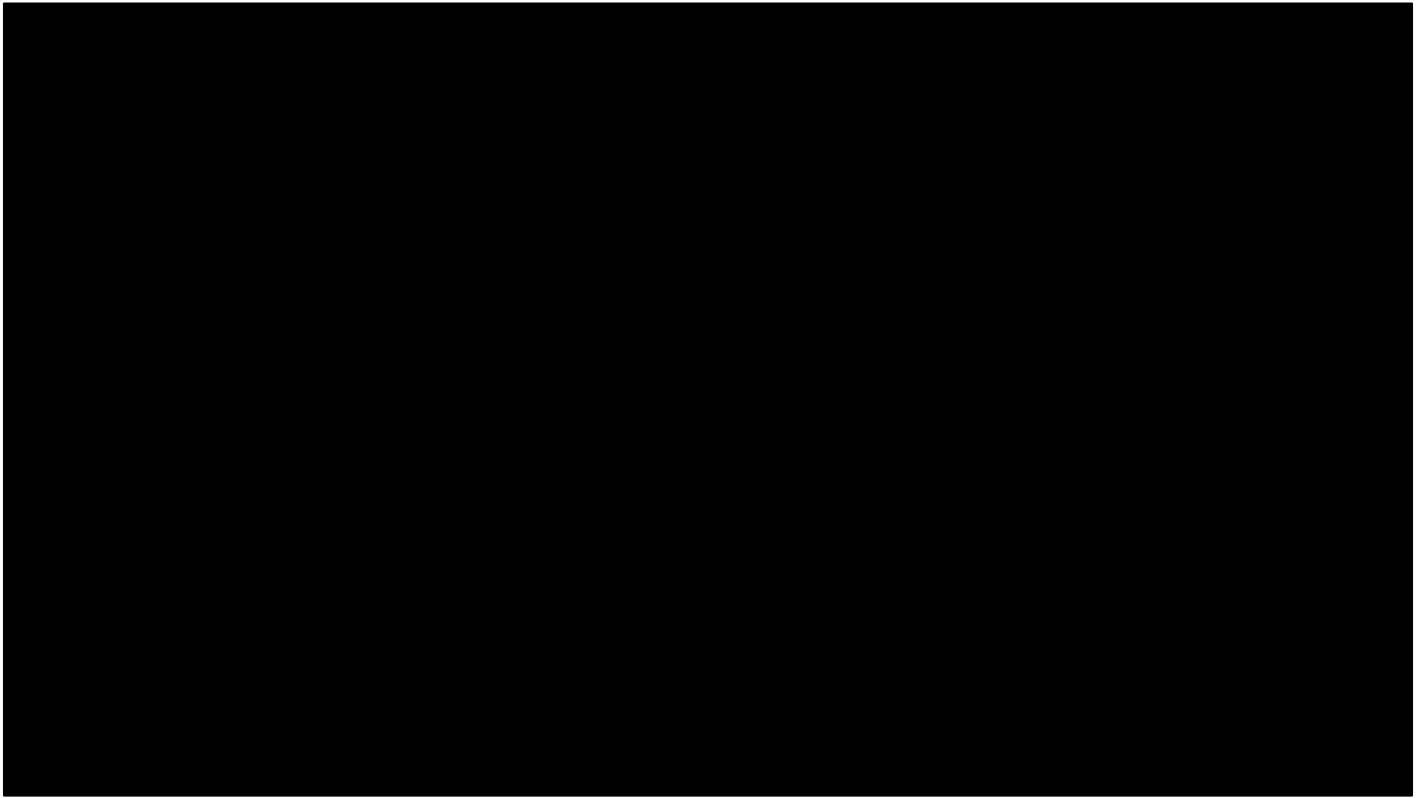


Revolutionizing Rural Housing & Building Jobs:

The Potential of Concrete 3D Printing in Eastern Kentucky

Eric Wooldridge, PE, RA
Robert Gabbert, PE





FIRST U.S. OWNER-OCCUPIED HOUSE



PRODUCTION TIME: 28 hours.



NASA HABITAT 3D PRINTERS

\$60M





ARMY & MARINE BARRACKS SINCE 2016



FORT BLISS LARGEST BUILDING IN THE WEST



\$4000/24 hours

**Local
materials
\$900**







\$299,999 (1/2 LOCAL SALES COST)



