



Typical printed cylinder

## Technology Summary

Cementitious three-dimensional construction printing (C3DCP) employs additive manufacturing to fabricate buildings and structural components. The Penn State inventors experimentally determined the C3DCP concrete mixture compositions for high performance concrete and for ordinary concrete used in regular construction. The Penn State researchers examined the range of mixture composition consisting of different ingredients and corresponding performance analysis. Sensitivity analysis of the various compositions highlighted the tradeoffs with compressive strength test, setting test and flow table characteristics, whether for a robotic arm or gantry system. The inventors also conducted cost sensitivity analysis relative to performance as it relates to certain ingredients such as calcium chloride, required strength and the ambient conditions.

## Application & Market Utility

The construction industry has begun to employ large 3D printers to manufacture major structural components and buildings, increasing construction efficiencies and reducing waste and labor savings from the higher productivity and quicker construction. Greater understanding of the specifications for workability, buildability, flowability and pumpability accelerates the industrial adoption curve of C3DCP for the resulting cured concrete with the desired strength and setting time characteristics that avoids buckling during printing and cracking after setting.

## Next Steps

A range of prism and bar-shaped prototypes have been tested. Seeking licensing opportunities.

### TECHNOLOGY READINESS LEVEL

4-7

#### Seeking

Investment | Licensing | Research

#### Keywords

- Cement
- Mixture Design
- Additive Manufacturing
- 3D Printing
- Robotic Construction

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