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Keynote Paper

Global Factor Method for Safe Non-Linear Analyses

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ABSTRACT

The keynote lecture presents the Global Factor approach introduced in the new European Model Code 2020 by G. Monti, M. Hendricks, M. Engen, and D. Allaix, for performing non-linear analyses (NLA) according to a given reliability target.

The underlying concept is that the mean capacity of a structural system, expressed in terms of any usable quantity with reference to any Limit State (LS) of interest, is usually evaluated through NLA, using the mean values of the basic parameters.

The design value of such capacity, that is, the one meeting a given reliability target, can be obtained from a full probabilistic approach. However, from a code standpoint, where more practical and affordable methods are adopted, an alternative simpler approach is preferred, where the design value is obtained by applying a Global Factor to the mean outcome of a NLA.

The innovative aspect is that such global factor is obtained from a probability-based interpretation of the non-linear response of a structural system. As concurrent local failure mechanisms (LFMs) develop within the structure, they are logically arranged as an alternate hierarchy of series and parallel subsystems, based on their position and role within the structural system. This process can be easily performed while the NLA is being carried out. This allows expressing the design value of the system global capacity through an analytical expression. From this, a general equation for the Global Factor is derived, as function of the target reliability and of some essential features of the structural system response.

The generality of the method allows its adoption for any LS-exceedance, not only collapse, so that global factors can be estimated for any LS of interest. The method relies on a consistent definition of the global LS-exceedance, as derived directly from the corresponding LS-exceedance in the LFMs. No alternative metrics (e.g., interstory drift) or phenomenological criteria (e.g., collapse at 85% of the peak capacity) are needed. Overall, the method requires running a single non-linear analysis with mean values of the basic variables, plus, if needed, one perturbation analysis to compute the sensitivity of the outcome with respect to the basic variables of the LFM identified as critical. Both assumptions of uncorrelation and full correlation among the basic variables of the LFMs are considered.

The potential of the method is shown through some applications to different structural systems of increasing complexity.