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Indian Standard

METHOD OF TEST FOR ABRASION RESISTANCE OF CONCRETE

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Indian Standard

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Indian Standard

METHOD OF TEST FOR ABRASION RESISTANCE OF CONCRETE

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 30 October 1979, after the draft finalized by the Cement and Concrete Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Abrasion resistance of concrete can be one of the measures of its durability. Deterioration of concrete surface may occur due to abrasion by sliding, scraping, percussion or action of abrasive materials carried by water. Therefore, it becomes difficult to assess the abrasion resistance of concrete, as the mode of abrasive action in each case may vary, but evaluation of relative resistance of concrete surfaces is possible.

0.3 This standard describes the method of assessing the relative resistance of concrete surfaces by finding the abrasion loss of the specimen subjected to an abrasive charge. The procedure laid down in this standard approximately simulates abrasion under physical effects suffered by concrete pavements (roads and air-fields), industrial floors, railway platforms, dock-yards, footpaths, etc. This applies generally for normal weight concrete with a density of 24-26 kN/m^3. Tentative suggested values of permissible abrasion loss for different concrete surfaces are given in Appendix A for broad guidance only.

0.3.1 The method of test covered in this standard may also be applied to assess the abrasion resistance of surfaces made up of materials, such as stone and cement mortar.

0.4 The Committee responsible for the preparation of this standard has taken into consideration the practices followed in this country in conducting test for determining abrasion resistance of concrete. Due weightage has also been given to the need for international co-ordination among the standards and practices prevailing in different countries of the world.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated,

expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers determination of abrasion resistance characteristics of concrete under physical effects only by subjecting it to the impingement of air-driven silica-sand using 10-cm concrete cubes.

2. WORKING PRINCIPLE

2.1 The surface of the concrete cubes is subjected to impingement of an abrasive charge (*see* **3.3**). As a result, abrasion of the concrete surface of the cubes occurs and resulting loss in mass of the cubes is taken as the abrasion loss of concrete.

3. APPARATUS

3.1 Scale — The scale shall have a capacity of 5 000 g or more. The permissible variation at a load of 5 000 g shall be ± 5 g.

3.2 Pneumatic Sand Blasting Cabinet

3.2.1 The pneumatic sand blasting cabinet consists of a wooden cabinet with a tightly closing door (*see* Fig. 1). A high carbon steel nozzle, the axis of which is vertical, shall fit through the top of the cabinet. While the inside diameter of the nozzle shall be $1{\cdot}7 \pm {\cdot}006$ cm, the internal diameter of the nozzle tip shall be $0{\cdot}8 \pm {\cdot}003$ cm. The body of the nozzle tip shall be push-fit to the body of the nozzle and be replaceable. The length of the nozzle along with the tip shall be 15 cm and shall be fitted on the cabinet such that the distance between the tip of the nozzle and the surface of the concrete sample shall be $5 \pm {\cdot}02$ cm. An annular copper or brass air tube of 0·48 cm in diameter shall be provided inside the nozzle. Beyond the nozzle, the diameter of the air tube shall change smoothly to a diameter of 1·7 cm. Inside the nozzle, the tube shall end at a distance of 2 cm from the tip of the nozzle. Four number 0·48 cm diameter holes shall be provided on the side of the nozzle immediately below the collar of the nozzle for passing sand into the nozzle. Sand is drawn into the nozzle by suction caused by the high air velocity at the nozzle tip.

*Rules for rounding off numerical values (*revised*).

