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IPRO 325
Designing Affordable Water, Energy, and Shelter Solutions for the World's Poor

EVAPORATIVE COOLING SUBGROUP

Problem

•3 million people live on less than $3 a day worldwide.
•Malnutrition affects 792 million people in the world.
•5 million children die from malnutrition in rural poor regions.

•*Micronutrient malnutrition (MNM):*
A medical condition resulting from an insufficient consumption of nutrients

EVAPORATIVE COOLING SUBGROUP

Background

•1 out of 5 people (158 million) suffering from MNM has access to needed fruits and vegetables, but are unable to store them.
•20% of fruit and vegetable losses occurs during storage.
•Loses are primarily temperature and humidity related

EVAPORATIVE COOLING SUBGROUP

REFRIGERATION FOR THE WORLD'S RURAL POOR

Goal

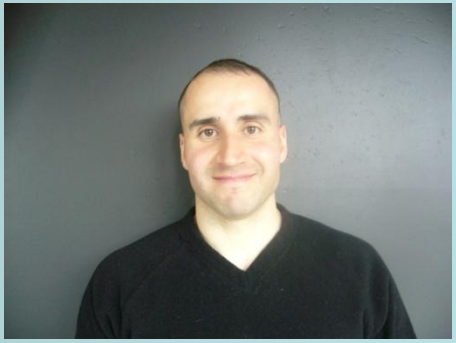
• Help combat Micro-Nutrient Malnutrition (MNM)
    •Provide better way to store food for extended periods of time

Objectives

•Improve on previous evaporative cooling designs
    • Continue research on effective prototype
    • Design prototype
    • Construct prototype
    • Test prototype
    • Provide plan for field implementation

INDIVIDUAL ROLES

Sara Wilde
Team Leader/
Research Manager/
Field Implementation



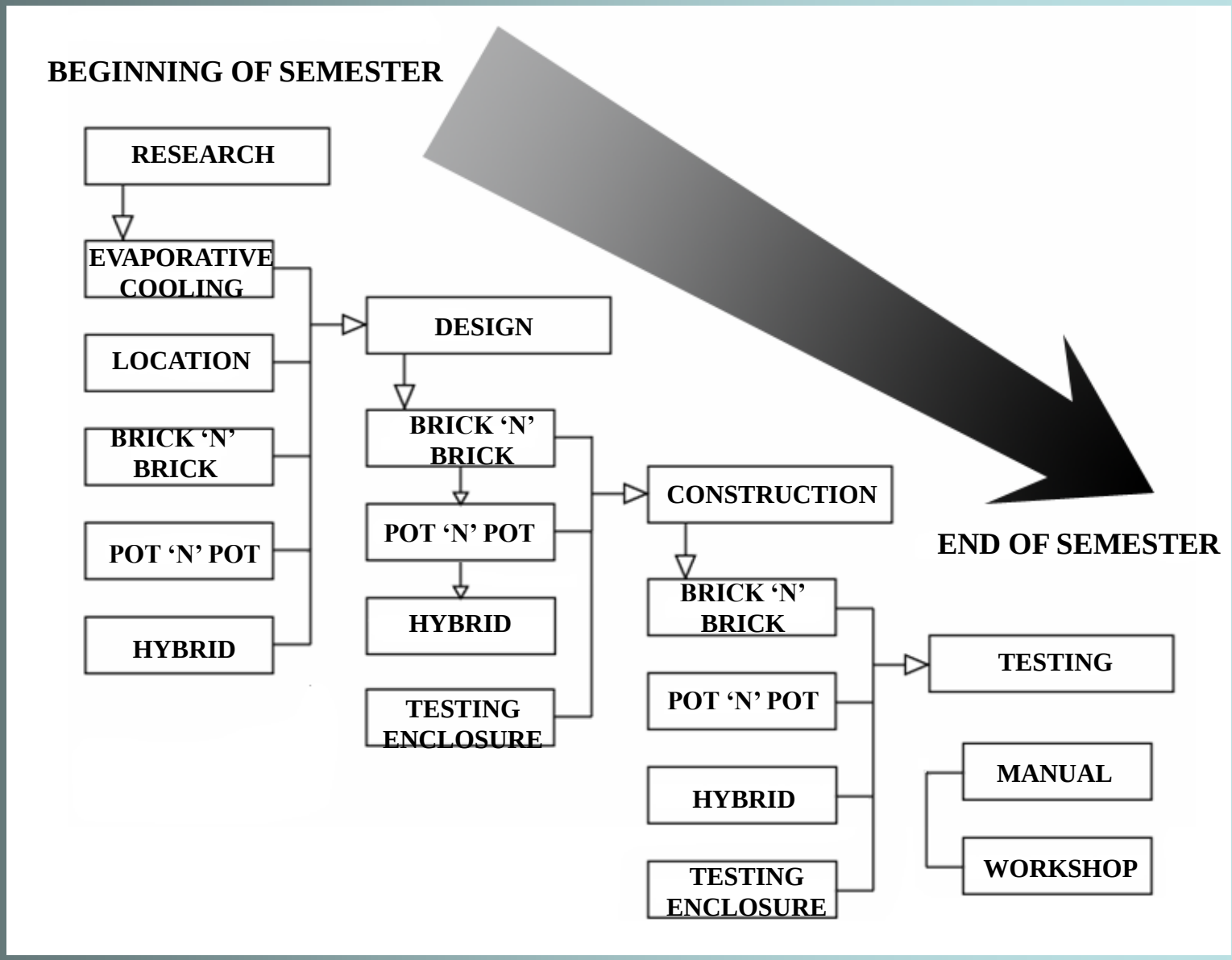
Narciso Corral Jr.
Team Co-Leader/
Construction Manager/
Field Manual/
Testing

