NASA
Centennial Challenges Program

3D Printed Habitat Challenge
Phase 3
Open for Registration

Allied Organization:
Bradley University

Sponsors:
Caterpillar
Bechtel
Brick & Mortar Ventures

November 7, 2017

centennialchallenges

3D Printed Habitat Challenge Objective:

Advance additive construction technology needed to create sustainable housing solutions for Earth and beyond.

Autonomous Additive Manufacturing of Habitats for Earth and Beyond		
Phase 1	**Phase 2**	**Phase 3**
Design: Develop state-of-the-art architectural concepts that take advantage of the unique capabilities offered by 3D printing. **Prize Purse: $50K**	**Structural Member:** Demonstrate a recycling additive manufacturing **material** system that can create structural components using terrestrial/space based materials and recyclables. **Prize Purse: $1.1M**	**On-Site Habitat:** Demonstrate an automated 3D Print System to **create a complete habitat**. **Phase 3 Purse: $2.0M**

More info: http://www.nasa.gov/3DPHab

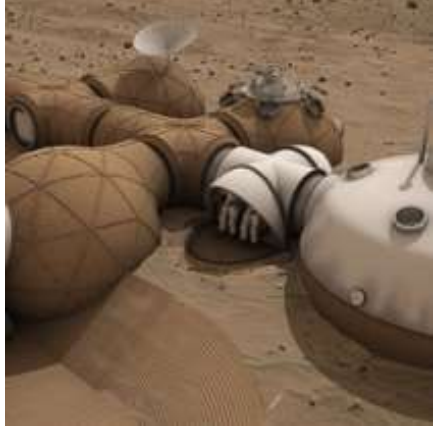
$3.15 Prize Purse

Today, 3D printing
touches our world

Phase 1 Completed September 27, 2015

1st
SEArch/Clouds
Ice House
New York

2nd
GAMMA
New York



3rd LavaHive
Europe

Develop state-of-the-art architectural concepts that take advantage of the unique capabilities offered by 3D printing.

Credit: SEArch/Clouds Ice House New York

Phase 2 Completed August 26, 2017

Demonstrate a recycling additive manufacturing **material** system that can create structural components using terrestrial/space based materials and recyclables.

Level 1
Cylinders

Level 2
Beams

Level 3
Domes

Phase 3 Virtual Construction Levels (Summary)

Virtual Construction (BIM) Level 1

Design Development (60% Complete)

Completeness of Model
Layout Programming
3D-Printing Scalability/Constructability of Model
Aesthetic Representation

5 teams with highest scores awarded prize proportional to score for Total Level 1 amount of up to $100k

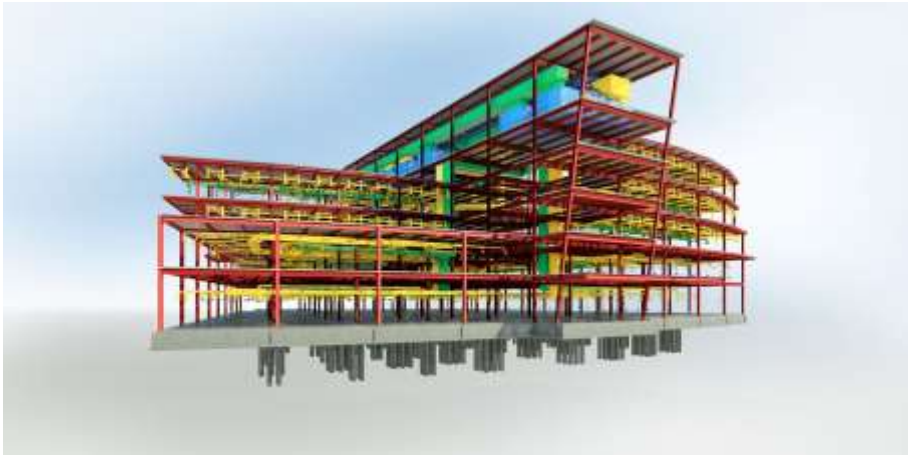
All registered teams eligible to submit an entry for Virtual Construction Level 2