3D Printed Homes Built/In Planning By State

Estimated as of April 15, 2022

STRONGER

FASTER

HEALTHIER

DRAMATIC COST REDUCTION

EMERGENCY RESPONSE

STRENGTH



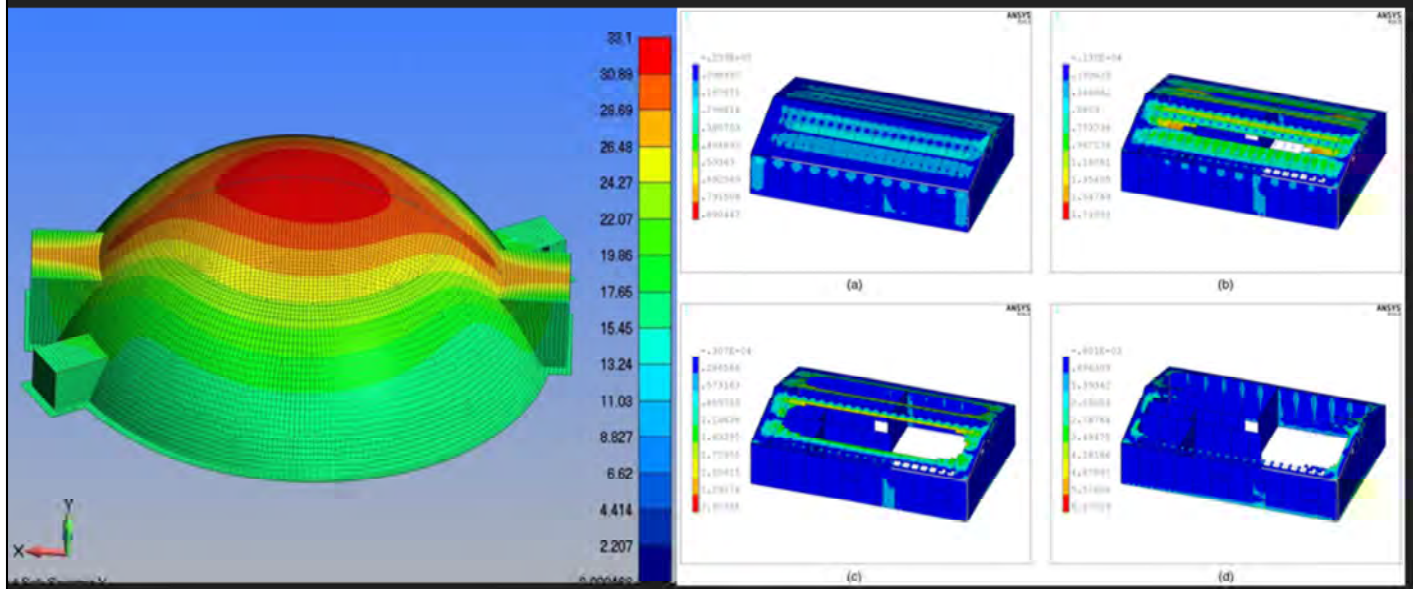
TRADITIONAL

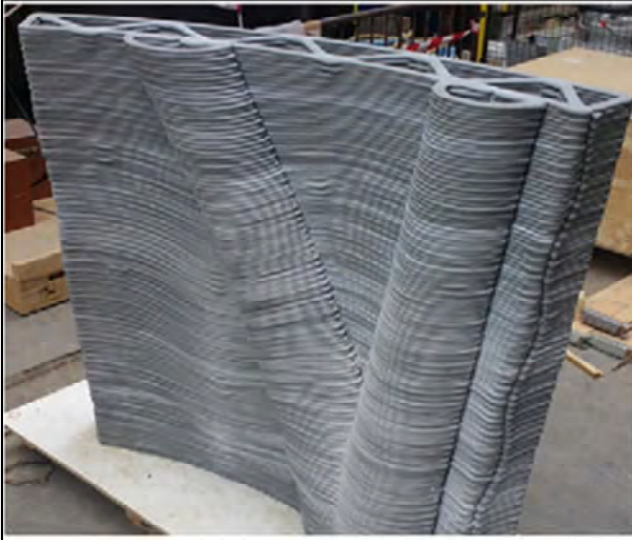
VS

3D PRINTED

