IMPLEMENTATION OF A STRUCTURAL MONITORING NETWORK IN THE NEW STONE MASONRY BRIDGE IN VILA FRIA - PORTUGAL

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SYNOPSIS

This paper reports on the case of a new stone masonry bridge fully instrumented for structural monitoring under service loading. Both the monitoring scope and the instrumentation actually installed are described for this singular type of new construction. The acquisition systems as well as remote data transmission and archive are also addressed. Some preliminary monitoring results are included.

INTRODUCTION

The structural behaviour of stone masonry bridges still persists a challenging and pertinent topic of research, although it typically refers to old structures. The very fact that a large number of such constructions exist, in Portugal as in many other countries, under service conditions for which they were not designed, increases the problem relevance (Costa, 2002). The need of improved knowledge based on the actual behaviour of real structures becomes even more stringent if one bears in mind that some of such constructions exhibit clear signs of degradation and lack of maintenance that, quite often, suggest serious doubts on the safety level they can ensure under service conditions.

The case described in this paper is believed to assume particular relevance for the scientific and technical community interested in the field of structural analysis and monitoring of old masonry constructions, bridges in particular. The case study refers to the new stone masonry bridge in Vila Fria - Portugal, over the Vizela River, recently built according to traditional techniques of masonry construction to replace an old and very deficient passage (Figure 1).

a) b)

Fig. 1 The Vila Fria bridge: (a) old passage and (b) new stone masonry bridge.

The bridge is 6 m wide and has a total span of 60 m, distributed by five stone arches of 4.8 m to 6.0 m long and two abutments. The main structural elements, namely arches, piers and spandrel walls are fully made of stone masonry brickwork, whereas the bridge interior is made of filling material composed by a selected *tout-venant*.

INSTRUMENTATION AND DATA ACQUISITION

By taking profit of the construction process a large instrumentation network was installed in the bridge, including both electrical type and fibre optic based sensors, the later particularly relying on fibre Bragg gratings (Ferreira *et al*, 2004). Strain in stone blocks is measured in 48 points by electrical and optical strain gauges; since this type of structure has very low stress level in the linear elastic domain, the strain measures give directly an indication of the stresses installed. Pressure distribution in a selected region is monitored by 7 total electrical pressure cells (Geokon, 2002) as usually adopted in geotechnical works. Vertical movements are obtained using 16 ultra-low differential electrical pressure sensors from Honeywell with an appropriate silicone oil to measure differential displacements between a series of points along the bridge deck. Relative opening/closing and slip displacements in joints between blocks, as well as relative displacements between spandrel walls are monitored by means of 53 displacement transducers based on fibre optic sensors; the same technology has been adopted for temperature measurement (28 sensors).

Data of all the sensors are collected by appropriate acquisition systems, namely one BraggMeter measurement unit containing an optical switch from FiberSensing and one Compact Fieldpoint acquisition unit from National Instruments. Both equipments are connected by TCP/IP to a router allowing wireless data transmission by GPRS/UTMS to a remote server at FEUP where monitoring results are collected in a specifically designed database and accessible through an internet site.

FINAL REMARKS

By the time this abstract is being written, the whole system is ready to work and a load test is about to be done. Therefore, the paper basically describes characteristics and details of the implementation process and, possibly, some results of the monitoring process if they are already available.

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