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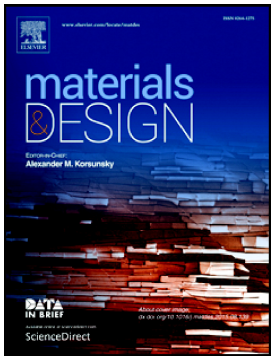

3D Printing of Asphalt and its effect on Mechanical Properties

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3D Printing of Asphalt and its effect on Mechanical Properties

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Abstract

The paper describes work to design, build and test an asphalt 3D printer. The main difficulty encountered is that asphalt behaves as a non-Newtonian liquid when moving through the extruder. Thus the rheology and pressure in relation to set temperature and other operational parameters showed highly non-linear behaviour and made control of the extrusion process difficult. This difficulty was overcome through an innovative extruder design enabling 3D printing of asphalt at a variety of temperatures and process conditions. We demonstrate the ability to extrude asphalt into complex geometries, and to repair cracks. The mechanical properties of 3D printed asphalt are compared with cast asphalt over a range of process conditions. The 3D printed asphalt has different properties from cast, being significantly more ductile under a defined range of process conditions. In particular, the enhanced mechanical properties are a function of process temperature and we believe this is due to microstructural changes in the asphalt resulting in crack-bridging fibres that increase toughness. The advantages and opportunities of using 3D printed asphalt to repair cracks and potholes in roads are discussed.

Key words: asphalt, bitumen, 3D printing, additive manufacture, repair,