



Advanced Dynamic Triaxial Testing System (DYNTTS)

Overview: The Advanced Dynamic Triaxial Testing System (DYNTTS) is a high-end testing apparatus combining a triaxial cell with a dynamic actuator capable of applying load, deformation and stresses at up to 5Hz.

The axial axis is screw-driven from an integral base unit housing the motor drive. Axial force and axial deformation are applied through the base of the cell.

Key Features:

High accuracy electro-mechanical control:

Interchangeable load cells:

In-built balanced ram (up to 5Hz systems):

Interchangeable pedestals and triaxial extension top caps:

Direct closed loop of axial displacement & axial force:

Adaptive Control as Standard:

Benefits to the User:

The DYNTTS system is capable of very small strain static tests through to large strain dynamic tests.

Allows user to accommodate very soft to very stiff soils with ranges of 1, 2, 4, 8, 10, 16, 25, 40 and 60kN.

Keeps cell pressure constant during cycling, meaning a dynamic pressure controller is not required (unless dynamic cycling of cell pressure is required).

Allows testing of 38, 50, 70 and 100mm diameter test specimens in the same cell.

Accurate control in either axial displacement or axial force mode.

Adaptive Control significantly improves the dynamic load control performance of an apparatus, leading to increased testing precision.

Tests that can be Performed:

Consolidated drained (CD), consolidated undrained (CU), consolidation (Triaxial), dynamic cyclic loading of samples under either load or strain, slow cyclic testing, quasi-satic (low speed/creep) tests, stress paths, K-Zero and user defined waveforms.

Upgrade Options:

Dynamic cell pressure, larger sample sizes up to 300mm diameter, higher cell pressure up to 5MPa, Bender element system (Vertical, Horizontal, S and P waves), Hall Effect Local Strain, LVDT local strain, unsaturated testing and temperature controlled testing.

Technical Specification:

Actuators:	High accuracy electromechanical
Axial Force Accuracy:	<0.1%
Axial Force Resolution:	24bit (i.e. <0.4N for 10kN load cell, <1.5N for 40kN load cell)
Axial Load (kN):	10, 25, 40 or 60
Displacement Range (mm) & Resolution:	100 & 0.20um
Operating Frequency (Hz):	2Hz - 10kN to 60kN
Pressure Range (MPa):	5Hz - 10kN to 60kN
Cell Pressure Range (Static):	2MPa (standard), optional 5MPa upgrade available with max sample size 70mm, or 10MPa with max sample size 100mm
Cell Pressure Range (Dynamic) for 2Hz and 5Hz System:	Optional dynamic cell pressure 1000kPa/200cc available for 2Hz and 5Hz systems
Speed of Measurement and Control:	5, 16kHz
Sample Sizes (mm):	38, 50, 70, 100 (other sizes available on request up to 300)
Temperature Control:	-10°C to +60°C, -20°C to +65°C, -20°C to +85°C

Systems Elements & Options

The fundamental system hardware elements are shown in Fig. 1 below. The actual hardware used may be chosen to suit your testing and budgetary requirements. The more common arrangements are as follows:

GDSLAB 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, additional modules are added for your testing requirements.

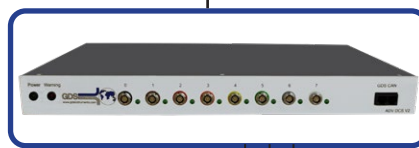


Note: Connection via USB

Advanced Digital Control System (ADVDCS V2)

The GDS dynamic systems are all based around the high speed GDS Digital Control System (GSDSCS) with closed-loop feedback of displacement and load.

With 24 bit data acquisition (A/D) and 16 bit control output (D/A), the GSDSCS runs at a control frequency of 16kHz per channel. This means that when running at 16Hz the system uses 1000 control points per cycle. When running at 1Hz, it uses 10000.



