IS : 2720 (Part XXXIX/Sec 1) - 1977

Indian Standard

(Reaffirmed 1997)

METHODS OF TEST FOR SOILS

PART XXXIX DIRECT SHEAR TEST FOR SOILS CONTAINING GRAVEL

Section 1 Laboratory Test

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Indian Standard

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Section 1 Laboratory Test

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Indian Standard

METHODS OF TEST FOR SOILS

PART XXXIX DIRECT SHEAR TEST FOR SOILS CONTAINING GRAVEL

Section 1 Laboratory Test

0. FOREWORD

0.1 This Indian Standard (Part XXXIX/Sec 1) was adopted by the Indian Standards Institution on 30 September 1977, after the draft finalized by the Soil Engineering Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 With a view to establish uniform procedures for the determination of different characteristics of soils and also for facilitating a comparative study of the results, the Indian Standards Institution is bringing out this Indian Standard methods of test for soils (IS : 2720) which is being published in parts. 38 parts of this standard have been published so far. This part [IS : 2720 (Part XXXIX/Sec 1)-1977] deals with the laboratory determination by direct shear, the shear strength of soils containing gravel with particle size more than 4·75 mm on with disturbed specimen. The test is of two kinds depending upon the state of samples, namely, laboratory test and *in situ* test. The *in situ* test is being covered separately.

0.3 In the formulation of the standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country.

0.4 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard (Part XXXIX/Sec 1) covers the method for the laboratory determination by direct shear, of the shear strength of soils containing gravel (with particle size more than 4·75 mm).

NOTE — It is recommended that the 300-mm box shall be used for soils containing gravel up to 30 mm size.

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

1.2 The test shall be carried out at natural moisture content. In case, the deposit is likely to get saturated, the test shall be carried out in the saturated condition.

2. APPARATUS

2.1 Shear Box — (*See* Fig. 1) of mild steel, totally open at top and bottom of size 300 × 300 mm and deep enough to hold a sample of size 300 × 300 × 150 mm. The box shall be divided horizontally so that the dividing plane coincides with the central plane of the sample. These two parts shall be accurately attached together by two easily removable screws which pass vertically through the walls of the upper half and fit into the lower half. Suitable spacing screws to separate the two halves of the shear box, when it is assembled for the test by the amounts required for the test shall be provided.

2.1.1 Suitable holes, about 1·5 mm in diameter shall be provided on the sides of the lower half of the shear box to enable entry of water below the bottom of the soil specimen.

2.2 Container for Shear Box — so constructed that it holds the bottom of shear box rigidly with respect to the top half and holds water to surround the shear box when it is placed in the container. A drain cock shall be fitted to the container for filling and draining water.

2.3 Gripper Plates — (*See* Fig. 2A and 2B) two pairs of mild steel plates to fit into the shear box; one pair plain and one pair perforated.

2.4 Top and Bottom Plates — (*See* Fig. 3A and 3B) two pairs of toothed mild steel plates to fit into the shear box; one pair plain and one pair perforated.

2.5 Base-Plate — (*See* Fig. 4) of mild steel with grooves on its top face, to fit into the shear box.

2.6 Loading Plate — A mild steel plate of adequate thickness fitting the shear box which shall distribute the load from a yoke over the specimen normal to the shear plane. The lower face of the loading plate shall have cross grooves.

2.7 Loading Device — The major requirements of the loading device are the following:

a) The vertical stress on the sample shall remain vertical and constant during test. The normal load shall be applied uniformly on the soil specimen in the shear box without eccentricity;

b) The shear stress or strain shall be applied in the same plane as the dividing plane of the two parts of the shear box;

c) In case of a stress controlled apparatus, it should be possible to maintain a constant rate of stress increase during the test irrespective of the strain rate; proper arrangement shall be provided to get different rates of stress increase;

d) In case of strain controlled apparatus, the strain rate shall remain constant irrespective of the stress. Suitable arrangement shall be provided to provide different strain rates; and

e) No vibrations shall be transmitted to the sample during the test and there shall not be any loss of shear force due to friction between the loading frame and the shear box container assembly.

