3. WF 25735 Cyclic simple shear system

Application

The cyclic simple shear apparatus is generally used for research into the dynamic field of soil behaviour, since can simulate quite easily many different field loading conditions, as for example:

- Stability under seismic events of submerged slopes on the continental shelf characterised by layered clays
- Degradation of shear stress for saturated granular soils under small and media cyclic angular deformation
- Evaluation of the liquefaction parameters of saturated cohesionless soils.
- Evaluation of the shear modulus decrease with increasing strain and damping for non linear constitutive models of the ground response.

The cyclic simple shear is a plane strain device. The shear strain is induced by horizontal displacement at the bottom of the sample relative to the top. The horizontal diameter of the sample remains constant, therefore any change in volume shall be as a result of vertical movement of the top platen.

This imposed distortion is termed "Simple Shear"

The system is designed to allow a sample to be consolidated, drained and then sheared. Pore pressure measurement is possible thus allowing equilibrium to be achieved prior to shearing.

Sample

The standard sample is 70 mm dia. The test can also be performed on 50 mm dia. samples using the conversion kit **WF 25737** *(see page 63).*
It is positioned on a pedestal with a top cap the same as a triaxial sample and supported by a rubber membrane placed and secured with O-rings.
To maintain a constant diameter throughout the test the sample is supported by a series of slip rings.

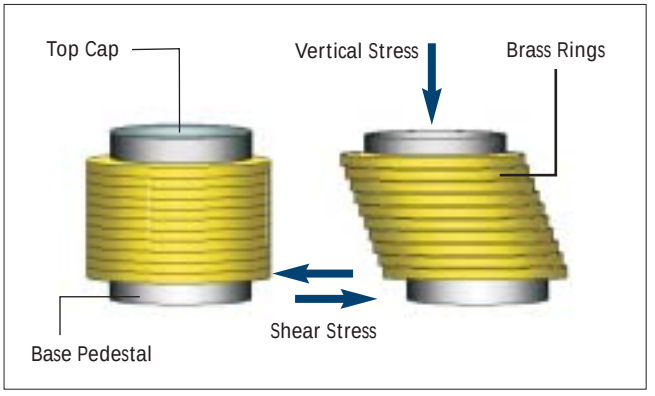
Shear stage

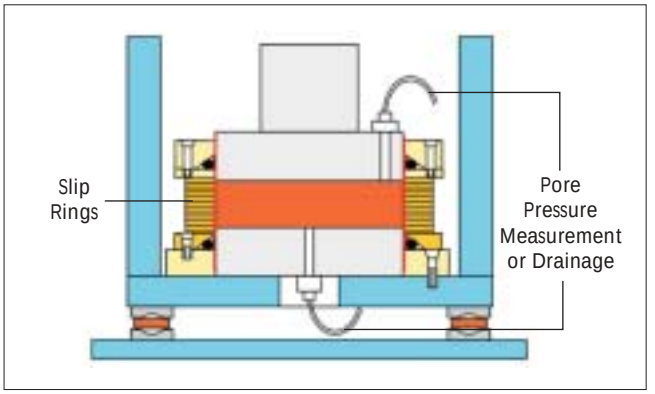
During shear the rings slide across each other as shown.
During the shearing stage of the test the vertical height of the sample is maintained at a constant height by the vertical actuator in a closed control loop with the vertical displacement transducer. The rings maintain a constant sample diameter.
During shear only the length of the sample side changes. The test is undrained so we maintain a constant volume.
The height stays constant, which gives us the required test conditions for Simple Shear.

Main features

- Frequency up to 70 Hz
- Plane strain measurement
- Shear at a constant height
- Shear at a constant stress
- Shear at a constant rate of strain

WF 25735





3. Cyclic Simple Shear System *(continued)*

General description

Base system

The system consists of a simple shear load frame, air receiver with vertical and horizontal loading control valves. It incorporates a control and data acquisition system as described below, with two 5 kN actuators.

The system is mounted on a cabinet supporting all components. The horizontal and vertical actuators are fixed to the frame, which supplies the reaction to the forces applied. Each actuator has an internal displacement transducer, which relays the actuator piston position back to the computer. This is very important when setting up a sample; it allows you to set enough travel for the test duration.

