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HARINGVLIET BRIDGE
STABILITY AND SAFETY THROUGH DATA

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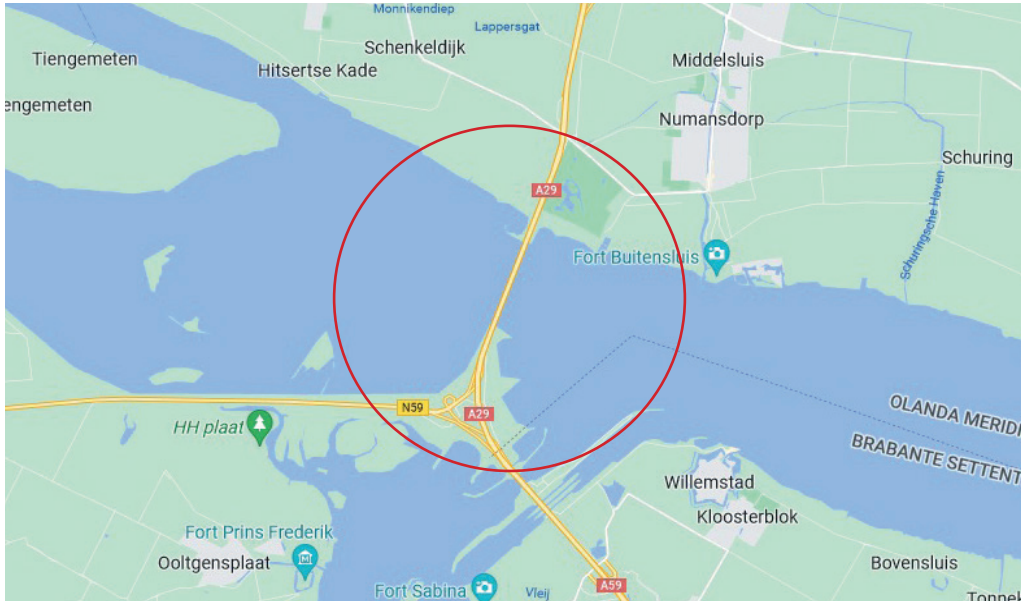
CONTRACT INFORMATION

Location: Numansdorp, the Netherland
Customer: Witteveen & Bos for Department of Public works (RWS)
Duration of monitoring service: 9 months
Project start date: November 2019

