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DIVISION OF ENGINEERING SERVICES
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METHOD OF TEST FOR CLEANNES AND SOUNDNESS OF PORTLAND CEMENT CONCRETE SURFACES AND QUALITY OF BONDED OVERLAYS AND SEAL COURSES

A. SCOPE

This test is designed for use in the field or laboratory to develop quantitative data essential to the proper application and evaluation of bonded overlays and seal course.

It is important to locate the areas for testing which are representative of the entire area in question. For instance, in evaluating the cleanness of portland cement concrete roadway surface, it will be necessary to run tests in the tire tracks, between the tire tracks, and along the gutters. Each of these areas may have a different surface condition.

This test method is divided into the following parts:

- PART 1 Evaluation of Bonded Overlays and Seal Course
- PART 2 Evaluation of Soundness of Portland Cement Concrete Surfaces
- PART 3 Evaluation of Cleanness of Portland Cement Concrete Surfaces
- PART 4 Method of Testing in a Laboratory

B. REFERENCES

ASTM C1583 - Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)

C. APPARATUS

1. Tensile test apparatus used to measure and record the force needed to pull the bobbin from the surface to which it is bonded (See Figure 1). Refer also to ASTM C1583, Figures 1 and 2.
2. Cable connector:

Cable with one end having a welded threaded plug so cable can be screwed into the bobbin.
3. Bobbins:

2 in. \pm $\frac{3}{8}$ in. diameter \times 1 to 2 $\frac{3}{8}$ in. long steel or aluminum bobbin with threaded hole to receive cable connector.
4. Coring drill bit: (See Figure 2)

A tungsten carbide or diamond-tipped core bit (used to make the annular cut). When the test is used to measure the adhesion of a bonded overlay or seal course to concrete, an island of overlay or seal course equal in diameter to the bobbin is isolated by using the core bit to cut through the overlay or seal course.

5. Portable, heavy duty coring drill and base stand with rack and pinion mechanism.

6. Heating torch:

A conventional gasoline blowtorch or liquefied propane burner as a heat source (used to speed the cure of the adhesive).

7. Mixing and application tool:

A metal spatula, such as those sold for kitchen use, or wooden tongue depressor.

8. Wire brush:

A clean, oil-free wire brush (used to roughen and clean surfaces).

D. MATERIALS

1. Bonding agent to glue bobbin to overlay.

Use any high strength, fast setting, resin adhesive to bond the bobbin to the surface to be tested. Epoxy and hot glue have been used successfully.

2. Plastic or paper cups (used to measure and mix multi-component adhesive).

E. PROCEDURE

PART 1. EVALUATION OF BONDED OVERLAYS AND SEAL COURSE

1A. TEST PROCEDURES

1. Drill an annular hole through the overlay or seal course and just down to the concrete base (See Figure 3). An isolated island of bonded overlay equal in diameter to the bobbin is thereby created. Care need be exercised to avoid, as much as possible, applying unnecessary torque at the bond plane.

2. Prepare the bobbin and the overlay surface for bonding with the bonding adhesive. Scrub with a wire brush and wipe with a clean cloth to remove all contaminants from the surfaces.

3. Apply the adhesive to the overlay. Carefully follow the manufacturer's mixing and/or application instructions.

4. Position the bobbin on the isolated island of the bonded overlay or seal course.

5. When the bobbin has been heated, allow it to cool to within 18°F of the ambient air temperature. Allow 30 min for cooling, or check the bobbin with a pyrometer to ensure that the cooling process has been completed.

6. Record the temperature of the overlay.

7. When the bobbin has reached an acceptable temperature, position the testing apparatus over it and level the testing apparatus. Screw the cable into the threaded bobbin hole.
8. Apply the proper loading by rotating the handle at a speed required to increase tension to the bobbin at the approximate rate of 90 lb every 5 s until failure (See Figure 6).

1B. CALCULATION OF RESULTS

When the test is completed, record the maximum tensile load developed before failure, as indicated on the gauge of the test apparatus. Convert this into unit stress (psi) according to the following formula:

$$\text{Tensile Strength (psi)} = L/A$$

Where: L = tensile load (lb)

A = surface area of the bobbin (in.²)

Record the nature of the failure, which is described by stating the percentage of the cross section of the break, which reveals failure in the overlay, in adhesion between the overlay and the concrete, and/or in the concrete road surface.

