

OFFICE MEMORANDUM

July 1, 1969



MICHIGAN
DEPARTMENT OF STATE HIGHWAYS

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To: R. L. Greenman, Engineer of Testing & Research
Testing and Research Division

From: L. T. Oehler

Subject: Evaluation of Lane Tie Bolts for Slip-Form Paving. Research
Project 69 F-109. Research Report No. R-710.

In response to your telephone request of June 12, 1969, the Structures Group has performed pull-out and tension tests on samples of Ohio hook bolts and threaded rods. These new types of lane ties are intended for use with slip-form paving equipment and tested for conformance to our specifications for joint hook bolts.

Sample Description

Ohio Hook Bolt - Three sample bolts were submitted by the manufacturer, Brown Machine-Tool Repair Company, Mantua, Ohio. The bolt is 12 in. long, 9/16 in. in diameter with 1 in. length of 5/8 in. thread on one end and formed into a wave-like configuration. The sleeve is 1-7/8 in. long and 1-1/16 in. in diameter with a 5/8 in. internal thread.

Threaded Rod - Nine samples were submitted by the manufacturer, Threaded Rod Company, Inc., Indianapolis, Indiana, at the request of Mr. Vinning, of Jones & McKnight, Chicago. The rod is 15 in. long, 9/16 in. in diameter and threaded full length. There is no positive stop to prevent the rod from being threaded beyond the center of the coupling. The rod utilizes a standard hook bolt sleeve (2 in. long and 15/16 in. in diameter with a 9/16 internal thread.)

Test Procedure

Pull-out Tests - Three samples of each type of tie bolt were tested. The samples were cast into reinforced concrete blocks 3 ft by 3 ft by 9 in. thick. One sample was embedded in the center of each side of the blocks. The position of the tie bolts was maintained during casting by bolting through the form into the tie bolt sleeves. The blocks were cast of high-early strength concrete and cured for seven days to obtain the 28 day minimum compressive strength of 3,500 psi required for concrete pavement.

The pull-out strength of the tie bolts was obtained by applying a tensile force to the bolts through a hydraulic ram incorporated in a frame constructed for this type of test.

Tension Test - Three samples of the threaded rod tie bolt assembly were tested in the Tinius-Olsen testing machine to determine the tensile strength. Lack of samples prevented similar tests of the Ohio hook bolt assembly.

Test Results

Tensile Strength - The tensile strength of the threaded rod tie bolt assembly was as follows:

| Sample No. | Tensile Load | Average Tensile Load | Remarks |
|------------|--------------|----------------------|--|
| 1 | 13,200 lbs | 13,200 lbs | All samples failed in threaded rod portion of the assembly |
| 2 | 13,100 lbs | | |
| 3 | 13,300 lbs | | |

On the basis of the tensile stress area of the rod the material from which the rod is made would have an average tensile strength of 72,500 psi.

As mentioned no tension tests were made on the Ohio hook bolt assembly. However, the manufacturer was contacted and it was learned that the samples submitted meet Ohio's specification requirements of 14,000 lbs minimum. Thus the ultimate tensile strength of the material would be not less than 62,000 psi. He also said that since the specified value is a minimum, strengths of around 15,000 lbs are not uncommon, but he was aware that the assembly would not meet Michigan specifications.

Pull-Out Strength - Before giving the test results it should be stressed that the manner in which the bolts were installed in the test blocks was entirely different from the method to be used in the field. In the Laboratory, the concrete was vibrated around the stationary tie bolts whereas it is understood that in the field the bolts are to be inserted in the slab edge with little or no vibration. Therefore, the following results represent strengths of bolts installed in the best possible manner:

| Sample No. | Bolt Type | Pull-Out Strength | Concrete Compressive Strength | Remarks |
|------------|-----------|-------------------|-------------------------------|--|
| 1 | Threaded | 15,300 lbs | 4,090 psi | All bolts failed in tension, 1/2 in. from embedded end of sleeve |
| 2 | | 15,600 lbs | 4,090 psi | |
| 3 | | 16,800 lbs | 4,600 psi | |
| 4 | Ohio | 19,800 lbs | 4,090 psi | All bolts failed in tension at embedded end of sleeve |
| 5 | | 20,400 lbs | 4,090 psi | |
| 6 | | 20,600 lbs | 4,600 psi | |

The higher tensile strengths obtained in the pull-out tests is attributed to the fact that bond and shear stresses acting along the interface of concrete and assembly increases the force required to break the bolts. The results indicate that if good concrete consolidation around the bolts can be obtained in the field, a pull-out strength equal to the assemblies' required tensile strength can possibly be attained.

Conclusions

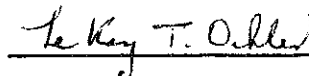
1. On the basis of tension tests on the threaded rod assembly, and discussion with the manufacturer of the Ohio hook bolt assembly, neither assembly meets specified tensile strength requirements for joint hook bolts.
2. Although the pull-out tests indicate that sufficient bond may be obtainable with good concrete consolidation around the assemblies, it is uncertain that machine installed bolts can attain sufficient bond strength.

Remarks

It appears that tie bolt assemblies of the type tested can easily be modified to meet required strengths. For example, a threaded 3/4-in. diameter rod of the same material will be satisfactory or if the size submitted is installed at closer spacings they could be used. The Ohio hook bolt assembly could be modified in the same manner.

With respect to testing the bond capacity of bolts installed by machine, it would be necessary to develop a Laboratory method similar to the field method to obtain meaningful results. It may also be possible that field testing of machine-installed bolts on a regular paving project could be arranged.

TESTING AND RESEARCH DIVISION



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