Time-variant reliability analysis of deteriorating structures

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Abstract

Civil engineering structures are as a rule exposed to unfavourable environmental effects and various time-variant actions. Analysis of structural reliability may then require appropriate description of the load combination under non-stationary conditions due to deterioration.

In the present contribution it is assumed that time-variant actions like imposed and climatic loads can be well described by rectangular wave renewal processes with intermittencies, Rackwitz (1998). Time-variant analysis is then based on the outcrossing approach, Bolotin (1981) and Sýkora (2011), coupled with application of the Laplace transform.

In a case study the proposed procedure is applied in the assessment of an existing road bridge. Failure probability related to a given remaining working life is estimated considering probabilistic models for traffic and thermal actions based on measurements. Results based on the proposed procedure are compared with those based on the PHI2 method, Andrieu-Renaud et al. (2004).

The submitted study indicates that reliability of deteriorating structures exposed to the combination of time-variant loads can be analysed using the proposed procedure. The numerical example reveals that this technique is efficient with respect to computational demands and yields sufficiently accurate estimates of the reliability level. Moreover, partial factors to be applied in a deterministic verification can be readily derived.

References

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