
THE REAL DEAL

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Builders have high hopes for 3D-printed housing

Startups like Texas-based ICON believe printed homes can address crises from affordability to climate change

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By [Cindy Widner](#)



Community First Village, Austin (ICON)

America's first fully permitted 3D-printed home took twice as long to print and cost more than double what its backers expected. Yet it was far from a failure.

The 350-square-foot house was set to be printed in a total of 24 hours over the course of several days at the South by Southwest Interactive Conference 2018 in Austin.

Unfortunately, storms and record-setting rainfall swept the city that week — causing it to take 48 hours. The construction cost for the prototype one-bedroom was \$10,000 — exceeding Austin startup Icon Technology's long-term goal of \$4,000 per home.

It's been a mere four years since those wild few days at SXSW, when Icon, partnered with international housing nonprofit New Story, printed its proof-of-concept house, and both the hype and the reality of 3D-printed buildings are in overdrive.

“To build the future, we must change the way we design and build for a world that will enhance human happiness and flourishing,” Icon co-founder Jason Ballard said in his SXSW 2022 keynote. “The future starts with 3D printing.”

If the visionaries are to be believed, the technology has the potential to upend the housing game — addressing every crisis from affordability to climate change. And the need is clear. The U.S. has a shortage of almost 6 million homes, according to Realtor.com, or more than five years of building using current techniques.

With Icon's minimalist, photogenic printer — which looks like a cross between a house-sized cat litter cleaner and a cake-decorating tool if it were designed by Apple — walls can be programmed into the software and built in a matter of a few days, saving time, material and labor.

Grabbing headlines

The printed-housing revolution is on the horizon, and it will be televised.

When Icon embarks on a new project, the story makes international news. Its co-founders — Ballard, Alex Le Roux and Evan Loomis — are named to splashy lists in Newsweek, Fast Company, Forbes and Time. The company has raised \$451 million — \$185 million of it in a funding round led by Tiger Global Management in February, when an anonymous source told TechCrunch the company's valuation was approaching \$2 billion. Norwest Venture Partners, LENx (Lennar), D.R. Horton, 8VC, Bjarke Ingels Group, Bond, Citi, Fifth Wall, Moderne Ventures and Oakhouse Partners are also investors.

Icon has its own proprietary building material (“Lavacrete”) and printer technology, as do most printed-home builders. That means that they can build long-lasting, sturdy structures that are resilient amid climate change and natural disasters. The technique also offers virtually endless design options, meaning the homes are marketable to a wide range of buyers — including entities providing for unhoused and low-income residents, middle-class homebuyers, planned-community builders and wealthy clients seeking architectural dazzle along with environmental virtue signaling.

One of a handful of such innovators in the U.S. and Europe, Icon isn't even the only company pursuing a 3D-building agenda in Texas. In the town of Uhland, 30 miles south of Austin, two brothers, real estate developer Patrick Tighe and environmental conservationist Andrew Tighe, are busy building Eden — a 20-acre planned community with 34 printed houses, centered around an edible forest and garden.

“Eden will be a self-sustaining, climate-positive community that produces twice as much energy as it uses and attempts to produce enough food to feed 30 families,” Patrick wrote in an email.

Using a COBOD Bod2 printer, it’s also “one of the first companies trying to print a community at scale in the U.S. market,” he said. They’ve already put in roads and will break ground on the first houses this fall. They also have a project planned in Lockhart and are looking at others in the Austin area.

“The future starts with 3D printing.”

JASON BALLARD, ICON CO-FOUNDER

“After we build out our first use case, we hope to scale rapidly. We’re looking for local real estate development partners in major U.S. markets that share our vision of sustainable developments,” he wrote.

Icon is also forging strategic partnerships with some of the building industry’s design leaders and innovators on a range of projects.

