ANALYTICAL STUDY BY FINITE ELEMENT METHOD FOR CONCRETE
CONFINEMENT IN TIED COLUMNS

by

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B.Sc. in Civil Engineering, 1984

Thesis Submitted in Partial fulfillment of the
requirements of the degree of Master of Science in
Civil Engineering
Jordan University of Science and Technology

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April, 1988
ABSTRACT

The present equations of design of tied reinforced concrete columns do not consider the confinement effect of lateral reinforcement. However, it has been found that ties contribute to the ultimate strength of the member.

An analytical investigation into the behavior of square reinforced concrete columns is described. A model for the confinement mechanisms in tied columns has been developed. The model is based on the finite element results. The strength of the confined concrete is calculated by using the concept of the effectively confined concrete area within the nominal concrete core. A complete stress–strain curve for confined concrete is proposed. The influence of volumetric ratio of lateral ties, and the distribution of longitudinal bars around the core is investigated.

A general approach for nonlinear analysis of reinforced concrete columns based on the finite element method, and using Cedolin, Crutze, and Deipoli's material model for concrete, is presented. The general approach accounts for concrete cracking with a tension stiffening effect, multiaxial behavior and strength properties of concrete under generalized stress condition, nonlinear stress–strain characteristics of the steel, and the shear stiffness in cracked element due to aggregate interlock and dowel action. This approach is useful in enabling the nonlinear analysis to be performed using a
linear finite element program (SAFIV). Three-dimensional finite elements are used to model the concrete and three-dimensional truss elements to model the steel.

Before the general procedure of analysis is applied to analyze the reinforced concrete columns, a plain concrete column is analyzed to assess the applicability of the proposed method of analysis. Good agreement is obtained between experimental and finite element results. Then, reinforced concrete columns with different volumetric ratios of lateral ties are analyzed.