Modeling of failure surface of a reinforced concrete slab with fuzzy loading-an interval approach

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Abstract

In this paper, a two-way reinforced concrete slab subjected to uncertain loading is analyzed. The uncertainty in loading is defined by a fuzzy membership function. The interval values of load at specified levels of uncertainty are extracted from this membership function using the α-cut approach. Pownuk's sensitivity analysis approach and Muhanna's interval finite element approach are used to determine interval values of generalized displacements of the slab.

Post-processing is performed to obtain the interval stresses in concrete and steel along long span and short span directions of the slab. Fuzzy membership functions of stresses in concrete and steel are obtained by using the procedure suggested by Muhanna and Mullen, Rao and Chen, Moens and Vandepitte.

The interval stresses obtained from the analysis are used to define the interval failure surface. A mathematical model for the interval version of Drucker-Prager yield theory is developed for this purpose. A nested family of interval failure surfaces is utilized to construct a fuzzy membership function for yield surface. Further, the sensitivity of failure surface with

reference to corresponding change in loading is evaluated. The present approach allows the designer to have a detailed knowledge about the effect of uncertainty on the stress distribution of the slab and its failure pattern.

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