COST OPTIMIZATION OF COMPOSITE BEAMS USING GENETIC ALGORITHMS

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ABSTRACT

This paper presents a genetic algorithm model for the cost optimization of composite beams based on the Load and Resistance Factor Design (LRFD) specifications of the AISC. The model formulation includes the costs of concrete, steel beam, and shear studs. Two examples taken from the literature were analyzed in order to validate the model, to illustrate its use, and to demonstrate its capabilities in optimizing composite beams. The results obtained show that the cost optimization model achieved substantial cost savings and consequently can be of practical value to structural designers.

Keywords: Genetic algorithms; cost optimization; composite beam; information technology (IT), computer-aided design

INTRODUCTION

Composite floor construction is widely used in commercial multistory buildings. An economical design is often achieved by attaching a concrete deck to the top (compression) flange of steel beams to carry the maximum positive moments. To create a composite floor, a concrete slab is often mechanically connected to a hot-rolled steel section by shear connectors/studs.

The design of composite beams is complicated and highly iterative. Depending on the design parameters a beam can be fully or partially composite. In the case of the design on the basis of the LRFD code (AISC, 1999), the plastic deformation has to be considered. A source of complexity is due to the fact that the location of the plastic neutral axis (PNA) can be within the concrete slab, the steel beam flange, or the steel beam web (Figures 1 and 2). Since the value of a design parameter affects other values, all design parameters cannot be found simultaneously. In practice, slab thickness and the size of shear studs are often chosen by engineers somewhat arbitrarily.