Real Time GNSS Bridge Monitoring

by Hélène Leplomb

The French surveying company 3GE worked hand in hand with Leica Geosystems to install the first GNSS automatic monitoring systems in France on two exceptional bridges: the Tancarville Bridge and the Normandy Bridge.

The Chamber of Commerce and Industry (CCI) of Havre manages two exceptional works of art: the Tancarville suspension bridge, spanning 608 m (1,995 ft), which is celebrating its 60th anniversary this year, and the Normandy cable-stay bridge with a central span of 856 m (2,808 ft), inaugurated in 1995. These two bridges are crucial for the economic development of the region: more than 12 million vehicles cross the bridges each year and more are expected in the coming years.

Because French regulations stipulate increased monitoring of bridges spanning more than 500 m (1,640 ft), to date they have been regularly monitored using manual tachometry. In 2007 the Havre CCI launched a tender for the implementation of monitoring services. Among the responses for monitoring by tachometry was an alternative proposal for automatic monitoring by means of GNSS technology proposed by the company 3GE (Garrigou and Gaillet Géomètres Experts au Havre). After studying the different proposals, Didier Jean, the Technical Manager

Products Used

- Leica GMX 901 GPS Antennas
- Leica AX1202GG Multi-GNSS Antennas
- Leica GNSS Spider Software for single stations and networks
- Leica GNSS QC Software for reference station quality control and data analysis

of the Havre CCI, was won over by the GNSS variant: "Above all I opted for the most economical proposal, which also provided additional benefits."

The seven Leica Geosystems GNSS signal receivers installed on the Normandy bridge and the eight receivers on the Tancarville bridge comprise a network that enables high precision measurements. Positions calculated in real time (up to 20 positions a second) attain better than centimeter precision, while post-processing calculations of the data produce millimeter precision solutions.

While the tender set out a measurement schedule of five days per quarter, the GNSS sensors installed at strategic points on each bridge take measurements in real time 24 hours a day, 365 days a year. Once the measurements are recorded, the surveyor can analyze them on request, e.g. during a storm. "The method enables us to avoid going out at night or in bad weather conditions; difficult access and visibility no longer bother us, and we can avoid all risk to humans and materials," remarks Serge Garrigou, manager of the company 3GE.

Three-dimensional point sets allow continuous, comprehensive monitoring of deformations caused by climate-related changes. Because suspension and cable-stayed bridges are dynamic by nature, the data must also allow comparisons between actual movements and theoretical models and behavior observed in wind tunnels. In addition to the fluctuations, the Havre Chamber of Commerce and Industry is also interested in the works' internal frequencies. With the new installation, it is now possible to permanently study and monitor the behavior of the bridges, in particular during storms, periods of strong wind and heavy traffic. Since the data are synchronized, an exact dynamic model of the structures is obtained at any given moment in real-time or time-lapsed. In the context of sustainable development of bridges, there is no doubt that these exemplary works will help advance the state of the art for monitoring of dynamic bridges in France. ■

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