

DIRECT SHEAR APPARATUS

In a direct shear test, the failure of the soil sample in shear is caused along a pre-determined plane. Test is performed as per IS 2720 part XIII

The normal load, strain and shearing force are measured directly during the test. It is also used to estimate residual stress of soil. The apparatus utilizes a square box divided horizontally into two halves. The box containing the sample is placed in a water jacket and subjected to constant normal load while a horizontal force is applied till the specimen fails along the plane of juncture of the two halves. A number of specimens are tested under different loads and from the data obtained the angle of internal friction and shearing strength of the soil can be evaluated. Following pages give details of both hand operated and motorised versions of direct shear test apparatus conforming to different Indian Standard Specifications.

●● HS24.05

Direct Shear Apparatus, Hand Operated IS : 2720 (Part XIII)

The unit conforms to IS2720. It has a hand operated horizontal loading system for shearing the specimen. Hangers are provided for creating normal stress.

It comprises :-

- i) Shear box assembly, 60 mm square, complete with a U-bracket, guide pins and spacing screws, made of brass.
- ii) Gripper assembly consisting of two plain grid plates, two perforated grid plates, one base plate and one loading pad, all made of brass.
- iii) Two porous stones, each 6 mm thick, fitting the shear box
- iv) Shear box housing of brass, complete with two ball roller strips.
- v) Loading unit with normal loading of 8 kg/cm² on 60 mm square specimen.
- vi) Specimen cutter for a specimen size of 60 mm x 60 mm x 25 mm.
- vii) Set of weights to give a normal stress upto 3 kg/cm² through lever, comprising 4 of 0.05 kg/cm², 1 of 0.1 kg/cm², 1 of 0.2 kg/cm², 3 of 0.5 kg/cm² and 1 of 1 kg/cm².

Complete as above but without dial gauges and proving ring.

●● HS 24.15

Direct Shear Apparatus, 12 speed, Motorised IS : 2720 (Part XIII) IS:11229

The unit is same as HS24.05 except that it is motorised. It is provided with a turret type gear box to get 12 different constant rates of strain i.e 1.25, 0.625, 0.25, 0.125, 0.05, 0.025, 0.01, 0.005, 0.002, 0.001, 0.0004, and 0.0002 mm/min. and arrangements to carry out residual shear strength tests. Suitable for operation with 220V, 50 hz, single-phase supply.

OPTIONAL ACCESSORIES:

HS30.15 Proving Ring (Integral) capacity 200 kg (2 kN) (Tension/Compression)

HS29.15 Dial Gauge 0.01 mm x 25 mm range for measuring strain and consolidation. (Two gauges are required).

Note: Tension- compression proving ring and dial gauge required for carrying out residual shear strength tests, does not form a part of the standard outfit and has to be ordered separately.



HS24.15



●● HS24.515

Electronic Direct Shear Apparatus, 12 Speed, Motorised Microprocessor Based, As per IS:2720 (Part-XXXIX/Sec-1)

The unit is same as HS 24.15 except that the transducers like displacement sensors and load cell with micro-processor display system are provided instead of dial gauges and proving rings. Total loading capacity of the apparatus is 8 kg/cm^2 . It is provided with standard 60mm shear box assembly. Set of weights to give a normal stress up to 3 kg/cm^2 on the specimen through lever is provided as standard. Additional weights are to be ordered separately.

Electronic System

Load cell universal (universal) 2kN - 1 No.

LVDT $\pm 20 \text{ mm}$ - 2 No.

Digital display /conditioning unit

The Three-channel micro processor based signal conditioning unit is the three-function system. The functions are load, horizontal displacement and vertical displacement directly indicated in their respective engineering units.

The system receives the output signal from the sensors i.e. Load cell and Displacement Sensors attached to the Direct shear Test apparatus. It consists of the power supply, signal conditioning cards and processing card. The signal-conditioning card amplifies the signal of each sensor and transfers it to processing card.

