Available specimen sizes (dxh)

- **50mm x 100mm** ✓
- **70mm x 140mm** ✓
- **Custom** ✓

***Power amplifier*:**

- **Current driven** ✓

Available tests:

- **Torsion** ✓
- **Flexure** ✓
- **Damping** ✓

Optional tests:

- ***Torsional shear*** ✓

Upgrade to Unsaturated Testing:

- ***Method A*** ✓
- ***Method B*** ✓

Resonant Column Apparatus (RCA)

What is it?

The GDS Resonant Column Apparatus (RCA) is used to excite one end of a confined solid or hollow cylindrical soil specimen. The specimen is excited in torsion or flexure (bending) by means of an electromagnetic drive system. Once the fundamental resonant frequency is established from measuring the motion of the free end, the velocity of the propagating wave and the degree of material damping are derived. The shear modulus (torsion) or Young's modulus (flexure) is then obtained from the derived velocity and the density of the sample.

Features

GDS RCA software (see Fig. 1) is used for control and data acquisition of the RCA apparatus. The software allows testing to occur via a simple, user-friendly interface. The tests that may be performed using the GDS RCA software are as follows:

- *Resonance in torsion.*
- *Resonance in flexure.*
- *Damping Ratio in torsion.*
- *Damping Ratio in flexure.*
- *Slow speed (<2Hz) torsional shear.*

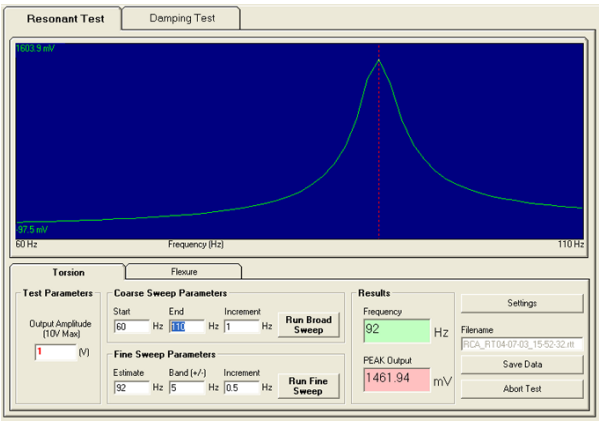

Fig. 1 GDS RCA software resonance test data

Technical Specifications

- Standard cell capable of 1MPa gaseous cell pressure (other cells available up to 25MPa)
- Electromagnetic drive system incorporating precision wound coils and composite sintered neodymium iron boron (NdReB) "rare-earth" magnets
- Transconductance current driven amplifier
- Inner cell for silicon oil (to aid membrane sealing)
- Energisation mode of coils is switchable by software to provide torsional and bending (longitudinal) tests
- Internal LVDT for measurement of sample deformation
- Internally mounted, counter-balanced accelerometer
- 1 off transconductance current driven drive amplifier
- 1 off high-speed 16-bit data acquisition/control card with associated GDS RCA control box/interface panel
- 3 off calibration weights and calibration bars provided of differing stiffness to enable calibration of system Io value
- 1 off computer controlled proportional gas valve to control cell pressure from software
- Back pressure by GDS Standard pressure/volume controller (STDDPC)
- Options for environmental temperature chamber (-20 degs C to +40 degs C) and an axial loading actuator and frame
- Standard specimen sizes: 50mm x 100mm and 70mm x 140mm (diameter x height) - other sizes available on request

Damping by free vibration

When performing damping ratio tests (see Fig. 2), the apparatus is designed to minimise the influence of equipment damping. During free vibration decay (after the power is normally shut off at resonance) 'back' EMF is usually generated in the coils by the movement of the magnets. This causes large equipment damping errors. In the GDS resonant column the software switches the hardware to provide an 'open circuit' through the coils during free vibration decay, which prevents 'back' EMF generation.

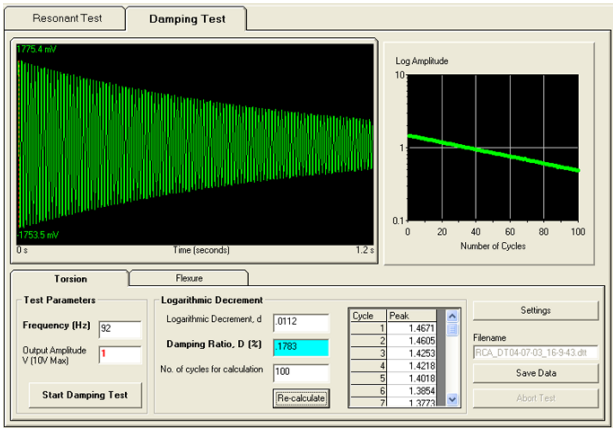

Fig.2 GDS RCA software damping test data

A software video CD is available which demonstrates the use of the GDS RCA software. This CD as with other GDS software and hardware demonstration CDs are available by request on-line at www.gdsinstruments.com