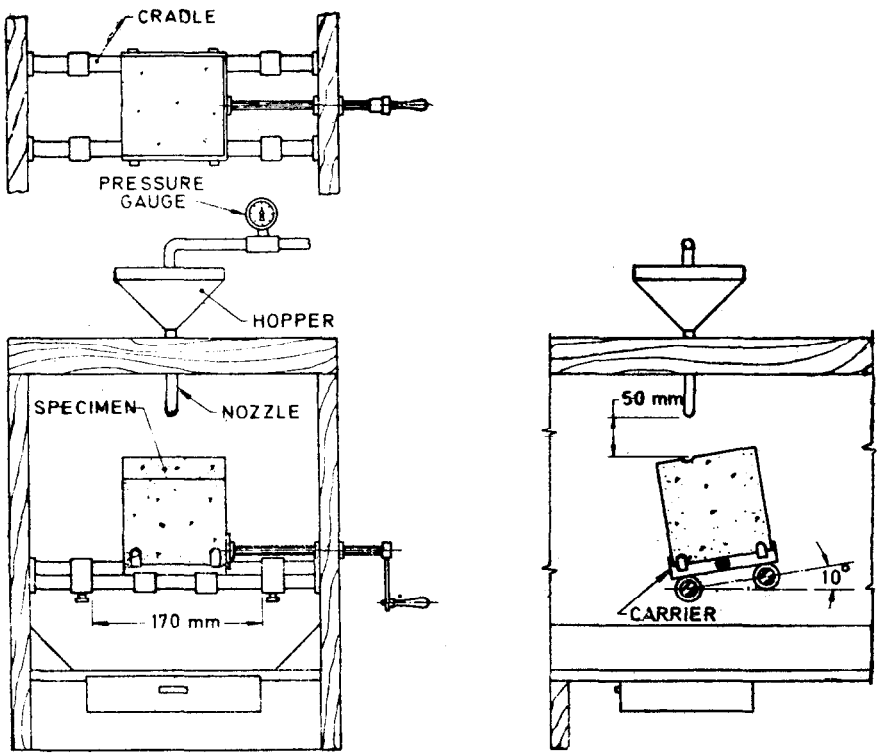
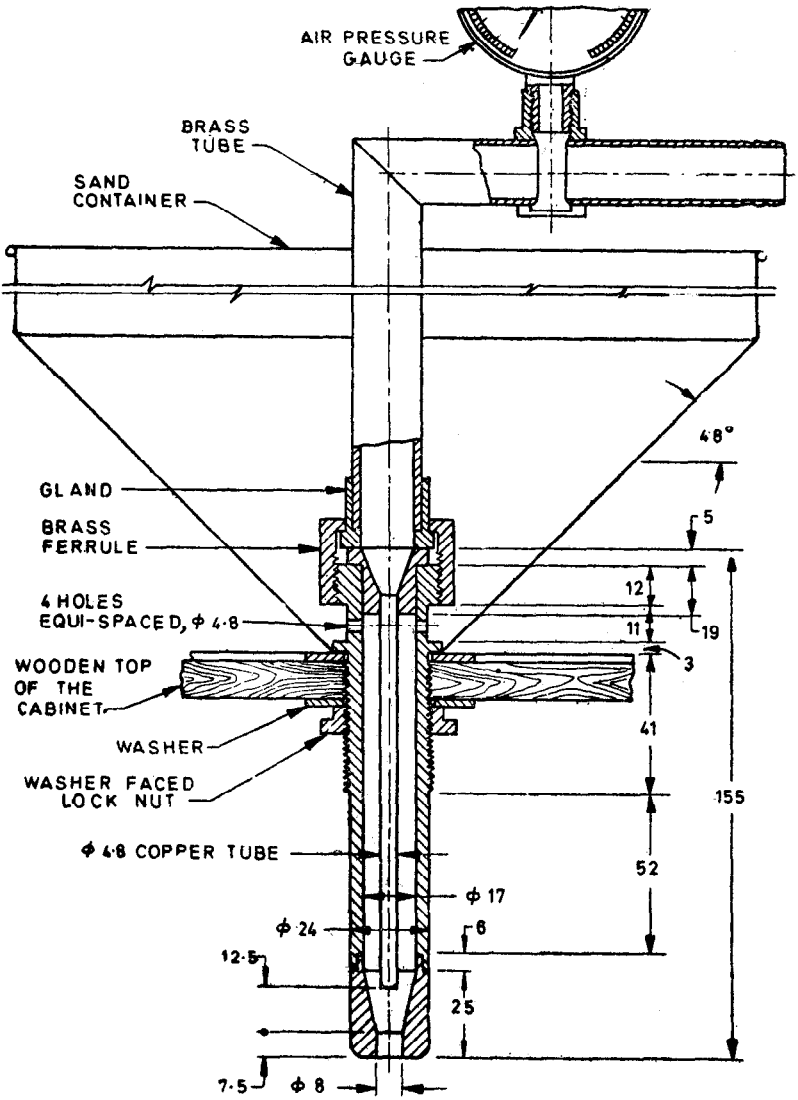


FIG. 1 PNEUMATIC SAND BLASTING CABINET SHOWING THE CRADLE

3.2.2 A conical galvanized iron hopper shall be provided at the top of the cabinet for holding the charge of sand driven by air pressure. The nozzle shall be passed through the bottom of the hopper and also through the top of the cabinet such that the sand inlet holes are located at the bottom of the hopper. Where the nozzle passes through the top of the cabinet, the pertinent portion there shall be threaded. A lock nut and washer combination fixes the whole nozzle assembly to the cabinet. A pressure gauge shall be fitted to the copper or brass air tube to record accurately the air pressure as close to the nozzle as possible. The tube shall be connected to a compressor with pressure control device giving a supply of air at a pressure of 0·14 N/mm^2 as recorded in the pressure gauge. The angle of the cone of the hopper shall be such that the sand runs down the sides on its own as it is being fed into the cabinet. The dimensions of the apparatus are given in Fig. 2.



