Saturated/Unsaturated Back Pressured Shearbox (GDSBPS)

Overview: The GDS Back Pressured Shearbox (GDSBPS) is used for direct shear testing on soil specimens with the unique feature that sample pore pressures can be fully controlled. Two versions of the GDS back pressured shearbox exist: saturated and unsaturated. Both versions allow the pore water pressures within the sample to be controlled - the unsaturated version with the enhanced ability to also control pore air pressure and therefore the matric suction in the soil. Based on the axis-translation principle, the matric suction can be controlled over a range far greater than the cavitation limit for water under negative pressure. The control of pore pressures during direct shear testing allows real-world situations to be modelled in the laboratory. This device is ideal to recreate landslide conditions in soils and to test pre-existing failure planes in rock samples.

Key Features:	Benefits to the User:
Rigid aluminium cell body:	To minimise system compliance.
Shear gap manually adjustable from outside the pressure vessel whilst under pressure:	A design unique to GDS, allows the customer to adjust the shear gap whilst under pressure for minimum sample disturbance following pre-loading conditions.
Internal submersible loadcell for shear force:	Submersible loadcell for shear force ensures load measurements are made as close to the sample as possible for greater accuracy, whilst also removing the requirement for any ram friction corrections.
Unsaturated Testing:	The unsaturated GDSBPS is based on a standard, saturated device but modified to allow the measurement and control of pore water and pore air pressures, and hence the matric suction (the difference between the pore air and water pressures).
Both systems run using GDSLAB control and data acquisition software:	Both standard and advanced direct shear tests easily defined by the user with the user friendly GDSLAB software. Advanced tests such as constant normal stiffness, are easy to set up and are fully automated.
Real-world situation to be modelled in the laboratory:	Both versions allow the pore pressures within the sample to be controlled. The control of the pore pressure during direct shear testing allows real-world situations to be modelled in the laboratory.
Optional low-cost version:	Low-cost version available which uses hanging weights for axial load instead of feedback controlled actuator.

Tests that can be Performed:

Direct shear tests with full control of pore water pressure and pore air pressure (pore air pressure in the unsaturated version only). Quasi static cyclic loading of samples under either load or strain control, multi-stage testing, consolidation, quasi-static (low speed/creep), ramp and cycle pore pressures or volumes, saturation ramp, back pressure cyclic direct shear displacement tests, back pressure cyclic direct shear load tests, geo-membrane shear test, constant normal stiffness, stress dependant soil water characterstic curve determination (SDSWCC).

Upgrade Options:

Bender Elements, 100kN axial 100kN shear rock testing version.

Technical Specification:

Maximum Axial Load:	25kN
Maximum Shear Load:	10kN
Maximum Pressure:	1MPa
Displacement Accuracy:	<0.1% FSO
Displacement Resolution:	Axial = +/- 15mm, Shear = +/- 25mm
Dimensions (mm):	L= 875mm x W = 350mm
Power:	240V or 110V 50/60Hz single phase
Resolution of Measurement and Control:	16 bit: ± 25mm = ± 0.7µm(shear), ±10mm = ±0.3µm (axial)
Sample Sizes:	75mm x 75mm square, 100x100 square, 60mm diameter circular

System Overview

The standard GDSBPS apparatus uses a 75mm x 75mm square test specimen, although alternative sizes are available on request. The sample is placed into the shearbox sample chamber, as is usual for a shearbox. The chamber is then placed into the pressure vessel and connected to the shear actuator and internal submersible shear loadcell (see Fig. 1 below). The top of the pressure vessel is replaced and the back pressures can be applied. A GDS pressure controller is used to apply the water back pressure through a high air entry porous stone (unsaturated version) or a normal porous disk in the saturated system in the base of the shear box. This controller also records measurement of pore water volume change. A GDS pneumatic controller is used to apply pore air pressure for unsaturated version. Sample volume is measured directly from the shear travel and sample height (due to the fact that direct shear samples are constrained, sample volume measurement is relatively simple). Consolidation is carried out using either the manual weight hanger or the optional feedback controlled actuator. Once the specimen is consolidated and the required degree of saturation is achieved, the shearing stage can begin. All of the system and tests are controlled by GDSLAB software. Compared to the triaxial test, the direct shear test is simpler to perform and requires shorter test durations due to the smaller drainage paths, which is particularly useful in the case of unsaturated testing where test lengths are typically quite long.

