OPTIMAL DESIGN FOR COMPOSITE COLUMNS UNDER BIAXIAL BENDING

Mohamed A. A. EL-Shaer

ABSTRACT
This paper presents an efficient computer-based method for optimal criteria design of composite columns under biaxial bending. The width, depth and steel section are taken as the design variables. The strength constraints for the design are formulated using the finite element method. The method solves columns having any slenderness ratio taking into consideration the material non-linearity due to the change in stress-strain curves of steel and concrete, and geometric non-linearity due to the change of the path of the beam column during deformation. The formulation depends on the principle of Virtual Work. An optimality criteria method is applied to minimize the cost of concrete, steel, and form subject to constraints on strength and stiffness. Five full composite concrete columns examples are presented to illustrate the features of the design optimization method.

It is shown that the design method provides an effective iterative optimization strategy that converges in relatively few cycles to a least-cost design of reinforced concrete element satisfying all relevant requirements of the governing design code. The iterative process is insensitive to the selected initial design and converges smoothly to a final design involving column dimensions and steel section consistent with usual design practice. A complete computer program has been developed to solve the problem of full composite-columns under biaxial bending for any slenderness ratio.

KEYWORDS:
Composite columns, concrete-steel columns, finite element, material and geometric non-linearities, incremental loading, Virtual work, optimization.