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Effect of Correlation of Random Variables on Structural Reliability Index

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Abstract : The problem of correlation between random variables in the structural reliability analysis has been extensively discussed in literature on the subject. The cases taken under consideration were usually related to correlation between random variables from one side of ultimate limit state: correlation between particular loads applied on structure or correlation between resistance of particular members of a structure as a system. It has been proved that positive correlation between these random variables reduces the reliability of structure and increases the probability of failure. In the paper, the problem of correlation between random variables from both side of the limit state equation will be taken under consideration. The simplest case where these random variables are of the normal distributions will be concerned. The case when a degree of that correlation is described by the covariance or the coefficient of correlation will be used. Special attention will be paid on questions: how much that correlation changes the reliability level and can it be ignored. In reliability analysis will be used well-known methods for assessment of the failure probability: based on the Hasofer-Lind reliability index and Monte Carlo method adapted to the problem of correlation. The main purpose of this work will be a presentation how correlation of random variables influence on reliability index of steel bar structures. Structural design parameters will be defined as deterministic values and random variables. The latter will be correlated. The criterion of structural failure will be expressed by limit functions related to the ultimate and serviceability limit state. In the description of random variables will be used only for the normal distribution. Sensitivity of reliability index to the random variables will be defined. If the reliability index sensitivity due to the random variable X will be low when compared with other variables, it can be stated that the impact of this variable on failure probability is small. Therefore, in successive computations, it can be treated as a deterministic parameter. Sensitivity analysis leads to simplify the description of the mathematical model, determine the new limit functions and values of the Hasofer-Lind reliability index. In the examples, the NUMPRESS software will be used in the reliability analysis.

Keywords : correlation of random variables, reliability index, sensitivity of reliability index, steel structure
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