

RECOMMENDED CAPACITIES FOR
EXPANSION ANCHOR LANE TIES, AND
EVALUATION OF FRAZER AND JONES
CONCRETE EXPANSION ANCHORS



MICHIGAN DEPARTMENT OF
STATE HIGHWAYS AND TRANSPORTATION

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This report presents the results of testing conducted to evaluate the performance of torque-type concrete expansion anchors submitted by Frazer and Jones Company of Syracuse, New York. The purpose of this evaluation was to determine the suitability of the subject anchors for use as lane ties on highway projects. It has been determined from previous testing programs that the ultimate pull-out load that an expansion type anchor can sustain usually occurs after considerable slippage has taken place. Since the primary application of expansion anchors in highway construction is for use as lane ties, it is imperative that any given anchor be able to sustain maximum loads with minimal slippage. Also, if an anchor is installed too near a surface or in relatively new concrete, the possibility exists that the concrete may be spalled if excessive force is generated during expansion or loading of the anchor. These tests were conducted to determine the load capacity at 1/32 in. slippage.

Test Samples

The Frazer and Jones D-13 concrete expansion anchors are designed for installation in a 1-1/4-in. diameter hole. This type anchor is quite similar in design to the Bethlehem K-1, except for the bail utilized to hold the wedges in place while the expanding plug is pulled outward when the bolt is torqued. Frazer and Jones anchors use a sheet metal bail mechanically fastened to a pair of wedges, while Bethlehem utilizes a bail integrally cast with the wedges. Also, the expansion plug on the Frazer and Jones anchors is longer than that used by Bethlehem. Frazer and Jones anchors are supplied as a shield, the bolt portion of the assembly is a separate item. The Frazer and Jones D-13 anchors were evaluated in 5/8 and 3/4-in. diameter sizes. The shield itself is identical for both sizes except that the expanding plug can be threaded to accommodate either size.

Frazer and Jones Company also supplied samples of FJ-1 anchors. These anchors are different from the D-13 in that each of the two wedges is split in half for approximately three-fourths of a length to form a total of four sides instead of two, and therefore the expanding plug is also four sided. The FJ-1 anchors are supplied for use with 5/8-in. diameter bolts only, and are installed in a 1-1/8 in. diameter hole.

Installation

The anchors were installed in the edge of an unused ramp at the Grass Lake truck weighing scales located on westbound I 94 east of Jackson. The slab is 9 in. thick, built in 1962. Project records show core compressive strengths of approximately 6,000 psi in the vicinity of the area used for the tests.

The holes for the anchors were drilled with an electric roto-hammer and carbide tipped drill bit of the recommended size. After drilling, all holes were cleaned with compressed air.

Testing

Load to the anchors was applied by using a 20,000 lb capacity aluminum test frame. The load was applied at a uniform rate by a hydraulic pump and cylinder, and monitored with a dynamometer ring and dial indicator. The pull-out load placed on the anchors was recorded when the anchor slippage reached 1/32 in. as measured by means of a dial indicator.

Results

Since there has been a recent design change, requiring lane ties to be 5/8 in. minimum diameter, the 5/8-in. anchors will not be considered acceptable for use as lane ties. Threading the rod would reduce the minimum diameter below the allowable size.

Results of pull-out tests for the 3/4-in. D-13 anchors are shown in Table 1.

TABLE 1
RESULTS OF TESTS ON
3/4-in. F&J D-13 ANCHOR

Concrete Hole Depth, in.	Nominal Bolt Torque, lb-ft	Load at 1/32 in. Pull-Out, lb			Average Load, lb
		Sample 1	Sample 2	Sample 3	
4	90	12,000	8,000	6,800	8,900
4	120	6,000	5,700	6,600	6,200

As can be seen, the load sustaining capability of the 3/4-in. Frazer and Jones D-13 anchors dropped noticeably when the torque was increased from 90 to 120 lb-ft. This is probably due to failure of the bail-to-wedge connection, not allowing proper expansion of the anchor. Also, the average loads sustained by the Frazer and Jones anchors are considerably less than the recommended 10,000 lb design load value given in Research Report R-807, March 1972. The recommended 10,000 lb design value for torque type anchors was based on pull-out tests of Bethlehem K-1 anchors torqued to 100 lb-ft, installed and tested in the same manner as the Frazer and Jones D-13 anchors.

Comments

1. Results of additional tests performed since the design values for 3/4-in. diameter self-drilling type anchors were issued, have shown, in some cases, values under those which were originally recommended. The reasons for this may be slight variations in anchor steel hardness or of the

concrete in which the anchors were installed. In any case, the variations that have occurred should be taken into account when establishing recommended design values. Results of tests performed on a total of 18, 3/4-in. diameter, self-drilling anchors to date, show average pull-out loads at 1/32 in. extrusion of 7,700 lb instead of the 8,400 lb average of nine samples on which the originally recommended design value was based.

2. From the results of tests performed to evaluate the Frazer and Jones anchors, the design load should be 6,000 lb. On the basis of the Department's load sustaining requirement of 3,000 lb/lin ft of joint, the anchors would need to be installed at 24 in. spacing. From an economic standpoint, it seems unlikely that contractors would utilize this type of anchor instead of the Bethlehem K-1 which can be installed at a spacing of 40 in. The results have shown that overtorque can cause substantial changes in capacity. Since installation torque is not closely controlled in the field, such variations would seem to be quite likely to occur.

Recommendations

1) Based on the above comments, we recommend changes in utilization of anchors and of design values as given in Table 2. This table includes recommended capacities and spacing for self-drilling anchors and Bethlehem K-1 anchors from previous evaluations, for ready reference. Please note that the value for 3/4-in. self-drilling has been reduced from 8,000 to 7,500 lb.

2) Due to the present requirement for 5/8-in. minimum diameter for laneties, it is recommended that the FJ-1 anchors not be approved for use, because the threaded 5/8-in. bolt has a root diameter considerably smaller than 5/8-in.

3) It is recommended that F&J D-13 anchors not be approved because of the probability of load capacity variation due to overtorque at the time of installation.

TABLE 2
RECOMMENDED USAGE AND DESIGN VALUES

New Concrete Widening

Anchor Type	Diameter, in.	Allowable Design Load, lb	Maximum Anchor Spacing, in.
Self-Drilling*	3/4	7,500	30
	7/8	12,000	48

Old Concrete Widening

Anchor Type	Diameter, in.	Torque, lb-ft	Allowable Design Load, lb	Maximum Anchor Spacing, in.
Self-Drilling*	3/4	---	7,500	30
	7/8	---	12,000	48
Bethlehem K-1 (torque type)	3/4	100	10,000	40

* Acceptable self-drilling type anchors are: Phillips, Star, or Chicago.