The reassessment of existing load bearing structures – implementation into the swiss standard

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1. INTRODUCTION

Structures are planned and designed to fulfil certain requirements in regard to the safety of the users and in regard to the reliability of the fulfilment of the purpose of the structures over the prospected service life. The fulfilment of these requirements is often understood as the performance of the structure. Usually the design follows the relevant codes and standards and in general it is assumed that a structure designed according to these codes is efficient and fulfils the given requirements. Sometimes however, the conditions presumed in the design of the structure, including its exposure to loads and environment during the service life are violated or subject of changes. In these cases the reassessment of the performance of existing structures becomes necessary.
Apart from standard ISO 13822 (International Organization for Standardization ISO 2001), most available codes (incl. the CEN Structural Eurocodes) have been written for the design of new structures and therefore lack of adequate tools and formulations needed for the reassessment of existing structures. CEN/TC 250 therefore recently has decided to include the reassessment of existing structures in the strategy plan as a possible item for the further development within the Eurocode programme (CEN/TC 250 2008).
Recent efforts in Switzerland aim at editing a new series of standards for the maintenance and reassessment of existing structures. The present paper reflects the main innovative aspects of this new generation of structural codes and sums up the basic procedural steps of codified reassessment of structures.

1.1. Structure of the code

The Draft Swiss Code SIA 269 for the assessment and maintenance of existing structures (Swiss Society of Engineers and Architects 2007) includes the following main parts:

- General (examination, monitoring and maintenance, economic and cultural value)
- Requirements (use, structural safety, serviceability, proportionality/effectiveness of maintenance interventions)
- Updating (actions, properties and condition of construction products and soil/foundation, structural model, geometry, ultimate resistance, deformations)
- Structural analysis and verification (deterministic and probabilistic)
- Examination (procedure, condition survey and evaluation, recommendation of maintenance interventions)
- Maintenance interventions (concept, realisation, monitoring, maintenance, immediate measures, additional measures regarding safety, repair, modification)
- Construction documents (service criteria agreement, service instructions, basis of design, history of the structure, hazard events, monitoring and maintenance plan, inspection reports,

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result of monitoring, documents resulting from examination and maintenance interventions, record/plans of construction)
- Annex (stepwise procedure in examination, updated examination values, hints for the probabilistic verification).

2. CONCLUSIONS AND OUTLOOK

2.1. Conclusions

It can be concluded that:

- Assessing existing structures is getting more and more important. Whereas ISO standards and some national codes exist, the structural Eurocode program by CEN up to now lacks of adequate tools.
- The assessment of existing structures should be performed on base of a stepwise procedure with increasing deepening (see Fig. 1).
- Assessing the structural safety and serviceability of new structures to be designed differs from reassessing existing structures because the amount and the quality of available information are different. When reassessing existing buildings all available information has to be made use of by updating the design variables. However the detail of the analysis is subject to the stepwise approach illustrated in Figure 1.
- The deterministic verification of existing structures on base of the well-established partial safety factor concept should be the "usual" case. Updating of the basic random variables is of great importance.
- In cases where either the deterministic verification was not successful or where the costs for strengthening a structure are large, a semi-probabilistic or a probabilistic verification can be helpful. Furthermore it has to be mentioned that the probabilistic approach provides a better basis from which system behaviour can be explored and assessed. This might be advantageous especially for the assessment of existing structures where strength reserves due to system effects can alleviate the need for expensive strengthening.

2.2. Outlook

The provision of a codified basis for the assessment of existing structures is an important step towards the efficient management of our built infrastructure. However, for the implementation of the tools and procedures presented in the present paper it is essential that the additional information that is gathered during the reassessment procedure can be related to the basic variables of the limit state function at hand. It is the responsibility of the corresponding research community to develop and deliver models describing these relationships.

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