Sustainability of 3D printing for building construction using innovative and ecological materials

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Summary

The construction industry must be able to address the objectives of the European Green Deal and the SDGs of the United Nations. In this scenario, the construction industry should be able to convert and utilize waste into sustainable construction material. Some researchers have outlined the exploration of the circular economy in 3D printing. However, 3D printing for construction lacks research on the properties of wastes and natural fibres to attain a sustainable mortar mix. Hence, this work aims to valorise the waste through additive manufacturing and attempts to establish the foundation for discourse around 3D printing in a circular economy. The major objectives of this work are:

1. Widening the knowledge on the use of industrial wastes such as forest-based biomass fly ash (FA), stone sludge in cement-based formulations;
2. Understanding the behaviour of natural fibers such as hemp for the development of fiber reinforced concrete suitable for construction 3D printing;
3. Examine the characteristics of mortar after the incorporation of wastes and natural fibre, Hemp to attain the properties suitable for printing, by comparing the developed compositions against printability and buildability for 3D printing in construction;
4. Understanding the effect and limitations of the use of green construction materials in terms of mortar quality and sustainability;
5. Conducting physical and mechanical performance evaluation of selected mixtures;
6. Conducting sustainability assessment by quantifying the environmental impacts in terms of energy consumed and CO2 emissions of the printing process and mixtures as illustrated by different binder systems;
7. Performing life cycle assessment to understand the environmental impact, considering the preservation of environment, savings of natural aggregates and minerals.

Keywords

Waste materials, natural fibres, life cycle assessment, sustainability, 3D printing, construction.

The robotic arm used for printing.