Molding Earth Outline: Typology, Technology and Morphology of Earth Building

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METHODS AND AIMS OF THIS RESEARCH

Introduction

This research considers the history of compressed earth-block building combining mechanical and technological considerations with a typological analysis. The study of these interconnected features will provide the basis for a knowledge pattern that will be useful to either understand existing architecture or plan new projects. It has to be made clear that the results presented in this paper must be considered as a partial contribution to this knowledge area, taking in mind that our approach has excluded many other interesting aspects that could bring about other important hints.
Nevertheless, in the history on building techniques, these topics we deal with in this paper are those most often overlooked. The method used in conducting this research is both theoretical and practical as will become clear at end of this paper. Information from bibliographic sources has been carefully compared with data obtained in laboratory.

For writing a history of unfired earth building

Constructions made of compressed earth blocks have been common all over the world since the ancient times, and the building techniques used during the centuries are innumerable, depending on the sites, the living needs of the inhabitants, climate, technology and the surrounding conditions. To write a comprehensive "history of compressed earth-block building" is not possible for the following reasons:

- All traces of the origins of such ancestral techniques is lost and now we can only collect records of relatively recent events;
- Buildings made of compressed earth blocks need continuous maintenance and are doomed to decay with the civilisation that has made them. We can find only sparse remains from relatively recent civilizations or in extraordinarily dry areas, where long term preservation was possible;
- Many civilisations have achieved very similar technological solutions through totally different paths. It would be more correct; therefore, to talk about "histories"of compressed earth-block building.

The contemporary age is the only one which we may refer to when we talk about a unified worldwide history of earth building. Industrial Revolution followed by globalisation have provided a common attitude to viewing compressed earth-block buildings as the legacy of a poor past to got rid of, in favour of a rich present made of steel and concrete. From Ethiopia to Yemen, China and Santo Domingo, from India to Nigeria the world seems to agree with the Congolese anthropologist J. L. Touadi and his assertion "we did not share the same past, but we will have the same future".

Aim of the research

Earth is a weak material when compared with many other building materials, due to its low compressive strength, almost no tensile strength and to its low resistance to water. During the design stage it is therefore necessary to act with the utmost attention so as to exploit as fully as possible the mechanical, physical and chemical characteristics of the available material. This research aims at showing that the formal architectural solutions using compressed earth blocks (morphology = *venustas*) are resulting from a complex mechanical background (mechanics = *firmitas*) combined with keen attention towards inhabitants and their utilisation of so created spaces (typology = *utilitas*).

HISTORY: DIACHRONIC ANALYSIS

We have already talked about the impossibility of writing a unitary history of compressed earth-block building. Therefore we will outline a few uncontroversial points typical of the different geo-cultural areas.

Darkest Africa: the place where everything started

Morocco, Algeria, Tunisia and Libya are countries belonging to the Mediterranean area both economically and culturally. To various extents these countries, with also North Sudan are part of the area influenced by the Arabian culture. The rest of the continent is called in this paper Darkest Africa. It was in this area that paleolithic civilisations began 800,000 to 50,000 years ago. At the same time this area saw the change to the Neolithic period (50,000 years ago). During the late Paleolithic human beings lived in caves or trees, elements that we can surely define *Archetypal* respectively of the techniques identified as "opaque-plastic" and "transparent- colouristic". During the late paleolithic men were no longer satisfied by the refuges offered by nature so that the cave gave way to a hand made grotto, then piled earth and eventually brickwork made of shaped blocks. In the same way men moved from trees to pile-dwellings, then to the wooden huts and eventually to a framework daubed with earth.

North Africa and the Mediterranean: the masonry culture

During the Neolithic revolution man made a decisive step: the nomadic civilisation gave way to stable settlements. This change brought man to see the house as a fixed and durable structure that had to be built to last as long as possible. For this reason techniques based on monolithic earth or earth blocks prevailed over those based on frameworks even in woody sites. A heavy masonry box structure is in fact much more resistant and long lasting than a wooden frame daubed with earth: it has a greater mechanical strength; it is fireproof and stands up to rain. During this age monolithic techniques gave way to those using earth blocks, a kind of embryonic *pre-fabrication*. The link between these two techniques is represented by the stage called *bauge*, consisting of earth blocks layered in courses without being previously dried.

