Imperfection Modeling Using Finite Element Approach with Particular Discretization

AM El-Kholy, UA Morsy, SA Mourad - Journal of Structural Engineering 140 (7), 04014034, 2014,

This research presents an attempt to improve the modeling of imperfections in structures using finite element approach with particular discretization. This approach, termed the modified finite element beta method (MFEM-β), is an improvement of a finite element scheme that can handle displacement discontinuity. In MFEM-β, a multi-linear isotropic hardening model is implemented, a random imperfection procedure is proposed and a modified failure treatment is adopted. The paper reviews the progression of the original scheme, presents the proposed imperfection procedure and uses the results of two experimental tests to demonstrate the imperfection effect on the failure of uniaxailly elongated plate and to validate MFEM-β. The proposed method simulates the boundary and internal imperfections and controls the intensity and distribution of the imperfections using six input parameters to randomly assign the imperfections to the numerical model. Showing an advance over the original scheme, the predicted stress and strain distributions of an imperfect cylinder under pressure are realistic. Also, the predicted crack path and failure load for an elongated imperfect steel plate match well the experimental results.