

Revolutionizing Rural Housing:
Using 3D Printing to Address the Housing Crisis in Eastern Kentucky
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Background:

Eastern Kentucky, like many rural areas in the United States, has a need for affordable, safe, and healthy homes, particularly after being affected by natural disasters that have destroyed their homes. Traditional construction methods can be too costly and time-consuming for rural areas, and many of the available homes are in disrepair. However, a new technology, 3D printing, has the potential to revolutionize the way houses are built and address many of the housing issues faced by Eastern Kentucky communities.



3D printing uses a digital model to construct physical objects layer by layer. This technology has the potential to greatly reduce the time and cost of building a house, while also offering new design possibilities. Additionally, 3D printed houses have the potential to withstand natural disasters better, be more energy-efficient, and have mold resistance, which can lead to better health outcomes. These benefits can improve the housing situation in Eastern Kentucky and provide new opportunities for families in the region.

Objectives:

- **Strengthen Natural Disaster Relief:** 3D printing technology has the potential to revolutionize the construction industry by allowing for the creation of more resilient houses that can withstand natural disasters like fires, floods, and wind. With 3D printing, houses can be designed with reinforced walls and roofs that offer greater protection against these hazards. To further enhance the safety of the inhabitants, 3D printed houses can also incorporate "smart" technologies, such as sensors and automated systems that can detect gas leaks or shut off water or electricity in the event of a flood, which can help to limit the damage caused by a natural disaster and make the house safer for its inhabitants.
- **Streamline Infrastructure Repair:**
3D printing has the potential to revolutionize the way we repair and replace infrastructure such as culverts and bridges. One of the key advantages of 3D printing is the ability to produce precise, pre-fabricated parts quickly and cost-effectively. This technology can streamline the repair process by reducing the need for manual labor and on-site adjustments. Additionally, 3D printing allows for the use of a wide variety of materials, including those that are stronger and more durable than traditional materials, which can improve the overall longevity and resilience of the infrastructure.
- **Produce Affordable Housing:** 3D printing is a promising technology for addressing the issue of affordable housing. One of the major benefits of 3D printing is that it can use a wide variety of inexpensive, locally sourced materials, which reduces the cost of construction. Additionally, the use of 3D printing reduces the need for skilled labor and specialized equipment, further reducing the cost of construction. As a result, the cost-effective and efficient construction process offered by 3D printing could make housing more accessible to low-income families and communities.
- **Improve Indoor Air Quality and Reduce Chronic Health Risks:** One of the key advantages of 3D printing is the precise control over a structure's shape and size. This feature helps prevent water from pooling in the structure and thus inhibiting mold growth. Additionally, many of the materials used in 3D printing, such as certain types of concrete



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and plastic, can also be mold-resistant. This precision in the construction process eliminates many of the imperfections found in traditional construction that can lead to issues with mold and pests. With 3D printing, it is possible to build houses that are less prone to mold growth and pest infestations, which can contribute to a healthier living environment and better health outcomes overall.

- **Empower Local Communities:**

In the aftermath of a disaster, it is crucial to not only provide immediate relief but also to build resilience for the long-term. One way to achieve this is through the implementation of 3D printing technology. By leaving a set of small, medium, and large 3D printers in the affected county and training local residents on how to operate them, we can empower communities to rebuild and create new economic opportunities. This training can help foster an entrepreneurial spirit by providing individuals with the skills and resources to create and export products, which can help to jumpstart local economies. Additionally, by providing access to 3D printing technology, communities will have the ability to produce necessary goods and materials quickly and efficiently, further reducing the dependence on external aid.

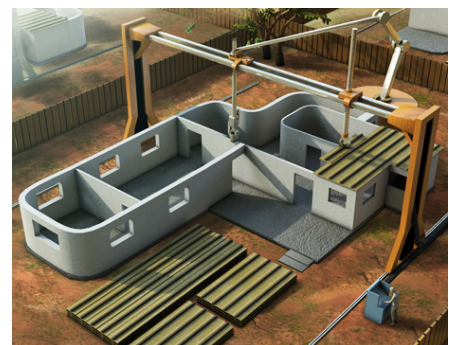


Supporting Work:

The KCTCS Additive Manufacturing Center (AMC) is one of Kentucky's most advanced additive manufacturing (3D printing) technological centers and oversees Kentucky's widest AM reach. The AMC, housed at Somerset Community College's Valley Oak Research Complex encompasses over 15,000 square feet of lab space, 30 acres of testing fields, and incorporates a broad range of AM technologies and equipment, including FDM, SLA, DLP, BMAM, SLM, and SLS processes. Conventional machining, fabrication, injection molding, as well as advanced CNC applications, also make up the AMC's capabilities. The AMC houses one of Kentucky's largest FDM 3D printers with nearly 100 cubic feet in build volume, has a mobile AM production and demonstration trailer, and is currently researching and developing several applications for concrete additive construction. The AMC also specializes in multimedia production and editing for the creation of high quality educational and social media content related to AM techniques, awareness, and opportunities.

Unresolved Issues:

- Purchase of a large scale 3D printer is required
- Limited number of 3D printer manufacturers
- Training and time needed to operate the machine
- Establishing Building Code compliance
- Environmental and health testing compliance
- Finding the best materials to use with the printer is necessary



Target Funder and Partners:

- FEMA, Public Housing Agencies, NSF, NIH, DOT, USDA RD, Abandoned Mine Lands.
- Bristol Group, Minova, KY DHBC, AMIST.