A novel approach in the life cycle assessment of engineering structures

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Summary

Structural Health Monitoring (SHM) is fundamental for the assessment of the behavior of existing and new structures under service conditions. It is most suitable to identify the initiation of deterioration and to validate design hypothesis such as load distribution paths, bond between materials, composite action between precast members and cast-in-place parts, among others.

The proper characterization of a structure requires the knowledge of the main events that occurred in the past, namely, climatic and load history. This is an almost impossible task to be performed in existing structures since records do not exist. Nevertheless, it can be easily implemented in newly structures.

This paper presents a new low cost SHM system developed by VESAM. The concept of a structural identification card is also disclosed and typical applications illustrated. Based on this approach, it is possible to preview in advance the initiation of deterioration, reducing the maintenance costs and extending the structure lifetime. Therefore, a predictive maintenance approach is promoted.

Keywords: Monitoring, SHM, SID-Card, Predictive, Maintenance, Life-cycle.

1. Introduction

VESAM is a European company, based in Portugal, dedicated to design, fabrication, assembly, monitoring and maintenance of steel and mixed constructions. The core business are residential buildings, industrial facilities, bridges and special structures. Founded in 2005, VESAM is currently present in Europe and Africa with more than 90% of the business volume originated from foreign countries.

With a strong emphasis in innovation since the early years, VESAM seeks continuously the integration of civil engineering with technology, namely electronics and computer sciences. The need to increase the knowledge about the behavior of our structures under service conditions, combined with a large distance between the headquarters and the typical construction site, mainly in Africa, motivated the existence of an R&D Department to create unique solutions to overcome our needs.

Aiming this, the R&D Department of VESAM developed during the last year two innovative concepts that are described in this paper. First, a structural health monitoring system, named of SIGMA, is disclosed [1]. Afterwards, the concept of a Structural Identification Card, named of SID-Card, is revealed. Both are integrated with MERP, the Metallic Enterprise Resource Planning, which is a specific planning and management software developed by the company for steel and mixed construction, integrating the entire structure life-cycle into a single application. From the early days, VESAM feel the need to close the construction cycle offering an integrated solution that incorporates the design, fabrication, assembly, monitoring and maintenance, Fig. 1.

Our R&D strategy at long-term is based in the recognition of the advantages that structural health monitoring can bring to civil engineering [2, 3] and, in particular, the adoption of a predictive

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