The Middle East: the earth becomes covering

The Middle East zone that is now arid or semi-arid has been so for only a few thousand years: the desertification process began 6000 years b.C. ending about 2500 years b.C. It is very important to point out that the most ancient buildings made of compressed earth blocks that have been found (Nubya, Iran, Yemen and Afghanistan) date back to this period. Therefore we may think that the first earth buildings in this area could be even more ancient, since their remains may have been wiped out by atmospheric conditions. The first earth architecture we have evidence for in the Middle East date back to three thousand years b.C., and are characterised by architectural elements such as arches, vaults and domes. Such elements represent for the first time the solution to the problem of covering using only compressed earth blocks, so that the need for a wooden frame is no longer necessary.

The American continent: a parallel path

The American continent is so large and varied that we cannot refer to it as a unique area. In this paper we will only identify two main zones in South America that have had a common evolution until the Spanish colonization. The Inca people influenced the east of the continent (the first zone). In this area stone footings covered with earth and straw prevailed because of the particular geological resources: poor quality earth and very good stone. We can therefore talk of a stone area.

The Guaranì people influenced the second zone (interland, plateau, forest and west coast). In this area we find mostly circular huts made of wood and coated with just straw or straw and earth. We can talk therefore of a specialised wood area whose main characteristic is the use of light tensile building elements, matting and elastic structures. These were the building types before the Spanish colonization that involved the whole continent. The Spanish introduced the Rancho, a structure made with mixed technique using wooden frames coated with *Adobe* with earth and straw coverings.

The Indian sub-continent and The Far East: architecture and construction

Contrarily to what is commonly thought buildings in compressed earth blocks are historically connected to the town rather than the countryside. Only with the advent of the modern age, from the Industrial Revolution onwards, most towns lost any trace of earth dwellings that have been replaced by structures in reinforced concrete. On the contrary, people living in the countryside didn't have the means to change their dwellings and this is the reason why in these sites we can find the most important evidence of earth buildings. This is the only reason for which earth is now connected to the idea of poverty and countryside. It is in the Far East and especially along the banks of Indus

River, that we find the clues of the deep urban character of earth building. Here we can find the first urban clusters by compressed earth blocks, taking on very complex aspects and dating back from 2,500 to 1,500 b.C.

Here we can see houses with courtyards, arrays of terraced houses big buildings in line, long roads and squares with earth buildings. Here the language of wood and masonry coexist and are used with great awareness. Load bearing structures are normally monolithic walls, whereas partition walls are made with wood frames daubed with earth, coverings are in wood or bamboo coated with fired earth and footings are in stone.

Figure 1. Two Ethiopic buildings: the first one is an intermediate stage between root-type, transparent-colouristic stage and the hut structure. The second one is the typical hut in which the central tree has been replaced by a wooden pole.

TYPOLOGIES: SYNCHRONIC SYNTHESIS

The typology of compressed earth-block building techniques.

Building techniques by compressed earth blocks are innumerable and each of them has different features depending on local culture, the kind of earth, the degree of development and all social and material surrounding conditions.

Trying to make a synthesis it is possible to identify three broad categories to which all building techniques may be referred:

1) *TORCHIS*: all building techniques involving the use of a light bearing structure (mainly wood or bamboo) coated with one or more layers of earth, having the purpose of closing any opening. These are the most ancient techniques, where the two functions of bearing and closing are separate.
2) *PISÉ*: this family collects all the monolithic techniques. Here we have bearing and closing masonry that are put in place with or without shuttering. *Pisé* properly said is made with shuttering, but some archaic variants (dug earth, hand-formed earth masonry) don't require its use.
3) *ADOBE*: this family groups all the techniques using earth blocks: pressed blocks, extruded blocks, stabilised blocks, hand-formed blocks and so on. Involving partial prefabrication, this is the most sophisticated technique. This is also the only way of using compressed earth blocks to build arches, vaults and domes. These solutions are the utmost expression of earth architecture since they allow the material to its best advantage (that is under compressive stress), even when building roof coverings. By these techniques either structural or non-structural, closing or non-closing elements may be built.