Pore Pressure (kPa)

Axial Strain (mm)

Load Cell (kN)

Load frame control

Cell pressure / volume

Back pressure / volume



Pressure Volume / Controllers

The cell and back pressures can be controlled with either one of the below:

- The Standard Pressure/Volume Controller (STDDPC) with pressure ranges from 1 to 4MPa, serial PC connectivity and 200cc volumetric capacity.
- The Advanced Pressure / Volume Controller (ADVDPV) with pressure ranges of 2 to 4MPa, USB connectivity and 200cc volumetric capacity, (ADVDPV 2MPa controller can be bought as a 1000cc volumetric capacity item).

Optional Electromechanical dynamic cell pressure actuator: The dynamic actuator allows cycling of cell pressure between two user chosen values. For example between 200kPa- 400kPa cycled a 1Hz, enabling dynamic stress path testing to be performed. The maximum pressure of this actuator is 1MPa.

Frequency Range (Hz)

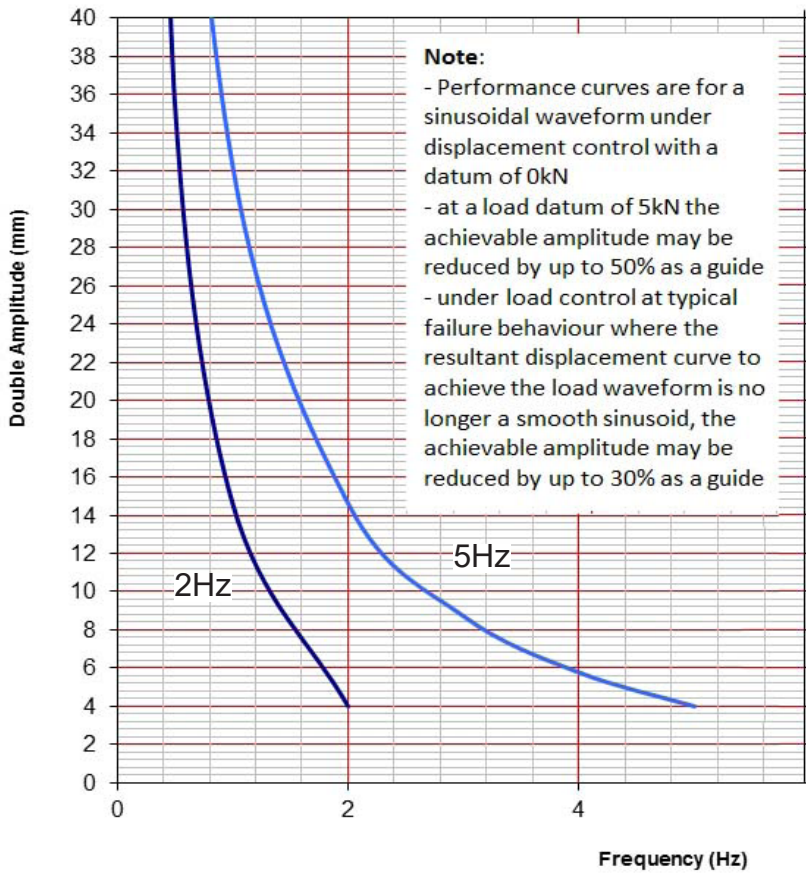
- 2 & 5

Load Range (kN)

- 10, 16, 20, 40 60.

Specimen Sizes (mm)

- 38, 50, 70, 100, 300, other sizes available upon request.



Typical system behaviour showing frequency and amplitude for 2Hz/10kN and 5Hz/10kN systems

Frequency	2Hz - Double Amplitude (mm)	5Hz - Double Amplitude (mm)
0.1	100.0	100.0
0.2	99.6	100.0
0.5	35.8	100.0
1	14.6	32.3
2	4.0	14.6
3		8.7
4		5.8
5		4.0

