Options available for LDCTTS

Load ranges

100kN ✓ **250kN** ✓
Custom range ✓

Load frequency

0 to 10Hz ✓

Sample dimensions

450mm height ✓
300mm diameter ✓
Custom sizes on request ✓

Volume change measurement

Inner cell 'HKUST' type ✓

International standards

ASTM D3999-91 ✓
prEN13286-7 ✓

Large Diameter Cyclic Triaxial Testing System (LDCTTS)

What is it?

The GDS Large Diameter Cyclic Triaxial Testing System (LDCTTS) is hydraulically actuated with a large diameter triaxial cell suitable for testing samples with large particle sizes such as railway ballast. The system is capable of both monotonic (static) and dynamic triaxial tests as well as other advanced triaxial tests usually expected from a GDS system.

Using GDSLAB software with optional test control modules, GDSLDCT can run tests such as stress paths, slow cyclic, dynamic cyclic and K0, all under PC control.

Overview

The basic system consists of the following major components:

- GDS 10Hz hydraulic load frame (100kN/200kN)
- Hydraulic power pack to supply the load frame
- GDSDCS (dynamic control system) for data acquisition and control
- GDS single channel pneumatic regulator for cell pressure
- Optional GDS dual channel pneumatic regulator for both cell pressure and back pressure (in this case, single channel device above is not required)
- GDSLAB data acquisition and control software

The system is controlled by the user's PC running MS Windows® and GDSLAB software.

The operator chooses the type of test from a test menu (eg U-U, C-U, multi-stage, dynamic cyclic, stress path etc) and then enters the test parameters (of cell pressure, back pressure, testing rate and so on) and test termination conditions.

The test then proceeds automatically with all test data being saved to a file. On-line graphics are presented with up to three graphs displayed together with a block of current live test data.

The computer directly controls all parameters for the test in addition to logging these parameters to the PC hard drive. Of course, additional transducers may be configured easily and logged during the test.

Technical specification

- **Displacement range** = 100mm
- **Displacement resolution** = 16bit (i.e. <2µm)
- **Displacement accuracy** = <0.15% (i.e. <0.15mm)
- **Axial force resolution** = 16bit (i.e. <0.4N for 10kN load cell, <1.5N for 40kN load cell)
- **Axial force accuracy** = <0.1% of load cell range (i.e. 10N for 100kN load cell)
- **Control data points** = 10,000points/sec
- **Maximum saved data points** = 100points/cycle
- **Compliance with international standards**
- **MS Windows® software** = GDSLAB for automated test control and data collection
- **Future proof fully expandable software to allow additional testing or hardware to be incorporated at any time**

System capabilities

Load frame

- Direct closed-loop dynamic control of axial displacement or axial force to 10Hz, sinusoidal, triangular or user defined waveform.
- Performance specification conforming to the requirements of **ASTM Designation D3999-91** "Standard Test Methods for the Determination of the Modulus and Damping Properties of Soils Using the Cyclic Triaxial Apparatus" and **prEN13286-7** "Unbound and Hydraulically Bound Mixtures – part 7 Cyclic Triaxial Test". Method A of prEN13286-7 (variable confining pressure) requires the optional dynamic cell pressure actuator.

Triaxial cell

- Optional interchangeable (internal submersible) load cells to accommodate very soft to very stiff soils with ranges of 2, 4, 8, 16, 25, 32, 64, 128, 250kN are available. The load frame is supplied with an external load cell to match the model maximum load range as standard (i.e. 100 or 250kN).
- Double acting ram system holds the cell in place on the load frame whilst the lower ram applies forces to the specimen. The top ram allows for correct positioning of the submersible load cell. This means that load frames with base actuators do not have to overcome the weight and momentum of the whole triaxial cell, and the full load frame range may be applied directly to the specimen.
- 300mm diameter x 450mm height test specimen. Other sizes can be catered for by interchangeable base pedestals and triaxial extension top caps.
- Simple access for transducers, valves and pipework via 12 port transducer ring.
- Quasi-static closed-loop control of cell pressure

Fig. 1 shows a large diameter triaxial cell within a 100kN load frame.

GDS DCS – Digital Control System

- With 16 bit data acquisition (A/D) and 16 bit control output (D/A), the GDS DCS high speed digital control system runs at a control frequency of 10kHz per channel. This means that when running at 10Hz the system uses 1000 control points per cycle. When running at 1Hz, it uses 10,000 control points per cycle.

