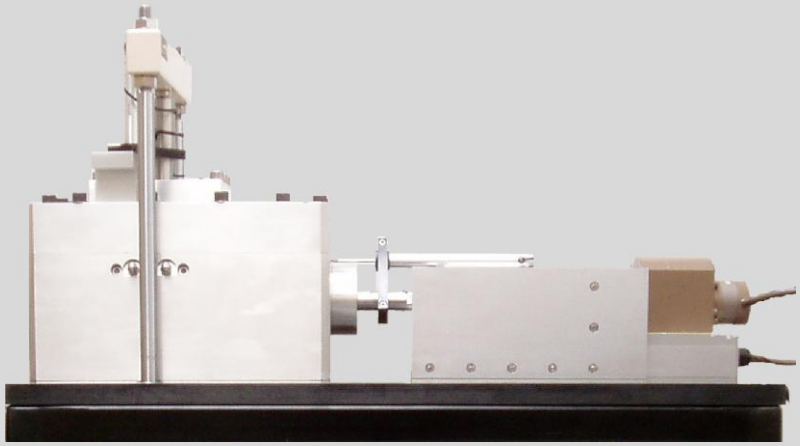
Saturated BPS features:

Fully supported by GDSLAB	✓
Optional bender elements	✓
1MPa back pressure (water)	✓
5kN shear load	✓
Internal submersible shear and axial loadcells	✓
Maximum pressures and loads may be custom specified	✓
Optional: 5kN axial load	

Unsaturated BPS features:

1MPa pore air pressure	✓
Optional high air entry porous disk in base pedestal. Standard ranges:	
300, 500 or 1500kPa	✓

Saturated/Unsaturated Back Pressured Shearbox (GDSBPS)



What is it?

The saturated GDS Back Pressured Shearbox (GDSBPS) is used for direct shear testing on soil specimens with control of sample pore pressures. Two versions of the GDS back pressured shearbox exist (Saturated and Unsaturated). Both versions allow the pore pressures within the sample to be controlled. The control of pore pressure during direct shear testing allows real-world situations to be modelled in the laboratory. GDS back pressure shearboxes have been used in the past to recreate landslide conditions in soils and to test pre-existing failure plains in rock samples.

The unsaturated GDSBPS is based on a standard, saturated device but modified to allow the measurement and control of matric suction (the difference between the pore air and water pressures). Matric suction is applied to the soil specimen by maintaining air pressure in the test chamber and a water pressure below the high-air-entry porous disks in the base pedestal. The measurement and control of matric suction during shearing is critical for simulating the behavior of partially saturated soils. As such the GDSBPS provides a realistic model of many real-world geotechnical problems, such as slope stability in semi-saturated conditions.

Both systems run using GDSLAB control and data acquisition software. This allows standard direct shear tests to be carried out as well as advanced unsaturated tests. Computer control parameters of the software include:

- Shear force and displacement
- Effective stress control
- Total stress control
- Pore air (for unsaturated systems) and pore water pressures
- Axial (normal) force and displacement (with optional axial actuator)

Features of the Shearboxes

- Low-cost version uses hanging weights for axial load
- Internal loadcells for shear and normal force
- Closed-loop control of shear force/displacement and normal force/displacement (if axial actuator upgrade is ordered)
- Shear gap manually adjustable from outside the pressure vessel whilst under pressure
- Rigid aluminium cell body to reduce system compliance
- Optional bender elements

Technical specification

- **Overall dimensions:** L= 875mm x W = 350mm
- **Standard specimen size =** 75mm x 75mm (alternative sizes available on request)
- **Displacement range:** axial = +/- 15mm, shear = +/- 25mm
- **Displacement accuracy =** <0.1% FSO
- **Displacement resolution of measurement =** 16 bit with optional external transducers (± 25mm = ± 0.7µm(shear), ±10mm = ±0.3µm (axial))
- **Force accuracy =** <0.1% of load cell range on both axial and shear (i.e. 5N for 5kN load cell, 10N for 10kN load cell)
- **Force resolution (control) =** 1.25N for 5kN load cell
- **Force resolution (measurement) =** 0.5N for 5kN load cell
- **Data acquisition =** 8 channel, 16 bit with, serial interface and 8 user definable gain ranges from 10mV to 10V input.
- **Control modules =** closed-loop control feedback system integrated with each independent actuator control unit (shear and axial).
- **Electrical specification =** 240V or 110V 50/60Hz single phase

System overview

The standard GDSBPS apparatus uses a standard 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 the shear loadcell (see Fig. 1). The top of the pressure vessel is closed 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. 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.

