

Optimum design of continuous partially prestressed concrete beams

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Civil Engineering

January 1991

Abstract

A comprehensive method for the minimum cost design of a two-span continuous, uniformly loaded, fully or partially prestressed concrete beams is presented. The prestress losses along the tendons profile are calculated exactly during the transfer and service stages. Variable prestressing force along tendons profile, which may be jacked from one end or both ends with flexibility in overlapping range and location, and the induced secondary effects are considered.

The design variables represent the geometry of a uniform unsymmetric I-cross section, areas of prestressing steel, tensile and compressive mild reinforcement and tendons profile geometry. The imposed constraints are on flexural stresses, ultimate flexural strength, cracking moment, ultimate shear strength, and cross section and cables profile geometries. The optimum design is in accordance with ACI 318/83 code provisions. Minimum total cost of the member, as a design criterion, in terms of concrete, prestressing steel, tensile and compressive mild reinforcement shear stirrups and form-work, is adopted. The resulting optimum design formulation at the member level is highly nonlinear in cost function and constraints with a total of thirty design variables.

A computer program PCBDOS, which stands for prestressed concrete beams optimization system, is developed. Parametric study related to section height and shape optimization, load intensity and span length influence as well as units cost sensitivity analysis is carried out through several examples of applications.