NOM – Prénom
DOULGEROGLOU Androniki-Anna

TITRE DE LA THESE

A novel macroelement to assess the vulnerability of reinforced concrete frame structures under severe dynamic loadings

Résumé

This thesis has been carried out in collaboration with Ecole Centrale Nantes and Groupe-ESSOR (*thèse CIFRE*). The main objective is to develop a simplified tool to numerically study the vulnerability of Reinforced Concrete (RC) frame structures subjected to severe dynamic loads and their behavior till failure, based on the macroelement concept, the beam theory and the Embedded Finite Element Method (E-FEM). A 3D finite element model of a RC structural element is first built and suitable constitutive laws are adopted. Numerical simulations considering various 3D loading combinations of axial, shear and flexural loads, are carried out in order to identify characteristic states of the beam sectional response. 3D interaction diagrams for symmetrically reinforced concrete square sections with various reinforcement ratios are obtained and a simplified stress-resultant constitutive model is implemented in a Timoshenko beam finite element. The softening behavior till failure is finally reproduced by coupling the continuous stress-resultant model to a cohesive model, which describes the response in terms of generalized force - generalized displacement jumps, within E-FEM. Comparisons with experimental results show the performance of the novel macroelement which is simple to use and computationally fast, making it suitable for engineering design purposes.

Mots-clés : Reinforced concrete; FEM; Interaction diagrams; Timoshenko beam; E-FEM; Strong Discontinuity.