FIBER OPTIC STRAIN AND DISPLACEMENT SENSORS FOR ROAD PAVEMENT MONITORING

opSens

Innovation. Precision. Solutions.

FIBER OPTIC STRAIN AND DISPLACEMENT SENSORS FOR ROAD PAVEMENT MONITORING

Measurement of strains and deflections in pavement structures is essential for the development and the validation of mechanistic pavement response models. It is also required to support pavement design and analysis methods.

Designed to perform in harsh environments, Opsens' fiber optic solution is ideal to monitor pavement structure performance. It combines Opsens' ProSens signal conditioner, fiber optic deflectometer and strain sensors designed for accurate measurement of pavement response under a moving load and provide reliable data to Engineers in charge of improving structure lifetime. Fiber optic sensors assemblies are perfectly suited for road structure monitoring and are well adapted for measurements of horizontal strains and vertical deflection in existing pavements.

BENEFITS & ADDED VALUE

Opsens' fiber optic sensors are attractive for many reasons. Sensors assemblies are compact and easy to install . They are well adapted for measurements of horizontal strains and vertical deflection in new or existing pavements.

Their capabilities to operate in harsh environments make them an attractive alternative to electrical sensors for road pavement response monitoring and similar applications.

The new patent pending fiber optic strain sensor and deflectometer also overcome many of the problems caused by existing technologies – gauge misalignment and displacement due to excessive thermal and mechanical stresses.

OPSENS OFFERS OUTSTANDING FIBER OPTIC SOLUTIONS FOR ROAD PAVEMENT MONITORING

Some typical applications are:

PAVEMENT BEHAVIOR ANALYSIS UNDER SIMULATED TRAFFIC

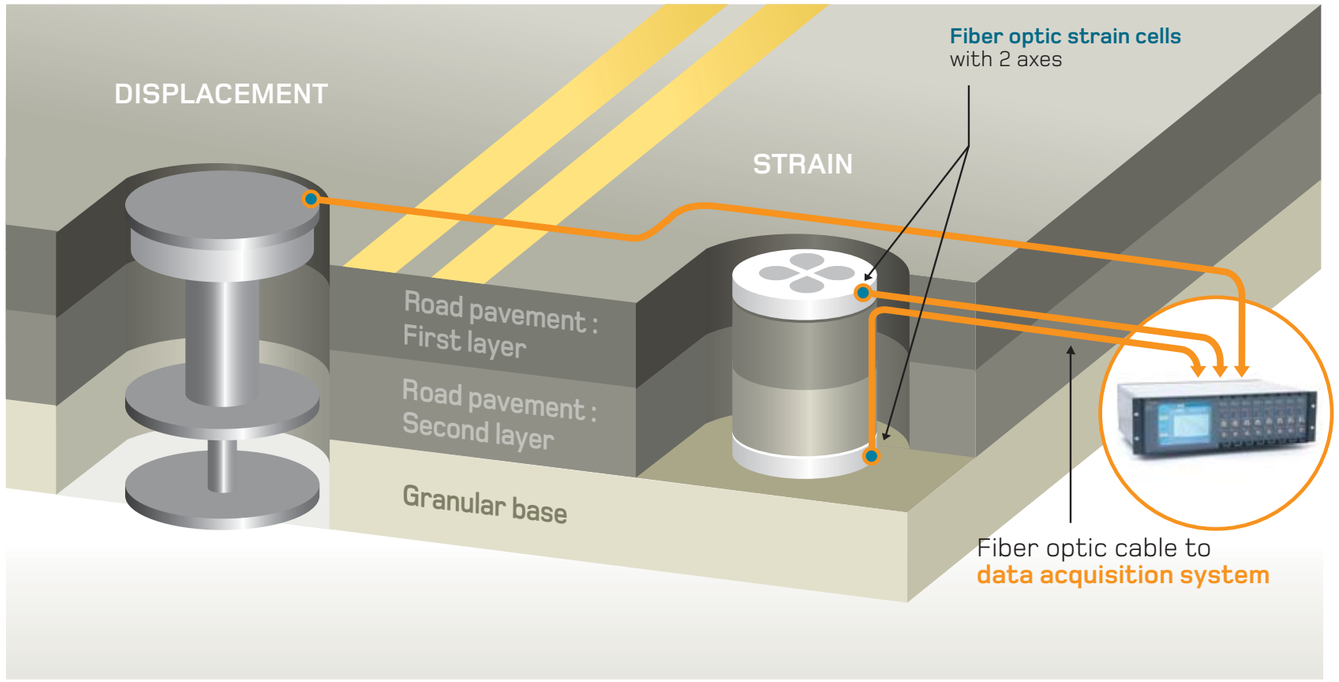
MULTI-DEPTH STRUCTURE CRITICAL STRAIN AND DISPLACEMENT MONITORING

PAVEMENT RESPONSE ANALYSIS DURING SEASONAL VARIATION LIKE SPRING THAW

ANALYSIS OF TIRE INFLATION PRESSURE IMPACT ON PAVEMENT RESPONSE AND PERFORMANCE

ODP SPECIFICATIONS

Linear stroke length	25 mm standard
Accuracy	0.2% F.S. (@ 25 °C)
Resolution	1 micron (based on 20 data samples averaging)
Operating temperature range	- 40 to 85 °C
Operating humidity range	0-100 %
EMI/RFI susceptibility	Fully immune