Virtual Construction (BIM) Level 2

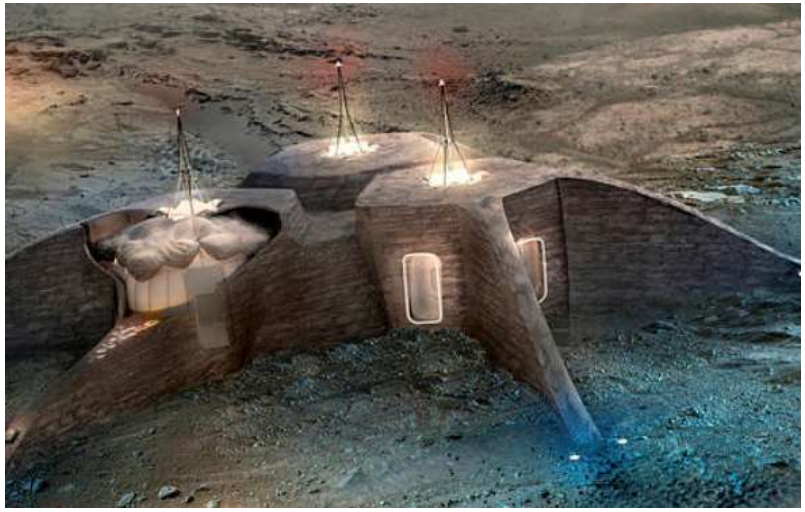
Construction Documentation (100% Complete)

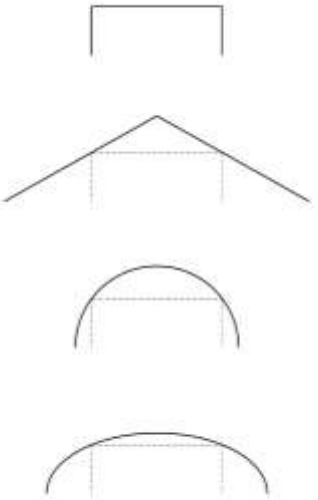
Completeness of Model
Layout Programming
3D-Printing Scalability/Constructability of Model
Aesthetic Representation
Optional 4D Model (*Site Layout Planning, 3D Printer and Autonomous Feeding System (Equipment) Flow and Virtual Prototyping)*

3 teams with highest scores awarded prize proportional to score for Total Level 4 amount of $100k

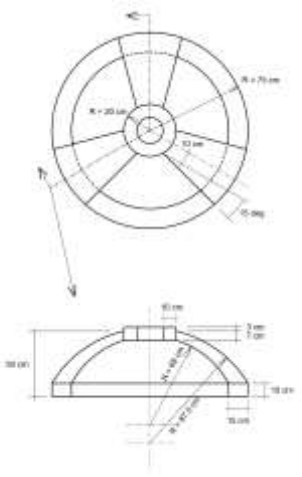


LET’S TAKE BIM TO MARS!

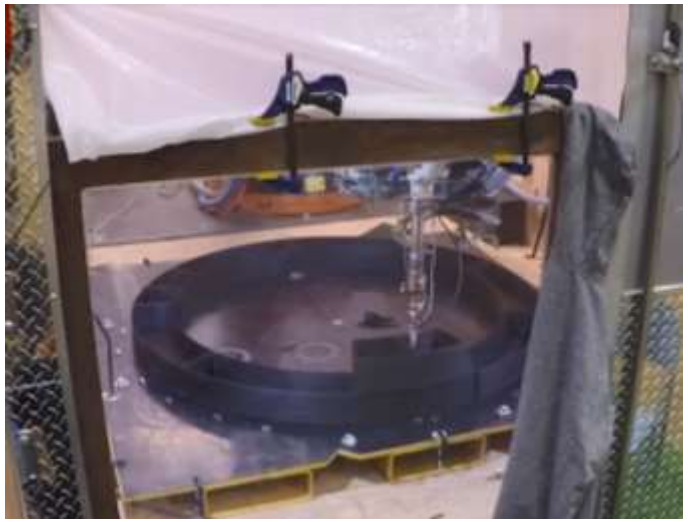


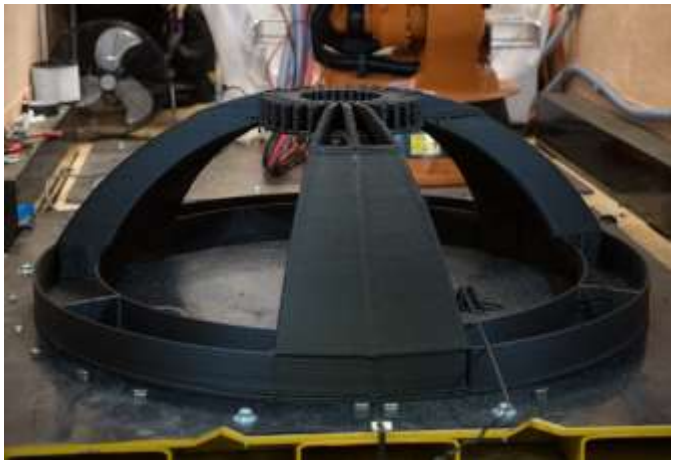


HABITAT WITH WALL PENETRATIONS



BIM TO
BUILDING





HABITAT MINIMUM REQUIREMENTS

- 1000 FT^2 OF LIVABLE SPACE
- THREE 46 FT^3 ECLSS SPACES (ENVIRONMENTAL CONTROL & LIFE SUPPORT SYSTEMS)
- STRUCTURAL AND MEP LAYOUT
- EXTERIOR WALL PENETRATION
- FUNCTIONAL FOR 4 ASTRONAUTS FOR ONE YEAR

WHAT CAN I WIN?

