Farmington Hills, MI, 2001, 44 pp.

3. ACI Committee 330, "Guide for Design and Construction of Concrete Parking Lots (ACI 330R-01)," American Concrete Institute, Farmington Hills, MI, 2001, 32 pp.

4. Banka, B., "Expansion Joints Prevent Buckling of Cart Paths," *Concrete Construction*, V. 40, No. 5, May 1995, pp. 474-475.

5. Burke, M.P., Jr., "Reducing Bridge Damage Caused by Pavement Forces," (two-part article) *Concrete International*, V. 26, No. 1, Jan. 2004, pp. 53-57, and V. 26, No. 2, Feb. 2004, pp. 83-89.

6. Albright, R.O., "Beware of Unrestrained Expansion," *Concrete Construction*, V. 43, No. 4, Apr. 1998, pp. 371-374.