Virtual Infinite Stiffness Loading System (GDSVIS)

Overview: The GDS Virtual Infinite Stiffness loading system (GDSVIS) is the premier load frame in the GDS range. The VIS allows the axial loading system to operate as though it has infinite stiffness (zero system compliance). This type of frame is unique to GDS. The VIS functionality is achieved by calibration and correction of system compliance.

The GDSVIS is extremely stiff and designed principally for rock testing to allow minimum backlash at the point of sample shearing (other, less stiff load frames do not give analagous results at this critical point in the test due to the recovery of the load frame under fast unload conditions).

Key Features:	Benefits to the User:
Electro-mechanical actuators that give superior performance, reduce space and provide cost savings:	Electro-mechanical actuators can carry out tests with greater accuracies than comparable pneumatic actuators. Mains powered means no external noisy power packs and opposed to pneumatic systems electro-mechanical systems draw only the power that is required.
Load-deformation relationship:	The GDSVIS is calibrated to provide precise data on the load-deformation relationship of the entire load application and load measuring system, which is then automatically used for self compensation.
Built in feedback:	All VIS frames have feedback control and continuous display of axial load and platen displacement to allow simple and confident control of force and displacement.
Automatic correction:	VIS provides automatic correction for system compliance, a common cause of error, which can under-estimate results of sample stiffness.
Column strength:	The 500kN load frame has been built with 4 columns for extra strength and rigidity and can hold a cell size with a 700mm outer cell diameter.

Tests that can be Performed:

B-check, consolidated drained (CD) triaxial, consolidated undrained (CU) triaxial, consolidation (Triaxial), constant rate of loading (CRL), constant rate of strain (CRS), slow cyclic testing, K0 (K-Zero), multi-stage testing, quasi-static (low speed/ creep) tests, stress paths and unconsolidated undrained (UU) triaxial.

Typical Applications:

High Pressure / Load triaxial testing and unconfined testing.

Technical Specification:

Computer Interface:	USB
Dimensions:	Nominal Size: 2.3m x 1.0m x 0.96m
Displacement Accuracy:	0.05% of full range
Displacement Range (mm):	100
Load Range (kN):	100, 250, 400, 500
Power:	92-265 VAC, 48-62Hz, 650-2000W, single phase earthed supply
Resolution of measurement and control:	100kN = 3N, 250kN = 8N, 400kN = 12N, 500kN = 15N

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.

8 Channel Serial Pad

The standard GDS 8 channel data acquisition device, known as the "serial data pad", may be used within any of the system combinations. This 16 bit device has 8 computer controlled gain ranges, specifically designed to suit transducers used in a triaxial test. i.e.

+/-10mV, +/-20mV, +/-30mV (load cells)
+/-100mV, +/-200mV (pressure transducers)
+/- 1V, +/- 5V, +/- 10V (displacement transducers)

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 only, additional modules may be chosen for your testing requirements.

Note: Connection via USB interface to PC.

Pore Pressure (kPa)
Axial Strain (mm)
Load Cell (kN)

Load frame control

Cell pressure / volume

Back pressure / volume

Pressure Volume / Controllers

- Enterprise Pressure Volume Controllers (1MPa) (ELDPC).
- Standard Pressure Volume Controllers (3MPa) (STDDPC).
- Advanced Pressure Volume Controllers (2MPa) (ADVDPC).
- High Pressure Volume Controllers (≥ 16MPa) (HPDPC).

Load Frames & Triaxial Cells

- 100kN (10ton), 250kN (25ton), 400kN (40ton) and 500kN (50ton). Custom ranges available on request.

- Daylight clearance for 100kN test cell
- Max width = 500 mm
- Max height = 735 mm

- Daylight clearance for 250/400/500kN test cell
- Max width: 750 mm
- Max height: 1050 mm

Applications in the geotechnical laboratory

Through the control panel (stand alone) or through the computer interface, you can enter either targets or linear time ramps of load or platen displacement. These RAMP functions can also be used to cycle load or displacement in a low frequency triangular wave form. Of course, via the computer interface, any wave form is possible. All GDSVIS machines are fully compatible with GDSLAB control and data acquisition software. Conventional and advanced tests can be carried out including:

• Classic compression and extension
• Creep (constant axial total stress)
• Stress paths defined in terms of the stress invariants p and
• q, or s and t
• Cyclic stress paths
• Low frequency cyclic loading
(Please refer to the GDSLAB dedicated datasheet for more details on control software).

