OFFICE MEMORANDUM

MICHIGAN
DEPARTMENT OF STATE HIGHWAYS

February 4, 1972

To: L. T. Oehler
Engineer of Research

From: J. D. Culp

Subject: Pull-Out Tests of Scotchkote-Coated Dowel Bars.
Research Project 70 NM-280. Research Report No. R-801.

Some time ago U. S. Steel Corporation submitted a loose plastic sleeve for dowel bar protective coating against corrosion. As a result of correspondence with them concerning the limitations of this means they came back with the subject Scotchkote corrosive protection coating. This report covers pull-out testing of Scotchkote-coated dowel bars, submitted by U. S. Steel through the McCormick Brothers Corporation. This testing has been completed in a cooperative effort by the Research Laboratory's Concrete and Structures Groups.

Coating

"Scotchkote" Brand Protective Resin No. 202 is a one part, thermosetting epoxy powder coating designed for application on preheated surfaces by air or electrostatic spray. It is reported to possess good corrosion resistance and toughness and to have good adhesion to steel. Typical properties of the coating material include Rockwell hardness of 63-M, adhesion overlap shear value of 4,900 psi (according to ASTM D 1002-64), and a specific gravity of 1.22, according to information supplied by vendor. The coating supplied was opaque and green in color. The Scotchkote coating thickness was approximately 0.008 in., and appeared quite smooth and uniform on the dowels furnished.

Test Procedure

Four concrete test blocks 9 by 9 by 12 in. were cast, each containing one bar. The bars were nominal 1-1/2 in. diameter, 19 in. long. Ends were sawed to eliminate the effect of shear deformations. Embedment depth was 9 in. A special fixture was used to maintain dowel alignment perpendicular to the block face (Fig. 1).

Concrete cylinders were cast along with the test blocks for determination of strength. Compressive strength of the concrete was approximately 3,500 psi at the time the bars were pulled.

Pull-out testing was done on a Universal Testing machine; a dial gage was used to indicate relative movement between the bar and block (Fig. 2). Bars were pulled out a total of 1/2 in. each test. No-load machine speed was approximately 0.030 in./min. Limited surface spalling occurred around the dowel during pull-out on all but one of the test blocks.

Results

The actual pull-out resistances measured in this test were scaled down to equivalent values expected for 1-1/4 in. diameter dowels so the results could be compared to previous tests. These equivalent maximum pull-out resistances developed by the Scotchkote-coated dowels ranged from 4,000 to 7,800 lb. Average pull-out resistance varied from 4,200 to 7,600 lb (determined by averaging the load values at 0.1-in. increments of pull-out).

Discussion

Previous pull-out tests on 1-1/4-in. dowels, conducted in the same manner as the subject tests, were reported in Research Report No. R-659, in a letter of December 10, 1968, and in Research Report No. R-782. The previous results indicated maximum pull-out loads of 100 to 250 lb for asphalt-coated, saw-cut bars; 380 to 450 lb for plastic coated, saw-cut bars; 1,250 lb for asphalt-coated, shear-cut bars; 5,000 lb for shop painted, shear-cut bars; and 7,300 to 9,100 lb for Adiprene coated, saw-cut bars.

Comparison of the previous results noted above with the results of this test indicates that the Scotchkote coating, as applied, causes high pull-out resistance. Apparently the concrete forms a strong bond with the coating, thus resisting relative sliding of the coating surface on the concrete surface. Some sort of bond breaker would be required to lower this resistance to sliding.

Conclusion

Scotchkote-coated dowel bars of the type submitted for this evaluation should not be permitted for use in concrete pavement joints. While the material used in coating the bars may be suitable for such use, they would require the additional step of applying some sort of bond breaker during placement, which seems undesirable.