The processing card consists of a Micro controller that stores the reading of each sensor and finally transfers it to computer. The data of all three channels of Direct Shear Test can be transferred to computer and can be monitored online. The Unit also provides the facility of online monitoring of data through LCD display.

Broadly the following facilities are incorporated in the system:-

- i) Three independent channels. Load (N), Horizontal Displacement(mm), Vertical Displacement (mm)
- ii) Independent display for each channel simultaneously.
- iii) Print interval / data transfer interval is programmable (between 10 second to 1 hour)
- iv) Automatic data saving on stop button.
- v) 25 set of results can be stored in the electronic unit.. Sample number can be programmed
- vi) Online date and time of test is stored

along with the data. On line (while the test is in progress) data transfer to the computer which is stored in the computer with a particular file name (through RS232).

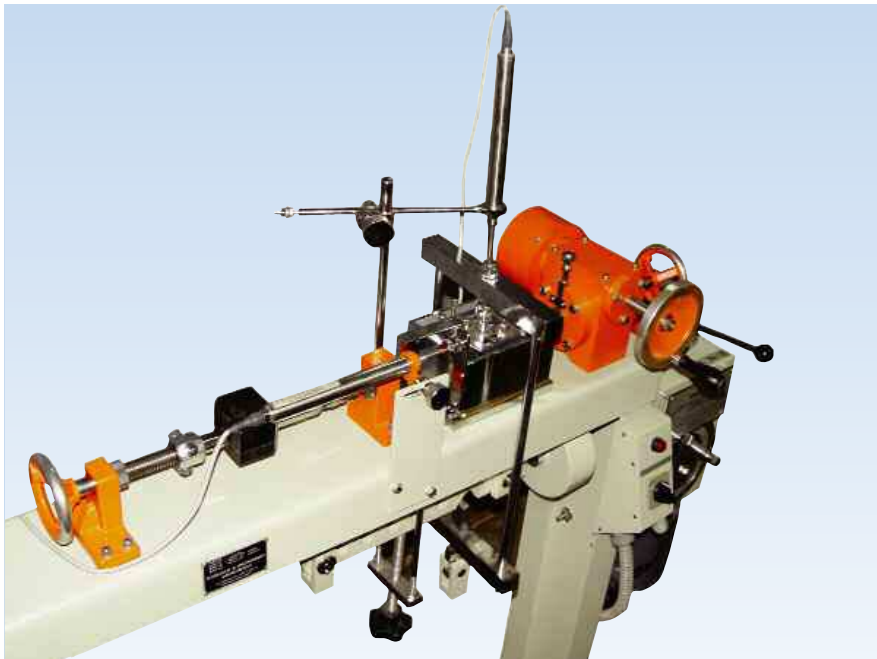
- vii) Data can be downloaded to the computer after the test, which is stored even after the power is off.
- viii) Without computer, test data can be printed through printer port provided in the electronic unit.
(Computer not part of the system)

