ALTERNATIVE ARCHITECTURAL SOLUTIONS

Climate Resilient, Rammed Earth Housing in the Rural Village of Devgain, Jharkhand, India

Nicole C. Little,* Korydon Smith,** University at Buffalo.
Anil Kumar Sharma,** Harish Mohan*** Pradhipa Shivakumar, Aswathy Kichu, Monish Kalathuru , Thiviya Kamalaseka, Amrita University.

*Poster Author and CGHE Student Travel Funding Recipient, **Guiding Professors, ***Project Guide

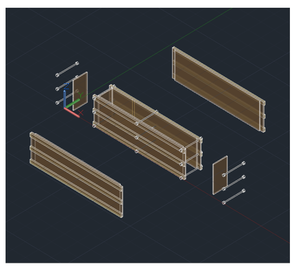
Introduction

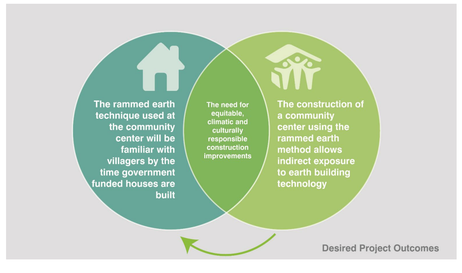
Vernacular homes in the rural village of Devgain, Jharkhand, India display the deep connection that villagers have with the surrounding environment. Homes are constructed using local, natural (and mostly free) resources. The traditional form of housing consists of mud walls, clay roof tiles, and timber frames. This design responds effectively to the hot, tropical climate. However, homes face rapid deterioration from erosion each rainy season, along with other issues of water and property damage – leading to frequent, time-consuming, and labor-intensive maintenance – which, if neglected, can cause greater issues of health and safety. Changing climatic conditions and ambivalent weather patterns have exacerbated these conditions, and residents cannot keep up. About 90% of families sustain themselves through agriculture - many being subsist farmers. Yields have dropped at alarming rates due to the rapidly changing climatic conditions. Recurring heavy losses leave farmers under mounting debt.[1]

Initiatives to relieve housing needs have relied on prototypical concrete or brick constructions. Although a quick-fix solution, these are not affordable materials to residents not receiving funding. They also cause harmful environmental impacts, lack cultural influence, and results in homes with unlivable interior conditions during hot months.

Methods

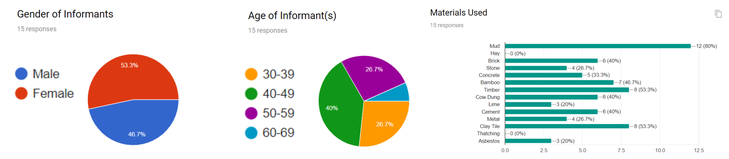
In January 2018, I was granted to opportunity to travel to Amrita University through CGHE student travel funding. There, I partnered with civil engineering students and Ammachi Labs to find intersections between sustainable materials and methods, accessible and affordable engineering technologies, and age-old earth construction methods. While in the village, we conducted informal interviews and workshops with residents, in order to trade local and technical knowledge, better understand perceptions of housing needs, and suggest responsive, replicable, cost-effective, yet strong solutions for community building. We surveyed a range of informants in age, geography, gender, and housing type. A secondary goal, while in the village was to indirectly expose residents to rammed earth construction technologies (which produces mud walls with significantly higher structural integrity than wattle-and-daub method traditionally used) through the construction of a community center, which could then be applied by residents in the construction of their homes. For this portion of the project, we conducted site surveys, collected soil samples for analysis, and catalogued local materials.





Data Analysis

Quantitative data was collected and compared based on the three prevalent construction types, house uses and programming, and occupation of the homes. Homes types were evaluated through satisfaction levels of various environmental factors, construction, and maintenance.



