Material quantities and embodied carbon of footbridges

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Abstract

The current sustainability assessment methods in the building sector comprise two shortcomings, especially for the environmental impact of bridges, special structures and artworks: they focus mainly on operational energy and they cannot be extrapolated to all infrastructure projects. This paper looks at the environmental impact of footbridges in order to develop a first step toward a methodology to calculate the embodied carbon of infrastructure projects.

Life cycle energy in buildings includes operational energy for heating, cooling, hot water, ventilation, lighting on one hand and embodied energy for material supply, production, transport, construction and disassembly on the other. When looking at infrastructure projects, the embodied carbon becomes the main part of the environmental impact. A methodology is established to calculate the embodied carbon of such structures and is applied to a survey of footbridges.

Keywords: footbridges, environmental impact, embodied carbon, life cycle energy

1 Introduction

This paper addresses two shortcomings in the current sustainability assessment methods of buildings applied to bridges: the existing methods focus mainly on operational energy and they cannot be extrapolated to all infrastructure projects. The environmental impact of bridges is expressed in carbon emissions associated with the life cycle energy of the bridges. Life cycle energy includes operational energy for heating, cooling, hot water, ventilation, lighting on one hand and embodied energy for material supply, production, transport, construction and disassembly on the other. There is a lack of consensus between the many existing tools assessing embodied carbon.

The terms “embodied carbon” and “Global Warming Potential” (GWP) refer to the equivalent in carbon dioxide of all lifecycle greenhouse gas emissions and is expressed in weight of carbon dioxide equivalents (CO_2e).

Improved operational energy efficiency has increased the percentage of embodied energy in the total life cycle of structures. Despite a growing interest in this field, practitioners lack a comprehensive survey of material quantities and embodied carbon in building structures. Moreover, when looking at infrastructure projects, the embodied carbon becomes the main part of the environmental impact, since the operational phase of the bridges and other structures often only includes lighting and traffic. This paper looks at the environmental impact of footbridges as a case study for infrastructures. A first step toward a methodology is established to calculate the embodied carbon of such structures and is applied to a survey of footbridges. In future research, a holistic approach will be developed to

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