



Solutions, When the Conventional Ones Run Out of Breath



# STRUCTURAL HEALTH MONITORING OF TUNNELS

## Monitor Cracks in Tunnels Over Long Distances

### PROTECTION AGAINST

- structural deformation
- exceeded traffic load limits
- environmental corrosion
- material aging and flaking of concrete layers
- natural disaster hazards

### INTENDED FOR

- tunnel owners
- tunnel engineers
- cities
- construction companies

Tunnels play a significant role in the movement of people, goods, and services. Therefore their **carrying capacity, integrity, stability, and durability** are most important in not endangering public transport and traffic safety. With our latest **optical fiber technology**, it is possible to **continuously monitor the tunnel's structural health and deformation trends**, such as lining cracking, dislocation, falling blocks, etc. in real time 24/7.

- ▶ remote monitoring of tunnel's mechanical behavior under environmental effects and traffic loads
- ▶ assessment and prediction of tunnel's health condition
- ▶ online and real-time information about the tunnel



# ANALYZING TECHNIQUES



displacement  
of concrete  
structures



integrity  
of the tunnel  
shell



cracking to  
monitor  
changes



convergence  
of the tunnel  
structure



strain  
to monitor  
abnormalities

## FEATURES & BENEFITS

### Fiber Bragg Grating (FBG) technology

FBG technology brings many advantages over the conventional sensing methods, such as immunity to EMI/RFI, high precision, durability, quasi-distribution and absolute measurement, compact size, reduced cable requirement, etc.

### Service and maintenance planning

We will help you optimize your service and maintenance planning based on your specific needs to ensure efficient operation.

### Prevention of catastrophic failures

Thanks to the structural health monitoring of tunnels, you'll be able to take appropriate action in advance and thus minimize potential damages and losses.

### Use of existing fiber optic network

Installation of an expensive sensor infrastructure or availability of electrical power is not necessary, which is very economical even for large areas of monitored objects.

### Predicting structural deformation trend

By analyzing the measured data, structural deformation trends can be predicted and the level of the tunnel structure safety can be evaluated to provide key technical parameters and timely warning.

### No calibration or determining of new zero

The wavelength reflected by each FBG is modulated by the measured quantity, for example strain. The system measures this reflected wavelength which is an absolute parameter. Hence you can turn off or replace the instrument without having to recalibrate it or reset the zero level.

### Measuring over long distances

The distance between the unit and sensors can be up to several tens of kilometers. Therefore you can cover a large area with one unit and lots of sensors, and measure without additional equipment and without power connections to all monitored locations.

### Reporting and data analysis

Our solution for monitoring tunnels provides all necessary reporting and data analysis features. The available level of service is in accordance with SLA.

### Customized solutions and adjustments

The solution can be modified to meet your project's needs, such as the desired functionality, interoperability, and others.

### Multifunctional measuring platform

Several sensors with different functions can be connected in series on a single fiber without signals being confused and with the necessary cable length being considerably smaller.

### Early warning in case of events

The monitoring system is equipped with direct alarm relays for immediate notifications to be sent via email, SMS, or other communication interfaces in case of sizeable and unusual events.

### System management and data acquisition via the Internet

You will be able to manage the solution via a user-friendly web interface, which also provides all necessary information about the structure and reporting and data analysis features in accordance with your SLA.

# PRODUCTS USED



## FBGuard 1550

Highly accurate monitoring system for industrial measurements



## Data processing

Universal solution for your data analysis and processing needs



## GrafFlux

Data visualization, storage and analysis service



## Displacement sensor

Displacement sensor for continuous structure behavior monitoring



## Embedded strain sensor

Strain sensor embedded in structure for continuous monitoring



## FBG temperature sensor

Structural health monitoring based on temperature measurements



## ObjectGuard

Highly accurate vertical movement measurement



## L-Bracket sensor

Strain sensor for constant structure behavior monitoring

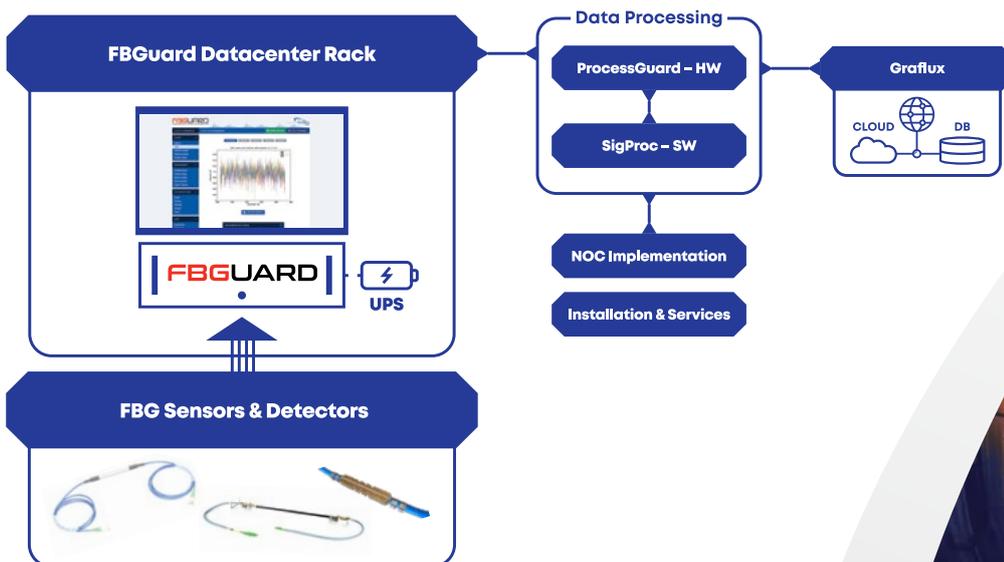


## Anchor sensor

Strain sensor for structure behavior monitoring

# APPLICATION SCHEME

Example of a typical setup. Choose the project scale that you prefer.



**GET IN TOUCH WITH US**  
and we will recommend the most suitable solution for your project.

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