The sample is set up in the machine, which has a rigidly fixed top half and a moving bottom half. The top half houses the 50 mm dia. vertical ram. This is housed in a linear bearing to allow vertical movement and prevent horizontal movement. The bottom half is mounted on roller bearings as in a standard shear box.

Integrated Multi-Axis Control System (IMACS)

The system is identical to that one which is part of the cyclic triaxial system, except for the input channels, which are 6 instead of 13. (*see page 53*)

5 kN actuators

These two double acting pneumatic actuators are identical to that one, which is part of the cyclic triaxial system described *on page 52*, digitally controlled and require a minimum air supply of 800 kPa working pressure.

System specification

Main frame: floor mounted, steel box frame including integral double acting horizontal and vertical pneumatic actuators.
Each with an internal displacement transducer. The top cap is fixed and the pedestal is mounted on roller bearings
Sample size: 70 mm dia.
(50 mm with conversion kit)
Maximum load: ± 5 kN vertical and horizontal
Frequency range: 0 – 70 Hz
Overall dimensions: 1500x1200x700 mm (HxLxW)
Electrical specification: 230 or 110 V, 50-60 Hz, 1 ph.
Weight approx.: 350 kg

The system includes the following:
- Cyclic simple shear machine with horizontal and vertical actuators 5 kN capacity
- Accessories for sample preparation
- Force and displacement transducers
- Control system and data acquisition
- Software and PC.

Sample having in the WF 25735 cyclic simple shear machine

3. Cyclic Simple Shear System *(continued)*

Transducers

Load cells

These two 5 kN load cells are fitted in-line with the horizontal and vertical actuators. The load cells are fitted with an in-line calibration module, allowing the transducers to be changed or moved within the data acquisition system without the need to re-calibrate them. Accurate to 1.2 N.

Displacement transducer

This ± 25 mm displacement transducer is built into the actuator. It measures the actuator piston position and can also be used as the control transducer for the cyclic strain test.

Vertical displacement transducer

This transducer is calibrated over 2 mm for controlling the sample height. Accurate to 1.2 µ.

In-line signal conditioning

This normalises all the transducer outputs, allowing transducers to be moved from channel to channel without having to re-calibrate.

Ordering information

WF 25735

Cyclic Simple Shear System. 110-230 V, 50-60 Hz, 1ph.

Accessories

Conversion kit for 50 mm dia. samples

WF 25737

50 mm dia. sample accessories including pedestal and top cap

Software

Consolidation stage

The consolidation stage is simply the application of a static axial loading stress to the specimen while the lateral loading (shear) axis is held stationary. Axial stress and specimen displacements (axial and lateral) together with pore pressure data are measured over time and logged by the system. Logged data is also displayed to the operator in the form of charts and tables as the test stage proceeds. The consolidation stage is manually terminated by the operator once consolidation of the specimen is determined to be complete.

Cyclic simple shear stage

This stage of the test applies a lateral cyclic shear force, or optionally a displacement, to the specimen, while the axial axis is either maintained at the specified stress, or optionally, the specimen height is maintained. Both axial and lateral force and specimen displacements together with pore pressure are measured for each loading cycle. Measured data is obtained from 50 sample points captured over the cycle period. This data is displayed to the operator in the form of wave shapes, charts and tables and also logged by the system to an archive data file. The loading cycle shape is operator selectable from predefined functions but may also be a user generated shape.

Linear displacement shear stage

The linear displacement shear stage of the test applies a rate of lateral shear displacement to the specimen. Both axial and lateral force and specimen displacement together with pore pressure are measured for each loading cycle.
Measured data is displayed to the operator in the form of charts and tables and also logged by the system to an archive data file.

