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Old Shali, a deserted town in Siwa Oasis in the Western desert of Egypt. An example of vernacular earth towns –built from Karshif blocks- dated back to 13th century.

EARTH VERNACULAR ARCHITECTURE IN THE WESTERN DESERT OF EGYPT

Marwa Dabaieh

Many academics and architects have noted that between one third and a half of the population of the world lives or works in earth construction buildings (See Dethier, 1983, McHenry, 1989, Warren 1999, Elizabeth, 2000, & Rael, 2009). Rammed earth, soil blocks, mud bricks or adobe are various applications for earth or clay soil (Minke, 2006). In Egypt, particularly in the Western Desert oases, earth is the main building material. Earth block buildings in Upper and Middle Egypt have been dated to more than 4,000 years back (May & Reid, 2010) and still exist today. Examples include the fortification of Habu city and the Ramses II temple near Gournah in Upper Egypt (Minke, 2000). Dethier and Rael mentioned that archaeologists discovered one pair of decorated coloured mud brick that is 3700-year-old in Egypt (Dethier, 1983, p. 8 & Rael, 2009, p. 113). Rael also mentioned that descriptions of tools, methods and techniques for making and building with mud brick are well documented in the hieroglyphs of ancient Egypt (Rael, 2009, p. 113).

In nearly all hot-arid climates, earth has always been the most prevalent building material (Minke, 2006, p. 11). It is one of the materials that can be considered a viable and realistic option for much of world housing (Steen, Steen & Komatsu, 2003, p. 14). It comes in a thousand different compositions and can be variously processed (Minke, 2006, p. 7) and can be used as a plastering material and also in painting and decorating

of walls (Guelberth, 2003). Earthen architecture is the product of relatively simple yet highly effective technology (Bourgeois, Pelos & Davidson, 1989, p. 55).

Earth provides a wide range of methods and techniques in building walls, roofs and floors. It was mentioned in the book *Built by hand* that earth can be molded into blocks; or hand-packed into structures or frames of other materials (Steen, Steen & Komatsu, 2003). Desert vernacular in the Western Desert is rich in examples of different approaches to earth building technology. Mainly, the building method for walls is mud bricks while exceptionally in the Siwa oasis it is salt blocks and mud (Karshif blocks). According to Rovero these blocks were utilized in the masonry with an abundant mud mortar very rich in salt (Rovero & others, 2009). Along with the earth, the main roof material is local wood, either from trees or palms. Reeds and palm ribs are used as secondary construction materials in roof construction. Earth is an extremely versatile substance. It can be combined with many other components or materials, especially straw and natural fibers, to form solid volumes, thick walls and unifying plaster.

Adobe is an ancient term for mud brick dating back more than four thousand years in Middle Egypt (Elizabeth & Adams, 2000). The word came from the Arabic *tuba* meaning brick which came from the Coptic *tobe* and from the Egyptian *dbt* (Garcias, Dethier & Meade, 1985). Then adobe was used in modern English to re-



Balat town in Dakhla oasis an example of mud brick town that is still inhabited.



Mud brick vernacular buildings in the oases can be up to four stories high.

fer to an architecture style popular in desert climates in North America (May, 2010). Mud brick (adobe) as a material for building has been claimed to be the oldest and most widely used form of vernacular construction in the world (Wright, 1991). Houses in the desert of Egypt, North Africa and also in the Middle East have been made out of mud bricks for at least 10 000 years (Marchand, 2009). Rael mentioned in his book *Earth Architecture* that almost half the world's people know how to build dwellings with unfired earth bricks, adobe, rammed earth or stamped earth and have extensive traditions for passing their knowledge on to following generations (Rael, 2009).

