Ek A2

University : **İstanbul Technical University**

Institute : **Institute of Science and Technology**

Science Programme : **Civil Engineering**

Programme : **Structural Engineering**

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Degree Awarded and Date : **PhD – June 2013**

ABSTRACT

LARGE DEFLECTION AND ELASTO–PLASTIC ANALYSIS OF MINDLIN PLATES WITH MIXED FEM

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This dissertation is concerned with the large deflection and elasto-plasti analysis of Mindlin plates in the framework of a two field mixed variational formulation. By adopting the formulation innovative solution strategies are proposed for mixed finite element procedure with monolithic approach. In this study large deflection bending responses based on von Karman kinematics uploaded to Mindlin's first order shear deformation assumptions are applied to laminated composite plates. Variational principle of Hellinger-Reissner is used two obtain the first variation of functional of the problem. Non-linear finite element equations are linearized by means of the incremental formulation. Elasto-plastic analysis of isotropic Mindlin plates were conducted with layered approach inorder to detect the spread of the plasticity through the plate thickness. A 3-D full implicit algorithm (backward Euler) is employed for the numerical integration of constitutive equations. C0 quadrilateral elements are generated according to a 2×2 Gauss integration scheme. Numerical problem is solved with Newton-Raphson iteration method. For both geometrically and materially non-linear problems, the proposed solution strategies are verified by solving the problems existing in the literature. It is observed that the presented formulation can predict the stresses in laminated plates very accurately and simulate the elasto-plastic behavior of plates successfully.

Keywords: Mixed finite element methods, Hellinger-Reissner, Mindlin plate, Large deflection, Elasto-plastic analysis