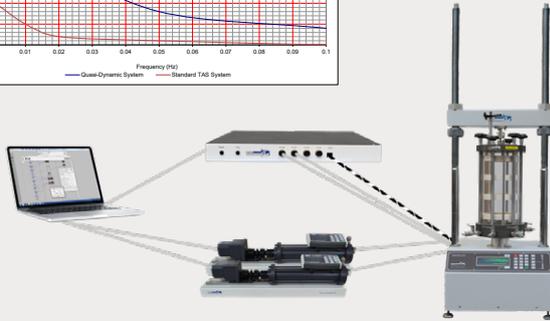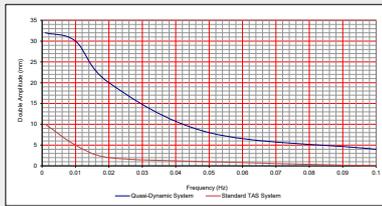## GDS Quasi Dynamic Triaxial System
(QDTAS)

Overview: The GDS Quasi Dynamic Triaxial Automated System is based exclusively on the static GDSTAS triaxial system as used in commercial laboratories and research institutes. The GDS 50kN load frame has the unique capability that it can run dynamically at frequencies up to 0.1Hz inherently, when combined with a dynamic logging system instead of the static logging system supplied with a GDSTAS as standard. The system is capable of cyclic displacement and cyclic load tests up to a frequency of 0.1Hz. The Quasi Dynamic System uniquely fills a gap in the market for medium speed cyclic testing, for half the cost of a typical, full capability, dynamic system.

Key Features:	Benefits to the User:
Up to 0.1Hz cyclic testing under displacement or load control:	Cyclic testing 30x faster than can be achieved with a standard static GDSTAS system for minimal additional cost.
Upgrade is possible from a GDSTAS static system (so long as it is using the v2 LF50 GDS load frame):	Dynamic testing up to 0.1Hz, can be achieved for approximately 50% of the cost of a full dynamic system, or upgraded for 20% of the cost of a typical dynamic system.
Realistic liquefaction testing on granular soils:	Liquefaction testing on free-draining soils is known to not be rate dependent, therefore cyclic testing on these soils is possible in a standard static triaxial system (so long as it has cyclic control that GDSLAB can provide as standard). However, by running these tests at 0.1Hz rather than the typical one cycle every 5 minutes with a static system, a typical test 1000 cycles long that would take 3.5 days in a static system, would take less than 3 hours in the Quasi Dynamic system.
Cost efficient:	Half the cost of a typical dynamic system (even pneumatically controlled dynamic systems which have been shown to generally only work up to 0.1Hz). For users who need to work up to 0.1Hz, this is a very economical system.

Tests that can be Performed:

Axial Displacement and Axial Load controlled cyclic tests up to 0.1Hz, B-Check, Consolidated Drained (CD) Triaxial, Consolidated Undrained (CU) Triaxial, Consolidation (Triaxial), Constant rate of Loading (CRL) Consolidation, Constant rate of strain (CRS) Consolidation, Slow Cyclic Testing, K0 (K-Zero), Multi-stage Testing, Quasi-Static (low speed/creep) tests, Stress Paths and Unconsolidation Undrained (UU) Triaxial.

Upgrade Options:

Bender Element System (Vertical, Horizontal, S and P waves), Hall Effect local Strain, LVDT Local Strain and Unsaturated Testing.

Technical Specification:

Load Range (kN):	50kN
Pressure Range (MPa):	Enterprise Set-up (ELTAS): 1 Standard Set-up (STDTAS): 1 to 4 Advanced Set-up (ADVTAS): 2 to 8
Sample Sizes (mm):	38 to 150
Data Acquisition:	16 bit
Computer interface:	USB
Maximum Axial Frequency:	0.1Hz

System 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.

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.

ELDCS Acquisition Pad

The ELDCS provides 4 channels of ultra-high resolution 24-bit data and a single additional incremental quadrature input channel. The 4 channels of fixed-gain inputs can be customised at the factory to enable any transducer in the GDS range to be connected via the industry standard DIN connector. Multiple ELDCS boxes can be joined via the CAN connector to provide synchronised data acquisition and control.

Pore Pressure (kPa)

Axial Strain (mm)

Load Cell (kN)

Load frame control

Cell pressure / volume

Back pressure

Note: Connection via USB interface to PC.

