Mapping structural engineering strategies for sustainable development

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Abstract

Considering current trends in the Netherlands with regards to sustainability, there is a strong desire at Delft University of Technology to incorporate sustainable structural design strategies in the civil and structural engineering curriculum. Based on literature study and own experiences in practice, a coherent approach was developed, that can help students and practitioners to increase sustainability in their projects. The approach consists of a roadmap with 4 key strategies: increase lifespan of existing structures by reusing them, increase lifespan of existing structural elements by reusing them, design future proof and with a long-life span, and optimise the design for environmental impact. The strategies are explained and illustrated with examples.

Keywords: sustainable structural design, environmental impact, carbon footprint

1 Introduction

Over the past century, humanity has been responsible for releasing large amounts of CO2 (in this paper we will use CO2, for all greenhouse gasses, although CO2equivalent (CO2e) might be more appropriate). As CO2 levels in our atmosphere have risen, so has the global temperature. Our planet is now approximately 1 degree Celsius warmer, compared to pre-industrialization levels. Since 1975 the temperature increased with approximately 0,15-0,2 degrees per decade [1]. This temperature rise has manifested itself through floodings, droughts, hurricanes and fires, leading to large damages on multiple facets.

In 2015 many countries signed the Paris agreement. These countries agreed that global warming should be limited to 2 degrees, preferably 1,5 degrees Celsius, to avoid inevitable, catastrophic, and hard to control consequences. It is evident that a change of behaviour is needed across the whole of society to limit CO2 emissions and get us anywhere near the set target of 1,5 degrees Celsius. To cite the Intergovernmental Panel on Climate Change (IPCC): "… unless there are immediate, rapid and large-scale reductions in greenhouse gas emissions, limiting warming to close to 1.5°C or even 2°C will be beyond reach" [2].

To appreciate the importance of sustainable structural engineering, it is important to realize buildings and construction together account for approximately 36% of global final energy use and 39% of energy-related carbon dioxide (CO2) emissions [3, 4]. On the other hand, the sector continues to grow at unprecedented rates. Over the next 40 years, the world is expected to build 230 billion square meters in new construction, adding the equivalent of Paris to the planet every single week.

The last decades, emissions during use of buildings have been reduced significantly, further accelerated by the energy crisis of 2022. In a current best-practice building, the construction phase is accountable for approximately 50% of construction and use related emissions [5]. The

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