This synthesis allows us to single out three great "families" of building techniques and is very important in order to read the technological culture of a given context, to understand its history and its possible development. In fact it is possible to create a hierarchy of the variants of each technique depending on its different degree of maturity and complexity, as shown in the following table **(Table 1)**

Table 1. The various earth building techniques

<table>
<tr><th colspan="5">UNFIRED EARTH BUILDING TECHNIQUES: COMPLEXITY / MATURITY</th></tr>
<tr><th></th><th>Archaic</th><th>Mature</th><th>Modern</th><th></th></tr>
<tr><td>Transparent/ Colouristic</td><td>Side-by-side timbers</td><td>Torchis</td><td>Membrane,
Twin torchis</td><td rowspan="3">C o m p l e x i t y</td></tr>
<tr><td rowspan="2">Opaque/ Plastic</td><td>Piled earth,
Cob</td><td>Pisé</td><td>SuperAdobe,
Extruded earth</td></tr>
<tr><td>Hand-formed Adobe
Dug turfs</td><td>Adobe</td><td>CEB, CSEB</td></tr>
<tr><td></td><td colspan="3">M a t u r i ty</td><td></td></tr>
</table>

Definitions of techniques mentioned in table 1:

- *Side-by-side timbers:* wooden walls without earth daubing, possibly with coating of leaves and reeds;
- *Membrane:* mats of bark, straw or bamboo daubed with earth mixture;
- *Twin torchis:* two wooden grids 20-30 cm far, used as a mould for earth ramming or pouring;
- *Piled earth:* layering of earth courses 30-40 cm high to form walls;
- *Cob:* mixture of mud and steeped straw directly formed into lifts 50-60 cm high;
- *SuperAdobe:* tubular fabric bags filled with earth or sand and arranged to form structural elements such as arches, vaults, false vaults, and false domes;
- *Extruded earth:* earth rich in clay extruded by a special press tool and put in place, while still in plastic state, into elements 50-100 cm long;
- *Hand-formed Adobe:* blocks made without mould, hand shaped;
- *Dug turfs:* grassy earth clods cut out and piled;
- *CEB:* Compressed Earth Blocks, formed by a manual or an industrial press;
- *CSEB:* Compressed Stabilised Earth Blocks stabilised with a small percentage of cement, lime or bitumen.

Table 2. Relationships between environment and building techniques

CULTURE – BUILDING TECHNIQUE INTERRELATIONS			
	Torchis	*Pise*	*Adobe*
Earth quality	inhomogeneous	few clay with gravel	very clayey
Presence of vegetation	wood or bamboo	none	straw
Expected lifetime	short	long	intermediate/long
Cultural level	primitive	intermediate	advanced
Vertical development	one stage	up to ten stages	one to three stages
Peoples	nomadic/Neo-sedentary	sedentary	sedentary
Climate	temperate	high thermal excursion	high thermal excursion
Weather	dry	rainy	intermediate
Labor cost	intermediate/high	intermediate	low

The earth building technique, with reference to sociological and environmental context.

There are very interesting studies (Scudo 1992; Paris 2003; Cataldi 1982) showing that the reason for the choice of one specific technique rather than another must be found in the material resources (kinds of earth, availability of wood, metals and stone; rain falls) as well as in the cultural context (known technologies, cost of manpower, degree of richness, religion). Within the frame of this research, this is a marginal issue, but a quick overview of it may be helpful all the same. In fact, we must consider not only the consequences of the use of earth, but also the reasons for it.

Referring to other studies for a deeper insight, (see "References" below) we think it may be helpful to provide an essential reading of these aspects in the following table **(Table 2)**.

Building techniques and architectural results

In this section we want to stress the consequences of the use of each technique. It is in fact that interesting to point out that every building method (*technique*), involves the use of some specialised shapes closely depending on the principles of statics (*morphology*). In turn, these shapes involve the use of different typological solutions (architectural elements).

Table 3 provides a first grid of what we have said so far, with no pretence of completeness. Here the main links among the three categories: *technique, morphology and architectonic elements* are indicated.