Torsional / flexural vibrations

During torsional tests, four pairs of coils are connected in series so that a net torque is applied to the sample. To apply flexural vibrations, the coils are switched (automatically) so that only two magnets are used applying a horizontal force to the specimen hence inducing flexural excitation. This allows the same coil and magnet arrangement to be used in both flexural and torsional vibration (see Fig. 3).

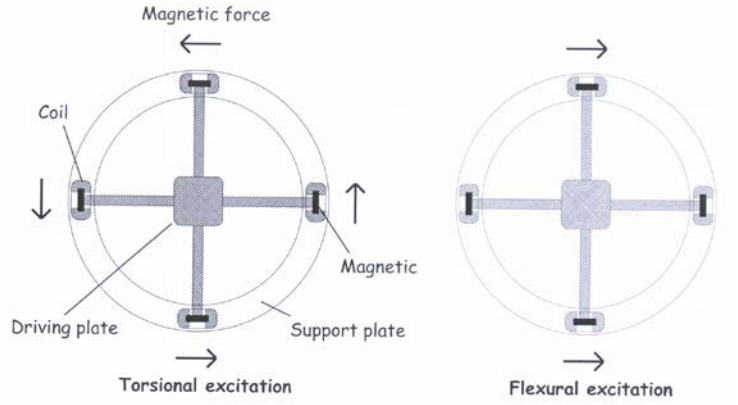

Fig. 3 Drive schematic for torsional and flexural excitation

Upgrade Options

The Lifting Frame: allows a user to safely remove the triaxial cell top by using a cable and pulley system. The option is very useful if you are working on the apparatus alone. The frame has a fitting for the handle to clip under, to allow the cell to be kept elevated whilst you work on the apparatus.

The frame does not attach to the resonant column, so it can be easily moved to another piece of apparatus or stored away until it is needed.

Bender Elements: A Resonant Column 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).

Fig 4. Shows a lifting frame for the resonant column

Upgrade to Unsaturated Testing

The GDSRCA system may be upgraded to perform unsaturated triaxial testing by one of the following options:

- **Method A:** Adding a 1000cc Advanced Pressure/Volume Controller (for application of pore air pressure and measurement of air volume change), see fig 5.
- **Method B:** Optional HKUST double cell (for more information on this please see the data sheet 'Unsaturated Triaxial Testing of Soil (UNSAT).

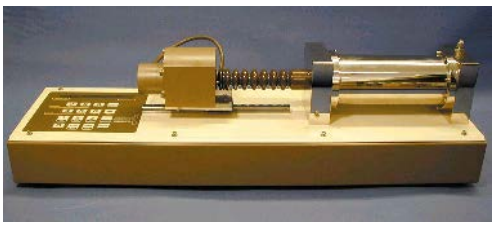

Fig 5. 1000cc Advanced Pressure/Volume Controller (ADVDPC)

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

State-of-the-art current-driven amplifier

RCA systems that GDS supplies are current driven using a transconductance power amplifier. This is due to the fact that the impedance of the RCA system changes with frequency. At higher frequencies, using a constant voltage, the current will be seen to reduce. As the torque is directly proportional to current, the torque will also reduce. This change to using a current driven power amplifier reflects the current thinking in the state-of-the-art resonant column testing throughout the world.

Calibration equipment

To derive Io and Iy experimentally, a test is performed on a calibration bar to compute its resonant frequency in torsion and flexure respectively. This is achieved by calibrating the apparatus by substituting metal calibration bars in place of the specimen whose mechanical properties are known.

The GDS RCA provides 3 calibration weights and 3 calibration bars of differing stiffness in order for Io and Iy to be calibrated by the end user (see Fig. 6).

Fig. 6 Calibration bars and weights

Why buy a GDS RCA?

- Designed to provide maximum rigidity, providing minimum losses and a more consistent Io v frequency.
- Minimum equipment damping by shutting off coils to reduce 'back EMF' during damping tests.
- Flexural tests equally as simple as Torsional tests.
- Upgrade to torsional shear tests available.
- Complete turn-key system i.e. 'works out the box'.
- Latest RCA developments as standard (i.e. current driven amplifier).
- Easy to use software which gives the use 'hands-on' appreciation of how the RCA test.
- Technical support from GDS staff familiar with RCA testing.