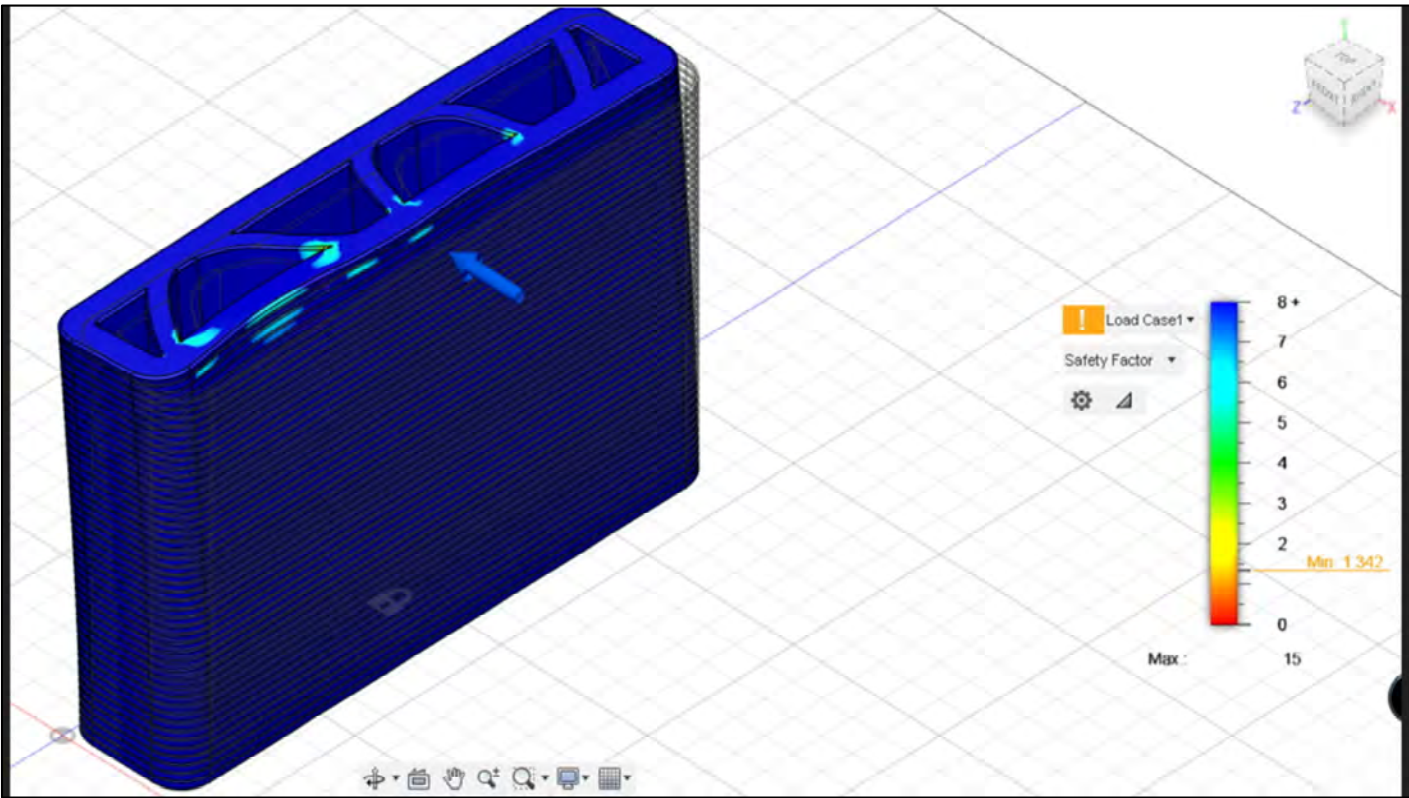


HIGH WIND PERFORMANCE





NATURAL STRESS REJECTION SHAPING



Strain capacity 300 – 500x



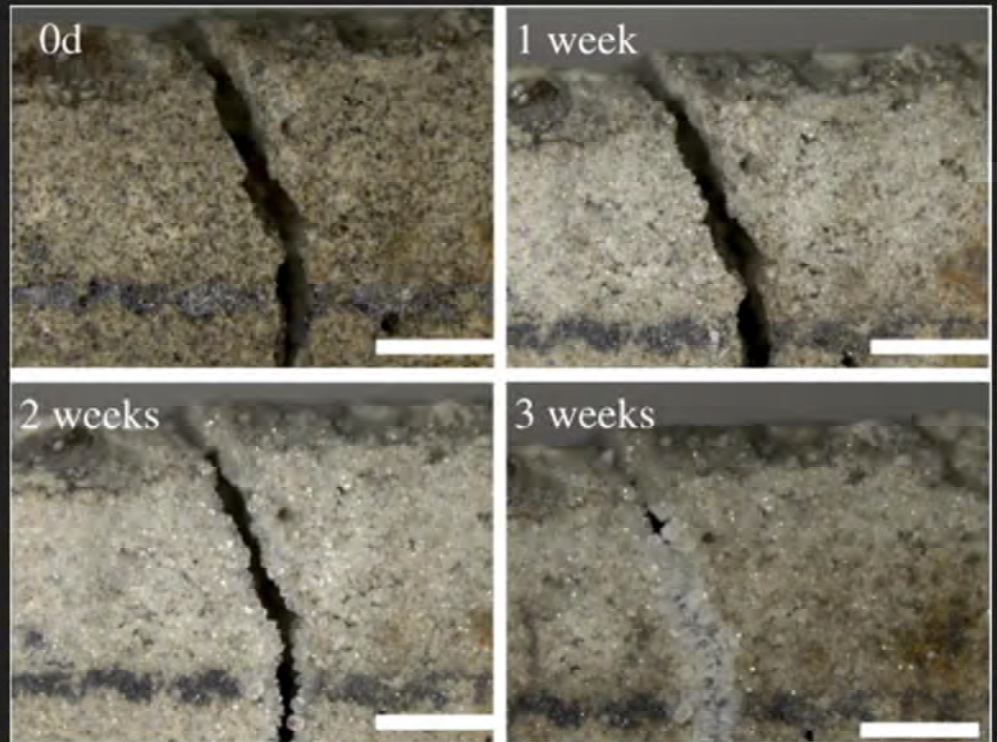
Before



After



Self-healing concrete contains bacteria and starch. Bacteria are dormant until a crack forms.



KENTUCKY'S NEED?