Also record the type of failure in percent of total area for the various type failures possible. The following is a typical example of data recorded:

Maximum tensile loading: 490 lb

Type of failure: 85 % concrete pavement, 10 % adhesion, and 5 % overlay.

The various type failures possible are:

1. Adhesion between adhesive and bobbin.
2. Cohesion of adhesive.
3. Adhesion between adhesive and bonded overlay.
4. Cohesion in bonded overlay.
5. Adhesion between bonded overlay and concrete surface.
6. Cohesion of concrete surface.

PART 2. EVALUATION OF SOUNDNESS OF PORTLAND CEMENT CONCRETE SURFACES

2A. TEST PROCEDURE

1. To test the surface soundness of concrete, clean a 4 in. × 4 in. area of surface to remove contaminants that may prevent a good bond between the concrete and the adhesive. This is accomplished preferably by sandblasting, or alternately by scrubbing with a wire brush and wiping with a clean rag dipped in a volatile solvent.

2. Without cutting the annular hole, as described in paragraph 1, Section 1A, bond the bobbin directly to the surface in the center of the 4 in. × 4 in. area. Then perform the test as described in Section 1A.
3. If the test results in failure in cohesion of the epoxy resin adhesive or any failure in adhesion, repeat the test. Repeated failures in adhesion, or cohesion in the adhesive, indicate improper cleaning of the concrete, wrong adhesive, or faulty adhesive application techniques.
4. Record the maximum tensile load developed before failure.

2B. CALCULATION OF RESULTS

Calculate results as shown in Section 1B.

PART 3. EVALUATION OF CLEANNES OF PORTLAND CEMENT CONCRETE SURFACES

3A. TEST PROCEDURE

1. Without drilling an annular hole, or cleaning the concrete surface, bond a bobbin directly to the concrete surface. Since the purpose of this test is to evaluate the cleanness of a surface, no surface preparation shall be undertaken.
2. Clean the bobbin by alternately scrubbing with a wire brush and wiping with a clean cloth dipped in volatile solvent.
3. Apply adhesive to the bobbin and the concrete surface.
4. Position the bobbin and perform the test as described in Section 1A.
5. Failures in the bond between the bobbin and the adhesive, or cohesive failures in the adhesive, nullify this test. As discussed above, repeated problems of this type indicate improper adhesive or adhesive application techniques.
6. When the test has been completed, record the maximum tensile load. Also record the percentage of failure occurring in the concrete and percentage of adhesion failure.

3B. CALCULATION OF RESULTS

Calculate results as shown in Section 1B.

PART 4. METHOD OF TESTING IN A LABORATORY

When this test is used in the laboratory, a universal testing machine may be substituted for portable tensile tester. The test procedure can be used for evaluating the adhesion and relative tensile properties of bonded overlays. Substrates for the overlays to be tested may be well cured portland cement concrete.

F. PRECAUTIONS TO BE NOTED IN PERFORMING TESTS

1. Since the purpose of this test is to determine the stress required to cause failures of the Types 4, 5, and 6 described in Section 1B, the test should be rerun if failures of Types 1, 2, or 3 result. This includes drilling new annular holes. Continued

failures in the adhesive or the bond of the adhesive indicate that an improper adhesive or technique for applying the adhesive is being used.

2. Failures of Type 1 and 3 could be caused by improper cleaning of the bobbin or the bonded overlay prior to application of the adhesive.
3. Repeated failures of Type 4 indicate poor quality of the bonded overlay, or that the bobbin has not been allowed to cool sufficiently before the tests are conducted.

G. HEALTH AND SAFETY

It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Prior to handling, testing or disposing of any materials, testers must be knowledgeable about safe laboratory practices, hazards and exposure, chemical procurement and storage, and personal protective apparel and equipment.

