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Indian Standard

(Reaffirmed 1997)

METHODS OF TEST FOR SOILS

PART XXXIX DIRECT SHEAR TEST FOR SOILS CONTAINING GRAVEL

Section 2 *In-Situ* Shear Test

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Indian Standard
METHODS OF TEST FOR SOILS
PART XXXIX DIRECT SHEAR TEST FOR SOILS CONTAINING GRAVEL
Section 2 *In-Situ* Shear Test

0. FOREWORD

0.1 This Indian Standard (Part XXXIX/Sec 2) was adopted by the Indian Standards Institution on 11 July 1979, after the draft finalized by the Soil Engineering and Rock Mechanics Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 With a view to establishing 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 on methods of test for soils (IS : 2720) which is being published in parts. Fortyone parts of this standard have been published so far. This part covers direct shear test. The test is of two kinds depending upon the state of samples, namely, laboratory test and *in-situ* test. The laboratory test is covered in Section 1 of this part. This part [IS : 2720 (Part XXXIX/Sec 2)-1979] deals with *in-situ* determination by direct shear, the shear strength of soils containing gravel and cobblestone.

0.3 In the formulation of this 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 2) covers the method for the determination by direct shear, the *in-situ* shear strength of soils containing gravels and cobblestone.

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

2. APPARATUS

2.1 Shear Box — The side of the shear box shall be not less than 10 times. the maximum expected particle size and the thickness of the samples not less than three times the maximum particle size. For convenience in handling the box could be of built-up sections from plates. The four sides of the box could be connected through bolts and nuts designed properly to form the box. Figure 1 shows the suggested size with 1 500 × 1 500 mm sample size.

2.2 Top Loading Plate (see Fig. 2) — A rigid steel plate fitting in the shear box suitably designed to distribute the load uniformly over the sample normal to the shear plane.

2.3 Hydraulic Jack — Suitable remote control hydraulic jack of adequate capacity for applying shear force.

2.4 Rolled Steel Joist and Wooden Sleepers — Adequate number of rolled steel joist and wooden sleepers and sand bags for making a platform and providing adequate kentledge for applying normal load on the sample.

2.5 Rollers — Suitable size of rollers equal to the width of plates forming the shear box frame to be placed in between the side of the box and a bed plate on either side of the box.

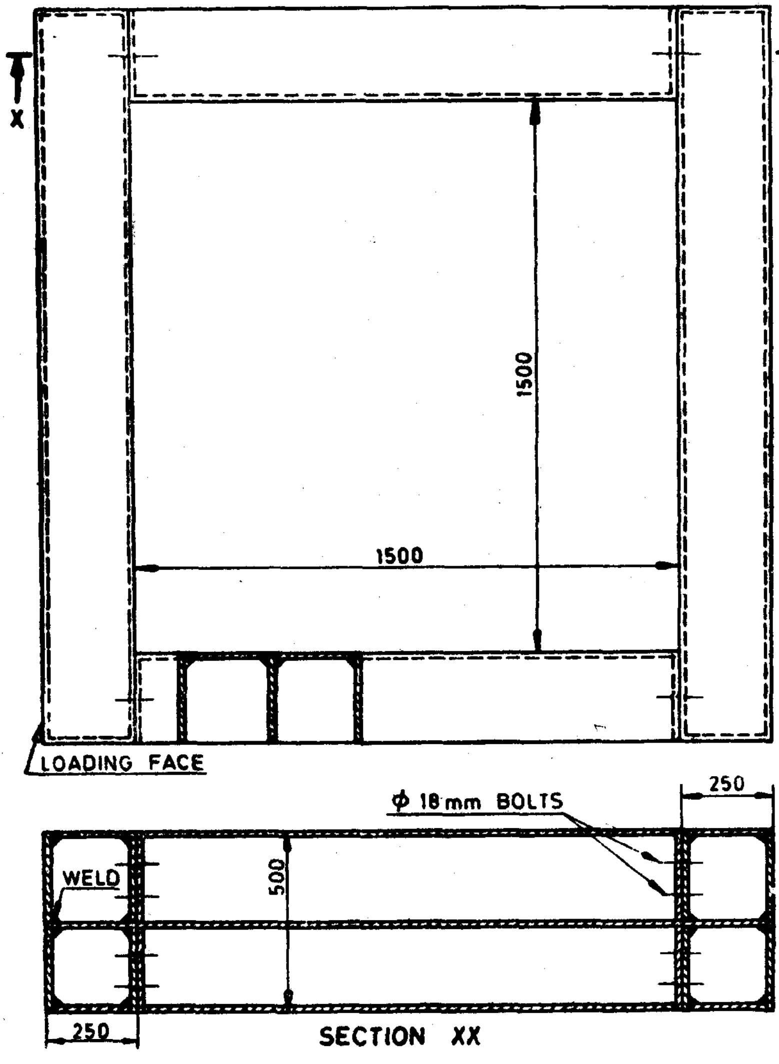
2.6 Datum Bars — Suitable section of steel bars to be hinged for two pegs fixed at a distance equal to the side of the box driven to a depth of minimum 500 mm on either side of the box.