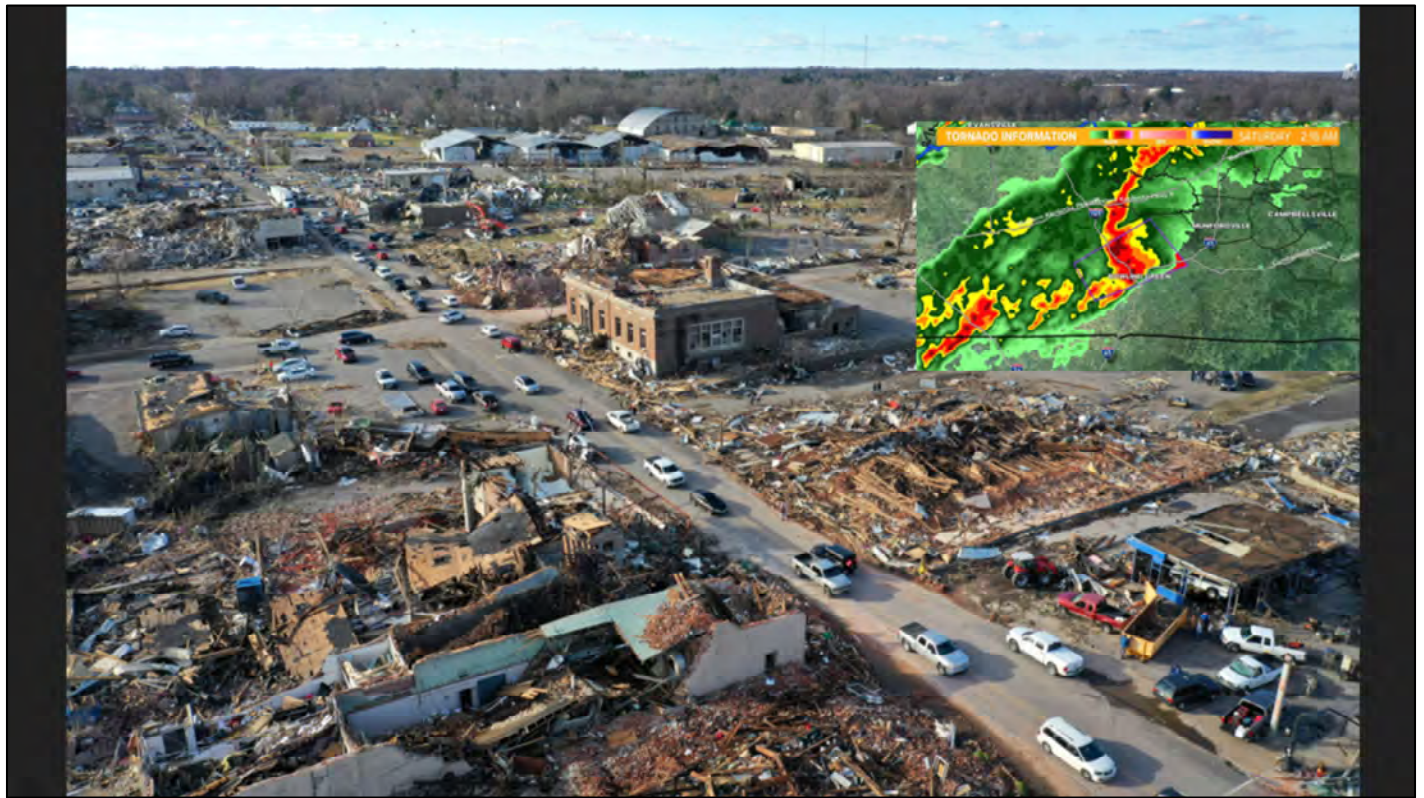
TEAM
KENTUCKY





**80% OF DAMAGED OR
DESTROYED
STRUCTURES WERE
OUTSIDE OF THE DESIGN
FLOOD PLAIN**





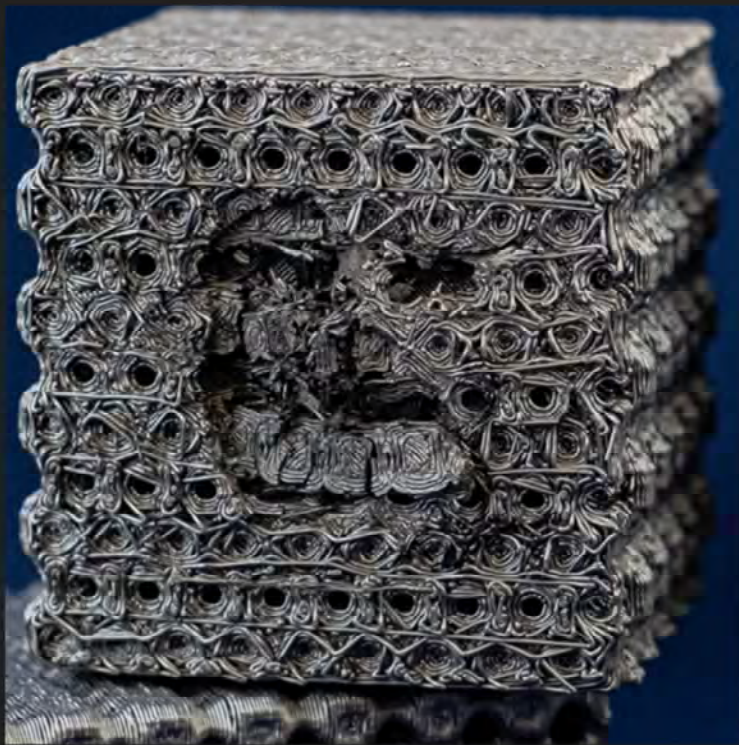


THE PROBLEM

**REBUILD HOUSES THAT
WILL **SURVIVE** THE
NEXT FLOOD AND
TORNADO**









HEALTH



WATER LEAKS

DAMPNESS

POOR VENTILATION

DIRTY CARPETS

PEST INFESTATION

FIRE HAZARD



NIH RESEARCH MATTERS

August 20, 2012

Household Molds Linked to Childhood Asthma

Three specific species of mold were more common in the homes of babies who later developed asthma. The finding highlights the importance of preventing water damage and mold growth in households with infants.

More than 6 million children in the U.S. have asthma. Genes are known to play a role, and so does the home environment. Childhood asthma has been linked to indoor mold growing in a child's home as a result of moisture problems such as water leaks. The connection between mold and asthma, however, is complicated and not fully understood. Asthma is often associated with allergies, and molds spread by releasing tiny spores into the air, which