2.8 Weights (If Necessary) — For providing the normal load through a normal loading device.

2.9 Proving Ring — of suitable capacity fitted with dial gauge accurate to 0·002 mm to measure the shear force.

2.10 Micrometer Dial Gauges — Accurate to 0·01 mm. Two, suitably mounted to measure the horizontal movement and the other two suitably mounted to measure the compression or expansion of the specimen.

2.11 Stop Clock

2.12 Balance — of 50 kg capacity sensitive of 1 kg.

3. PREPARATION OF SPECIMEN

3.1 Specimen may be compacted in layers to the required density by a suitable hammer into the shear box after fixing the two halves of the shear box together by means of fixing screws.

4. PROCEDURE

4.1 The shear box with the soil specimen should be fitted into position as shown in Fig. 1. The required normal load shall be applied. After the required normal load is applied, the shear strain shall be applied. Before the application of shear strain, the upper half of the box should be lifted up slightly to eliminate friction between the parts of the shear box. The shear strain should be applied at a constant rate of 0·2 mm/min on the upper half of the box till the failure of the specimen. The final shear shall be recorded through the calibrated proving ring. At the end of the test, the specimen should be removed from the box and the water content at the shear zone should be determined. The process shall be repeated for the next higher normal load. A minimum of 4 sets of readings shall be taken.

