

Scientists Develop Method to 3D-Print Concrete That Captures Carbon

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Blocks of concrete that scientists 3D-printed using a method to capture and store carbon dioxide. NTUsg / YouTube screenshot

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A team of scientists from Nanyang Technological University, Singapore (NTU Singapore) has developed a method of 3D printing that can also capture carbon dioxide and store it in concrete.

The process involves injecting carbon dioxide and steam into mixing cement, which is then used in a 3D printer to build structures. For this method, the team sourced both the steam and the carbon dioxide as byproducts of industrial processes. The 3D printer was connected to a steam jet and carbon dioxide pumps in order to incorporate these elements into the mixing concrete.

“The building and construction sector causes a significant portion of global greenhouse gas emissions. Our newly developed 3D concrete printing system offers a carbon reducing alternative by not only improving the mechanical properties of concrete but also contributing to reducing the sector’s environmental impact,” Tan Ming Jen, principal investigator of the study and professor at NTU’s School of Mechanical and Aerospace Engineering, [said in a statement](#). “It demonstrates the possibility of using CO2 produced by power plants or other industries for 3D concrete printing. Since traditional cement emits a lot of carbon, our method offers a way to plough back CO2 through 3D concrete printing.”

According to the team, the incorporation of carbon dioxide and steam strengthens the resulting concrete when compared to typical 3D-printed concrete, in addition to reducing the carbon footprint of the constructed material. The carbon-injected concrete was able to bear 36.8% more weight and was 45.3% more flexible compared to standard 3D-printed concrete. The scientists [published](#) their findings in the journal *Carbon Capture Science & Technology*.

As for carbon sequestration, this concrete could capture and store 38% more carbon compared to typical 3D-printed concrete, according to the scientists.

Not only was the resulting concrete stronger and better at storing carbon, but it was also easier to print. The study showed this concrete to have 50% more printability, or printing efficiency.

According to the World Economic Forum, cement manufacturing alone makes up about [8% of global carbon emissions](#). Emissions from the cement manufacturing industry totaled around 1.6 billion metric tonnes in 2022, and that number is expected to grow to 3.8 billion metric tonnes per year based on a business-as-usual scenario.

Using 3D printing can help lower emissions by reducing cement usage and waste, but innovations on the materials used in 3D printing are further reducing emissions in the construction industry. Engineers at Massachusetts Institute of Technology (MIT) have developed a way to [use recycled glass](#) in 3D printing, and scientists at University of Virginia School of Engineering and Applied Science are exploring ways of incorporating [plant-based cellulose nanofibrils](#) into 3D-printed concrete.

The study led by NTU further advances the growing research toward more sustainable building materials that will reduce construction-related emissions.

“Our proposed system shows how capturing carbon dioxide and using it in 3D concrete printing could lead to stronger, more eco-friendly buildings, advancing construction technology,” said

Daniel Tay, co-author of the study and a research fellow at NTU's School of Mechanical and Aerospace Engineering.

The scientists at NTU and their collaborators have filed an application for a U.S. patent for their method.

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