Monitoring of Forces in Stay Cables, Tendons and Bridge Bearings

Contrôle des forces dans des haubans, câbles et appuis de ponts

Ueberwachung von Kräften in Schrägseilen, Spanngliedern und Brückenlagern

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1. PRELIMINARY REMARKS

The systematic and properly performed maintenance of structures improves their durability. A schedule of maintenance measures should be included in the planning of every large construction project. An important aspect of this is to define criteria of when and in what circumstances appropriate action is to be taken. Programmes to draw up the actual condition of structures by means of pinpoint inspections, examinations and measurements of deformations, forces and stresses must be provided. Structural components subject to high stresses and therefore more at risk must be monitored more closely, at shorter intervals or even permanently. Such important load-bearing elements include, for example, the cables of cable-stayed bridges, prestressing cables, especially if located outside the concrete cross section as external tendons, and also ground anchors or bridge bearings. The ability to replace vital structural components while retaining the serviceability of the structure must be taken into account during planning.

2. CABLE-STAYED BRIDGES

The cable forces of a cable-stayed bridge can be measured and monitored by means of an annular load cell WIGAring ELASTO (Fig.1) between the anchor and the anchor plate with an accuracy of ≦ ± 1 % of the nominal value. The forces can be read off on a portable indicator at the anchorage location or at a central measuring station in the case of permanent monitoring. The special design of this load cell and the use of Neoprene as the pressure measuring medium mean that its installation height is extremely small. For example, for a nominal load of 10 000 kN it is only 162 mm.

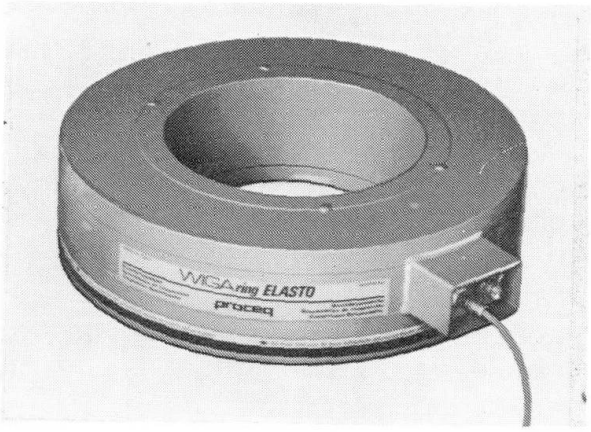
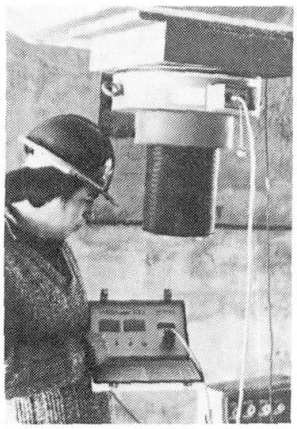


Fig.1 Load cell 10 000 kN

Permanent monitoring provides important information on the forces in the stay cables during the construction phase and in subsequent service. During service, it is above all the size of the load variations and the number of cycles occurring under different load combinations such as live loads, temperature differences, snow, ice, wind, vibration and other external influences which may affect the durability of the stay cables. Exact knowledge of the actual load variations provides also information for planning and design of stayed structures.

In the case of the Posadas-Encarnación cable-stayed bridge in Argentina (Fig.2), 28 BBR-HiAm cables were equipped with load cells. Such cables with particularly high fatigue resistance are produced in a factory with skilled labor under strict supervision and controlled conditions. This guarantees a high quality product as is required for such structures. A further example (Fig.3) shows force measuring by load cells in the cable-stayed bridge at St-Maurice, Switzerland.



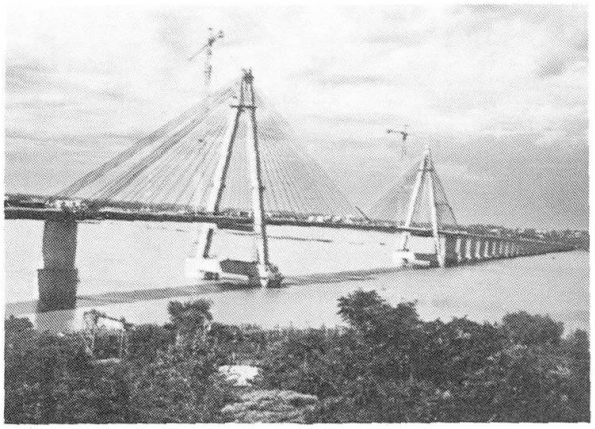


Fig.2 Posadas-Encarnación, Argentina

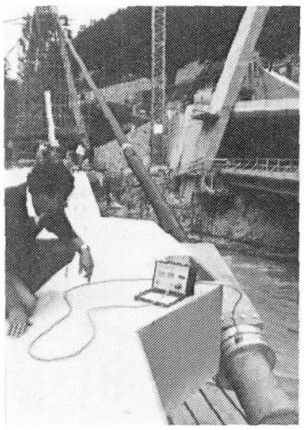


Fig.3 St-Maurice

3. FORCE MEASUREMENT BEARINGS IN BRIDGE-BUILDING

The function, operation and design of RESTON force measurement bearings are similar to those of WIGAring ELASTO load cells.

The use of force measurement bearings enables changes in bearing forces and load repartitions to be detected immediately, either during the application of prestressing, during load tests or when live loads and impact loads occur. Periodic measurements inform about long-term influences on the structure originating from settlements, displacements and load changes due to creep and shrinkage. Any necessary corrective and maintenance action can be initiated in good time.

Force measurement bearings RESTON have been employed successfully on bridges in Germany, France, Holland and Switzerland.

4. CONCLUDING REMARKS

It is to be hoped that the modern facilities available for recording the condition of structures will be used increasingly so that the necessary maintenance work can be initiated correctly and in good time to prevent any possible consequential damage.