

## **METHOD OF TEST FOR SCALING RESISTANCE OF CONCRETE SURFACES EXPOSED TO DEICING CHEMICALS**

### **1. SCOPE**

1.1 This test method covers determination of resistance to scaling of a horizontal concrete surface exposed to freezing and thawing cycles in the presence of deicing chemicals. It is intended for use in evaluating this surface resistance quantitatively by determining the dry mass of the flaked off concrete.

### **2. RELEVANT DOCUMENTS**

- 2.1 MTO Test Method LS-401
- 2.2 CSA A23.2 - 2C

### **3. DEFINITION**

3.1 Scaling is flaking or peeling away of the near surface portion of hardened concrete or mortar, or a thin layer of mortar flakes off the surface of coarse aggregate.

### **4. SIGNIFICANCE AND USE**

4.1 This test method can be used to evaluate the effect of mix proportions, surface treatment, curing, or other variables on resistance to scaling.

4.2 This test method is also used to evaluate salt scaling resistance of slabs cut from hardened concrete such as barrier walls, precast manholes, and noise barriers.

### **5. APPARATUS**

5.1 **FREEZING EQUIPMENT:** A cabinet or room of sufficient size to hold specimens and capable of lowering the temperature of the specimens to  $-18 \pm 2^{\circ}\text{C}$  within 16 to 18 hours and maintaining this temperature with a full load of specimens.

5.2 **THAWING ROOM:** A room or cabinet maintaining an air temperature of  $23 \pm 2^{\circ}\text{C}$  and a relative humidity of  $50 \pm 5\%$ .

5.3 **SCALES:** Scales for determining mass of batches of materials and concrete shall conform to the requirements of CSA A23.2 – 2C.

5.4 **BALANCE:** A balance or scale having minimum capacity of 5000 g and an accuracy of 0.1 g

5.5 **CONCRETE MIXER:** A mixer complying with the requirements of CSA A23.2 – 2C.

5.6 SLUMP CONE AND AIR METER: The apparatus shall comply with the requirements of CSA A23.2 - 5C, 4C (or 7C).

5.7 MOULDS: Moulds shall be 300 x 300 x 75 mm in inside dimensions and have collars attached to form ledges for the installation of a dyke. They shall conform to the requirements of ASTM C 192. Moulds made of 19 mm thick plywood are acceptable provided that they are waterproofed to make them non-absorptive and leakproof.

5.8 TAMPING ROD: A round straight steel rod 16 mm in diameter and approximately 600 mm in length, having the tamping end rounded to a hemispherical tip of the same diameter as the rod.

5.9 DRYING OVEN: An oven capable of maintaining a temperature of  $105 \pm 2^{\circ}\text{C}$ .

5.10 FILTER PAPER: Whatman No. 2, 320 mm in diameter or equivalent.

5.11 SMALL TOOLS: Wood strike-off board, 75 mm paint brush to provide the desired texture of the test surface, and a polyethylene sheet 350 x 350 mm, mounted on a plywood frame to cover the plastic concrete prior to placing in the moisture room.

## 6. PROPORTIONING AND MIXING

6.1 PROPORTIONING: The air content, cementing materials content, water cement ratio, slump, and other characteristics of the concrete and its ingredients shall be those appropriate for the purposes for which the tests are to be made.

6.2 MIXING: The mixing shall be in accordance with CSA A23.2 – 2C.

6.3 TESTING PLASTIC CONCRETE: All the standard tests shall be carried out in accordance with CSA A23.2 – 4C, 5C, (or 7C).

## 7. SPECIMENS

7.1 NUMBER OF SPECIMENS: At least two duplicate specimens, each 300 x 300 x 75 mm, shall be made for each test condition.

7.2 FABRICATION OF SPECIMENS: Coat the inside surface of each mould with a light film of form oil just prior to fabrication of the specimens. Fill the mould in one layer and rod one time for each  $1300 \text{ mm}^2$  of surface (300 x 300 mm area requires 70 strikes of the rod), leaving a slight excess of material after the final rodding. Tap around the mould perimeter with a nylon tipped hammer to close any remaining voids and immediately screen excess concrete with a wood strike-off board and finish the surface with two passes of a wood float, one in each direction. When the sheen of water has disappeared, gently brush the top surface with the paint brush to remove any laitance and to leave a slightly textured surface unless another method of surface finishing is to be evaluated.

