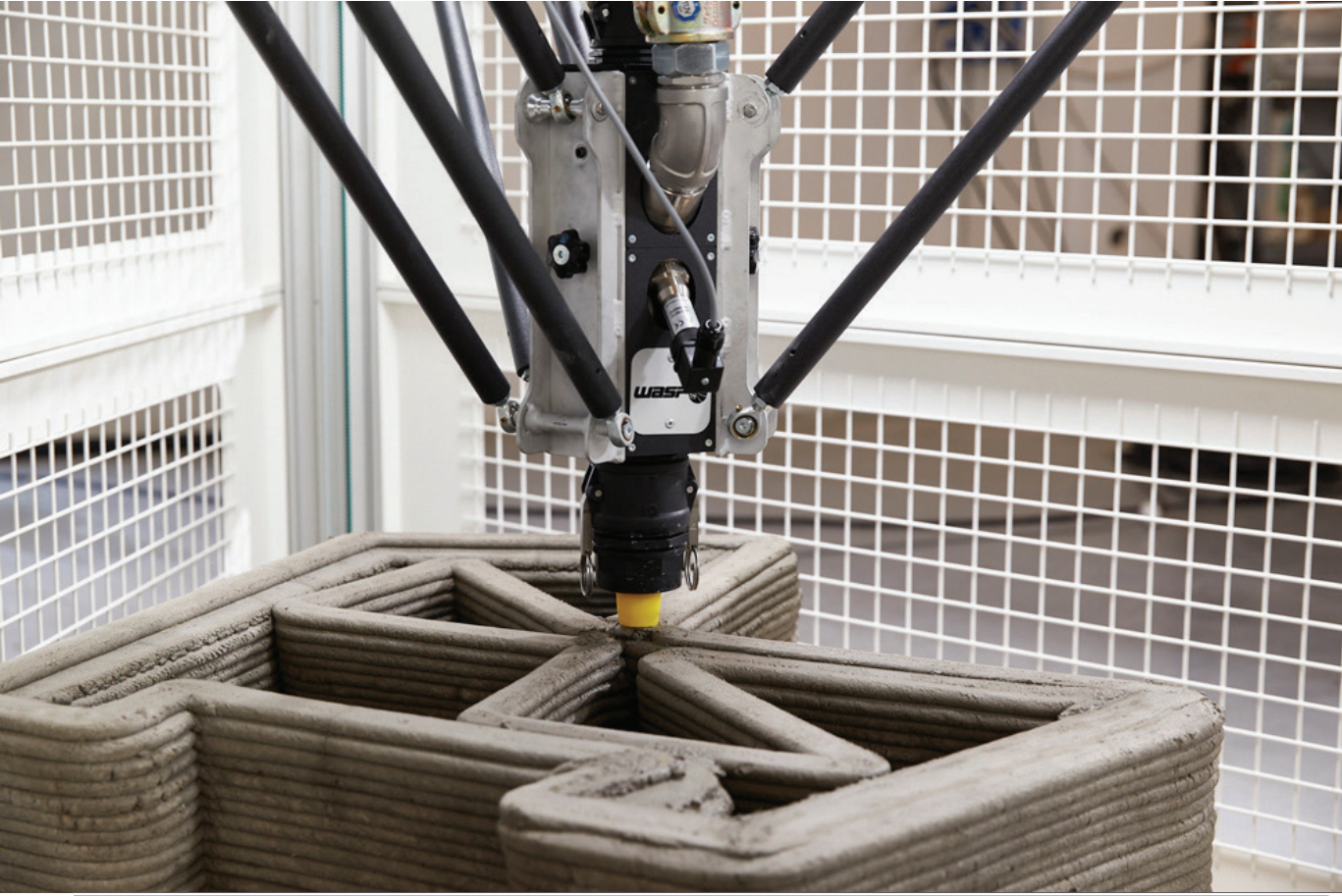


What is 3D Concrete Printing?

3D concrete printing, much like 3D filament printing, involves the extrusion of material, in this case concrete, onto a surface through a robotic print head that can move in three axes, allowing it to build objects layer by layer.



