ABSTRACT

Nowadays the preservation or renewal of old structures has become more and more important. Many structures erected in the last century are now reaching the end of their predicted lifespan or show at least serious signs of deterioration or damage. A quantification of the actual safety level of a structure would help to decide whether a structure still can be safely used. The information needed can be acquired using structural health monitoring. By monitoring certain parts of the structure ("weak points"), it can be guaranteed that a further increase of damage or deterioration is recognized before a dangerous situation can occur.

The reliability based system assessment of monitored building structures is the further development and optimization of the well known methods of the reliability analysis. The assessment can show the safety level of building structures during the hole life cycle. Therefore it is possible to react contemporary and systematically on critical modifications. This dissertation provides the necessary information and methods for the reliability based system assessment within the structural heath monitoring and shows the application on two prestressed concrete structures.

The reliability based system assessment combines the methods of structural analysis an the methods of reliability analysis. The realistic structural analysis is carried out with the finite element method. An advanced method of the monte carlo simulation is used for the reliability analysis. The interaction of the structural analysis and the reliability analysis is realized with a developed software.

Structural damages can affect the load bearing and deformation behavior and therefore the safety level of the structure. This effect is studied with possible damage scenarios based on the analysis of representative structures.

The reliability based system assessment of concrete structures starts in the first step with the analysis of a structure assumed as non damaged. The results show possible weak points of the structure and relevant parameters. The second type of analysis is used for prognosis based on postulated damage scenarios. It estimates the future development of the reliability of the structure. With the help of the results of these analyses, further decisions concerning inspection, monitoring and rehabilitation measures can be made. In terms of monitoring it is possible to establish quantitative threshold values. The target reliabil-

ity is no longer ensured if these values are exeeded. A new assessment of the structure is necessary when the inspection or monitoring of the weak points and relevant parameters show a modification.

The dissertation describes the basic approach of the reliability based system assessment of concrete structures to be used for optimization of structural health monitoring. The approach is shown on two prestressed concrete structures. Its analog application on different structures is possible, but the damage scenarios and failure criterions have to be specified for each type of structure.