Additive Manufacturing of Concrete for Sustainable Construction

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Abstract
The most common method, “the traditional formwork system”, used for construction has many disadvantages and restrictions. To overcome the disadvantages of the traditional construction method and ensure true construction sustainability, the development of new-generation sustainable construction methods is essential. In this regard, 3-dimensional (3D) AM, defined as the layer-by-layer deposition approach, has been attracting considerable interest as a new generation sustainable construction method in the construction industry because of its significant advantages over traditional techniques including high geometrical design flexibility, cost-efficiency, fast construction speed, low labor requirement and low labor-related mistakes, formwork-freedom construction process and lower potential to generate waste during manufacturing etc. The materials used for 3D-AM should possess some specific fresh and hardened features for successful printing without blockage of the system or instability of the printed elements. The materials’ mixtures must be extrudable to be able to be transferred/evacuated through the transmission system. The mixtures should also be buildable to be able to withstand the pressure from its own and consecutive upper layers without losing its extruded shape. The mixtures must also have adequate open-time to be able to be printed through a certain/adequate period. There should be also sufficient interface adhesion (bond strength) between the printed layers to ensure high quality final product. Therefore, the material development suitable for 3D-AM requires a multi-faceted approaches and methodologies designed to meet material-related requirements. In addition to the material-related requirements that should be met to ensure successful 3D-AM process, the 3D-AM equipment should be developed considering the rheological, chemical, physical and mechanical properties of the materials as well as the fresh and hardened properties to ensure compatibility between materials and equipment. In this presentation, the main emphasis is positioned on the 3D-AM as a sustainable construction method. It is believed that this kind of advanced construction methods will contribute significantly to reduce the economic and environmental burden of the building industry and to ensure sustainability in construction.