

## The Earth Construction Fallacy Hassan Fathy's New Gournia Revisited

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**ABSTRACT:** *The problems of earth construction uptake as a building technology in the Global South have long been recognized. The classic response to the low uptake has been newer compositions of construction earth blocks and biobased materials in one form or another. Nevertheless, the profession's modern origins of earth construction stem from responses to the destructive impact of concrete and fired brick. Relieving the destructive environmental impact using biobased and earthen materials led to many earthen construction products with low uptake. This paradox remains unresolved despite recent advances in the fabrication of earthen construction technologies using agro and non-agro-waste materials or the creation of new earth-building construction standards and new building materials engineers' efforts. This article reevaluates New Gournia in Luxor, Egypt, after 70 years of its creation, as a sustainable earth-based community in Luxor, Egypt, and whether earthen construction buildings and communities are socially and environmentally sustainable. Based on a field visit and interviews with local experts and users' current debates on the uptake of earthen construction and its sustainability, it outlines the intellectual origins of sustainability and analyses whether its theory supports the earthen construction hypothesis: earthen construction is more economically and socially sustainable than concrete construction. It concludes that conceiving buildings using earth and biobased resources in terms of materials with low environmental impact is neither necessary nor sufficient to achieve the goals ascribed to social acceptance, climate resilience, and economically viable communities. Instead, conceiving the buildings in terms of a long-term and participatory process holds more promise in attaining the elusive goal of a sustainable built environment. The study provides recommendations to inform funding and development aid agencies like the World Bank and the EU on the importance of adopting a holistic and multicriteria approach.*

**KEYWORDS:** *sustainable; building; design, environmental impact, bricks, materials, architecture*

### 1. INTRODUCTION

The urbanization of the global south is accelerating fast. Urbanization in the Global South: where the world's 33 megacities, 27 are in the Global South [1]. In comparison, some scholars note the significance of concrete and reinforcing steel constructions to assure structural stability and extend buildings' service life as the result of modernization and advancements of materials science [2] - represented through multi-story buildings- other thinkers point to the continuing, if not increasing, Green House Gas (GHG) emissions associated with the use of those materials and the need to replace them with earthen and biobased construction materials [3]. Between these two poles, massive funding occurs from foreign development and cooperation agencies or national governments to build green communities using earthen construction in rural areas of the non-industrial world, or in other words, the Global South [4].

Earthen construction technologies, including adobe, compressed earth blocks (CEB), and rammed earth, confers environmental and socio-economic advantages [5]. For example, between 2000 and 2023, more than hundreds of studies have been published to promote different mixes and combinations of the earth with biobased fiber

materials, including okra, cocos, banana, hemp, fonio, Bambusa vulgaris, invasive seaweed, jute, date palms, kenaf, rice husk, sugar cane and shea butter next to industrial waste fiber including plastic [6]. Despite the proliferation of research on CEB mainly led by civil engineers, there is a very low uptake of CEB in the housing market in the Global South. All continents possess a rich heritage of earthen architecture. It is estimated that about 1.7 billion people worldwide live in earthen houses [7]. About 50 % of the population is in developing [8] populations [7] (Fig. 1).

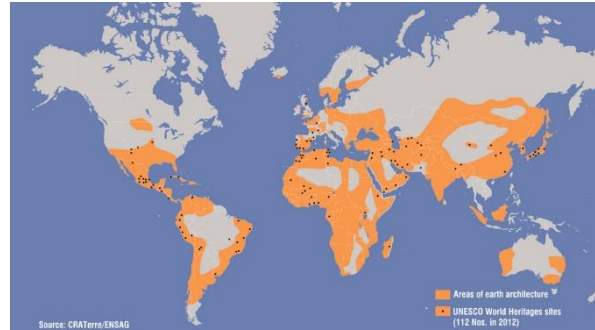


Figure 1: Earth construction areas of the world [7].

More importantly, most of those earthen and biobased constructions are not socially accepted. The Global South is a focus of world politics with significant energy and resource reserves and histories

of colonialism and imperialism. It is also the site of potentially immense green energy and material resources but is held back by resource-grabbing and neocolonial agendas [9].