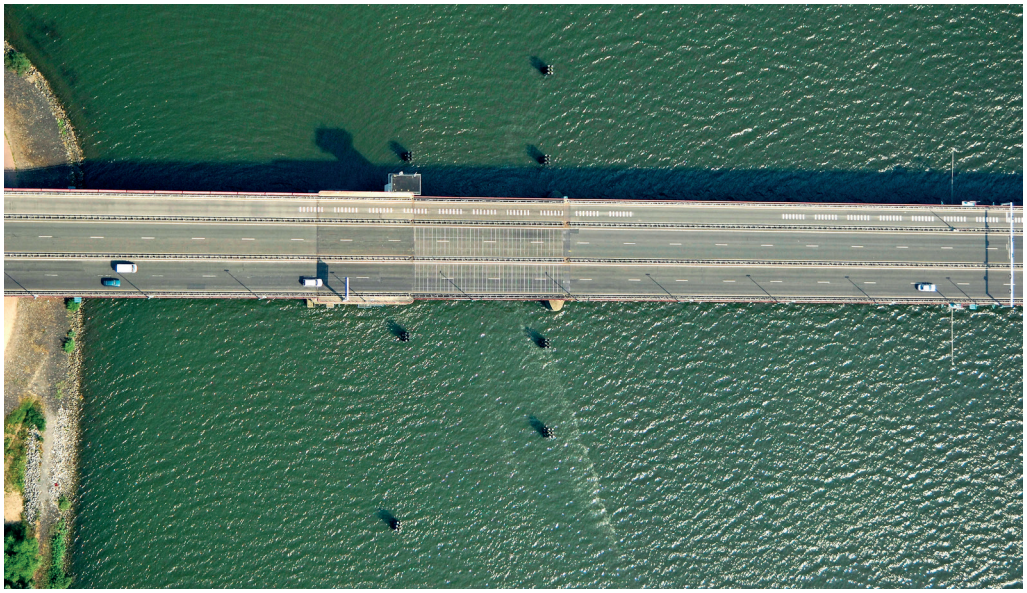


PROJECT DESCRIPTION

For the structural monitoring of the bridge subject to recalculation, consistently with the positions and quantities reported in the documents provided by the customer, it is foreseen the use of **49 strain sensors (bare fibre)** and **49 temperature sensors (steel tube)**. These sensors have been glued. In addition, four video cameras, one for each lane, were installed to identify vehicle type and license plates.

The temperature sensors were stick by tape or glue on the surface close to the strain sensors. The fibre used for strain and temperature is the same and to obtain the right measurement of temperature that sensor will be touching the same surface where the strain sensor is installed and temperature sensor will be close to the strain sensor. Using the gluing procedure of the temperature sensor, that one will be glued only at the edge of the sensor to guarantee a perfect contact between the sensor and the surface.

We have already used a configuration in which the temperature sensor is not incorporated in the deformation sensor, obtaining the same results as using the built-in temperature sensor. Furthermore, we compared the reading of a bare fibre temperature sensor with a steel tube temperature sensor and the results show a difference in order of the accuracy of each sensor.



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TECHNICAL DETAILS

The sensors provided will be accompanied by suitable transducers to be installed on the different surfaces of the bridge. The strain sensor makes use of the sensitivity of fiber grating to measure the strain.

Strain sensors bare fibre
The strain sensor makes use of the sensitivity of fiber grating to measure the strain. The sensors will be connected in series on a same optical fiber (generally in a variable number between 20 and 40: depending on the type of material on which they are installed). The optical strain sensors do not require electrical power and much less maintenance, after the first calibration after installation, will work in a continuous manner as long as it will not be disconnected. The chain of optical fiber to which are connected the strain sensors, and to which may also be connected to other optical sensors, is in turn connected to a machine of optical acquisition that will be in the central control. The interrogator is controlled by a computer that analyzes the data in real time and send alarms to the operator control.

Temperature sensors
FBG Temperature sensor is packaged by stainless steel. It can measure the temperature making use of the inherent feature of heat-sensitivity of FBG. It is suitable for long time temperature monitor in the applications for power station, railway and oil gas.

THE NUMBERS

- 49 strain sensors installed
- 49 temperature sensot installed

MOBILE INTEGRATION & DATA FEED
Deformation can be read remotely using Tablet, PC and Smartphones

MULTIPLEXING
Multiple sensor readable at the same time, installed on the same fiber.

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ADDED SENSORS

To showing the potential of its own monitoring system we propose to add some sensors to the Witteveen + Bos configuration,

In Section X1 and X2, we propose to add strain sensors on symmetric position respect to the neutral axis of the structure, to carry out differential measurements to discriminate the deformation due to the temperature from the deformation caused by the vehicle transiting on the bridge, and to obtain the deformation along three axes. Details of Section X in Fig.1. We propose to install a Section B, Bulb 14 and 15 (Fig.3) and a temperature sensor, with fibre optic sensors in parallel to analogue strain gauges, to compare themeasurements, results and repeatability of the measurements.