Morgan describes the benefits of earth vernacular building in his book *Earth architecture from ancient to modern*. He argues that earth vernacular structures in desert climates reach a degree of sophistication that makes houses warm in winter, cool in summer, well protected against wind and sand storms, capable of absorbing excess humidity, impervious to insects, fire and rot resistant as well (Morgan, 2008). Khalili stated that mud-brick is a traditional material which has high power of storage of cooling and heating energy and is able to equilibrate temperature in the interiors of buildings (Khalili, 1996).

One of the earth constructions' great advantages is its thermal properties. Because they may be as much as two feet thick, mud has high heat-retaining capacity. During the day, acting as passive solar collectors, they insulate well against high temperature, and at night the heat that has been absorbed is slowly released. While outside the temperature may soar or plummet, indoor ones stay remarkably constant. (Bourgeois, Pelos & Davidson, 1989, p. 56)

This quote supports the contention that earth is an environmental building material and copes efficiently with the harsh arid desert climate, especially during hot summers. It was mentioned in the book *Building without Borders* based on Hassan Fathy's experience in Egypt that traditional earthen interiors remain cool during the day and release warmth at night, the opposite of concrete, a material that, in Egypt's hot climates, traps and holds high temperatures unbearably (Kennedy, 2004).

Desert oases' inhabitants can recycle earth easily, either re-using old earth blocks or bricks as building material or returning it to the soil to grow vegetation. Earth has the ability to conserve energy, provides thermal insulation, good heat storage and stabilizes indoor temperature (Bourdier & Trinh, 2011, p. 86) and it can absorb excess humidity (Steen, Athena & others, 2003, p. 14). Economically, constructing an earthen house in the Western Desert costs almost nothing, because its material is obtained from the surrounding environment. In addition, a house built with such local resources can be easily enlarged at low cost, as need arises. As people build by themselves, there is no cost for workers' fees. In fact, neighbors and families help each other in the building process. In the oases you can offer your neighbor a meal as gratitude for helping with the construction and that is the maximum cost. Moreover there are no transportation or manufacturing costs. As the Egyptian Architect Hassan Fathy said of mud brick constructions: *A house is essentially a communal production: one man cannot build one house, but one hundred men can easily build a hundred houses.* (Fathy, 1973, p. 121).

Although earth may be perceived as a weak building material, due to desert vernacular trial and error experimentation of uncountable ideas, earth structures have managed to survive for centuries. Also the delicate



Sun dried casted mud brick is the common building materials in the desert oasis.



Building process with salt rocks and mud (Karshif blocks) which can be found only in Siwa oasis

craftsmanship, wisdom and accumulation of experience have led to good designs that are comfortable for living and sustainable to this day.

Recently, earth building techniques have not been as widely used by local inhabitants in the oases as in the past. The authors of *Vernacular Mud Brick Architecture in the Dakhleh Oasis* stated that in many places in Western Desert oases this form of architecture is slowly being superseded by more recent building techniques using reinforced concrete and concrete blocks (Schijns, Kaper & Kila, 2003).

Mud brick making in desert vernacular buildings

In the Western Desert of Egypt people build with blocks of loamy soil earth, packed and produced manually by throwing wet earth into a mould without bottom or cover. The mould is lifted off once the brick has been placed on the ground. This technique produces so-called mud bricks or sun dried earth blocks. To produce them, sand and soil are dug from the ground and mixed with water, straw and manure in proportions that differ from one place to another depending on soil type. Not all soil types are good for mud casting. Locals know from experience and trial and error where to get the proper soil. Mud brick can be cast on-site easily and quickly, thus eliminating the need for transportation and allowing mass production of bricks in a short time. Normally, bricks are cast first and building starts when the amount needed is ready. One person can cast over 600 bricks in 7 working hours.

Vernacular know-how in the Western Desert can be described as a continuously developing and maintained building tradition, a process out of which basic building principles were created. This transfer of know-how has succeeded in sustaining the desert habitats we see

today. Oliver described this know-how as the power of knowing and as a cognitive mix of the knowledge, awareness, understanding and intuition of the local inhabitants. He also stated that over long periods in the past this vernacular building know-how has been in continuous development (Oliver, 2006).