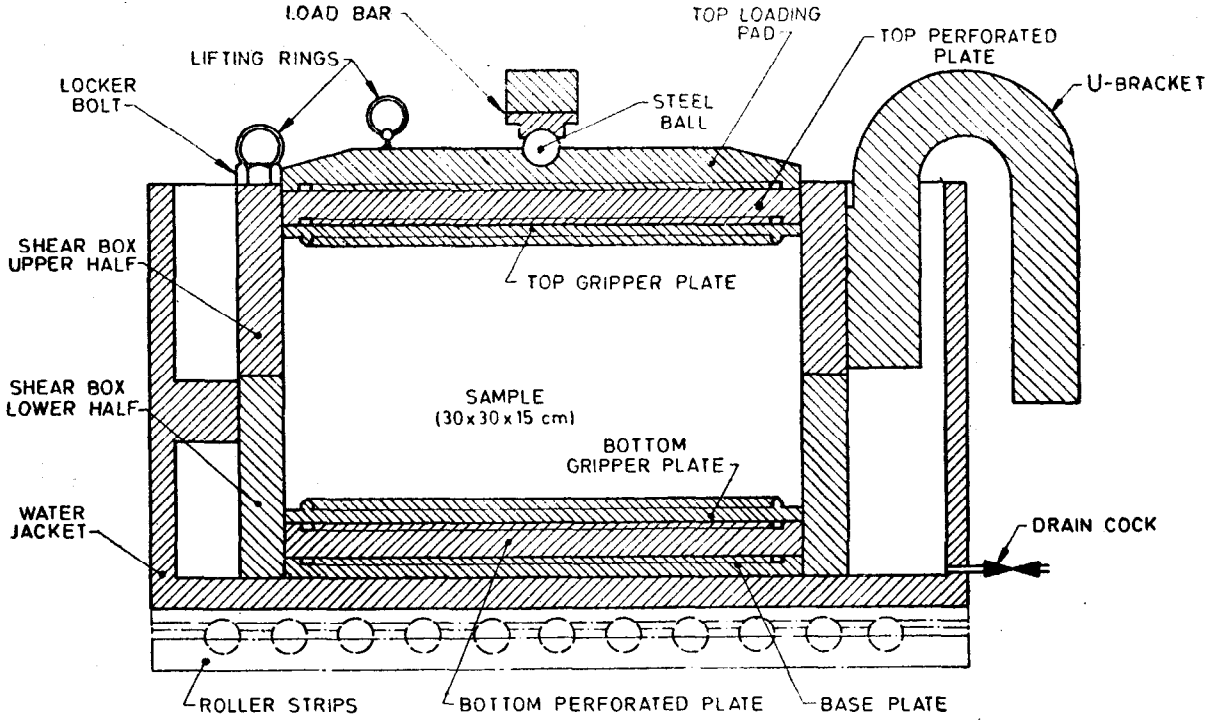
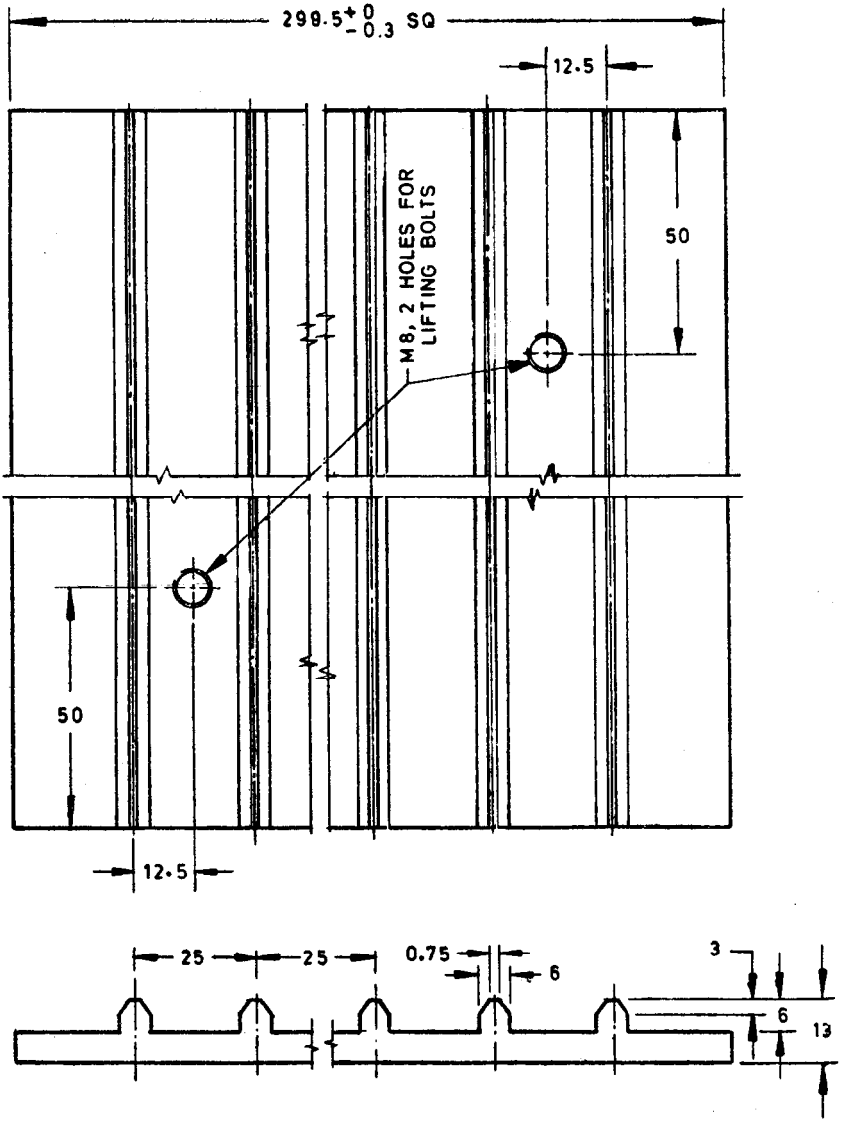