New Gourna is a living example of using local materials and techniques and building a new community. New Gourna was designed by a pioneer of sustainable architecture, Hassan Fathy, in Luxor and was commissioned by the Egyptian Government in 1945. The project incorporated traditional techniques and materials, such as adobe-baked mud bricks, to build a community of affordable houses and services based on vernacular and bioclimatic design principles. Fathy borrowed from Nubian and Gourna architecture to create representative enclosed courtyards and vaulted roofing and chose to build in mud brick. Unfortunately, the project failed as most residents refused to move to the new village [10].

Hassan Fathy had a true vision of sustainable architecture, but the project failed after half a century of social rejection and faced serious degradation [11]. New Gourna Village's main characteristics include its reinterpretation of a traditional urban and architectural setting, its appropriate use of local materials and techniques [9], and its extraordinary sensitivity to climatic problems. Following concerns on the serious state of degradation of the village by both the World Heritage Committee and the academic world of experts on Hassan Fathy's architectural work who submitted an international petition, UNESCO initiated a project in 2009 to safeguard this important site. This was agreed to in consultation with the Ministry of Culture of Egypt and the Governorate of Luxor [10].

One theme of this paper is the paradox between using earthen and biobased materials for construction and those buildings' low uptake and acceptability by their potential occupants. Despite the great efforts over the generations to promote earthen construction, this paradox has yet to be adequately resolved. The perception that earthen and biobased construction is an 'architecture for the poor' remains one of the main reasons for their low uptake. On the other hand, architects and aid organizations in industrial countries strongly promote earthen construction in the Global South as a sort of eco-construction neo-orientalism [12]. Therefore, this research reinvestigates the case of New Gourna and inquires on how effective earthen and biobased materials as an option is attaining a deep-seated shift in green architecture in the Global South toward truly socio-economic viable communities and not only sustainable communities.

## 2. METHODOLOGY

This article assesses answers to the research question through a literature review and case study research. By examining factual evidence and

intellectual foundations regarding New Gourna's failure, we can better judge whether earthen construction and biobased architecture are more sustainable than high-rise - concrete and reinforced steel constructions – and modern architecture.

The methodology uses both qualitative and quantitative methods of data collection and analysis. The methodology involved intensive observations of the state of the New Gourna community in 2023, 78 years after its construction. Two field visits took place in 2023. The purpose is to characterize the current buildings' state and distill learned lessons to understand the occupant's experience and the reasons behind the low uptake of earthen constructions in Egypt since then. Firstly, empirical evidence from the literature surrounds whether earthen and biobased architecture are sustainable and acceptable solutions in the Global South. This section remedies the first deficiency with a preliminary characterization of earthen constructions' low uptake and usability across several projects. It weighs the factual evidence on their socio-economic sustainability. Second, open interviews with some house occupants and users are conducted. During a field visit in February 2023, twelve stakeholders were interviewed, including the manager of the public buildings such as the Khan and the market.

Thirdly, a field study includes observations, photography, written documentation, and thermal comfort measurements of air temperature and humidity during July 2023. Two HOBO U12-012 (measuring temperature, relative humidity, and light data loggers were used to characterize thermal comfort in a dwelling based on outdoor and indoor temperatures. The dwelling in Figure 2 is the original Hassan Fathy house, where he spent most of his time in New Gourna.



Figure 2. After a major renovation, Hassan Fathy's residence stands alone, surrounded by high-rise concrete buildings.

Fourthly, open interviews, which took place, in some cases retrospectively, between 2013-2023, with architects and designers focused on the reasons for the low uptake of earth constructions in Egypt. Several architects were interviewed, including

Abdelhalim Ibrahim Gamal Abdel Amer, Adel Fahmy, Ahmed Hamid, Mohammed Hassanein, and Tarek Labib. The interviews focused on several criteria: standardization, durability, cost, social acceptance, and urban planning.