Building know-how

The most distinctive aspect of desert vernacular is not only the product of the knowhow but the know-how process itself. Its distinctiveness is also in the correlations of disciplines involved in the way of thinking about and implementing building traditions and in planning the towns and villages. Decisions must be made based on factors relevant to the inhabitants' understanding of the safety and security of their dwellings in relation to topography and the desert landscape. Know-how in desert vernacular is a mix of locals 'desire for consistency in developing their dwellings, their understanding of causality in taking their decisions, and economic aspects of building and construction.

In the building process itself, the know-how is a mix of the influence of culture, social inheritance, tradition and environmental adaptations. The building technology embodies considerations of belief, custom, and doctrines of traditional vernacular principles. The know-how in the building tradition is based on deep awareness and understanding of the harsh desert climate and weather conditions. Without any technical equipment or advanced technology, locals have managed to cope with their surrounding environment.

Oliver stresses that vernacular know-how is not a single phenomenon, and vernacular technology cannot be studied in general terms. He described this knowhow as knowledge intermingled with the specific nature of the



Decorated wood for door lintels in mud brick vernacular houses in the oases.



Pigeon towers are built also from mud brick structures in the oases.

particular cultures which employ its countless forms. He emphasizes the necessity of considering this inherited knowledge in relation to the cultural context, as well as in terms of its efficiency or performance, to understand the full implications of the technologies used (Oliver, 2006).

The know-how is also found in practical details, for example in the proper choice and use of building materials, or the proportions of sand, straw and mud used in clay mixtures for mud brick casting. How do builders cast the mud brick and what are the appropriate dimensions of bricks? What is the best type of wood to use for roofs or stairs and wall supports? How and when should they cut the wood and when should they start the building process; in what specific season and time of the year?

To answer such questions, locals always relate the details of building to cultivation and harvest seasons and to climatic changes affecting the natural building resources. The know-how is also found in the knowledge of how to utilize the available natural materials and resources. It is the basis for selection of the materials used for construction or decoration and even for simple things such as mud plastering and rendering. Traditional know-how also dictates the selection of the proper tools to use with certain materials in addition to the methods for building or construction. All these factors are also related to the skills and abilities of the builders who developed these techniques and inherited them from previous generations.

Mete Turan states in the preface to his book *Vernacular Architecture* that vernacular know-how is not a single phenomenon; it requires study of the specific cultures which employ its numerous forms. He added that it also needs to be studied beyond its merits without

overlooking the limitation, defects and failures (Turan, 1990).

I can also say that the know-how in the western desert oasis practice is a mixture of what is known and what is inherited. It is a merging of the collected wisdom and experience of the society and the norms that have become accepted as appropriate to the local desert environment. Also it has to do with the inherited knowledge of aspects of the natural environment such as climate, topography, seasonal variation, natural hazards and sustainability. Without doubt the influence of beliefs, observances, rituals and respect for ancestors and divinities also affect building norms and values in desert societies.

The know-how of building phases cannot be seen only as being born out of local materials and technology. It is an accumulation of knowledge, awareness, understanding and the locals' instincts and intuition, as well as their close relation to the environment. It is a responsiveness to climate mixed with reflections on customs and the community lifestyle, together with the search for compromise and solutions to, or transformation of, the available resources. Moreover we can not deny the collective wisdom and experiences given by elders to their society as well as norms that are appropriate to the built environment. The know-how also includes the knowledge of the natural environment, including the harsh weather conditions, topography, the surrounding natural hazards and knowledge of what will provide the sustainability of their town in that environment.