Pressure Volume / Controllers

- Enterprise Triaxial Automated System (ELTAS) which is based on 1MPa Enterprise Pressure / Volume Controller (ELDPC).
- Standard Triaxial Automated System (STDTAS) which is based on 3MPa Standard Pressure / Volume Controller (STDDPC).
- Advanced Triaxial Automated System (ADVTAS) which is based on 2MPa Advanced Pressure / Volume Controller (ADVDPC).

Load Frame & Triaxial Cells

- 50kN GDS LF50 version 2.

Triaxial Cells

- 2000kPa, specimens up to 50, 100 or 150mm (load frames > 50kN for 150mm cell due to size).
- 3400kPa, specimens up to 77mm.

Fig. 1 Fundamental system hardware elements

How does it work

In the 1990s, GDS were first to automate a standard slow speed velocity controlled load frame such that cyclic testing could be performed. Using feedback to the software from either a suitable positioned displacement transducer or an accurate load cell, sinusoidal cyclic testing could be performed with periods of around 4 minutes as the fastest rate. This level of load and displacement control based on closed loop feedback via the software opened up a host of testing possibilities for stress and strain controlled testing that were never thought possible on a standard velocity controlled load frame.

The Quasi Dynamic system represents the next step in this progression. With a control system that runs at 500Hz, the 'standard' velocity controlled load frame from GDS. The LF50, is capable of so much more than constant rates of displacement. The frame can accept linear and cyclic trajectories, and return high speed data accordingly, meaning that it can accurately run closed loop tests of load or displacement control up to 0.1Hz, with 100 datapoints per cycle with ease.

For full dynamic triaxial testing, a dynamic system capable of at least 2Hz is recommended. However for simply running cyclic reapeated loading tests significantly faster than what can be achieved with a static system, we feel that the Quasi Dynamic system fills a gap between traditional static and dynamic, for not much more cost over a static only system.

Typical System Performance
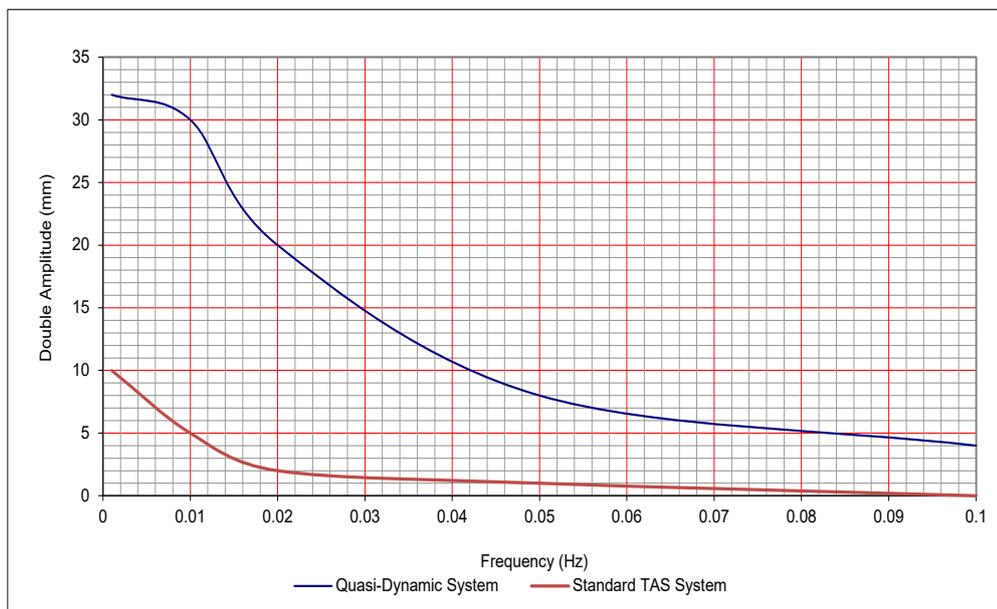
Frequency (Hz)	Quasi Dynamic System	Standard TAS System
	Amplitude (mm)	Amplitude (mm)
0.1	4	0
0.05	8	1
0.02	20	2
0.01	30	5
0.001	32	10

Upgrade Options:

Upgrade to Local Strain Measurement

A Quasi Dynamic System can 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.