Table 3. Relationships among building techniques, morphology and definition of an architectural vocabulary

TECHNIQUE - MORPHOLOGY – ARCHITECTURAL ELEMENTS INTERRELATIONS			
Category		***Structural***	***Non-structural***
TECHNIQUE	*closing*	*Pisé*, *Adobe*	**Torchis**
	not closing	**Adobe**	*Torchis*, *Adobe*
MORPHOLOGY	*closing*	wall box	partition walls
	not closing	pillars	baffles, membranes
ARCHITECTURAL ELEMENTS	*closing*	side-by-side houses, arrays, vaults, domes	screens, court-yards
	not closing	arcades, roof-terraces, loggias	ventilated surfaces, tensile structures

It is important to point out that in different geographic areas (e. g. in Yemen and in Morocco) we can often find the simultaneous presence of different building techniques, mainly *Adobe* and *Pisé* that can also be used for different parts of the same building.

Table 4. Classification between masonry language and wooden language, here called respectively *opaque-plastic and transparent-colouristic*

CLASSIFICATION INTO THE TWO AREAS OF CATEGORIES: MATERIAL - TECHNOLOGY - TYPOLOGY		
	Opaque - Plastic	**Transparent - Colouristic**
materiai	rigid-plastic materials	elastic materials
	compression strength	bending and tensile strength
	heaviness	lightness
	use of earth only	use of mixed techniques, e.g. with bamboo
	bearing earth	earth as coating
tecnology	*Adobe*, *Pisé*	**Torchis**
	need for foundations	foundations not strictly necessary
	permanence	temporariness
	side-by-side or stacked elements	bound, sewn or nailed elements
	arch	beam
tipology	closing bearing structures	separated closing and structural elements
	structures parallel to the front	deep structures
	narrow span as compared to thickness	wide span as compared to thickness
	prevailing full vs. empty	prevailing empty vs. full
	one- or two-axial structures	axial or polar structures

THE CONSTRUCTION KNOW-HOW FOR EARTH BUILDING

Trying to offer a suitable analysis tool for this study, it may be useful to define two categories: *opaque – plastic* and *transparent – colouristic* already cited in **Table 1**. In **Table 4**. we try to give the most complete definition of these contrasting categories. Please note that the study crosses the concepts of materials, technology and typology. Widening this concept we could talk about *opaque – plastic* and *transparent – colouristic* categories in relation to building morphology, but this wouldn't be useful to the present study.

The "rules" for building with earth

At this point we can try to the draw some conclusions, in form of statements, making a synthesis of what we have said so far. We shall divide the "rules" obtained in three categories: *universal* rules (i.e. those that can be applied to all earth buildings), *opaque – plastic* rules and the *transparent – colouristic* ones, being those belonging to only one well defined category.

- *universal* rules: ½
- *opaque – plastic* rules: 3/10
- *transparent – colouristic* rules: 11/15

Axial symmetry - the a.m. structural constraints are connected to the problem of stability rather then to strength. Therefore great attention must be paid when designing objects that have the task to balance the horizontal stresses and, at the same time can rearrange tensile stresses coming from differential soil settlements, earthquakes and strains of any other kind.

"Shoes and hat" - common sense teaches us that compressed earth-block buildings must have "good shoes and a large hat", that is very good foundations and projecting coverings. These expedients protect the earth from rainfalls and from humidity ascending through capillarity, the two main causes of decay. Here we must take into account such connotative elements as arcades, colonnade or cellars.

Organicism - in the architectural field this definition can have different meanings. In this study we refer to the typological meaning (Cataldi 1984), that is the fact that compressed earth-block buildings have well-defined structural limits, cannot cover great spans and must be therefore conceived as an organisation of quite small elementary dwelling units placed together in an organic way on the ground. This limit requires that we design well-organised small spaces rather than bulky buildings.

Modularity - modularity is not only due to the reasons explained in the previous point but also for technological reasons, such as the use of reusable moulds or the repetition of the positioning of building elements.

Lightening the structure towards the top - there is a rule according to which any building must be lightened while its height increases. In earth buildings this aim is achieved placing a heavy stone footing followed by one or more layers made of earth with wider and wider openings and, on the top, with a wooden covering.