Fig. 2 shows a 250kN VIS

Load frames and dimensions

100kN
Height: 2.02m
Width: 0.76m
Depth: 0.50m
Daylight clearance for test cell
Max width = 500 mm
Max height = 735 mm

250kN
Height: 2.80m
Width: 1.08m
Depth: 0.67m
Daylight clearance for test cell
Max width: 750 mm
Max height: 1050 mm

400kN
Height: 2.88m
Width: 1.08m
Depth: 0.71m
Daylight clearance for test cell
Max width: 750 mm
Max height: 1050 mm

500kN
Height: 4.41m
Width: 1.44m
Depth: 1.20m
Daylight clearance for test cell
Max width: 750 mm
Max height: 1050 mm

How does VIS (Virtual Infinite Stiffness) work?

VIS is a unique GDS development. To the observer, and in terms of the test specimen, it allows the axial loading system to appear to have infinite stiffness.

For the entire loading range, both the measurement and control of platen displacement is automatically corrected so that it corresponds to the deformation that occurs between the platen and the load button of the load cell. In this way, the platen displacement is corrected for strain in the load cell and side columns, bending flexure of the cross beams, and distortion within the motorised mechanical transmission.

The GDSVIS is computer calibrated to provide precise data on the load-deformation relationship of the entire load application and load measuring system. These measurements are made with the adjustable upper cross beam in the maximum and minimum positions. For each position, measurements are made with the platen at each end of its travel. The calibration data is loaded into the read only memory (ROM) of the system which constantly monitors the axial load and ses the calibration to apply a correction to the platen displacement. Therefore, it appears to the observer (or controlling computer) that the measurement of platen displacement (resolved to 0.1 micrometre) is derived from a machine with infinite stiffness. In this way the system has the characteristic of Virtual Infinite Stiffness.

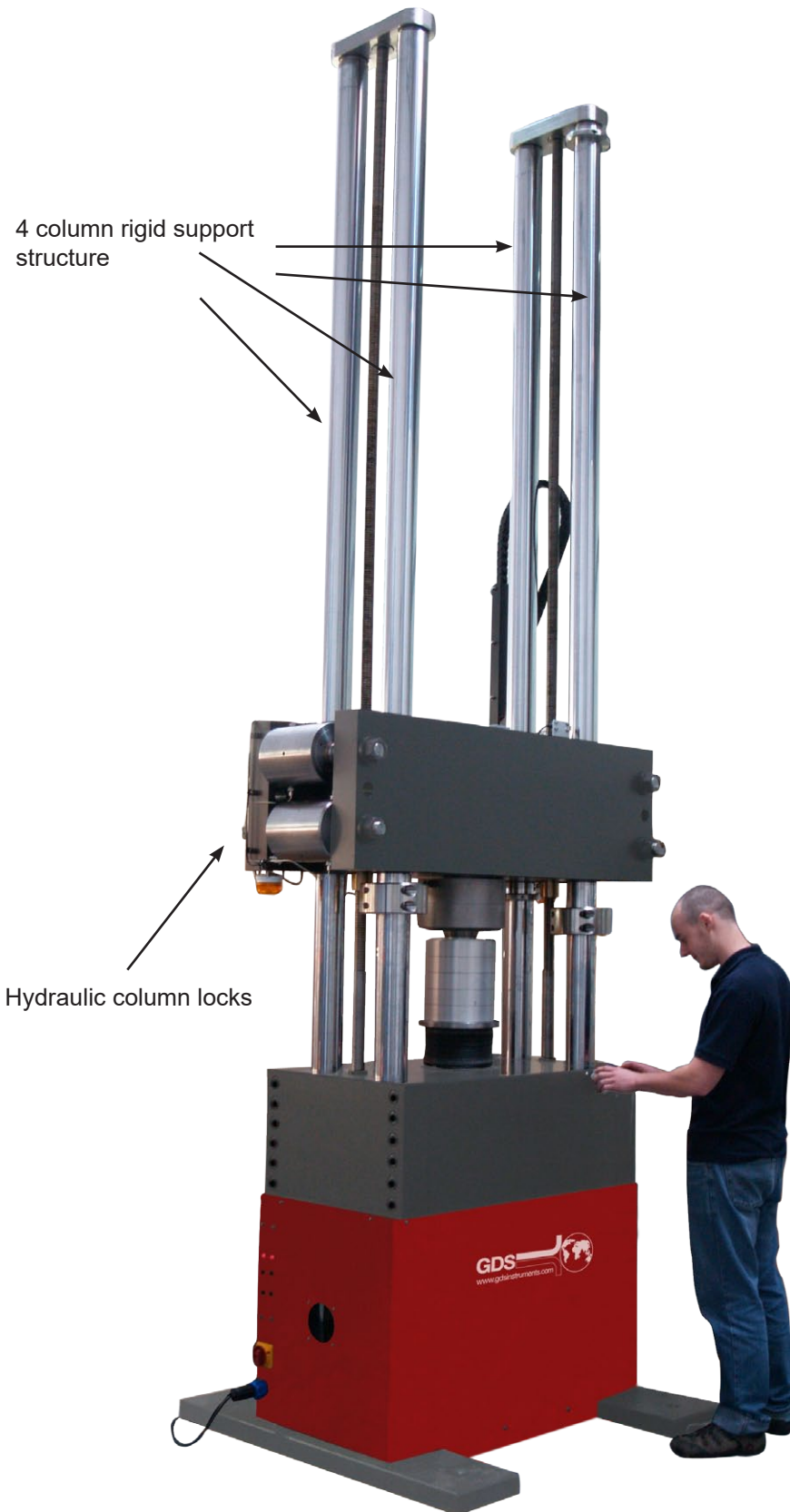4 column rigid support structure

Hydraulic column locks

Fig 3. 500kN VIS

High Pressure Testing

The premier load frame in the VIS range is the 500kN VIS, see Fig 3.