LVDT transducers come in 2 versions:

• Low pressure (up to 3500 kPa) version for use in water.
• High pressure (up to 200 MPa) version for use in nonconducting oil.

Fig. 2 LVDT transducers as shown on sample.

Upgrade to Unsaturated Testing

A Quasi Dynamic System can be upgraded to perform unsaturated triaxial testing with the addition of the following items:

• Unsaturated pedestal with high air entry porous stone
• 1000cc Advanced Pressure/Volume Controller (for application of pore air pressure and measurement of air volume change).

For further information on unsaturated testing methods, please refer to the dedicated unsaturated datasheet on our website.

Fig. 3 Advanced pressure controller used in Unsaturated Testing

Upgrade to Bender Element Testing

A Quasi Dynamic System can 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 (GDSBEAT):

The subjectivity and lack of satisfactory standards for interpreting shear wave travel times across the industry from bender element test data, has led GDS to develop a bender elements 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.
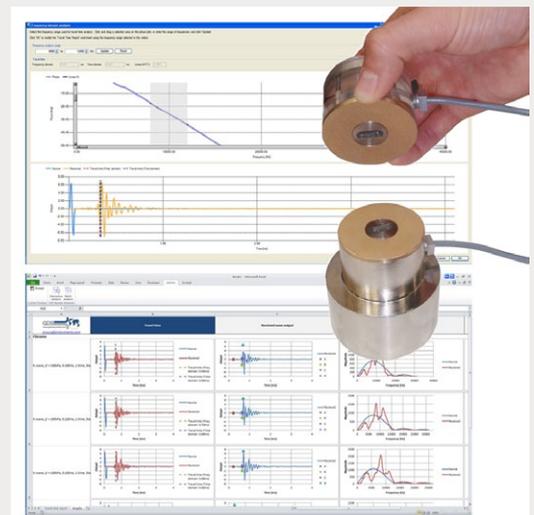

Fig. 4 Shows screenshots of the GDSBEAT software.

ELDCS Acquisition Pad Used for QDTAS

Overview: The ELDCS is our Enterprise level Analogue Acquisition and Control System designed for mid range dynamic testing and control. The ELDCS has been fully designed and developed by GDS' in-house engineering team and fits neatly as a lower cost version of the ADVDCS v2, with many of the same features that would be expected from a high level dynamic control system, but with a more economical price point.

The ELDCS provides 4 channels of ultra-high resolution 24-bit data and a single additional incremental quadrature input channel. The 4 channels of fixed-gain inputs can be customised at the factory to enable any transducer in the GDS range to be connected via the industry standard DIN connector. Multiple ELDCS boxes can be joined via the CAN connector to provide synchronised data acquisition and control.

A standard USB Interface provides direct PC connectivity and is fully supported by the GDSLab Test Software allowing seamless integration into new and existing test setups.

Technical Specification:

Connection to PC:	USB
Acquisition Channels:	4 Analogue + 1 Quadrature Decoder
Control Channels:	1 Analogue
Multi Box Capability:	x4
Max Number of Channels:	Up to 16 analogue + 4 quadrature channels with synchronised data acquisition
Sample Rate:	500Hz
Resolution:	24 bit, 16,777,216
Gain Ranges:	8 (preconfigured at factory)
Description:	Enterprise level solution for dynamic acquisition and control.
Voltage Resolution:	~ 0.000001 mVolts (1 nanovolt)
Voltage Input Type:	Fully Differential, Balanced Precision Inputs with Integrated Signal Conditioning
Transducer Excitation Voltage:	Differential, Fixed Precision +/-5V, Independent (not Ganged), Ratiometric Excitation
Number of Input Ranges:	Pre-Configured Single Fixed Gain per Channel. Each channel can be individually customised at the factory to meet application requirements from +/- 10mV to +/- 10V. Standard setup is 1 channel +/-10V, 2 channels +/- 200mV, 1 channel +/- 30mV.
Excitation Fault Tolerance:	Independent Per Channel, if any channel is shorted the other channels will continue to operate normally
Current Input Mode:	Yes - Via resistor fitted in cable termination (different ranges possible)
Differential Measurement Range:	-10mV…+10mV to -10V…+10V for balanced differential signals
Transducer Calibration:	Linear
Data Acquisition Options:	Digital filtering for noise reduction
Digital Control:	500 Hz 32-bit floating point control loop
Analogue Control:	Support for Analogue motor drives only
Compliance Estimation:	Set by user
Adaptive Control:	Cycle-by-Cycle Reference Adaptation
Custom Waveforms:	Repetitive custom waveforms with 256 points per cycle. Waveform streaming direct from file.
Sample Docking:	Manual
Display and Monitoring:	Data acquisition in GDSLab via USB interface, High resolution real time graphs
Software:	GDSLAB
System Characteristics:	40MHz 16-Bit Digital Signal Controller with Analogue Control Outputs
Minimum System Requirements:	OS: Windows 7 or later, CPU: 1.5 GHz or higher, Memory: 2 GB, USB 2.0

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.