Caltrans Laboratory Safety Manual is available at:

http://www.dot.ca.gov/hq/esc/ctms/pdf/lab_safety_manual.pdf

End of Text
(California Test 420 contains 6 pages)



Figure 1: Tensile Tester



Figure 2: Cutting "Islands" for Testing Overlays

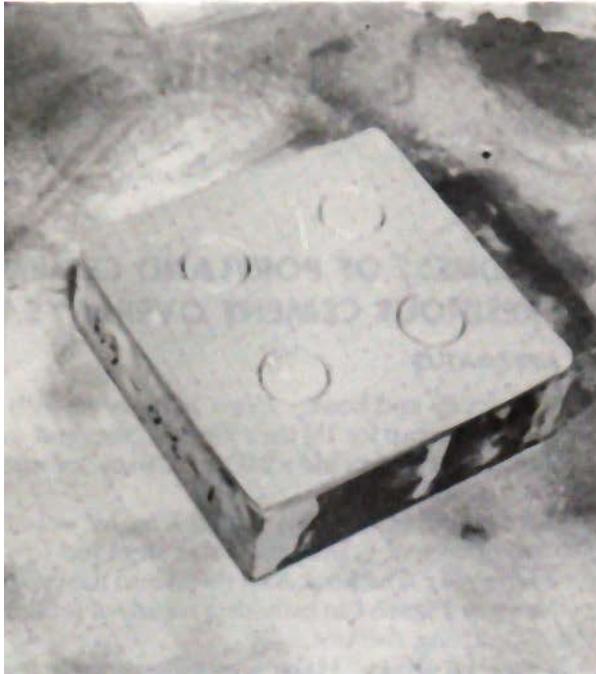


Figure 3: "Islands" Ready for Bonding Bobbins

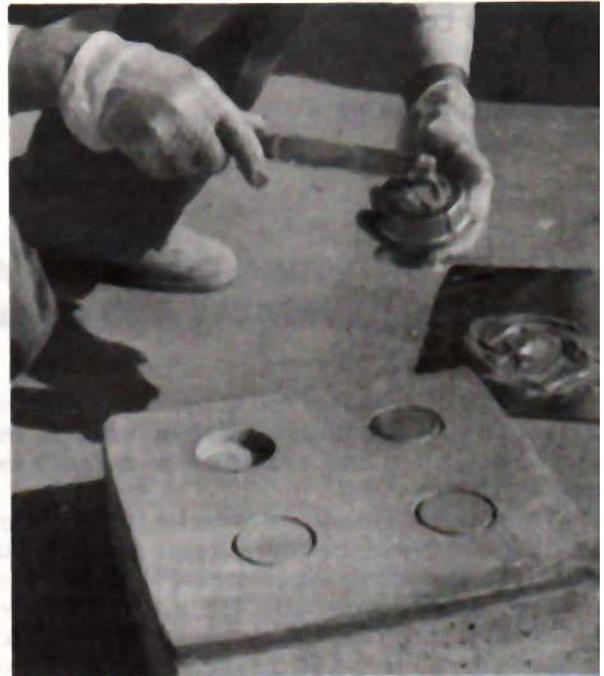


Figure 4: Bobbin in Place

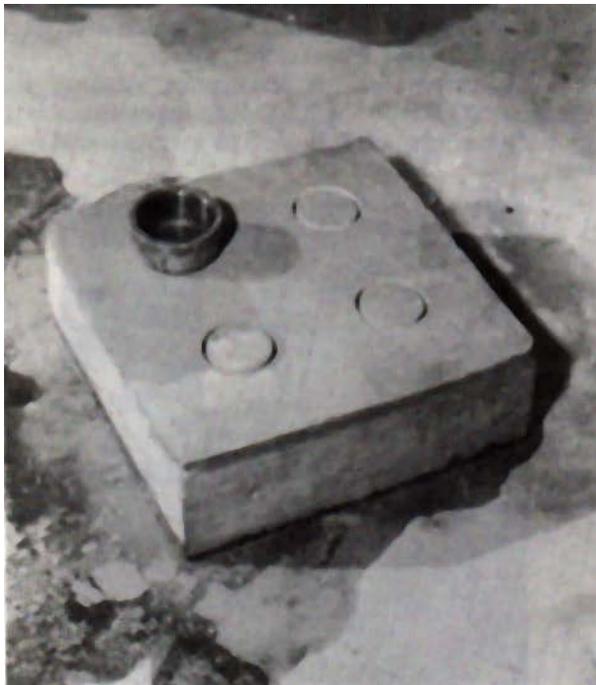


Figure 5: Pipe Bobbin in Place



Figure 6: Determining Tensile Strength