### 3. RESULTS

Adobe, compressed earth blocks, rammed earth, and bamboo are at the forefront of green and sustainable building materials for underprivileged societies in the Global South. However, the sustainability of using earth construction and biobased materials and their uptake by the local population in the Global South have fostered spirited debates. One strand of the debate is between housing durability and sustainability, and another is between free market land use and population uptake [13]. Based on the literature review findings [14] and our analysis, we can summarize the reasons for the failure of Hassan Fathy's New Gourna under four themes:

Firstly, the project did not ensure the use of durable earth blocks that last long and overcome water problems. The unfired adobe blocks could not resist the underground rising water levels, and the foundations were built using calcareous stones (limestone), which degraded over time. Moreover, the frequent flash rains eroded the mortar and bricks over time. The stability and durability of the buildings degraded significantly due to walls buckling and the structural cracks of domes and Nubian vaults. Without continuous maintenance, at least a major renovation every ten to fifteen years, there was no chance for such buildings to survive. Without the UNESCO support for renovation, the project would not have existed anymore.

Secondly, the project was not integrated into a comprehensive urban master plan that addresses infrastructure, sewage, and mobility issues. The dependence on septic tanks for sewage resulted in overflows and a constant increase in groundwater levels. With the population increase and the need for vertical expansion, the population abandoned the low-rise archetypes and opted for post and columns concrete buildings to reach 6-story buildings, as shown in Figure 2. Thus, the architect failed to anticipate the future need for densification.

Thirdly, the project was promoted as an architecture for the poor. The old Islamic and Arabic identity was emphasized in the architectural language. The residents strongly rejected sleeping under the Nubian vaults and domes. Residents associated the vaults and domes with tombs. Hassan Fathy was accused of being orientalist by imposing a certain style on the population influenced by personal heritage revival notions. Both messages were rejected by the local population aspiring for modern

architecture under the influence of Westernisation and globalization. The occupants' social acceptance and involvement through a participatory design approach were missing during the design process. This was another key reason for the rejection of the project by the local community.

Fourthly, the construction technology did not improve thermal comfort as expected. Figure 3 illustrates the ambient temperature difference between outdoors and indoors during the summer of 2023. Despite the 40 cm thick walls in Figure 3, the lower temperature bounds remain above 30°C at night, making the house uncomfortable from the thermal point of view. Our observations and interviews indicate that occupants sleep outdoors during the night or on the roofs to avoid the overheating effects (see Figure 4). Also, air conditioning units were observed in the neighborhood for humification or cooling. Finally, the lessons learned from New Gourna are crucial for any future development that seeks to use earthen construction techniques in the Global South.

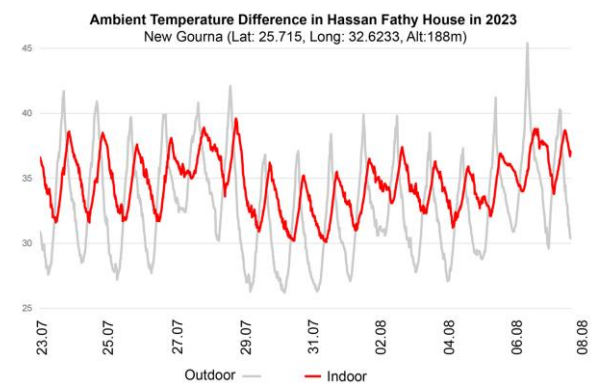


Figure 3. Ambient temperature in Hassan Fathy House between Jul. 23 and Aug. 08, 2023.



Figure 4. Residents sleep during hot summers outdoors under the portico of the Khan.

### 4. DISCUSSION

To put this finding in a contemporary and larger perspective, we must reflect on the importance of standardization of earth and biobased construction materials. Comparing the earth construction of Hassan Fathy (1945) in Egypt [15] and more recent

ones such as the projects of Francis Kere (2016) in Burkina Faso [16], [17] or the projects of Anna Heringer (2019) in Bangladesh [18], we can observe the same problems summarized in Figure 5.