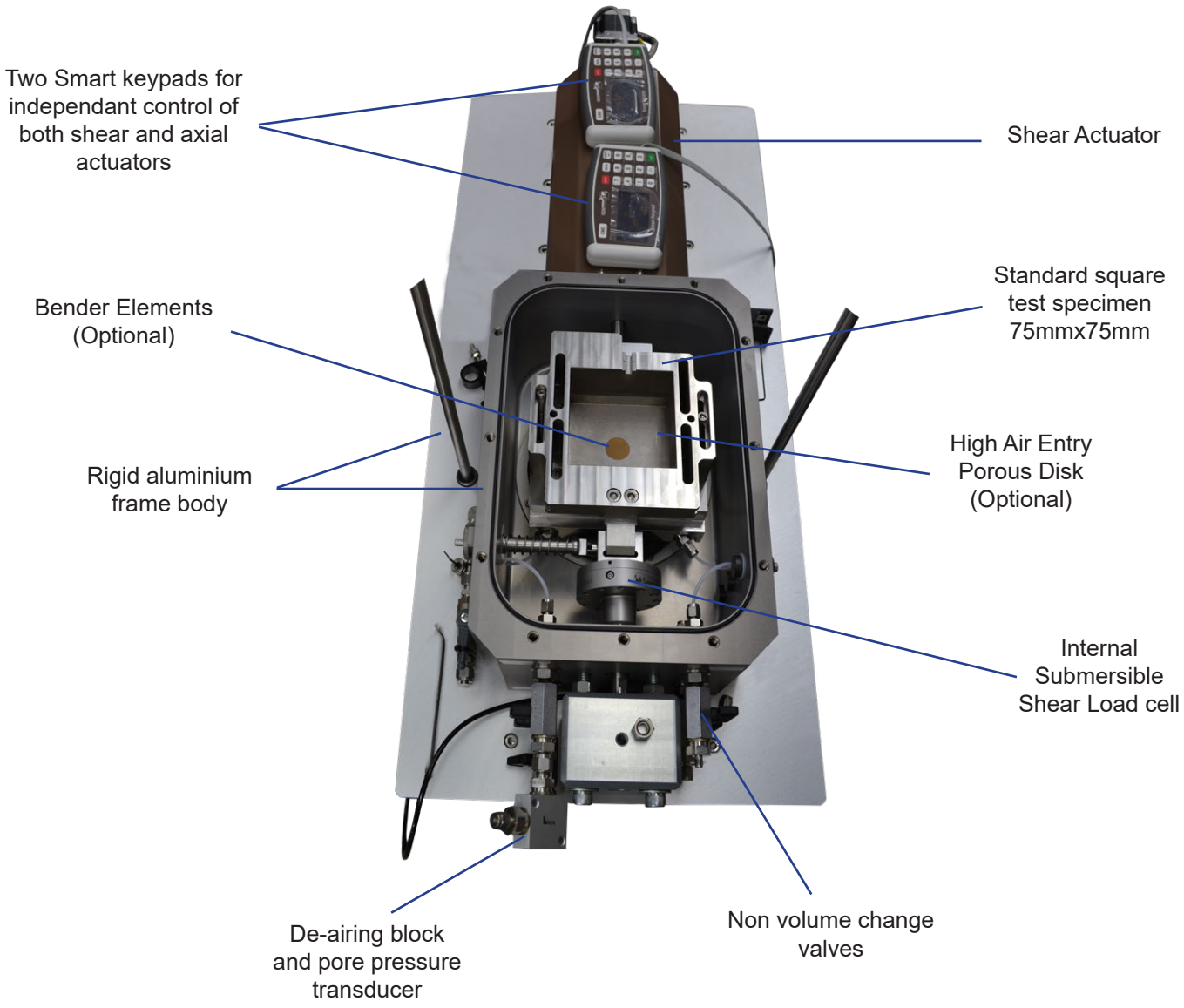

Fig. 1

High-air-entry Porous Disk

When testing unsaturated soils it is necessary to separate the pore-air and the pore-water so that differential pressures (known as matric suctions) can be maintained. This separation is achieved by the use of high-air-entry porous discs (HAEPD).

When a HAEPD is properly saturated it has the ability to maintain an air pressure on one side higher than the water pressure on the other side, without the air passing through the material. The maximum difference that can be held between these pressures is known as the 'air-entry value'. In a GDS system, the HAEPD is bonded into the base pedestal. Figure 2 shows the inside of an unsaturated shearbox with the high-air entry porous stone in the base.

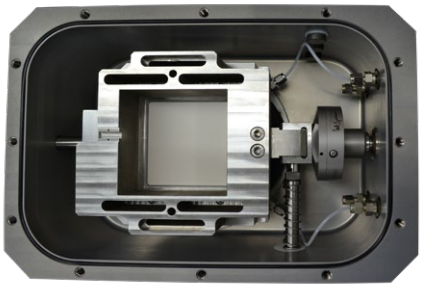

Fig. 2 HAEPD bonded inside the pedestal of the unsaturated shearbox.

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:

- Direct shear (with or without back pressure)
- Simple shear (static and dynamic)
- 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

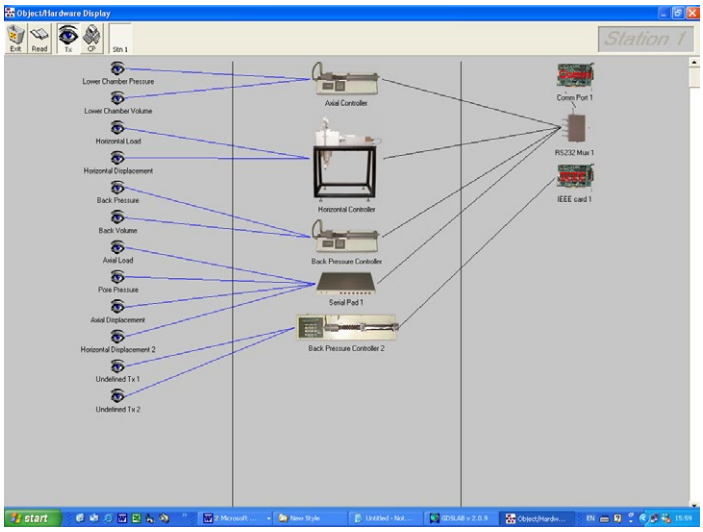

Fig. 3 GDSLAB object display showing a GDSBPS

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' (see Fig. 3). This makes setting up the devices and checking the connectivity extremely simple.

Upgrade Options

The GDSBPS apparatus can be specified with many different options, some are listed below but many more are available. Please contact GDS if the required specification is not listed here or if higher pressures / forces are required.

- **Maximum back pressure:**
  - 1MPa basic
  - Option to 10MPa (see rock mechanics high pressure BPS)
- **Maximum axial and shear load:**
  - 25kN axial, 10kN shear
  - Options to 100kN axial and 100kN shear (see rock mechanics high pressure BPS)
- **Bender elements**

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.