STUDY OF THE FRESH-STATE AND TRANSPORT PROPERTIES OF 3D-PRINTED CONCRETE WITH HIGH CEMENT REPLACEMENT AND MECHANICAL PERFORMANCE OF 3D-PRINTED COMPOSITE BEAMS

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ABSTRACT

3D printing of concrete (3DPC) has been demonstrated to be a potential and viable solution for different infrastructure applications considering its multiple benefits and the continuous advances in achieving an advanced manufacturing process, using innovative materials, and using unique approaches to demonstrate high-performance characteristics. Still, some challenges remain to be addressed as this technology advances through the stages of prototyping, validation, and testing; looking to establish itself as an alternative to cast concrete for the mass production of civil infrastructure. The research presented in this dissertation is focused on the influence of the fabrication process of 3D-printed concrete on three relevant aspects for its deployment in large-scale scenarios. These aspects include the scalability of mixture development for different printing systems, the mechanical performance of reinforced 3D-printed elements, and the initial evaluation of durability properties. This research aims to contribute to the development of strategies to understand the effects of the mixture composition and the use of supplementary cementitious materials (SCMs) in the process of mixture development to enhance the printability characteristics, fresh state properties, and durability properties of these materials. Furthermore, the incorporation of novel reinforcement alternatives and controlled architectures, in addition to the study of the transport properties of 3D-printed elements can lead to advances in the use of 3D-printed concrete in structural applications.