DISTRIBUTED FIBER OPTIC SENSORS

GEOKON®

MODEL DFOS



Various monolithic core, Distributed Fiber Optic Sensors

APPLICATIONS

Distributed Fiber Optic Sensors are designed to measure strain, temperature, displacement or vibration in or on:

- Dams
- Excavations
- Embankments
- Piles
- Tunnels
- Bridges
- Roadways
- Railways
- Other Geotechnical and Civil Applications

OPERATING PRINCIPLE

Distributed Fiber Optic Sensors (DFOS) provide distributed measurements over the entire length of the sensor. This enables highly detailed monitoring of the entire length of a structure. These lightweight instruments are easy to install and provide precise measurements of strain or deformation of the structure being monitored. Measurements of dynamic events are possible with DFOS gauges and the requisite optical interrogator.

DFOS sensors can be directly embedded in, or attached to, the structure being monitored.

ADVANTAGES AND LIMITATIONS

The key feature of DFOS technology is the ability to make distributed measurements, i.e., continuous measurements over the entire length of the sensor. The DFOS fiber is integrated with a composite, monolithic core. Typically, DFOS sensors are manufactured with at least two sensing fibers for redundancy and increased accuracy. This also makes it possible to create an optical loop at the end of the sensor, or to connect fibers to various interrogators in order to read different physical quantities simultaneously.

The sensors are resistant to environmental conditions including corrosion, electromagnetic fields and lightning strikes.

SYSTEM COMPONENTS

The entire DFOS system consists of the optical interrogator and the sensors. While the interrogator can be easily replaced, the sensors interact with the monitored structure throughout its lifetime.

The system can be designed based on the DFOS type, interrogator to be used, installation method, and/or data processing to measure.

To obtain high-quality data, appropriate design of the system is needed, including the interrogator and the sensors' technical parameters, requisite installation methods, thermal compensation, and data post-processing algorithms.

TECHNICAL SPECIFICATIONS					
	DFOS Sensor	DFOS Rebar	DFOS Flat	DFOS Graph	DFOS 3D
Measurement Type	Strain	Strain	Strain	Strain	Displacement
Resolution	1με	1με	1με	1με	1 mm ¹
Range	±4% (Compression & Tension)	±2% (Compression & Tension)	±4% (Compression & Tension)	±4% (Compression & Tension)	Dependent on multiple factors. An individual analysis is recommended in each case.
Elastic Modulus	3 GPa	50 GPa	3 GPa	3 GPa	2-3 GPa
Tensile Strength ²	N/A	fu >1100 MPa	N/A	N/A	N/A
Sensor Dimensions ³	Ø2 mm, Ø3 mm, Ø5 mm	Ø5 mm	6.5 × 2.5 mm	Ø2 mm, Ø3 mm, Ø5 mm	20 × 35 mm
Bending Radius	Ø2 mm (non-braided): 40 mm Ø3 mm (braided): 100 mm Ø5 mm (braided): 200 mm	400 mm	150 mm (perpendicular to the longer edge)	Ø2 mm (non-braided): 4 kg/km Ø3 mm (braided): 13 kg/km Ø5 mm (braided): 30 kg/km	450 mm
Sensor Mass	Ø2 mm (non-braided): 4 kg/km Ø3 mm (braided): 13 kg/km Ø5 mm (braided): 30 kg/km	45 kg/km	30 kg/km	Ø2 mm (non-braided): 4 kg/km Ø3 mm (braided): 13 kg/km Ø5 mm (braided): 30 kg/km	205 kg/km
Outer Braid	Bidirectional braid (Ø5, Ø3 mm) Non-braided (Ø3, Ø2 mm)	Unidirectional	Non-braided	Unidirectional braid (Ø5, Ø3 mm) Non-braided (Ø3, Ø2 mm)	Non-braided
Operating Temperature ⁴	-20 °C to +80 °C	–20 °C to +100 °C	-20 °C to +80 °C	-20 °C to +80 °C	-20 °C to +80 °C
Core Material	PLFRP (polyester fibers + epoxide)	GFRP (glass fiber + epoxide)	PLFRP (polyester fibers + epoxide)	PLFRP+G (polyester fibers + epoxide + graphite)	PVC
Scattering Compatibility	Rayleigh, Brillouin, Raman	Rayleigh, Brillouin, Raman	Rayleigh, Brillouin, Raman	Rayleigh, Brillouin, Raman	Rayleigh, Brillouin, Raman
Number of Sensing Fibers⁵	2	2	2	2	4
Type of the Fiber ⁶	Single-Mode SMF 9/125	Single-Mode SMF 9/125	Single-Mode SMF 9/125	Single-Mode SM / Multimode MM	Single-Mode SMF 9/125
Attenuation ⁷	<0.3 dB/km	<0.3 dB/km	<0.3 dB/km	<0.3 dB/km	<0.3 dB/km
Sensor Length ⁸	Up to 2 km	Up to 1 km	Up to 2 km	Up to 2 km	Up to 500 m

¹Typical in sections shorter than 50 m | ²According to ISO 10406-1 for rods with diameters up to 12 mm | ³Other dimensions available on request | ⁴Extended temperature range available on request | ⁵More fibers available on request ⁶Other fibers available on request | ⁴At 1550 nm wavelength | ⁸Sensors can be connected in series

DFOS COMPONENTS AND DIMENSIONS





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