TESTING AND RESEARCH DIVISION

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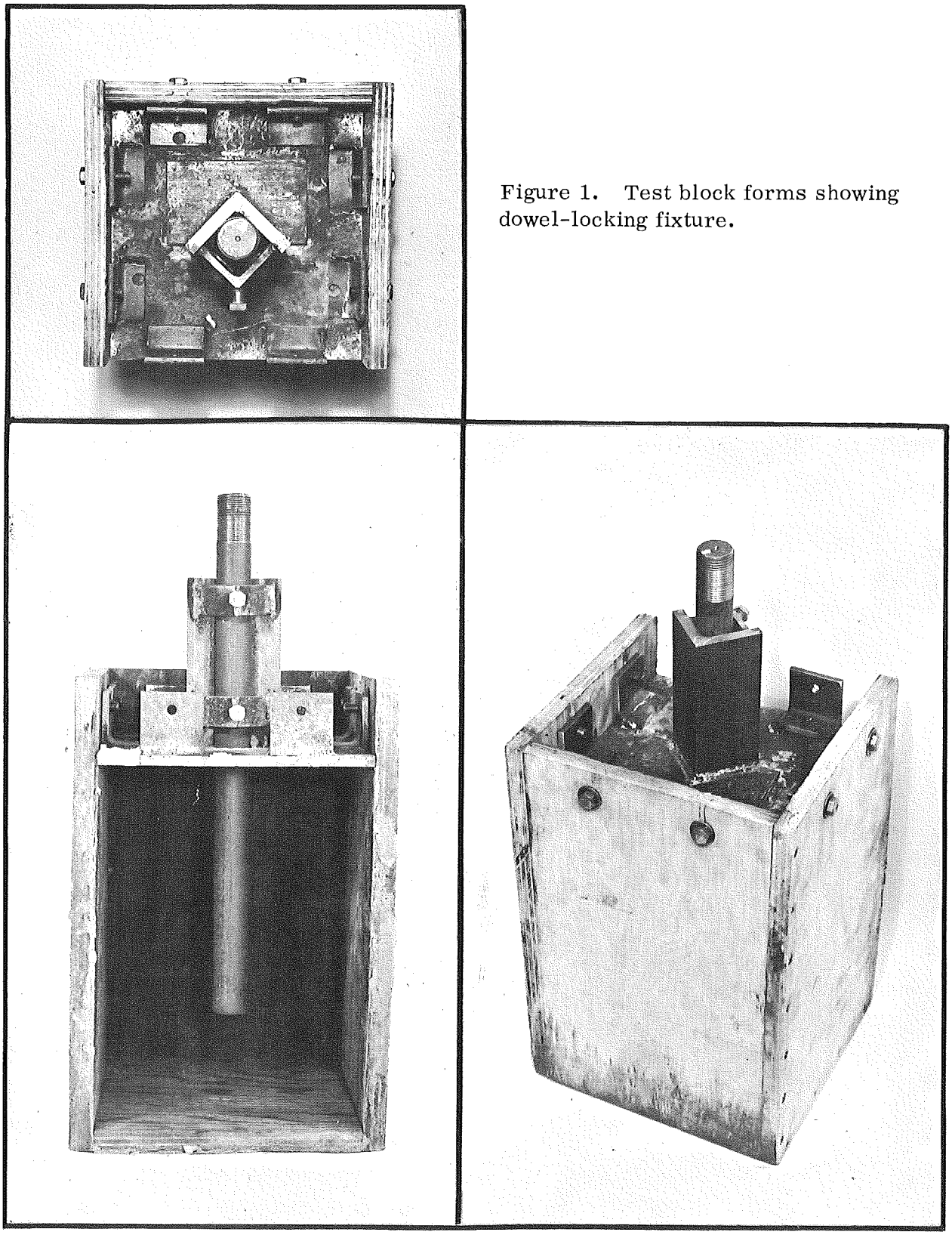

Figure 1. Test block forms showing dowel-locking fixture.