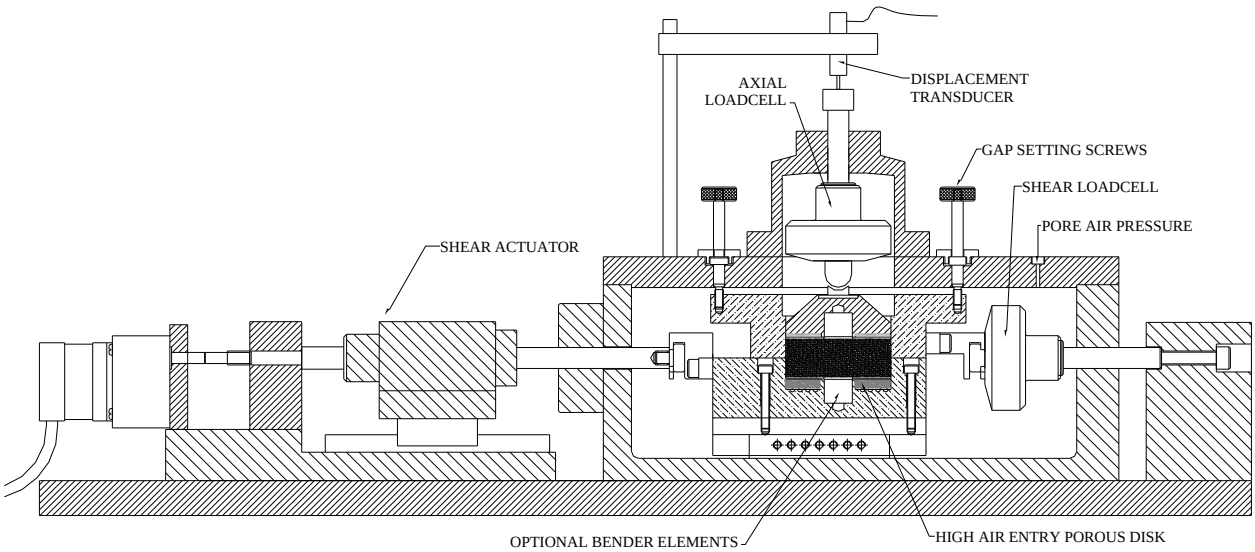


Fig. 1 Schematic of the GDS Back Pressured Shearbox (BPS) with full unsaturated options

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

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. 2). This makes setting up the devices and checking the connectivity extremely simple.

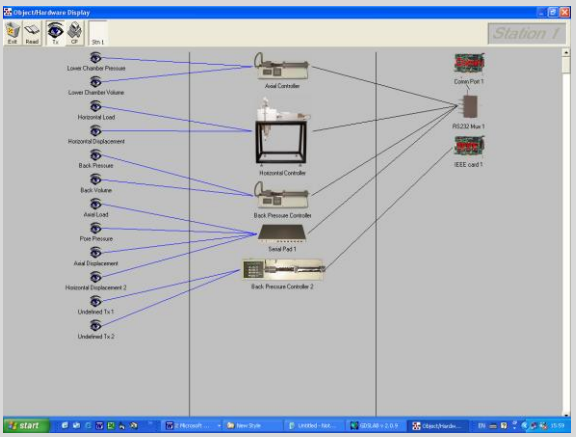


Fig. 2 GDSLAB object display showing a GDS BPS

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

Further 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 as part of standard range
- **Maximum axial and shear load:**
  - 5kN basic
  - options to 100kN as part of standard range
- **Normal (axial) load upgrade to electro mechanical actuator**
- **Bender elements**

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 (see Fig. 3). Other 'special' pedestals are available such as a HAEPD bonded into a bender element pedestal (see Fig. 4).

Fig. 3 HAEPD bonded into a standard triaxial pedestal

Fig. 4 HAEPD bonded into a bender element triaxial pedestal

Other shearing systems available from GDS include:

- **Electromechanical Dynamic Cyclic Simple Shear (EMDCSS)**
- **Standard Simple Shear (STDSS)**
- **Advanced Dynamic Cyclic Simple Shear (ADVDCSS)**
- **Automated Direct Shear System (GDSADS)**

Other unsaturated systems available from GDS Instruments include:

- unsaturated consolidation testing system
- HKUST volume change measurement system
- all GDS triaxial systems can be supplied in unsaturated versions

Why buy GDSBPS?

- Developed in conjunction with the University of Durham, UK (saturated version) and Zhejiang University, China (unsaturated version).
- The GDSBPS is unique to GDS.
- The system can be supplied as a complete, ready-to-test system.
- The GDSBPS is fully integrated into and supported by GDSLAB.
- GDS can customise most products to match the required specification
- Flexible data output which can be imported directly into Microsoft® Excel.
- Each system produced by GDS is tested as a complete system before dispatch to ensure the system is complete and fully functional.
- GDS is an ISO9001:2000 accredited company.

Due to continued development specifications may change without notice