Young Ju Jo
Design Manager/
Project Plan/
Testing

Abraham Akutagawa
Location Selection/
Lab Maintenance/
Field Manual

Andrew Rust
Engineering Notebook/
Field Workshop Lead

METHODOLOGY



RESEARCH

LOCATION SELECTION

Location Requirements

- Access to surface water
- Sand and Clay in the soil
- High Temperature, Mid-Low Humidity Season
- Population with pottery skills

Chosen Sites

Sincape, Peru

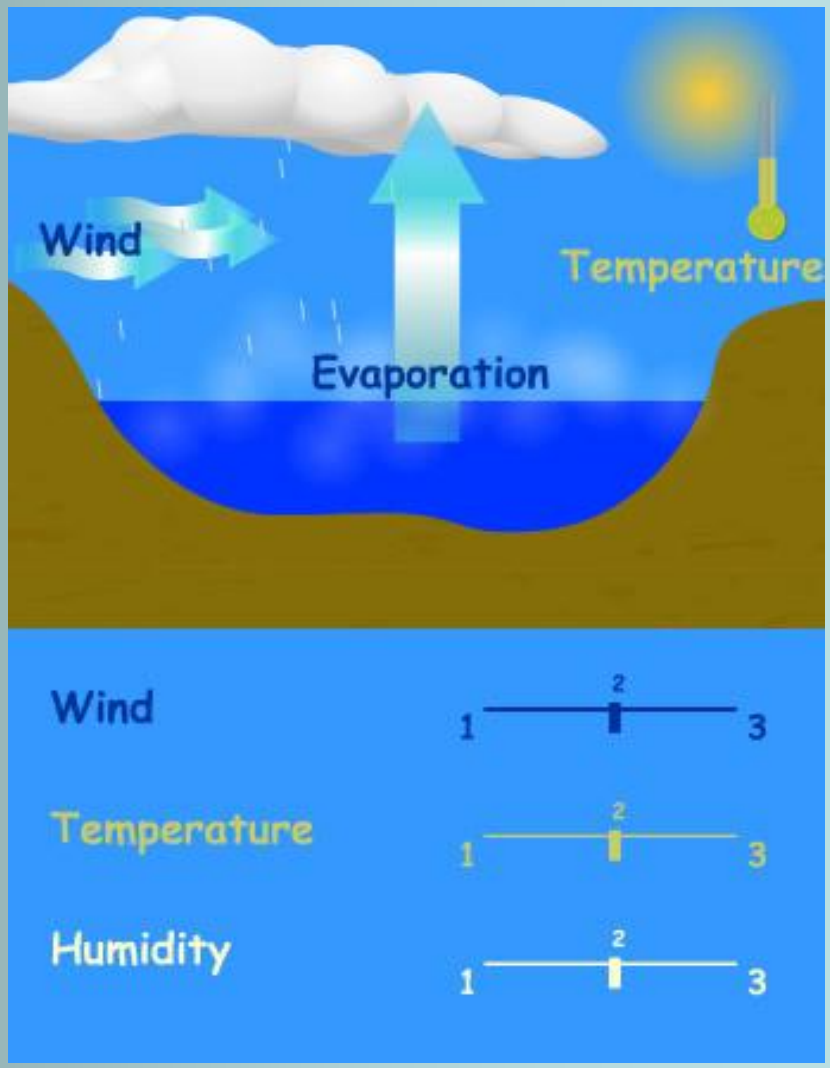
RESEARCH

EVAPORATIVE COOLING

•Reduction in air temperature that occurs when water evaporates

•Cool an object or a liquid in contact

•Higher Temperature, More Wind, and Lower Humidity = more evaporation



http://techalive.mtu.edu/meec/module01/EvaporationandTranspiration.htm

RESEARCH

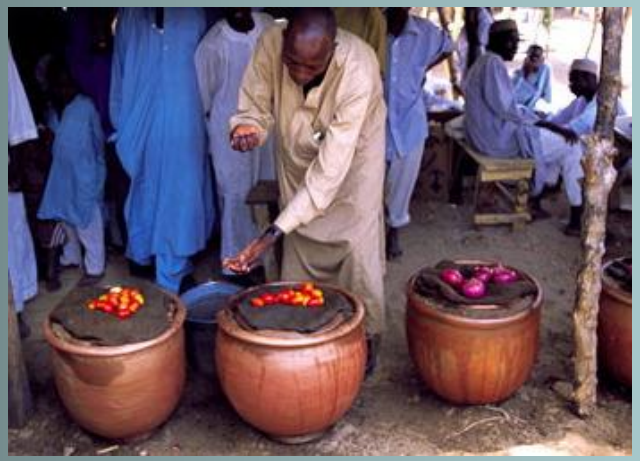
MATERIAL SELECTION

Adobe Bricks