Those include a community for Nacajuca, Mexico, residents in extreme poverty; six houses for Austin’s Community First tiny-home village for unhoused people; a four-home mainstream housing development in East Austin; a collaboration with homebuilder Lennar and Bjarke Ingels Group on a 100-home community; and House Zero — designed by marquee Central Texas design firm Lake Flato — that demonstrates the technology’s potential to integrate high design and sustainability.

The collaboration with Lennar is Icon’s first foray into planned communities. It caught the eye of Reinaldo Borges, a Miami architect, futurist and sustainable-building expert.

“When you see that Lennar is doing 100 houses, it starts to get people’s attention,” he said in a phone interview. “It’s a significant step forward.” He added that Icon is “smart” to “associate themselves with top developers and top designers” who demonstrate the aesthetic potential in the technology.

There are also the inevitable space-based construction technologies — adventures in “human-centered design” for space exploration and moon habitation. (Bjarke Ingels is a

partner in those projects as well.)

Icon has already delivered a 1,700-square-foot, 3D-printed Mars surface habitat at Johnson Space Center to aid in long-duration space missions.

Just walls

Still, as with any emerging technology with ambitions of solving giant worldwide problems, the question is how far, and how quickly, it can evolve to fulfill its considerable promises. So far, few 3D-printed homes have been produced and even fewer lived in. And the technology faces some challenges before it can make good on its promises.

For example, the only part of houses being built with 3D printers are the walls, architect Belinda Carr explained in an online talk to design industry group Passive House Accelerator.

In addition, concrete is hardly a sustainable building material, she said, although careful planning can result in less material waste.

The process can save on time and labor, Carr said, but workers are still needed to monitor and move the printers, and structural and logistical considerations make the touted 48-hour timeline virtually impossible.

And while the homes might cost less to make than a traditional house, Carr pointed out that four homes recently printed in Austin were listed for \$450,000 each.

“Concrete is not the best carbon material, we all know,” Lake Flato partner and House Zero architect Lewis McNeel said in a phone interview. “But the small amount of concrete we’re using and the efficiency we’re getting, it’s worthwhile for the longevity.”

Concrete has the advantage of strength, resistance to termites and mold, and high thermal mass, which reduces temperature fluctuations, saving on energy bills, Icon’s Michael Harper wrote in an email.

“We have printed in climates with extreme heat and in temperatures just below 40 degrees,” Harper added. “We heard from occupants who lived in an Icon home during extreme winter weather in Central Texas that they required less heating than neighbors. The homes completed in Nacajuca, Mexico, withstood a 7.0 earthquake. Icon’s 3D-printed

homes are expected to last as long or longer than standard Concrete Masonry Unit-built homes.”

3D printing is “one of the hottest topics in the construction industry now,” Carr said, but she thinks that in the end the technology will probably be used for something other than houses — perhaps structural pieces or entirely different kinds of enterprises. She also said Icon puts a lot of care and attention into the experience of the end product. And by incorporating designers, community groups and government entities, its projects demonstrate the potential of those collaborations, the most likely path to achieving 3D-printing proponents’ heady goals.

A big part of sustainability and adaptation to climate change is creating urban density. The flexible nature of 3D printing makes it adaptable to such projects, said McNeel.

“Given that 3D-printed houses have so far been built on flat, previously unused sites, using the technology in dense urban environments could be a challenge right now,” said Borges, the Miami architect, but they have the potential to help densify cities with structures such as townhouses and apartment buildings.

“I think we are 20-30 years out from seeing 3D printers climbing up the sides of urban towers, building as they climb,” Icon collaborator and architect Andrew Logan wrote in an email. “In my mind, this will be evidence of the technology having ‘scaled.’”

Like the modular and prefab homes that were touted as one-size-fits-all solutions to the housing shortage a few years ago, 3D printing in its current state is best considered part of a smorgasbord of solutions.

“There’s urgency, so we’re going to draw from the full palette of tools so we can continue to keep innovating and coming up with solutions to all the issues in our environment,” McNeel said. “Building high-quality, high-performing houses is a huge piece of the puzzle.” Like Icon, he’s “not ruling out any viable tools.”