



Industrialized light-weight steel bridge concept using corrugated core steel sandwich plates

Peter Nilsson

WSP | Parsons Brinckerhoff / Chalmers University of Technology

Mohammad Al-Emrani

Chalmers University of Technology

Contact: peter.c.nilsson@wspgroup.se

Abstract

A corrugated core steel sandwich plate is a high-performance all-steel structural element. It consists of two outer steel plates separated by a folded corrugated core plate. Connecting the three plates can be made through hybrid laser-arc welding. In bridge applications, steel sandwich bridge decks bring several benefits compared to conventional orthotropic decks; better load distribution, higher stiffness to weight ratio and a more industrialized production and construction process.

This paper presents a background to the concept of steel sandwich bridge decks and comparisons are made to conventional steel bridge decks in a qualitative and quantitative manner. The results from a study on the impact of the weld joint configuration on the fatigue performance and transverse shear stiffness is presented. In addition possible applications of sandwich bridge decks are discussed based on case studies. The results show that weight saving with up to 44% can be achieved by replacing conventional orthotropic decks with steel sandwich plates.

Keywords: Bridge deck, corrugated core sandwich, transverse shear stiffness, hybrid laser welding.

1 Introduction

The design of steel bridge decks has remained unchanged since the 1970's. A conventional orthotropic bridge deck consists typically of a deck plate and longitudinal open or closed stiffeners. For reasons related to production costs, all-steel bridges are only used where the stiffness to weight ratio is the driving factor in design [1] [2]. Conventional orthotropic bridge decks has frequently been reported to suffer from extensive fatigue damage and premature deterioration [2]. Increased deck plate thickness and geometrical constraints has been suggested to overcome these problems [2]. A steel sandwich panel (SSP) is an all-steel high-performance orthotropic plate, which consists of two outer faces separated by a

core. The core can have different geometries such as corrugated folds or it can be made of conventional hot-rolled I-beams. The cross-section of a steel sandwich plate with a corrugated core is shown in Figure 1. When used as a bridge deck, steel sandwich plates provide an increased bending and in-plane shear stiffness. Contrary to conventional stiffened plates, sandwich plates have a more pronounced plate behaviour which further enhances their stiffness and load-carrying properties. In addition, sandwich decks act more efficiently with the underlying structural elements giving better material utilization. Together, these factors, along with good fatigue performance can give a reduction of 20 – 40% of the total weight of the structure [1][3][4][5]. Therefore, steel sandwich bridge decks can make all-steel bridges