Thickness - the thickness of earth's masonry is usually very important because of the poor strength of the material. An important point is the tapering of the walls toward the top of the house.

Small openings - wall tapering is very often accompanied by the widening of the openings running from bottom to top. In any case they always have a limited size so as not weaken the masonry.

Justification of the openings - all the openings running from the bottom to top are generally "justified", for technical but also aesthetical reasons by frames, architraves, tympana, wall arches and stress releasing arches. Buildings without outside plaster very often have a white frame around the windows that in reality is the "extension" of inside plaster, providing a continuous surface to fixtures.

Arches and vaults - compressed earth blocks can stand only compressive stresses but not stand flexion and traction. This is the reason why we find frequently arches and vault structures that exploit this material at its best.

Positioning of empty volumes - the earth has a lower resistance if compared with other building materials. It is therefore necessary to proceed with caution against structural settlements. One of the most important rules consists in positioning holes and other weakening elements (such as recesses, trenches for utilities and similar installations) away from the corners that must always be reinforced.

Shape resistance - in the most meaningful transparent - colouristic buildings we can frequently find the concept of resistance due to the shape. This happens when the geometry of the elements represents a closed system that can stand the loads in an optimum way. In the Tukul for instance, the typical African hut, wood and reeds are bent as to form a basket: the first warp is radial, while the second is made of concentric circles. In this way the wood can work at its best that is under flection.

Incompatibility - the Torchis, the only transparent – colouristic technique in compressed earth blocks, can be hardly mixed with other techniques. On the contrary, Pisé and Adobe can coexist within the same building. Torchis represents a completely different building technique.

Light roof coverings - light structures require a light roof coverings that are commonly made of wood. As in the case of the Tukul the same walls, by bending and tapering, provide the covering that is protected by a layer of straw. In other cases we can find roof trusses and simple warps made of wood beams or bamboo.

Storey buildings - transparent – colouristic structures are mostly one-storey houses, built on ground (hut) or raised on piles (pile-dwellings). Sometimes the height of the roof allows the insertion of a mezzanine floor or at least of a shelf to store foods.

Mutual contrast between horizontal loads - heavy and bulky walls can stand very strong horizontal forces as those connected to arches, vaults and domes. Large and heavy walls can in fact create a vertical load and convey the resultant forces to the ground. This masonry culture is represented by elements such as buttresses, footings, plinths or spires. In light transparent – colouristic structures instead, every non vertical strain must be balanced by equal and opposite forces created by traction, deflection and sometimes by the compression of special architectonic elements. These elements comprehend systems such as tie rods, St. Andrew's crosses, quenn trusses and shelf – like structures.

Roof Coverings made in Adobe

From this analysis **(Table 1)** we can infer that adobe blocks represent the higher degree of complexity of mature techniques. The most complete expression of this solution can be seen in the pushing-type coverings. Here in fact the earth works at its best, i.e. by simple compression. Adobe pushing-type coverings can be of two structural models: vaults and domes. These structural systems answer real needs, especially in dry or in semi-desertic areas: to provide a covering structure without using wood. For this reason vaults and domes have been favoured in history, particularly their self-bearing variations. By "self-bearing" we mean a structure that remains stable during any stage of the erection and doesn't need centrings or any other temporary support structures.

The basic concept of these technologies is that earth blocks must never be perfectly vertical, but arranged with a proper inclination in order to react to gravity by a combination of compression and friction forces, enhanced by mortar cohesion at the joints. The activity presented in this paper, which is based on these considerations, has been carried out at the Lab.MAC (Laboratory of Construction Mechanics) of the University of Genoa, where we have reproduced two of these technologies: the Nubian Vault and the Ogival Dome.

Experimentation: the Nubian Vault

The Nubian Vault is a building technique for which we have evidence dating back to 4,000 years ago, in Nubia (low Egypt). This is a vault characterised by a catenary profile with oblique layers: each "arch" simply leans on the previous one, while the first ones are built against a vertical wall. This system allowed the covering of wide areas without using wooden centrings. Here we can already find an early expression of the concept of curve of main stresses, as revealed by the catenary profile.