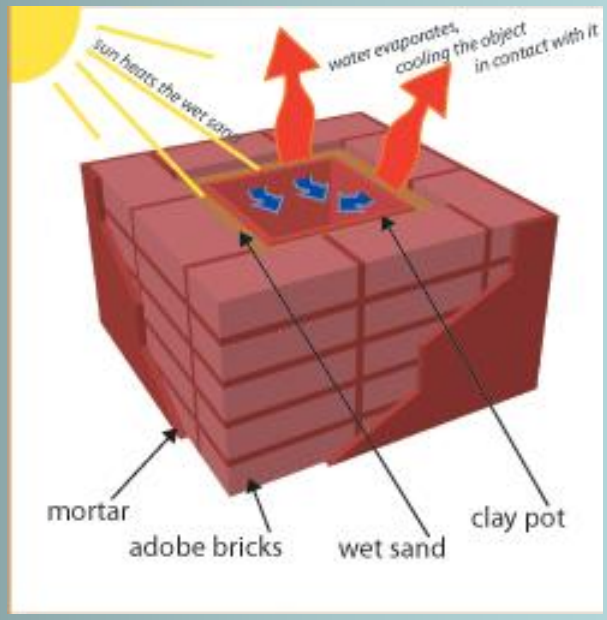
Terra Cotta Pots

RESEARCH

PRECEDENTS



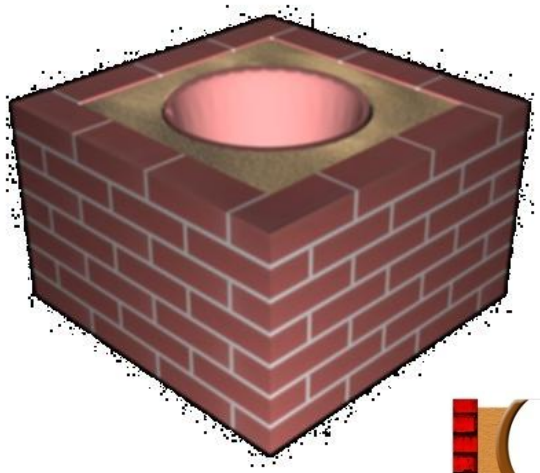
Zeer Pot System



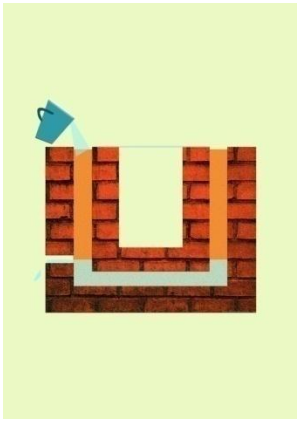
Static Cooling System

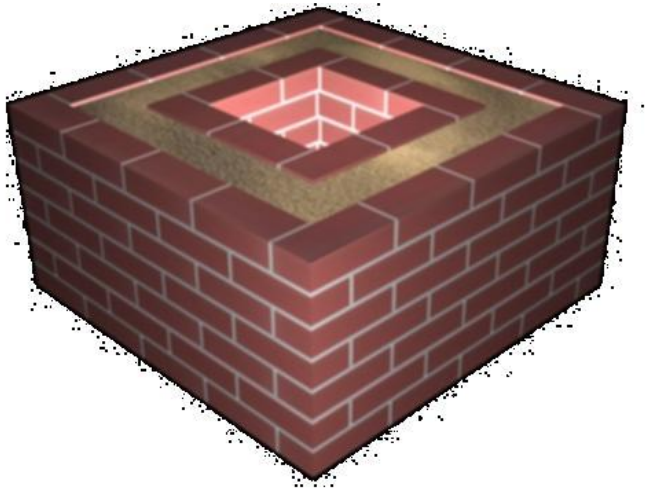
DESIGNS

Pot ‘N’ Pot



Hybrid





Brick ‘N’ Brick

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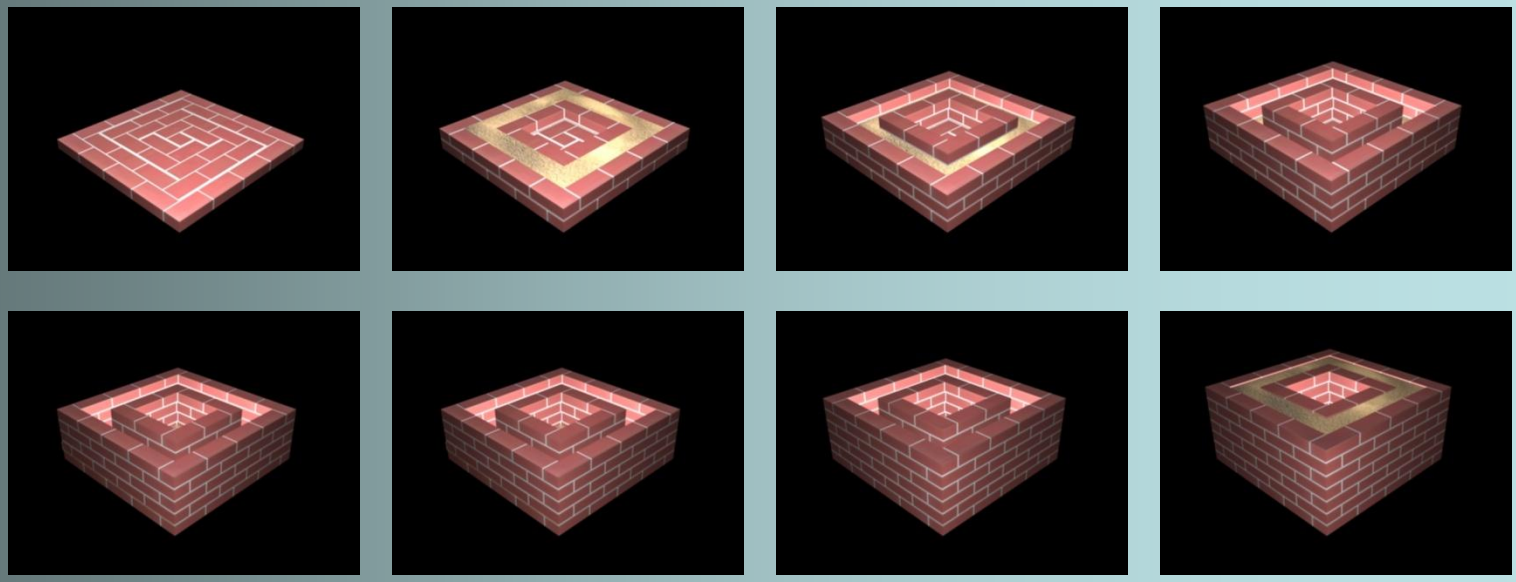
