

Shotcrete Stress Cell

VIBRATING WIRE STRESS MONITOR

FEATURES

- Low volumetric displacement
- Re-pressurising (pinch) tube for re-inflation in shotcrete
- Sensor with unique integral magnet design
- Accurate, highly sensitive and reliable
- Extremely stable for long term operations
- Frequency output for transmission over long distances
- Suitable for remote reading, scanning & data logging
- Robust and sturdy construction

APPLICATIONS

ES&S shotcrete stress cells are designed to measure radial and tangential stresses in shotcrete linings in tunnels. The measurement of radial and tangential stresses in shotcrete is very critical from the point of view of evaluation of the performance of the shotcrete linings in tunnel. The shotcrete stress cell serves as an important tool to determine the optimum thickness of the shotcrete lining. This measurement along with the measurement of convergence of the tunnel by tape extensometer and borehole extensometer has become an indispensable and integral part of the New Austrian Tunnelling Method (NATM).



Monitoring underground structures and their linings provides key information to engineers about how the structure is performing in its surroundings. Engineers can then use this feedback to redesign, improve future designs, reinforce or implement innovative methods to relieve stresses on a structure.

TECHNICAL SPECIFICATIONS

Standard Ranges	10, 20, 35, 50, 100, 200 kg/cm ² (higher ranges on request)	
Over Range	1.5 x Range	
Sensitivity	0.01% of Full Scale	
Accuracy	1% Full Scale (Optionally 0.5% or better)	
Thermal Zero Shift	±0.1% Full Scale/°C	
Material	Stainless Steel	
Operating Temperature	-20°C to 70°C	
Coil Resistance	120-140 ohm nominal	
Thermistor 3k ohm	Included	
Electrical Surge Protection	Optional	
Pressure Capsule	10 & 20 kg/cm ²	100 x 200 mm
	35 & 50 kg/cm ²	150 x 250 mm
	100 & 200 kg/cm ²	200 x 300 mm
Connecting Tubes	6 mm Ø	
Pressure Transducer	20 mm Ø	
Re-Pressurising Tube	6 mm Ø	
Electrical	4-conductor, shielded	
Wiring Code	V/W sensor	Red & Black
	Thermistor	White & Green

OPERATING PRINCIPLE

Any change in the pressure on the cell has to be balanced by a corresponding change in the pressure of the internal fluid. The latter is communicated to the pressure transducer and changes the tension of the vibrating wire. The wire is plucked by energising the miniature coil magnet so that it vibrates as its natural resonant frequency. The resonant frequency is proportional to the square root of the tension of the wire. A conventional readout unit can accurately measure the frequency of the wire. A microprocessor based readout unit can display the frequency as well as the value of the measured pressure directly in engineering units. Alternatively, data loggers can be used to record data, in engineering units, automatically at predetermined intervals. By the use of appropriate software, the data logger can present recorded data in desired formats, predict trends of variations and even generate alarms at pre-determined set points. A thermistor mounted in the transducer enable simultaneous measurement of temperature changes. Transducers with lightning protection are available on request.

Vibrating wire Shotcrete Stress Cell incorporates a vibrating wire sensor which has a unique integrated magnet design. A miniature magnet coil assembly is located inside the small stainless enclosure of the sensor at a very close proximity to the vibrating wire.

Shotcrete stress cells consist of two rectangular steel plates welded together around their periphery. A small length of high pressure stainless steel tubing connects the cavity to a pressure transducer. The high rigidity of the cell ensures that it responds immediately and accurately to increasing concrete stress. Shotcrete stress cells are installed in concrete or shotcrete that is characterised by an increase in temperature as it cures. The cell expands when the temperature rises and it contracts when it cools back, leaving a gap between it and the surrounding concrete. The gap will prevent the concrete or shotcrete stresses to reach the cell. To prevent this, a special set of pliers is used to pinch a fluid filled re-pressurising tube connected to the cell.

The cell is connected to a pressure transducer, this transducer consists of a rigid cylindrical housing containing a vibrating wire sensor. The VW sensor comprises of a small stainless steel enclosure having a high tensile strength, heat treated and tempered steel wire. The wire is anchored at one end to the enclosure and to a small diaphragm at the other. A miniature magnet coiled assembly is precisely located at the centre of the wire inside the same enclosure. This greatly enhances the response characteristics of the vibrating wire. The vibrating wire sensor is self-compensated against temperature variations. The 'O' ring seal provides complete waterproofing and a high degree of protection from humid and corrosive environment conditions. The vibrating wire sensor is completely isolated from the total stresses acting on the body of the transducer.