

ALQUIST 3D – VIRGINIA TECH

Virginia Tech University, Alquist



PROJECT DETAILS

PROJECT NAME

217 Carnation St.

LOCATION

[Richmond](#) ,
[VA](#)

BUILDER

[Alquist](#)

PROJECT TYPES

[Single Family](#)

PROJECT SCOPE

[New Construction](#)

SIZE

1,500 sq. feet

SHARED BY

[Madeleine D'Angelo](#)

PROJECT STATUS

[On the Boards/In Progress](#)

COST

\$181,000

PROJECT DESCRIPTION

FROM THE DESIGNERS:

[Alquist](#), a 3D printed home construction company, today announced it will break ground on the first 3D printed home funded by a public-private grant in the United States. With a \$500,000 Innovation Demonstration grant from [Virginia Housing](#), Alquist partnered with the [Virginia Center for Housing Research](#) (VCHR) at [Virginia Tech](#) to design, build, and study the home, which will be located at 217 Carnation St. in Richmond. [Project:HOMES](#) and the Better Housing Coalition will provide a site, guide regulatory compliance (including permitting, zoning, and insurance), and provide homeownership services.

The United States is experiencing a severe shortage of housing stock. While the shortages have existed for decades, the pandemic, climate change, and economic migration away from coastal cities have coalesced to create a crisis. Bidding wars have pushed entire populations out of the housing market. In fact, for every \$1,000 increase in the price of a home, 153,967 families are priced out ([National Association of Home Builders](#)).

However, building more houses using lumber is simply not doable at this time. Lumber shortages abound, and prices have skyrocketed more than 300% since April 2020 ([NAHB](#)). This increases the price of an average single-family home by almost \$36,000, rendering building costs too high to offset the selling price. That puts these new houses out of the purchasing range of more than 5.5 million families.

Alquist was founded to address this inequitable housing market. 3D printing technology can be utilized to create designs both traditional and futuristic, while also lowering the cost of housing and infrastructure in economically distressed and underserved communities, particularly in rural areas. Alquist's 3D printed homes are created using concrete, which preliminary estimates suggest provide initial savings of up to 15% per square foot in building costs. Additionally, the frame can be constructed with just two trained crewmembers in 12-15 hours, reducing a standard construction schedule by at least four weeks. For the Richmond project, Alquist will be 3D printing the exterior walls, while building both interior and exterior walls in future homes.

But there are also long-term savings. Alquist's concrete homes better retain temperature, saving on heating and cooling costs. They are resistant to tornado and hurricane damage. Additionally, Virginia Tech's proprietary Raspberry Pi-based monitoring system will be equipped standard in all Alquist homes. Specifically developed to track and maintain indoor environment data that enables a series of smart building applications, the Raspberry Pi-based system includes the following features which can help save homeowners money by modifying their behavior according to the system's findings:

- Indoor environment sensing, including air quality, temperature, humidity, lighting, sound, vibration, flame, and many kinds of gases
- Security and alarm system with motion detection in assigned building spaces
- Emergency management, including smoke and fire detection
- Occupant comfort analysis
- Space utilization analysis
- Energy consumption optimization

[Previous research by VCHR](#) observed a sample of 312 high-efficiency housing units to be 40% or more efficient than standard construction on average, saving 663 Kwh per unit per month. Findings from that study suggested a savings of \$54 per month on electricity bills, which amounted to \$648 annually.

“While most 3D printing endeavors focus on urban residential areas and commercial buildings, many of the regions facing the biggest housing challenges exist in rural America. That’s why we partnered with Virginia Housing and Virginia Tech to build homes for people who live outside of the places where most funding for housing programs is spent,” said Zachary Mannheimer, Founder and CEO of Alquist. “These two cutting-edge organizations are breaking barriers and finding new ways to serve their community, and we’re honored to be working hand-in-hand with them.”

Virginia Housing's grant will support Alquist's purchase of a BOD2 modular 3D printer from leading 3D printing company [COBOD](#) (Construction Of Buildings On Demand). The printer

runs on a gantry system that is assembled onsite, preventing the need to ship large, pre-built modular pieces to construction zones. The system can be assembled in four hours and disassembled in three hours. The BOD2 can also print on uneven surfaces. It is open-source, allowing a number of materials to be used, including new sustainable materials currently being developed. Even more remarkable, the system can be operated by just two trained construction workers.