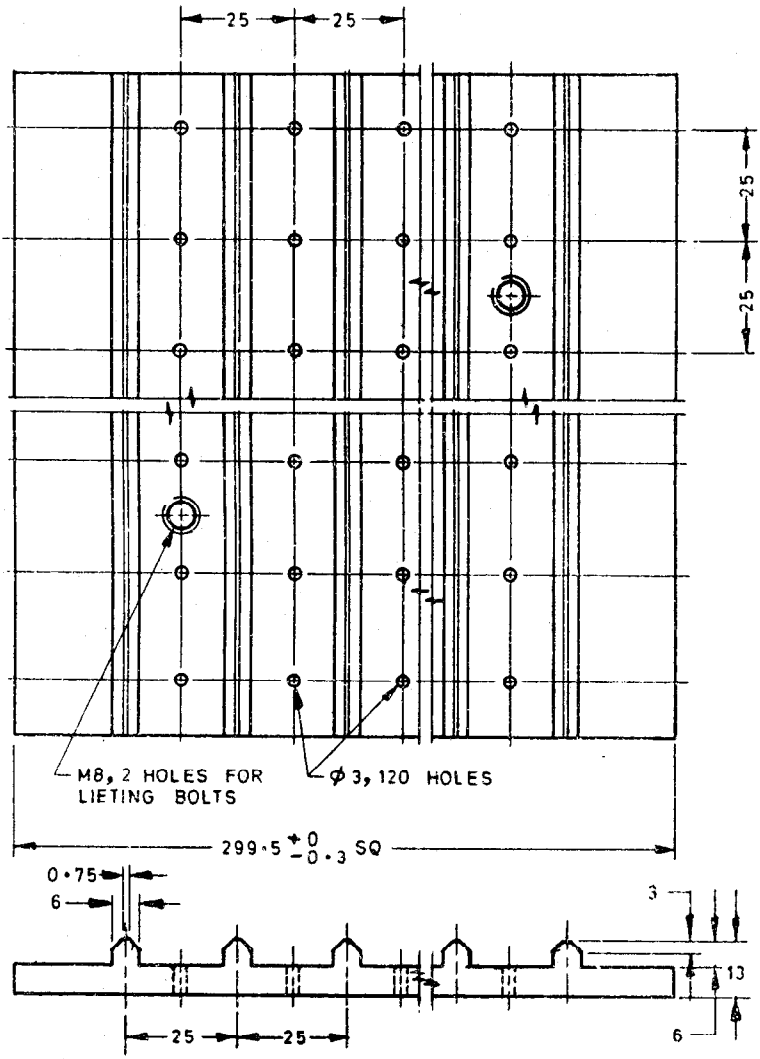
FIG. 1 SHEAR BOX ASSEMBLY



All dimensions in millimetres.

2A Gripper Plate (Plain)