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.
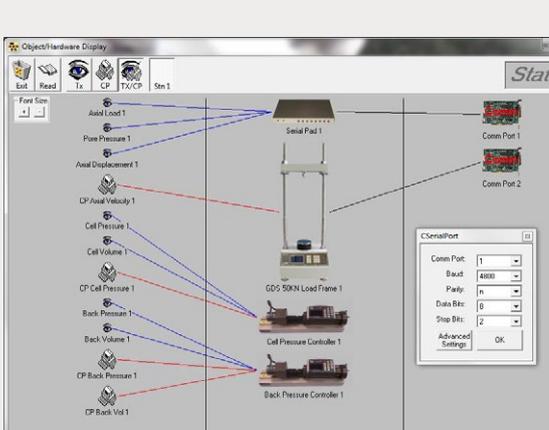
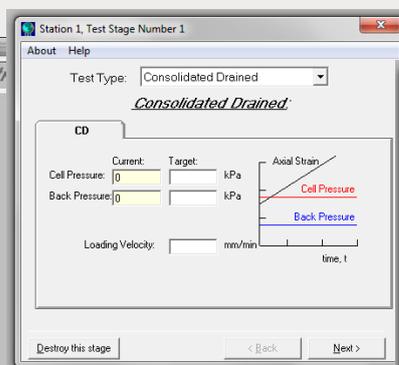Fig. 5 Shows a typical set-up screen in GDSLAB

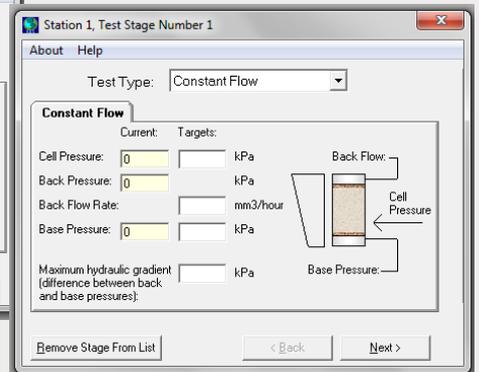Fig. 6 Shows a typical station test stage set-up in GDSLAB

Fig. 7 Shows a typical station test stage set-up in GDSLAB

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.

GDSLAB REPORTS Presentation Software

GDSLAB REPORTS software presents data obtained by GDSLAB to the National Standard, BS 1377:1990. The program can be used to present data whether obtained from a GDSLAB data file or inputted by hand.

GDSLAB Reports can as be used with other manufacturer's dataloggers as well as all versions of GDS data logger. The results can be exported as a CSV file into Microsoft Excel, allowing the user to customise the layout of results.
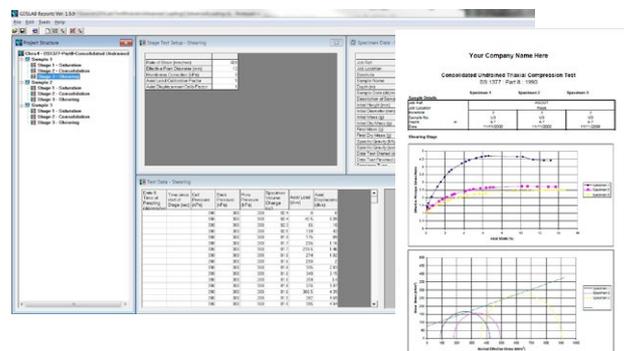
Fig. 8 show a selection of screenshots from the GDSLAB Reports software.

Why Buy GDS?

GDS have supplied equipment to over 86% of the world's top 50 Universities:

GDS have supplied equipment to over 86% of the world's top 50 Universities who specialise in Civil & Structural Engineering, according to the "QS World University Ranking 2020" report.

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

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".

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.