Fig. 1 LDCTTS testing system at the GDS factory

Hydraulic power unit

Pressure for the system is provided by a separate GDS Hydraulic Power Unit (see Fig. 2) which provides a constant source of pressure at 25MPa. This pressure source is used by the axial actuator to control pressure and displacement. It is also used to raise and lower the top beam. The hydraulic power pack is fully piped to include control valves, gauges, pressure and return line microfilters and water cooled heat exchanger. All electrical items are wired to a control box containing motor starters and fail safe shutdown interlocks, with local or remote control. Typical oil flow = 36litre/min, electrical power = 18.5kW, 380V 3-phase, 50Hz, cooling water flow = up to 25litre/minute. Noise specifications of power pack, <75 dB(A) at >5m, and <90 dB(A) at >1m.

Fig. 2 GDS Hydraulic Power Unit

HKUST inner cell volume measurement

The HKUST (Hong Kong University of Science and Technology) volume change measurement method involves measuring the cell volume displaced by the sample in an inner cell within the main triaxial cell (see Fig. 3).

Measurement of the volume change is made using a high-accuracy differential pressure transducer (DPT). This enables the cell volume change to be measured from just the inner chamber thus minimizing the error due to temperature and pressure changes.

The inner chamber containing the triaxial sample is connected to a reference tube via the DPT. As the sample deforms it will displace water in the inner chamber causing the water level to rise or fall. By measuring the pressure in the inner chamber with respect to the pressure in the reference tube, with the correct calibration factor it is possible to determine the volume change in the inner chamber and, therefore, the volume change of the specimen.

The advantage of this type of volume change method is the high accuracy and resolution that can be achieved for very large specimen volume changes. It must be noted however that due to settling time of the reference tube this measurement system is appropriate for measuring sample volume change during static tests only. For dynamic measurement of sample volume it is recommended that the HKUST inner cell is replaced by an LVDT local strain transducer set.

Note: Fig. 3 is for illustration only as the schematic is for a small diameter sample.

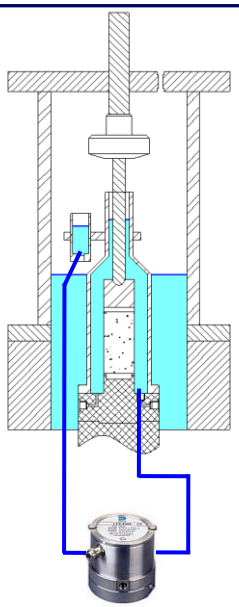

Fig. 3 HKUST sample volume change method

GDSLAB control software

The GDSLAB control and acquisition software is a highly developed, yet extremely flexible software platform. Starting with the Kernel module and the ability to perform data acquisition only, additional modules may be chosen for your testing requirements. Some currently available modules are as follows:

- dynamic triaxial tests
- SATCON (saturation and consolidation)
- standard triaxial
- stress path testing (p, q and s, t)
- advanced loading tests
- unsaturated testing
- K0 consolidation
- permeability

GDSLAB has the ability to be configured to your hardware of choice, no matter how unique the arrangement. A text file (*.ini) or initialisation file is created that describes the hardware connectivity to the PC. The hardware layout is available in graphical format via the GDSLAB 'object display'. This makes setting up the devices and checking the connectivity extremely simple (see Fig. 4).

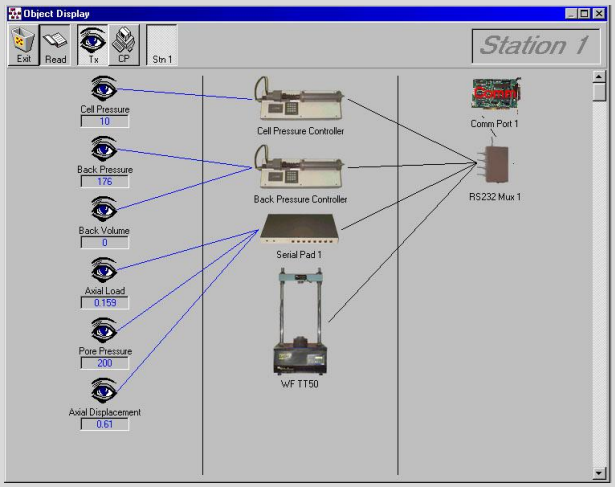

Fig. 4 Object display showing a triaxial test arrangement

For further information on GDSLAB, please refer to the dedicated GDSLAB datasheet.

Why buy GDSLDCT?

- Complete turn-key solution for dynamic measurement of large particle triaxial samples.
- Volume measurement by unique, proven method (HKUST)
- Flexibility in the capacity of the system (specimen size, load, pressures and so on) ensures a system is created to specifically suit the testing required and the budget.
- GDS worldwide technical support.

Due to continued development, specifications may change without notice.