Use of monitoring data for a probabilistic analysis of structures

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Summary

Probabilistic analyses are becoming more and more important in civil engineering. A Probabilistic analysis can be used for the calibration of partial safety factors of the semi probabilistic safety concept of current codes as well as in the context of sustainability evaluations of existing buildings or bridges. The probability of failure, p_f or the safety index β of the system, respectively are the main results of the calculation procedure of a probabilistic analysis. If more information from a structure are available, the uncertainty for the loads and the resistance decrease. For a probabilistic analysis the coefficient of variation for the considered basic variables may become smaller. With the new developments for a commercial use of sensors and of monitoring equipment in the last years the measurement of the parameters of a structure can be done very well. The paper shows the procedure of such an calcualtion and demonstrates the advantage of the use of monitoring data in an example.

Keywords: Monitoring systems, Reliability, ultimate limit state, assessment, probabilistic analysis

1. Introduction

The use of monitoring systems for loads and for the structural response gives additional information about the behaviour of structures, especially about the variation of the monitored parameters.The definiton of monitoring by mechanical means is the systematic recording, observation and automatically interception with technical facilities. The monitoring data leads to a decrease in uncertainty. With a probabilistic analysis for the calculation of the probability of failure p_f and the reliability index β, it is possible to consider the additional information of the structure better than with the semi-probabilistic safety concept from the codes. This can be done by the choice of statistical characteristics such as the coefficient of variation of the basic variables for the loads and the material properties in the considered ultimate limit state. The results of such an analysis, for example, are a higher permissible load class at the same safety level, or an extended lifetime.

2. Safety concepts for the assessment of a structure

2.1 Overview of the probabilistic methods

The following Table 1 gives an overview of the current safety concepts for the assessment of a structure.

https://doi.org/10.2749/222137810796012252