2.7 Spring Balance — Spring balance of 10 kg capacity of sensitivity 1·0 kg to weigh the sand bags.

3. PREPARATION OF SPECIMEN

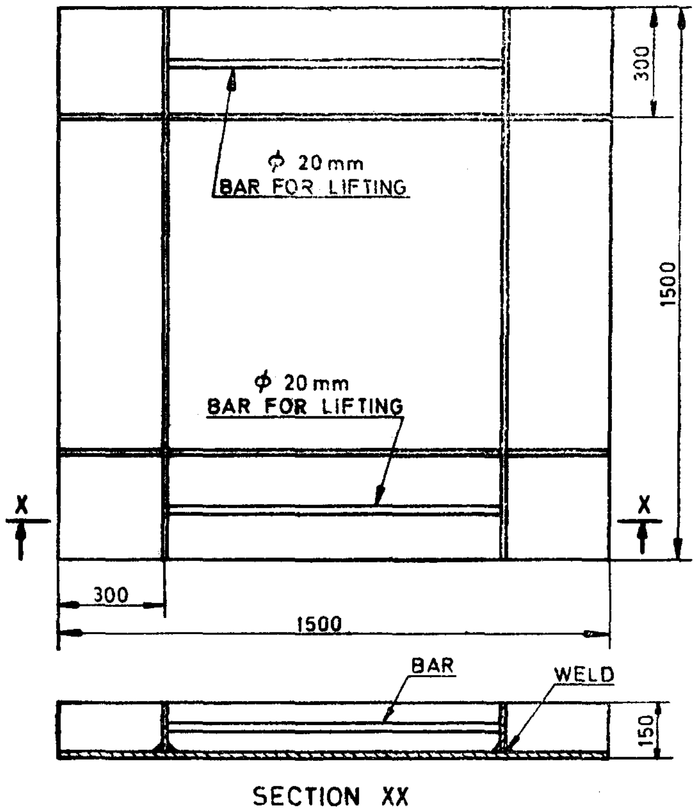
3.1 A steel box made out of mild steel plates of adequate thickness, provided with a cutting edge with the required internal dimension may be used for trimming the sample. This hollow box be pressed into the deposit under a load applied by hydraulic jack (*see* Fig. 3). The soil around the box be excavated, simultaneously with the penetration of the box to facilitate its easy sinking. Care shall be taken to ensure that the box shall sink in vertical position.

3.1.1 Alternatively, during excavation two blocks, of the required size be left undisturbed at the desired position. After the excavation is completed the assembled boxes shall be put on the top of the block and soil below the plate shall be excavated gradually till the boxes reach the required position.



NOTE — All members fabricated out of 10 mm thick plates.
All dimensions in millimetres.

FIG. 1 SHEAR BOX 1 500 × 1 500 mm SIZE



NOTE—All members fabricated out of 10 mm thick plates.
All dimensions in millimetres.

FIG. 2 TOP LOADING PLATE

3.2 Two rolled steel joists form the bed plates. A train of rollers shall be put in between the sides of the box and the bed plates on either side of the box. Gravels projecting above box frames shall be removed and the gap shall be filled up with medium to fine sand to give level surface for better seating of the top plate.

3.3 The loading cap befitting the internal dimension of the box made of steel plates of adequate thickness be placed on the soil.

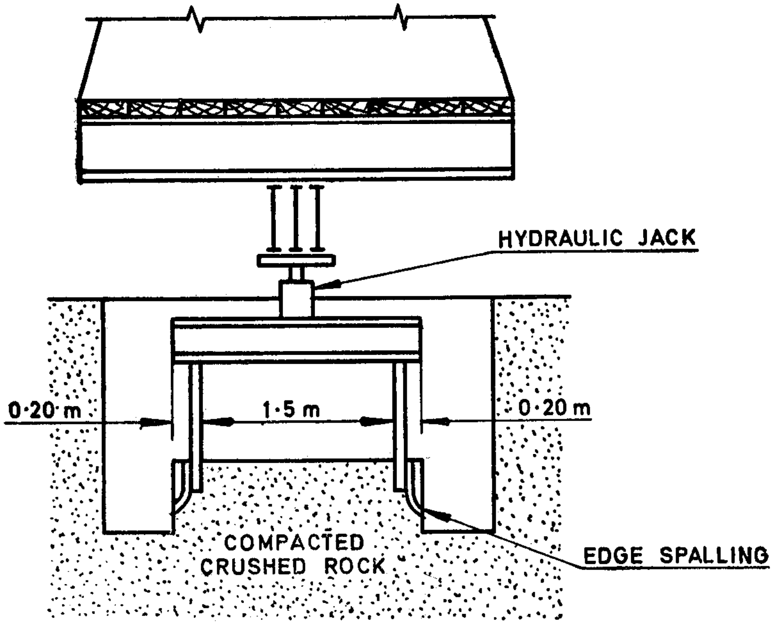


FIG. 3 ARRANGEMENT FOR OBTAINING SPECIMEN FOR *In-Situ* SHEAR TEST

3.4 The test should be carried out at moisture content as close to field condition as possible.

NOTE — In case of soils containing fines more than 12 percent, the test may be conducted in soaked state to simulate for worst field conditions; the soaking period may extend up to 4 days depending upon type of soils.

