DEAD WEIGHT
DIRECT/RESIDUAL SHEAR DEVICE
ASTM-3080

This latest shear device utilizes a dead weight loading system (straight on and a 10: 1 beam) for applying the vertical load to the sample. The device is a self-contained stand alone model that is compact and requires little floor space.

A load cell with digital readout is used for measuring shear forces. The vertical and shear displacement are measured with dial indicators. Optional linear displacement transducer/readouts with analog outputs to data acquisition are available.

The basic device comes complete with 2.5" diameter shear rings and water chamber. Maximum shear displacement is 0.8" from the home position). Travel is set with limit switches by the operator. A stepping drive motor and controller maintains the desired rate of strain. The strain rate is easily set with digital thumb wheels and is maintained within 1% by a crystal stabilized clock. The thumb wheel settings represents direct readings in inches per minute(0001 = .0001"/minute).

CONSTRUCTION

The Direct Shear was designed for harsh lab environments with a solid base (1.25" thick) for the loading and shear box assembly coupled with a sturdy aluminum cabinet. The upright rods are stainless steel and the cabinet is painted with an enamel finish. The shear rings are stainless steel and the water chamber is anodized aluminum for corrosion resistance. Cabinet legs are steel angle with floor mounting holes.

SPECIFICATIONS

MODEL	MAX VERTICAL LOAD	MAX HORIZONTAL SHEAR FORCE
2050	750 lb (340 kg)	750 lb (340 kg)

See Page 3 for ratios

Horizontal Movement:	.8" Maximum
Rate of Strain: 2050	.0001" to .2999"/min
Overall Height:	54"
Cabinet Height:	9"
Length:	36"
Depth:	14.5"
Weight:	180 lbs. (without wts.)
Power:	110 Volts 60 Hz

WEIGHT SET

8 TSF WT SET	1/8 TSF	1/4 TSF	½ TSF	1 TSF	2 TSF	4 TSF
1119	2	1	1	1	1	1

DEAD WEIGHT DIRECT SHEAR

The direct shear test may be run on any type of soil sample, but it is particularly adapted to cohesion materials. This machine can also be used to establish the undrained shear strength of saturated, highly plastic cohesive soils under certain conditions. The direct shear test is normally run as a strain controlled test. In order to obtain the effective stress parameters of any soil, excluding the most pervious medium and fine sands, it is necessary to use a slow rate of shearing in order for induced pore

pressures to dissipate. The remainder of this procedure presents a discussion on the sample preparation for testing, equipment preparation, and running the direct shear machine. Refer to ASTM D-3080 for procedures and details on the test methods.

INSTALLATION
The unit requires unbolting from the skid. The dead weight lever arm requires assembly, as it was repositioned for shipping. First remove all the tape and the lever arm adjusting screw support bracket on the right hand frame. Reposition the arm above the support bracket holes and reinstall the support bracket. Install the 3.5" diameter counter balance weight and the weight platform.

SETUP OF MACHINE-The direct shear requires a level floor for best results. Holes are provided in the frame for bolting to the floor.

DIAL INDICATOR ROD - Screws into the top platform to the right of the vertical pull-down rod

DIAL INDICATOR CLAMPING ARM - Attaches to the above rod

DIAL INDICATOR - CONSOLIDATION - Attach to the clamping arm with the screw provided

DIAL INDICATOR - SHEAR - Attach to the angle bracket on the top platform, right front

LINEAR DISPLACEMENT TRANSDUCER (Optional) - Attach to the angle bracket on the top platform using the clamping block

LOAD CELL - Connect the load cell to the support casting at the right end of the direct shear using the two knobs. Adjust the knobs so that the load cell is as far to the right as possible. This will allow room for assembling the water chamber and the shear rings with minimum interference. Connect the 5 pin din plug on the load cell to the socket at the rear of the cabinet. An analog output plug (3 pin) is also provided for connection to data acquisition.

WATER CHAMBER - Special care should be taken to see that the two (2) roller bearings between the water chamber and the base slide tracks are properly cleaned and contain a slight amount of oil during and after use. We advise using a cover over the direct shear after use to eliminate dust from entering the precision slide assembly. The roller bearings should be set in the middle of the bearing tracks with the water chamber shear rings centered to the load arm. The main drive shaft should be at its ”home” position. This will place the sample load pad in the center of the cross arm for consolidation.

