3rd International Conference on Steel & Structure
11-12 December 2018
Olympic Hotel, Tehran, Iran

Analytical Shape Optimization of Metal Deck with respect to Bending Capacity

*Nader Fanaie[1], Payman Rajaeian[2]

Abstract

Metal decks are commonly used in building construction as well as bridge industry as formwork for the wet concrete slab. They have ribbed profile with embossments designed to interlock with concrete slab creating a reinforced concrete slab serving the dual purpose of permanent form and positive reinforcement. The in-plane stiffness and strength of the metal forms are widely relied upon for stability bracing in buildings. There have been a number of previous investigations focused on metal decks. This paper aims to determine optimum rib height of the section so as to achieve maximum bending capacity. To this end, by keeping the whole length of the plate in a period being constant, its elastic section modulus is extremized, which results in $h_r = 3W_r$ as optimum condition, where h_r and W_r are rib height and rib width, respectively. To the authors' knowledge this is the first time that such analytical calculations are being performed.

Keywords: metal deck; rib height; bending capacity; elastic section modulus; optimization

Introduction

Over the past few decades, steel and concrete have been widely used in construction, especially composite floor consisting of a concrete deck systems poured on top of corrugated steel sheets. Steel-concrete composite structures are those which have the merits of both used materials. A merit of such structures is their high bending strength. Being strong, lightweight, cost-effective, and easy to install, metal decks are commonly utilized in building construction as well as engineering practice. As shown in Fig. 1, metal deck is made by cold forming of structural steel sheet into a repeating pattern of parallel ribs (SDI, 3rd edition). The concrete thickness above the top of the steel deck shall not be less than $50\,\text{mm}$, nor that required by any applicable fire resistance ratings requirements. Minimum concrete cover for reinforcement shall be in accordance with ACI 318 (ANSI, 2011). Fig. 2 illustrates steel headed stud anchors, as

*1 .Corresponding author, K.N. Toosi University of Technology, Civil Engineering Department, No. 1346,Vali-Asr Street, P.O. Box. 15875-4416, 19697 Tehran, Iran, Tel.: +98 21 8877 9623, Email: fanaie@kntu.ac.ir
2. Iran University of Science and Technology, Tehran, Iran, Email: Payman.civil2012@gmail.com