### The earth construction fallacy

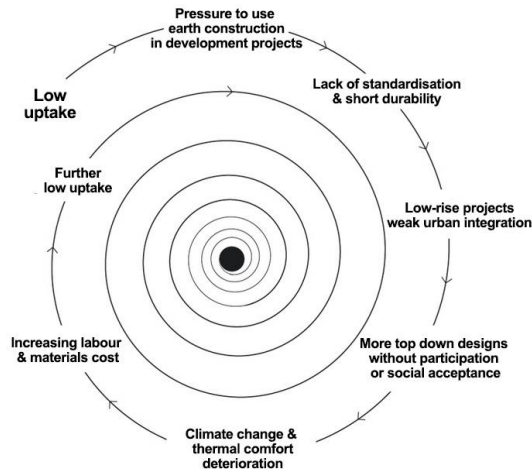


Figure 5. Earth-construction projects development process and its key shortcomings

Firstly, the Global South lacks a legal ecosystem of policies and standards that promotes using earthen and biobased materials for high-quality and sustainable architecture [19]. Future projects will fail without standardization of the mechanical, physical, and chemical properties of earth blocks, biobased components, agriculture bio waste, and their integrity as part of building structures. Earth construction requires a learning process to build experience, transfer knowledge and assure its realization quality. On one extreme, earth and bio-based materials should not require constant maintenance. On the other extreme, the mechanical and structural performance of earthen and bio-based construction materials should not always be compared to reinforced concrete materials [20]. Municipalities and building codes worldwide require architects and engineers –for building permits- to achieve the same performance thresholds of reinforced concrete structures, which disqualifies earthen and bio-based construction projects and legally hinders their uptake as durable and robust construction materials. Without assuring the durability of eco-construction materials and avoiding their deterioration and intensive maintenance, any biobased or earthen construction will fail from a functional and structural durability point of view.

At the same time, adding chemical binders, such as cement [21], to any earth block will disqualify it environmentally as an ecological and low GHG emissions construction material [22]. The use of cement (8-12%) in stabilized CEB will make it unable to compete with concrete blocks and firebricks

economically [23] and environmentally [22], especially when we calculate the total cost of technical training, marketing of earth construction products, maintenance, finishing and raising public awareness of sustainability nationally. The thickness of the walls of earth construction and their finishing quality are additional influential parameters.

Secondly, the Global South population is increasing rapidly, and the poor land use management and governance in many cities, next to capitalistic speculations, make access to land for new construction not affordable. Real estate speculation and political power structures in most countries of the Global South impede low-rise urbanization and land ownership. The lack of modern road infrastructure and difficulty funding water, sewer, and road infrastructure are other barriers to mobility. Consequently, low-rise urban development and spacious bioclimatic architecture – with large volumes and high ceilings- are not an option in many developing cities and countries. Thus, post-and-column structures are the most suitable building technology in densely populated communities.

Failing to address the urban density problem and suggesting only low-rise archetypes and projects located in remote areas and built by Western-educated architects using earthen and biobased materials [24] is naïve. In many cases, the efforts of many world organizations -including UN-Habitat and many European development organizations- to stimulate affordable housing in the Global South are counterproductive and lead to jeopardizing the sustainability of urban development in the long term. Therefore, the solution should be to promote high-rise bearing wall archetypes [25].

Thirdly, the social acceptance of earthen construction remains a challenge. The use of earth construction and biobased materials to build shelters in the Global South is a kind of green colonialism [9]. Many architectural schools and architects practice green colonialism, which does not lead to high-quality, climate-proof and healthy architecture. Therefore, participatory design process and communal collaboration are key for earth construction and urban development projects [13]. Earthen construction must be developed as a modern and high-quality architecture and not just a Western utopian projection of the use of ecological materials in the Global South driven by aid programs [26]. Aid-based earth construction is a political tool promoted by donors. As a consequence, during the last 30 years, there has been a strong movement of orientalism [15] in many North American and European architecture schools and research institutions that promote using ecological materials in Latin America, Africa [27], and Asia. Unfortunately, most of those designers fail to build earth

constructions in their permanent residence countries (Global North) because of the high-quality construction regulations that go beyond structural stability and require a building to be more than just a shelter.