SHEAR RINGS - The shear rings are held together with (2) stainless steel screws with lifting knobs. There are also (4) screws for adjusting the gap between the rings once consolidation has been reached. The gap is adjusted by turning the screws clockwise from the finger tight position. One full turn will give .031" gap. There is a line scribed on the adjusting knob for determining how much gap each screw has provided. The screws should be turned evenly to maintain a proper gap. At the bottom of each screw is a nylon glide which keeps the top shear ring from dropping during the test.

LOAD CELL READOUT - The S type load cell is connected to the rear of the cabinet with a five pin din plug. The readout will be activated when the main power switch is turned on. A tare button is located to the left of the readout and is used to zero the readout if required. A 3 pin din plug is provided for hook-up to data acquisition. Pin #1 is “+” and pin #3 is “-”. The output is 0-10 VDC. See separate instructions and calibration sheet on the load cell/readout.

POWER SWITCH - Located at the bottom of the control panel, an indicator light is present when power is turned on.

STRAIN RATE SELECTOR - The strain rate control is set with thumb wheel selectors. The switches are direct reading in inches/minute with an implied leading decimal point. Once the rate is set and the test is begun, the switch setting is ignored until the stop switch is pressed or a limit switch is tripped.

LIMIT SWITCHES - These switches are located on the platform behind the water chamber. Adjustment of these switches is made by loosening the Phillips-head screws and moving the limit switch assembly in the direction desired. The home position has been set so that the load cross arm is in the middle of the shear rings. The limit switch has been set for .8" travel and may require resetting depending on the test parameters.

CAUTION: THE TRAVEL LIMIT OF THE DRIVE SHAFT IS DEPENDENT ON THE LIMIT SWITCH SETTINGS. DO <u>NOT</u> OPERATE THE MOTOR WITH THE WATER CHAMBER DISCONNECTED BECAUSE THIS WILL MAKE THE LIMIT SWITCHES <u>INOPERABLE</u> AND CAUSE DAMAGE TO THE SHEAR SHAFT.

STOP SWITCH - Momentary push button to stop the motor.

DIRECTION SWITCH - Momentary (spring loaded) switch. After setting the desired shear rate, moving the switch in the desired direction will initiate movement. This switch will then become inactive until the stop button is pressed or a limit switch is activated. The left position will move the water to the left. It will continue until the water chamber activates the limit switch. At this time, the limit indicator light will be lit. The right switch position will move the shear box to the right until the home limit switch is made. **SEE ABOVE CAUTION.**

HOME & LIMIT INDICATORS - Used to indicate the limit of travel of the shear box.

FUSE -1 amp SLO BLO fuse located in the cabinet rear

SHEAR BOX ASSEMBLY
Be certain the tracks on the platform, shear box bottom and the roller assemblies are clean and are lightly oiled. Place the shear box

assembly on the slide tracks being careful not to damage the home and limit switches.

SAMPLE PREPARATION
Once extruded, the samples should be trimmed carefully down to the internal diameter of the direct shear rings, in a similar manner as for consolidation test samples. The object is to get at least one inch of soil sample sandwiched between a layer of filter paper and a porous stone on either side of the sample. The porous stones provide drainage and are used to distribute the pressure during the test. Place the bottom drainage plate and then a porous stone with a filter paper into the locked shear rings. Extrude one inch of soil sample into the shear rings. Place another piece of filter paper and porous stone on the top of the sample along with the top load pad.

SAMPLE SET-UP IN MACHINE
At this time, the direct shear rings are held together by two (2) bolts and the soil sample would be centered inside the rings. The shear rings with sample stones are then carefully placed inside the direct shear water chamber being certain the load cell shaft is connected to the shear rings. The shear ring assembly is placed against the end spacer. Alignment of the load cell connecting rod is required at this time. Tighten the two (2) shear ring clamping knobs located on the left side of the water chamber. Connect the load cell to the shear ring connecting rod using the stainless steel knurled nut.
Connect the load cell and adjust the knobs to read "0" on the load cell readout. It may be necessary to use the tare feature to read "0". The top cross arm is usually removed for placement of the rings into the water chamber. Re-install the cross arm and adjust the height until there is l/16" space between the arm and the stainless steel ball being certain the arm is level. The upper cross arm has a displacement indicator pin that is positioned on the load pad ball. Adjust the dial indicator or linear displacement transducer to the top of this pin and allow for sufficient travel when the soil sample compresses. The vertical dial indicator is positioned and set to read some arbitrary initial reading.