- UP TO $200,000 IN TOTAL PRIZE MONEY

- 60% DESIGN (STRUCTURE @ LOD 300, ECLSS & MEP @ LOD 100)
- 5 CASH AWARDS

- 100% DESIGN (STRUCTURE @LOD 400, ECLSS & MEP @ LOD 200)
- 4D SIMULATION
- 3 CASH AWARDS

http://bimforum.org/lod/

Phase 3 Sub-Scale Construction Levels

Level 1

Foundation

Material Performance Measures
Autonomy Capability (Printing)
Slab Quality/Durability
by July 11, 2018

10 teams with highest scores awarded prize proportional to score for total Level 1 amount of up to $400K

All teams that complete the submission requirements for Level 1 are eligible to submit for Level 2

Level 2

Hydrostatic (Leak) Testing

Material Performance Measures
Autonomy Capability (Printing/Placing)
Leakage/Sealing
By December 5, 2018

8 teams with highest scores awarded prize proportional to score for Total Level 2 amount of up to $600K

Top 8 teams will be invited to Level 3

Level 3

Head to Head – 1:3 Scale Habitat Construction

Material Performance Measures
Autonomy Capability (Printing/Placing Larger Elements)
Structure Robustness
April 29-May 4, 2019 @ Caterpillar Facility

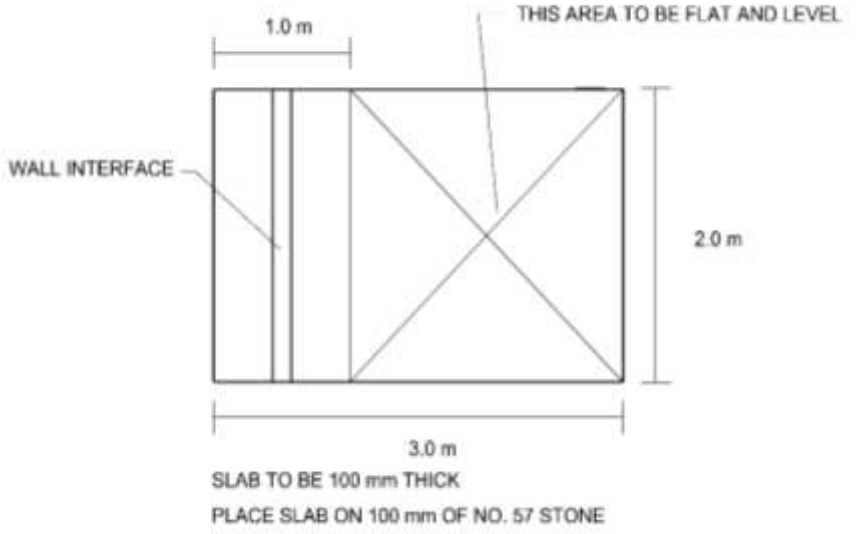
3 teams with Top 3 Scores win
1st $500K
2nd $200k
3rd $100k

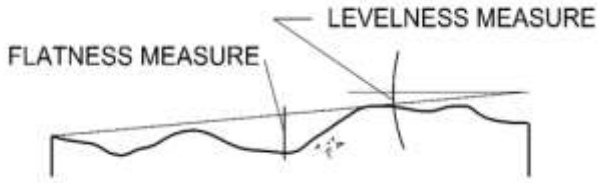
Phase 3 Completed

Phase 3 Construction Level 1

Foundation

- Team shall 3D print a 2 m by 3 m slab foundation with optional wall interface and assess it for quality (smoothness and levelness)
- Teams shall evaluate foundation durability by an impact test (drop a standard iron shotput from 5 m height)
- Team shall 3D print specimens for ASTM 666 freeze thaw testing and for ASTM C39 compression testing
- Autonomy to be scored based on number of physical and remote interventions required
- Data and Certified Test results must be provided to Bradley by July 11, 2018
- 10 teams with highest scores awarded prize proportional to score for total amount of up to $400k

