FLO:RE – A new floor system made of reused reinforced concrete and steel elements

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Abstract

Carefully extracting reinforced concrete (RC) elements from soon-to-be demolished structures and reusing them as load-bearing components is an emerging circular low-carbon alternative to building new structures. As floor construction typically accounts for the most upfront carbon footprint of buildings, this paper presents the design, structural verifications and construction process of FLO:RE, a new floor system built with reused saw-cut RC slab elements and steel beams. To value all pre-existing properties, the new system reuses the RC elements in bending, taking advantage of the existing steel reinforcement. The life-cycle assessment (LCA) shows that the upfront carbon footprint of the reused system can be as low as 5 $kgCO_{2,eq}/m^2$, reducing by up to 94 % compared to conventional RC flat slabs. The construction and monitoring of a 30-m^2 mock-up demonstrate the new-system construction ease and structural performance. This study proves the technical feasibility of reusing old RC slab elements in new floor systems.

Keywords: structural design, component reuse, reinforced concrete floor, life-cycle assessment, embodied carbon, circular economy, concrete reuse

1 Introduction

Concrete is not only the most used construction material worldwide, with an estimated yearly consumption approaching 30 billion tons (1): it is also the most discarded construction material, e.g., accounting for about 35 % of Swiss demolition waste (2). Today, even if in good condition, discarded concrete is crushed and, at best, downcycled as aggregates in new concrete mixes, where it partly replaces natural stone aggregates. Still, this process does not reduce upfront carbon emissions as the same or even higher cement quantity is needed for these mixes (3), and cement is responsible for the main part of carbon emissions during concrete production.

Figure 1. FLO:RE mock-up, made of reused reinforced-concrete and reused steel elements.

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