Stainless steel as a structural material in the drive toward net-zero bridges

Andrew Backhouse

Outokumpu Stainless Ltd, Sheffield, UK

Nancy Baddoo

The Steel Construction Institute, Ascot, UK

Contact: andy.backhouse@outokumpu.com

Abstract

In the last few decades, duplex stainless steels have emerged as a candidate material for bridges situated in demanding environments. This paper outlines some of the new design rules in the Second Generation Eurocode for stainless steel, EN 1993-1-4, which are relevant to bridge structures. A main factor in choosing to use stainless steel in bridge building is longevity and very low lifetime maintenance requirements. The outcomes of a recent life cycle cost (LCC) comparison between a carbon steel and duplex stainless steel road bridge are presented. In recent years the carbon footprint of bridges has started to become more important. This paper outlines the current state of the art with respect to the carbon footprint of stainless steel production and offers an insight into how the use of stainless steel can reduce the carbon footprint of a bridge.

Keywords: Stainless steel; Eurocode 3; durability; bridge; composite; life cycle cost; carbon footprint

1 Introduction

The last decades of the 20th century saw advances in steelmaking technology and the development of a family of high strength and durable duplex stainless steels with properties that are suitable for a wide range of structural engineering applications. Stainless steel began to emerge as a candidate material for bridge construction at the beginning of the 21st century. Duplex stainless steels are the most widely used stainless steel family for structural components in bridges due to their superior strength and excellent corrosion resistance, weldability and fracture toughness. More than 30 bridges have been constructed using duplex stainless steels over recent years, including the new road bridge at Pooley Bridge in the UK (Figure 1), pedestrian bridges in the towns of Haro and Aguilas in Spain, and railway bridges in Stockholm. For further examples see references [1,2,3].

Although the cost of stainless steel per tonne is higher than that of carbon steel, the high strength of duplex stainless steel (F_y ~460MPa) allows this to be partly mitigated and the high durability is an important advantage when considering whole life costs.

In addition to iron, the main constituents of stainless steel are chromium, nickel and sometimes

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