Life-cycle analysis of the Colne Valley Viaduct and assessment of optimised solutions

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Abstract

The Colne Valley Viaduct (CVV), a 3.4km precast post-tensioned segmental viaduct with 57 spans is set to become the UK's longest railway viaduct. This study aims to carry out a life cycle assessment (LCA) of the CVV. The carbon analysis will focus on the 462m long constant depth deck section of the viaduct, and this will be compared against alternative materials and deck types. The LCA calculations will concentrate on product modules (A1 to A3), the construction process (A4 and A5), the replacement (B4) as per the global warming potential (GWP) indicator in $kgCO_2e$. Calculations will be based on activity data from the CVV Bill of Quantities, selected carbon emission factors (i.e. for electricity or fuel) and generic Environmental Product Declarations for materials purchased. This study intends to highlight any bridge structural components with high carbon emissions, that will need to be tackled in future projects to reach the 2030 and 2050 ambitious UK carbon targets.

Keywords: Bridge design, Life cycle assessment, Carbon emission factors, Optimisation, Concrete, Steel.

1 Introduction

The built environment sector is a major actor in global warming, accounting for at least 37% of global greenhouse gas emissions [1]. With urbanisation intensifying to meet the needs of a growing world population, these emissions are set to increase. To address the major environmental and social challenges of the 21st century, all stakeholders in the construction industry need to ensure that future projects minimise their impact on the environment.

A wide range of solutions based on frugal construction, or the use of bio-sourced materials are available, such as earth concrete or construction with timber. However, these solutions are becoming rarer in the civil engineering sector, particularly for bridges as their limited strength make them more suited to the building industry. Through the example of the Colne Valley Viaduct's (CVV) construction, the aim of this paper is to analyse how the structural design office can play a key role in reducing the environmental impact of the structures they design.

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