

Building Tomorrow's House Today

MaineHousing
Special Achievement

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A MaineHousing research and design partnership with the University of Maine has resulted in the world's first home printed with recyclable resin made from sawdust and corn.

Big ideas are sparked by curiosity.

That's exactly what happened when MaineHousing Development Director Mark Wiesendanger emailed the University of Maine's Habib Dahger after Mark saw the news that the university's Advanced Structures and Composite Center had used its giant 3-D printer to print a boat.

"Perhaps there might be a way to produce housing using new, Maine-based, wood-based technologies that would be durable and energy efficient, and would benefit the local economy," Wiesendanger wrote. "Additionally, I think there is an opportunity to showcase Maine innovation while providing a public benefit."

Dahger took the question to heart and began to think about it another way, "Could we print a house?"

Now, three years and thousands of research hours later a first-of-its-kind home is sitting on the Orono campus undergoing environmental testing and studies to see if the materials it is printed from can endure all Maine's weather has to offer. MaineHousing was an early investor in this projects, pledging \$500,000 in seed money towards the experiment.

The prototype BioHome 3D, is the first of its kind, and now it won't be the last and a village of affordable homes printed in the same manner is on the horizon nearby in Bangor.

From the materials used for construction, to the method of printing, to the design of the 600-square-foot house itself the lab, in close consultation with MaineHousing's development team, is advancing this home of the future that offers solutions for a number of environmental and economic problems currently slowing the pace of affordable housing development in the U.S.

Other partners include the U.S. Department of Energy, Oak Ridge National Laboratories and the Maine Technology Institute.

"This pops us into the future. Never before seen, here in Maine, or in the country or across the world," said Gov. Janet Mills during a ceremonial ribbon cutting for the prototype home.

Using residual wood waste, sawdust really, from Maine's forest industry and a unique corn-based resin a revolutionary new building material has been invented. As strong as steel, lighter than concrete and far more sustainable, renewable even this evolving technology holds great promise for the future.

"That material is widely available and relatively inexpensive," Dahger said. "By automating the printing process and training the next generation of engineers to do that will solve the labor issue and the material costs issues using this technology."

When complete the research is expected to yield an out-of-the-box kind of opportunity for any company or investor looking to commercialize the system. This research is also expected to create a new sustainable industry and supply chain to sustain that industry within Maine, adding valuable jobs to the state's economy while providing new employment opportunities, especially in rural parts of the state.

As the technology advances and is refined the overall costs of producing the finish product is also expected to decrease. Meanwhile the savings from reduced labor construction costs will further enhance the home's affordability additionally lowering the final production costs.

Dahger believes as the technology scales up a new house could be printed every 48 hours with as few as four to five workers.

MaineHousing Director Daniel Brennan summed it up this way during an open-house celebration of the home on the university campus in November of 2022.

“This project gives us a real possibility to achieve something that has eluded us to-date, and that is the speed of production, to be able to mass produce in a very fast way housing, Brennan said. “The idea that we can create housing units in a fraction of the time with a fraction of the workforce — that is an efficiency that we’ve never experienced before. It’s going to stretch our precious state and federal resources exponentially, and most importantly, provide — quickly — for those most in need in our state.”

Innovation details:

- Each module is 100% additively manufactured- floors, walls, and roof- which differentiates this house from current commercial 3D-printed homes.
- Local wood fiber and bio-resin materials developed by the Hub & Spoke partnership
- Walls, floors, and roof are all printed, unlike existing 3D-printed housing projects.

600 square foot single-family home

- Highly automated, off-site, modular assembly
- Designed as separate, printed modules for ease of transportation and assembly.
- The materials used are 100% recyclable
- The house is insulated with a combination of wood fiber insulation and blown-in cellulose insulation.

Technical research and development efforts leading to BioHome3D

- Cellulose Nanofiber production including drying, functionalization, compounding with thermoplastics
- Multi-scale modeling
- Large, high-rate Additive Manufacturing processing
- Demonstrates new bio-based Poly Lactic Acid (PLA) grade formulated for additive manufacturing
- Life-cycle analysis

Appendix A Property Images



Appendix A

Property Images - continued



Appendix B News Article Links

BioHome3D - Advanced Structures & Composites Center

<https://composites.umaine.edu/biohome3d/>

First 100% bio-based 3D-printed home unveiled at the University of Maine

<https://umaine.edu/news/blog/2022/11/21/first-100-bio-based-3d-printed-home-unveiled-at-the-university-of-maine/>

UMaine unveils 3D-printed home to help solve affordable housing crisis

<https://www.bangordailynews.com/2022/11/21/news/bangor/umaine-3d-printed-home-affordable-housing-n6hjn1me0n/>

This 3D-printed home is made entirely of bio-based materials

<https://www.freethink.com/hard-tech/3d-printing-homes>

UMaine unveils the world's first bio-based 3D-printed house

<https://www.boston.com/news/local-news/2022/12/05/umaine-unveils-the-worlds-first-bio-based-3d-printed-house/>

This 3D-Printed House Is the First to Be Made Entirely From Bio-Based Materials

<https://www.architecturaldigest.com/story/umaine-3d-printed-from-bio-based-materials>

ORNL, UMaine 3D print home from biobased materials, develop blueprint for rapid manufacturing

<https://www.ornl.gov/news/ornl-umaine-3d-print-home-biobased-materials-develop-blueprint-rapid-manufacturing>

3D printed home neighborhood to be built in Bangor

<https://www.wabi.tv/2023/01/26/3d-home-neighborhood-be-built-bangor/>

UMaine unveils first 3D-printed home in a bid to mass-produce affordable housing

<https://www.mainepublic.org/environment-and-outdoors/2022-11-21/umaine-unveils-first-3d-printed-home-in-a-bid-to-mass-produce-affordable-housing>

UMaine unveils a first-of-its-kind 3D-printed house

<https://www.wmtw.com/article/umaine-unveils-3d-printed-house/42037043>

This 3D printed house is made from wood chips and sawdust

<https://www.fastcompany.com/90829686/3d-printed-home-is-made-from-wood-chips-and-sawdust>

Our View: If you print it, they will come

<https://www.centralmaine.com/2022/11/27/our-view-if-you-print-it-they-will-come/>

UMaine unveils house made with giant 3D printer

<https://www.pressherald.com/2022/11/21/umaine-unveils-house-made-with-giant-3d-printer/>