# Marines 3D Print First Reinforced Concrete Bridge in Western Hemisphere

MARINE CORPS BASE QUANTICO, Va. – Marines from the 1st Marine Logistics Group (MLG) at Camp Pendleton, California, transformed their motto – "Victory through Logistics" – to action when they successfully 3D printed a concrete bridge in December, with the help of the Marine Corps Systems Command Advanced Manufacturing Operations Cell (AMOC) and the Army Corps of Engineers.

During the Corps' annual Steel Knight exercise, Marines were trained on how to operate the Automated Construction of Expeditionary Structures – or ACES – printer, incorporated new equipment into the process, and printed and assembled a usable foot bridge to demonstrate the concrete 3D printing capability in an operational environment.

"One of our goals was for Marines to learn to operate the equipment on their own, which they did and it was great," said Capt. Matthew Friedell, AMOC project officer. "Another goal is that each time we do one of these tests, we use [fewer] people. Ultimately, we want one person standing there who hits 'print,' and the machine does all the work. We're getting there."

This was the first time in the U.S. or western hemisphere that a bridge was 3D printed on site rather than in a factory setting, Friedell said.

"This shows how close 1st MLG and the Marine Corps are to the bleeding edge of innovation," he said. "We didn't seek to break any new ground, but with Marine ingenuity, we sure did."

The demonstration included the use of a concrete mixing

process that removes some of the leg work for Marines. Sailors with Naval Mobile Construction Battalion 5 at Port Hueneme, California, brought a volumetric mixer to the site, which saves about six Marines from having to mix the large amounts of concrete needed for the print job.

“The barracks hut print [conducted in August], was more difficult because Marines had to mix the concrete [themselves],” Friedell said. “They had to take five-gallon buckets of gravel, pour them into a bigger bucket, and then use a fork lift to lift them up into the big mixer. The mixer had to mix it and then dump it into the pump. For [the bridge project], we used the volumetric mixer, which did all the gravel, mixed all the concrete and got it ready to pump without anyone doing the really hard work.”

The AMOC provided the printer and led the effort as part of the Corps’ only acquisition command, and the Army Corps of Engineers validated the bridge design to ensure it could bear the load, Friedell said. The idea and design for the bridge came from Marines in the 1st MLG.

“The 1st Marine Logistics Group is always trying to find new solutions when it comes to providing logistics support to I Marine Expeditionary Forces,” said Brig. Gen. Stephen Sklenka, 1st MLG commanding general. “Seeing the Marines learn and train with new technology, then apply their technical expertise to find new ways of maximizing our capabilities on the battlefield showcases both their dedication and their creativity. This was a terrific demonstration of innovative ideas resulting in tangible progress toward usable results that advance future progress in logistics operations.”

In addition to operational uses like bridges and barracks huts, Friedell envisions the Marine Corps using construction-sized additive manufacturing for the Corps’ humanitarian relief work as well.

“I see us going in and building things that help communities,” he said. “Making homes that don’t fall over in a typhoon or hurricane; [providing] buildings and infrastructure that lasts for a while, and possibly leaving the equipment there so they can keep building.”

The AMOC hopes to transition additive manufacturing to a program of record for the Marine Corps by fiscal 2021.

“The Army Corps of Engineers have been doing this work for the past four years to get us where we are, and they did a great job with the program before the Marine Corps ever came onboard,” Friedell said. “Our focus now is to help this transition into an actual system; a useable program of record. These experiments are helping us draft the requirements to get there.”

The Marine Corps and Department of Defense logistics communities are excited about the possibilities, he said.

“The 3D printed bridge demonstration was an excellent example of innovation coming to fruition,” Sklenka said. “It is exciting to see our Marines using their creativity to find ways to enhance the way we conduct logistics operations. 1st Marine Logistics Group continuously trains using new technology to test the boundaries of innovation so we can provide the support for maximum readiness. I think this 3D printed bridge was just the beginning of our progress.”