

3-D-printed concrete to help build offshore wind energy infrastructure

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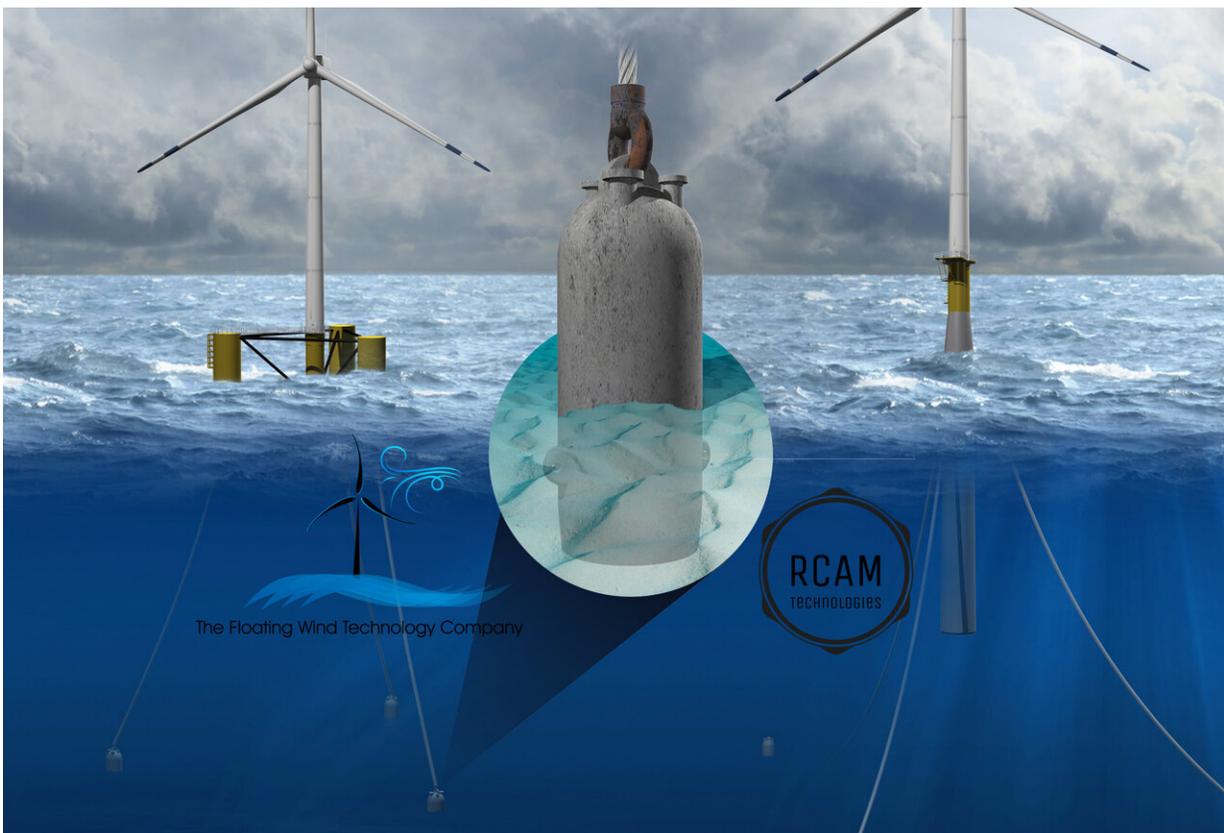


Illustration of a 3D-printed concrete suction pile anchor for connecting floating wind turbines to the seabed via mooring lines. Credit: RCAM Technologies

Wind off the coasts of the U.S. could be used to generate more than double the combined electricity capacity of all the nation's electric

power plants, reports have suggested.

But building [wind turbines](#) offshore is expensive, requiring parts to be shipped at least 30 miles away from a coast.

Purdue University engineers are conducting research on a way to make these parts out of 3-D-printed concrete, a less expensive material that would also allow parts to float to a site from an onshore plant.

"One of the current materials used to manufacture anchors for floating [wind](#) turbines is steel," said Pablo Zavattieri, a professor in Purdue's Lyles School of Civil Engineering. "However, finished [steel structures](#) are much more expensive than concrete."

Conventional concrete manufacturing methods also require a mold to shape the concrete into the desired [structure](#), which adds to costs and limits design possibilities. 3-D-printing would eliminate the expenses of this mold.

The researchers are working in collaboration with RCAM Technologies, a startup founded to develop concrete additive manufacturing for onshore and offshore wind energy technology. RCAM Technologies has an interest in building 3-D-printed [concrete structures](#) including wind turbine towers and anchors.

"Purdue's world-class capabilities and facilities will help us develop these products for offshore products for the U.S. Great Lakes, coastal and international markets," said Jason Cotrell, CEO of RCAM Technologies. "Our industry also needs universities such as Purdue to provide the top-quality university students for our workforce needs for these cutting-edge technologies."

The work also is funded by the National Science Foundation INTERN

program.

The team is developing a method that would involve integrating a robot arm with a concrete pump to fabricate wind turbine substructures and anchors.

This project is a continuation of the team's research on 3-D-printing cement-based materials into bioinspired designs, such as ones that use structures mimicking the ability of an arthropod shell to withstand pressure.

The group's current research involves scaling up their 3-D printing by formulating a special concrete—using a mixture of cement, sand and aggregates, and chemical admixtures to control shape stability when concrete is still in a fresh state.

"Offshore wind power is a nearly perfect platform for testing 3-D printing," said Jeffrey Youngblood, a Purdue professor of materials engineering.

The goal is to understand the feasibility and structural behavior of 3-D-printed concrete produced on a larger scale than what the team has previously studied in the lab.

"The idea we have for this project is to scale up some of the bioinspired design concepts we have proven on a smaller scale with the 3-D printing of cement paste and to examine them on a larger scale," said Mohamadreza "Reza" Moini, a Ph.D. candidate in civil engineering at Purdue.

The researchers will determine how gravity affects the durability of the larger-scale 3-D-printed structure. The scaling up research could also be applied to optimizing and reinforcing structures in general.

"Printing geometric patterns within the structure and being able to arrange the filaments through or playing around with distribution of the steel are both possibilities we have considered for optimizing and reinforcing the structures," said Jan Olek, Purdue's James H. and Carol H. Cure Professor of Civil Engineering.

Provided by Purdue University

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