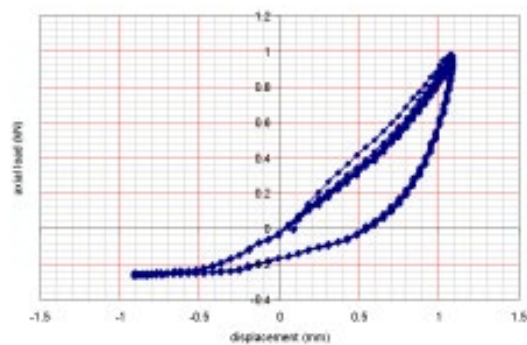
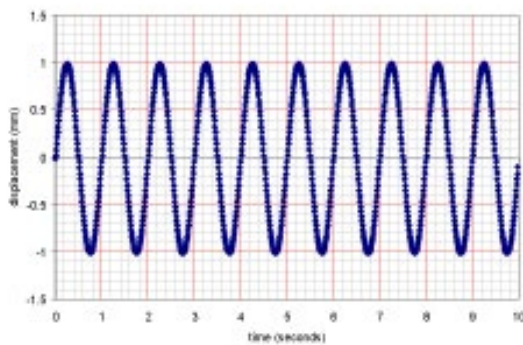
Typical Test Results Showing Displacement Control at 1Hz

Axial displacement feedback control

Frequency (Hz): 1.00

Peak to peak (mm): 2.000

Radial stress (kPa): 200.0



Adaptive Control - As Standard

Adaptive Control is a cutting edge technology that significantly improves the dynamic load control performance of an apparatus, leading to increased testing precision.

The GDS Adaptive Control firmware algorithm automatically adjusts the control gain values based on the observed specimen stiffness, removing the need for the user to enter a specimen stiffness value prior to the test. This has the additional advantage of ensuring specimen stiffness changes during a test are also dealt with correctly. When testing using an apparatus running GDS Adaptive Control, the firmware automatically optimises the control gains' values based on variations in soil stiffness as a cyclic test stage progresses, enabling a consistent loading amplitude to be applied to the test specimen. This marks a significant improvement over traditional PID closed-loop systems which, especially when testing multiple specimens of varying stiffness, require the user to re-tune the system before each dynamic cyclic test as well as risk under-performance when specimen stiffness changes during loading.



Temperature Controlled Testing

The DYN-TTS may be upgraded to include a temperature control system, enabling the dynamic cyclic response of soil to be observed and quantified when placed under frozen and/or heated conditions

It is possible to have a range of -10°C to +60°C or -20°C to +85°C, depending on the required range. The heater and chiller units used have a resolution of 0.01°C with a bath stability of +/-0.05°C, this stability & resolution is not necessarily reflected in the cell.

The control solutions consist of heating and cooling hardware, or heating hardware only. Gaseous back pressures, such as carbon dioxide or nitrogen, may also be applied within the temperature controlled systems.



Upgrade to Bender Element Testing

Any GDSTAS system may be upgraded to perform P and S wave bender element testing with the addition of the following items:

- Bender element pedestal with bender element insert.
- Bender element top-cap with bender element insert.
- High-speed data acquisition card.
- Signal conditioning unit which includes amplification of source and received signals (P and S-wave) with user controlled gain levels (via software).

GDS Bender Element Analysis Tool:

The tool allows the rapid, automated analysis of bender element tests to objectively estimate the shear wave travel time. The analysis tool is available to download from GDS' website.

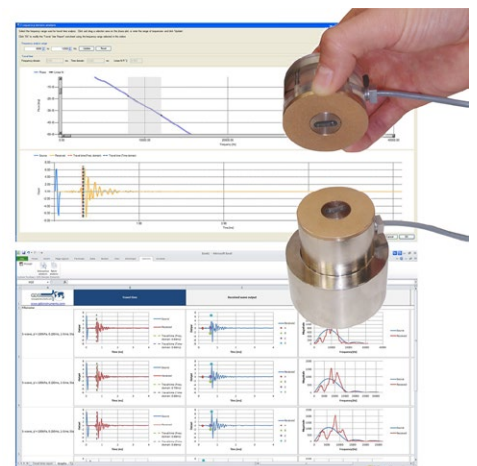


Fig. 4 Screenshots of the GDSBEAT

Upgrade to Unsaturated Testing

Any DYNNTS system may be upgraded to perform unsaturated triaxial testing with the addition of, unsaturated pedestal with high air entry porous stone a 1000cc digital air Pressure/volume controller (ADVDPCC) for the application of pore air pressure and measurement of air volume change. Optional HKUST double cell or a double walled cell are available.

