The Use of GNSS to Aid the Structural Health Monitoring of the Seven Suspension Bridge's Suspension Cables and Support Towers.

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SUMMARY

The Severn motorway Suspension Bridge is a 1,600m long suspension bridge, with a main span length of 988m long, and towers of 136m in height. The bridge spans the River Severn and the River Wye, and took three years to construct. The bridge was opened on the 8 September 1968 by Queen Elizabeth II. The Bridge was granted a Grade I listed status on the 26 November 1999. The bridge is a conventionally designed suspension bridge, where the bridge deck is supported by two main cables slung between two pairs of steel support towers. The cables that support the bridge deck were spun from 29,000km of wire, and each of the two main cables are made up of 8,322 individual 5mm diameter wires. The hanger cables connecting the deck to the suspension cables are not vertical, but are arranged in a zig zag manner. This was a part of the design to help reduce the vibrations of the bridge, as is the use of Stockbridge dampers upon the cables. In 2010, a series of field trials were conducted upon the Severn Bridge, whereby 9 GNSS receivers were placed upon the bridge, and two were placed as reference stations adjacent to the bridge. Of the 9 on the bridge, 4 were located at the tops of the two pairs of towers and the remaining 5 were placed at strategic locations on the bridge's suspension cables. Four on the north side cable, and the 5th on the south side cable. This configuration allows the movements of the North cable to be analysed, at 3 different locations, as well as the differential movement between the two suspension cables. In addition, this configuration allows the movements of the tops of the towers to be compared to the cables, as well as to each other. All in all, allowing the relative movements of the various locations on the bridge to be compared. This is possible in terms of the magnitude of the movements in the 3-Dimensions of the bridge, as well as the frequencies of the movements. Three days of data at 10Hz and 20Hz were gathered at all these locations. During these periods, normal traffic flow was experienced. This paper focusses on the accuracy of the measurement of movements of the towers, and how they correlate to the movements of the suspension cables, as well as the correlation of frequencies of movements experienced at each location.