Building Rammed-Earth Systems

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1 Introduction

"Rammed-earth" / "pisé de terre" / "tapial" / "hāngtǔ" is a particular earthen building material formed by a particular construction process. Physically and conceptually enduring, the material-method has diffused around the world from original concentrations in (at least) Asia, Africa, and the Middle East. [2]

> *"Have we not in Africa and in Spain walls of earth, known as 'formacean' walls? From the fact that they are moulded, rather than built, by enclosing earth within a frame of boards, constructed on either side. These walls will last for centuries, are proof against rain, wind, and fire, and are superior in solidity to any cement."*
> — Pliny the Elder. *The Natural History.* Circa 77 A.D.. (tr. Bostock. 1855.)

Rammed-earth has sustained its own particular composition, construction logistic, and design logic while also adapting to various sociotechnical contexts.

> *"Historically, rammed earth has expressed itself as an economical do-it-yourself project for farmers, enthusiasts, and environmentalists. It has also been understood as a way to correct social ills, minimize financial difficulties, and remedy overabundances of labor."*
> — Jennifer Lynn Carpenter. *Dirt Cheap: The Gardendale Experiment and Rammed Earth Home Construction in the United States.* 2010.

At last, the Second Law has caught up to rammed-earth building in the U.S.. Contemporary technological contrivances such as cement-stabilized, pre-insulated, and prefabricated walls disorganize the historical material-method through contemporary fixations on standardization, insulation, and mass-production [3]. It is hypothesized herein that rammed-earth's historical and particular coupling of local material with low-tech construction methodology is the key to its veritably sustaining quality (physically and conceptually enduring for many years). Despite the modernized criteria of scalability, safety, and sustainability, contemporary deviations from the original rammed-earth methodology subtly but significantly challenge the sustaining quality.

> *"Contemporary stabilized rammed earth (SRE) draws upon traditional rammed earth (RE) methods and materials, often incorporating reinforcing steel and rigid insulation, enhancing the structural and energy performance of the walls while satisfying building codes. SRE structures are typically engineered by licensed Structural Engineers using the Concrete Building Code or the Masonry Building Code."*
> — Bly Windstorm and Arno Schmidt. *A Report of Contemporary Rammed-Earth Construction and Research in North America.* 2013.

What follows is an attempt to design a system of design for rammed-earth building by considering separately the historical logistic of rammed-earth building and the contemporary logistic of building in general. By drawing these two logistics apart, it is theoretically possible to preserve the ante-technological sustainability of rammed-earth in light of and potentially bootstrapped by the modernized, analytical, and hyper-connected building system.

> *"The history of building construction can be construed as a narrative of the inertia and momentum of two divergent construction logistics. One mode, discussed above, has very minimal historical inertia coupled with great current industrial momentum (the muli-layered assemblies of modernity.) The other has great historical, physical, and thermodynamic inertia that is coupled with minimal industrial momentum in the contemporary building industry/building science industry (more monolithic assemblies and masses). The former follows the short history of the*

twentieth century "rationalization" of construction, air-conditioning, factory production, lightweight envelopes, and, more recently, mass customization. The latter is a several-thousand-year history of accumulative knowledge and performance all but forgotten in the interesting yet hubristically selective amnesia of twentiety century architecture."
— Kiel Moe. *Convergence.* 2013.

Aside from historic preservation—for which there is no real positive heritage of rammed-earth building in America to preserve—it is argued that preserving the distinct material-method associated with "rammed-earth" is the key to preserving its historical ability to sustain. Objectively, contemporary contrivances in industry such as cement-stabilized, pre-fabricated, and pre-insulated rammed-earth walls already appear to shear meaning from rammed-earth in order to satisfy important, but not entirely sustainable layers of the building megastructure.

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2 BUILT EARTH

The historic, monolithic, massive inertia of rammed-earth meets the momentum of modern, multi-layered, lightweight building industry. Upon this meeeting, basic physics suggests an interaction between the two bodies, however, it is not immediately apparent as to how rammed-earth's historically sustaining qualities interface with the conception of sustainable development, nor how the relatively laissez-faire rammed-earth technic fits the complicated structuring of contemporary building.

2.1 Sustainable Development as Such

If rammed-earth reappeared in the United States in the 1840s to fit a growing rural economy, and reappeared around the Great Depression to remedy socioeconomic woes [2], there can be little doubt that rammed-earth appears today in regards to sustainable development. For the sake of argument, sustainable development/sustainability as such was mainly conceived in the 1960s, when adverse anthropogenic effects could, for the first time, be observed and measured globally. [1] The U.N.'s first major deliberation on environmental issues, The Stockholm Conference (1972), "marked a turning point in the development of international environmental politics." [1] The global conversation about humanity and the environment indeed turned political, and

2.2 Materials and Products

2.3 Veritable Sustainability?

[1] sustainabledevelopment.un.org/milestones/humanenvironment

3 THERMODYNAMIC EARTH

"The general struggle for existence of animate beings is therefore not a struggle for raw materials — these, for organisms, are air, water, and soil, all abundantly available — not for energy, which exists in plenty in any body in the form of heat albeit unfortunately not transformable, but a struggle for entropy, which becomes available through the transition of energy from the hot sun to the cold earth." — Ludwig Boltzmann

4 COMPUTATIONAL EARTH

References

[1] Charlotte Kelly. *Origins of Sustainability. Report for Task 1.1 – Appraisal of Sustainability Project.*

[2] Anthony F. Merrill. *The Rammed Earth House.* Harper and Brothers, 1947.

[3] Kiel Moe. *Convergence. An Architectural Agenda for Energy.* Routledge, 2013.