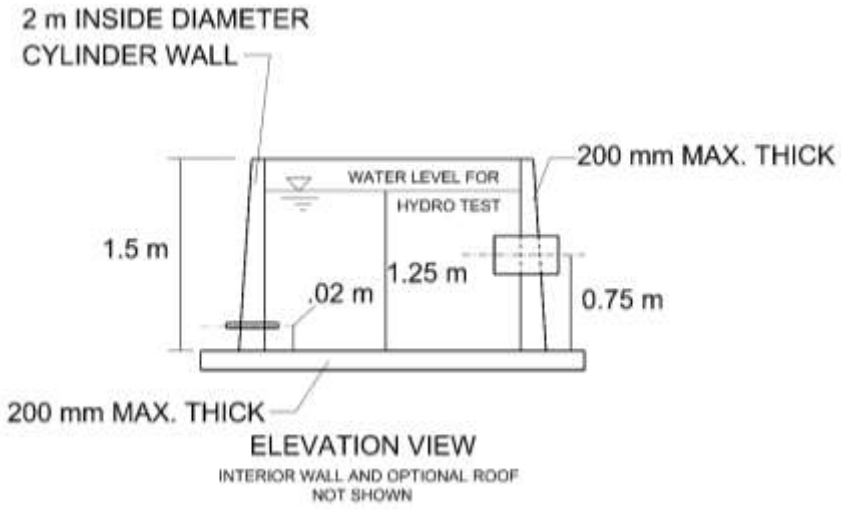


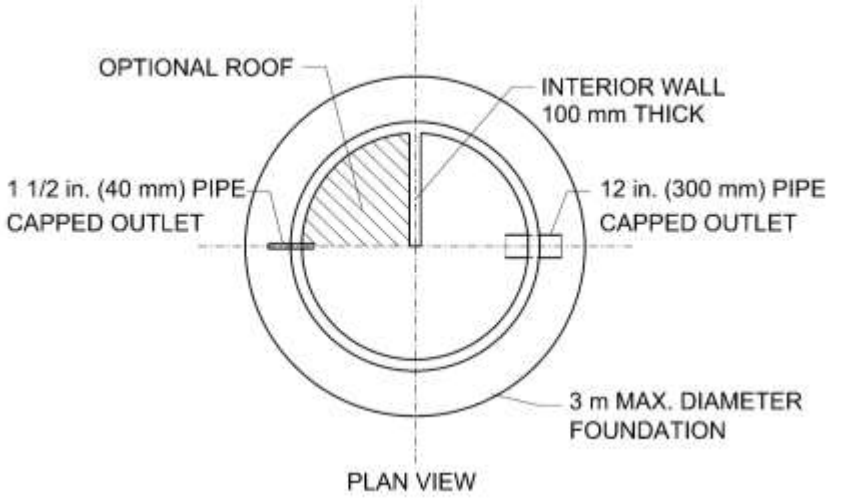


Phase 3 Construction Level 2

Hydrostatic (Leak) Testing

- Team shall 3D print a foundation and walls with optional roof section (wall penetrations to be autonomously placed and sealed) and assess sealing via water leakage testing
- Team shall 3D print specimens for ASTM 666 freeze thaw testing and for ASTM C39 compression testing if there are changes from Construction Level 1
- Autonomy to be scored based on number of physical and remote interventions required
- Data and Certified Test results must be provided to Bradley by December 5, 2018
- 8 teams with highest scores awarded prize proportional to score for total amount of up to $600k

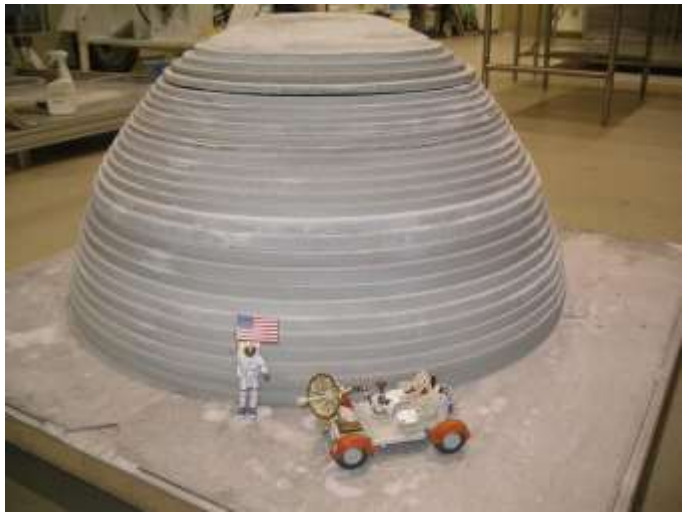




Phase 3 Construction Level 3

Sub-Scale Habitat

- Team shall 3D print a 1:3 model of their full scale habitat design, simplified as specified in the rules
- Pre-printed parts may be autonomously placed to speed the competition
- Habitat will be subjected to a smoke test for leakage, a projectile drop test for robustness, and a crush test for ultimate strength
- Autonomy to be scored based on number of physical and remote interventions required
- Additional tests and points will be based on material properties of printed materials (similar to Levels 1 and 2)
- $500k for first prize, $200k for second prize, and $100k for third prize



