Unlocking Modularity Benefits with the Use of Precast Segmental Technology

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Abstract

Modularity plays a key role in the rationalisation of industrially produced consumer goods and the optimisation of their fabrication technologies. With reduced numbers of individual components, rationalisation, automation, and digitalisation of involved processes become more feasible, and reduction of material quantities and process waste can be achieved. The user further benefits from the possibility of replacement and repair of damaged components as well as disassembly and reuse of components at the end of life. To transfer these benefits to loadbearing engineering structures, the authors propose a modular product family for footbridges using precast segmental technology with dry joints and external CFRP post-tensioning. This article describes the applied principles and benefits of modularity, the modular footbridge design and the influence of dry joints and external CFRP post-tensioning on the bridge's overall structural performance.

Keywords: modularity; automation; structural design; footbridge; precast segmental construction; CFRP; concrete; precast; dry joint.

1 Introduction

On a global scale, continuous population growth creates the demand for an ever-increasing rate of building and infrastructure construction. However, not only population growth in absolute numbers, but also the endeavours of billions of people around the world to increase their prosperity and well-being is leading to a demand for new houses, schools, hospitals, commercial buildings, spaces for public life, bridges and other infrastructure.

The delegates of the IABSE Congress 2023 in New Delhi had the privilege to become first-hand witnesses of the enormous growth in Indian urban areas. The organisers of the conference had very aptly chosen the theme "Engineering for Sustainable Development", highlighting the need for future growth to not only meet the short-term needs of society, but to be long-lasting, resilient, adaptable to future generations' needs and to take into account the protection of the climate and natural environment. In many European countries, the maintenance of a large and aging building stock as well as construction in heavily congested urban areas pose further challenges.

A promising strategy to improve the productivity of the construction industry on the one hand, and to achieve greater speed and flexibility, higher quality and less disruption on construction sites on the other, is to utilise the benefits of modularity [1, 2]. The principles of modular design have been applied for many years in the production of consumer goods like cars, electronics, furniture, and even software. By embracing modularity, the total number of individual components within a product family

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