Experimentation: the Ogival Dome

It is common belief that hemi-spherical geometry of the earliest earth domes was not ensured by a wooden frame but by a simple rope one end of which was fixed in the ground, in the centre of the hemisphere, whereas the other end was tied around the wrist of the worker that, in this way, the brick could be placed in exactly the right position. Problems started when closing the dome above 50° on the horizontal plane, and the blocks started sliding towards the centre. Whenever a new ring was completed, it started to settle and move of a few millimitres. Getting near to the last layers, the bricks became almost vertical making the problem of sliding of difficult solution. Ogival Domes were devised to solve this problem. They ensured a lower inclination towards the vertical axe while making erection much easier.

This technique has been perfected by Architect Fabrizio Caròla, who has developed a special device, called a beam compass, that makes the building of Ogival Domes much simpler providing the worker with the place and positioning of any single block. The central top of the dome is almost always left open so as to provide a chimney and give light.

Experimentation: the earth recipes

The main problem of compressed earth-block buildings is water, whether as rainfall or as humidity oozing up from the ground. Therefore besides paying attention to the shape of the buildings, it is also necessary to treat the earth so it will not wash away with water. Only relatively recently and only in few geographical areas this problem has been solved by firing the bricks. Quite often the material has been stabilised adding different substances: bitumen and pitch to fluidify earths poor in clay, were already used in the ancient Egypt; straw absorbs humidity and gives resistance to traction; lime and cement form a skeleton of waterproof chemical bonds; vegetal and animal fibres brace the earth and restrain washing away; manure and termitary earth provide hydrophobic colloids. A complete list of these substances would be very long, from lard to horsehair, from ox blood, to soap scales. We must consider that during the last few years we have understood the physical and chemical action of recipes that have been used for millennia.

FURTHER REMARKS

"L'arte del costruire tra Conoscenza e Scienza"

Under this title, Salvatore di Pasquale collects a long and ponderous series of considerations about the complex reationship between art and building science (Di Pasquale 2003). The most surprising suggestion from Di Pasquale is the existance of a whole of mechanical and structural ideas in people unable to conceive science in the modern sense, the old master masons. They were able to build architectural works of great structural complexity making only use of the so-called "knowledge without fundamentals" i.e. founded on empirical considerations, without formalised mathematical and physical bases. This concept is present in ancient unfired earth architecture.

Vaults and domes of very large size follow precisely the curve of main stresses (catenary), in order to exploit at its best the properties of earth blocks, i.e. through compression.

Where stresses are lower masonry elements are thinner, on the contrary where stresses are greater masonry becomes thicker matching well with the maximum isostatic lines. Many architectural elements such as tympana, stress releasing arches, pilaster strips, or cornices highlight the static schemes of the structure. A continuous dialogue exists between structure and architecture with a never ending series of cross-references.

Figure 2. Assembling stages of the Nubian Vault: the first inclined layers are not complete, only after a certain number of layers the catenarian arch may be closed.

Figure 3. Assembling stages of the Ogival Dome: thanks to the special compasses being used, the largest diameter of the dome is above the ground level and the section is cuspidated.

History and modern times

It is very important to give a clear definition to two contrasting concepts that we will call *progress and development*. This is very interesting when we come to study new interventions, as well as to interpret critically the historical development of earth building. In summary we could say that progress is an addition, whereas development is a multiplication: progress consists therefore in adding new technologies, new materials, new cultural horizons; the development is instead the reinforcement and optimization of what is already existing.

Figure 4. Metylene blue test measures the earth reactivity, while soaking test is to determine resistance to water immersion. In this way it is possible to verify the effectiveness of different earth stabilisers.