RESPIRATORY INFECTIONS
ASTHMA
CHRONIC DISEASE
INFECTIOUS DISEASES
CARDIOVASCULAR DISEASE
MENTAL HEALTH



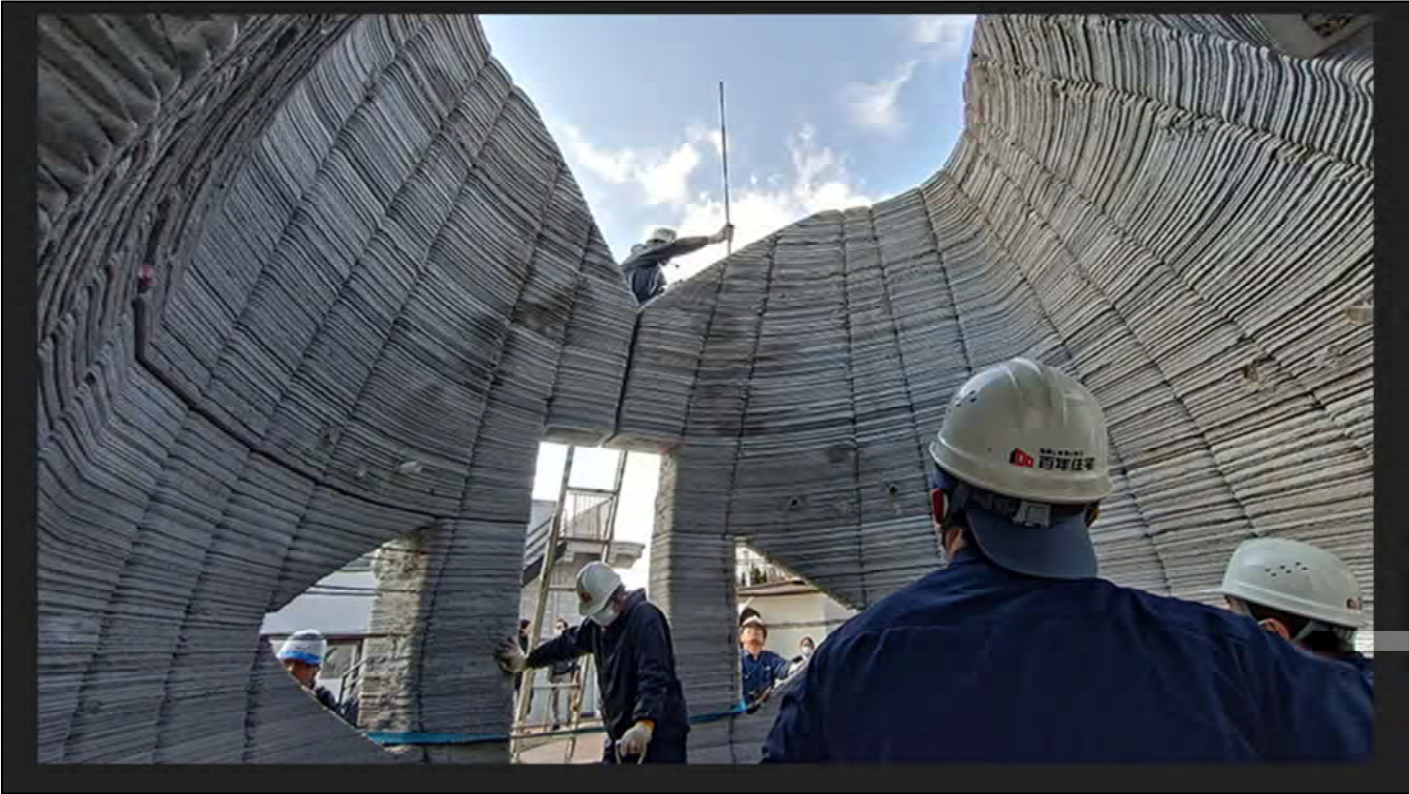
ECONOMICS

VARIABLE	3D PRINTED HOME	CONVENTIONAL HOME
COST (STRUCTURAL)	\$10,000	\$80,000
HOME INSURANCE	\$300-\$500	\$600-\$2,000
SPEED	<1 Week	6-7 Months
STRENGTH AND DURABILITY	Designed to withstand floods, fires, and other natural disasters	Varies by construction type, <u>less</u> resilient
SHAPE	Curvilinear, Rectilinear, Geometric, etc.	Typically <u>only</u> Rectilinear