4. APPLICATION OF NORMAL LOAD

4.1 The normal load on the sample shall be applied with the help of a platform made of rolled steel joist and wooden sleepers and loaded with sand bags (*see* Fig. 4).

5. TEST PROCEDURE

5.1 The shear force shall be applied through a remote control hydraulic jack and proving ring arrangement taking reaction from the adjacent box (*see* Fig. 4).

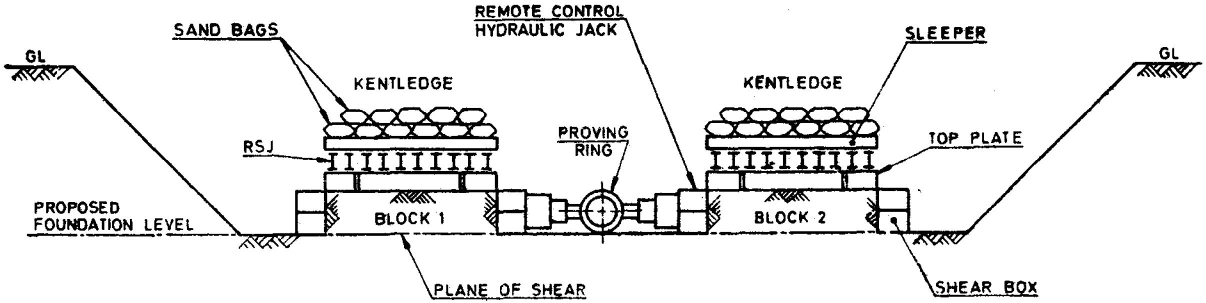


FIG. 4 TEST SET UP FOR LARGE SIZE *In-Situ* SHEAR TEST

5.2 Two tests at different normal pressures shall be carried out at one location. After the block with lesser normal pressure failed, the space between the failed block and the side of the pit shall be blocked by boulders and also by struting. The normal load on failed block shall be increased, and then the test on the other block shall be completed by taking reaction of shear force from the failed block.

5.3 The jack shall be so fitted so that the application of the lateral load occurs as far as possible near to the plane of shear.

5.4 The test shall be conducted by giving an equal increment of shear load under the normal load, each increment of shear load shall be maintained constant till the equilibrium conditions are reached, the readings shall be recorded with the help of suitably mounted dial gauges. The next increment of shear load shall then be applied and the process continued till the failure of the specimen occurs. The normal loads applied shall be more than the existing over-burden and cover the anticipated loading range in the area. The range of normal load should represent the site loading conditions as far as possible. Two more tests at different normal loads shall be carried out at adjacent location, to make four tests, a minimum number required necessary for interpretation.

6. CALCULATION AND REPORT

6.1 Results of test shall be recorded suitably. A recommended pro forma for recording the results is given in Appendix A.

6.2 The horizontal displacement at a particular load shall be recorded from shear displacement dial readings.

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

6.4 The maximum shear stress and the corresponding horizontal displacement and applied normal stress shall be recorded for each test and the result be presented in the form of a graph in which the applied normal stress is plotted as abscissa and shear stress as ordinate. The angle which the resulting straight line makes with the 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 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 tangent to the normal stress and maximum shear stress curve at the point of normal stress expected in the field.

APPENDIX A

(*Clause* 6.1)

I PRO FORMA FOR RECORDING *IN-SITU* TEST RESULTS

Project ....

Rate of load increment ....

Location of sample ....

Specimen No. ....

Depth of test ....

Proving ring No. ....

Providing ring constant ....

Normal load applied ....

SOIL SPECIMEN MEASUREMENT

Dimensions ....

Initial water content ....

Final water content ....

Maximum size of particle ....

Area of specimen ....

Height of specimen ....

Volume of specimen ....

Unit weight of soil ....

II PRO FORMA FOR RECORDING SHEARING STAGE

i) Thickness of sample .... mm

ii) Area of cross section of sample .... cm^2

iii) Rate of shearing .... mm/min

iv) Normal stress applied .... kg/cm^2

Date & Time	Shear Displacement Dial Reading		Shear Displacement		Average Shear Displacement	Proving Ring Reading	Shear Force	Shear Stress	Vertical Reading		Vertical Displacement		Average Vertical Displacement
	D_{h1}	D_{h2}	D_{h1}	D_{h2}					D_{v1}	D_{v2}	D_{v1}	D_{v2}	

Plot — Shear stress versus shear displacement and find:

a) maximum shear stress at the peak of curve, and

b) corresponding shear displacement.

III PRO FORMA FOR RECORDING SUMMARY OF RESULTS

Test No.	Normal Stress	Proving Ring Constant	Shear Stress at Failure	Shear Displacement at Failure	Initial Water Content	Final Water Content	Remarks

Plot — Shear stress-normal stress relationship to obtain:

a) cohesion intercept, and

b) angle of shearing resistance.

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