DEIR EL BALLAS
MUD BRICK CONSERVATION FIELD SCHOOL

Introduction

Egypt is fortunate to have much of the world's oldest standing architecture, a significant percentage of which is of unbaked mud brick. The importance of the protection and conservation of buildings made from this material is well understood, but the actual conservation in many cases has been neglected.

Earthen architecture is significantly less resistant to deterioration than stone architecture, which should make its conservation an even higher priority than might otherwise be the case. The primary factors which leads to the deterioration of earthen buildings are rain, wind, surface and ground water, seismic events, and human and animal activity. Seldom do any of these factors act singly; normally the deterioration results from a combination of these causes. For example, if animals have created voids in walls, the strength of which has already been compromised by water intrusion, the entire structure becomes more susceptible to even minor tremors.

Because of the importance of conserving Egypt's wealth of mud brick architecture, there is a need for specified training in the conservation of structures built in this material. Students in the conservation of mud brick architecture need to understand the composition of the material, the ways in which it is used for construction, the various conditions that cause deterioration, and the often unique features and details of structures built in this material. They then need to learn how to properly document and

record these details in order to understand the structures and plan proper and effective conservation interventions and presentation programs.

Documentation

The first step in conservation is to develop a process for recording specific information that is directly related to to the needs of those who are responsible for the protection of heritage monuments and sites. The needs for documentation are varied, being as wide as the needs to produce presentation renderings for site interpretation, to understand the cause and effect relationship of decay, to provide a base line to which more detailed information can be added in the future, to specify interventions, and to monitor deterioration, among others. The need to identify important characteristics so that their future protection can be incorporated into the planning process requires that those characteristics be appropriately documented.

Earthen Architecture and Mud Brick in Ancient Egypt

Adobe is a building material of mixed earth and straw, is commonly employed in arid environments as the standard construction material. In fact, the word adobe can be traced back to the ancient Egyptian word for brick, *Dbt*, which became the Coptic *twbe*, which entered into Arabic as *toob*, which probably eventually reached Spanish as adobe. Within Egyptology, these sun-dried building blocks traditionally have been identified as mud-bricks.

Most ancient Egyptian constructions employed unfired mud-brick as the primary building material. Though the scale differs, the materials used to make the bricks are relatively consistent: a mix of sand, clay, and silt combined with chopped straw or dung as temper and binding agent. If the earth mixture has a high enough percentage of clay, the straw is not always necessary; omitting the straw can reduce the chance of insects eating through the organic content of the bricks, thereby weakening them. However, bricks with a high percentage of clay can dry slowly, shrink, crack, and lose their shape. The ratio of sand to clay to silt varies in the surrounding environment from place to place, but the mix that creates the best bricks, a mix containing no more than thirty percent clay or silt and no less than fifty percent sand, is standard.

To make bricks, mud is dumped in a circular area created for the job, broken up with adzes or hoes, and mixed with water to form a stiff mixture. Chopped straw is then added to the earth mixture in a ratio of roughly one-part straw to five parts earth. Straw in

The straw is kneaded into the earth mixture with hands or by treading, and the mix is left to age and ferment for a night or two. The following day, the earth-straw mixture is re- kneaded and more water is added, at which point the mixture is ready to mold.

Although double molds for making two bricks at a time are sometimes used in the southwestern United States, Egyptians universally tend to employ single molds. Egyptian molds are simple rectangles made of wood, with one end of a long side extended to create a handle. The earth-straw mixture is carried in flat, round baskets from the preparation area, the *makhmara*, to a brick field that has been strewn with straw to prevent the molded bricks from adhering to the ground surface while drying.

The wooden mold is quickly dipped in water to prevent the earth-straw mixture from sticking to it during the molding process, then filled to slightly over capacity with the earth-straw mixture, which is compacted and flattened out. The mold is then carefully removed, without jostling the form of the newly-made brick, and the process is repeated. Bricks are lined up with the thickness of the mold's edges between them and left to dry for three days before being turned over and left to dry for another three days. After six days, the sun- dried bricks are piled on their sides and left to continue drying, the longer the better. Thus, the total number of days needed to produce usable bricks varies depending on personal idiosyncrasies in technique, but eight or nine days from beginning to stacking seems to be average. Bricks that have been dried longer are preferred and thus require even further planning; for construction in the fall, bricks could be made in the spring and left to dry all summer.

