Additive Manufacturing of Precast Concrete Molds for Construction Applications

Oak Ridge National Laboratory in partnership with Gate Precast and Precast/Prestressed Concrete Institute

Demonstrating how additively manufactured precast concrete molds outperform conventional molds.

Innovation

Polymer composite AM has reached new heights in recent years with the development of large-scale systems such as the Big Area Additive Manufacturing (BAAM) system and the Wide and High Additive Manufacturing (WHAM) machine. Oak Ridge National Laboratory (ORNL) has also made significant advances in working with industry to develop polymer chemistries for pellet feedstock material for use on these large-scale systems. To date, ORNL has successfully printed over 70 various fiber-reinforced polymers.

Outcomes

Technology Advancement

One of these materials, 20% carbon fiber-reinforced acrylonitrile butadiene styrene (CF-ABS) was used to 3D-print precast concrete molds to refurbish the façade of the Domino Sugar Building in Brooklyn, New York. ORNL, Gate Precast (a supplier of precast structural and architectural concrete), and the Precast/Prestressed Concrete Institute (PCI) demonstrated the feasibility of using the BAAM system to manufacture this tooling.¹

Impact

Conventionally manufacturing the molds is a slow and expensive process with a shrinking workforce. The 3D-printed molds have been successfully used for 190 pours while still being usable – traditionally manufactured molds can only be used for 20 to 30 pours. In addition, the 3D-printed mold can provide the durability to complete precast concrete test samples with the required accuracy of less than 0.05 inch surface defects.²

Timeline

Summer 2015: ORNL and PCI initiate collaboration on advancing precast construction¹

July 2016: Additive Engineering Solutions becomes a service bureau and purchases a BAAM system after interacting with ORNL, provides support to precast concrete project

July 2017: ORNL and Gate Precast design, manufacture, and evaluate 3D-printed mold prototypes¹

August 2017: ORNL and Gate Precast begin production of molds and precast façade components¹

¹ ORNL. ornl.gov/sites/publications/Files/Pub102721.pdf
² OSTI.osti.gov/servlets/purl/1471898