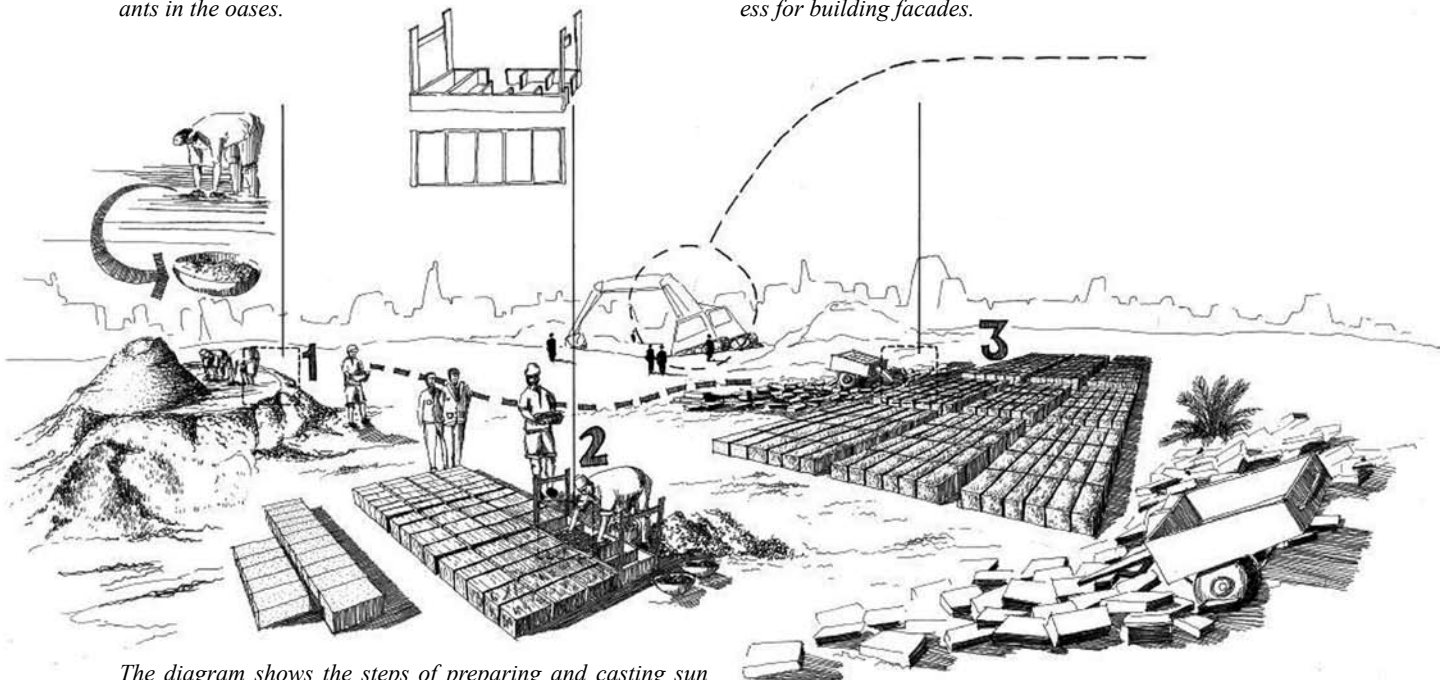
The current problem is that the transmission of building know-how will disappear very soon. Youth rarely inherit this tacit knowledge from seniors. Young generations who are supposed to be part of this transmission cycle and to continue this building tradition are often no



Building process is always a festive event for local inhabitants in the oases.



Ladies are always responsible for final mud rendering process for building facades.



The diagram shows the steps of preparing and casting sun dried mud bricks. / drawing by MD

longer interested in the vernacular tradition of housing. Documenting the intangible oral heritage of this know-how is thus a necessity. Protecting this transmission of building knowledge from discontinuing is a challenge in contemporary time.

Mud brick and building technology

The technology of making mud brick is inherited from ancient times in Egypt. Inhabitants in choose the best soil for mud brick casting. There are common places they tend to go and get the mud from. They are nearby their farm lands on the periphery of the town. They choose these locations because they are places where grazing animals are taken every day to graze. As a result, the soil is full of animal manure. Moreover it is far

from the farming land, where the upper layer of the soil is salty or recently affected by fertilizers.

