Design of infrastructure incorporating monitoring regimes to evaluate the performance and schedule maintenance over the entire life time

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Summary

Bridges are generally designed for a life time of 120 years. The structural behaviour and material degradation mechanisms are considered during the design stage in order to achieve this design life. The life time of the structure, which is subject to a variety of loads and exposed to certain environmental conditions, depends therefore to a large extent on the assumptions made during the design stage. However, experience has shown that especially loading conditions i.e. traffic loading is likely to deviate from the assumptions made during the design stage. Further, the impact of exceptional events such as earthquakes could affect the integrity of the structure. The degradation of a structure very often has not progressed very far and when the structure is monitored, it is possible to extend maintenance free periods. Further, with monitoring hard- and software becoming more and more sophisticated, it is possible to have this information readily available any time. Therefore, it is recommended that monitoring regimes are considered as an integral part of the design and become part of the maintenance schedule of any major infrastructure project. In short, monitoring regimes can be used to optimise spending on maintenance. In this paper, one possible use of structural monitoring is shown on the example of the bridge over the river Reuss in Wassen, Switzerland. The cost of the monitoring regime is compared to the cost savings made by it over the lifetime of the project. In addition, the design criteria of such a system required to achieve a permanent monitoring throughout the lifetime of a structure are explained and the use of the data for a bridge maintenance strategy is shown. Monitoring regimes can be used as a maintenance tool to optimise spending over the life time of the object and, ultimately, to safe costs.

Keywords: Bridge Monitoring, Life Cycle management, structural health monitoring, fibre optics, Osmos, dynamic measurements, weigh-in-motion-system.

1. Introduction

The bridge over the river Reuss in Wassen, Switzerland is monitored continuously since May 2004. The bridge is constructed in reinforced concrete comprising a prestressed concrete box section spanning 192 m across a valley. The bridge was refurbished after its partial destruction in a flood event of 1987 and it is in pristine condition. It does not require a monitoring regime in the sense of the classical safety approach. However, it is a structure that in respect of its design, exposure and traffic load represents many other structures in Switzerland, if not world-wide. Therefore, it has been decided to install a monitoring regime, that would be suitable to permanently monitor the structure in order to obtain a better understanding on its long term performance.

2. Objectives of monitoring regime and system

2.1 Objectives of the monitoring regime

The bridge over the river Reuss in Wassen, Switzerland, is a typical motorway bridge. Its construction and its loading represents many other similar structures in Switzerland and elsewhere.

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