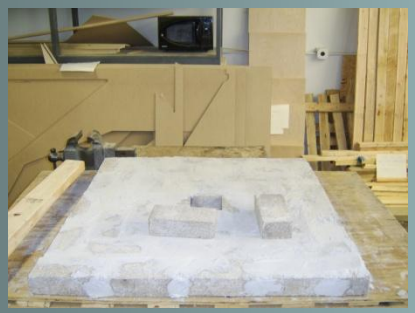
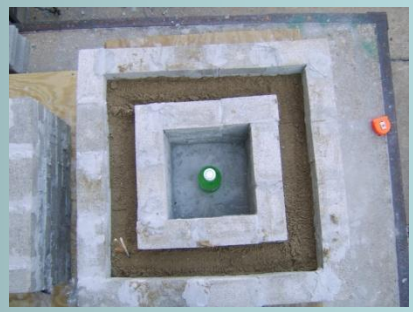
CONSTRUCTING THE BRICK 'N' BRICK







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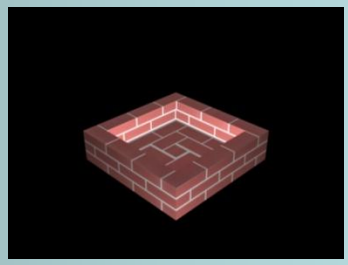
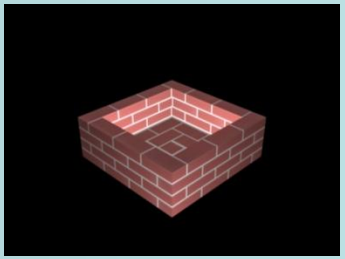
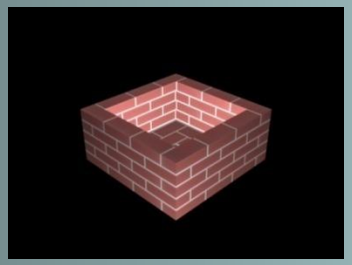
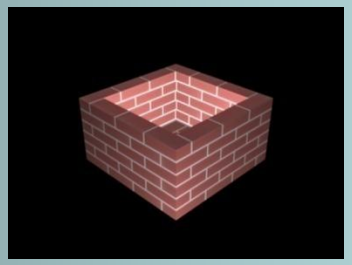
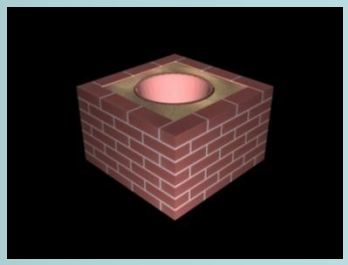
CONSTRUCTING THE HYBRID







