In a direct shear test, the failure of the soil sample in shear is caused along a predetermined 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.

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.

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.
HS24.515

Electronic Direct Shear Apparatus, 12 Speed, Motorised with Microprocessor Based Electronic Unit, 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/cm². It is provided with standard 60mm shear box assembly. Set of weights to give a normal stress up to 3 kg/cm² 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 ± 20 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.

(Optional is 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 Dilation 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.
(2) Computer

Note: The computer with latest configuration will be supplied.

👀 HS24.617

Direct/Residual Shear Test Apparatus (Confirming 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 within the limits of ±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) Load cell
   Universal type: 2000N
2) Displacement sensor horizontal: ±20mm
3) Displacement sensor vertical: ±20mm

Supplied complete with weight up to 3kg/cm²

COMPUTER

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

👀 HS24.620

Computer Controlled Direct Shear Apparatus

Conforming to IS: 2720 (Part XIII) & BS1377

The unit is totally computer controlled, it has 2 servo motors, one for shear load and the second for maintaining normal load. Circuit for normal load is based on closed loop principal.
Salient Features-

- Enables Direct shear tests through a total computer controlled operation
- Conforms the test requirement of IS-2720 (Part-XIII) & BS 1377
- Programmable Normal stress from 0.01N/mm² to 0.5N/mm² and maintain Stress level within the limit of + 0.5%
- Strain rate programmable form 0.00001 mm/min – 9.9999 mm/min.
- Shear box suitable for 60x60 mm sample (Optional 100x100 mm sample)
- Online plotting of Load vs Displacement, Load vs Time and Displacement vs Time curves and display of data for all the channels
- Advanced Analysis Software

The complete System consists of the following:-

i) Shear Box Assembly

ii) Loading Frame

iii) Shear box assembly, 60 mm square, complete with a U-bracket, guide pins and spacing screws, made of brass

iv) Gripper assembly consisting of two plain grid plates, two perforated grid plates, one base plate and one loading pad, all made of brass

v) Two porous stones 6 mm thick, fitting the shear box

vi) Shear box housing of brass, complete with two roller strips

vii) Specimen cutter for the specimen

viii) PC Based Control system and Control Software

a. Signal Conditioning and Controlling Unit with Transducers
b. Dedicated Computer for controlling and Data acquisition
c. Control & Analysis Software

**Loading Frame**

<table>
<thead>
<tr>
<th>Rate of strain :</th>
<th>0.0001 - 9.9999 mm/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shearing Load capacity :</td>
<td>+ 2000 N</td>
</tr>
<tr>
<td>Displacement range :</td>
<td>+20 mm</td>
</tr>
<tr>
<td>Normal stress range :</td>
<td>0.01 N/mm² - 0.5 N/mm²</td>
</tr>
</tbody>
</table>

**PC BAESD Control System and Control Software**

Control system provides the digital control of the motors to apply normal stress and shearing load, data acquisition etc. for the continuous operation of the system.

a. Signal Conditioning and Control Unit with Transducers

The four-channel signal conditioning and control unit has drive cards that controls the operation of the two motors independently to set the normal stress and shearing strain. Signal conditioning unit also receives the output signal from the various transducers (Load cells and Displacement Transducers) and amplifies and process that signal as per the requirement and transfer it to computer through connecting cables where it is accepted by the data acquisition system. The readings of Shearing Load, Normal stress, Horizontal and Vertical Displacement are directly indicated in the computerized display. The Load is displayed in terms of ‘N’ with a resolution of 1.0N, Normal stress in ‘N/mm²’ with resolution of 0.01 N/mm², Horizontal Displacement and Vertical Displacement in terms of mm with a resolution of 0.01 mm each. Three analog output voltage points for each channel with ground is also provided in the unit.

**Transducers Specification:**

1. **Load Cell**
   - Capacity : 2000 N

2. **Linear Variable Differential Transformer (LVDT) Type (2 No.s):**
   - Stroke : ± 20 mm

b. Dedicated Computer for controlling and Data acquisition

System is provided with dedicated computer with built in data acquisition card. Broad specification of the computer and the data acquisition card is given below.

(Note- Latest available model of the computer will be supplied at the time of delivery)

c. Control and Analysis Software

Control software is the integral part of the system for precise controlling & Data Acquisition and analysis.

**Salient Features-**

- Windows based user friendly software
- Programmable Rate of shearing and Normal stress
- On-Line Data Acquisition from Signal Conditioning Unit to Computer
- Computer/Software programmable Safety Limits for each load & displacement
- Independent Taring of each channel
- Facility to Load and Unload the specimen at specified rate
- Facility to hold the shearing loading and restart the loading during the test.
- Facility for Inch and release for adjustment of the gap
- On-Line Data Acquisition from Signal Conditioning Unit to Computer
- On-line display of readings of Shearing Load, Normal stress, Horizontal and Vertical Displacement

- On-line display of Shear Load v/s Horizontal Displacement & Vertical Displacement v/s Horizontal Displacement graphs

- Auto adjustment of graph scales

- Calculations of various parameters

- Facility to save the data after the test

**Analysis Software**

- Off-Line Data Analysis Software that does all the calculations of Direct Shear Test as per IS:2720 Part VIII.

- Has option for manual as well as automatic recording of data.

- Calculates Area, Volume, Bulk density, Dry density, Moisture content etc. of the specimen

- Display the following Plots (Graphical)
  
  (a) Horizontal Displacement vs Shear Force
  
  (b) Horizontal Displacement vs Vertical Displacement
  
  (c) Normal stress vs Shear Force
  
  (d) Maximum value of the Dilation Angle

**Optional**

100mm shear box assembly complete with porous stone and gripper plate.
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 plain 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 ±50mm -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 24.620 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 whereas 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/ml.

ii) Load range capacity : ± 50kN

iii) Displacement range : ±50mm

For Vertical Consolidation:

i) Capacity : 5kg/cm²

ii) Range : 0-20 mm

Electronic Sensors

i) Load cell

ii) Universal type : 50kN

iii) Displacement sensor horizontal : ±50mm

iv) Displacement sensor vertical : ±50mm

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 ø values.