Optional Accessories

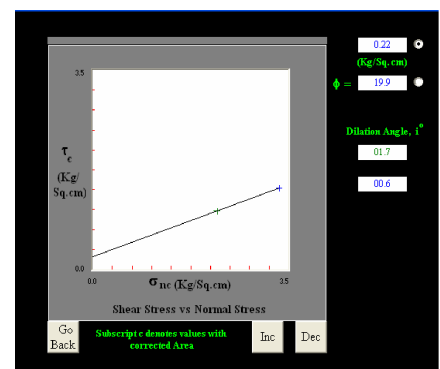
(1) Software

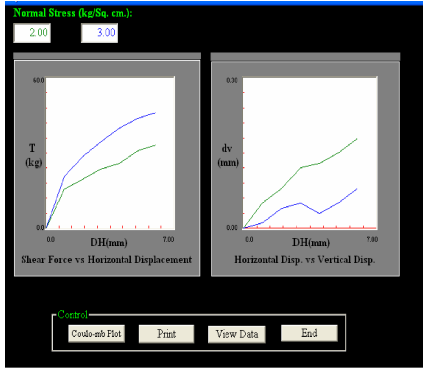
- i) On-Line Data Acquisition Software
- ii) On-Line Data Transmission from Signal Conditioning Unit to Computer
- iii) Off-Line Data Analysis Software that does all the calculations of Direct Shear Test.
- iv) Has option for manual as well as automatic recording of data.
- v) Calculates Area, Volume, Bulk density, Dry density, Moisture content etc. of the specimen
- vi) Display the following Plots.
 - a Horizontal Displacement vs Shear Force
 - b Horizontal Displacement vs Vertical Displacement
 - c Normal stress vs Shear Force
 - d Maximum value of the Dilatation Angle

The software is windows based and user friendly. It is easy to operate and has the flexibility to enter different sizes of test specimen up to 1000mm x 1000mm.



HS 24.515





(2) Computer

Pentium IV - 3.0Ghz or higher 512MB RAM, 80 GB HDD, CD writer, Standard Keyboard, Scroll Mouse, Color Monitor, Printer

Note : The computer with latest configuration will be supplied.

●● HS24.617

Direct/Residual Shear Test Apparatus(Confi rming to IS2720 Part XXXIX and BS1370)

An automatic system enables performing of Direct Shear and Residual Shear tests through a total computer control. It is a table-mounted model and has stepper motors controlling shearing load. Stress levels can be maintained with in the limits of $\pm 0.5\%$ through set of weights. Vertical and horizontal displacements and shearing load are all displayed in their respective engineering units on LCD display.

Board specification of the unit are:-

- 1) Rate of strain: 0.0001-9.9999 mm/min
- 2) Load range capacity : ± 5 kN

Electronic Sensors

The unit includes :-

- 1 **HS30.520U** Load cell
Universal type : 2000N
- 2 **HS29.555** Displacement
sensor horizontal : ± 20 mm
- 3 **HS29.555** Displacement
sensor vertical : ± 20 mm

Supplied complete with weight upto 3kg/cm^2



HS 24.617

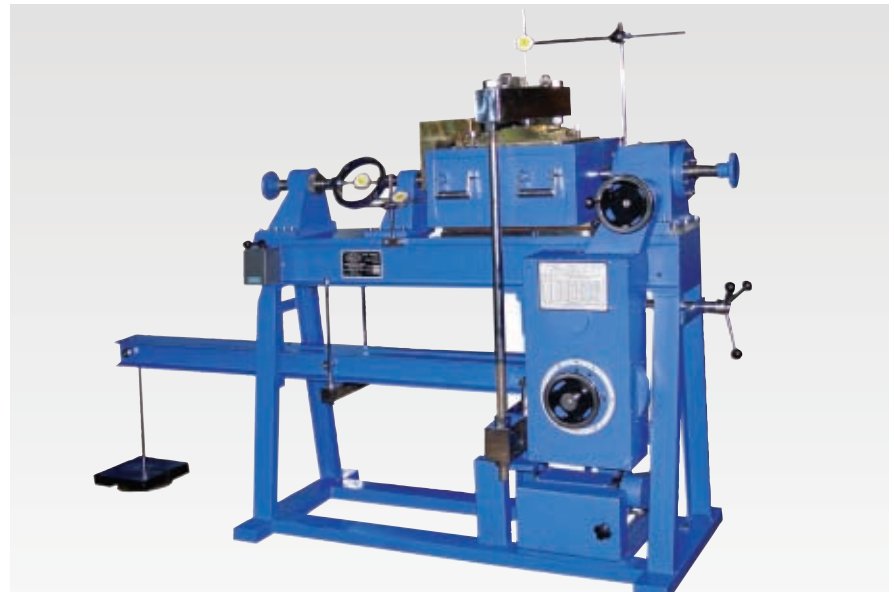
COMPUTER

Dedicated Computer with Data Acquisition card with latest configuration will be supplied.