7.3 SPECIMENS FROM HARDENED CONCRETE: Slabs obtained from hardened concrete shall have a test area approximately equal to the area of the cast specimens (7.1). The surface to be tested shall be free of any damage.

## 8. CURING AND DYKING

8.1 LABORATORY CAST SPECIMENS: Immediately after finishing the surface (7.2), cover the surface with a polyethylene sheet (5.11) and move the specimens into moist storage ( $23 \pm 2^{\circ}\text{C}$ , at least 95% R.H.). At 20 to 24h after addition of water to the mix, remove the specimens from the moist storage, demould, identify each and return them to the moist storage. Remove the specimens from the moist storage at the age of 14 d and place them in air for 14 d at  $23 \pm 2^{\circ}\text{C}$  and relative humidity of 45-55%. The dyke may be made of any material that will adhere to the specimen and serve to maintain the salt solution on the surface of the specimen throughout the period of the test. The dyke must be applied during the dry period. The dyke must not affect the test results. If a dyke is a precast mortar dyke, an air entrained paste shall be applied to the recessed edges around the perimeter of the test specimen. Then the precast mortar dyke shall be lowered into the recess (Fig. 1) and any excess paste shall be removed. After allowing the paste to harden for 24 h, apply epoxy sealant to the inside, top, and outside of the dyke extending the outside surface epoxy treatment to 25 mm below the joint.

8.2 SPECIMENS FROM HARDENED CONCRETE: The dyke requirements are the same as those for laboratory cast specimens.

## 9. TEST PROCEDURE

9.1 SALT SOLUTION: The deicing salt shall be a 3% solution of sodium chloride. The test surface shall be covered with approximately 6 mm of the solution.

9.2 FREEZE-THAW CYCLE: At the age of 28 d, cover the test surface with the salt solution and expose the specimens to continuous freeze-thaw cycling, each cycle consisting of 16-18 h in the freezing environment followed by storage at  $23 \pm 2^{\circ}\text{C}$  relative humidity of 45-55% for 6-8 h. Add the salt solution before each freezing phase of the cycle as necessary to maintain the required depth. During the test, each specimen shall be supported by means of wood strips to allow free air circulation under, around, and over it (Fig. 1).

9.10 MASS LOSS: After each 5 cycles, remove the salt solution together with all the flaked off concrete from the surface and place into a watertight container. The operation is best accomplished by tilting the slab into a funnel approximately 500 mm in diameter and washing the surface of the specimen with the salt solution. The washing should continue until all loose particles are removed from the concrete. The solution shall then be strained through a filter and the residue dried out in an oven at  $105^{\circ}\text{C}$  to a constant mass condition. This residue shall be cumulatively weighed after each 5 cycles. This residue shall be defined as the loss of mass and expressed in kilograms per square

metre of exposed slab area. The loss of mass shall be calculated to the nearest 0.01 kg/m<sup>2</sup>. After the washing of each slab, the surface shall be covered with a new solution of sodium chloride.

9.11 NUMBER OF CYCLES: Unless otherwise stated in the test program, terminate the test after exposure to 50 cycles.

## 10. REPORT

The report shall include the following:

### 10.1 SPECIMENS FABRICATED IN THE LABORATORY.

10.1.1 Mix proportions.

10.1.2 Source and type of each concrete ingredient.

10.1.3 Slump and air content.

10.1.4 Curing of specimens if other than standard.

10.1.5 Area of the surface exposed to scaling (each slab).

10.1.6 Cumulative mass loss after each 5 cycles (each slab).

10.1.7 Photographs of each slab at 0, 10, 25 and 50 cycles (if test is extended, photographs also required at completion of test).