EMERGENCY RESPONSE

<24 hours
10 yds of
concrete



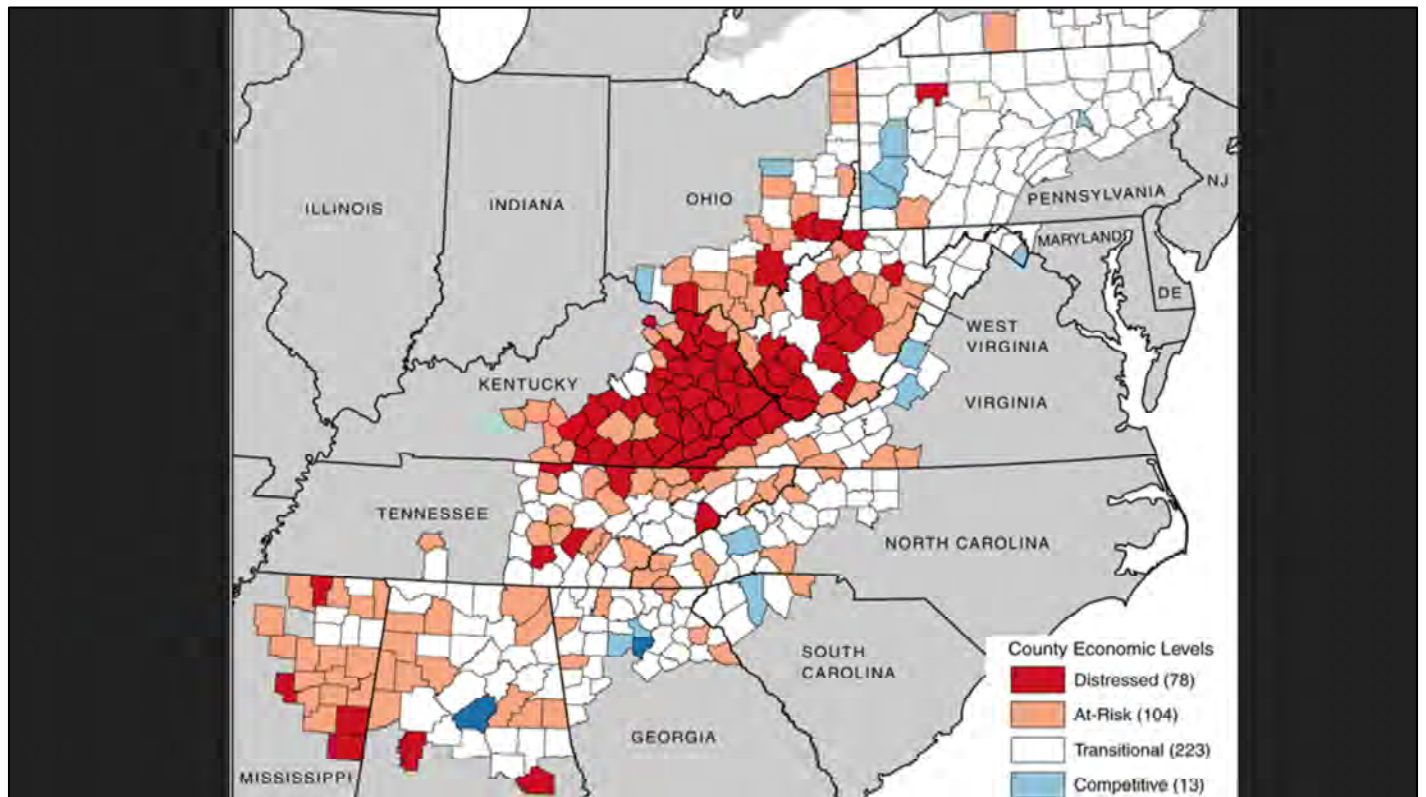


NEW METHOD FOR LIH









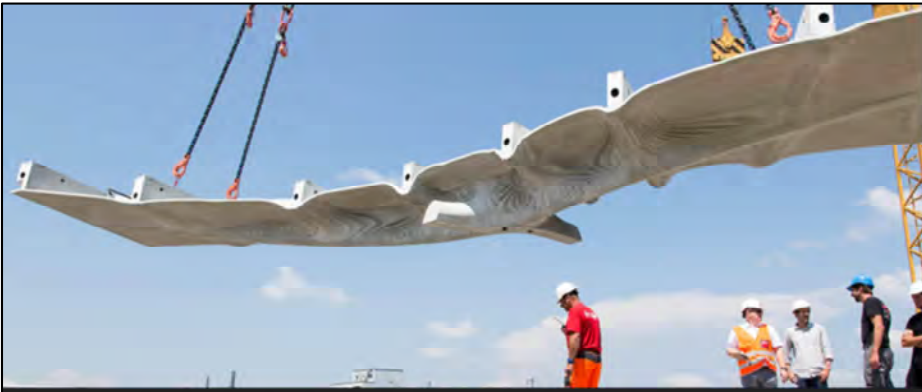


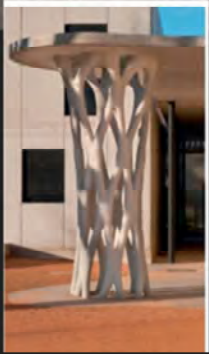
**BUT THAT ONLY SOLVES
THE HOUSING PROBLEM**

SAME 3D PRINTER:

**INFRASTRUCTURE
AND
CONSUMER PRODUCTS**









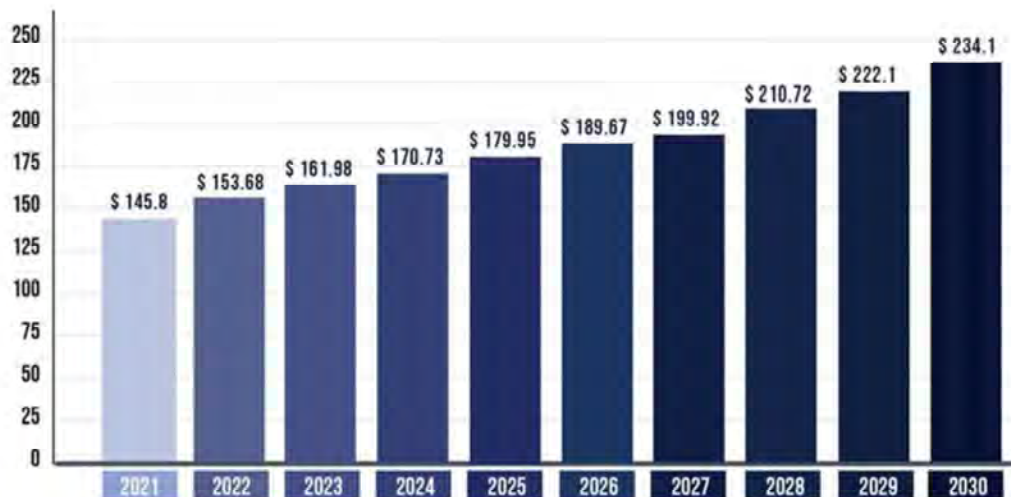








PRECAST CONCRETE MARKET SIZE, 2021 TO 2030 (USD BILLION)



\$234 BILLION BY 2030

EMPLOYABLE SKILLS:

TRUCK DRIVERS

COMPUTER TECHS

CRANE OPERATORS

PAINTERS

CONCRETE WORKERS

EXCAVATORS

CARPENTERS

MACHINE/EQUIPMENT OPERATORS



**ENDLESS
OPPORTUNITIES**



ALREADY BEHIND



PROJECT AMRAE

**ADDITIVE MANUFACTURING
RECONSTRUCTION AND EXPORTS**

PHASES:

1. **PROCURE** EQUIPMENT

2A. **TEST** SAMPLES TO
ESTABLISH CODE COMPLIANCE

2B. **PRODUCE** TEST CIVIL, AG, CP,
NON PERMIT STRUCTURES

PROJECT AMRAE

3A. **TRAIN** ON-SITE TECHNICIANS

3B. BEGIN RESIDENTIAL **CONSTRUCTION**

4A. **DEVELOP** COMMERCIAL PRODUCTS

4B. BEGIN (CP) **PRODUCTION**

PROJECT AMRAE

5A. SET UP **MICRO FACTORIES**

5B. **PIVOT** SOME EQUIPMENT
FROM HOUSES TO PRODUCTS

6A. FOCUS ON **MARKET CAPTURE**

6B. **RESEARCH**/ENGINEER NEW PRODUCTS

6C. LICENSE, SUPPORT, AND **SCALE**

PROJECT AMRAE

AMRAE GOAL: \$15M

