

## Bridge Management by Modelling, Monitoring and Experimental Research

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### Summary

The traffic intensity in the Netherlands has grown rapidly during the past decades. To effectively manage the infrastructural network, many existing constructions are reconsidered to check for structural safety and future capacity. Effective asset management requires insight in the short and long-term behaviour of civil structures.

The “Hollandse bridge” in the Dutch highway A6 was upgraded with a concrete overlay in 2008. Strukton Civiel performed, in association with Delft University of Technology, a research that investigated the effect of traffic induced vibrations on the hydration of early-age concrete. The motive lies in the uncertainty if vibrations cause degradation of young concrete versus conservative guidelines on civil works. As a consequence, these safe approaches result in temporary detours during maintenance, causing vast traffic disturbances. To investigate necessity, the research combines theoretical vibration analysis with monitored responses of the Hollandse bridge as input for laboratorial research on the degradation of concrete loaded with traffic induced vibrations.

**Keywords:** Asset Management Infrastructure, Operate & Maintain, Structural Health Monitoring, traffic induced vibrations, early-age concrete, concrete overlay, bridge rehabilitation.

### 1. Introduction

Asset management for infrastructure is the potential solution for managing operation & maintenance versus cost optimization. Bringing together different parties such as universities, contractors, private parties and the government is considered to be the key to success. Nowadays a shift is visible from predefined requirements by the government towards functional prescribed Operation & Maintenance. This tendency is driven by different factors, by which the technical knowledge is shifting from Design & Built towards an integral approach including knowledge of construction upgrades and Operation & Maintenance. Besides technical issues other factors are involved:

- Lack of knowledge on the infrastructural condition. In the United States several collapses have recently occurred;
- Most bridges in the Netherlands have been built in the years 1955-1975. Many of these bridges need maintenance on a short term;
- Growth of traffic intensity, larger average vehicle weights and changes in design codes;
- Shift from building to maintaining. Technical, contractual and organizational issues occur.

This paper discusses the case study project “Reinforcement and maintenance of the Hollandse bridge”. This bridge has been maintained, strengthened and widened with a concrete overlay in 2008. Concurrent with the overlay execution, Strukton Civiel initiated a research program in association with Delft University of Technology to investigate the effect of traffic vibrations on the hydration process of early-age concrete. The research is divided in the following parts:

- Identification domain objectives bridge management, design of bridge monitoring system;
- Modelling and monitoring of traffic vibrations;
- Experimental program. Load simulation and material consequence investigation.