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Prediction of the bolt fracture in shear using finite element method

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Abstract

This study was aimed to propose appropriate failure criteria for bolt fracture prediction in shear when threads are excluded from the shear plane. In this regard, the finite element methods for such prediction were divided into two main categories and for each category the available methods were discussed. Then, using finite element modeling and available experimental results of previous researchers, three methods here referred to as MTD1, MTD2 and MTD3 were proposed. MTD1 and MTD2 were based on the monitoring of the level of stress and strain at the critical elements of the bolt shank, while MTD3 was based on the extended finite element method and consisted of two main steps including defining crack initiation and crack evolution. Analytical results indicated that MTD1 and MTD3 were reasonably acceptable for prediction of the bolt fracture in shear with negligible amount of error. Method MTD1 is a suitable method when a progressive collapse analysis is not of interest and only the capacity of the system at the onset of the first bolt fracture is required. However, MTD3 can be used in a progressive collapse analysis where the amount of reduction in a system strength by fracturing of each component is of interest. However, in comparison to MTD1, MTD3 is remarkably time consuming.

Keyword: Bolt fracture, extended finite element method, bolt shear strength, finite element modeling

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