

## Upgrading of São João Bridge Structural Health Monitoring System

**L. Oliveira Santos**  
Senior Research Officer  
LNEC  
Lisbon, Portugal  
*Luis.OSantos@lnecc.pt*



Luís Oliveira Santos, born 1964, received his civil engineering degree in 1987 and his PhD in 2001, both from the Technical University of Lisbon. His research interests include monitoring, testing and assessment of bridges.

### Summary

São João Bridge is a railway bridge, 1028 m long, with a main span of 250 metres. This bridge was instrumented during its construction and its structural behaviour has been experimentally followed since then. After fifteen years in service, the system used for this purpose was updated in order to get automatic data acquisition as well as dynamic monitoring, with remote access and real time data processing. This paper presents how the original sensors were integrated in the new structural health monitoring system and the new devices used. Finally, some experimental results are presented and compared with the analytical values predicted by a finite element model.

**Keywords:** prestressed concrete bridge, structural health monitoring, automatic data acquisition, hydrostatic levelling system, time dependent behaviour, real time data processing.

### 1. Introduction

São João Bridge is a railway bridge crossing the River Douro, in Oporto, Portugal. Designed by Edgar Cardoso, it has been open to traffic since 1991.

This bridge was instrumented during the construction and its structural behaviour has been experimentally followed since then. The original observation plan includes the measurement of strains and temperatures in concrete, horizontal displacements at expansion joints in abutments, vertical displacements in the deck and rotations at the bottom and top of the piers. However, the observation of the bridge was based only on periodical measurements.

Recently, the structural health monitoring system was updated in order to get automatic data acquisition as well as dynamic monitoring, with remote access and real time data processing. All the original sensors that could be used by the automatic acquisition system were kept and several news sensors were introduced to measure vertical displacements, horizontal displacements at expansion joints, and to measure rotations. The data acquisition is guaranteed by nine data loggers connected through a local fibre optic cabling network. All the measured values are processed by an industrial computer kept in the bridge.

After the description of the bridge, this paper presents the experimental procedures used in upgrading the structural health monitoring system, as well as some experimental results measured since bridge construction, which are compared with the analytical values predicted by a finite element model.

### 2. Brief description of the bridge

São João Bridge is a prestressed concrete bridge, with a total length of 1028 m, including a main span of 250 metres, two 125 m side spans and approaching viaducts from both sides of the river banks (Fig. 1).