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Cost Optimization and Sensitivity Analysis of Composite Beams

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Abstract

This study presents exact solution analysis for the cost optimization of Composite Beams (CB) based on the Load and Resistance Factor Design (LRFD) specifications. Matlab code formulation is applied to analysis of sensitivity for various parameters such as cost of concrete, steel beam, span length, concrete slab thickness, compressive strength of concrete, steel beams space and shear connectors on CB. Almost 20 thousands design were analysed to obtain various contour which be found that it is feasible, efficient and effective and capable in optimization of composite beam designs.

The obtained results represent that many of the contour are capable by achieving substantial cost savings for composite materials. Therefore, the analysis can be developed for practical designs to structural designers. A parametric study was also conducted to investigate the effects of IPE, IPB, INP profiles, UNP size and thickness of slabs and beam length on the cost optimization of CB.

Keywords: Composite Beam;Cost Optimization; Sensitivity Analysis.

1. Introduction

The design of composite beams is highly iterative and complicated which is depending on the design parameters a beam can be fully composite or partially composite. In the case of design has to consider plastic deformation on the basis of the LRFD and American Institute of Steel Construction (AISC) codes. Many researchers has been applied cost optimization of composite beam using prediction models such as neural dynamics, discrete using a floating point genetic algorithm, one way waffle slab and slab formwork using charged system search algorithm, social harmony, improved harmony search, ant colony system and genetic algorithm models [1-11]. Adeli and Kim [12] implemented genetic algorithm to cost optimization of composite floor. The total cost function includes the costs of concrete, steel beam, and shear connectors. And design was based on the AlSC and LRFD in the plastic design concepts. Based on a comparison with example designs presented could concluded that a formal cost optimization can result in substantial cost savings. In another one [13] three different materials: concrete, steel, and formwork used to minimize the cost as well as weight minimization which can be applicable for beams, slabs, columns, frame structures, bridges, water tanks, folded plates, shear walls, pipes, and tensile members. The concluded that life-cycle cost optimization of structures where the life-cycle cost of the structure over its lifetime is minimized instead of its initial cost of construction only.

In another view of this work due to sensitivity analysis of optimization is better to mention some work what has been done prior. There is some works on sensitivity analysis such as sensitivity analysis of reinforced concrete beams, composite floor systems channel-section and hollow-section trusses, design optimization of shell and tube heat exchangers, Structural optimization, honeycomb sandwich cylindrical columns under axial crushing loads, frequencies and modes for composite laminated structures, lateral-torsional buckling resistance of steel beams, machine repair problem and frequency sensitivity analysis for beams carrying lumped masses with translational and rotary inertias [14-23]. Hongbone is study the economic optimization and sensitivity analysis of photovoltaic system in residential

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