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Non-destructive evaluation system for quality control of 3D printed hybrid concrete structures

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ABSTRACT

3D concrete printing is an innovative construction technology that enables the fabrication of structures without the need for conventional formwork, providing significant design flexibility. For its successful implementation in construction, aspects such as material quality assurance, structural design, and process optimization must be carefully considered. Numerous studies have explored the structural performance of 3D printed concrete to integrate it into load-bearing members. However, limitations in the allowable aggregate size due to printing system constraints pose challenges in maintaining consistent quality and design flexibility. Consequently, the long-term behavior of 3D printed concrete structures differs from that of traditional concrete structures. Additionally, 3D printed concrete exhibits weak bonding with reinforcement, which is critical for ensuring the tensile strength of structural elements. Addressing these challenges requires extensive research to achieve performance levels comparable to conventional reinforced concrete structures. To overcome these limitations, a hybrid construction approach has been proposed, where 3D printed concrete serves as permanent formwork, with reinforced concrete cast inside. In this method, the printed concrete also functions as the cover concrete, necessitating strict quality control during fabrication to ensure the structural integrity and durability of the hybrid system. This research focuses on developing advanced non-destructive evaluation techniques to support structural design, quality assessment, and process optimization for producing hybrid reinforced concrete columns.

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