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Calibration of Elasto-Magnetic Sensors for Bridge-Stay Cable Monitoring

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We report on the calibration of built-on-site elastomagnetic (EM) sensors for monitoring the tension in bridge-stay cables. The stays being monitored were 116 mm and 128 mm full locked cables, supporting a 260 m long bridge deck, with design load from 5000 to 8000 kN. The EM sensing principle is based on the variation under stress of the magnetic permeability in a ferromagnetic material. The calibration included two test phases, one in the laboratory and the other on site. In the laboratory, the sensor was built around a segment of cable, identical to that under monitoring, loaded up to 9000 kN with a tension testing machine; the response of the sensor at different load levels was then compared with the load applied by the machine. The calibration shows that: the experimental load-to-permeability relationship is non linear but its slope is independent of the fabrication process; the permeability is very sensitive to temperature and the thermal compensation coefficient varies with load; the sensor is repeatable except for an offset, which must be identified at site by comparing the sensor response with the cable under known load and temperature. To record independently the load on site, we carried out vibration tests, estimating the tension by analyzing the harmonic sequence of the cable frequency response function.

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