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# Reliability Levels of Reinforced Concrete Bridges Obtained by Mixing Approaches

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**Abstract :** Reinforced concrete bridges designed by code are intended to achieve target reliability levels adequate for the geographical environment where the code is applicable. Several methods can be used to estimate such reliability levels. Many of them require the establishment of an explicit limit state function (LSF). When such LSF is not available as a close-form expression, the simulation techniques are often employed. The simulation methods are computing intensive and time consuming. Note that if the reliability of real bridges designed by code is of interest, numerical schemes, the finite element method (FEM) or computational mechanics could be required. In these cases, it can be quite difficult (or impossible) to establish a close-form of the LSF, and the simulation techniques may be necessary to compute reliability levels. To overcome the need for a large number of simulations when no explicit LSF is available, the point estimate method (PEM) could be considered as an alternative. It has the advantage that only the probabilistic moments of the random variables are required. However, in the PEM, fitting of the resulting moments of the LSF to a probability density function (PDF) is needed. In the present study, a very simple alternative which allows the assessment of the reliability levels when no explicit LSF is available and without the need of extensive simulations is employed. The alternative includes the use of the PEM, and its applicability is shown by assessing reliability levels of reinforced concrete bridges in Mexico when a numerical scheme is required. Comparisons with results by using the Monte Carlo simulation (MCS) technique are included. To overcome the problem of approximating the probabilistic moments from the PEM to a PDF, a well-known distribution is employed. The approach mixes the PEM and other classic reliability method (first order reliability method, FORM). The results in the present study are in good agreement whit those computed with the MCS. Therefore, the alternative of mixing the reliability methods is a very valuable option to determine reliability levels when no close form of the LSF is available, or if numerical schemes, the FEM or computational mechanics are employed.

**Keywords :** structural reliability, reinforced concrete bridges, combined approach, point estimate method, monte carlo simulation
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