

Reliability of exceptional structures

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Abstract

The paper discusses structures for which no long-term experience is noted or that were built only recently. Such structures are called exceptional structures. Many simplifications have been included in the European Standard EN 1990 and the simplified proposals for the design of structures that are classified as reliability class RC3 have been given. Probabilistic analyses that are implemented in this paper check the level of reliability of exceptional structures in case that the proposed simplified corrections of partial factors with the correction factor K_{FI} are used. The results of probabilistic analyses have shown that such an approach does not give an acceptable level of reliability for all load combinations that may be realistically expected. Finally, more complex probabilistic analyses of exceptional structures that include a large number of design situations that would result in calibrated and detailed differentiated values of correction factor K_{FI} are proposed. This way the engineering procedure that is proposed by EN 1990 has preserved its simplicity and ensured the sufficient level of reliability for today already widely represented exceptional structures.

Key words: reliability, exceptional structures, partial factors, reliability class, probabilistic analysis, reliability index

1. Introduction

The basic concepts and procedures for the assessment of reliability of structures are given in detail in the leading European Standard for structures EN 1990 [1] and International Standard ISO 2394 [2]. Additional explanations and bases for the reliability concept are given in the document that was published by the Joint Committee of Structural Safety (JCSS) [3]. According to this standard EN 1990 the basic principle of determining partial factors γ_i and the factors for variable action ψ_i is based on the calibration procedure of the existing structures. It shall be noted here that the calibration of structures from different European countries that were built according to different national regulations and standards has been conducted. Therefore, the obtained results of calibration that were used for the development of European Standard were obtained from the set "European structures". It is obvious that such generalised experience has resulted in many simplifications that have been introduced in EN 1990 so that this standard can encompass most of different ordinary structures.

However, there are structures for which no long-term experience is noted or that were built only recently. Such structures are called 'exceptional'. Considering that EN 1990 is based on ordinary structures, for determining the reliability level of exceptional structures there is another option that is based on experiments. The obtained statistical data from these experiments can be then used for verification by using probabilistic methods. Considering that experiments are extremely expensive