“When we first looked at 3D printed home technology, we jumped at the chance to partner with Alquist. The technology is itself an interesting challenge and its possible impact on housing costs, schedule, and quality are exciting,” said Andrew McCoy, Ph.D. and Alquist’s Virginia Tech lead. “The long- and short-term cost and time savings over ‘standard built’ houses continued to reveal themselves throughout the design-build process, and we are excited to pass those savings along to the family that eventually calls this amazing project ‘home’.”

Virginia Housing boasts a long history of establishing public-private partnerships to help make affordable housing more accessible. By working with local governments, community service organizations, lenders, realtors, and developers, Virginia Housing provides mortgages for first-time buyers, finances neighborhood revitalization efforts, offers free classes and counseling, and much more. The Richmond 3D home construction is not the first time Virginia Housing has helped create innovative housing opportunities. The organization has previously led efforts to create new modular and factory-built homes that were more affordable than houses constructed using traditional techniques. Its partnership with Alquist and Virginia Tech is yet another cutting-edge strategy to address the area’s housing challenges.

“Virginia Housing is funding and leading this collaborative 3D-printed home with a team of housing experts and community partners,” said Susan Dewey, CEO of Virginia Housing. “Our latest project builds off of recent innovative approaches we’ve explored, including modular and factory-built homes, and it reflects our longstanding commitment to making homes affordable for all Virginians. The lack of affordable housing impacts every family and every community, and we won’t stop until every Virginian has a safe, affordable place to call home.”

While 3D-printed homes have taken off around the world, there are only a handful of companies focusing on 3D-printed buildings in the United States, and they are largely focused on urban or commercial development. Alquist aims to address the housing shortage in rural areas, which are especially stressed due to exurban migration away from the coasts accelerated by the COVID-19 pandemic. The Richmond, VA home is the first of many projects currently planned around the country for Alquist, including rural communities in Arkansas, California, Iowa, North Carolina, North Dakota, Pennsylvania, and more.

Virginia's first 3D-printed home going up in Richmond's Southside

By [Terrance Dixon](#)

Published: Jun. 24, 2021 at 3:40 PM PDT

RICHMOND, Va. (WWBT) - History was made in South Richmond as construction began on a house being built using a 3D printer.

Thursday morning, the massive piece of technology used concrete to help build a 1,550-square-foot home with three bedrooms and two baths.

"It's a home where your wall are made out of concrete instead of wood that's it," said Zachary Mannheimer, CEO of Alquist, a 3D printing construction firm from Iowa City.

"It's mixed in a mixing bowl and from there it goes through a tube into a printer head and that printer head is programmed to go around and print the wall system," said Chris Thompson, Director of Virginia Housing.

The process to build the walls takes about 15 hours but requires less labor, and fewer materials than your standard job, but besides that, contractors say this home is no different from any other.

"It's the same plumbing, same electrical, same HVAC, and same roof structure. All of that is the same," said Mannheimer.

This new housing project comes from a grant made possible through several organizations:

- Virginia Center for Housing Research at Virginia Tech
- Alquist, a 3D printing construction firm from Iowa City, Iowa, will be working directly with the VCHR to print the home's exterior walls.
- The Better Housing Coalition
- HOMES
- RMT Construction & Development Group

All of these organizations have researched 3-D printing for years, hoping this printer has the potential to reduce the cost of homeownership.

"The housing prices have been out of control for decades and the pandemic has only made it worse," said Mannheimer. "We think this technology can drop the cost make it more efficient and also help families customize a home to fit their lifestyle in ways they may not have been able to do before."

“It’s a good time to really start testing and understand how we try new material, and how do we try new ways of building,” said Andrew McCoy, Director of Virginia Center for Housing Research at Virginia Tech.

Currently, Florida and Arizona are the only other two states that have dabbled into the home printing world, and now, Virginia is next on that list hoping to print opportunities of the American homeownership dream.

“It gives us room to experiment and test which is all that needs to happen,” said McCoy.

“This is the future of construction,” said Mannheimer.

The house is expected to be finished in October and sell for roughly \$200,000.

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