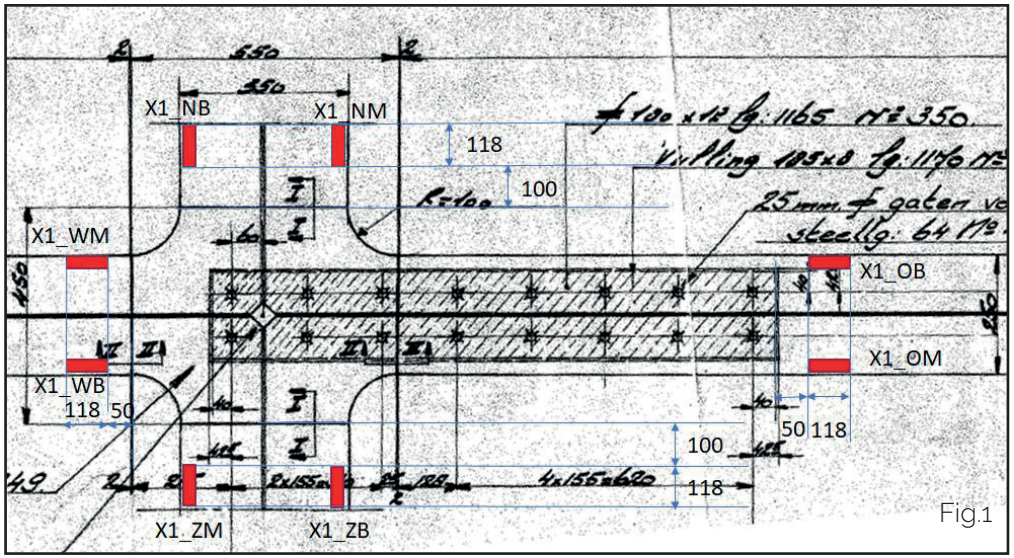

Fig.1

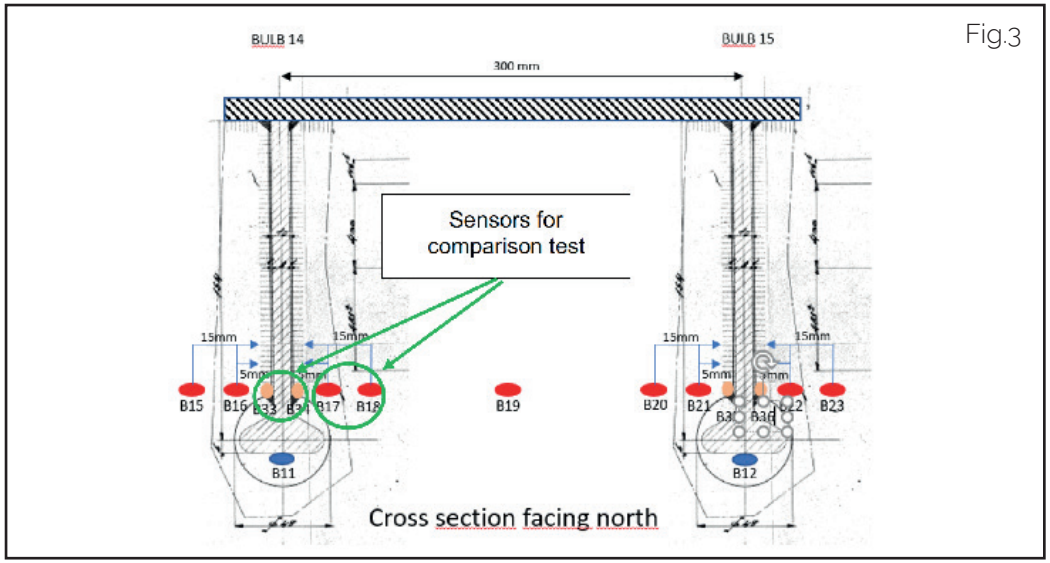

Fig.3

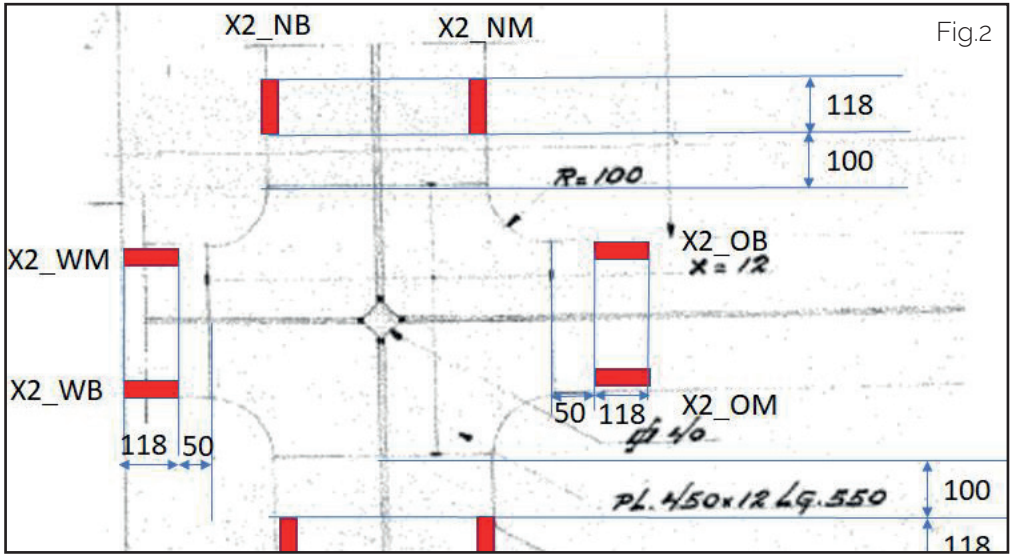

Fig.2

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WHY CHOOSE "OF" SYSTEM

Optical fiber sensing is a passive measuring instrument, immune to the environment, long-lived, eco-sustainable and with reduced maintenance costs. Buildings, roads, bridges, tunnels, railways, trains.

Vehicles in constant motion, people on the street, operators at work. In a world in constant activity and movement, monitoring infrastructure means checking the health of structures and guaranteeing the safety of the users. The "OF" solutions create a nervous system of sensors that monitor the structures and their critical elements, activating a timely and constant remote control.

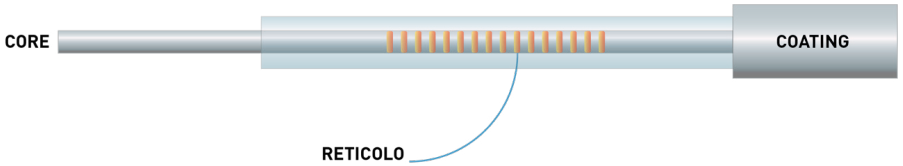
The proprietary data processing software EG-NTSG and the IoT-NTSG software platform, process the data, analyse the information and estimate the state of the structure, with the ultimate aim of optimizing the planning of maintenance activities.

Our systems prevent failures, damage, for the safety and health of all..

ADVANTAGES OF THE SYSTEM

- Chance to place the data acquisition tool at **large distance** (km) from the monitoring area, without reducing the accuracy of the measurement;
- **Multiplexing**, up to 160 sensors, even of different types, applied in series on the same fibre;
- Reduce the required wiring to monitor a structure.
- **High sensitivity**;
- **Small size** and insertion possibilities inside composite materials;
- **Sensors are passive**, do not generate and are not affected by electric and magnetic fields.
- **Reduction of maintenance costs** and energy consumption up to 17 times less than traditional systems with copper cables: a valid tool on the way to aecological transition

THE FIBRES, THE SENSOR, THE MATERIALS



FBG - fibre Bragg Grating
The grating is "written" in the fibre core with an ultraviolet laser.
The grating is the sensor itself.

Grating dimension: 0.5-2 cm.
A peculiar characteristic of the FBG technology is that on a single optical cable can be wired in series, for the measurement of various parameters, using different sensors such as strain gauges, accelerometers and temperature sensors. The acquisition is performed with just one interrogation system.

DIAMETER
Core: 5-9 µm
Cladding: 125 µm
Coating: 170-250 µm

COMPARISON
Human hair:
About 90 µm