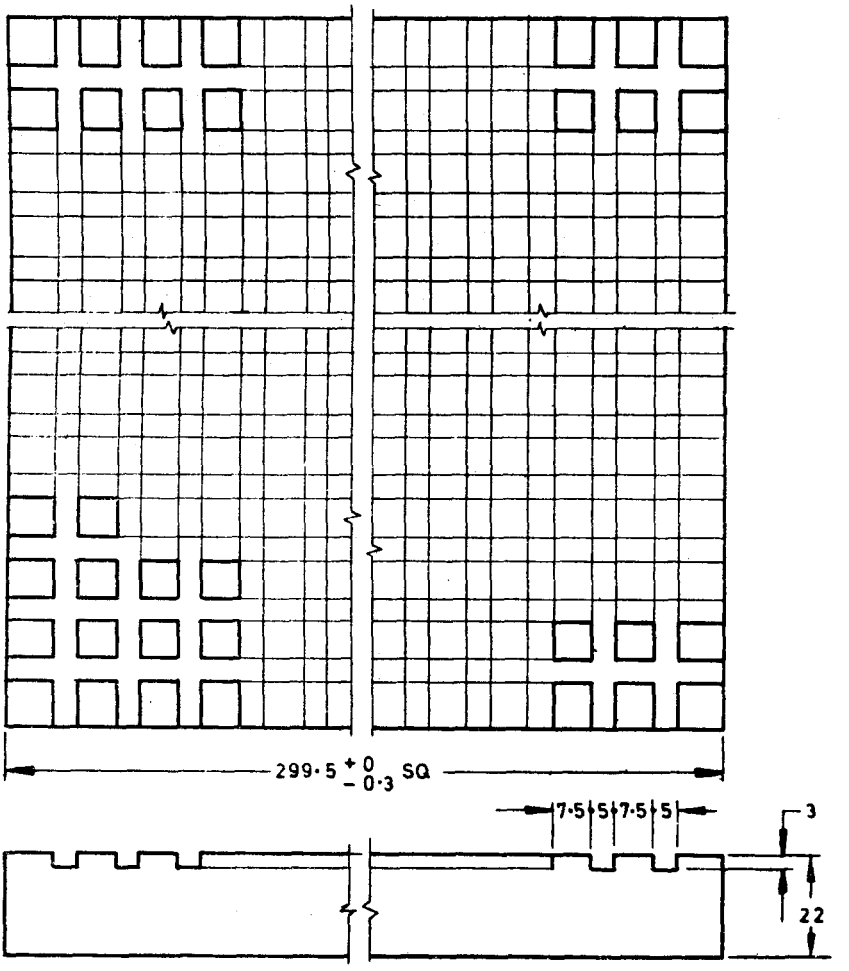
FIG. 2 GRIPPER PLATES — (*Contd*)



All dimensions in millimetres.

2B Gripper Plate (Perforated)

