Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Institute of Structural Engineering
Group Risk and Safety

Master Thesis

Bayesian Probabilistic Approach for Risk Assessment of Large-scale Concrete Structures

Introduction

Many concrete structures can be considered as large parts of engineering systems. For these, deterioration of concrete structures in the context of inspection and maintenance planning has become increasingly recognized by engineers and decision makers as being important. The present master thesis aims at establishing probabilistic model of the performance and risk of large-scale concrete structures. Realistic modeling of deterioration and the planning of inspection and maintenance activities requires explicit consideration of the interdependencies among the individual elements of the structure. Based on an idea introduced by Benjamin and Cornell (1970) and previous works by our group it is demonstrated how condition indicators may be formulated for the general purpose of quality control and for assessment and inspection planning in particular. The challenging problem herein is how to consistently integrate the experience and expertise of the inspection personnel and the collection of information into a model. The key solution to this problem is the adaptation of Bayesian probabilistic networks, which provide the rationale for combining the prior knowledge with the statistical data and give a logistical representation between the variables relevant for risk assessment of large-scale concrete structures.
The master thesis provides the opportunity to gain the knowledge about the practice of inspection and assessment of real large-scale concrete structures as well as the techniques on statistical analysis and probabilistic modeling.

Task and scientific relevance

The present master thesis starts with the collection and analysis of the data related to some existing concrete bridge in Denmark, followed by the construction of the database of all the elements and the whole system. Based on the existing data and the identification of the probabilistic relations between the relevant parameters, the Bayesian network for assessment of the concrete bridge will be established. The following steps are to be processed.

1. Collection and analysis of the existing data.
2. Construction of the database of all the elements and the whole system.
3. Establishment of the Bayesian network for risk assessment of the system.
4. Development of interaction between the Bayesian network and the updated database.

The efficient linkage of the established Bayesian probabilistic model will be connected with the data layers of a Geographical Information System (GIS) such as to facilitate the required risk and reliability assessments. The GIS furthermore must facilitate that quasi-real time information can be utilized for updating, documenting and visualizing the development of risk and facilitate in the planning and execution of maintenance activities.

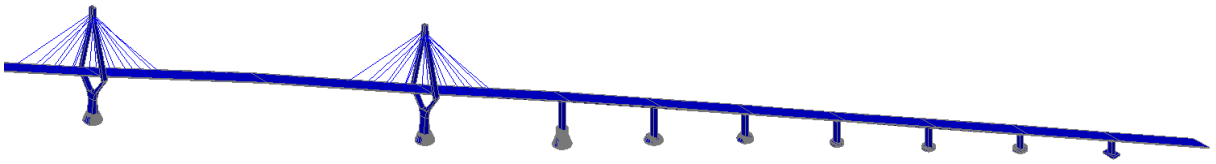

Figure 1. Three-dimension model of Farø Bridges

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