The process starts by adding water to the soil to achieve the proper consistency, plasticity and workability. Straw and dung are added to increase malleability and impermeability. Finely chopped rice or wheat straw is mixed with the mud to act as shrinkage compensator and for reinforcement. This helps the entire mud brick block to dry evenly from inside and from outside. It also increases compaction, which reduces cracks and keeps the brick more solid. The straw is taken from the fields and stored after harvest. Winter straw is used because it is better than that from spring growth.

In the literature it is mentioned that straw acts as a binder, incorporated into the mix and that it makes the



Three photos for desert vernacular towns in the Western Desert of Egypt with shaded streets and alleys. When hot air touches the damp and shaded mud brick walls and surfaces it cools down.

mud easier to tread and to handle when casting. Moreover it strengthens the wall, slows down erosion, helps combat shrinkage and reduces cracking (Wright, 1991, p. 27 & Warren, 1999). Traditionally the proportion of straw in the mud mixture is determined by sight and the feel of the mixture. Dung is also added to this mixture. It was mentioned in the literature that dung acts as a binder and also as an added protection against moisture penetration (Wright, 1991, p. 31). It was also mentioned in *Vernacular architecture of West Africa* that adding manure and straw to earthen mortar helps microbial products to cement particles of earth and the fermentation of these organic elements reinforces the materials' cohesion (Bourdier & Trinh, 2011, p. 87).

Locals mix the clay either by hand, by foot or with wooden sticks in a pit and then leave it to mellow for a day or two. Thereafter, the material is ready to harden into a durable building material for casting. The final step consists in pressing the mix into wooden moulds that have neither base nor top. Mud bricks are cast in wooden moulds which vary in size according to use. The moulds should be wet and the mud mixture is damp. Sand or loose soil is sprinkled on the ground first to prevent the raw mud bricks from sticking. The mud mixture is smoothed by hand from the top and the mould is lifted off to be used for the next brick. The standard wooden moulds for ground floor bricks are 30 cm x 15 cm x 15 cm. Other sizes used include 25 cm x 15 cm x 12 cm for first and second floors and roof fences. The cast bricks are left in the sun to dry before using and flipped on all faces every day to make sure that they dry on all sides.

For the wall plastering, manure is added to the plastering mixture. It does not smell inside the house, but insects do smell it and this odor keeps them away from

eating the straw inside the bricks or causing any holes inside the walls, ceilings and floors. Straw is added in small amounts to the plastering mixture as well. It makes the mud easier to handle and tread by hand when plastering. For the rendering, people mix fine sand with water. Usually colored soil enhances the variety, providing several tones for plastering. Women help in the final mud rendering and decorating of the walls. This final layering using fine silt or clay protects the walls from bad weather conditions and fulfils aesthetic functions as well. Generally, it is preferred to build in late winter or early autumn because summer is very hot and high temperatures can cause cracks in the mud bricks due to dryness.

Conclusion

The paper discussed in detail different aspects of the mud brick vernacular in the Western Desert of Egypt. It describes the experiences of the inhabitants as they construct their vernacular dwellings, time after time, following long-held traditions and customs.

The paper shows that vernacular in the Western Desert is also a flexible building process that is responsive to changing needs. The process is based on accumulated knowledge transferred from one generation to the next. Unfortunately, the transfer of this traditional building know-how is about to stop and not be continued by the present generation. Understanding the many assets of the vernacular puts into our hands insights into the essence of the problems the inhabitants face and the threats to their heritage. It can be concluded that the lesson from the past is not that the mud brick dwellings are striking structures, but that the essence of desert vernacular is in the inherited attitudes of social and physical development that the desert vernacular embodies.



A mosque minaret that reach up to 20 meters high constructed from mud bricks.

smooth curves and human scale proportions in mud brick structures. / all photos: MD

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