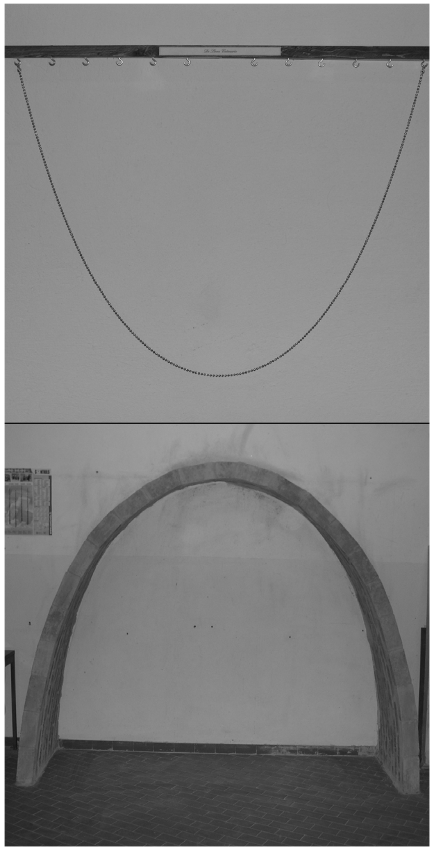

Figure 5. The catenary line obtained with a chain curved under its own weight and the Nubian Vault. The geometrical symmetry corresponds to the symmetry of stress and strains: only traction in the chain, only compression in the vault.

The move from Guarani culture to the Hispanic one in the Americas, for instance, could be seen as progress. In contrast the slow evolution from piled earth to Pise in the African area can instead be identified as development of a technique. Comparing what we have said with the present times we have the example of Fabrizio Caròla, an architect who stresses the concept of development in his African architecture: the use of local materials, of traditional techniques and the energetic and economic optimization are typical features of development (Caròla, 2002). Generally we can consider as development anything that follows a well-defined evolutionary line. **(Fig. 6)**

The technological triangulation – typology – morphology

We have already talked about the relationship among technology, typology and morphology. From our study we can infer that the order of these three categories is not arbitrary, since morphology is the result of typology that in turn is strongly influenced by technology and infrastructure. We have therefore a hierarchic relationship since the lines of influence run mainly in the same direction. Nonetheless it is important to understand that this relationship is effective also in the contrary sense: man needs a shelter, that is a space with a given morphology. To obtain it, he must think about the typology of his house and he must consider the technologies necessary to this aim.

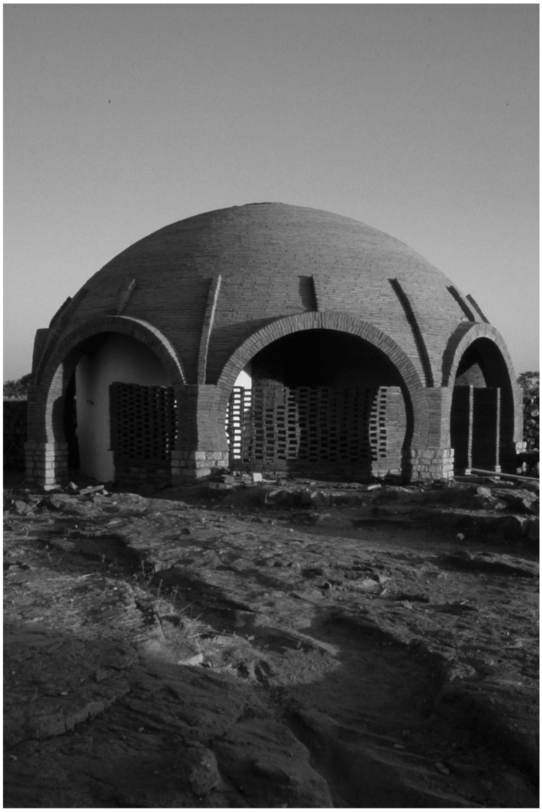

Figure 6. Fabrizio Caròla's architecture in Mali. Appropriate technologies, local materials and the concept of substainability are factors of true *development.*

CONCLUSION

The research presented in this paper represents a first typological approach exclusively aimed at the earth building. It belongs to that line of research which was originated by Saverio Muratori (Muratori, 1967), passing through Giancarlo Cataldi (Cataldi, 1984) and Paolo Maretto (Maretto, 1993). We want to propose a new line linking the typology with strictly technological and mechanical aspects, so as to understand the real causes involves the use of some recurring typologies.

We have intentionally left out any considerations of the study of civilisations and territory in order to limit the range of this analysis and also because we think that such factors do not affect the subjects dealt with. Possible developments of this research are of two kinds: on one hand the application of these reading schemes to the history of architecture, on the other hand the use of these tools for designing, particularly in developing countries.

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