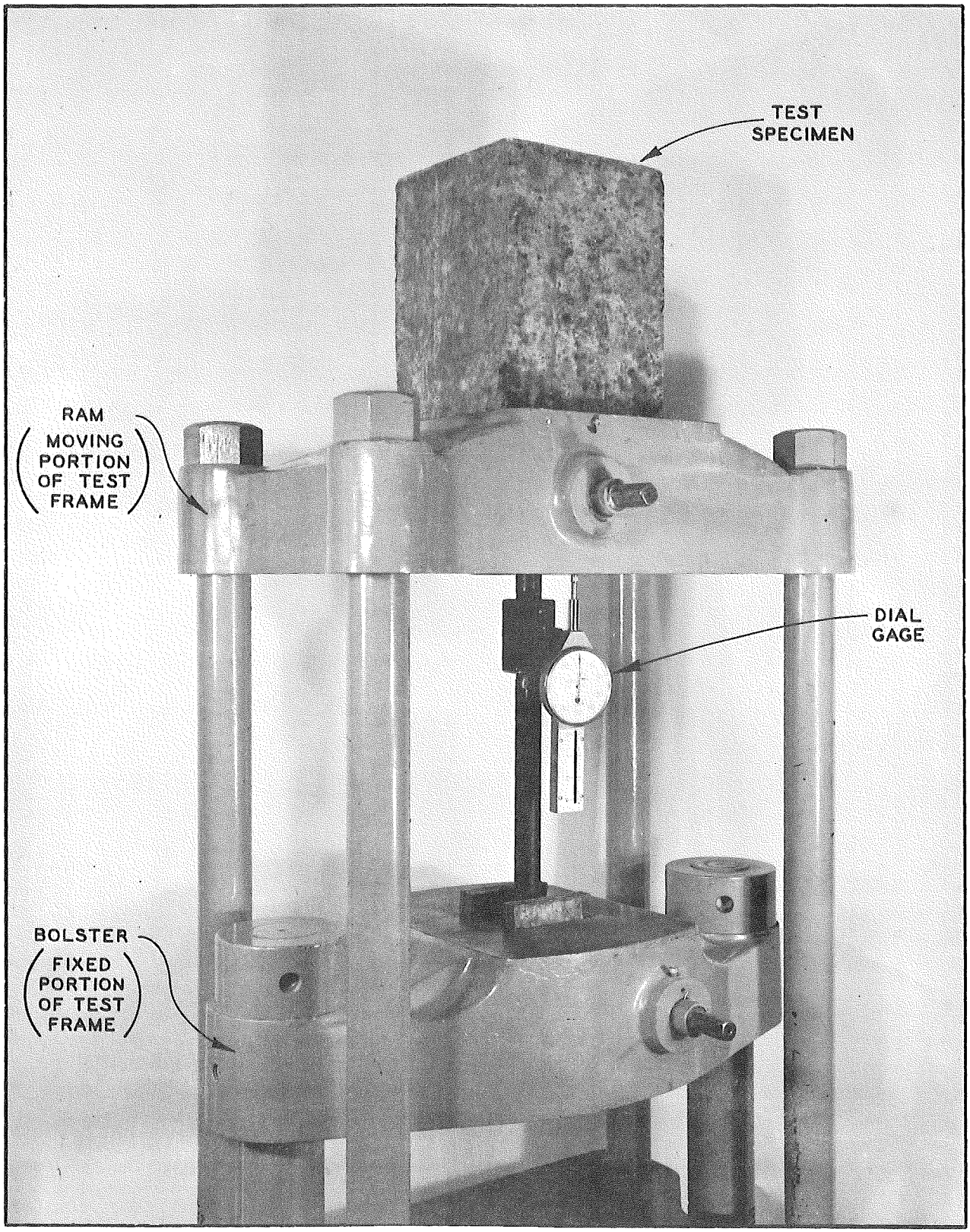

Figure 2. Pull-out test equipment.