

The Effect of Ignoring Dependence between Failure Modes on Evaluating Structural Reliability

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Abstract

Statistical dependence between failure modes induces a difficulty in evaluating structural reliability. Instead, the dependence is often ignored and the sum of individual reliabilities has been used as a conservative approximation. However, it is not well known that the error of ignoring dependence between failure modes depends on the level of reliability. In many cases, engineering structural systems require a high level of reliability in which a structural failure is rarely seen. In such a rare failure event, the dependence between failure modes becomes loose, and therefore, the error of ignoring dependence also becomes small. This paper focuses on quantifying the effect of ignoring dependence in multiple failures modes with various copula models. It is found that the effect is ignorable even with the presence of high statistical dependence, $\rho = 0.8$, between failure modes when the reliability index of interest is greater than 3.6.

Keywords: Multiple failure modes; Statistical dependence; Reliability evaluation