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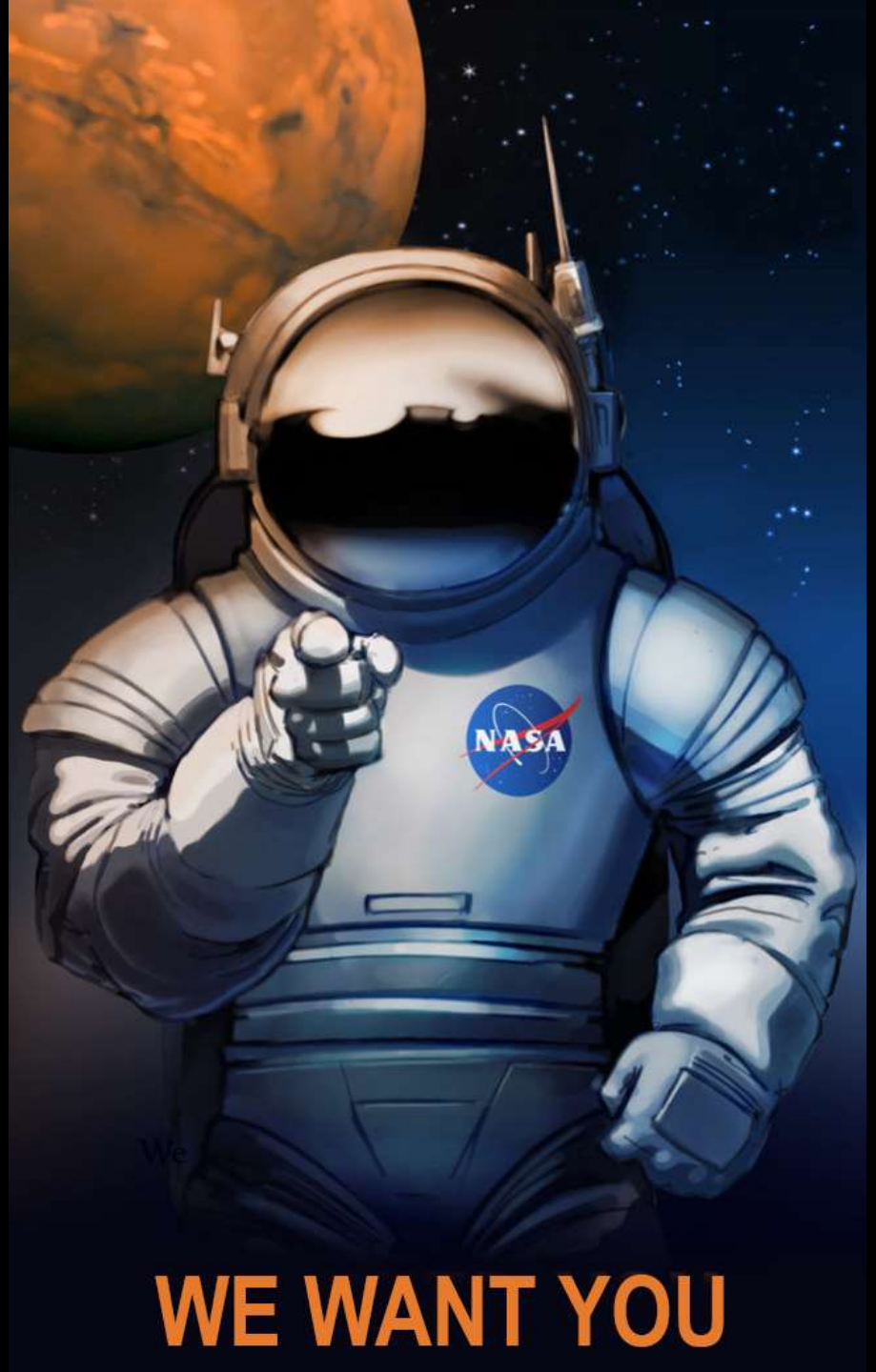
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WE WANT YOU