Prosens
Signal Conditioner

The ProSens is a polyvalent, scalable system that includes a control unit, modular signal conditioner units, TFT 6.5" Touch-screen color display with an advanced graphic interface and a variety of fiber optic sensors for measuring temperature, pressure, strain and displacement.

This modular platform can accept up to 8 modules and is perfectly suited for strain and displacement measurement with Opsens' OSP and ODP fiber optic sensors. Providing reliable results with high linearity, precision and resolution, the signal conditioner offers scalable sampling rate up to 1000 Hz.

OSP SPECIFICATIONS

Dimension	230 µm diameter
Gauge factor accuracy	± 3 %
Resolution	0.15 µε
Transverse strain sensitivity	Transverse strain insensitive
Temperature operating range	- 40 °C to +250 °C
EMI/RFI susceptibility	Fully immune

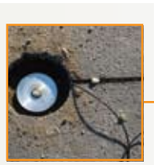
ODP **DISPLACEMENT** FIBER OPTIC SENSOR

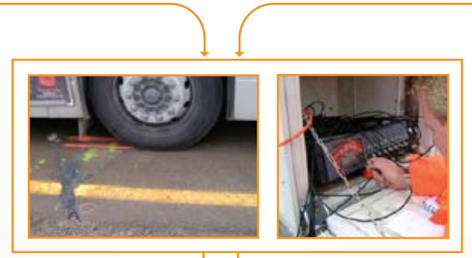
Opsens' ODP fiber optic displacement sensor is designed to offer high precision in the most demanding environments. Combined with Opsens ProSens signal conditioner and with the inherent advantages of fiber optics, the ODP delivers unprecedented repeatability, resolution and reliability required to monitor pavement mechanical response.


Fiber optic displacement sensor

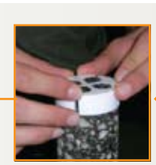

Robust assembly in displacement cell

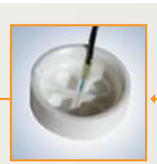

Cell preparation for installation

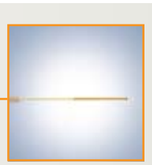

Cell installation in test site




Retrofit test site


Assembly fixed to pavement core


2 axes fiber optic strain sensor


Fiber optic strain sensor

OSP **STRAIN** FIBER OPTIC SENSOR

The OSP fiber optic strain sensors, integrated in the optical fiber optic strain cell (Patent pending), provide the reliability and the accuracy required to monitor road pavement infrastructure with great efficiency. They are perfectly suited to measure any change in dimension due to mechanical response of pavements.

MULTILEVEL MONITORING

Composed of many different layers, each made with various materials, road structure is far from being a homogeneous platform. Each layer has its own role in the pavement structure and reacts differently under moving loads. To get the picture at different depth, Opsens has developed a multi-level fiber optic monitoring system to evaluate road behavior.

The fiber optic strain cell (patent pending) is a unique innovative system efficiently adapted for structure strain measurements in pavement bound surfacing materials. It consists of a proof body holding one or two orthogonal fiber optic strain sensors designed to be incrusted in a laboratory prepared core ready to be retrofitted in existing pavements. Designed to provide all the required protection to the sensors, the fiber optic load cell annihilates stresses imposed to the strain sensors during pavement construction thus maximizing the rate of success of pavement instrumentation.

RETROFITTING STRAIN SENSORS IN EXISTING PAVEMENT

In the context of aging transportation infrastructures, the need for a better understanding of pavement behaviour at middle age (before and during distress manifestation) requires good quality data on the mechanical response of existing pavement.

Strain sensors installed during pavement construction typically have a short service life and cannot be used reliably to monitor pavement response after a few years. Operations required to retrofit strain sensors in existing pavements tend to disrupt stress fields in the bound layers and have also typically resulted in unreliable strain data. This major problem was solved by combining the fibre optic technology with the exclusive design of Opsens' patent pending fiber optic strain cell.

OUTSTANDING FIBER OPTIC SENSING SOLUTIONS FOR ROAD PAVEMENT ANALYSIS

KEY FEATURES

- Robust design optimized for installation in road structure.
- Excellent accuracy and long term stability. No drift over time.
- Could perform both short test and long term monitoring.
- EMI/RFI/Lightning immunity; intrinsically safe.
- High linearity, excellent precision and resolution.
- Scalable sampling rate between 100 to 1000 Hz.

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