

# Building and Rebuilding with earth

## Earthen architecture in Cyprus; the problem of conservation

Diomedes Myrianthefs

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School of Architecture, NTU Athens, Greece, 1983-89. MA in Architectural Conservation, IoAAS, U of York, UK, 1990-91. He has been working in the conservation of historical buildings field, in Greece and Cyprus, since 1989. He participated in several seminars and congresses in the field of history and conservation of Byzantine, Post Byzantine and traditional architecture.

### Historical Information

It seems that mud brick structures were common in Cyprus from the Neolithic age (7000-6000 BC) to the first decades of the 20th century. The earliest example of such structures were found at Choirokitta, a Neolithic Age settlement. Through archaeological investigation and excavations it was found that adobe was used in several places of Cyprus from the Neolithic, to the Classic Period. The construction of those walls is very simple; mud bricks of different sizes and thicknesses are resting on a rubble-stone substructure. This technique continued to be used throughout the various periods of Cypriot history. Mud bricks were also used in military structures like the Venetian walls of Nicosia as well as in some Medieval churches. Adobe as a basic building material is met mainly today in the rural and urban traditional architecture of the 19th and 20th c.

### Types of traditional architecture

The basic rural dwelling in Cyprus is the single-unit structure. Two can be considered the main types of this. In the plains and in the settlements of the foothills of the mountains the type that prevails is the broad-front single-room house (*makrinari*). The maximum width of the *makrinari* varies from 3-4 meters which is determined by the constructional properties of the timber available where the length of the building varies between 6-8 meters or even more. A second basic type of a single-unit house is that in which the almost rectangular room (*palati* or *dichoro*) is divided either by a large, often pointed, arch that supports the roof or by a wooden post on which the central beam rests and carries either a pitched roof or an almost flat roof. In these cases and according to the timber available the dimensions are about 6X6 meters. Of course the variety of the islands rural houses is not limited to the above mentioned basic types. There are many house variations as a result of either successive extensions or additions of auxiliary units to the basic one. According to the plot and the area available a house was built and extended as a single-storey building (plains) or in two levels (mountainous regions). In the towns the typology differs, especially from the end of 19th century onwards, as neo-classical characteristics were incorporated both in typology and façade formation. In this category a central common room (*ilakos*) is surrounded on both sides by rectangular rooms which with the backyard additions, the verantahs etc create a more complex type of dwelling.

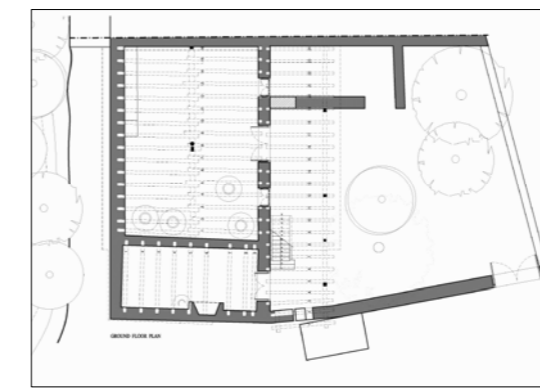
### The structure

#### Mud brick construction

Adobe architecture has been mainly used in the plains where soil is plentiful and stone rare and difficult to obtain. Mud bricks were made with the use of local soil and the addition of binders such chaff, straw and ear as the most common ones. Also goat hair and seaweed was used depending on the location and availability. The mixture of soil, straw and water was left for few hours up to a day so as cellulose was released to give adhesive properties and make it mouldable. Mud bricks were prepared with the use of a wooden mould of internal dimensions 30x45x5 cm and were left to dry for at least a week. Mud bricks were only made during the summer.



Mud brick construction



Plan of typical mud brick house



Different types of walls and mud bricks

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### The causes and effects of decay on mud bricks structures

The main cause of mud brick, and its render, deterioration is water penetration.

1. Deterioration at the base of the wall. The rising damp penetrates into the mass of the wall and depending on the temperature alterations it is drawn outwards. Thus the evaporating water leaves behind crystalline salts breaking this way the coherence of the soil and creates disintegration of the material which is then easily eroded by wind action. The process continues upwards and inwards, undercutting the wall structure and it may end to a collapse.
2. Deterioration at the top of the wall. Water penetrates when the roof structure at the top of the wall fails. Hair cracks due to excessive wetting gradually develop to channels which become thinner and die out as they progress downwards. This procedure leads to extensive disintegration of the bricks and to vertical cracking.
3. Disintegration of the material. Damp penetrated the wall gradually evaporates and through the freezing-thawing cycle causes loss of the material cohesion which is pulverised and becomes dust.
4. Cracking is developed as a result of structural inefficiency due to extrinsic causes like earthquake or due to poor foundation construction which causes displacements and bending.
5. Human activity. In order to "strengthen" or "protect" the sensitive mud brick material or its stone base from external dump and water, cement plaster was extensively applied. This method proved to be catastrophic for the mud wall as the cement render being stronger than the earthen core does not allow humidity to be released and leads to humidity accumulation in the core of the wall. This leads eventually to the extensive disintegration of the mud brick.



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### Repair methods

An intervention on a damaged mud brick structure aims at the restoration of those parts by eliminating the causes of its destruction. Also additional strengthening by means of modern techniques must be considered if necessary.

1. Intervention on the stone base of a mud brick wall. The most common techniques for the strengthening of the stone wall and the prevention of the rising damp are, the underpinning, the construction of a proper drainage system and the grouting by compatible injection grout. Stone replacement as well as repointing of the wall are also common practice.
2. Repairs in the body of the wall. Heavily damaged mud bricks should always be replaced. Precaution must be taken in relation with the "soil compatibility" and the proper bonding of the new with the existing. Replacements of mud bricks with other material than that (fired bricks etc) should be avoided as incompatibility may result to poor connection. If the damaged part is a corner or is accompanied by cracks a further strengthening method must be applied. The most common one is the insertion of a wooden tie beam at an appropriate length and at several levels along the height of the wall (stitching). If it is necessary wooden tie beams could be inserted on both sides of the wall and should be, in this case, properly connected between them. The same way a proper interlocking of the corners must be inserted if the existing one is not appropriate or does not exist at all. It is of crucial importance to create a proper tie at the top of the wall to establish the diaphragm function. This can be done by the insertion of ring beam(s) where the wood structure of the roof/floor can rest.

Other strengthening methods that are widely used is the increase of the length of the sitting of a wooden beam so as load is distributed in a wider area and the increase of the length and section of the lintels of the openings. In an extreme case where a wall has a very low load bearing ability, a timber frame structure (vertical posts and horizontal beams properly connected) can be incorporated to carry the load of the structure.



Before repair



After repair



Wooden pegs to receive new plaster



Insertion of wooden beams to "tie" and strengthen mud brick walls



Completion of missing upper part of the wall with new adobe



Construction of new roof (with tiles & cane) on a mud brick wall



New metallic structure inserted into mud brick wall

### Inappropriate interventions



Non compatible concrete beam



New cement plaster as "protective" coat



Incompatible concrete beams to support the roof & strengthen the foundation

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