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TO: Detroit City Council

FROM: David Whitaker, Director 
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DATE: March 30, 2022

RE: **Cost of 3D Printers for the Development of Housing in Detroit**

Council member Coleman A. Young II requested the Housing and Revitalization Department (HRD) and the Legislative Policy Division (LPD), report on cost of 3D printers for use in the development of housing for the City of Detroit, and to also report on how this could improve the development of housing as well.

The commonly used term of a 3D printer for the manufacturing of buildings, is a direct reference to an additive manufacturing device. “As defined in the American Society for Testing and Materials (ASTM) International’s 2012 standard terminology for additive manufacturing technologies, *additive manufacturing* or *AM* is a process of joining materials to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodologies¹ that remove layers.”²

Some have argued that 3D printing is more than just an interesting development in manufacturing techniques—it represents the dawning of the next industrial revolution. 3D printing challenges a number of traditional characteristics of manufacturing. While most manufacturing approaches removing material during the production process, 3D printing techniques add material, building up an object. 3D printing techniques may allow manufacturing to move into an era of mass customization, making products that are more relevant and working more efficiently by reducing the volume of waste produced.³

¹ [What is subtractive manufacturing? Definition and examples \(marketbusinessnews.com\)](http://www.marketbusinessnews.com/what-is-subtractive-manufacturing-definition-and-examples/)

² [How 3D Printing Will Change Cities | The Urbanist](http://www.theurbanist.com/2014/03/10/how-3d-printing-will-change-cities/)

³ [Public Administration Review - 2018 - Dickinson - The Next Industrial Revolution The Role of Public Administration in \(1\).pdf](http://www.dickinson.edu/~publicadmin/PDF/Public%20Administration%20Review%20-%202018%20-%20Dickinson%20-%20The%20Next%20Industrial%20Revolution%20The%20Role%20of%20Public%20Administration%20in%20(1).pdf)

We learned that the city of John Day, Oregon in Eastern Oregon, which is dealing with a housing shortage, in the spring of 2022 is planning to use 3D home printing technology as a solution.⁴ The technology prints the walls of the house using a concrete mix that can add curvature and print in multiple directions, which may even print the roofs, thereby printing a complete shell. The printers also have the potential to cut down on work, which is expected to provide relief from the current labor shortage, given that the technology requires fewer people.

According to news accounts, John Day city manager Nick Green indicated that the City has started the land development for the site where the printed homes will be built, and that veterans will have first priority for the two-bedroom homes with a target rent rate of \$700 a month. According to Zachary Mannheimer, the CEO of Alquist, the company the City of John Day is working with, which owns the machines, "A 3D concrete printed home vs. a stick-built home, you're going to have savings somewhere in the ballpark of 10-15%... Over the next 24 months, that will increase to 30%." Alquist owns two printers, they cost anywhere from \$300,000 to \$1 million.

According to a March 2020 report by the National Low Income Housing Coalition, extremely low-income renters — households with incomes at or below the poverty level or 30 percent of the area median income — face a housing shortage of 7 million available and affordable rental homes. The report also found that the lack of affordable housing is prevalent in communities of color with 71 percent of Black, extremely low-income renters spending more than half of their income on housing.

Organizations like Habitat for Humanity are betting that 3D printing could help alleviate the increased demand for low-cost housing. April Stringfield of Williamsburg, Virginia, has rented apartments since her early twenties, she applied for affordable housing provided by Habitat for Humanity. Habitat for Humanity selected her home as its first 3D-printed project. Initiated between a partnership with Alquist, a 3D-printing construction company, it is the organization's effort to confront the nation's affordable housing crisis, which increased due to multiple factors including the heightened costs of materials during the pandemic and a booming demand on the housing market. Late in 2021, she and her teenage son moved into their new, 1,200 square-foot home in Williamsburg, Virginia, constructed with the help of a 3D printer.⁵



The printer head of a giant 3D printer begins laying cement for the foundation of a Habitat for Humanity home. Consociate Media

⁴ [3D-printed homes to help housing shortage in Oregon city | kgw.com](https://www.kgw.com/story/news/3d-printed-homes-to-help-housing-shortage-in-oregon-city/7000000002)

⁵ [How 3D printing can be the solution to the nation's affordable housing crisis \(nbcnews.com\)](https://www.nbcnews.com/tech/innovation/how-3d-printing-can-be-the-solution-to-the-nations-affordable-housing-crisis-n1234567)



Alquist 3D CEO Zach Mannheimer with new Habitat for Humanity homeowner April in front of her new home. Habitat for Humanity



Habitat for Humanity's first 3D-printed house in Williamsburg, Va. Habitat for Humanity

⁶ Tawkiyah Jordan, senior director of housing and community strategy for Habitat for Humanity, said the organization adopted this method of building to meet the need to innovate, while also keeping high-quality homes affordable. It costs approximately \$150,000 to construct a typical home with wood. By using concrete to construct homes with a 3D printer, it saves Alquist up to 15 percent on building expenses.

