

Lessons from the Past:

Re-Examining Earthen Design and Construction as an Abundant, Innovative, Acoustical, and Energy Efficient Ingredient of Sustainable Architecture

Daniel Butko
University of Oklahoma

Environmental doom and gloom stories seem to circulate the news and stimulate media on a daily basis, but there is hope. Architecture has the ability to span time, assimilating past and present methods of design into hybrid assemblies per particular sites and occupancies. As architects, engineers, and contractors move rapidly toward more sustainable building practices, educators, students, and design professionals must experiment and continue to research the built environment while being mindful of the past. Earthen design and construction is a method preceding modern day technology still able to equip architects through historical relevancy. A new enthusiasm for architecture literally based on the earth can support a return to an early and basic form of sustainability, which existed merely as a regional development decades if not centuries before it was considered necessary or trendy. People simply managed local resources and developed labor skills that correlated to the local environment and readily available palette of materials. There was a personal connection that defined and related to function, occupancy, and lifestyle - ultimately steering design and construction. This lesson from the past is the heart of modern day sustainability.

Typically known as the three R's - reuse, reduce, and recycle - a fourth and equally important factor is "regional." Earth is one such material capable of addressing and fulfilling all four R's. Soils from footings, basements, swimming pools, general site cut, and utilities are sometimes spoils and hauled off-site for a fee. At minimum, the embodied energy of transporting soil off-site and transporting other materials to the site can be minimized by using existing soil to produce a portion of construction materials for the proposed building as a method of preserving natural resources. Furthermore, since CEB (Compressed Earth Block) units do not require heat to cure, they are not absorbing that additional embodied energy prior to installation. Embodied energy is a compound equation, so one must also consider differences between on-site and factory production. The carbon footprint and total embodied energy associated with building a factory, transporting the raw materials, manufacturing the product, and transporting the final goods to the construction site represents more environmental impact when compared to making the CEB on site from typical spoils.

History has proven that diverse nationalities from various climatic locations have successfully constructed earthen structures that outlast most other construction types while having minimal impact on the environment. The design profession can learn a great deal from re-examining these structures, assimilating traditional and modern approaches, and allowing a hybrid of technologies to emerge. The materials and design need to be sustainable at the macro level of the environment, macro level of the site, and for the buildings's entire life span. This poster explores Compressed Earth Block as a viable alternative for residential construction through a collaborative multidisciplinary research project including students of various education levels and a partnership with Habitat for Humanity comparing two adjacent and simultaneously constructed residences of equal interior volume -- one CEB residence and one wood-framed residence.

HOME is where the DIRT is
Comparing the Sustainability of a Compressed Earth Block House to a Conventionally Framed House Built to National Green Building Standards

1. Background and Problem Definition
The objective of this multi-phase research project is to produce new knowledge and develop best practices for CEB construction processes. Our hypothesis is that:

2. Purpose, Objectives, Scope
The objective of this multi-phase research project is to produce new knowledge and develop best practices for CEB construction processes. Our hypothesis is that:

3. Data, Finding, Outputs/Outcomes
The research team intends to build a single-story house with a wood frame and a CEB residence side-by-side. The CEB residence will be built using a 3-point bending method. The wood frame residence will be built using a conventional wood frame construction method. The research team will compare the two residences in terms of embodied energy, acoustical performance, and construction costs.

4. Discussion, Conclusions, Recommendations
The research team concludes that CEB construction is a sustainable and energy-efficient alternative to wood frame construction. CEB construction requires less energy to produce, produces virtually no landfill waste, and reduces residential HVAC energy consumption. The research team recommends that CEB construction be used for residential construction in areas with abundant soil resources.

5. P3 Phase II Project Description
The research team intends to build a single-story house with a wood frame and a CEB residence side-by-side. The CEB residence will be built using a 3-point bending method. The wood frame residence will be built using a conventional wood frame construction method. The research team will compare the two residences in terms of embodied energy, acoustical performance, and construction costs.

6. References
1. Daniel Butko, et al. "HOME is where the DIRT is: Comparing the Sustainability of a Compressed Earth Block House to a Conventionally Framed House Built to National Green Building Standards." University of Oklahoma, 2014.
2. Daniel Butko, et al. "The 3-Point Bending Method: A Sustainable and Energy-Efficient Alternative to Wood Frame Construction." University of Oklahoma, 2014.
3. Daniel Butko, et al. "Acoustical Performance of Compressed Earth Block Construction." University of Oklahoma, 2014.
4. Daniel Butko, et al. "Embodied Energy Analysis of Compressed Earth Block Construction." University of Oklahoma, 2014.

Acoustical Measurements comparing CEB and Wood Framed Residences.

Embodied Energy

Shear load wall testing in-plane

LESSONS FROM THE PAST
The University of Oklahoma College of Architecture
reexamining earthen design & construction as an abundant, innovative, & energy efficient ingredient of sustainable residential architecture.
Collaboration among Architecture, Construction Science, and Engineering students partnered with Cleveland County Habitat for Humanity.
Daniel Butko
AIA, NCARB, LEED AP, ASA