Upgrade to Local Strain Measurement

Any DYNNTS system may be upgraded to perform Local Strain measurement using either Hall Effect or LVDT transducers. Both device types enable axial and radial deformation to be measured directly on the test specimen via lightweight aluminium holders. Hall Effect transducers may be used in water up to 1700kPa.

GDSLAB Control Software

GDSLAB is the control and data acquisition software for geotechnical laboratory applications. GDSLAB starts with a core application known as the kernel. The GDSLAB kernel allows for data acquisition from your hardware, but no test control. Simply add the appropriate module or modules to complete the test suite functionality you require. GDSLAB is compatible with all existing GDS equipment and furthermore key hardware from other manufacturers.

Required Operating System: Windows 7 SP1 or higher (We strongly recommend that Windows is fully up to date and running the latest Service Pack/Version available). Recommended PC Specification: 2GHz processor, 4GB Ram, 64Bit Operating System and USB connectivity. Note: GDS software can run on lower spec PC's however, performance and processing of data may be affected.

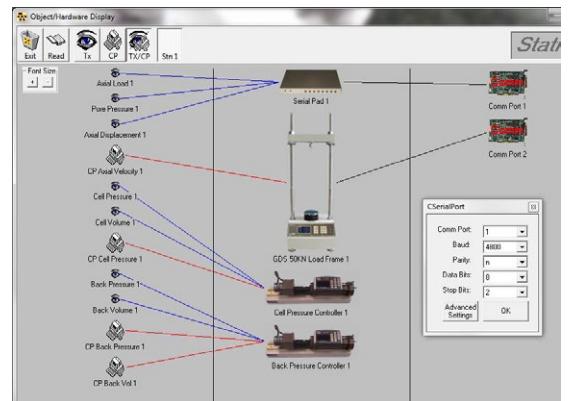


Fig. 5 A typical set-up screen in GDSLAB



Optional Lifting Frame

The Advanced Dynamic Triaxial Testing System now has the option of a lifting frame. The pulley driven lifting frame attaches to the apparatus and allows easy access to the sample.

The lifting frame is suitable for cells up to 150mm in size, weighing up to 150kg.

Why Buy GDS?

GDS have supplied equipment to over 84% of the world's top 50 Universities:

GDS have supplied equipment to over 84% of the world's top 50 Universities who specialise in Civil & Structural Engineering, according to the "QS World University Ranking 2019" report.

GDS also work with many commercial laboratories including BGC Canada, Fugro, GEO, Geolabs, Geoteko, Golder Associates, Inpijn Blokpoel, Klonn Crippen, MEG Consulting, Multiconsult, Statens Vegvesen, NGI, Ramboll, Russell Geotechnical Innovations Ltd, SA Geolabs, SGS, Wiertsema and Partners to name a few.

**TOP
50**

Would you recommend GDS equipment to your colleague, friend or associate?

100% of our customers answered "YES"

Results from our post-delivery survey asked customers for feedback on their delivery, installation (if applicable), supporting documentation, apparatus and overall satisfaction with GDS. The survey ran for two years.



Made in the UK:

All GDS products are designed, manufactured and assembled in the UK at our offices in Hook. All products are quality assured before they are dispatched.

GDS are an ISO9001:2015 accredited company. The scope of this certificate applies to the approved quality administration systems relating to the "Manufacture of Laboratory and Field Testing Equipment".

**40 YEARS OF
BRITISH
INNOVATION** 

Extended Warranties:

All GDS apparatus are covered by a 12 month manufacturers warranty. In addition to the standard warranty, GDS offer comprehensive extended warranties for 12, 24 and 36 months, for peace of mind against any repairs in the future. The extended warranties can be purchased at any time during the first 12 months of ownership.



GDS Training & Installation:

All installations & training are carried out by qualified engineers. A GDS engineer is assigned to each order throughout the sales process. They will quality assure the apparatus prior to shipping, if installation has been purchased, install the apparatus on the customers site & provide the training.



Technical Support:

GDS understand the need for ongoing after sales support, so much so that they have their own dedicated customer support centre. Alongside their support centre GDS use a variety of additional support methods including remote PC support, product helpsheets, video tutorials, email and telephone support.