### 10.2 SPECIMENS FROM HARDENED CONCRETE

10.2.1 The size and shape of the specimen.

10.2.2 Orientation of the specimen in the structure.

10.2.3 Curing if other than standard.

10.2.4 Area of the surface exposed to scaling (each slab).

10.2.5 Cumulative mass loss after each 5 cycles (each slab).

10.2.6 Visual rating of the surface after each 5 cycles (each slab).

10.2.7 Photographs of each slab at 0, 10, 25 and 50 cycles (if test is extended, photographs also required at completion of test).

## 11. GENERAL NOTES

11.1 If the method is used to evaluate a concrete coating or penetrating sealant, the sealant shall be applied during the dry storage period at the time and in the manner specified by the test program for the sealant. The treated specimens shall be exposed to the cycling at the time required by the test program.

11.2 Curing of the specimens may differ from the standard depending on the mix, e.g. latex mix. In such cases, the specimens are cured as required by the test program.

11.3 If there is any interruption in the daily cycling, the specimens shall be kept frozen.

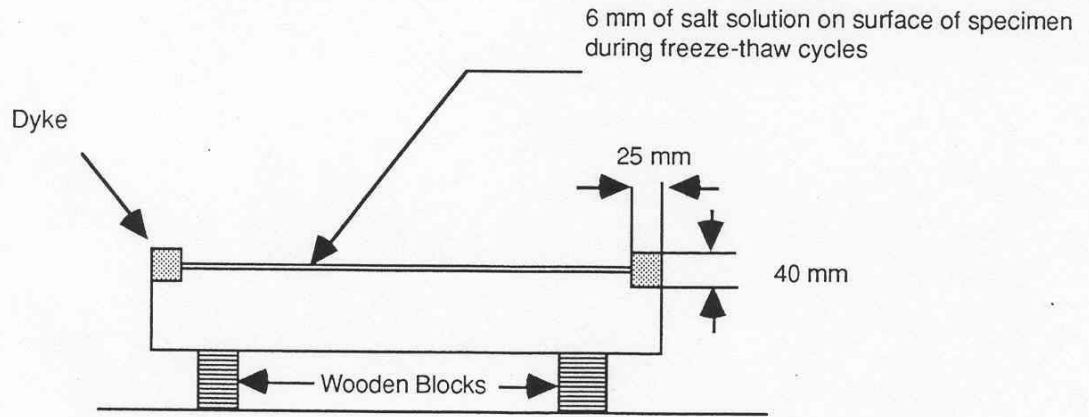


Figure 1

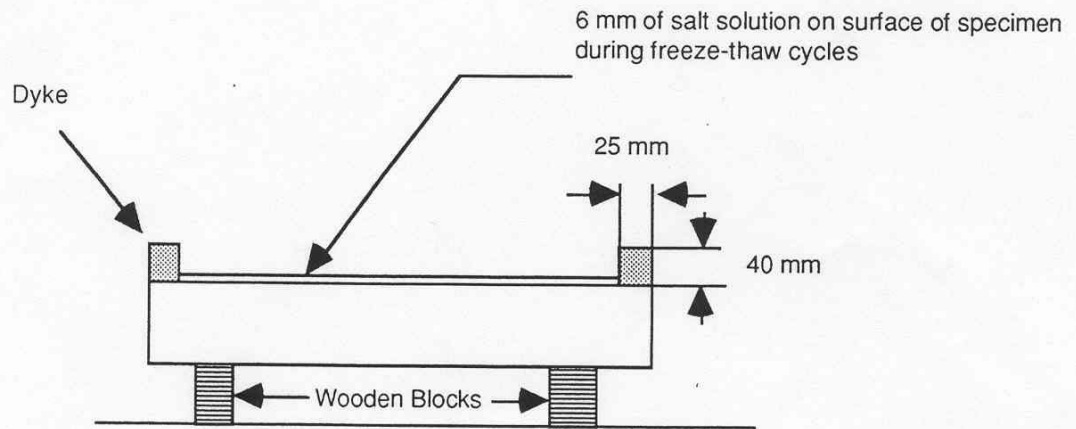


Figure 2