3D-printed homes are also said to have an environmentally friendly impact, as the production process reduces the potential waste of materials, such as extra quantities of wood and metal that would otherwise end up in landfills. However, 3D-printed housing is still a relatively new concept, and it's still being developed. A majority of startups in 3D home construction have only begun creating the technology and not yet created actual homes. Almost all other 3D construction printer makers and construction 3D printing service providers tend to work with large-scale or high-profile projects where the municipality is either involved or was engaged for a long time in order to be granted construction permits.

The cost to build an average sized 3-bedroom house with conventional building methods is from \$250,000 to \$320,000. Building the same home with 3D printing technology would cost from 20 percent to 40 percent less to build. So that same 3-bedroom house would presumably cost between \$140,000 to \$240,000 to build with 3D printing technology.

The biggest roadblock, arguably, is government regulations regarding what can or cannot be allowed as a means of construction. Government regulations and construction permits vary wildly across the globe. But one thing they all have in common is the reluctance of public bodies to allow cutting-edge technology to be used by the general population at such an early stage. Construction 3D printing has quietly positioned itself as the outstanding future of home building. 3D printed housing promises cheaper, yet just as durable and diversely designed housing options that can be built from the ground up in a matter of days instead of months.⁷

Between late November and early December 2021, home builder SQ4D announced the listing of the first 3D printed family home on the open market via [Zillow.com](https://www.zillow.com). The home located in Riverhead, NY, has 3-bedroom 2 baths and comes with a price tag just shy of 300k.⁸



3D printed house listed for sale on the MLS in 2021

⁷ [The 3D-printed space-age houses that could solve America's housing crisis | TheHill](#)

⁸ [When will 3D printed houses become available on the housing market? | 3DRIFIC](#)



The Construction3D printer Photo by Lara Gendre¹⁰

Some of the main benefits of 3D home construction:

- Speed: Often, it doesn't even take 24 hours to build a small 3D-printed home, although this build-out is typically done in waves rather than all at once.
- Cost: 3D-printed homes are surprisingly cheap to create, running around \$10,000 on average today. 3D-printed home leader ICON hopes these homes are even more affordable in the future, with a projected goal of reducing builds down to \$4,000. Once plumbing, electrical and other additional construction is added, the final housing cost is around \$140,000 to \$160,000 on average today.
- Versatility: Rather than having to enlist the help of an architect, homebuyers can use 3D technology to customize their home shape and build in the blueprint phase without a hefty price tag.
- Sustainability: 3D-home construction boasts a shorter supply chain and less waste due to over-engineering. This reduction in process and waste makes these homes more eco-friendly.

⁹ Two people only are necessary to operate the machine on the construction site.

¹⁰ [Machines 3D host Machinarium, demonstrates 3D printing for construction - 3D Printing Industry](#)

Select 3D-printed home milestones around the world:

- The first fully 3D-printed home in the U.S. was unveiled at Austin’s South by Southwest conference in 2018. The 650 square-foot home made of concrete was printed onsite, and cost approximately \$10,000 to build.
- Since then, a 3D-printed neighborhood construction project has been underway in Southern Mexico to bring 50 homes to a poverty-stricken area that is prone to natural disasters such as earthquakes and flooding. The idea is that the 3D-printed structures will help the community withstand the extreme weather conditions.
- Dubai is currently home to the world’s largest 3D-printed building, a two-story office space that is 31 feet tall and 6,900 square feet. Dubai is also striving to have 25% of its new buildings constructed through 3D printing by 2030.¹¹

As it stands, consumers in most cases would be unable to commission a 3D printed house construction directly. The printers themselves are expensive investments for any local construction company. 3D construction printer generally starts at **\$39,000 for the small basic models, to the upwards of \$100,000 for the larger models.**

Exactly how the City of Detroit could benefit and utilize the full potential of this emerging technology would be best spelled out by the Housing and Revitalization Department.

Please contact us if we can be of any further assistance.

¹¹ [3D-Printed homes: How 3D printers are building affordable housing | The Zebra](#)