CONSOLIDATION OF THE TEST SAMPLE
The weight of the consolidation load arm with two upright rods lower cross arm and lower weight platform is 11.9 lbs.
The lever arm on the right side of the device has three ratios (9:1, 10:1 & 11:1). Select a consolidation load and apply the required weights. Refer to ASTM D-3080 for sample preparation and computations.

SAMPLE SIZE	LOWER WEIGHT PLATFORM CALCULATIONS	10:1 LEVER ARM CALCULATIONS
2.5" DIA.	1 LB WEIGHT = 29.3357 LBS/SQ FT	293.357 LBS/SQ FT
2.5" DIA.	1 KG WEIGHT = 29.3357 KGS/SQ FT	293.357 KGS/SQ FT
4.0" SQ.	1 LB WEIGHT = 9 LBS/SQ FT	90 LBS/SQ FT
4.0" SQ.	1 KG WEIGHT = 9 KG/SQ FT	90 KGS/SQ FT

TEST PROCEDURES
The final dial reading after consolidation is noted on the data sheet. Adjust the shear force on the sample by adjusting the two knurled nuts on the load cell support casting. Allow a small seating load to be exerted on the sample. The horizontal dial indicator is then adjusted to some convenient zero point. Until this time, the two shear rings have been held together by two (2) screws -- these screws are now removed. There are also four (4) screws for adjusting the gap between the rings once consolidation has been reached. The gap is adjusted by turning the screws clockwise from the finger tight position. One full turn will give .031" gap. For sands of a fine to medium size, 1 1/4 of a revolution of the adjusting screw is used. For coarser sands, 1 _ revolution is used. For fine grain soils and clays, ½ revolution is used. These values are not absolute and can be altered accordingly. Initial readings are taken at this time. The screws should be turned evenly to prevent tilting the top ring. The test is now started at the prescribed rate of shear by setting the shear rate selector. Unless automatically recorded, the shear and compression dial indicators will be read at various prescribed horizontal deflection readings such as every ten divisions of the three place dial until failure. Usually the test is carried out past failure to determine the residual strength which may be used in design. At this point the test is completed and the shear loading is stopped and the vertical load is removed.

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SAMPLE REMOVAL AND CLEAN-UP
Put the motor drive in reverse (towards the home position) and stop when zero (0) load is reached on the load cell readout. Remove the sample at this time and inspect per ASTM D-3080. The vertical load is now reduced to zero (0) by adjusting the pressure regulator to zero (0) psi. The apparatus is taken down in reverse order as assembled. The sample is extracted and weighted in order to determine the dry density and water content at failure. The water chamber is returned to the home position by using the drive motor. Cover the roller bearing slide assembly to prevent dust and dirt from entering the bearings.

MODEL 2050
DEAD WEIGHT SHEAR LOAD CHART

2.5" DIAMETER SAMPLE
AREA = 4.9087 IN²

WEIGHTS ADDED 10:1 BEAM = SAMPLE LOAD			
QUANTITY	**LB. WT.**	**TOTAL LBS.**	**TSF**
1	.852	8.52 lbs.	1/8
1	.852	17.04 lbs.	1/4
1	1.704	34.09 lbs.	1/2
1	3.409	68.18 lbs.	1
1	6.818	136.35 lbs.	2
1	13.635	272.7 lbs.	4
1	27.27	545.4 lbs.	8

5/16/00

Remove this angle bracket (repositioned for shipment), lift weight lever arm and reinstall bracket under the weight lever. Then attach the brackets under the 1 1/4" diameter pivot shaft using the 2 screws provided. The straight on load platform is then screwed into the bottom of this bracket.