CONSTRUCTING THE POT 'N' POT

CONSTRUCTING TESTING ENCLOSURE

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TESTING


1


2


3


4


5


6


7


8


9

TESTING

TESTING MATERIALS

- Pot ‘N’ Pot Structure
- Brick ‘N’ Brick Structure
- Hybrid Structure
- 3 Thermometers
- 2 Indoor Conventional Heaters
- 1 Humidifier
- Sealed Testing Enclosure
- 3 wet Clothes
- Water Bucket
- Barometer

TESTING

- 5 days
- 16 hours combined
- In heated environment
- Varying humidity
- Brick VS. Hybrid
- Brick VS. Hybrid VS. Pot

ANALYSIS

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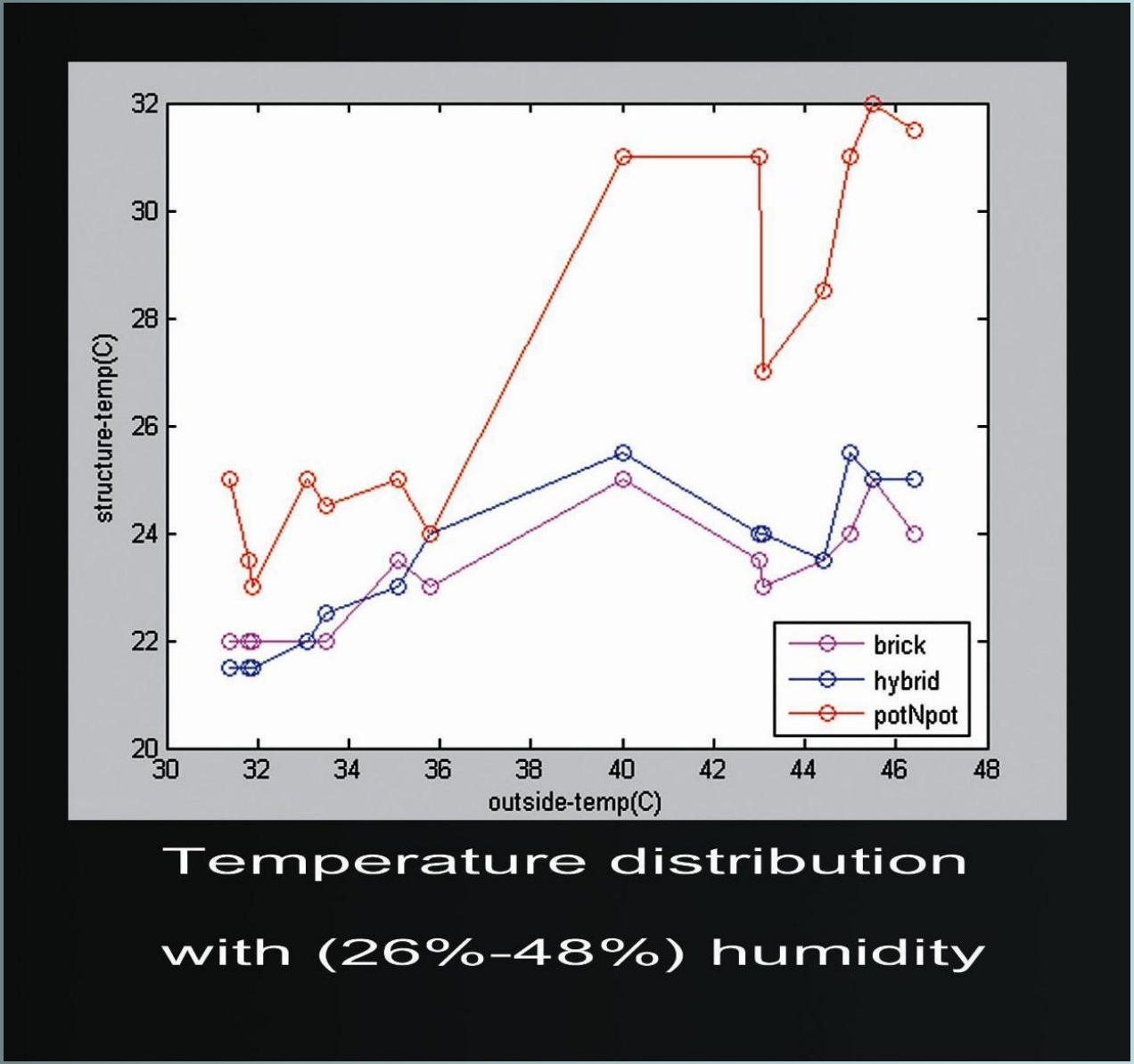


