3D PRINTED XBENCH AND XTABLE

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Fibre entrainment enhances the mechanical integrity of 3D printed cement-based composite (3DPC) objects. Their inclusion, however, modifies the rheology of the fresh composite, with implication for printability (pumping and extruding) and constructability, or cost-efficient rate of additive construction without plastic collapse of the fresh product. In Figure 1, 3D printed hard landscaping elements are demonstrated by their designer and 3D printer CDSI members.

Figure 1: 3D printed fibre concrete XFurniture

A rheo-mechanics approach was developed by the CDSI for design of 3DPC constructability. This entails four model parameters, which are a newly defined re-flocculation rate, the structuration rate, and the initial dynamic and static yield shear strengths of the fresh composite. These parameters are determined from rheometer tests, but correlation with small slump flow table tests is under way.

The fresh state properties govern the design of the construction stage, but also influence the hardened mechanical properties. The interfacial bond in the layered topology is most directly influenced by the fresh state rheology. By manipulating the degree of thixotropy though mix design, which includes the choice of fibre, and to a large extent the selected surfactants and dosage, a level of fusion of the deposited layer with the substrate layer can be achieved. Figure 2 shows the 3D printing of a sacrificial structure for subsequent extraction of specimens for mechanical testing of horizontal and vertical interlayer, and intralayer strength and fracture energy. The scheme of extraction, and schematized notched specimens for direct tensile testing are also illustrated.

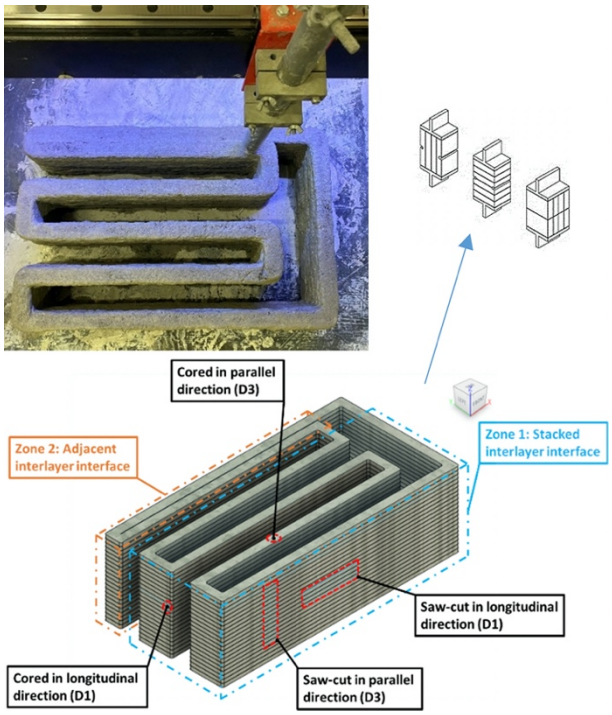

Figure 2: Specimen extraction

This work takes part in an ongoing research that will be presented in greater detail at the IIBCC 2021.

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