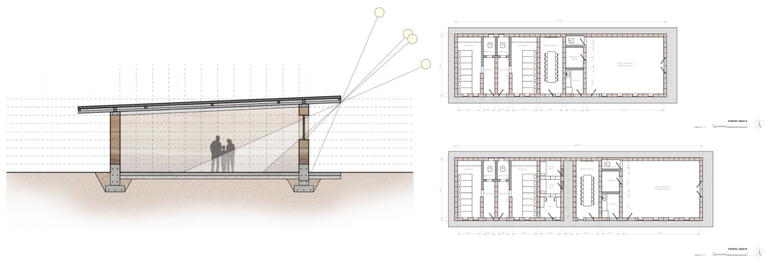
Findings

Mud Homes: Respondents were generally very happy in these homes. Most stated them to be comfortable during hot months and affordable. The most common issues identified were: the homes are cold in the winter, leaky in the rainy season, require a lot of maintenance, and have termite issues with the timber structure.

Brick homes: Homes tended to be warm in winter and require minimal maintenance. However, many are incomplete since they are government funded and expensive to build, skew perceptions of wealth in the village, and create unlivable environments during summer. Most are used as storage or cattle sheds due to being incomplete.

Concrete Homes: Responses were similar to brick homes. The homes tend to be complete and inhabited in winter.

Community Center Design



Housing Prototype

A constructability study was conducted to test the feasibility of using the villages soil in rammed earth with various stabilizers. The study will include observing the performance of the structure through rainy season.

Conclusion

The community center design was submitted and, once approval is received from the jurisdiction, will move forward in construction. The structure will be used for village meetings and celebrations, as well as host visitors, who previously had to stay in the healthcare center and daycare center. In addition, a housing feasibility study was conducted by another set of students who participated in the Live-in-Labs program. The indirect exposure and skill training which can happen through the community center can potentially lead to, on a micro scale: more reliable, healthier climate resilient housing which is also equitable. This can allow families to focus more on farming or other activities. On a macro scale, benefits of housing can include:

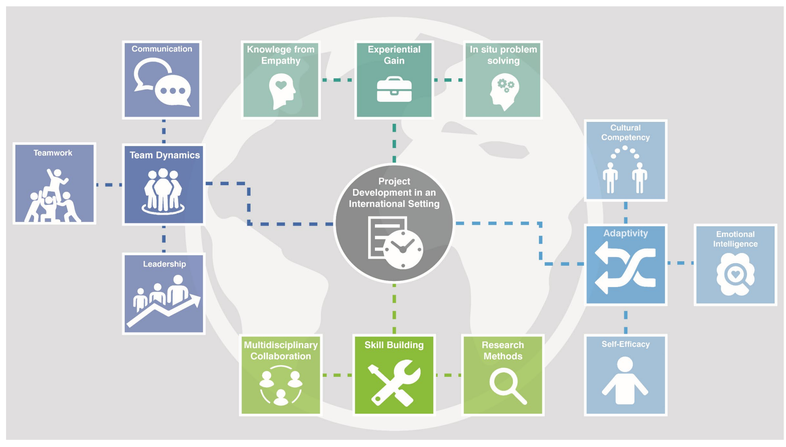
A. *Economic:* equitable materials, reduced property damage, reduced maintenance time can lead to more time on income-generating activity.

B. *Health:* improved interior environments, reduced mold and pests, improved indoor air quality, better health outcomes, life safety.

C. Environment: climate responsive homes, reduced CO2 emissions, reduced embodied energy in materials, prevention of pollution, reduction in construction and deconstruction wastes.

D. Social: Historic preservation of culture, pride, quality of life, security.

Learning Outcomes & Acknowledgments



In addition to learning through the project itself, I was able to improve a wide variety of personal skills pertaining to multidisciplinary team collaboration, situational adaptability, international communication, cultural competency, and in-situ problem solving. One of the core values of the program was to immerse ourselves in village life and learn from the rich culture and lifestyles. One of the most notable experiences was attending the village Mela, or harvest festival. I am incredibly grateful for this opportunity that was made possible by the Community for Global Health Equity's student travel funding, Amrita University's Live in Labs program, and Ammachi Lab's project guidance. I will forever cherish the memories, new knowledge, insights, inspiration, and colleagues that resulted from the opportunity.

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