While the style of wooden brick molds employed to produce bricks was standard in ancient Egypt, the size of the molds, and therefore of the bricks themselves, was not standardized, and ancient bricks ranged greatly in size. In general we see smaller bricks in the earlier periods, with average brick size increasing through the Middle Kingdom, New Kingdom, and Late Period, and a subsequent size reduction in the Ptolemaic, Roman, and Coptic Periods, a trend attested elsewhere in the ancient Near East. However, this trend is only broadly true for Egypt and ought not be taken as ultimately chronologically diagnostic.

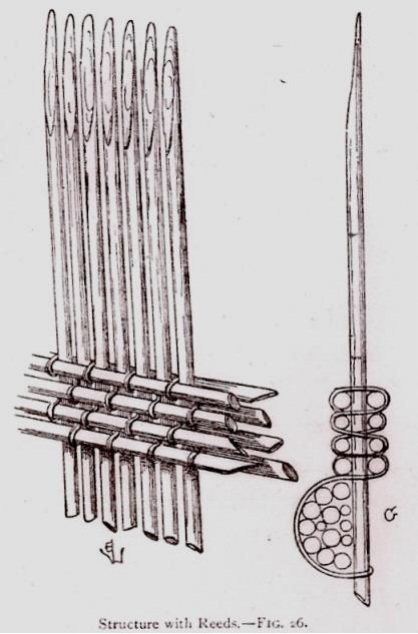
Mud bricks should contain at least three of the following ingredients: course sand for strength, fine sand to lock the course sand in place, silt and clay as binders and a plastic medium. A large quantity of aggregate makes strong bricks when dry, but they crumble easily in a wet environment. On the other hand, high amounts of clay may result in a more highly water resistant brick that proves to be weaker overall.

As mudbricks are prone to dissolution when wet, sometimes stone, sand or gravel foundations often support mudbrick superstructures. Mud plaster and render coatings protect walls from weathering and further water exposure.

Other Earthen Materials

In addition to unbaked mudbrick, the ancient Egyptians also used pisé, another earthen building technology found frequently in Anatolian and Near Eastern architecture. In pisé construction,

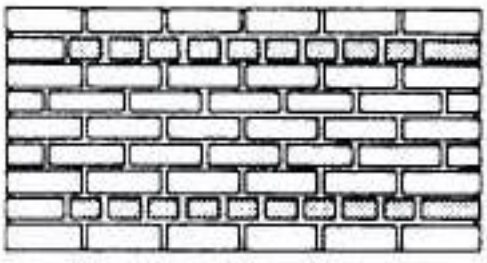
the mud mixture is poured and packed into in situ wooden frames/forms, rather than being formed into individual bricks. The frames are often larger enabling more efficient construction, as pisé dries in place. Mud plaster can also be applied to a wickerwork construction in a technique known as wattle and daub.



To make wattle and daub this reed framework would be plastered with mud.

Brick Bonding Patterns

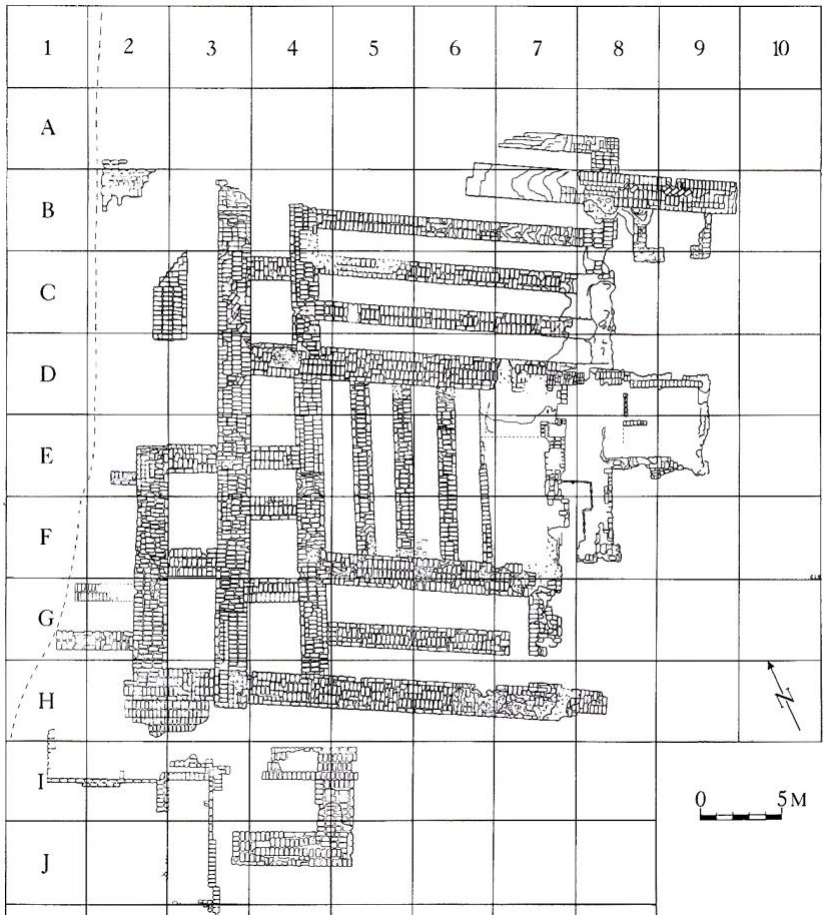
In ancient Egypt mudbricks were often laid in alternating rows of headers and stretchers, though they could also be set on and angle to fill spaces or used to make a course level