A 3D concrete printer at work [5]

Fibre Reinforcement in 3D Concrete Printing

Benefits and Challenges of 3D Concrete Printing

- Allows for the optimization of structure design [1], [2]
- Potential for emissions reduction [1]
- No need for time and cost-prohibitive formwork or moulds [3]
- Mixture design
- Reluctance to change in the construction industry [2], [3], [4]
- Lack of standardization [2], [3], [4]

Finding an Ideal Mixture

Any Concrete 3D printing mixture requires Pumpability, Printability, and Buildability

to be able to be pumped to the printhead

to be able to be extruded through the printhead or printed

to be able to build multiple layers on top of each other without collapsing

A mixture that is too pumpable or flowable causing its ability support multiple layers to be weak

Each of these characteristics needs to be balanced as a mixture; a very pumpable mixture will not be able to support multiple layers.

Multiple cement-like materials and admixtures, such as fly ash and silica fume, have been used to establish a cement paste or mortar that balances these.



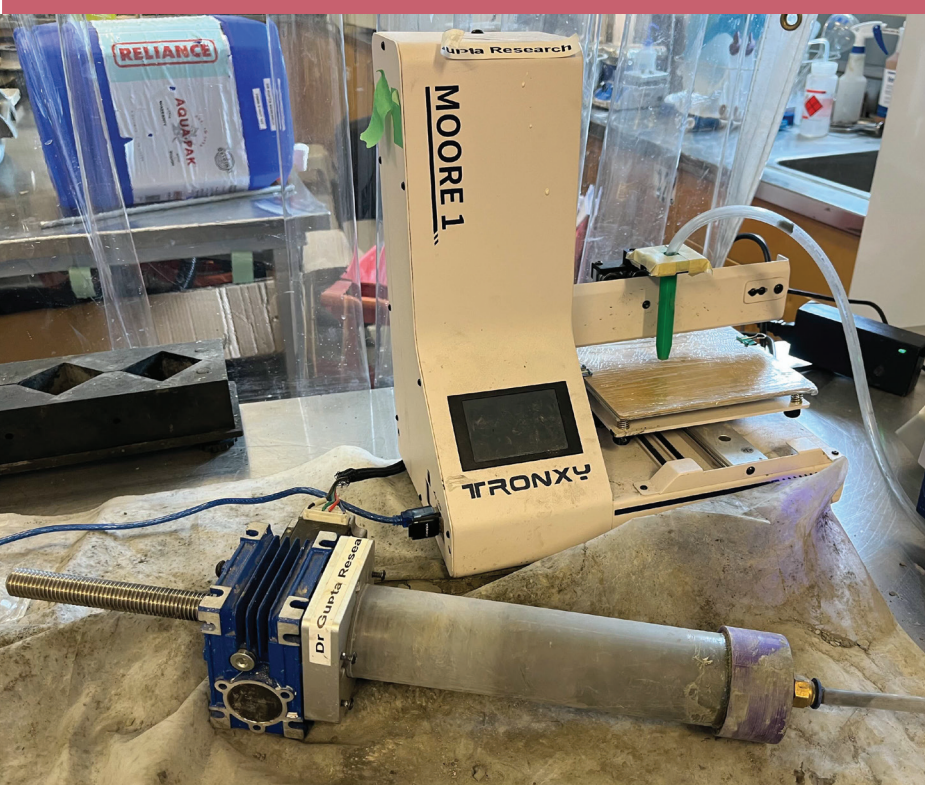
Cellulose fibres offer a sustainable way to help reinforce the mixture, providing better flexural and tensile strength, while reducing viscosity, as observed [6].

Cellulose fibres come from numerous organic sources, including plant waste from other industries, offering an opportunity for the recycling of what would have otherwise been waste [6].

Observed effects of fibre mixture

- The addition of fibres requires more water in a mixture to keep the viscosity roughly the same
- Setting time was around 2.5 hours, the addition of more accelerator could lessen this and help increase buildability

Printing the Mixture



A Moore 1 printer in the FIMIN lab

Print settings can have large effects on the end result including the strength between layers which can be reduced by:

- higher print speeds
- longer intervals between layers printed [2], [3]

Scale of printing can vary from small tabletop printers to larger printers as can be seen in these two images



A Scara Roadrunner printer in the Materials lab