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Designing sustainable footbridges: comparing steel, concrete and FRP.

Liesbeth TROMP
FRP Engineer/Consultant
Royal HaskoningDHV
Rotterdam, The Netherlands
Liesbeth.Tromp@RHDHV.com

Over 20 years experience in designing FRP (architectural) footbridges, vehicular bridges. Member of CEN-TC250 WG4 working towards and FRP Eurocode.

Kees van IJSELMUIJDEN
Bridge Engineer
Royal HaskoningDHV
Amsterdam, The Netherlands
Kees.van.IJselmuijden@RHDHV.com

Civil engineer with >20 years experience in bridge engineering in concrete and FRP. Working on automated design for additive manufacturing.

Jorrit ZUIDEMA
LCA Specialist
Royal HaskoningDHV
Amersfoort, The Netherlands
Jorrit.Zuidema@RHDHV.com

As a consultant, Jorrit facilitates sustainable development. His focus is on environmental impact assessments (LCA and carbon footprint).

Contact: Liesbeth.Tromp@RHDHV.com

1 Abstract

More and more clients and the public are asking for sustainable and circular solutions for infrastructure. Many opinions and often prejudice exist on the sustainability of each material. However, sustainability is just as much a design property as a material property. To illustrate how choices made by the designer affect the environmental impact of the structure, this study compares solutions in steel, concrete and Fibre Reinforced Polymer (FRP) for footbridges of 15m and 25m span as they exist today. Boundary conditions have been set in advance and the designs have been prepared to the same level of depth by senior engineers with comparable expertise in the respective materials. The concepts have been compared on CO_2 -emissions over the life cycle, including maintenance. End-of-life (EoL) scenarios are described qualitatively but it is debated how to include these in the CO_2 -emissions, as in a 100 years' time technologies for recycling will be substantially different from today's. Including the EoL in this comparison study therefore means that a uncertain parameter is made part of the equation. Use has been made of the EcoInvent database and the EuCIA Eco Impact Calculator, an environmental impact tool developed by the FRP industry association using the latest data available on FRP. This paper identifies the challenges in the assessment of sustainability of the designs, the relevance of certain design parameters and discusses how to deal with future EoL aspects in today's assessment.

Keywords: Sustainability, LCA, Durability, Glass Fibre Reinforced Polymer (GFRP), bridge, low maintenance, design, lightweight engineering, structural analyses.

2 Introduction

In the last 10 years there is a growing awareness in infrastructure for the responsibility to limit our impact on the environment. More and more clients are asking for sustainable solutions. But what exactly is a sustainable design? How can we quantify it? As a community we are still developing this definition as well the associated methodologies.

Often the focus is on the sustainability of the materials we are using. Which is an important aspect, obviously. But designers or engineers make many choices that influence the environmental impact of the design significantly. Sustainability is just as much a design property as a material property.

To illustrate how these choices affect the environmental impact, this study compares solutions in steel, concrete and Fibre Reinforced

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