Microcracks assessment during unloading for structural elements reuse

Sushree Sunayana, Lisbeth M. Ottosen

DTU Sustain, Technical University of Denmark, Kongens Lyngby

Contact:limo@dtu.dk,

sussu@dtu.dk

Abstract

Larger scale concrete production to satisfy rapid infrastructural development leads to significant resource exploitation. One of the important ways to achieve sustainability in concrete construction is by optimizing the use of resources. To address this challenge, reusing structural concrete elements emerges as a viable alternative. During the process of selective demolition, structural concrete elements are unloaded. To assess their quality for reuse, a non-destructive testing technique is required. This study investigates the propagation of surface cracking during loading and unloading states using a digital image correlation (DIC) technique. Standard concrete prism specimens were subjected to compression loading at different stress levels before reaching the peak stress and subsequently unloaded. A novel method was developed to analyze the microcracks during unloading by digitally reproducing the DIC data. Quantification of surface cracking in the unloaded state can provide insights into the previous stress state experienced by the concrete elements and potential areas for reuse.

Keywords: Digital image correlation, unloading, compression, reuse, strain fields

1 Introduction

The exponential growth of concrete infrastructures is alarming in the context of sustainability. There is an urgent need to establish a balance between the rising demand for concrete infrastructures and the necessity to minimize CO_2 production and resource consumption to achieve sustainability in concrete construction. In this context, recycling of construction demolition wastes such as coarse aggregates, fine aggregates or cementitious materials from recycled concrete powder have been explored by many previous studies (1-2). However, this total demolition of structures and their recycling process is more energy intensive with heavier equipment and less focus on quality materials for reuse (3). The performance of concrete produced using these recycled wastes depends on many factors like the parent concrete source, crushing method, quality and quantity of adhered mortar content affecting the higher water absorption of recycled materials, and formation of two interfacial transition zones due to the attached mortar layer which leads to more weakness at microstructure of concrete (1). On the other hand, the selective demolition process focuses more on the extraction of materials or components with a greater potential for reuse and avoids the large quantity of waste generation, sorting, and

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