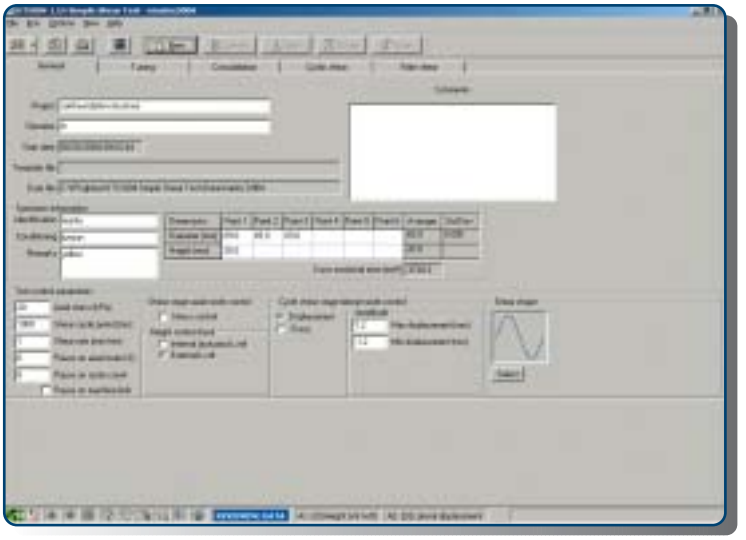
3. Cyclic Simple Shear System *(continued)*

Software screen shots

Set up parameters

This stage of the software allows you to select the type of test parameters you wish to carry out for example:

Consolidation stage force pressure
Shear stage axial mode to be controlled in stress or constant height
Shear stage lateral mode to be controlled in force or displacement with choice of wave shape
Shear rate speed
Test termination on cycle counts or % axial strain.

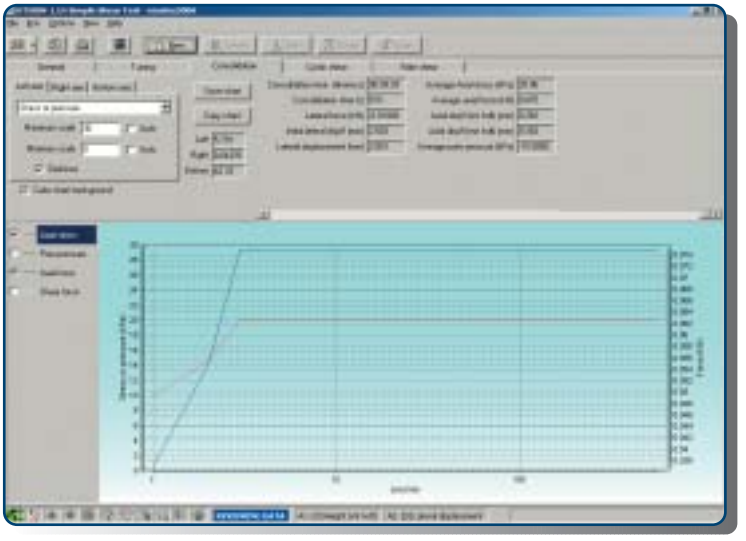


Consolidation

This stage shows the consolidation forces being applied to the sample.

Graph displays

Axial stress against time
Pore pressure against time
Axial force against time
Shear force against time

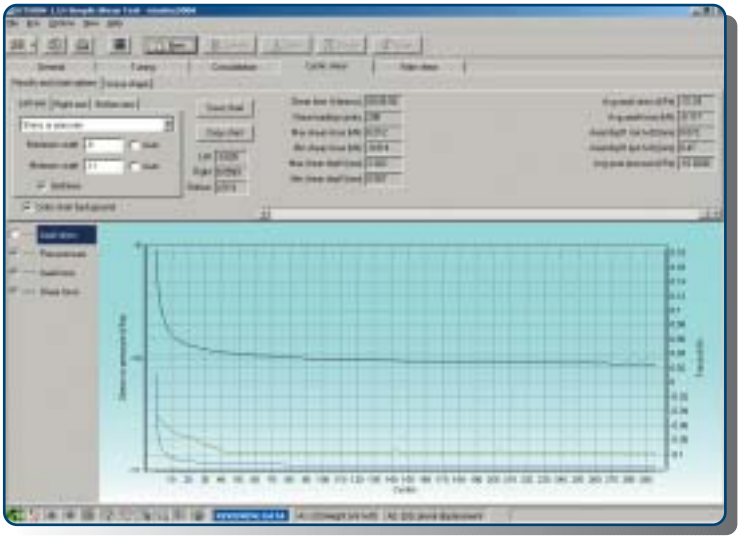


Cyclic shear

This stage shows the dynamic forces/ displacements being applied to the sample.

Graph displays

Axial stress against cycles
Pore pressure against cycles
Axial force against time
Shear force against time



Rate shear

This stage shows the rate shear being applied to the sample.

Graph displays

Axial stress against cycles
Pore pressure against cycles
Axial force against time
Shear force against time