All dimensions in millimetres.

FIG. 2 DIMENSIONS OF THE NOZZLE

3.2.3 The specimen carrier shall be mounted on a cradle, that can be moved below the nozzle between two fixed points by means of a manually operated handle (*see* Fig. 1). The distance between the fixed points for movement of the cradle shall be 17 cm. The angle of the carrier and the cradle shall be 10 degrees to the horizontal so that the face of the concrete specimen under test is presented to the direction of the nozzle jet at an angle of 10 degrees to vertical. The position of the cradle shall be such that the tip of the nozzle remains approximately 2·5 cm away from the edge of the specimen (10 cm cube). This will enable making two impingements on the same surface by rotating the specimen by 180°.

3.2.4 Provisions shall be made to collect the used charge of sand and the dust emanated from the concrete wear from the bottom of the cabinet.

3.3 Abrasive Charge — The charge of sand driven by air pressure and used for abrading the concrete surface is termed as the abrasive charge. It shall conform to IS : 650-1966* but graded to pass 1·00-mm IS sieve and retained on 0·50-mm IS sieve. The charges can be reused after sieving through 0·50-mm IS sieve.

4. OPERATING CONDITIONS

4.1 The following operating conditions shall be kept for determining the abrasion loss of concrete:

a) Operating air pressure shall be 0·14 N/mm^2,

b) Abrasive charge shall be as stipulated in **3.3**,

c) The quantity of charge shall be 4 000 g for each impingement, and

d) Abrasion loss of specimen shall be taken as the loss in mass in grams for two separate impressions on the same face of the concrete cube under test.

5. PREPARATION OF SPECIMENS

5.1 The 10 cm cube concrete specimens, duly cured for 28 days or as received, shall be placed in an oven at 50°C for 24 hours and thereafter removed for test. The surface of the specimen shall be rubbed with emery paper to remove cement laitance and expose aggregate grains, before conducting the test.

*Standard sand for testing of cement (*first revision*).

6. PROCEDURE

6.1 The weighed, dry specimen shall be placed on the specimen carrier (*see* **3.2.3**) with the surface (any one out of the four smoother vertical surfaces of the cube, that were in contact with the mould) to be tested facing the nozzle tip. The nozzle tip shall be at the middle of the half side of the cube (that is, 2·5 cm away from the edge of the specimen). The surface shall then be exposed to blast for the full charge of sand (4 000 g). During the process, the cradle shall be moved slowly between the two fixed points (*see* **3.2.3**) by the handle provided there for. The test shall be repeated on the same surface after rotating the sample by 180° on the horizontal plane thus enabling two impressions to be made on the same surface. After the test is over, the sample shall be removed, cleaned and weighed to determine the loss of mass in grams for one surface of the sample.

6.2 This procedure shall be repeated on the other three vertical surfaces (*see* **6.1**) of the same sample.

6.3 Three cube specimens (of the same lot or as received) shall be tested to determine the abrasion loss of concrete.

7. CALCULATION

7.1 The loss in mass of the sample for each surface shall be calculated as follows:

$$m = m_1 - m_2$$

where

m = loss in mass in g,

m_1 = mass of the specimen before each test in g, and

m_2 = mass of the specimen after each test (on one surface with two impressions) in g.

8. REPORT

8.1 The abrasion loss of concrete shall be reported as the average of the results obtained for the 12 surfaces (that is 4 surfaces each of 3 cubes), to the nearest 0·01 g and expressed as percent loss.

APPENDIX A

(*Clause* 0.3)

TENTATIVE SUGGESTED VALUES OF ABRASION LOSS

A-1. The following maximum values of abrasion loss for the different categories of concrete surfacings have been tentatively suggested for broad guidance only.

Sl No.	*Surfacing Category*	*Maximum Values of Abrasion Loss, Percent Loss*
i)	Concrete Pavement:	
	a) With mixed traffic including iron-tyred traffic	0·16
	b) With pneumatic tyred traffic only	0·24
ii)	Factory floors	0·16
iii)	Dockyard	0·16
iv)	Railway platform	0·24
v)	Footpath	0·40

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