MATERIALS-TESTING-ADMIN-TRAINING-TECHNICIANS

(15 to 20) PRINTERS: SMALL, M, LARGE



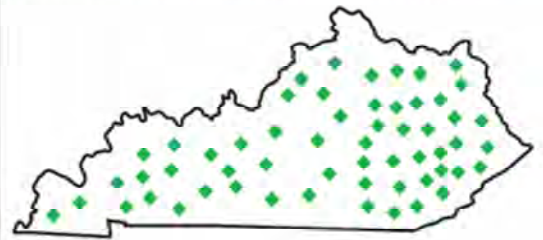


PARTNERS

PROJECT AMRAE



**PRINTING BUILDINGS,
HOMES, & PRODUCTS
ACROSS THE BLUEGRASS**



Linked in Eric Wooldridge, PE, RA



amlab115

eric.wooldridge@kctcs.edu

Facebook.com/CADD.LAB



- scclab115

PROJECT AMRAE

CONSTRUCTION STAGES



CONSTRUCTION STAGES



CONSTRUCTION STAGES



CONSTRUCTION STAGES



CONSTRUCTION STAGES



CONSTRUCTION STAGES



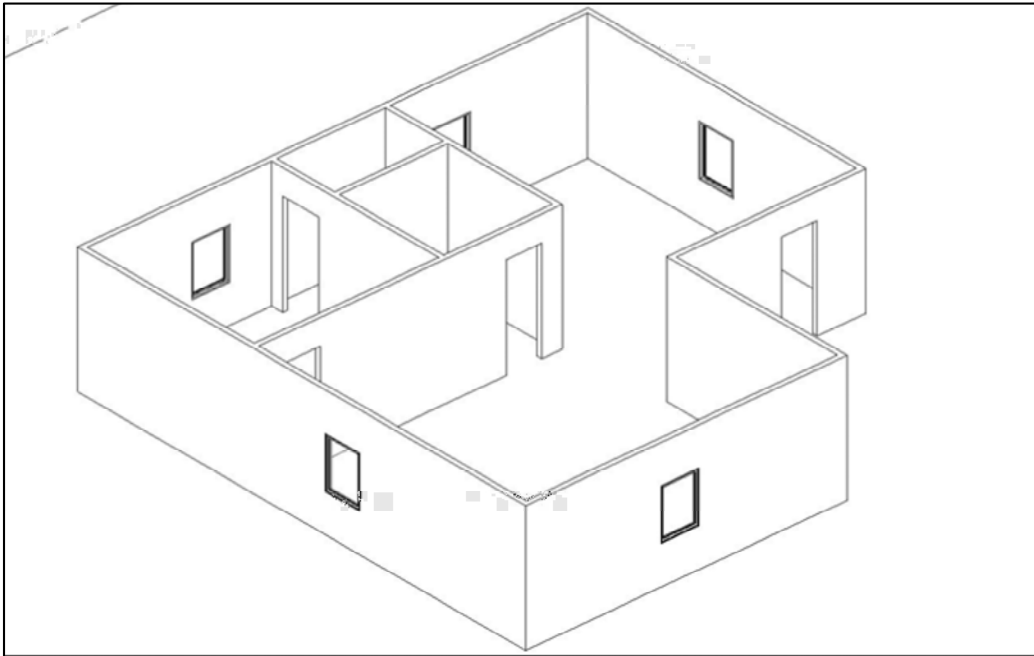
CONSTRUCTION STAGES



CONSTRUCTION STAGES



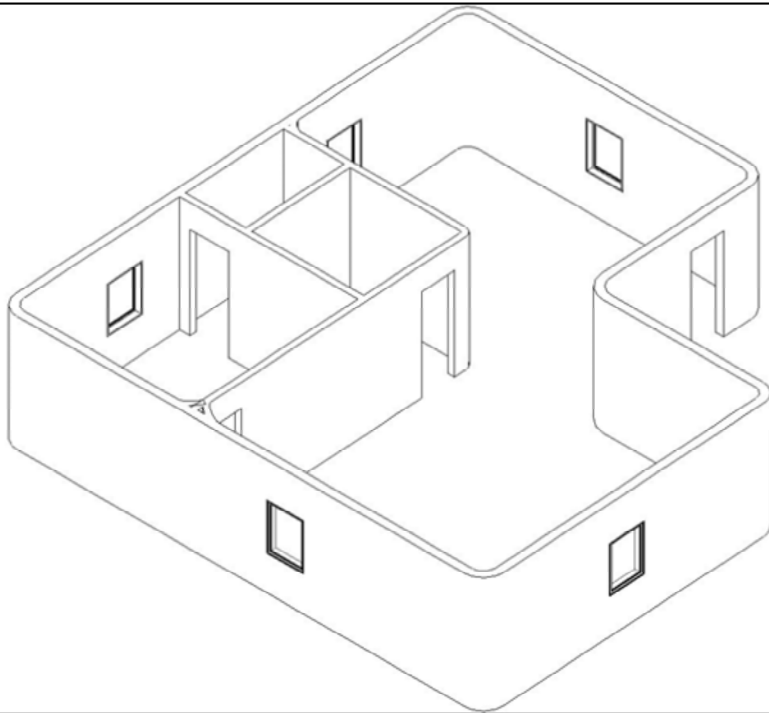




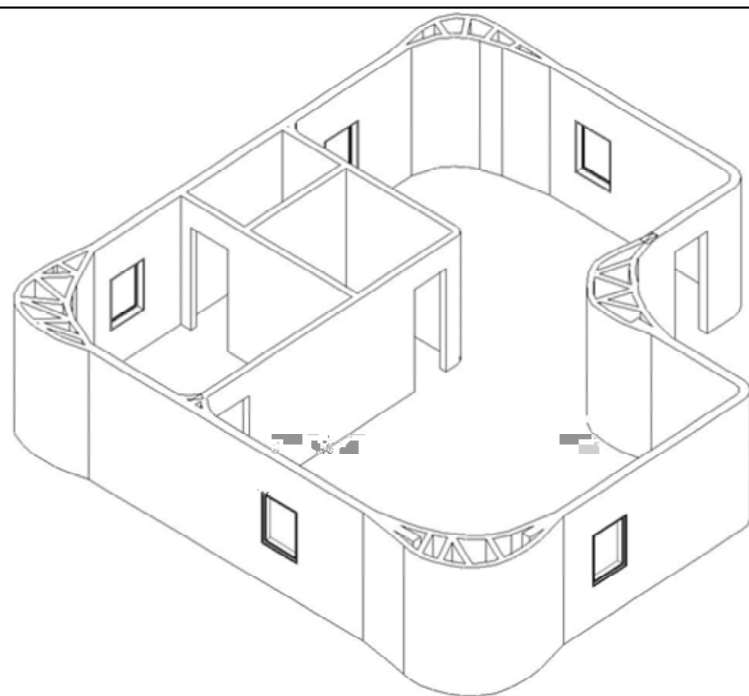
STRUCTURAL PERFORMANCE



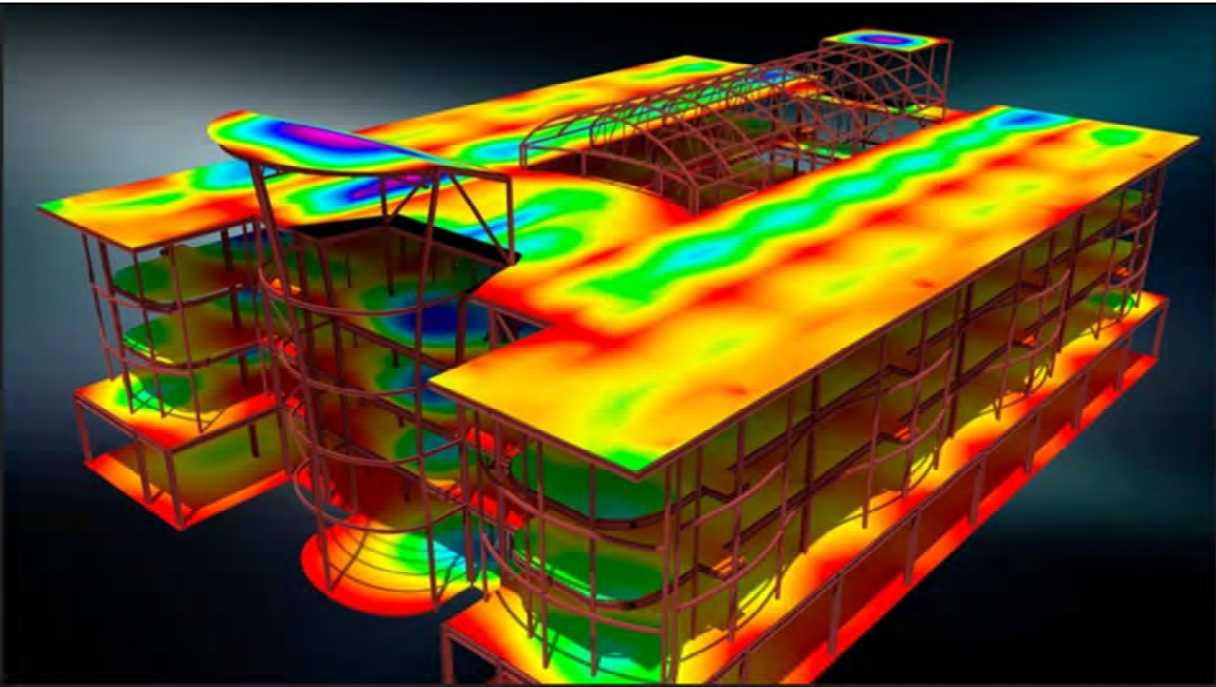
STRUCTURAL PERFORMANCE



STRUCTURAL PERFORMANCE



STRUCTURAL PERFORMANCE



STRUCTURAL PERFORMANCE

