

Probabilistic properties of limit-state location in directional simulation in load space

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Summary

Among varieties of techniques to estimate structural reliability, directional simulation is well developed. This technique was first proposed to be used in standard Gaussian space where all random processes/variables are involved [1]. The main advantage of this procedure is that in each directional sample a closed form expression is available to estimate structural probability of failure conditioned on the sampled direction. The technique was then extended to a space in which all random variables/processes are involved, but they are not necessarily Gaussian [2,3]. Furthermore, Melchers [4] proposed this technique to be utilized in the load space rather than the space of all loads and structural resistances. This idea made it possible to work in a lower dimensional space which in turn made the calculations more efficient. As expected, however, in this space the location of the relevant limit states, due to structural resistance variability, is not constant. In order to take this variability into account different approaches were discussed (see [4]). One approach was that for differentiable limit states, by invoking the central limit theorem, a simple normal distribution is assumed to model the limit states location variability along each direction simulated. This required only two first moments of the relevant direction variable to be found. It is, however, of interest to examine the accuracy of the results obtained by making the above assumptions. In this paper the issue of probabilistic description of the structural resistance variability (along each simulated direction) is discussed in more detail. The probable un-accuracies which may happen due the above assumptions will be investigated and then effort will be made to propose solutions to improve the results.

keywords: Directional Simulation, Load Space, Resistance Variability, Limit state.

References

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