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Investigation of the rheology and strength of geopolymer mixtures for extrusion-based 3D printing

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Abstract:

This study presents the development of fly ash-based geopolymer mixtures for 3D concrete printing. The influence of up to 10% ground granulated blast-furnace slag (GGBS) and silica fume (SF) inclusion within geopolymer blends cured under ambient conditions was investigated in terms of fresh and hardened properties. Evolution of yield stress and thixotropy of the mixtures at different resting times were evaluated. Mechanical performance of the 3D printed components was assessed via compressive strength measurements and compared with casted samples. SF demonstrated a significant influence on fresh properties (e.g. recovery of viscosity), whereas the use of GGBS led to higher early strength development within geopolymer systems. The feasibility of the 3D printing process, during which rheology was controlled, was evaluated by considering extrusion and shape retention parameters. The outcomes of this study led to the printing of a freeform 3D component, shedding light on the 3D printing of sustainable binder systems for various building components.

Keywords: Rheology; geopolymers; thixotropy; 3D printing; performance