Beneficial Use Case Study

Near-Zero-Carbon 3D-Printed Homes

Coal Combustion Product Type
Fly Ash, Pozzolan

Project Name
Near-Zero-Carbon 3D-Printed Homes

Project Location
Round Top, Texas

Project Participants
Eco Material Technologies, Hive3D, Starred Sky Development, CyBe Construction

Project Completion Date
Late-2023

Project Summary
Three times yearly, the tiny towns of Round Top, Burton, Warrenton, and Carmine, Texas, host one of the largest antique fairs in the country. In fall, winter, and spring, the populations of these towns swell from hundreds to hundreds of thousands, as collectors descend on an 11-mile stretch of Highway 237 between Houston and Austin. While the area boasts numerous bars, restaurants, wineries, and breweries, housing and hotel accommodations are scarce. In March 2023, developers commenced construction of The Halles, a collection of homes designed to showcase the potential for sustainably built, modest-sized affordable houses to alleviate the lack of lodging.

Project Description
While 3D printing of houses has become more widely adopted as a way to reduce the labor and material costs associated with homebuilding, most are still fabricated from portland cement-based concrete—less expensive than traditional building methods but hardly sustainable. Eco Material Technologies has now partnered with Hive3D to supply PozzoCEM Vite®, a near-zero-carbon, longer-lasting and more durable cement alternative, for the 3D printing of affordable houses at The Casitas @ The Halles, in Round Top, Texas. Eco's green cement features in the construction of a collection of studio, single-bedroom, and two-bedroom homes ranging in size from 400 to 900 square feet.

Eco Material's PozzoCEM Vite®, which is manufactured at the company's Jewett facility northwest of Houston, replaces 100 percent of the ordinary portland cement (OPC) that would commonly be used in the concrete mix, has 92 percent lower emissions, and sets in just 2-3 minutes—significantly faster than OPC. For the construction work at The Casitas, Hive3D and Eco Material created a system to mix Eco Material's cement replacement products with locally sourced aggregates onsite using modified commercial mixing equipment. This allowed Hive3D to produce printable material at a fraction of the cost of other commercially available 3D printing mortars, and subsequently build houses for significantly less than they could be built by traditional means.

"These small homes will serve as a model for affordable and eco-friendly housing throughout the country," said Hive3D CEO Timothy Lankau. "We plan to build them at a speed and cost point that is unprecedented in the affordable housing space."

In October 2022, Hive3D printed a 3,150-square-foot home in Burton using Eco Material's near-zero-carbon cement PozzoSlag® at lower cement replacement levels than those used at the homes in Round Top. The Burton house, which used PozzoSlag® at 50 percent replacement for portland cement, features several innovations never attempted before in a 3D-printed house, including parametric wall designs, foamcrete wall insulation, and pigmented concrete layers.

Photo courtesy of Hive3D