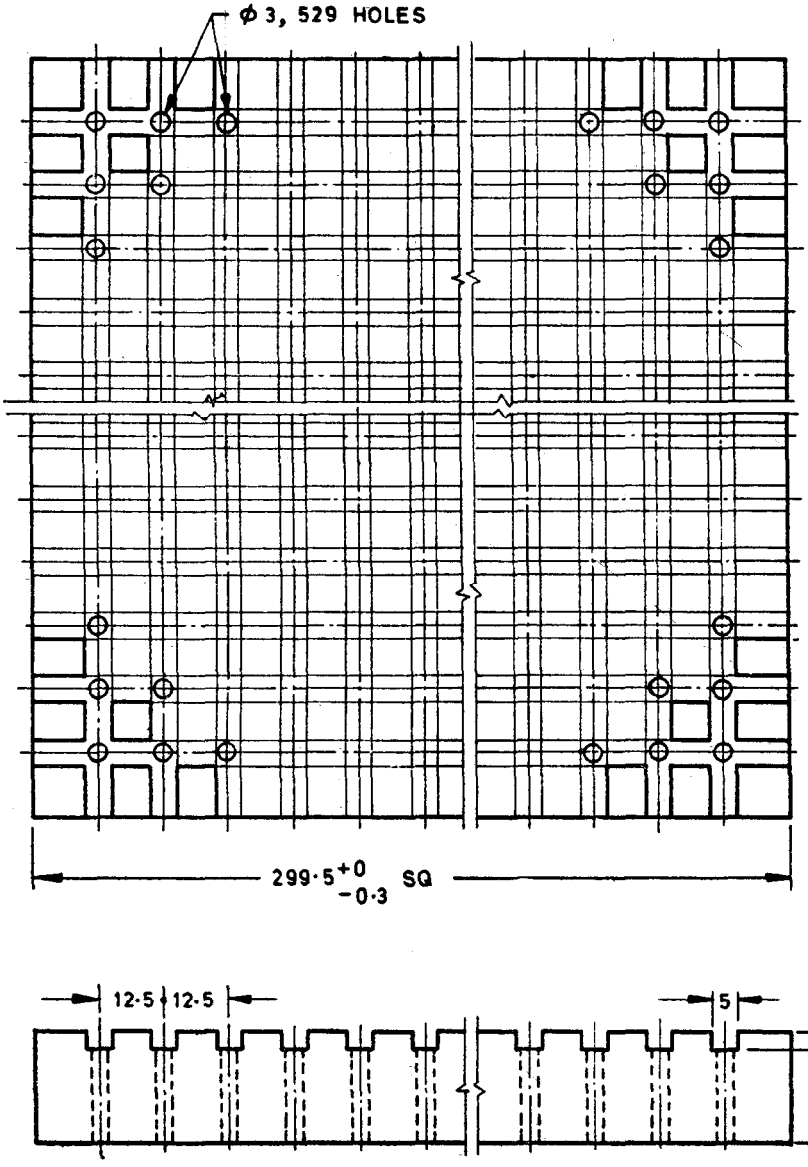
FIG. 2 GRIPPER PLATES



All dimensions in millimetres.

3A Plain Plate

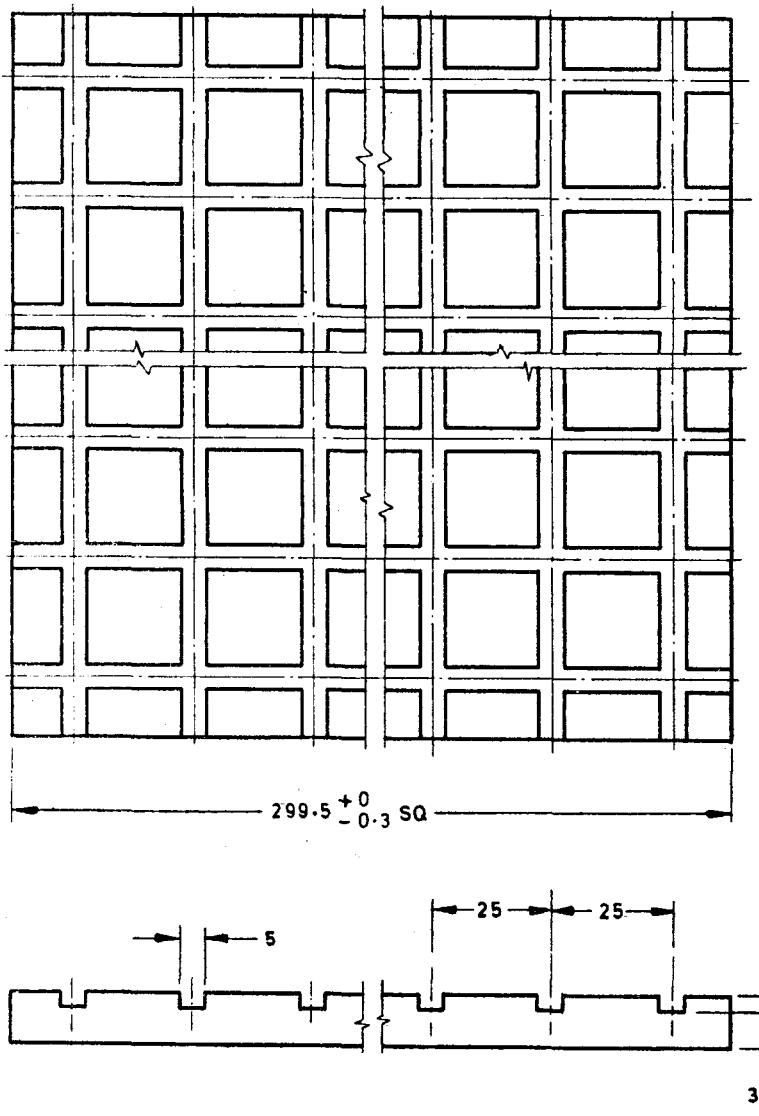
FIG. 3 TOP AND BOTTOM PLATES — (*Contd*)



All dimensions in millimetres.

3B Perforated Plate

FIG. 3 TOP AND BOTTOM PLATES



All dimensions in millimetres.