●● HS24.20

Direct Shear Apparatus, Large, Motorised IS: 2720 (Part XXXIX/Sec. I)

This is required for testing 300 mm x 300 mm x 150 mm soil sample containing gravel with particle size more than 4.75 mm.



HS 24.20



The unit provides 72 different constant rates of strain for shear load ranging from 0.0014 mm/min. to 10.16 mm/min and is suitable for carrying out residual shear strength test.

The equipment comprises of the following :-

- i) Loading Unit having a normal load capacity of 3 kg/cm² through lever and shearing load capacity upto 5000 kg maximum.
- ii) Shear box assembly in two halves, complete with two guide pins and three spacing screws.
- iii) Shear box housing, complete with two ball roller strips.
- iv) Two perforated gripper plates.
- v) Two plain gripper plates.
- vi) Two plaid grid plates, one for top and one for bottom.
- vii) Two perforated grid plates one for top and one bottom.
- viii) One base plate.
- ix) One loading pad with lifting handles.
- x) One set of slotted weights to give a maximum normal stress intensity of 3 kg/cm² on the specimen through lever system.

Suitable for operation on 220 V, 50 Hz, single phase supply. Supplied without Proving Ring and dial gauges which are to be ordered separately.

ACCESSORIES & SPARES:

HS29.15 Dial Gauge 0.01 x 25 mm for consolidation measurement.

HS29.20 Dial Gauge 0.01 x 50 mm for horizontal strain measurement.

HS30.241 3000 kg Proving Ring for shear load measurement.

HS30.245 5000 kg Proving Ring for shear load measurement.

HS24.20.1 Perforated gripper plates set of two.

HS24.20.2 Plain Gripper plates set of two.

HS24.20.3 Grid plates plain set of two.

HS24.20.4 Grid plates perforated set of two.

●● HS24.520

Electronic Direct Shear Apparatus, Large, Motorised IS: 2720 (Part XXXIX/Sec. I)

Same as HS24.20 except that the unit is provided with electronic digital system & sensors for vertical displacement, & horizontal displacement & load cell for shearing load.

Broad specification of digital display unit is given below.

Sensor

Displacement sensors ± 50 mm -2 Nos.
Load Cell 30kN -1 No

Digital display system with RS232 - 1 No

●● HS24.622

Digital Direct Shear Apparatus

This unit is similar to Hs 24.617 except that it can accommodate sample size of 300*300*150 mm. Servomotor can create power to give a shearing load of 50kN. Additional Stepper motor is provided for normal stress. This stepper motor can create a maximum stress of 5kg/sqcm. Total controlling is through the computer. Parameters like shearing load, vertical strain and horizontal strain is shown on the monitor.

Operation is based on the close loop Principle the specimen to be sheared can be loaded either on strain basis or stress basis. Selection of this mode has to be made at the beginning of the test. Maximum strain rate that can be achieved is 9.9999mm/min where as the minimum strain rate could be programmed as low as 0.0001mm/min.

Loading System

For Horizontal strain controlled through micro stepper motor:

- i) Rate of strain : 0.0001-9.9999mm/mi.
- ii) Load range capacity : ± 50 kN
- iii) Displacement range : ± 20 mm

For Vertical Consolidation:

- i) Capacity : 5kg/cm²
- ii) Range : 0-20 mm

Electronic Sensors

- i) HS30.520U Load cell
- ii) Universal type : 50kN
- iii) HS29.555 Displacement sensor horizontal : ± 50 mm
- iv) HS29.555 Displacement sensor vertical : ± 50 mm

Salient Features of software and graphical plots

- i) It is supported by user-friendly windows based software for graphical plotting and numerical tabulations.
- ii) Horizontal displacement vs. Vertical displacement
- iii) Normal stress vs. Shear stress
- iv) Displays maximum value of dilation angle along with c and ϕ values.