Reuse of cast-in-place concrete slabs in new structures

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Abstract

This paper presents the approach of reusing existing concrete slabs in new constructions as a method to vastly reduce the environmental footprint of building structures. The general method including structural challenges are described concerning the reused slabs and their needed substructure. A life-cycle-assessment is conducted, stating that the reusage of concrete slab elements is potentially climate- and resource-neutral. The LCA-comparison between a conventional layout design and a design implementing reused concrete slabs shows a reduction of 27% and 32% of carbon and material footprint, respectively.

Keywords: urban mining; reuse; life-cycle-assessment; circular economy; global warming potential; total material requirement

1 Introduction

As the recycling of cement is technically not feasible today, the CO_2- and resource-intensive production of cement from raw materials precedes the manufacturing of any sort of concrete. The piecewise reuse of complete components therefore presents a unique possibility for an almost climate- and resource-neutral supply of structural concrete elements, as almost only energy resources are needed during the manufacturing process. In contrast to the conventional demolition, this urban mining approach demands a selective dismantling of building structures, followed by extracting and potentially repairing the reclaimed concrete elements. Due to the relative structural simplicity and the abundance in concrete structures, the reuse of cast-in-place concrete slabs seems feasible and would have significant ecological benefits. To implement these often 50-year-old elements into new structures, the reused concrete slabs need to satisfy the ultimate limit state (ULS) criteria of today's industry standards and frameworks. Additionally, a substructure of newly produced elements needs to be designed, allowing for an easy reinstallation of the slabs. This paper presents a method for implementing reused cast-in-place concrete slabs in new structural design. Besides identifying significant factors concerning the properties and the ultimate limit state of reused slabs, the necessary substructure of conventionally produced elements will be described based on a generic layout design. A life-cycle-assessment (LCA) will be conducted using the software GaBi to identify the environmental benefits of reusing concrete slabs in new structures.

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