However, within African and Asian countries, most earth and biobased construction projects are believed to target lower-income users [28], [29] or extremely rich users. The stigma of associating earth construction with poverty remains prevailing. Therefore, using earth construction for middle-income people should be the first step to promoting this technology. The finishing quality is the key. Housing authorities should prioritize promoting earthen construction for its architectural and life quality attributes [30], not environmental qualities. There is a need to show the beauty and capacity of earth and biobased materials and bring out the best of it. The right message is to promote earth materials as a high-end product and excellent architecture with different finishing qualities and varied fiber content.

Fourthly, the association of earthen and biobased architecture with unlimited acclimatization [30] must be broken. The overestimation of the role of hygrothermal properties of earthen construction to enhance indoor thermal comfort needs to be moderated and supported with evidence. A modern earthen construction must provide thermal comfort, and in hot and humid regions [31], this cannot be achieved without active systems, including electric fans, air conditioners and evaporative coolers. Earthen construction should not be only associated with naturally ventilated buildings or wide-limits adaptive thermal comfort models with extreme indoor thermal comfort conditions unless CFD and thermal simulation proves their performance.

Despite the perception of the improved thermal comfort effects of earthen architecture, it remains unsatisfactory in modern buildings in the Global South. The air acceleration of velocity, humidification or dehumidification strategies in indoor spaces are not a proxy for tolerating overheating, dust from sand storms, mosquitoes and overall discomfort. With climate change and the increasing intensity of heat waves, the Global South cities, towns, and villages' earthen construction must be associated with air quality and thermal comfort. People living in hot climates are striving for thermally comfortable houses. They aspire to live in better conditions than the older generations. Failing to equip earth construction projects with active cooling systems is unacceptable because it emphasizes the stigma of poverty and low-quality life, work and learning lifestyles. Also, the claims that people living in the Global South have an endless thermal adaptation ability are false.

Finally, the four shortcomings in Hassan Fathy's New Gourna and the wider global context are the most common themes in the literature [17], [30-32]. All four common problems, shown in Figure 5, are behind the Earth Construction Fallacy. They are closely interconnected and influence the uptake of earth construction technologies and materials. The key question to stand up against this fallacy is that architects and development organizations ask themselves a question: Does the earth and biobased architecture address this paper's four common sustainability problems? This is a question of self-critique.

## 5. CONCLUSION

This paper presented an important reflection on the earth construction practice through the investigation of New Gourna's Village in Egypt. The investigation attempts to overcome previous limitations of orientalism and romantic attitude in transforming earth and biobased materials into shelters and not architecture. By choosing the example of Hassan Fathy village, a UNESCO-recognized heritage, and tracking its evolution over 75 years, we raise the awareness of future designers about the earth construction fallacy. Also, we propose practical recommendations to cross the current barriers of earth construction uptake.

We must take care not to extend this critique too far. The attempts to use stabilized or unstabilized earth construction and biobased materials are encouraged, and we can envision high-density communities that mainly use earth construction. By reversing the barriers indicated in this study through a co-evolutionary process, the use of earth construction as a form of sustainable architecture is a viable one that we can strive to reach.

One of the main limitations of this study is that we did not address the cost and environmental impact of earth construction using a quantitative modeling approach for the investigated case study. There is a need to perform a full life cycle analysis, including cost based on environmental product declarations of earth construction projects, to quantify their impact. Several interviewed experts pointed out that construction labor cost is increasingly more important than the material sourcing cost. In most countries, the ratio between total material cost and the total construction labor cost tends to lean toward higher labor costs. In the Global South, the labor cost in the construction sector is becoming high [33]. Therefore, future work should focus on performing environmental and cost analysis with long building life scenarios and maintenance cycles to evaluate the durability of earth construction in comparison to concrete-based construction techniques.

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