Alternating headers and stretchers sometimes called 'common bond'

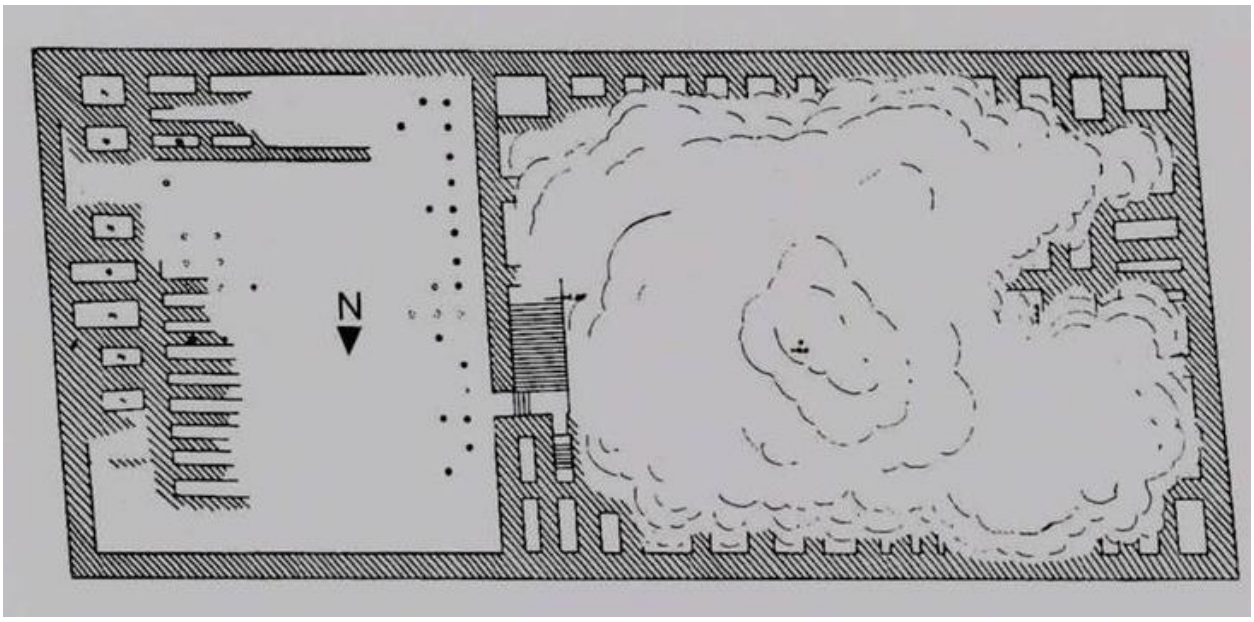
Mud Brick at Deir el-Ballas

The site of Deir el-Ballas has a variety of mud brick architecture. The North Palace is built of enormous unbaked Nile mud bricks 53 cm. X 24 cm. X 16 cm. in size. In it, as well, are later Romano-Coptic constructions using smaller sized baked brick. The interior of the palace had an elevated second story built up on casemates- rectangular compartments of brick that were filled in with sand and rubble and capped with a mud brick pavement.



North Palace casemate foundation

The ‘South Palace,’ which was not actually a royal residence, but a watch tower, was also built up of casemates that incorporated the top of a hill to make a rectangular structure. It was also made of unusually large bricks 46 cm. x 22 cm. x12 cm. and the façade wall was strengthened with reed matting laid down between several rows of courses.



The "South Palace" at Deir el- Ballas. Here casemates were used to square off the top of a hill and to create a flat terrace facing an elevated platform.

The houses are constructed of smaller bricks made of both Nile mud and desert gebel.

House by North Palace