

GCSU: Future civil engineer performs unique research on 3D printed concrete

By Margaret Schell

Georgia College & State University

Addison Stuart is a junior physics major in Georgia College & State University's dual-degree program where she'll pursue a civil engineering degree from Georgia Tech. This summer, Stuart participated in the National Science Foundation's Research Experiences for Undergraduates at Clemson University.

During her REU, Stuart researched improving the mixture design of 3D printed concrete used in housing construction components and larger buildings. As technology improves, it has the potential to become a more common method for constructing buildings and other infrastructure projects.

"This research contributes to efficiency as 3DPC has shown reductions in costs, time and materials," Stuart said. "This could make it more practical for widespread use."

Stuart's goal was to produce a printable mixture while maximizing compressive strength and minimizing the carbon footprint.

"I implemented a two-step process of data refinement, using machine learning, followed by mixture optimization [making it as effective, functional or efficient as possible] with a

multi-objective optimization framework," she said.

"Two of the four selected mixtures were workable and subjected to rheological [how matter deforms and flows under the influence of external forces] and compressive strength testing," Stuart said.

One mixture was selected for further experimental 3D-printing validation based on her results.

Developing a printable 3D-printed concrete mixture traditionally requires extensive experience, repeated laboratory testing and considerable material consumption. By integrating these digital methods, this study successfully identified a printable, high-strength and low-carbon mixture within an experimental optimization cycle.

Stuart's critical thinking skills learned from Georgia College provided the foundation for her successful research.

"Working closely with professors taught me to ask questions, consider different approaches and break complex problems into more manageable pieces," she said.

These learned problem-solving and decision-making skills will also help Stuart, as an engineer, solve complex issues, identify design weaknesses, develop proposals and communicate with clients.



"Working closely with professors taught me to ask questions, consider different approaches and break complex problems into more manageable pieces."
- Addison Stuart"

Addison Stuart uses a gantry-based printer for 3D industrial design.

Courtesy of GC University Relations

Stuart plans to pursue a career in civil engineering and water resources, working for an engineering consulting firm or industrial company in Atlanta or along the coast. She aspires to work on large infrastructure and water-related projects.

"Now, I hope to explore new areas of civil engineering research to gain experience in different disciplines and discover where I can make the greatest impact," Stuart said.

Since participating in the summer REU program, Stuart is excited to begin the fall semester while working toward her chosen profession.

"After seeing examples of new water systems and infrastructure in less developed areas and countries, it opened my eyes to the possibilities in this field," she said. "My goal is to use my career to serve others in need while making a positive impact in communities."

Header Images: During her REU at Clemson, Addison Stuart used a gantry-based printer for 3D industrial design and lab equipment for compressive strength tests.