USING SOIL CONCRETE IN 3D PRINTING

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Construction 3D printing (3DCP) is one of the developing branches of additive technology. Main differences from other 3D printing technologies are a large size of printed object, it's solidity, durability in different climate conditions, relatively low accuracy requirements.

Cement based soil concrete is known, but rarely used construction material for buildings. It has serious disadvantages that make it impracticable for classical building technologies, but also it has some useful properties that make it suitable for 3D printing process. The objective of the research is to show a possibility to print arches and domes with at least 45 degrees overhang (which is hardly achievable for Contour Crafting) using cement based soil concrete as material. To reach this goal several concrete composition was tested, then suitable 3D printer and printhead was made and printing process implemented.

The main useful property of a soil concrete is it's plasticity (rheological model of Bingham fluid can be used) during first several minutes it was mixed with a water. Fortunately the plasticity allows to implement DIW (direct ink writing) printing method and reach whole specter of a geometry could be printed with clay. Unfortunately it is impossible to use common DIW extruder types because of short lifetime of a fresh mixed printing media, so the special hardware have to be designed.

To implement a soil concrete 3D printing process there should be an extruder, that is a mixer also, so we could mix a dry component powder with a water (or another fluid) continuously, following right proportions, and extrude it as soon as possible before rheological properties of mixture gone unsatisfactory. The possibility to make relatively small and lightweight suitable hardware caused by the fact, that a mixing of fluid and powder in small volume is significantly affected by capillary suction, so there is no lengthy and intensive mechanical mixing needed.

The article contains several qualitative statements about using a soil concrete as a material for 3DCP and it's experimental approvement, also it contains some quantitative characteristics of print media that is suitable for 3D printing.

The result of research is a 3D printed dome with 45 degrees overhang, that means it's possible to use a cement based soil concrete to print such kind of geometry.