FIG. 4 BASE PLATE

5. CALCULATION AND REPORT

5.1 Results of tests shall be recorded suitably. A recommended proforma for recording the result is given in Appendix A.

5.2 The longitudinal displacement at a particular load shall be recorded from the shear displacement dial readings.

5.3 The maximum shear force shall be the peak load from load-displacement curve or where the tangent of flatter portion of later part of the curve leaves in case the curve does not give peak point.

5.4 The maximum shear stress and the corresponding longitudinal displacement (shear displacement) and applied normal stress should be recorded for each test and the result should be presented in the form of a graph in which the applied normal stress is plotted as abscissa and the maximum shear stress is plotted as ordinate. The angle which the resulting straight line makes with horizontal axis and the intercept which the straight line makes with the vertical axis shall be reported as the angle of shearing resistance and cohesion intercept respectively.

NOTE — The normal stress *versus* maximum shear stress relationship may not be straight line in all cases. In such cases the shear parameter shall be obtained by drawing a tangent to the normal stress and maximum shear stress curve at the point of normal stress expected in the field.

APPENDIX A

(*Clause* 5.1)

PROFORMA FOR RECORDING TEST RESULTS

Project .....
Rate of shear strain.....
Location of sample .....
Sample No. .....
Proving ring No. .....
Proving ring constant .....
Weight of loading frame .....
Normal load applied .....

Soil Specimen Measurements

Dimensions .....
Initial wet mass of specimen .....
Water content .....
Bulk density .....
Final wet mass of specimen .....
Water content at the shear zone.....
Area of specimen.....
Volume of specimen .....

Proforma for Recording Shear Stage

i) Thickness of specimen ..... mm
ii) Area of cross-section of specimen ..... cm^2
iii) Rate of shearing ..... mm/min
iv) Normal stress applied ..... kg/cm^2

Date and Time	Shear Displacement Dial Reading	Shear Displacement	Proving Ring Reading	Shear Force	Shear Stress	Vertical Dial Readings	Vertical Displacement
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

Plot — Shear stress *versus* shear displacement and find
a) Maximum shear stress at the peak of curve, and
b) Corresponding shear displacement.

Proforma for Recording Summary of Results

Test No.	Normal Stress	Shear Stress at Failure	Shear Displacement at Failure	Initial Water Content	Final Water Content	Remark
(1)	(2)	(3)	(4)	(5)	(6)	(7)

Plot — Shear stress minus normal stress relationship to obtain
a) Cohesion intercept, and
b) Angle of shearing resistance.

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PROF T. S. NAGARAJ (*Alternate*)	

AMENDMENT NO. 1 SEPTEMBER 1987

TO

IS:2720(Part 39/Sec 1)-1977 METHODS OF TEST FOR SOILS

PART 39 DIRECT SHEAR TEST FOR SOILS CONTAINING GRAVEL

Section 1 Laboratory Test

(Page 4, clauses 2.1 to 2.6) - Substitute the following for these clauses and renumber the subsequent clauses accordingly:

"2.1 The shear box and its assembly shall conform to requirements given in IS:11593-1986 'Specification for shear box (large) for testing of soils'."

(Pages 6 to 11, Fig. 1 to 4) - Delete.

(BDC 23)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 2 OCTOBER 1992
TO
IS 2720 (Part 39/Sec 1) : 1977 METHODS OF TEST FOR SOILS

PART 39 DIRECT SHEAR TEST FOR SOILS CONTAINING GRAVEL

Section 1 Laboratory Test

(*Page* 13, *Appendix A*, Proforma for Recording Shear Stage):

a) *Col* 2 — Substitute the word 'Readings' *for* 'Reading' and subdivide the col as 'a' and 'b'.

b) *Col* 3 *and* 8 — Insert the word 'Average'.

c) Subdivide col 7 as 'a' and 'b'.

(CED 23)

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(*Continued on page* 2)