Health monitoring of a cable-stayed timber footbridge

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1. INTRODUCTION

The number of timber bridges has increased a lot in Sweden during the past 20 years. In general today the health of the bridges is assessed at regular intervals by visual inspections and if necessary some minor local tests. Continuous measurements could complement the inspections and provide a better basis for planning maintenance activities and evaluating the remaining service life. This paper presents a structural health monitoring system to a timber bridge that will be built in Skellefteå during 2011. The bridge is a cable-stayed timber footbridge spanning 130 meters. The main objectives of the research project are to develop and implement a health monitoring system for the bridge, verifying the bridge design and the long-term behavior of the bridge. Secondary research goals are a scalable health monitoring system and a database with models and tools for further research on performance and quality on timber constructions.

2. THE HEALTH MONITORING SYSTEM

Wood as a construction material has several advantageous properties; good weight to strength ratio, renewable, sustainable, aesthetics, etc. But wood is also prone to deterioration by decay, fungi, insects and temperature. Bridges in Sweden are inspected and cleaned at least every year, and bridges with heavy traffic load even more often. A more thorough major inspection is every six years. The major inspection should predict the performance of the bridge for the coming ten-year period and decide if any repairs must be done (Pousette 2008). Therefore it is important to be able to monitor timber bridges with modern inspection measures. Long time monitoring can provide tools for better planning of the inspections. A good health monitoring system should decrease the frequency of inspections needed to assure the structural integrity of the bridge. With a limited number of sensors it was decided to monitor only the southern half of the bridge (see figure 1). By monitoring half the bridge the density of the sensors will be higher and give a more detailed view of the movement compared to monitoring the whole bridge. The health monitoring system for the bridge consists of weather stations, moisture content sensors, strain gauges, accelerometers, GNSS receivers and a laser positioning system.

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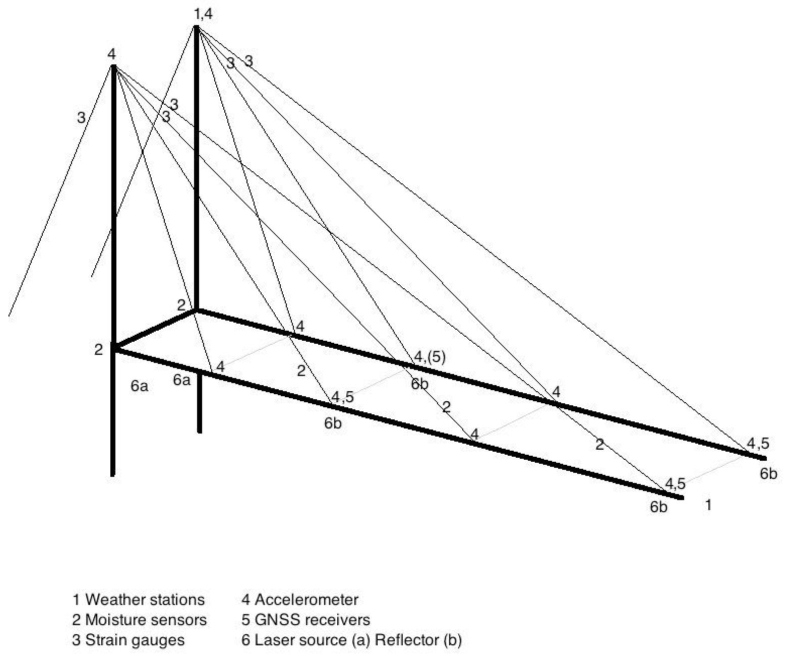

Figure 1 – Schematic picture of location of the sensors (not drawn to scale). The sensors depicted on the deck will be mounted beneath the bridge deck.

The sensors will measure the following parameters: wind velocity, wind direction, temperature, moisture content (MC), relative humidity (RH), wire tension, acceleration and deflection. The different systems will be evaluated with regard to accuracy, reliability, long-term stability and cost. The bridge will also be equipped with a web camera, which besides exposing the bridge will be used to determine the traffic on the bridge. The wind load is the dimensioning load on the bridge, while vertical loads induced by traffic will be relatively small, only a handful of pedestrians or bicyclists will cross the bridge at the same time. The health monitoring system will measure both short- and long-term deformations. Short-term deformations are induced by traffic, wind, temperature etc. whereas long-term deformations are due to stress relaxations, foundation settlements, local deformations caused by moisture changes, behavior of connections, etc.

REFERENCES

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