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An Efficient Numerical Method to Define Failure Surface for Concrete Structural Members Repaired by Steel Jacket

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Abstract

In seismic retrofitting of existing old buildings or reforming the earthquake harmed buildings, sometimes it becomes necessary to improve the seismic performance of concrete sections against future earthquakes by applying steel cover. Thus, prediction the factual behavior of steel covered concretes against lateral loads is important and needs implementation of nonlinear analysis and considering materials nonlinear behavior. To perform nonlinear analysis having access to details of section's failure surface is essential. The failure surface of a cross section can be defined as the locus of points that correspond to ultimate strength. In this article a quick and efficient numerical method based on fibre method concepts is presented to determine failure surfaces for steel covered concretes. Moment-curvature diagrams, bending moment-axial force interaction curves and biaxial bending-axial force failure surfaces are defined by this method. The predicted results show high correlation with experimental results.

Keywords: concrete sections coverd by steel jacket, numerical method, nonlinear analysis, failure surface, interaction curve.

1. INTRODUCTION

In this recent modern world with development of industrial societies and economy propagation, structures get more enormous, complicated and higher and novel construction systems have been expanded. Simultaneous usage of different material such as concrete, steel bars, prestressed concrete, concrete casing, steel jacketing and etc in modern structures have been prevalenced. Afterwards objects like earthquake and fire resistance, ductility, durability caused prime concerns for engineers. Through them the subject of structures's resistance against earthquake and prediction their behavior against seismic lateral loads become one of the most important engagements for scientist. In dissertation of resistance against lateral loads in existing old buildings or seismic harmed structures, utilizing of steel covered concretes is posed. Concrete structural members repaired by steel jacket are used to retrofit existing old buildings or to reform seismic harmed buildings. Hence, prediction their nonlinear behavior against seismic lateral loads is in particular importance. One of the most capable and effective procedures for prediction the nonlinear performance of structural members, subjected to external loads, is by determination and checking the generalised stresses for exceeding the elastic limit by comparison with axial force-biaxial bending moments failure surface [1]. Despite of widespread studies on comprehension the nonlinear behaviour of concrete, nonlinear modeling of concrete is still one of the most contentious objects in the field of civil engineering. Cause of complexity of conctere's substantial traits, development of accurate constitutive models which are reliable in nonlinear analysis is difficult [2]. In this work, a new and simple numerical method for construction of the failure surfaces for concrete structural members repaired by steel jacket is represented. Advantages of this algorithm are accurate nonlinear modeling in compression and tension for concrete and elastic perfect plastic behaviour for steel cover. The failure surface is widely used in damage analysis, where a damage index can be derived from the distance of the current load state to failure surface[3].

A failure surface is made up of some interaction curves for different neutral axis rotations, on the other part, an interaction curve is constructed point by point via the pick value of moment-curvature diagram for various values of axial load. So, for simplifying the verification of proposed algorithm axial force-bending moment interaction curves are regarded. To prove the accuracy and veracity of the proposed algorithm, axial force-bending moment interaction curve for a rectangular RC section that beforehand was obtained by Penelis and Kappos [4] by experimental data and after them Sfakianakis [5] used their results in his investigations, is selected. The numerical results are in accordance with experimental data. At the end, to