The load frame has been built with 4 columns for extra strength and rigidity and can hold a cell size with a 700mm outer cell diameter. Extra tall columns allow heavy cell tops to be raised from their boxes using the automatic cross beam raising and lowering mechanism, making sample preparation quick and easy for a single operator.

Hydraulic column locks replace the standard torque wrench's tightened locks, allowing the user to quickly exert clamping forces when adjusting the height of the frame.

The GDS 500kN VIS is just part of the high pressure testing equipment available from GDS. GDS have a range of triaxial cells, pressure controllers and software to create a fully automated testing solution.

GDS produce an extensive range of triaxial cells in order to satisfy the complex range of tests required by today's modern geotechnical laboratories. The traditional passive triaxial cells which fit the VIS load frame are available from 1- 100MPa and can be supplied with or without a balanced ram.

Pressure / Volume controllers used to regulate cell and back pressure are available from 1-150MPa.

GDSLAB is the control and acquisition software from GDS. The flexible software platform is based on a modular system whereby, product specific test modules are available to for your exact testing requirements.

Tests that can be Performed:

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, QuasiStatic (low speed/creep) Tests, Stress Paths and Unconsolidation Undrained (UU) Triaxial.

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.
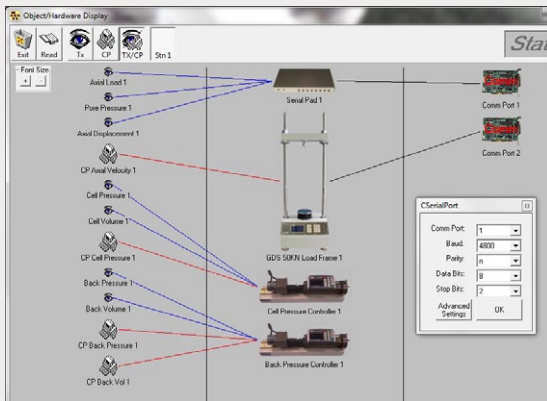

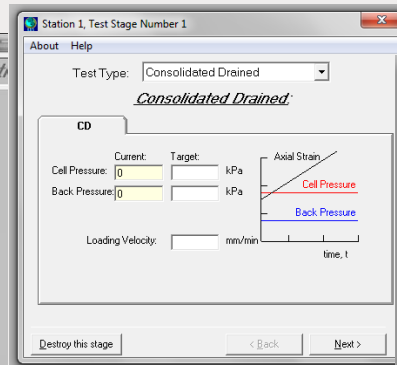Fig 4. Show a typical set-up screen in GDSLAB

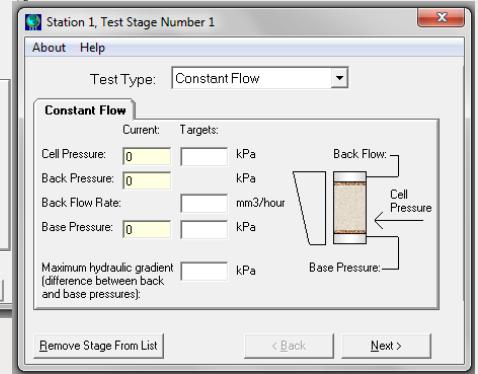Fig 5. Show a typical station test stage set-up in GDSLAB

Fig 6. Show 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.
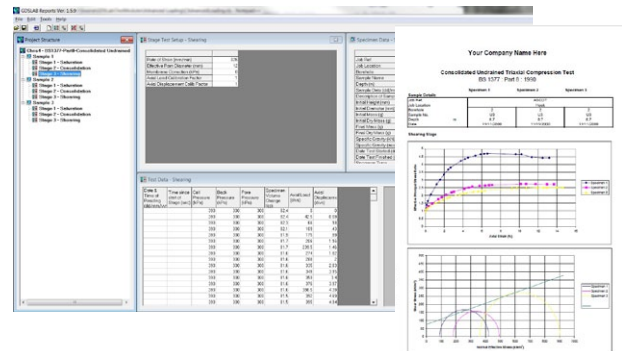

Fig 7. show a selection of screenshots from the GDLAB Reports software.