RESULTS

Built working prototype

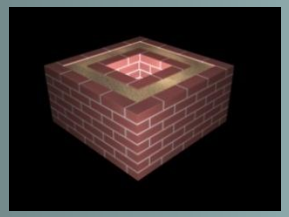
Local materials
Sustainable

Tested in third-world conditions

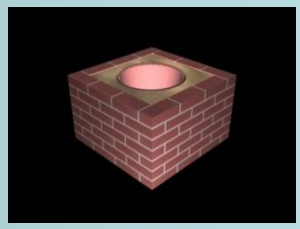
Testing Performed

Average temperature decrease 10-14˚F
Best result was a 17˚F drop
Pot in pot test average decrease of 7˚F

CONCLUSIONS



VS.



- Cooler
- Large structure
- More expensive
- Hard to clean
- Hard to maintain

- Near same results as brick
- Smaller to build
- Same size storage chamber
- 1/3 the cost
- Easier to clean & maintain

RESULTS

Budget:

Research	Design	Bricks	Terra Cotta	Testing	Misc.	Total
$0	$0	$185	$43	$50	$70	$348

Hours:

	Research	Design	Construction	Testing	Admin	Total
Sara	15	5	20	20	15	75
Narciso	20	15	30	20	30	115
Young Ju	20	20	30	30	20	120
Abraham	20	5	15	15	20	75
Andrew	20	10	15	15	20	80
Total	95	55	110	80	105	465

OBSTACLES

- **Making Structures mobile**
- **Construction Site**
- **Transportation & Acquisition of Construction Materials**
- **Replicating target region environment for testing**
- **Equipment failure**
- **Testing equipment damage**
- **Updating Project Plan to meet Milestones & Objectives**
- **Coordinating with team and varying schedules**
- **Fundraising**

CONTINUATION PLAN

- **Additional testing**
  - FOCUS ON DESIGN IMPROVEMENTS
  - Size and shape variations
  - Varying water levels
  - Different lid designs
  - Long term testing
  - Using food from the target region for storage tests
- **Create Construction Manual**
- **Complete Educational Workshop**
- **Field Research**
  - **Can targeted region build our design, per our criteria?**
  - **Does our design actually work in the field?**
  - **How durable will it be in the field?**
  - **How long will it last?**

ACKNOWLEDGEMENTS

• **Architecture Department (Bldg 3410)**

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• **Dr. Ferguson**

• **Dr. Jacobius**

• **Engineer Without Borders**

•**Political Science Department (Financial Contribution)**

• **IIT Facilities**

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QUESTIONS / COMMENTS?