Structural Health Monitoring of the Stonecutters Bridge

General project information

Project location: Hong Kong (between Stonecutters Island and Tsing Yi Island)

Date: 2006-2008

OBJECTIVE

The Stonecutters Bridge is a 1,596 metre long dual 3-lane high level cable stayed bridge, with a clear span of 1,018 metres. It is a major part of the section of Route 8 between Tsing Yi and Cheung Sha Wan. The bridge will straddle the Rambler Channel at the entrance to the busy Kwai Chung Container port. It will be situated at the back-up land of the Container Terminal 8 (CT8) at the eastern side on Stonecutters Island. At the western side it will be built on the back-up land formed for Container Terminal 9 (CT9) on Tsing Yi Island. The Stonecutters Bridge when completed will be one of the longest span cable-stayed bridges in the world.

The objective of the structural health monitoring project of FOS&S is the monitoring of temperature and strain inside the stay cables of the Stonecutters bridge.

Figure 1: Stonecutters Bridge

SOLUTION

FOS&S monitors the temperature and strain inside the stay cables by inserting several fibre optic strain and temperature chains inside the stay cables. The fibre optic strain and temperature chain make use of the inherent strain, respectively temperature sensitivity of the Fibre Bragg Grating (FBG). The chain consists of a fibre containing different FBGs.

In case of strain sensing, the fibre with the FBGs is inserted into a stainless steel capillary with a diameter of 1,5 mm. The cable can be used to measure strain (or displacement) between different anchoring points. The strain chain SC-02 can measure distributed strain with a resolution of 1 μ e and an accuracy of 10 μ e . The sensor is also sensitive to temperature changes: 1°C corresponds to 8 μ e . In order to compensate for these influences a FBG temperature chain that has not been strained is used to compensate for these effects.

In case of the temperature chain, the fibre with the FBGs is inserted into a stainless steel capillary with a diameter of 3 mm. The capillary is filled with a special gel which keeps the fibre in a loose tube configuration. This loose tube configuration maintains the fibre stress free over the complete operating conditions. The temperature chain can measure distributed temperatures with a resolution of 0.1 °C and an accuracy of 2°C .

The sensors have been installed into the stay cable during the fabrication process by the stay cable manufacturer. The Fiber Optic sensors run along the stay cable and exit directly through the Anchor within a stainless steel tube as can be seen in Figure 2. Figure 3 shows the sensor locations within the Stay Cable: the 1,5mm and 3mm SS tube are used for respectively strain and temperature measurements at various positions within the stay cable. Each stay cable that is monitored contains 6 FBG chains; four chains for strain measurement and two chains for temperature compensation. The different FBG chains are read out using the FBG Datalogger of FOS&S.

Figure 4 shows the Fibre Optic temperature and strain chains coming out of the Stay Cable.

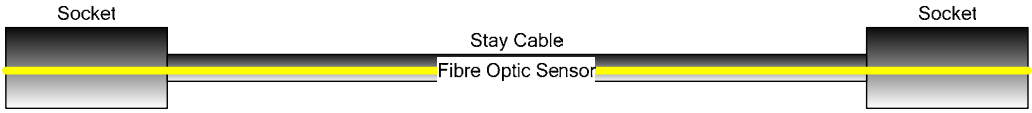

Figure 2: Fibre Optic Sensor inside the stay cable

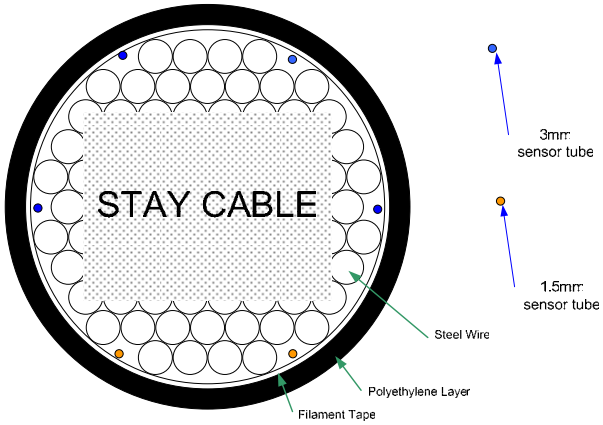

Figure 3: Location Fibre Optic Sensors within the Stay Cable

Figure 4: FBG Sensors inside the Stay Cable